UNION RADIO-SCIENTIFIQUE INTERNATIONALE INTERNATIONAL UNION OF RADIO SCIENCE



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INTRODUCTION

ACKNOWLEDGEMENT

The XXXIVth General Assembly and Scientific Symposium of URSI was held at 'La Sapienza Faculty of Engineering', Rome, Italy, from 28 August to 4 September 2021. For the first time in history, the GASS was a hybrid event. The GASS was held on-site, with provision for online participation and presentations.

In introducing this account of the records, it seems appropriate to offer the warmest thanks of the Union to:

- the Italian National Committee of URSI;
- the Local Organising Committee;
- the Coordinator of the Scientific Programme;
- the Chairs, Vice-Chairs and Early Career Representatives of URSI Commissions, who planned the scientific sessions, and to the session Chairs and speakers;
- the organisations which provided funds in support of the Young Scientist Programme: the URSI Member Committees in Japan;
- the Gold sponsors of this meeting : Elettronica Group and Huawei.

OUTLINE OF THE ASSEMBLY

The URSI Council - which is composed of the official representatives of the Member Committees - met in Rome (virtually and physically) on four occasions between 27 August and 4 September 2021. The Resolutions and Recommendations adopted by the Council are reproduced at the end of this volume. Summary accounts of the business transacted by the Council are given elsewhere.

An abundant scientific programme, consisting of 1356 papers (1171 oral communications and 185 Flash Interactive Papers (FIP's) had been prepared for the 1212 registrants. Among them were the 92 Young Scientists, who attended the URSI GASS (95 were awarded a YS Award). The programme consisted of 3 General Lectures, 1 Public Lecture and 10 Tutorials.

The Public Lecture was entitled:

• 'Recent advances in the comprehension of the personality of Guglielmo Marconi' by Gabriele Falciasecca

The General Lectures, of interest to all participants, were entitled :

- Precise time scales and navigation systems: what time is it and where are we?, by Patrizia Tavella
- The ALMA Observatory and the ALMA2030 Development Roadmap, by Sean Dougherty
- Medical Imaging in the Framework of Topics Covered by URSI, by Frank Prato

Each Commission had been asked to provide a Tutorial Lecture in its own sphere of interest. The titles of these Lectures were as follows :

- RF Energy Harvesting for IoT Applications (Commission A, Nosherwan Shoaib)
- Physical bounds for functional surfaces and materials (Commission B, Daniel Sjöberg)
- Cognitive Radar (Commission C, Kumar Vijay Mishra)
- Radiofrequency Identification against COVID-19: How state of the art RFID Technology and Research may help facing Pandemics (Commission D, Gaetano Marrocco)
- Monitoring and predicting terrestrial and space environments using electromagnetic methods (Commission E, Yasuhide Hobara)
- Radio-waves for Remote sensing of the Earth (Commission F, Dr. Luca Baldini)
- Ionospheric Imaging with Assimilative IRI (Commission G, Ivan Galkin)
- Machine learning in space physics and space weather (Commission H, Jacob Bortnik)
- The Past, Present and Future of Phased Array Feeds in Radio Astronomy (Commission J, Wim Van Cappellen)
- ICNIRP guidelines on RF EMF human exposure limitations(Commission K, Rodney Croft)

LIST OF URSI OFFICERS AND OFFICERS OF MEMBER COMMITTEES

Following the elections at the XXXIVth General Assembly and Scientific Symposium in Rome, Italy, the Officers of the Union and the URSI representatives on other Organisations are as given below. The list of Presidents and Secretaries of URSI Member Committees is based on information available at the URSI Secretariat up to the time of going to press.

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Prof. P. Lagasse (Belgium)

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President:	Prof. P.L.E. Uslenghi (U.S.A.)
Past President:	Prof. M. Ando (Japan)
Vice-Presidents:	Prof. P. Doherty (U.S.A.)
	Prof. K. Kobayashi (Japan)
	Prof. G. Manara (Italy)
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Secretary General:	Prof. P. Van Daele (Belgium)

SCIENTIFIC COMMISSIONS AND COMMITTEE

Commission A:	
Chair :	Prof. N.B. Carvalho (Portugal)
Vice-Chair :	Prof. A. Sen Gupta (India)
ECR :	Dr. N. Shoaib (Pakistan), G. Signorile (Italy)
Commission B:	
Chair :	Prof. J. Volakis (USA)
Vice-Chair :	Prof. H. Wallén (Sweden)
ECR:	Dr. A. Michel (Italy), Dr. D. Tzarouchis (U.S.A.)

Commission C:	
Chair :	Prof. Y. Louët (France)
Vice-Chair :	Dr. K.V. Mishra (U.S.A.)
ECR:	Prof. H. Zhang (China, CIE), K.K. Cwalina (Poland)
Commission D:	
Chair :	Prof. N. Shinohara (Japan)
Vice-Chair :	Dr. A. Kanno (Japan)
ECR:	Assoc. Prof. H. Asghari (USA), Dr. V. Palazzi (Italy)
Commission E:	
Chair :	Prof. V. Deniau (France)
Vice-Chair :	Prof. C. Carobbi (Italy)
ECR:	Dr. C. Kasmi (France), Dr. R. Trinchero (Italy)
Commission F:	
Chair :	Prof. T. Tanzi (France)
Vice-Chair :	Dr. M. Sato (Japan)
ECR:	Dr. M. Sasaki (Japan), Dr. F. T. Dagefu (U.K.)
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Chair :	Dr. G. de Franceschi (Italy)
Vice-Chair :	Dr. K. Groves (UK)
ECR:	Dr. S. Elvidge (UK), Dr. Bruce Fritz (USA), Dr. Dario Sabbagh (Italy)
Commission H:	
Chair :	Prof. J. Manninen (Finland)
Vice-Chair :	Dr. Craig Rodger (New Zealand)
ECR:	Dr. F. Nemec (Czech Republic), Dr. E. Shirokov (Russian Federation)
Commission J:	
Chair :	Dr. D. Bock (Australia)
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Chair :	Prof. K. Ito (Japan)
Vice-Chair :	Prof. F. Apollonio (Italy)
ECR:	Dr. K. Sasaki (Japan), Dr. E. Porter (USA)

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Standing Publications Committee Chair : Dr. W. Ross Stone (U.S.A)

AT-RASC Standing Committee Chair : Prof. W. Baan (the Netherlands)

AP-RASC Standing Committee Chair: Prof. P. Smith (Australia)

Standing Committee on Young Scientists Chair : Prof. P. Cannon (U.K.)

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COSPA	R (Committee on Space Research):
	Prof. I. Stanislawska (Poland)
IAU	(International Astronomical Union):
	Dr. L.I. Gurvits (The Netherlands)
ICG	(International Committee on Global Navigation Satellite Systems)
	Prof. P. Doherty (U.S.A.)
ISC	(International Science Council):
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	Prof. P.L.E. Uslenghi (U.S.A.)
ISC	World Data System
	Dr. D. Bilitza (U.S.A)
ISES	(International Space Environment Service) :
	Prof. M. Ishii (Japan)
ISPRS	(International Society for Photogrammetry & Remote Sensing)
	Prof. T.J. Tanzi
IUCAF	(Scientific Committee on Frequency Allocations for Radio Astronomy and
	Space Science)
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	Prof. I. Häggström (U.S.A., Com. G)
	Prof. S.C. Reising (USA, Com. F)
	Dr. A.T. Tzoumis (Australia, Com. J)
	Dr. W. Van Driel (France, Com. J)
IUGG /	IAGA (International Union of Geodesy and Geophysics / International
	Association of Geomagnetism and Aeronomy) :
	Dr. S. Elvidge (U.K.)
SCAR	(Scientific Committee on Antarctic Research) :
	Dr. G. de Franceschi (Italy)

 SCOR (Scientific Committee on Oceanic Research) : Prof. V. Chandrasekar (U.S.A.)
 SCOSTEP (Scientific Committee on Solar-Terrestrial Physics) : Dr. J. Chau (Peru)
 WHO EMF (World Health Organisation-Electromagnetic Field Programme) Prof. J. Wiart (France)

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	Prof. K. Kobayashi (AP-RASC)
	Dr. W. R. Stone (GASS & Publications)
Secretary :	Ms. I. Heleu (Executive Secretary)
5	Ms. I. Lievens (Administrative Secretary)

Names have been updated to reflect recent changes

OPENING MEETING

The Opening Ceremony was held on Sunday 29 August 2021 in the Basilica San Pietro in Vincoli for the on-site attendees and live streamed for the virtual attendees. Prof. Peter Van Daele, Secretary General of URSI, officially opened the 34th URSI General Assembly and Scientific Symposium in his welcome speech and then gave the floor to Carlo Carobbi, President of the Italian National URSI Committee.

WELCOME ADDRESS BY THE PRESIDENT OF THE ITALIAN NATIONAL URSI COMMITTEE

by Prof. Carlo Carobbi, President of the Italian National URSI Committee

Ladies and Gentlemen, Young and Senior Radioscientists,

On behalf of the URSI Italian National Committee and of the Local Organizing Committee, I welcome you to the 34th URSI General Assembly and Scientific Symposium.

The GASS already started yesterday and continued today with the pre-conference program, including short courses, the school of Commission B, workshops and Early Career Representative tutorials, all provided LIVE by instructors and speakers to on-site and online attendees.

Board, Council and Coordinating Committee meetings were also held in these two days. In the next days, the program will move on along the track of the traditional GASS, hence including scientific sessions, general lectures, tutorial lectures, a Public Lecture, the Student Paper Competition, business, working group and pop-up meetings. Flash Interactive Presentations will be offered to provide the informal interaction scheme previously implemented by traditional poster sessions.

I want to dedicate a special mention to the workshop "Women in Radioscience", which will be held on Tuesday afternoon. Speakers in this workshop are top level scientists in their field. Don't miss it! By the way, women involved in the LOC provided **crucial** support to the organization of URSI GASS 2021.

The Public Lecture, on next Saturday, will be devoted to an insight of the personality of Guglielmo Marconi, the Italian inventor that had a prominent role in the history of Radioscience.

A live virtual tour of Marconi Museum will be offered on Tuesday. We now show a 2 minutes video announcing this event. (A video of the Marconi Exhibition is shown on screen).

From the perspective of the Local Organizing Committee this is the final stage of a long journey, which started more than two years ago, in 2019, when nobody could foresee what would have happened in a few months.

The GASS 2020 was planned to be held in the main Sapienza Campus, placed about 4 km from here. When the decision was taken to postpone GASS 2020 to 2021, the revision process of 1700 submissions had been completed, and room assignments had begun. GASS 2021 is held in two venues: The Faculty of Civil and Industrial Engineering of Sapienza University, and in what we call ViVe, the Virtual Venue. I just say that this change in the organization of the GASS was not painless for the Local Organizing Committee. But not all evil comes to harm!

The present venue, which develops around the beautiful cloister designed by Giuliano da Sangallo, is a Faculty of Engineering since 1935, hosting 4 departments and offering more than 30 programmes, between bachelors, masters degree and PhD courses. The venue is at walking distance from Palazzo Brancaccio (where the banquet will be held on next Wednesday), and from Coliseum, Fori Imperiali and Piazza Venezia.

I am talking at few meters from the Moses of Michelangelo! (Moses is shown on screen). The Virtual Venue allows LIVE attendance and interaction of online and on-site participants. Every scientific session is recorded and made available on demand to registered participants. In this long journey we have lost an estimated colleague and friend, Prof. Roberto Sorrentino, (picture of Prof. Roberto Sorrentino is shown). President of the URSI National Committee until his passing away, on March 3, 2020 at age 72. This was a shock to us, but his memory has been the drive not to frustrate the fruit of his efforts.

It is now time for a long list of thanks. First, I would like to thank the URSI President, Prof. Makoto Ando, and the URSI Board for their availability and understanding when difficult decisions had to be taken. We are sincerely in debt with the Secretary General, Prof. Peter Van Daele, and URSI Secretariat, for continuous and tireless support and advice.

A special thank goes to the Scientific Program Chair, Prof. Alain Sibille, and the Scientific Commissions' Chairs, Vice-Chairs and Early Career Representatives for having prepared two times (the first time for GASS 2020 and the second time for GASS 2021) an extraordinarily rich and variegate scientific program.

I sincerely thank Prof. Giuseppe Mazzarella, President of "Società Italiana di Elettromagnetismo", without whose support the GASS could not probably have been held in Italy.

I would like to thank the Dean of the Faculty of Civil and Industrial Engineering of Sapienza University, Prof. Antonio D'Andrea, for his understanding and flexibility in hosting the GASS in these difficult times. I thank the European and International Relation Office of Consiglio Nazionale delle Ricerche for secretarial support during the various URSI Italian National Committee meetings of these last two years.

A heartful thank goes to the volunteers and technicians that are working to assist session chairs, speakers and attendees toward a smooth integration of the on-site and online venues.

Thanks to the 21 industrial, research and academic institutions that entrusted URSI GASS 2021 with their logo. I would like to acknowledge, in particular, the support of the GOLD sponsors: ELETTRONICA GROUP and HUAWEI. (show the slide with the GOLD sponsors).

My final thanks go to the authors of the many papers that are going to be presented in the next days. The share of scientific research results for the progress of humanity is the essence of our collective effort. Let me wish you, a fruitful participation to the URSI GASS 2021. Thank you.

WELCOME ADDRESS BY THE URSI PRESIDENT

Professor Makoto Ando, URSI President

Honoured guests, Ladies and Gentlemen, Awardees,

It is wonderful to gather here in Rome Italy for this General Assembly. Due to the extension of COVID19, we finally meet again after 4 years since the success of GASS2017 in Montreal. Thank you very much for your consistent support as the authors, participants, LOC members and sponsors which make GASS2021 happen. This is the first challenge for URSI to have it in Hybrid mode. About half of the attendees is joining it remotely. I appreciate the Sapienza University of Rome which provides this venue with IT facility.

I want to start by thanking the Italian National Committee of URSI (ITNC=URSI-CNR Commission) led by Carlo Carobbi and LOC chaired by Guglielmo D'Inzeo for the really difficult job that they have done in putting this meeting together in this disaster. Thanks are also going to the Italian National Research Council (CNR) for strongly supporting URSI GASS through the ITNC (=URSI-CNR Commission.) I would also especially like to thank Alain Sibille, the Scientific Programme Coordinator, and URSI team, Professor Peter Van Daele, Secretary General and Dr Ross Stone, Assistant Secretary General. They substantially had to organize two meetings GASS2020 and GASS2021 with tremendous efforts.

Fantastic technical programme has been provided by the collaboration with the Commission Chairs, Vice-Chairs, conveners, and of course you, the authors attending physically and remotely. I believe that you learn, contribute and of course have a very fruitful discussion in this hybrid meeting.

In 2018, ICSU for natural science and International Social Science Council (ISSC) were merged and International Science Council (ISC) started. URSI had been a member of ICSU and is now a member of ISC. Today, we are honored to have with us Daya Reddy, the President of ISC.

Furthermore, I welcome the representatives from other organizations:

Harvey Liszt from IUCAF; Patricia Doherty from SCOSTEP Christian Heipke from ISPRS Kathy Whaler from IUGG

I want to briefly review triennial activities in URSI. Since the establishment in 1919 as one of the four Unions under the ICSU, URSI is almost 100 years old. A preview of the book entitled "100 years of URSI" is available here. It consists of one historical overview and articles from 20 Member Committees and all 10 Commissions. The Board appreciates the hard work of the editors, Philip Wilkinson, Paul S. Cannon and W. Ross Stone.

We have three flagship meetings in each triennium. AT-RASC in Gran Canaria, AP-RASC in Delhi India were successful, while the General Assembly in Rome was postponed by 1 year. We rescheduled them so as to return into the original triennial schedule on and after GASS2023 Sapporo.

URSI *Radio Science Letters* (RSL) started in 2019 as an electronic journal owned and operated by URSI. RSL is an open access, peer reviewed letter journal in all areas of radio science. The URSI Board has appointed George Uslenghi as the first Editor-in-Chief (EIC). Since its start in GASS2014 in Beijing, Early Career Representatives(ECR) reached a steady state of two ECRs per Commission in this triennial. ECRs have introduced different and fresh perspectives into the Board and Commission activities and operations. Commission is now operated by 4 officers, Chair, Vice-chair and 2 ECRs.

URSI Individual Membership proposed in last triennium has been implemented and started. Currently, we have 109 URSI Fellows, 515 Senior Members, and 223 Corresponding Members. From January 2018, reduced registration fees were applied to all URSI flagship meetings and some Partner meetings with MOU. So, please apply now through the URSI website.

It is now my sad duty to record the passing of distinguished colleagues during 2017-2021. All the names are shown on screen.

Balmain, Keith, Chairman LOC, URSI GA Toronto Bolinder, E. Folke, USA, impedance transformation Brazil, Thomas J., Com D, President Ireland MC, Off Member in Ireland Carpenter, Don, URSI Dellinger Medal 2002 Clarricoats, Peter J.B., Vice President and Treasurer of URSI Farley, Donald T., URSI Appleton Prize 1996 Hultqvist, Bengt, Chair, Commission G, 1978-80 Itoh, Tatsuo, Chair, Commission D, 1993 - 96, Awards Referee Kimura, Iwane, Chairman LOC, URSI GA Kyoto McNamara, Leo, Com G, high frequency (HF) propagation, Ionosphere Commun. Petit, Michel, Chair, Commission H, 1981-83, Pres. URSI-France (CNFRS) Potekhin, Aleksandr P., URSI WG on Studying the Upper Atmosphere Rawer, Karl, Vice Chair, Commission G., Chair, International Reference Ionosphere (IRI) WG. Karl Rawer Gold Medal since 2017 Rodger, Alan S., Editor of the J. of Geophysical Research (Space Physics) and former Interim Director of the British Antarctic Survey (BAS). magnetosphere-ionosphere physics Rush, Charlie, Com G Senior, Thomas B.A., President of URSI, URSI Van der Pol Gold Medal 1993 Shifrin, Yakov S., Statistical Antenna Theory, education in USSR and Ukraine Shmelev, Alexander B., Com C, Russia Deceased URSI colleagues 2017-2021 3/3 Sorrentino, Roberto, President Italian URSI committee, Chairman LOC GASS 2020, Chair Commission D, 1996-99, President Italian Electromagnetic Society (SIEM) Swarup, Prof. Govind. India, Com J, URSI Dellinger Medal 1990, GMRT Telescope near Pune, India, Award Expert

Tatarskii, Dr. Valeryan I., USA, Com F, random media, statistical radiophysics, Awards referee
Taylor, George N., URSI Correspondent, UK
Van Bladel, Jean, Honorary President and former Secretary General of URSI 1979-1993, Chair LOC URSI 75
Vietzorreck, Larissa, President of the German MC
Walde, Carl-Henrik, longtime Secretary of the Swedish URSI committee
Wright, John William (Bill), Com J, USA

I ask you to remember: Roberto Sorrentino. GASS2020 Rome was proposed by Roberto's leadership in 2017 and GASS2021 is a dream-comes true for him. We invite his wife Mrs. Linda Sorrentino for playing piano today. Please join me in standing and a moment of silence remembering our great predecessors.

Triennial to annual operation transition has been terribly disturbed by this pandemic, but this could also be taken as the chance to reform URSI structure, operation and activities.

Remote Conferences and meetings, compelled by COVID-19 remind us the importance of communication. Physical Distance may be virtually reduced. Now, infection prediction and vaccine development using big data and digital technology enhanced by AI are reported on TV every day. People recognizes the importance of evidence-based(informed) and science-based decisions in policy-making. There seems to be increased trust and demands for the experts or science itself. The radio science is also getting closer to the people than ever.

URSI should take this opportunity and enhance the presence in the interdisciplinary and cross Commission topics, such as, disaster risk management, climate change, environment, and disparity between generations, for example, even after Corona Era.

Finally I would encourage the Young Scientists. Transformational breakthroughs in the world always take place through the younger leaders; all commissions are waiting for your idea. So please attend your Commission coordination activities (Commission Business Meetings) and contribute as much as you can in both scientific and operational activities.

I hope that you all enjoy your safe and healthy stay in the meeting, by following updated COVID-19 guidance on GASS website.

WELCOME ADDRESS BY THE DEAN OF THE FACULTY OF CIVIL AND INDUSTRIAL ENGINEERING, SAPIENZA UNIVERSITY OF ROME

Prof. Antonio D'Andrea, Dean

Good afternoon to all of you and my compliments to the staff of the organization and to my great friend professor D'Inzeo for the effort to realize the present conference concerning a technical field so actual and so important for the future in the next years.

In my dean experience, with a lot of congresses in our old building, I saw how large is the engineering word, how rapidly it expands, and I am amazed if I look at the state of the technique in my formation years and the recent advancement. But more and more I am amazed if I think at the time of the foundation of our School by

Four years ago, we celebrated the completion of the second century of that school, transformed during time in our Faculty of Engineering.

the Pope Pio the Seventh in October 1817.

From the initial unique study program in civil engineering (Water and Road Infrastructures), the activity of the School covered any kind of innovative specialization, from mechanical and electrical in the decades of the first industrial revolution, to robotics, biomedical, nanotechnology and internet of things in the last years. History is "inside" our institution and our buildings breathe history, too.

When Italy became a unique reign, the properties of the Church was assigned to public services and the School of Engineering was located in the actual site, the Convent of the monks of the Holy Saviour (Congregazione del Santissimo Salvatore Lateranense) of San Peter in Chain.

The site was predestined to studies and culture, I suppose, because if you walk around the Faculty you can admire the ruins of the library of the Baths of Trajan (Terme di Traiano) on the south limit, as you can see in the slide.

In November 2010, following the reorganization of Sapienza University, the Faculty of Engineering was divided into the Faculty of Civil and Industrial Engineering and the Faculty of Information Engineering, Computer Science and Statistics. Then I give you the welcome and the wishes for a nice and successful congress both in my name, as dean of the Civil and Industrial Faculty, and in the name of prof. Fabio Grasso, dean of the Information Faculty, with the hope that this division could be overcome in the next future in consideration of the strict interaction of all the branches of engineering and the need of interdisciplinarity to face the complexity of the recovery plan after the pandemic emergency.

WELCOME ADDRESS BY THE DELEGATE OF THE PRESIDENT OF CNR

Dr. Ivo Rendina, Vice-President of URSI National Committee

Good afternoon,

It is a pleasure and an honor to welcome you on behalf of the President of the Italian Consiglio Nazionale delle Ricerche (CNR), Prof. Maria Chiara Carrozza.

A century has passed since Italy, during the International Research Council of 1919, joined the Union Radio Scientifique Internationale (URSI), and when in 1922, during the first General Assembly of URSI, the Italian membership was ratified under the representative role of the Consiglio Nazionale delle Ricerche, at that time, a very young governmental research organization that will be then officially established in 1923. In the same year, the first president of the CNR, Vito Volterra, appointed a committee of experts under the prestigious chairmanship of the Nobel Prize for physics Guglielmo Marconi, who will then be president of the CNR from 1927 to 1937.

After a century, the Italian URSI Committee continues to be appointed by the CNR President, with the aim to serve the national and international scientific community, providing proposals for the effective Italian participation in the URSI activities.

And after a century, the Consiglio Nazionale delle Ricerche has greatly changed, becoming the first Italian public research organization, with 88 research Institutes, where about 8000 scientists contribute to all the branches of knowledge, among which more than 2000 researchers are involved in engineering and physics studies, therefore correlated to the scientific activities of URSI interest.

Thus, in closure, let me give the warmest welcome to URSI-GASS 21 on behalf of this wide and active scientific community of Colleagues of the Italian CNR. I wish you nice and interesting days in the beautiful Rome, and to enjoy the Conference. Thank you.

Award Presentation GASS 2021

Prof. Paul Cannon, Chair of the URSI Awards Panel

Good afternoon. It is an URSI tradition that the immediate past President has the honour of both Chairing the Awards Panel and also those parts of the Opening Ceremony when we recognise our most esteemed colleagues. On this occasion the honour falls to me.

Assisting me in selecting the laureates for recommendation to the Board from a very strong field of nominees were Yoshiharu Omura, Lotfollah Shafai and Günter Steinmeyer and I would like to publicly thank them for their service to URSI.

As you are well aware the URSI 2020 award presentations have been delayed by one year due to the pandemic, so let's not delay further.

BALTHASAR VAN DER POL GOLD MEDAL

presented by Prof. Paul Cannon, Chair of the URSI Awards Panel

The Balthazar van der Pol Gold Medal for 2020 is awarded to Koichi Ito for "Contributions to research and development in the fields of medical applications of electromagnetic waves and their evaluation using human-equivalent phantoms". Prof Ito will respond online.

REPLY BY КОІСНІ ІТО

Thank you for the introduction.

I feel very honored and humbled to receive the Award of the Balthasar van der Pol Gold Medal. I sincerely thank the Awards Panel members for selecting me for this very prestigious Award. I also thank Prof. Yagitani, my Nominator, and colleagues who supported my nomination.

I accept the Award on behalf of all my colleagues of URSI Commission K as well as Center for Frontier Medical Engineering, Chiba University.

I would like to acknowledge their great contributions and cooperation. Particularly, I would like to thank former students and staff of my laboratory at Chiba University, and my family. Thank you very much.

JOHN H. DELLINGER GOLD MEDAL

presented by Prof. Paul Cannon, Chair of the URSI Awards Panel

The John H. Dellinger Gold Medal for 2020 is awarded to Stefano Maci for "Contributions on diffraction theory, metasurfaces and for impact on education in electromagnetism". Prof Maci will respond via a video.

REPLY BY STEFANO MACI

It is a honour and distinct pleasure to receive the John Howard Dellinger Medal from the Union Radio Science International. This is a very prestigious award, and I thank the URSI Committee for having selected me among exceptionally qualified scientists. I would like to thank first of all Grazia, my wife, for understanding me in all moments of my life, my nominator for this award and great friend Professor Nader Engheta, who is always a source of scientific inspiration. Special thanks to Enrica Martini, Alberto Toccafondi and Matteo Albani, from the University of Siena, and Giuseppe Vecchi from the Polytechnic of Turin. A final thanks to all my present and former students. They are important for my scientific research and I learn every day from all of them. Thank you so much.

BOOKER GOLD MEDAL

presented by Prof. Sembiam Rengarajan, Chair of the US National Commitee

The Booker Gold Medal is awarded to John Volakis for "Seminal contributions to electromagnetics, including small, ultra-wideband and textile antennas and arrays, low power transceivers, diffraction and for transitioning hybrid finite element methods into commercial computational toolsets". Professor Volakis is here in Rome and the medal will be presented by the Chair of the US National Committee, Sembiam Rengarajan.

REPLY BY JOHN VOLAKIS

It is a special honor for me to have the fortune to receive the Booker Gold Medal in the land of Marconi.

URSI was built on Marconi's inventions and leadership. Marconi was a dreamer and dreamed to make our lives better using wireless communications.

Today, we can all agree that your cell phone is one of the most important devices we constantly carry and an inseparable part of our lives.

Starting with applications to wireless telegraphy and radars, today, our cell phone and PDAs are used for all sorts of sensing and information gathering with increasing expansion to wearables for medical monitoring.

I like to also express my appreciation and honor in receiving this medal with Prof. Henry Booker name on it.

Prof. Booker's career has much similarities to my own. He dedicated his career to educating and developing the careers of many talented graduate students and to research in antennas and large projects, like the Arecibo facility. At the same time, he build large research programs at more than one Universities.

My many thanks to my nominator, Prof. Notaros, as well as Profs. Rahmat-Samii, Ando, Uslenghi, Jackson and Balanis for their support. I am forever indebted to them for their gracious support and efforts.

APPLETON PRIZE

presented by Prof. Paul Cannon, Chair of the URSI Awards Panel

The Appleton Prize is awarded to Richard Horne, for, "Leadership and theories of charged particle dynamics in the Earth and planetary magnetospheres leading to practical space weather forecasting of the high energy particle environment". Professor Horne will respond online.

REPLY BY RICHARD HORNE

Thank you, Paul, thank you very much for this magnificent prize and all it stands for. And thank you to Mike Warrington and the British National Committee, the Nominations Committee, and my colleagues around the world for your support – I am truly honoured to receive this prize named after Edward Appleton, the distinguished Nobel prize-winner.

Science – research - is a very creative process. We think of the Arts as creative – but science is too. As scientists we think about the natural world, we explore new things, we identify problems, we generate new ideas, new thoughts, and we devise new ways of solving problems. It is very creative.

And creativity needs inspiration. That inspiration comes in many ways and from many people. I'd like to thank the late Richard Thorne, a great friend and great scientist

who inspired me in many ways. To my close colleagues at BAS, especially Sarah Glauert and Nigel Meredith, and all my URSI colleagues for all the talks, the sessions, the new results which have inspired us, all of us, with new ideas.

And a special thanks to my father who inspired a sense of wonder when I was a boy, to my sister Carolyn who asks so many questions, my three children Charlotte, Bertie and Louise who provide inspiration in a way that only children can. And finally, to my wife, Julie, for her true love throughout our long and happy marriage, her advice and wisdom, and without whom this would not be possible.

Thank you – I am truly honoured and truly grateful.

REPORT BY THE SECRETARY GENERAL

by Professor Peter Van Daele, Secretary General of URSI

Distinguished guests, Ladies and Gentlemen,

Good morning, good afternoon, good evening, good night, to all of you participating from all over the world! Welcome to Rome, for one week literally now the center of the world in Radio Science.

It is the traditional duty of the secretary general to present a concise report of the scientific activities, the finances and the general administrative situation of our Union. In past triennium which spanned a period of 4 years, the Board under the leadership of our president, Prof. Makoto Ando, has worked hard towards 3 objectives: to expand the scientific activities in the field of Radio Science, to stimulate the participation of young and emerging scientists in our Union and to improve the service in general that URSI can bring to the Radio scientists worldwide.

URSI is now more than 100 years old. The centenary celebrations which were planned and announced at the occasion of our previous General Assembly in Montreal in 2017 were nearly all cancelled due to COVID 19 pandemic which unfortunately coincided exactly with our 100th anniversary. These original initiatives implied special sessions at the GASS 2020, a special symposium in Brussels with attendance of His Royal Highness King Philip of Belgium and dedicated publications covering the history and activities of URSI over its life-span.

At this GASS 2021 in Rome, some of the sessions scheduled last year are still taking place and we also have some extra initiatives like e.g. the Marconi exhibit. I am also very proud to announce that, just prior to this GASS, we finished, under the guidance of Prof. Wilkinson, Prof. Cannon and Dr. Stone, the editing of the centennial book "100 years of URSI". It has been an enormous effort by the editors and by the Secretariat, especially Ms. Inge Lievens, to produce this 600 + pages book. I am very grateful for their work.

The book includes contributions by about 2/3rd of the Member Committees and all URSI Commissions describing the evolution, important aspects or significant contributions in our field of research over the last 100 years. This book is now available for pre-order through our website and will also be on display here in Rome. Please make sure to check it and pre-order your printed copy if required. The PDF-version will be freely available for download.... But printing 600 pages yourself might be less environmentally friendly than ordering the printed copy. Over the past few years the URSI Board has taken several initiatives to engage young scientists and young researchers in our union. The well-known Young Scientists programme was also implemented here in Rome both last year and this year. Over the 2 editions we received 426 applications were received of which 211 were awarded. These brilliant young researchers will present their work throughout the programme of this GASS on the same level as more senior researchers and experts and for some, this might even be the 1st international conference in which they participate. For this YS programme, we are very grateful to the Japanese MC for financial support.

We also support Student Paper Competitions at national level and with thanks to the US National Committee a SPC here in Rome with 99 applications over both editions with 2 times 10 finalists.

Facilitating the exchange of scientific information and results is one of the primary tasks of URSI. Next to our symposia the Radio Science Bulletin thanks to the continuing efforts of Ross Stone has become a respected scientific journal. Immediately following the Montreal GASS, the URSI Board supported the initiative taken by Prof. George Uslenghi to set up a new International Open Access Journal, the Radio Science Letters. It is an electronic journal owned and operated by URSI with the purpose to rapidly publish original scientific research work in all areas of radio science. Special reduced page charges are available for URSI Senior Members and for those having presented a paper at the URSI Flagship meetings, including this General Assembly.

May I use this opportunity to call on all of you to submit papers to the RSB and Radio Science Letters so as to make it a favored means of communication between radio scientists.

En tant qu'union scientifique URSI est membre de ISC (le Conseil scientifique international). Ce Conseil est une organisation non gouvernementale avec une composition mondiale unique qui rassemble 40 unions et associations scientifiques internationales, comme l'URSI, et plus de 140 organisations scientifiques nationales et régionales, y compris des académies et des conseils de recherche. L'ISC a été créé en 2018 à la suite d'une fusion entre le Conseil international pour la science (ICSU) et le Conseil international des sciences sociales (ISSC). C'est la seule organisation non gouvernementale internationale réunissant les sciences naturelles et sociales et la plus grande organisation scientifique mondiale de ce type. Après mon rapport Dr. Daya Reddy, le President de l'ISC, va prendre la parole pour quelques mots d'introduction. In the framework of the ISC, URSI collaborates with other scientific unions and related to this, we will have on Wednesday the Kick-Off meeting of the workgroup on Risk and Disaster Management.

From a financial point of view URSI is still in relatively good shape. In view of the changing environment in which we live, URSI also had to adapt to the fast digital transformation of our society... and this in all of its activities: publishing, conferences and now since 2 years also in the way we run administrative meetings.

Investment in digital tools and software was required and especially the secretariat had to adapt rapidly to this changing way of working. Thanks to the endless efforts and flexibility of both our staff members, Mrs. Inge Heleu and Mrs. Inge Lievens, we have been able, at the Secretariat, to cope with these new challenges and, just like many amongst us, we are now very familiar with Zoom, Teams, WebEx, video calls .. at any time of the day, any day of the week, any day of the year as we cover with URSI the whole world and all time zones. I am very grateful to both of them for all their efforts and commitment.

Let me come back to our changing environment. Radio Science in all of its aspects, has evolved over the 100 years URSI has been active, no one will deny this. While in the beginning, Radio Science was an academic playfield, with only expected interest for and from a happy few, this has evolved in a domain which has driven the change of our society much faster and much more than any field ever before. Think about the evolution in the field of communications... from the telegraph, included in the original name of the organisation "*Commission Provisoire Internationale de Télégraphie Sans Fil Scientifique*" out which URSI was born, over fixed line telephony to mobile communications and the internet....

The evolving field of radio science has also enabled us to overcome in an economic way this unseen and unexperienced pandemic that all of us "locked down at home". Can you imagine what the world would have been experiencing this kind of impact 20 years ago, without the high-capacity communication links and internet?

What this pandemic has learned us is that despite predictions, video meetings cannot fully replace human contact. We as humans feel the need for close contact, personal contact, experiencing body language and expressions and emotions. All of you, joining this GASS from home or work, will regret not being here in Rome, meeting your colleagues and enjoying the social activities the LOC has planned for us. For those being here in Rome, let's enjoy the event, let's enjoy being here amongst our peers, colleagues and friends and let's all remember that we, as scientists also need each other and let's pamper and appreciate personal contact.

Let me conclude by thanking all members of the outgoing board for their work, dedication and friendly collaboration in guiding the development of URSI in the past 4-years spanning triennium.

Regarding the new board it is my pleasure to announce the results of the elections that were held earlier today.

Was elected as:

President: Prof. George Uslenghi As Vice Presidents: Prof. Patricia Doherty Prof. Kazuya Kobayashi Prof. Giuliano Manara Prof. Ari Sihvola

And I thank Council for allowing me to continue to serve as secretary general. I look forward to a fruitful collaboration with this new board.

Let me also express my sincere gratitude to the whole local organizing committee of this GASS who have worked hard, to make this unique and very challenging GASS a success. With regard to the scientific program, I would like to thank Prof. Alain Sibille for his contribution as Scientific Coordinator of this GASS. And please do not forget, both Alain and the LOC did the job twice as they also prepared for 2020. Finally my most sincere thanks to my Assistant Secretary Generals, Stefan Wijnholds, Ross Stone and Kazuya Kobayashi. Their support makes my task much easier. I wish you all a most fruitful, rewarding and pleasant GASS in this magnificent city of Rome, or, from home. Thank you.

Message from the International Science Council (ISC)

by Professor Daya Reddy, ISC President

Prof. Makoto Ando, President of the International Union of Radio Science Prof. Alain Sybille, Scientific Program Chair Prof Guglielmo D'Inzeo, Chair of the GASS Distinguished scientists, guests, colleagues

It is a great pleasure to have this opportunity to address the International Union of Radio Science, or l'Union Radio-Scientifique Internationale, on the occasion of its 34th General Assembly and Scientific Symposium.

URSI, as it is widely known, celebrates more than 100 years of existence, with its foundation in 1919, and first GA in 1922. Its foundation came at a significant time for international scientific cooperation, coinciding with the establishment of the International Research Council in Brussels in July 1919, comprising 16 national academies and six international unions. The IRC became, in 1931, the International Council of Scientific Unions or ICSU, with both national elements and unions as full and equal members.

Science has always been, in one way or another, international in its need for shared thought and joint action. Such cooperation is vital for the growth and health of scientific activities and for scientific advances. Science is affected by events outside the world of science, and the converse is, or should be, true: science has a unique role to play in addressing the range of problems that face communities, and which do not respect national boundaries.

A more thoroughly embedded multidisciplinarity is required to address such challenges effectively: to overcome institutional silos through regular opportunities for dialogue to understand fundamental differences between the natural and social sciences, and to build trust and confidence in each other through collaboration. And so we saw the merger of ICSU and the International Social Science Council (ISSC), to form the International Science Council (ISC), in July 2018, with URSI a founder member.

The work of the ISC is framed around major challenges that include planetary sustainability; social transformation; the digital revolution; the science-policy interface; and ensuring the health and growth of scientific creativity and exploration, across the world.

The rapid development of new technologies such as those that fall under the heading of Artificial Intelligence, and a cluster of advances referred to as Bio-Tech, Nano-Tech, and Info-Tech, all carry the promise, and in many cases the reality, of fundamental benefits to society in areas as diverse as agriculture, energy, transport, and health. These new technologies have had a profound impact on the shaping of ISC priorities.

I am pleased to note the many activities of URSI that are closely aligned with such developments: for example, yoru work on managing the EM environment with regard to naturally occurring and anthropogenic electromagnetic emissions. The worl on Space Solar Power Systems carries much promise for clean, renewable and sustainable energy production. And of course URSI is committed to research contributions in the development of micro-electronic-mechanical systems and metamaterials.

The ISC looks forward very much to the cooperation of its members in working towards realizing our significant objectives, and in this way giving substance to the vision of the Council of science as a global public good.

I am pleased to have learned from the programme something about some of the pioneers of radio science through the medals and prizes that bear their names, and which have been awarded to outstanding individuals, to all of whom I extend my warm congratulations on behalf of the ISC.

I conclude by reiterating my congratulations to the International Union of Radio Science on the occasion of its centenary, and extend my wishes for a successful General Assembly and Scientific Symposium. I thank you,

INTRODUCTION TO THE SCIENTIFIC PROGRAM

by Professor Alain Sibille, GASS 2021 Scietific Program Coordinator

It is my great pleasure and honour to introduce the scientific program of the 34th General Assembly and Scientific Symposium of URSI.

The outline of my presentation is the following: I will first explain briefly how the scientific program was elaborated, including some key figures, then I will give some main indications on the contents of the pre-conference program, which takes place on the week-end prior to the main week program. Subsequently, I will present the main features of the latter, both in terms of activities and schedule. I will conclude with some words about my experience and feeling regarding this special edition of the GASS.

Coming to the way the scientific program was elaborated, I would first like to show some quite important figures regarding the contribution of the scientific community as a whole. We had nearly 600 papers accepted from 2020 and transferred to 2021, after we gave the choice to authors if they wished so or preferred another option. Then, a little over 1100 papers were submitted by the deadline of Feb. 12 of this year, so that overall we reached more than 1700 submitted papers, quite an excellent result at this time, given the unfavourable context of the pandemic. This figure was similar to GASS 2017 in Montreal and just 200 less than the record of submissions (GASS 2020) before the COVID crisis started.

Unfortunately, but not surprisingly, a significant fraction of these papers did not make it, either from rejection by the scientific committee or by withdrawing. The resulting figure of 1356 effectively presented papers is split into 1171 papers in regular oral slots and 185 "FIP" papers, a new modality initiated by GASS 2021 in replacement of conventional posters.

Despite the unusual situation of this GASS and the necessity by the Local Organizing Committee to develop a hybrid scheme, both virtual and physical, the traditional structure of the scientific program was used, with minor adjustments.

Let me now show a shorthand view of the pre-conference program, which just ended today. We had two workshops of 4 H each. There has also been the delivery of 12 short courses, a relatively high number, given the context. Actually this was made possible by the virtual platform, allowing a larger number of participants to register to these courses, so that none of the proposed - and accepted - ones was closed. This is an interesting observation for the future. 4 ECR tutorials have also taken place this afternoon, open to anyone like basically all scientific activities. This is a recent but welcome idea, namely to offer scientists who are still young, the possibility to disseminate their work.

The week program contains the respectable number of 188 sessions, for which we made our best with the support of the secretariat to fill them with 3 papers so that these sessions were complete. There are 2 FIP sessions, where the idea was to create a sort of virtual poster session, allowing direct exchanges with participants, while short "flash" presentations accessible "on-demand" allowed attendees to quickly select the works they were mostly interested in. There are also the 10 traditional 1 H tutorials, which anyone can attend well beyond the originating commission.

Furthermore, one workshop, 3 general lectures and 1 public lecture are implemented, maintaining what has been done over many previous GASS. Finally, 1 working group presentation, open to any participant, is on the schedule.

This is a bird's eye view of the program scheduling framework, common to all commissions. What has been done this year is to tighten slightly the timing and unifying it, so that all oral sessions contained 3 slots followed by a pause, break or other activity. Further, the FIP sessions of Tuesday and Thursday were duplicated on morning and afternoon, so to facilitate participation/attendance, taking into account remote persons and diverse time zones. Finally, the "commission coordination activities" is a new name for the previous "business meetings", this name being more modern and adapted to what is done there.

A short word now on the student paper competition and the young scientist awards, another supporting initiative taken by URSI long ago toward the recognition and encouragement of young radioscientists. In GAS 2021, this has been fully implemented, resulting in 46 SPC candidates, from which 10 of them were selected to present their work this Monday in the hope to win one of the 3 offered prizes.

We also received the large number of 179 applications for an YSA, from which 95 were accepted, providing significant support to the awardees to help them participate, especially from less favoured countries where extra support is provided. Let me also stress that, although by far most of the financial contribution comes from URSI, some comes from volunteering national committees and some extra awards are delivered by such committees.

Let me now conclude by saying that, at the end of the day, GASS 2021 is nearly a "normal GASS". This is largely due to the efforts of the scientific community. I would like to express particular recognition to the Commission Chairs, Vice-chairs and ECRs, plus very much to the Local Organizing Committee and to the URSI secretariat, and the Board. I hope that the hybrid scheme will allow a smooth participation, both for authors and attendees, this is my wish and my belief.

Award Presentation GASS 2021 (Part 2)

Prof. Paul Cannon, Chair of the URSI Awards Panel

KARL RAWER GOLD MEDAL

presented by Prof. Paul Cannon, Chair of the URSI Awards Panel

The Karl Rawer Gold Medal is awarded to Raj Mittra for "Contributions to Analytical and Numerical Techniques in Electromagnetics and to Antenna Theory and Design". Dr Mittra will respond via a video.

REPLY BY RAJ MITTRA

Good evening friends, it's a great honour and privilege for me to be with you this evening to accept this prestigious Karl Rawer Medal of URSI. I'm told that I have 60 minutes (no, 16 seconds !) and I'm told that my colleagues from Politechnics Torino think that the podium will collapse if I go over my time limit, so I'd better get moving. Anyway, I've had many medals and awards in my live, the last one was from IEEE, the Alexander Graham Bell Award but despite all these medals and honours, I never had anything from URSI. So it's a great moment for me to get this prestigious Rawer Medal, which is a combination of my career, the holy grail, if you will. Especially because it recognizes my career achievement. I'm sure that you saw that in the Olympics, when they receive a medal, they pick it up and kiss it and try to bite it, but I'm going to stay with the tradition. I'm just going to say my thanks to the organizers, the referees, who wrote recommendations that got me selected for the award. But most of all I want to thank my students and postdocs (more than 150) over a career of 40 decades because they work hard, day and night, and they generated over 1000 papers. So I dedicate this medal to you, my students, postdocs and colleagues, who have helped me my whole career. With that I close. Thank you.

THE ISSAC KOGA GOLD MEDAL

presented by Prof. Paul Cannon, Chair of the URSI Awards Panel

The Issac Koga Gold Medal is awarded to Ruisi He for his "Outstanding investigations of radio propagation and channel modelling in high mobility scenarios that has resulted in significant improvements in communication system evaluation and design." Prof He will respond via a video.

REPLY BY RUISI HE

Good afternoon, everyone. This is Ruisi HE. I extend my warmest greetings to the members of the URSI and to all of the other guests in attendance.

I'm sorry I can't be with you in person, but please know that I am definitely with you in spirit at this special time. I can't tell you how honored I am to receive this amazing award.

I have been working on radio propagation and communications in high mobility scenarios. I'm very glad to see that this technology is developing very fast in railways and vehicles all over the world. I thank the URSI committee for finding my work worthy of this honor.

I also want to thank my Nominator Amir Zaghloul for the kind support, and my award supporters Sana Salous and Andreas Molisch. I would like to thank China CIE, and my supervisors Zhangdui Zhong and Bo Ai for all the kind help in my career. I want to take this opportunity to share with them the pleasure and honor of receiving this award. Thank you very much, and I will try my best to contribute to radio science and the URSI community. My best wishes to you all.

THE SANTIMAY BASU PRIZE

presented by Prof. Paul Cannon, Chair of the URSI Awards Panel

The Santimay Basu Prize is awarded to Xiaolan Xu for "Developments in Wave Propagation and Scattering in Dense Random Media with Applications to Microwave Remote Sensing of Snow." Dr Xu will respond via a video._

REPLY BY XIAOLAN XU

Hi I'm Xiaolan Xu, a scientist working at Jet Propulsion Lab. I am so honored to have my work recognized by the Santimay Basu award. This accomplishment is not something that I did alone, and many others deserve to share in this award.

First, I would like to thank my Ph.D. advisor Prof. Leung Tsang, who lead me into this field and guide me along the way. I would also like to thank all my colleges especially Dr. Simon Yueh for their mentorship, support, and inspiration. And most importantly, I want to thank my family for their endless love and support.

Last, but not least, thanks to the international union of radio science, Dr. Santimay Basu, and his wife for offering recognition to young scientists like me. I hope that this recognition of my work can serve as an inspiration to others in the field. I will continue my efforts to explore more possibilities for the application of random media theory and look forward to creating innovative solutions to all kinds of remote sensing problems for many years to come. I am humbled and appreciative. Thank you!

THE PRESIDENT'S AWARD

presented by Prof. Paul Cannon, Chair of the URSI Awards Panel

In the last triennium we introduced the President's Award to recognise one exceptional person, per triennium who had, over a protracted period, supported and developed URSI.

The President's Award for 2020 is made to Prof Kazuya Kobayashi for "his leadership and untiring efforts in initiating, organizing and establishing AP-RASC as one of the URSI Flagship Meetings." Prof Kobayashi will respond online.

REPLY BY KAZUYA KOBAYASHI

It is a great honor for me to receive this prestigious award! I am really happy with this award.

The "Asia-Pacific Radio Science Conference" (AP-RASC) was established based on the initiatives by the Japan National Committee of URSI, and it was held for the first time in Tokyo, Japan in 2001. Since then, I have been involved in organization of all the six AP-RASC meetings held in the past, and every time I enjoyed working with the Local Organizing Committees in the host countries. This was a very precious experience for me.

I would like to express my appreciation to my colleagues, friends, and students who supported me constantly in various ways. I should never forget my wife who helped me a lot all the time in my life. Without all these supports, this award would never have been possible for me.

I would like to devote myself to the progress of URSI, and will definitely work hard for future AP-RASC meetings to be more successful. Thank you very much!

CERTIFICATES OF RECOGNITION

presented by Prof. Paul Cannon, Chair of the URSI Awards Panel

URSI is nothing without it's wider spectrum of supporters and members and at this GASS the following persons are both recognised and also thanked for all of their hard work during the previous three years and before by the award of Certificates of Recognition. Prof. S. Anantkrishanan, for "establishing a significant and pro- longed URSI activity in India".

Prof. S. Rengaragan, for "his leadership of the student paper competition at GASS 2017, AT-RASC 2015 and 2018 and GASS 2020 and 2021".

Prof. C. Carobbi, for "his outstanding contributions devoted to organizing the URSI GASS 2020 and 2021".

Prof. G. D'Inzeo, for "his outstanding contributions devoted to organizing the URSI GASS 2020 and 2021".

Prof. A. Sengupta, for "his outstanding contributions to the organization of the URSI Asia- Pacific Radio Science Conference (AP-RASC) 2019".

Prof. A. Sibille, for "his outstanding contributions as Scientific Programme Coordinator of URSI GASS 2020 and 2021".

Dr. P. Wilkinson, for "his untiring efforts in editing and perfecting the contributions to the Centenary Book".

And finally, but not least to: Prof. R. Sorrentino, "for his outstanding national and international contributions to URSI and in particular to both GASS 2020 and 2021 held in Rome, Italy".

It has been a great pleasure being involved in selecting these, our esteemed colleagues. I now return the microphone to Peter Van Daele. Thank you.

The Opening Ceremony ended with musical entertainment from Mrs. Linda Sorrentino (wife of Roberto Sorrentino) accompanied on the piano by the soprano singer Mrs. Marina Comparato.

A reception was held afterwards at the Cloister of the Faculty of Civil and Industrial Engineering.

CLOSING MEETING

The Closing Meeting was held on Saturday 4 September in Room 1 of Sapienza Faculty of Engineering, Rome, Italy.

CLOSING REMARKS BY THE CHAIR OF THE ITALIAN URSI NATIONAL COMMITTEE

Professor Carlo Carobbi

Ladies and Gentlemen, Young and Senior Radioscientists,

The 34th URSI General Assembly and Scientific Symposium is going to conclude. They have been eight days of very intense scientific, business and, I am particularly proud and happy to say, social activities for those here in Rome.

We reached the notable number of 1212 registered participants, nearly 400 attendees attending on-site with a peak of 290 scanned QR codes in one day. This is also the scenario that we predicted (and even better), considering the ongoing pandemic. All the scientific sessions are available on-demand through the Virtual Venue. So, if you did not attend some sessions LIVE, or you want to attend some inspiring sessions twice, do remember that the Virtual Venue is available for that purpose.

Next days will be devoted to learning from this very special URSI GASS 2021 experience, considering what went well and probably should be reused for future URSI flagship conferences, and what should be improved. The LOC is quite open to share this experience with URSI community.

Unlike the opening, in this closing ceremony I would like to be quick in conclusive remarks, so I have a tiny but quite relevant list of thanks.

The URSI Italian National Committee and the LOC are in debt with all the many volunteers that welcomed registrants, checked COVID certification, green pass, QR
code, assisted chairs and speakers during the sessions, faced and solved a myriad of very diversified issues.

We are ALL also in debt with Prof. Francesca Apollonio (chair of the LOC onsite activities) and Prof. Micaela Liberti (chair of the LOC Virtual Venue activities) who recruited the volunteers and coordinated their activity without implementing for themselves any, let me say, energy-saving mode in these days. I personally thank them for their commitment.

Finally, I thank our 21 academic and industrial sponsors, and in particular the GOLD sponsors, Elettronica Group and Huawei, for their tangible support. To those in presence, I wish a SAFE trip back home.

We are looking forward to meeting you at the next URSI flagship conferences in Gran Canaria, for AT-AP RASC 2022, and Sapporo, for the next URSI GASS 2023. Thank you.

CLOSING REMARKS BY THE SECRETARY GENERAL

Professor Peter Van Daele

Distinguished Guests, Colleagues, Ladies and Gentlemen,

At the request of the President, I am pleased to recall the results of the elections held at the occasion of this General Assembly. The newly elected Board of Officers was announced at the Opening Ceremony: the new incoming President is Prof. George Uslenghi (USA), and the new Vice-Presidents are in alphabetical order: Prof. Patricia Doherty (USA), Prof. Kazuya Kobayashi (Japan), Prof. Giuliano Manara (Italy) and Prof. Ari Sihvola (Finland), while I continue as secretary general. Let me welcome the new Board members and thank the outgoing Board members and in particular Prof. Willem Baan, Prof. Ondrej Santolik, who are leaving the Board, for their work and for their dedication to URSI. A special word of thanks also to Prof. Paul Cannon who is leaving after 13 years of service, 7 years at the Board and 6 years before that as Chair and Vice-Chair of Commission G, so 19 years in total. All of us at the Secretariat are extremely grateful to Prof. Paul Cannon for updating and modernizing all the URSI documents and for teaching us how to use and write proper English. Prof. Makoto Ando will remain in the Board as Past President.

During the course of this General Assembly the 10 URSI Commissions, within their Coordination Activity meetings also elected the new Chairs, Vice-Chairs and Early Career Representatives for the next triennium.

The election results of the Chairs and Vice-Chairs of the Commissions are as follows:

Commission A: Chair: Prof. Nuno Borges Carvalho (Portugal) Vice-Chair: Dr. Amitava Sen Gupta (India) Commission B: Chair: Prof. John L. Volakis (USA) Vice-Chair: Dr. Henrik Wallén (Finland) Commission C: Chair: Prof. Yves Louet (France) Vice-Chair: Dr. Kumar Vijay Mishra (USA) Commission D: Chair: Prof. Naoki Shinohara (Japan) Vice-Chair: Dr. Atsushi Kanno (Japan) Commission E: Chair: Prof. Virginie Deniau (France) Vice-Chair: Prof. Carlo Carobbi (Italy) Commission F: Chair: Prof. Tullio Tanzi (France) Vice-Chair: Dr. Motoyuki Sato (Japan) Commission G: Chair: Prof. Giorgiana De Franceschi (Italy) Vice-Chair: Dr. Keith Groves (USA) Commission H: Chair: Prof. Jyrki Manninen (Finland) Vice-Chair: Prof. Craig J. Rodger (New Zealand) Commission J: Chair: Prof. Douglas Bock (Australia) Vice-Chair: Prof. Stefan J. Wijnholds (The Netherlands) Commission K: Chair: Prof. Koichi Ito (Japan) Vice-Chair: Prof. Francesca Apollonio (Italy)

The outgoing Commissions Chairs have been involved for at least 2 trienniums in URSI and have spend much time in coordinating the activities within the Commissions and also coordinating the programme for all our URSI Flagship meetings. URSI is very

grateful to them and we wish to call the outgoing Chairs which are still on-site on the stage to present them with a certificate of appreciation for their work and commitment. Since 2014, the Commissions also incorporate Early Career Representatives which have proven to bring in new ideas and initiatives in the Commissions and stimulate new discussions. They play a role model for young scientists in URSI. These newly elected ECRs will continue now to serve for 6 years in URSI

The results of this election are:

Commission A : Giovanna Signorile (Italy)
Commission B : Dimitrios Tzarouchis (USA)
Commission C : Krzysztof K. Cwalina (Poland)
Commission D : Valentina Palazzi (Italy)
Commission E : Riccardo Trinchero (Italy)
Commission F : Fikadu Tafes Dagefu (USA)
Commission G : Bruce Fritz (USA) and Dario Sabbagh (Italy)
Commission H : Evgenii Shirokov (Russia)
Commission J : Danielle Fenech (UK)
Commission K : Emily Porter (USA)

This General Assembly also marks a big change in the ECR committee as Prof. Stefan Wijnholds steps down as Chair of the committee and will eb replaced by Dr. Nosherwan Shoaib from Pakistan. Stefan has been very active and has participated as ECR Chair in the Board meetings channelling the many new ideas originating from the ECRs towards the Board and triggering new initiatives within the ECR committee itself. URSI is also very grateful to him and I would ike to call Stefan on stage to present him also a certificate of appreciation.

The next General Assembly will be held in Sapporo 2023, that was already decided at our previous General Assembly, but Council now also accepted the invitation of the Member Committee in Poland to organise the 2026 URSI General Assembly and Scientific Symposium. The venue will be Krakow, 15-22 August 2026.

As in previous General Assemblies the quality of the scientific presentations was very high. There was a good balance between contributed papers, invited papers, tutorials, general and public lecture. At this point I would like to express the gratitude of the URSI community to Prof. Alain Sibille, the scientific coordinator, the commission chairs, vice chairs and convenors who managed to put together the excellent scientific program of this GASS. Let me also thank Prof. Paul Smith and Dr. W. Ross Stone who volunteered to serve as the Standing Finances Committee and Professor Jean-Benoit Agnani, Prof. Alain Sibille, Prof. Paul Cannon and Dr. W. Ross Stone who volunteered to serve as the drafting committee during this GASS and to put all the Terms of References and Resolutions in impeccable French and English. As most of you probably don't know, French is still the first language and as some of you might have wondered why I suddenly switched to French during my speech at the opening ceremony, well that's the reason. Special thanks are also due to the Awards Panel, which under the chairmanship of Prof. Paul Cannon, managed to bring the difficult selection process to the right conclusion. At last my gratitude to the Awards ad hoc committee who carefully checked and improved the rules for URSI Awards and I already invite you to think of nominees for the URSI Awards in 2023. Please send your suggestions to your member committee.

We also had a very nice social program. I would like to take the opportunity to point out at our social media channels Facebook, Twitter and LinkedIn, where we regularly post updates and messages about URSI and our activities. This is the new way of communicating. A picture taken at the YS Party last Monday has already reached nearly 6000 impressions on LinkedIn and nearly 1500 impressions on Facebook. Please make use of these channels, subscribe, like or post messages and enlarge our community and visibility.

This GASS was a very special one. I would call it the hybrid mask, the masked GASS, but it was a GASS which everybody was looking forward to. It was a GASS of hope, to be able to get together again, to meet our colleagues, to enjoy each other's company, to enjoy the beautiful city of Rome. It only came through for some of us, many were forced to stay at home and follow the programme online. Practical problems arose, technical problems interfered with the scientific programme, nature, in terms of the differences in time zones inhibited live interactions. During the GASS many practical problems arise that needed to be solved. The LOC, under the guidance of Prof. Guglielmo d'Ínzeo, Prof. Carlo Carobbi, but especially thanks to the endless efforts of Prof. Micaela Liberti and Prof. Francesca Apollonio, supported by tens of volunteers and colleagues here in Rome, they did the job!! Council voted a special resolution of thanks to the team, but I would like to call upon all of you to thank them for a magnificent job despite the difficult circumstances.

I would like to express my sincere thanks to Mrs. Inge Lievens, assisting me here on site, and Mrs. Inge Heleu backing me up online from our office in Gent to smoothly resolve all problems related to running the meetings embedded in the General Assembly.

I know that the GASS with its large number of technical sessions, Council meetings, various committee meetings and its YS program is very complex to organise. From a financial point of view it is also a challenge due to the extensive logistical requirements and the revenue required by URSI. May I in the name of URSI express my deep gratitude and congratulations to the Italian URSI Member Committee, and SIEm, for the financial responsibility they took to organize and host our General Assembly in these uncertain times. A special word of thanks is also due to La Sapienza University for hosting and supporting us in their facilities.

Finally there is one group of people I need to thank, and as URSI our most sincere thanks have to go to them and that is YOU, authors, co-authors, participants. Taking the challenge to present your work at our General Assembly, taking the effort to come to Rome, confronting with the difficulties of following the sessions online from home is worth more than we can express. Your work, your effort is the heart of each of our Flagship Meetings. We can choose a nice venue, we can choose a nice social programme, we can choose a good team, but without your participation, without your papers, it would have been a very boring week.

URSI has now a Flagship meeting every year. I invite you to submit your work to the joint AT-AP-RASC conference next year end of May in Gran Canaria meeting. Make it even a more interesting event as again, without your presentation and participation there will be no conference at all. I look forward to welcome all of you next year and 2 years from now at the GASS in Sapporo.

I wish you all a very nice evening, a good night, a very good morning or a nice remainder of the day, wherever you are in the world, thank you and have a very safe trip back home for those here on site in Rome.

CLOSING REMARKS BY THE OUTGOING PRESIDENT

Professor Makoto Ando

We spent a challenging and exciting days in GASS2021. It has been really busy but very satisfying. We all leave, with great memories of a Rome, time spent well with colleagues and, of course excellent talks and papers. GASS2021 had to be in hybrid mode and about half of scientist could attend only remotely. I could not imagine how much hours and efforts have Carlo Carobbi, Guglielmo D'Inzeo, the LOC members and the staffs at Sapienza Faculty of Engineering as well as PCO AIM Group International, spent for preparation and operation of this assembly. The special and endless care not only for the remote conference facilities but also for safe and healthy environment offered by them brought us GASS during the pandemic. I once again thank the Italian team.

Meeting you, radio scientist in GASS, and especially the young scientists was exciting and a pleasure. The ECRs continue to provide great service and flesh ideas to URSI. I hope you are the key players in the 2nd century of URSI which contributes sustainability of society and humanity.

At the end of my 4-year term as President, I would also like to thank Inge Heleu and Inge Lievens for the wonderful advice and help. I would especially like to thank Peter Van Daele for leading the secretariat.

Thanks go to my four vice-Presidents Prof. Ari Sihvola, Prof. Willem Baan, Prof. Ondrej Santolik and Prof. George (P.L.E.) Uslenghi for all of their open and honest advice and help through four years. I enjoyed discussion with you, each has his own and diversified opinion; I believe we could find the best comprehensive solution for the difficult problems without rigorous solution. Paul S. Cannon has been the super past-President, full of experience and he always suggests the right direction for the board and URSI. Prof. Stefan J. Wijnholds always join this with different perspectives as the ECR leader.

George Uslenghi, Kazuya Kobayashi and Ross Stone contribute significantly in making AT-RASC, AP-RASC and this GASS a series of flagship meetings of URSI.

Serving as URSI President has been a huge honour in my life and I wish URSI grows well under the leadership of its excellent new President, Prof. George Uslenghi and superb Secretary General, Peter Van Daele. Thank you, Italy and URSI.

CLOSING REMARKS BY THE INCOMING PRESIDENT

Professor George Uslenghi

Prof. Uslenghi first greets all the participants in his native language Italian. He delivered his speech in both French and English.

Chersparticipantsàla34èmeAssembléeGénéraleetauSymposiumScientifiquedel'URSI, Distingués invités, Mesdames et Messieurs,

Il y a quelques jours, les représentants des pays membres de l'URSI m'ont élu président de cette merveilleuse organisation scientifique pour les deux prochaines années, jusqu'à la prochaine AGSS de l'URSI à Sapporo, au Japon. Lorsque j'ai quitté ma ville natale de Turin, la première capitale de l'Italie, pour m'installer aux Etats-Unis il y a plus de soixante ans, je n'aurais jamais pu imaginer que je me trouverais aujourd'hui à Rome, la troisième et éternelle capitale de mon pays natal, pour me voir offrir ce grand honneur et cette responsabilité. J'accepte cet honneur avec humilité, conscient des responsabilités qu'il implique. Lorsque Jules César est rentré à Rome au terme de sa campagne militaire transalpine, son rapport au Sénat romain tenait en trois mots : veni, vidi, vici - je suis venu, j'ai vu, j'ai vaincu. Le discours que je vous adresse aujourd'hui ne sera pas aussi concis, mais je vous promets qu'il s'efforcera de l'être.

Pour paraphraser Charles Dickens, nous vivons la pire des époques et la meilleure des époques. J'ai bon espoir et je suis optimiste que cette terrible peste, qui rappelle tant les romans d'Albert Camus et d'Alessandro Manzoni, qui a ravagé tout le tissu social pendant près de deux ans, sera bientôt derrière nous, et que l'URSI continuera sans entrave à répondre à nos attentes scientifiques et humanitaires au cours de son deuxième siècle d'existence. Il est juste et approprié que ce deuxième siècle de l'URSI commence dans le pays qui a vu la naissance de la méthode expérimentale avec Galilée, de la radiotélégraphie avec Marconi, et de tant de contributions fondamentales à l'électromagnétisme par Volta, Galvani, Ferraris et d'autres scientifiques.

L'URSI occupe une place unique dans le monde scientifique, car ses activités couvrent tous les domaines des radiosciences sans barrières entre les sous-domaines, ce qui permet à l'URSI de s'occuper non seulement des domaines traditionnels, mais aussi d'évoluer en douceur et rapidement vers de nouvelles initiatives interdisciplinaires. Cependant, l'URSI doit faire face à une concurrence croissante de la part de nombreuses organisations internationales. Pour prospérer, l'URSI doit renforcer ses activités dans quatre secteurs : le recrutement de jeunes scientifiques, la promotion de la diversité, les réunions scientifiques pour échanger des idées et des collaborations entre scientifiques du monde entier, et les publications d'archives.

Ces dernières années, j'ai convaincu le Comité national américain de l'URSI de parrainer financièrement, et le Conseil de l'URSI d'accepter, les concours d'articles d'étudiants lors des AGSS 2008, 2011, 2014, 2017, 2020 et 2021 et de l'AT-RASC 2015 et 2018. Par conséquent, la tradition d'organiser un concours de communications d'étudiants lors des symposiums phares de l'URSI est désormais bien établie et, avec notre soutien de longue date aux jeunes scientifiques et l'introduction de représentants des jeunes chercheurs en tant que membres des commissions, elle a entraîné une très forte augmentation de la participation des étudiants et des jeunes chercheurs à ces symposiums. J'ai l'intention de proposer au Bureau de l'URSI des initiatives supplémentaires pour sensibiliser les jeunes du monde entier aux radiosciences et les inciter à y participer.

La diversité est extrêmement importante, non seulement d'un point de vue moral, mais aussi pour la survie à long terme d'une organisation scientifique. En paroles et en actes, nous devons nous engager individuellement et collectivement à rejeter toute discrimination fondée sur la race, l'ethnie, le sexe et l'orientation sexuelle, l'invalidite', la nationalité, l'idéologie religieuse et politique ou les idées scientifiques. Nous devons également nous engager à mener la recherche scientifique dans une atmosphère exempte de principes idéologiques. Dans le cadre de mes fonctions de président et de coprésident du programme technique de l'AT-RASC 2018, j'ai invité le professeur Pellinen-Wannberg à organiser un atelier spécial sur les femmes dans les sciences de la radio (WIRS). L'atelier a été très réussi, il a fourni un prototype pour des activités similaires à l'avenir et, espéronsle, galvanisera la participation des femmes aux activités de l'URSI. Après cet atelier, le premier chapitre WIRS a été créé aux États-Unis, suivi d'un chapitre en Italie. J'ai l'intention de proposer au Bureau de l'URSI de coordonner les activités et d'apporter un soutien financier à la création des femmes aux activités scientifiques et aux rôles organisationnels au sein de l'URSI.

Pendant mes deux mandats de vice-président de l'URSI, j'ai insisté auprès du Bureau sur le fait que l'URSI avait besoin d'une conférence internationale annuelle, et pas seulement d'une AGSS tous les trois ans. Le Conseil a accepté ma suggestion et m'a confié la responsabilité de l'AT-RASC 2015 et 2018 en tant que président et coprésident du comité de programme ; ces réunions ont été un grand succès sur le plan scientifique et un succès modéré sur le plan financier. Le Conseil de l'URSI envisage maintenant de faire de l'AP-RASC une conférence de l'URSI à part entière. En tant que co-président de l'AP-RASC 2016 à Séoul et de l'AP-RASC 2019 à New Delhi, je me suis fortement engagé et continuerai à m'engager pour le développement de cette conférence en tant que colloque URSI à part entière.

La présence de l'URSI dans les publications d'archives a été souhaitée. L'URSI dispose du « Radio Science Bulletin », édité de manière experte par Ross Stone. Sa seule autre publication était la revue « Radio Science » qui, cependant, appartient à l'American Geophysical Union. Il était évident pour moi que l'URSI avait besoin d'un organe de publication pour tous les domaines couverts par les dix commissions, qui soit entièrement détenu et géré par l'URSI. J'ai proposé au Conseil la création des « Radiosciences Letters » de l'URSI (RSL), une publication rapide en libre accès au format électronique d'articles courts rigoureusement révisés contenant des résultats originaux dans tous les domaines des radiosciences. En juin 2018, le Conseil a accepté ma suggestion et m'a nommé premier rédacteur en chef de cette nouvelle revue, qui en est à sa troisième année d'existence. Je demande instamment à tous les auteurs contribuant à cette AGSS 2021 de soumettre les travaux présentés à Rome à la RSL ; vos soumissions sont nécessaires pour assurer le succès de notre nouvelle revue.

Ainsi, il me semble que l'URSI est maintenant bien positionnée pour accroître ses activités dans les quatre domaines cruciaux que j'ai mentionnés précédemment. Cependant, pour réussir, l'URSI a besoin de la coopération enthousiaste de chacun d'entre vous, tant dans le domaine scientifique que dans le domaine organisationnel de notre Union. Au cours des deux prochaines années, le Secrétariat poursuivra son travail sous la direction experte de Peter Van Daele qui a été réélu au poste de Secrétaire Général et sera aidé par Inge Heleu et Inge Lievens. Le Conseil de l'URSI a élu Patricia Doherty, Kazuya Kobayashi, Giuliano Manara et Ari Sihvola comme vice-présidents de l'URSI pour la prochaine période biennale. Ils apportent une riche expérience au Conseil ; entre autres, je note que le Dr Doherty est la présidente sortante de la Commission G et la deuxième femme à occuper le poste de vice-présidente dans l'histoire de l'URSI ; que le Professeur Kobayashi est le président sortant de la Commission B, le rédacteur en chef de « Radio Science », et qu'il a consacré de nombreuses années à l'organisation de l'AP-RASC ; que le Professeur Manara est un ancien président de la Commission B et l'organisateur de l'EMTS 2014 à Pise ; que le Professeur Sihvola, qui entame son second mandat de vice-président de l'URSI, est un ancien président de la Commission B et l'organisateur de l'EMTS 2016 à Helsinki. Joignez-vous à moi pour les féliciter, ainsi que les nouveaux présidents, vice-présidents et représentants en début de mandat des dix commissions de l'URSI.

Je tiens à souligner le travail remarquable accompli au service de l'URSI au cours des quatre dernières années par le Prof. Makoto Ando en tant que Président, par les Professeurs Willem Baan et Ondrej Santolik en tant que vice-présidents, et par les membres du bureau des dix commissions.

Le succès de 'AGSS de l'année dernière et de l'AGSS de cette année, dans les circonstances difficiles imposées par la pandémie de Covid, aurait été impossible sans le dévouement, l'expertise et l'enthousiasme du Comité d'organisation local, du Comité scientifique et du Secrétariat de l'URSI. Le regretté Professeur Roberto Sorrentino, les Profs. Carlo Carobbi et Guglielmo D'Inzeo et leurs collaborateurs du COL méritent notre gratitude pour le bon déroulement des deux AGSS. Le professeur Alain Sibille et les membres du comité scientifique ont fait un travail impressionnant en préparant le programme scientifique des deux éditions. Sur une note personnelle, je remercie MMs Agnani et Sibille pour leur aide dans la version française de mes remarques. Peter Van Daele, Inge Lievens et Inge Heleu ont fourni l'assistance organisationnelle centrale qui était essentielle pour le succès des deux AGSS. Veuillez-vous joindre à moi pour applaudir le travail accompli par tous ces collègues dévoués.

Je vous remercie tous d'avoir participé à cette AGSS. Je vous encourage à participer aux prochains symposiums phares, l'AT-RASC l'année prochaine à Gran Canaria et l'AGSS 2023 à Sapporo. Je vous souhaite un agréable séjour à Rome et un bon voyage de retour.

Dear Participants in the 34th URSI General Assembly and Scientific Symposium, Distinguished Guests, Ladies and Gentlemen,

A few days ago, the representatives of the URSI member countries elected me as President of this wonderful scientific organization for the next two years, until the next URSI GASS in Sapporo, Japan. When I left my home city of Turin, the first capital of Italy, to move to the United States over sixty years ago, I could not have dreamed that I would be here today in Rome, the third and perennial capital city of my native country, to be offered this great honor and responsibility. I accept this honor with humility, mindful of the responsibilities that it implies. When Julius Caesar returned to Rome at the conclusion of his trans-alpine military campaign, his report to the Roman Senate consisted of three words: veni, vidi, vici – I came, I saw, I conquered. My address to you today will not be quite as concise, but I promise that it will try to be brief.

To paraphrase Charles Dickens, this is the worst of times and the best of times. I am hopeful and optimistic that this awful pestilence, so reminiscent of the novels by Albert Camus and Alessandro Manzoni, that has ravaged all fabrics of society for almost two years will soon be behind us, and that URSI will proceed unimpeded to fulfill our scientific and humanitarian expectations during its second century of existence. It is proper and fitting that this second URSI century should begin in the country that saw the birth of the experimental method with Galilei, of radio telegraphy with Marconi, and of so many fundamental contributions to electromagnetism by Volta, Galvani, Ferraris and other scientists.

URSI has a unique place in the scientific world, because its activities cover all areas of Radio Science without barriers between sub-disciplinary areas, and this allows URSI to cater not only to traditional areas, but also to move smoothly and rapidly into newly forming inter-disciplinary initiatives. However, URSI is facing increasing competition from many international organizations. In order to prosper, URSI needs to strengthen its activities in four sectors: recruitment of young scientists, fostering of diversity, scientific meetings to exchange ideas and collaborations among scientists from all over the world, and archival publications.

In past years, I have convinced the United States National Committee of URSI to sponsor financially, and the URSI Board to accept, student paper competitions at the 2008, 2011, 2014, 2017, 2020 and 2021 GASS and at the 2015 and 2018 AT-RASC. Consequently, the tradition of having a student paper competition at the URSI flagship symposia is now firmly established and, together with our long-standing support of young scientists and the introduction of Early Career Representatives as officers in the Commissions, has resulted in a very large increase in students' and young researchers' participation at such symposia. I intend to propose to the URSI Board additional

initiatives to increase awareness and participation in Radio Science by young people all over the world.

Diversity is extremely important not only from a moral viewpoint, but also for the long-term survival of a scientific organization. In word and deed, we must be individually and collectively committed to reject any discrimination based on race, ethnicity, sex and sexual orientation, disability, nationality, religious and political ideology, or scientific ideas. Also, we must be committed to the conduct of scientific inquiry in an atmosphere free of ideological tenets.

In my roles as General Chair and Technical Program Co-Chair at the 2018 AT-RASC, I invited Prof. Pellinen-Wannberg to organize a special workshop on Women in Radio Science (WIRS). The workshop was very successful, it provided a prototype for similar activities in the future, and hopefully will galvanize women participation in URSI activities. After that workshop, the first WIRS chapter was established in the United States, followed by a chapter in Italy. I intend to propose to the URSI Board that coordination of activities and financial support be provided for the establishment of WIRS chapters in all member countries, with the ultimate goal of augmenting participation of women in scientific activities and organizational roles within URSI.

During my two terms as Vice President of URSI, I insisted with the Board that URSI needed a yearly international conference, not just the GASS every third year. The Board accepted my suggestion and put me in charge of the 2015 and 2018 AT-RASC as General Chair and TPC Co-Chair; those meetings were a great success scientifically and a moderate success financially. The URSI Board is now considering making the AP-RASC a fully owned URSI conference. As General Co-Chair of both the 2016 AP-RASC in Seoul and the 2019 AP-RASC in New Delhi, I have been deeply committed and will continue to be committed to the development of this conference as a full-fledged URSI symposium.

The presence of URSI in archival publications has been wanting. URSI has the Radio Science Bulletin, expertly edited by Ross Stone. Its only other publication was the journal Radio Science which, however, is owned by the American Geophysical Union. It was evident to me that URSI needed a publication outlet for all areas covered by the ten Commissions, that was fully owned and operated by URSI. I proposed to the Board the creation of the *URSI Radio Science Letters (RSL)*, an open-access rapid publication in electronic format of rigorously reviewed short papers containing original results in all areas of radio science. In June 2018, the Board accepted my suggestion and appointed me as the first Editor-In-Chief of this new journal, which is now in its third year of existence. I urge all contributing authors to this 2021 GASS to submit the works presented in Rome to the RSL; your submissions are needed to ensure the success of our new journal.

Thus, it appears to me that URSI is now well positioned to increase its activities in all four crucial areas that I mentioned previously. However, in order to succeed, URSI needs the enthusiastic cooperation of all of you in both the scientific and the organizational realms of our Union. In the next two years, the Secretariat will continue its work under the expert direction of Peter Van Daele who has been re-elected as Secretary General and will be aided by Inge Heleu and Inge Lievens. The URSI Council has elected Patricia Doherty, Kazuya Kobayashi, Giuliano Manara and Ari Sihvola as URSI Vice-Presidents for the next biennium. They bring a wealth of experience to the Board; among other activities, I note that Dr. Doherty is the Immediate Past Chair of Commission G and the second woman to serve as Vice-President in the history of URSI; that Prof. Kobayashi is the Immediate Past Chair of Commission B, the editor of Radio Science, and has devoted many years to the organization of AP-RASC; that Prof. Manara is a Past Chair of Commission B and the organizer of the 2014 EMTS in Pisa; that Prof. Sihvola, entering his second term as URSI Vice-President, is a Past Chair of Commission B and the organizer of the 2016 EMTS in Helsinki. Please join me in congratulating them as well as the new Chairs, Vice-Chairs and Early Career Representatives of the ten URSI Commissions.

I want to acknowledge the outstanding work performed in the service of URSI during the past four years by Prof. Makoto Ando as President, by Profs. Willem Baan and Ondrej Santolik as Vice-Presidents, and by the Officers of the ten Commissions.

The success of last year GASS and this year GASS under the trying circumstances imposed by the Covid pandemic would have been impossible without the dedication, expertise and enthusiasm of the Local Organizing Committee, of the Scientific Committee, and of the URSI Secretariat. The late Prof. Roberto Sorrentino, Profs. Carlo Carobbi and Guglielmo D'Inzeo and their collaborators on the LOC deserve our gratitude for the smooth running of both GASS. Prof. Alain Sibille and the members of the Scientific Committee have done an impressive job in preparing the scientific program of both GASS. On a personal note, I thank Profs. Agnani and Sibille for their assistance with the French version of my remarks. Prof. Van Daele, Inge Lievens and Inge Heleu have provided the central organizational assistance that was essential for the success of both GASS. Please join me in a round of applause for the work performed by all these dedicated colleagues.

Thank you all for participating in this GASS. I encourage you to attend the next flagship symposia, the AT-RASC next year in the Gran Canaria and the 2023 GASS in Sapporo. I wish you an enjoyable stay in Rome and a safe trip home.

REPORTS OF MEETINGS

BOARD OF OFFICERS SUMMARY REPORT

The URSI Board of officers met on two oaccasions during URSI GASS 2021:

Saturday 27 August (11.00 am - 12.30 pm) Saturday 4 September (17.00 pm - 18:00 pm)

1. Board on Saturday 27 August 2021

The Board decided that the per diem for all the officials attending the GASS 2021 onsite is fixed at 175 Euro per day. This includes the costs for the hotel and the meals. All the officials attending online can join the council and CC meetings through a zoom link that was sent out by email, but the electronic voting is only allowed for those appointed by their Member Committee.

The Board also decided that the conditions to receive a reduced rate for publishing an accepted URSI GASS paper in RSL should be rephrased from 'accepted' to 'accepted and presented' for future flagship meetings. For GASS 2021, it will be decided on an 'ad hoc' basis if an accepted paper which is not presented at GASS 2021, will receive the reduced rate.

The agenda for the Coordinating Commissies was discussed. The Board decided that the Commission budget will be reduced to 12.000 Euro (instead of 15.000) because the next 'triennium' is only two years long.

Since the AP-RASC, which was scheduled for 2022 is postponed to 2025, the Secretary General proposed to combine AT-RASC and AP-RASC to AT-AP-RASC 2022. This will give authors from the Asia-Pacific region the opportunity to submit and present their paper in 2022. The Board unanimously approved this proposal.

The Board looked into the Council agenda to check if any specific items needed further preparation.

2. Board on 4 September 2021

The tasks and responsibilities for the members of the newly elected URSI Board were discussed.

The functions were divided as follows :

- Ari Sihvola : appointed as URSI Tresaurer
- Ross Stone : appointed a Assistant Secretary General for GASS and for URSI Publications
- Willem Baan : appointed as Assistant Secretary General for AT-RASC
- Kazuya Kobayashi :
 - will help Willem Baan as Assistant Secretary General for AP-RASC with AT-AP-RASC
 - preparation for GASS 2021
 - will work on the relations with countries who have showed their interest to become an URSI Member Committee
- Giuliano Manara : will be responsible for the URSI Membership (Individual Membership + attracting new Member Committees)
- Pat Doherty : will be responsible for Women in Radio Science
- Stefan Wijnholds : Assistant of the Secretary General
- Makoto Ando : will be the responsible for the URSI Awards and the Inter-Union relations with other Unions
- Paul Cannon : will be the Chair of the Young Scientist Commitee

There still needs to be someone appointed who will be responable for the MOU's with other partners.

The Board will continue to meet at monthly online Zoom meetings. The first one is planned for the end of October 2021.

COUNCIL

SUMMARY REPORT

The Resolutions and Recommendations adopted by the URSI Council are reproduced at the end of this volume.

Council met on

Saturday 28 August (11.00 AM to 12.30 PM) Sunday 29 August (11.00 AM to 12.30 PM) Saturday 4 September (17.00 PM to 18.00 PM).

1. Membership of the Council

President :	Prof. M. Ando
Secretary General:	Prof. Van Daele

Australia:	Prof. Paul Smith
Austria:	Prof. Helmut Rucker
Belgium:	Prof. Peter Van Daele
Canada:	Prof. Dave Michelson
China CIE:	Prof. Jian Wu
China SRS:	Prof. Lou-Chuang Lee
Czech Rep.:	Dr. Ivana Kolmasova
Denmark:	Prof. Olav Breinbjerg
Egypt:	Prof. Mahmoud El-Hadidy
Finland:	Prof. Jaan Praks
France:	Prof. J-B Agnani & Prof. Alain Sibille
Germany:	Prof. Ludger Klinkenbush
Hungary:	Prof. Janos Lichtenberger
India:	Dr. Anil Bhardwaj
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	Dr. Mairtin O uro	oma						
Israel:	Prof. Enud Heym	1an						
Italy:	Prof. Carlo Carol							
Japan:	Prof. Satoshi Yag	(11an) 1 1.1.						
Netherlands:	Prof. Stefan Wijn	inolds						
New Zealand:	Dr. Craig Rodger	1						
Nigeria:	Dr. Abodian Adi	mula						
Norway:	Dr. Terje Tjelta							
Peru:	Dr. Jorge Heraud							
Poland:	Prof. Jozef Mode	elski						
	Prof. Andrzej Wi	tczak						
Portugal:	Prof. Luisa Mend	les						
Russia:	Dr. Yuri V. Gulya	lev						
Slovak Republic:	Prof. Vladimir St	ofanik						
South Africa:	Dr Lee-Anne Mc	kinnell						
South Korea:	Prof. Sangwook	Nam						
Spain:	Prof. Francisco N	Iedina-Mena						
Sweden:	Prof. Daniel Sjöb	berg						
Switzerland:	Dr. Marcos Rubin	nstein						
Turkey:	Prof. Özlem Özg	Prof. Özlem Özgur						
United Kingdom	Prof. Mike Warrington							
USA	Prof. David Jackson							
	Alternate: Prof. Sembian Rengarajan							
		C J						
Observers :								
USA:	Ms. Ana Ferreras	Ms Ana Ferreras US National Academies						
Italy:	Prof. Giuliano M	anara						
Commission A:	Chair:	Prof. Y. Koyama						
	Vice-Chair:	Prof. N. Borges Carvalho						
Commission B:	Chair:	Prof. K. Kobayashi						
	Vice-Chair:	Prof. J. Volakis						
Commission C:	Chair:	Prof. A. Zaghloul						
	Vice-Chair:	Prof. Y. Louët						
Commission D:	Chair:	Prof. A. Georgiadis						
	Vice-Chair:	Prof. N. Shinohara						
Commission E.	Chair:	Prof. F. Gronwald						
	Vice-Chair	Prof. V. Deniau						
Commission F.	Chair:	Dr V Chandrasekar						
	Vice-Chair	Prof. T. Tanzi						
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Commission G:	Chair:	Prof. P. Doherty
	Vice-Chair	Prof. G. de Franceschi
Commission H:	Chair:	Prof. J. Lichtenberger
	Vice-Chair:	Prof. J. Manninen
Commission J:	Chair:	Prof. R. Bradley
	Vice-Chair:	Prof. D. Bock
Commission K:	Chair:	Prof. J. Wiart
	Vice-Chair:	Prof. K. Ito

The Officers of the Board, the Coordinator of the scientific program and the Assistants Secretary General attended in an advisory capacity. Some Chairs of standing committees and various URSI Officials attended the meetings partially or totally.

2. Elections

The Officers of the Board were elected during the first Council meeting. For the first time in history, an electronic voting system was used. The result of the election was as follows:

a) President

There were two candidate nominated for President: Prof. Willem Baan (the Netherlands) and Prof. P.L.E. Uslenghi (U.S.A.). Prof. P.L.E. Uslenghi was elected as President for the biennium 2021-2023.

b) Vice-Presidents

The result of the elections for Vice-President, conducted by the secret electronic voting system, was as follows (in alphabetical order):

Prof. Patricia Doherty Prof. Kazuya Kobayashi Prof. Giuliano Manara Prof. Ari Sihvola

c) Secretary General Prof. Peter Van Daele was elected by acclamation.

d) Commission Chairs & Commission Vice-Chairs

Council approved the outcome of the elections of the new Commission Vice-Chairs:

Commission A	Chair:	Prof. N.B. Carvalho (Portugal)
	Vice-Chair:	Dr. Amitava Sengupta (India)

Chair:	Prof. J. Volakis (USA)
Vice-Chair:	Dr. H. Wallén (Finland)
Chair:	Prof. Y. Louët (France)
Vice-Chair:	Dr. K.V. Mihra (USA)
Chair:	Prof. N. Shinohara (Japan)
Vice-Chair:	Dr. A. Kanno (Japan)
Chair:	Prof. V. Deniau (France)
Vice-Chair:	Prof. C. Carobbi (Italy)
Chair:	Prof. T. Tanzi (France)
Vice-Chair:	Dr. M. Sato (Japan)
Chair:	Dr. G. de Franceschi (Italy)
Vice-Chair:	Dr. K. Groves (USA)
Chair:	Prof. J. Manninen (Finland)
Vice-Chair:	Dr. C; Rodger (New Zealand)
Chair:	Dr. D. Bock (Australia)
Vice-Chair:	Prof. S. Wijnholds (the Netherlands)
Chair:	Prof. K. Ito (Japan)
Vice-Chair:	Prof. F. Apollonio (Italy)
	Chair: Vice-Chair: Chair: Vice-Chair: Chair: Vice-Chair: Chair: Vice-Chair: Chair: Vice-Chair: Chair: Vice-Chair: Chair: Vice-Chair: Chair: Vice-Chair: Chair: Vice-Chair: Vice-Chair: Vice-Chair: Vice-Chair: Vice-Chair:

e) Election Early Career Representatives (ECR)

The Secretary General reports on the outcome of the elections of the Early Career Representatives. It was decided to keep the ECR's who served from 2017 to 2021 for another term. For every Commission, a second ECR was elected. For Commission G, there was a tie. Therefore an extra Commission G ECR's was elected.

Commission A:	Dr. N. Shoaib (Pakistan) (Chair)
	Dr. G. Signorile (Italy)
Commission B:	Dr. A. Michel (Italy)
	Dr. D. Tzarouchis (USA)
Commission C:	Prof. H. Zhang (China CIE)
	Dr. C. Cwalina (Poland)
Commission D:	Assoc. Prof. H. Asghari (USA)
	Dr. V. Palazzi (Italy)
Commission E:	Dr. C. Kasmi (France)
	Dr. R. Trinchero (Italy)
Commission F:	Prof. M. Sasaki (Japan)
	Dr. F. Tafes Dagefu (USA)
Commission G:	Dr. S. Elvidge (UK)
	Dr. B. Fritz (USA)
	Dr. D. Sabbagh (Italy)

Commission H:	Dr. F. Nemec (Czech Republic)
	Dr. E. Shirokov (Russian Federation)
Commission J:	Dr. J. Gilmore (South Africa)
	Dr. D. Fenech (UK)
Commission K:	Dr. K. Sasaki (Japan)
	Dr. E. Porter (USA)

This result is formally approved by Council.

3. Establishment of Temporary Committees and Ad Hoc Groups

Council approved the formation of a Drafting Committee (for the Terms of References, Recommendations, Resolutions) with as members: Prof. A. Sibille and Prof. J-B Agnani (French), Prof. P. Cannon and Dr. W.R. Stone (English). If there is an interpretation problem between the two languages, French is the official language.

Council also approved the formation of the Awards ad hoc committee, under the chaimanchip of Professor Paul Cannon, who carefully checked and improved the rules and Terms of Reference for the URSI Awards. The following members were appointed to help him with this task: Yoshiharu Omura, Lot Shafai and Günter Steinmeyer. Council approved the changes in the last Council meeting.

4. Finances

Prof. Paul Smith and Dr. W. Ross Stone were appointed as members of the Standing Committee on Finances. They examined the report prepared by Prof. Ari Sihvola (Treasurer) of the URSI Finances covering the period 2017-2021 and they noted that the accounts have been audited by Ernst&Young. On the basis of this information the report was found to be a fair and reasonable description of the URSI finances.

Council approves the report and thanks the Standing Finance Committee for its work.

Council authorized the Board to increase the unit contribution for Member Committees by 1% per annum.

5. URSI Membership

- Argentina, Bulgaria, Chile, Greece, Iraq, Singapore, and Ukraine stay Associate Members of URSI
- during the first Council Meeting there was an electronic vote regarding the membership

of Brazil and Spain. They were both more than 3 years behind with their annual payments to URSI. The outcome of the voting was to keep Spain as a regular member and to move Brazil to the status of associate membership. The URSI Committee in Spain is very active and is searching solutions for their payment problems, while there is no activity in the Brazilian URSI Committee. However, there was some confusion regarding the wording of the question during the electronic vote. It was therefore decided to repeat the voting in the third Council meeting for Brazil. Council voted to keep Brazil as a regular member. The Treasurer of URSI is requested to seek contact with the URSI Committee in Brazil to investigate the future membership of Brazil in URSI.

6. Publications

For the next triennium the Standing Committee on Publications will be composed as follows:

- Dr. W. Ross Stone (Chair, Editor of the Radio Science Bulletin)
- Prof. P. Cannon
- Prof. S. Reising
- Prof. S. Salous
- Prof. T. Tanzi
- Prof. P. Van Daele
- Prof. P.L.E. Uslenghi
- Dr. P. Wilkinson

Dr. W. R. Stone apologized for the delay of The Radio Science Bulletin and explained that this is due in part because of delays in receiving the papers associated with special issues, and in large part due to the hospitalization and associated recovery period of the Editor earlier this year.

Sana Salous asked to promote the journal Radio Science more at URSI sponsored meetings (EURAP & IUCAF).

Dr. Stone also anounced the publication of the centenary book '100 Years of URSI'. It's an eclectic compendium of more than 600 pages with articles from 20 URSI Member Committees and all 10 Commissions, plus one historical article written by Paul Lagasse, Honorary President of URSI. The book was edited by P. Wilkinson, P. Cannon and W.R. Stone, with support of the URSI Secretariat. It is available online for free download on the URSI website, but a printed copy can be ordered for 36 euro to cover printing and mailing costs.

7. URSI Flagship Meetings

7.1 Selection of venue of the XXXVIth General Assembly and Scientific Symposium of URSI in 2026.

The venue for URSI GASS 2023 (Sapphoro, Japan) was already chosen in Montreal. For 2026, there was only one proposal from Poland (Krakow). The Secretary General asked the Council, since there was only one candidate, if it was necessary to have a formal vote. No one from the on-site and online member committees raised their hand. There was no objection either. The proposal was approved by acclamation.

7.3 Report on AT-RASC 2018 and presentation of AT-AP-RASC 2022

Prof. P.L.E. Uslenghi gave a presentation on AT-RASC 2018. Professor Peter Van Daele, gave an update on the next AT-RASC, which was initially scheduled to be held in 2021, but was postponed, due to the COVID-19 outbreak, to 2022. Since the AP-RASC 2022 was postponed to 2025, it was decided to organise a combined hybrid AT-AP-RASC Flagship meeting in 2022 and also invite authors from the asia pacific region to submit papers. In addition to the topics covered by the URSI commissions, this 2022 AT-AP-RASC will have a plenary focus session on Artificial Intelligence for Electromagnetics and Radiosciences and a dedicated General Lecture as part of the scientific program of the conference. Ari Sihvola proposed possible speakers for the General Lectures.

7.4 Report on AP-RASC 2019 (Dr. Amativa Sen Gupta)

Dr. Amitava Sen Gupta gave a presentation on AP-RASC 2019. The next AP-RASC which was initially scheduled for 2022 to be held in Sidney, Australia, is postponed, due to the COVID 2019 outbreak to 2025. It is not sure yet if the venue will stay the same.

11. Scientific Commissions

Council approved the updated terms of reference of the Commissions, which are:

Commission A on ELECTROMAGNETIC METROLOGY, Electromagnetic measurements and standards.

The Commission promotes research and development of the field of measurement standards and physical constants, calibration and measurement methodologies, improved traceability, accuracy, and reduced uncertainty, and the inter-comparison of such. Areas of emphasis are:

- The development and refinement of new measurement techniques and calibration standards;
- Primary standards, including those based on quantum phenomena;
- Realization and dissemination of reference time and frequency standard;
- Characterization of electromagnetic properties of materials, physical constants, and properties of engineered materials, including nanotechnology;
- Methodology of electromagnetic dosimetry/measurements for health diagnostics, applications, and biotechnology, including bio-sensing;
- Measurements in advanced communication systems, space metrology, and other applications, including antenna and propagation measurement techniques.

The Commission fosters the best practices and training for accurate and consistent measurements needed to support research, development, and exploitation of electromagnetic technologies across the spectrum and for all Commissions.

Commission B on FIELDS AND WAVES, Electromagnetic theory and applications.

The interests of Commission B are fields and waves, encompassing theory, analysis, computation, modeling, simulation, experiments, validation, and applications. Areas of emphasis are:

- Time-domain and frequency-domain phenomena;
- Scattering and diffraction;
- Propagation and effects, including waves in specialized media;
- Guided waves and components;
- Antennas and radiation;
- Inverse scattering and imaging.

The Commission fosters the creation, development, and refinement of analytical, numerical, simulation, and measurement techniques to understand these phenomena. It encourages innovation and seeks to apply interdisciplinary concepts and methods.

Commission C on RADIO COMMUNICATION AND SIGNAL PROCESSING SYSTEMS

The Commission promotes research and development in:

- Information theory, coding, modulation, and detection;
- Massive MIMO
- Waveform for radar & communications
- Smart radio-communications: cognitive radio, software defined radio

- Reconfigurable intelligent surfaces
- Radar, sonar, navigation systems & positioning
- Artificial intelligence and machine learning
- Energy efficient communications and (wireless) power transfer
- Security & privacy in communications
- Quantum communications
- Wireless networks
- 6G and future high frequency radio systems

The design of effective radio-communication and signal processing systems also includes scientific, engineering, and economic considerations. This Commission emphasizes the scientific aspects of radio communications, but also provides enabling technologies to other areas of radio science.

Commission D on ELECTRONICS AND PHOTONICS

The Commission promotes research and reviews new developments in:

- Electronic systems that push beyond current frontiers;
- Microwave, millimeter-wave, and THz devices, circuits, and systems;
- Nanomaterials, nanotechnologies, and nanoelectronics;
- Combined and hybrid photonic and electronic systems;
- Photonic devices; systems, and their applications;
- Photonic signal processing schemes, regardless of frequency of signal processed;
- Optoelectronic systems, plasmonics, and electro-optics;
- Physics, theoretical modeling, and numerical simulation of all of the above.

The commission focuses on electronic and photonic devices , circuits, systems and wireless solutions to address applications in particular 6G and beyond, IoT, Sensors, Artificial Intelligence, energy harvesting, WPT, Pandemics/disaster management.

Commission E on ELECTROMAGNETIC ENVIRONMENT AND INTERFERENCE

The Commission promotes research and development in:

- Terrestrial and planetary noise of natural origin including lightning, and seismically associated electromagnetic fields;
- Man-made electromagnetic environments;
- The composite noise environment;
- The effects of noise on system performance;
- The effects of natural and intentional emissions on equipment performance;

- The scientific basis of noise and interference control, and electromagnetic compatibility;
- Spectrum management.

Commission F on WAVE PROPAGATION AND REMOTE SENSING (planetary atmospheres, surfaces and subsurfaces)

The Commission encourages:

- The study of all frequencies in a non-ionized environment:
 - wave propagation through planetary, neutral atmospheres and surfaces;
 - wave interaction with the planetary surfaces (including land, ocean and ice), and subsurfaces;
 - characterization of the environment as it affects wave phenomena;
- The application of the results of these studies, particularly in the areas of remote sensing and communications;
- The appropriate co-operation with other URSI Commissions and other relevant organizations.

Commission G on IONOSPHERIC RADIO AND PROPAGATION

The Commission deals with the study of the ionosphere in order to provide the broad understanding necessary to support space and ground-based radio systems. Specifically, the Commission addresses the following areas:

Global morphology and modelling of the ionosphere;

- Ionospheric space-time variations and the impacts of space weather on systems;
- Development of tools and networks needed to measure ionospheric properties and trends;
- Theory and practice of radio propagation in and through the ionosphere;
- Application of ionospheric information to radio systems.

To achieve these objectives, the Commission co-operates with other URSI Commissions, corresponding bodies of the ISC family (IUGG, IAU, COSPAR, SCOSTEP, SCAR, etc.) and other organisations (ITU, IEEE, etc.).

Commission H on WAVES IN PLASMAS (including space and laboratory plasmas)

The goals of the Commission are:

- To study waves in plasmas in the broadest sense, and in particular:
 - the generation, propagation, and detection of waves in plasmas,

- wave-wave and wave-particle interactions,
- plasma turbulence and chaos,
- spacecraft-plasma interaction,
- instabilities, heating, and diagnosis of laboratory plasmas;

To encourage the application of these studies, particularly in the areas of solar/planetary plasma interactions, space weather, and an increased exploitation of space as a research laboratory.

Commission J on RADIO ASTRONOMY

The activities of the Commission include:

- Observation and interpretation of cosmic radio emissions from the early universe to the present epoch, and
- Radio reflections from solar system bodies.

Emphasis is placed on:

- The promotion of science-driven techniques for making radio-astronomical observations and data analysis;
- Support of activities to protect radio-astronomical observations from harmful interference.

Commission K on ELECTROMAGNETICS IN BIOLOGY AND MEDICINE

The Commission is charged with promoting research and development in the following domains:

- Physical interaction of electromagnetic fields (from static to optical) with biological systems;
- Biological effects of electromagnetic fields;
- Mechanisms underlying the effects of electromagnetic fields;
- Exposure systems of experimental electromagnetic fields;
- Assessment of human exposure to electromagnetic fields;
- Medical applications of electromagnetic fields.

CO-ORDINATING COMMITTEE

Summary Report

The Co-ordinating Committee met on Saturday 28 August 2021 (1.30 PM to 5.10 PM) and Saturday 4 September 2021 (3.30 PM to 6.00 PM).

1. First Co-ordinating Committee meeting

1.1 GASS 2021 Program

Prof. Alain Sibille described the role of the Commission Chairs in building the GASS 2021 Program:

- Propose Sessions (Conveners/descriptions of sessions, Workshops, Short Courses)
- Stimulate conveners and national Committees to submit papers
- Reviewing of all the submitted papers
- Allocate accepted papers to FIP/Oral Sessions

The overall task for Commission Chairs is to coordinate and actively interact with conveners, authors, Scientific Program Coordinator and Secretariat where necessary.

It was remarked that shortening the sessions and 'squeezing' the Program a bit was very convenient for hybrid meetings as people attending from home do not like to sit for hours behind their laptop screens.

Alain Sibille gave some statistics on the sessions and submissions. From the 198 initially proposed sessions, 177 were included in the program. 1711 submissions were received which was a very positive result in the context of Covid. Finally 1356 papers were

presented at GASS 2021 (1171 oral and 185 FIP). It was decided at AP-RASC 2019 to limit the number of invited papers to 25%. The percentage of invited papers is varying from 13 % to 37% amongst the commissions.

1.2 GASS 2021 Local Arrangements

Carlo Carobbi, President of the URSI National Committee, explained that 'hybrid' means that the GASS 2021 is an onsite conference with provision for live participation and presentation.

The venue (La Sapienza Faculty of Engineering) in Rome was already equipped with audio-visual tools needed to make live presentations possible. There were also physical rooms for all the on-site attendees.

The virtual platform for the virtual interaction and online presentation was a tailored solution, which is cheaper but requires more work for the LOC, the SPC and the URSI Secretariat. An advantage is that all the material will stay available on-demand.

At this GASS, it was not possible to hold physical poster sessions, due to the COVID restrictions on-site and also because a lot of the authors could not travel to Rome. The poster session was therefore transformed to FIP sessions (Flash Interactive Presentations). Authors of FIP could upload a pre-recorded presentation of 3-5 minutes. The platform used for the FIP Presentations and for interaction between the authors was Wonder.

At the time of the opening of the GASS, the LOC received 1173 registrations. Approximately 400 registrants attended on-site.

Carlo Carobbi explained that the LOC had to cope with a lot of practical difficulties due to the uncertainty caused by COVID-19.

1.3 CCA Meetings

The former Business Meetings were rebranded to Commission Coordination Activities meetings to stimulate participation from a wider audience. These meetings were included in the GASS 2021 Program and free accessible for all GASS registered participants. Professor Peter Van Daele urged the Commission Chairs to use these meetings to engage with their community. He also explained which topics should be discussed in these CCA meetings.

1.4 Elections of Vice-Chairs and ECR's

The URSI Secretary General explained the new voting procedure/tool for Vice-Chairs and ECR's. The voting was for the first time 100% online. Votes that have been received before the GASS by email were included in the voting tool before the real voting started. This voting could only be done by the official national representatives in a Commission (or a proxy designated by this national representative). Important is that the outcome of this voting was preliminary, as Council had the last word and could change the order of the result.

1.5 Update guidelines for the support of URSI Meetings

The objective for changing the guidelines is to improve the visibility of URSI and create a return on investment, to give more decision power to the Commissions and to harmonize and structure the URSI support.

The new guidelines are available under 'URSI download forms' on the URSI website.

1.6 Commission Budget

The objective is to give more decision power to the Commissions and to have a better prediction on the spending of the Commission budget. An incentive is offered to Commissions for participation of their Commission (variable amount based on total attendees and number of papers) in URSI flagship meetings.

Commissions have full budget control regarding the attendance of the flagship meetings. In other cases the approval of the Board is required.

First action point for the coming months is to stimulate participation to AT-AP-RASS 2022.

1.7 Planning URSI Flagship Meetings

Prof. Peter Van Daele explains that Commissions should prepare a list of topics and conveners for AT-AP-RASC 2022. This proposal has to be presented during the second CC meeting.

1.8 Publication related matters

Dr. W.R. Stone, Assistant Secretary General for Publications, explained what the task for Commissions is regarding the URSI publications.

- identify Commissions editors for the Radio Science Bulletin
- sollicit papers for Radio Science Letters: RSL needs enough papers to get an impact factor for 2021
- encourage to publish special issues, tutorials and General Lectures in the Radio Science Bulletin
- it is advised to use the URSI Publication Agreement for all your URSI conferences. This gives the URSI the license to copy, publish and distribute but the author retains the copyright. Ross is the contact person if you want to use it.

2. Second Co-ordinating Committee meeting

2.1. AT-AP-RASC input from Commissions

Every Commission described its planned sessions for AT-AP-RASC in a 2/3-page PowerPoint presentation with the titles of the sessions and the conveners.

2.2 Instructions on the use of the URSI Mailing Lists

URSI has two Mailing lists which can be used by the URSI Commission Leads:

- ursi_comc_members@lists.ursi.org : all who have expressed interest in the Commission (1000 +)
- ursi_comc@lists.ursi.org : only the official members (60 to 80 depending on Commission)

The mailing lists are moderated and monitored by Inge Heleu.

The policy, as discussed within the Board, is that:

- all SPAM: is discarded by Inge, nearly automatically
- messages from outsiders posted and which might be interesting: for these Inge always seeks approval / rejection by the Chair
- messages from insiders (on the lists) are normally accepted by Inge within 24 hours during the week

The Secretary General insists to make use of this mailing lists.

2.3 Guidelines for Chairs, Vice-Chairs and ECRs

Each Commission has a Commission website on the URSI website with six tabs: Description, Official Members, Working Groups, Commission Reports, Commission

Resolutions and a tab 'Extra', which can be used for specialized training within the Commission or extra information from the Commission.

Prof. Van Daele explains the responsibilities of the Commission Officers. It is extremely important that within each Commission the officers work as a team.

The Commission Chair has overall responsibility for a three-year period commencing at the end of the GASS(in which they served as the Vice Chair). He is responsible for ensuring that the Vice-Chair, ECR and other appointed individuals(e.g., Working Group Chairs) fulfil their commitments. He is also responsible for the Commission budget and for the GASS commission programme.

The Vice-Chair acts as Chair of the Commission in the absence of the Chair, or should the Chair be unable or unwilling to perform their duties. The Vice-Chair is responsible for planning and overseeing the Commission's Atlantic Radio Science Conference (AT-RASC) programme.

The Early Career Representatives (ECRs) work with the Chair and the Vice-Chair to ensure that the Commission is attractive to their early-career peers. The ECR is a member of the Early Career Coordinating Committee, which will meet at the GASS, AT-RASC and the AP-RASC Meetings. The Committee will report directly to the President and Secretary General.

It is required that both the Chairs, Vice-Chairs and ECR's attend the URSI Council meetings, URSI Coordinating Committee Meetings and URSI Commission Coordination Activities Meetings in person at the GASS. For AT-RASC and AP-RASC it is required that the Chair or the Vice-Chair and 1 ECR attend on-site and the others online.

The Secretary General explains wat is expected from the Commission leads the 1st 6 months. It is important to identify who the Official Members are and to keep them engaged. The Commission budget should also be checked with the Treasurer & the Secretary General.

It is also advised to make use of the URSI social media channels (Facebook, LinkedIn and Twitter) to promote Commission activities.

TREASURER'S REPORT ON URSI FINANCES

This treasurer's report of the International Union of Radio Science (URSI) covers the period of four years 2017–2021, instead of a three-year period. This is due to the fact that the triennial Council Meeting and the General Assembly was postponed from 2020 to 2021. The financial data (figures of assets, income, expenditure) are listed below in a table for the years 2017, 2018, 2019, and 2020.

General observations about the finances and their developments over the past four years:

- The Financial Statements of the International Union of Radio Science (U.R.S.I.) as at 31 December 2020 have been audited on 8 April 2021 by EY Bedrijfsrevisoren BV, represented by partner Francis Boelens.
- The income consists mainly of membership fees from national committees and the surplus from successful Flagship meetings.
- The largest expenses are due to administration (Ghent office), support to the activities of the ten commissions, arrangements of Board and Committee meetings, and supporting flagship conference organization (including the Young Scientists programme), and URSI publications.
- Due to the different character of the three flagship meetings, the expenses and income vary in a three-year life cycle of URSI:
 - Atlantic Radio Science Meeting **AT-RASC** (2015, 2018, 2022, Gran Canaria) is completely organized by URSI, with total financial responsibility including expenses and income.
 - Asia–Pacific Radio Science Conference **AP-RASC** (2016 Seoul, 2019 New Delhi, 2025 Sydney) is in the hands of the local organization, but URSI provides a certain financial support and receives in return free registration for the Board and Coordinating Committee members.
 - URSI General Assembly and Scientific Symposium GASS (2017 Montreal, 2021 Rome, 2023 Sapporo) is the main event in the life cycle of our Union. While the main financial responsibility lies with local organizers, URSI is heavily involved in technical and organizational support. The return to URSI consists of a fixed amount per registered participant plus a certain percentage of the registration fees.
 - The time of pandemic has severely affected the scientific activities of URSI. All Flagship and Commission meetings have been postponed by one year or even more. An obvious consequence is that the income and expenses in the URSI finances have not followed the expected cycle during the year 2020.
 - As to the future, the fact that many meetings, workshops, and conferences will probably have a hybrid character for a certain time to come will make it difficult



to predict their financial implications to URSI. Hybrid and online meetings bring additional costs due to the requirements by the digitalization of the event and securing its fluency in communications, but on the other hand, savings result from the reduced need for physical lecture spaces, refreshments, and social programme.

- The income to URSI from the Membership fees of the national committees, shown below, have stayed rather stable during the past years. The increase of the membership fees to URSI has been kept very modest: the membership contribution payment in average has increased less than one percent per year. The yearly variation of the financial input from the membership fees is due to occasional delays of the payments by individual countries, which, on the other hand, may be compensated by the fact that the arrears sometimes appear later as cluster income in the balances.

As a final remark, I express my sincere thanks to the Secretary General and officers in the URSI Headquarters for their excellent handling of day-to-day finances.

Ari Sihvola Treasurer, Vice President URSI

INTERNATIONAL UNION OF RADIO SCIENCE (URSI) BALANCE SHEET: 31 DECEMBER 2020

				EUI	RO			
ASSETS	31.12	2020	31.12	2019	31.12.	2018	31.12.2	2017
Installations, Machines & equipment		0,00		1.316,91		2.633,83		0,00
Dollars en molere								
BNP Paribas USD	4 737 57		118.98		137.46		1	
BNP Paribas CAD	0.00		0.00		64 622 60		4 244 08	
BNP Paribas GBP	15 713 50		0.00					
BNP Paribas JPY	2,600,31		0.00				1	
Paypal USD	11.495.20		0.00					
		34.546.58		118,98		64,760,06		0.00
Euros							1	
Banque Degroof	0,00		0,00		0,00		0,00	
BNP Paribas zichtrekening	87.682,18		127.791,04		46.871,42		23.553,20	
BNP Paribas spaarrekening	692,87		692,87		692,87		693,61	
BNP Paribas portefeuillerekening (001-02)	142.955,59		117.415,44		32.049,25		11.950,09	
BNP Paribas portefeuillerekening (001-84)	0,57		0,57				1	
Paypal	691,32		691,32		0,00		0,00	
		232.022,53		246.591,24		79.613,54		36.196,90
Investments							1	
DPAM Bonds EMU (formerly Demeter Sicav Shares)	0,00		0,00		22.681,79		22.681,79	
Rorento Units	0,00		0,00		111.995,67		111.995,67	
DPAM MML MON (formerly Aqua-Sicav)	0,00		0,00		63.785,56		63.785,56	
Bonds	1.044.197,46		1.068.197,46		381.000,00		400.000,00	
	1.044.197,46		1.068.197,46		\$79.463,02		598.463,02	
652 Rorento units on behalf of van der Pol Fund	11.833,55		11.833,55		11.833,55		11.833,55	
		1.056.031,01		1.080.031,01		591.296,57		610.296,57
Petty Cash		208,39		208,39		126,49		39,48
Total Assets		1.322.808,51	-	1.328.266,53	-	738.430,49		646.532,95
Less Creditors								
IUCAF	36.024,86		36.783,12		34.750,50		35.535,19	
ISES	5.053,53		5.053,53		5.053,53		5.053,53	
		(41.078,39)		(41.836,65)		(39.804,03)		(40.588,72)
Balthasar van der Pol Medal Fund		(11.833,55)		(11.833,55)		(11.833,55)		(11.833,55)
Basu Medal Fund EV Berdrilfsrovis	oren BV	(4.216,35)		(4.216,35)		(4.216,35)		(4.216,35)
Paid Remuneration For Identification ourse	ses only -	10.906,71	_	7.522,80	_	6.752,90	_	6.273,56
NET TOTAL OF URSI ASSETS	1	1.276.586,93		1.277.902,78		689.329,46		596.167,89
							1	

	EURO							
	31.12.2020	31.12.2019	31.12.2018	31.12.2017				
The net URSI Assets are represented by:								
Closure of Secretariat								
Provision for Closure of Secretariat	122.000,00	120.000,00	115.000,00	115.000,00				
Scientific Activities Fund								
Scientific Activities in 2020	60.000,00	60.000,00	60.000,00	60.000,00				
Routine Meetings in 2020	15.000,00	20.000,00	20.000,00	10.000,00				
Publications/Website in 2020	40.000,00	40.000,00	40.000,00	40.000,00				
Young Scientists in 2020	0,00	0,00	0,00	0,00				
Administration Fund in 2020	105.000,00	105.000,00	105.000,00	105.000,00				
LC.S.U./ ISC Dues in 2020	6.000,00	6.000,00	6.000,00	6.000,00				
	226.000,00	231.000,00	231.000,00	221.000,00				
Flagship Meetings								
GASS 2017 - Montreal	0,00	0,00	0,00	0,00				
GASS 2020 - Rome	180.000,00	180.000,00	120.000,00	60.000,00				
GASS 2023 - Saporro	60.000,00	0,00	0,00	0,00				
AT RASC- Gran Canaria (2021)	90.000,00	60.000,00	30.000,00	40.000,00				
AP RASC- Sydney (2022)	20.000,00	10.000,00	30.000,00	20.000,00				
				177.000.00				
Total allocated UKSI Assets	698.000,00	601.000,00	526.000,00	456.000,00				
Unallocated Reserve Fund	578.580,94	676.902,78	163.329,40	144.411.97				
	1.276.586,94	1.277.902,78	689.329,46	\$00,411,97				

Statement of Income and expenditure for the year ended 31 December 2020

				EU	RO			
L INCOME	31.12	2020	31.12	.2019	31.12.	2018	31.12.3	2017
Contributions from National Members (year -1)	35.920,00		21.563,50		35.918,00		30.095,72	
Contributions from National Members (year)	185.625,59		189.725,00		177.890,30		133.889,50	
Contributions from National Members (year +1)	19.513,95		24.725,00		8.510,00		6.315,00	
Income General Assembly 2017/2020	0,00		1.500,00		168.100,25		0,00	
Income AT RASC 2015/2018	0,00		0,00		254.405,98		0,00	
Income AP RASC 2019	0,00		0,00		0,00		0,00	
Support Conf. Organisation - General	2.600,92		0,00		0,00		0,00	
Support Conf. Organisation - ECIO	0,00		1.500,00		0,00		0,00	
Support Conf. Organisation - BSS	0,00		1.000,00		0,00		0,00	
Support Conf. Organisation - ECOC	1.840,00		2.100,00		0,00		0,00	
Support Conf. Organisation - Benehox Forum								
Sales of Publications, Royalties	19.243,50		0,00		0,00		0,00	
Bank Interest	0,00		0,00		0,00		10,04	
Other Income	3.811,61		753.800,62		7.432,40		4.573,71	
Total Income		268.555,57		995.914,12	-	652.256,93	_	174,883,97
II. EXPENDITURE								
A1) Scientific Activities		48.132.57		105.351.88		391.797.22		211.096.07
General Assembly 2014/2017	7,772.27		8.870.92		16.789.02		167.888.56	
Mid Term Meetings 2015	0.00		0.00		0.00		0.00	
AT RASC	7.536.28		6.759.66		339.052.60		11.657.53	
AP RASC	7.536.28		51,797,23		28.806.01		13,729,18	
Support Conference organisation	18,987,74		9.611.79					
Scientific meetings: symposia/colloqiua	6.300.00		25.300.00		5.239.93		8.447.01	
Representation at scientific meetings	0.00		3.012.28		1.909.66		9.373.79	
Other	0.00		0.00		0.00		0.00	
A2) Routine Meetings		9.418.48		39.431.58		285,20		0.00
Bureau/Executive committee	9.418.48		39.431.58		285,20		0.00	
Other	0.00		0,00		0.00		0.00	
A3) Publications EY Bedriifsrevisor	ren BV	39.606,27		33.641,84		34.105,06		28.665,13
For identification purpose	es only							
B) Other Activities		5.975,00		5.897,00		5.821,00		5.710,00
Contribution to ICSU/ ISC (2020)	3.975,00		3.897,00		3.821,00		3.710,00	
Contribution to other ICSU / ISC bodies	2.000,00		2.000,00		2.000,00		2.000,00	

	EURO							
	31.12.2020		31.12.2019		31.12.2018		31.12.2017	
C) Administrative Expenses		165.621,77		221.349,24		128.537,62		120.197,98
Salaries, Related Charges	124.806,96		116.567,31		99.535,91		93.388,25	
General Office Expenses	1.200,39		2.096,23		1.693,71		4.389,69	
Travel and representation	2.601,56		3.971,52		5.918,34		2.776,45	
Insurances/Communications/gifts	9.153,78		7.649,34		8.013,33		7.083,15	
Office Equipment	0,00		0,00		0,00		0,00	
Accountancy/Audit Fees	7.014,47		8.410,66		6.170,42		6.832,26	
Tax/Legal advice	16.008,31		0,00		0,00		0,00	
Bank Charges/Taxes	3.519,38		81.337,26		5.888,99		4.222,54	
Depreciation	1.316,92		1.316,92		1.316,92		1.505,64	
Loss on Investments (realised/unrealised)		-						
Total Expenditure:		268.754,09	-	405.671,54		560.546,10	-	365.669,18
Excess of Expenditure over Income		(198,52)		590.242,58		91.710.83		(190.785.21)
Currency translation diff. (USD => EURO) - Bank Accounts		(1.117,32)		(1.669,26)		(2.793,34)		(105,03)
Currency translation diff. (USD => EURO) - Investments		0,00		0,00		0,00		0,00
Currency translation diff. (USD => EURO) - Others		0,00		0,00		0,00		0,00
Accumulated Balance at 1 January 2020		1.277.902,78	-	689.329,46		600.411,97	_	791.302,21
		1.276.586,94		1.277.902,78		689.329,46		600.411,97

ADDITIONAL INFORMATION								
Rates of exchange	USD	CAD	GBP	лүү				
January 1, 2020	0,8915 EUR	0,6849 EUR	1,1819 EUR	0,0082 EUR				
December 31, 2020	0,8243 EUR	0,6849 EUR	1,1128 EUR	0,0079 EUR				

	EURO						
	31.12.2020	31.12.2019	31.12.2018	31.12.2017			
Balthasar van der Pol Fund							
652 Robeco Global (formerly Rorento Shares) : market value on December 31							
(Aquisition Value: USD 14.175,00/EUR 11.833,55)	37.457,40	37.457,40	37.457,40	37.457,40			
Book Value on December 31, 2020/2019/2018/2017	11.833,55	11.833,55	11.833,55	11.833,55			
Market Value of investments on December 31, 2020-2014 DPAM EMU (formerly Demeter Sicav Shares)	0,00	0,00	94.832,10	94.426.20			
Robeco Global (formerly Rotento Units) (1)	0,00	0,00	720.720,00	746.850,00			
DPAM MML MON (formerly Aqua-Sicav)	0.00	0,00	89.156,20	89.521,53			
Bonds	1.033.197,46	1.068.197,46	381.000,00	400.000,00			
	1.033.197,46	1.068.197,46	1.285.708,30	1.330.797,73			
Book Value on December 31, 2020/2019/2018/2017	1.056.031,01	1.080.031,01	591.296,57	610.296,57			
(1) Including the 652 Rorento Shares of v d Pol Fund							

APPENDIX				EUI	RO			
Detail of Income and Expenditure	31.12.2020		31.12.2019		31.12.2018		31.12.2017	
L INCOME								
Other Income								
Young scientist support (Japan)	0,00		0,00		0,00		0,00	
Income bonds	634,37		753.800,62		4.639,40		4.357,67	
Other	9.098,97		0,00		2.793,00		216,04	
		9.733,34		753.800,62		7.432,40		4.573,71
II. EXPENDITURE								
General Assembly 2017/2020								
Organisation	7.536,27		8.870,92		15.025,34		32.342,01	
Vanderp ol Medal	0,00		0,00		0,00		647,96	
Basu award	0,00		0,00		0,00		16,40	
President's award	0,00		0,00		0,00		166,02	
Young scientists	0,00		0,00		0,00		23.659,83	
Expenses officials	0,00		0,00		0,00		48.190,16	
Support Commissions	236,00		0,00		1.763,68		62.866,18	
		7.772,27		8.870,92		16.789,02		167.888,56
AT RASC								
Organisation	7.536,28		6.759,66		228.957,77		11.657,53	
Young scientists	0,00		0,00		25.930,98		0,00	
Expenses officials	0,00		0,00		41.744,55		0,00	
Support Commissions	0,00		0,00		42.419,30			
		7.536,28		6.759,66		339.052,60		11.657,53
AP RASC								
Organisation	7.536,28		11.387,52		28.806,01		10.069,72	
Young scientists	0,00		0,00		0,00		0,00	
Expenses officials	0,00		15.076,11		0,00		5.131,27	
Support Commissions	0,00		25.333,60				(1.471,81)	
		7.536,28		51.797,23		28.806,01		13.729,18

			EURO					
	31.12.2020		31.12.2019		31.12.2018		31.12.2017	
Support Conference Organisation								
ECOC	18.571,30		7.893,04					
Benehax Forum	416,44		1.718,75					
		18.987,74		9.611,79				
Routine Meetings								
Board Meeting	9.418,48		39.431,58		285,20		0,00	
		9.418,48		39.431,58		285,20		0,00
Symposia/Colloquia/Working Groups								
Commission A	0,00		0,00		0,00		0,00	
Commission B	0,00		13.300,00		0,00		5.043,06	
Commission C	0,00		0,00		0,00		0,00	
Commission D	0,00		0,00		0,00		0,00	
Commission E	0,00		0,00		0,00		0,00	
Commission F	0,00		0,00		0,00		1.243,95	
Commission G	2.000,00		5.000,00		0,00		660,00	
Commission H	2.000,00		0,00		1,700,00		0,00	
Commission J	0,00		3.000,00		0,00		0,00	
Commission K.	0,00		0,00		0,00		0,00	
Central Fund	0,00		0,00		0,00		0,00	
Central Fund (Student Award MC)	2.300,00		4.000,00		3.539,93		1.500,00	
		6.300,00		25.300,00		5.239,93		8.447,01
Contribution to other ICSU bodies								
IUCAF	2.000,00		2.000,00		2.000,00		2.000,00	
		2.000,00		2.000,00		2.000,00		2.000,00
Publications								
Publications / Website	39.606,27		33.641,84		34.105,06		28.665,13	
		39.606,27		33.641,84		34.105,06		28.665,13
REPORTS OF THE STANDING COMMITTEES

URSI STANDING COMMITTEE ON PUBLICATIONS

This report summarizes the status of the *Radio Science Bulletin* (with some exciting news about its usage on IEEE Xplore), the URSI centenary book, the URSI *Radio Science Letters*, and the journal *Radio Science*. The reports on *Radio Science Letters* and *Radio Science* were provided by their Editors-in-Chief.

1. Radio Science Bulletin

The *Radio Science Bulletin* is behind schedule, due in part because of delays in receiving the papers associated with special issues, and in large part due to the hospitalization and associated recovery period of the Editor earlier this year. The September 2020 issue should be distributed before the Rome GASS, and work is underway on the December 2020 issue. The plan is to have the publication back on schedule by the end of the first quarter of 2022.



Figure 1. The number of papers published per issue in the *Radio Science Bulletin*.

XXXIVth GASS, Rome, ITALY, 28 August - 4 September 2021

Figure 1 shows the number of papers that have been published in each issue of the *Radio Science Bulletin* since December 2005. Figure 2 shows the same data since March 2013. The peaks typically correspond to special issues, and these are becoming more common. The September 2019 issue had four papers from the 2019 AP-RASC Student Paper Contest and one of the keynote talks. The December 2019 issue had papers based on the General Lecture, two of the Commission keynotes, and one of the Student Paper Contest papers from the 2019 AP-RASC. The March 2020 issue had three papers from the Japanese National Radio Science Meeting Student Paper Contest, and the June 2020 issue had five papers from the Student Paper Contest at the Italian URSI annual meeting. Figure 2 gives an expanded view of Figure 1 for the most recent years.



Figure 2. An expanded view of Figure 1 for the most recent years.

The good news is that the *Radio Science Bulletin* seems to be attracting a larger number of special issues. In fact, special issues are booked through the current issues. Assuming this continues, it should result in a steady stream of content for the *Bulletin*. However, this does need to continue: we have not been receiving contributions from the Commissions. We do need to encourage the Commissions to more actively solicit papers from their members. We have had very few Commission-originated submissions in recent years.

The September 2020 issue contains six papers from the 2019 Commission B Electromagnetic Theory Symposium held in San Diego, California. The December 2020

issue will contain three papers from the 2020 URSI Italian National Committee Young Scientist Awardees, along with an additional contributed paper.

Inge Lievens continues to do an outstanding job of layout and composition for the *Bulletin*, and of handling the interface with IEEE Xplore. Her efforts are greatly appreciated.

1.1 Exciting News: Radio Science Bulletin Usage on IEEE Xplore

The *Radio Science Bulletin* has been available on IEEE Xplore as an open-access publication (no subscription required for access) for about six years. The IEEE has just made tools available that give us the ability to track a variety of usage statistics for the publication. For 2020, the *RSB* had 30,665 downloads of articles, with an average of 24.4 downloads per article. So far in 2021 (through July), there have been 18,099 downloads, with an average of 14.09 downloads per article. This is a very substantial amount of usage, and it means that the *Radio Science Bulletin* is reaching far beyond the traditional URSI community.

2. URSI Centenary Book

The centenary book celebrating 100 years of URSI is complete, and will be distributed in electronic and hard copy form at the URSI GASS in Rome. It has approximately 617 pages, consisting of 32 chapters. These include contributions from all 10 Commissions and 22 Member Committees, as well as an early history of URSI written by Paul Lagasse. The book was fully edited, with much of this work being done by Phil Wilkinson, as well as by Paul Cannon and me. Inge Livens did the massive job of composition and layout for the book, and Inge Heleu and Peter Van Daele also played essential roles. It is a publication of which URSI can be proud.

3. URSI Radio Science Letters

Editor-in-Chief George Uslenghi has provided the following report:

The *URSI Radio Science Letters (RSL)* is a new online journal fully owned and operated by URSI. It was approved by the URSI Board in May 2018 with Piergiorgio L. E. (George) Uslenghi as its first Editor-in-Chief. It is a rigorously reviewed, open-access journal that is in its third year of operation.

In its first year of operation (2019), the *RSL* received fourteen submissions. Of these, five were rejected or withdrawn, and nine were published as the first volume.

In its second year of operation (2020), the *RSL* received sixty-six submissions, of which nineteen were either rejected or withdrawn, and forty-seven were published as the second volume. All submissions except two originated from works accepted at the 2020 URSI GASS.

At the end of June 2021, in the middle of its third year of operation, the *RSL* had received seven submissions, of which five were rejected or withdrawn, and two were accepted for publication in the third volume.

It has become evident that until the *RSL* is assigned an impact factor in Journal Citation Reports, most submissions will originate from the URSI flagship conferences. It is therefore important to continue advertising the *RSL* at all flagship conferences, and to provide reduced page charges for letters emanating from such conferences and from all other conferences technically cosponsored by URSI.

The members of the *RSL* Editorial Board and of the URSI Secretariat deserve recognition and a vote of thanks for their selfless and competent service to the *RSL*.

4. Radio Science

The following report was provided by the Editor-in-Chief, Sana Salous.

4.1 The Status of the Editorial Board

Sana Salous' term as Editor-in-Chief began January 1, 2019, working with Prof. Kazuya Kobayashi, current Chair of Commission B of URSI, who has taken the role of Editor.

4.2 A Status Report on Radio Science

4.2.1 Scope of Radio Science

Radio Science is published by the American Geophysical Union (AGU) and is cosponsored by URSI.

Radio Science publishes original scientific contributions on radio-frequency electromagnetic propagation and its applications. Contributions covering measurement, modeling, prediction and forecasting techniques pertinent to fields and waves – including antennas, signals and systems, the terrestrial and space environment and radio propagation problems in radio astronomy – are welcome. Contributions may

address propagation through, interaction with, and remote sensing of structures, geophysical media, plasmas, and materials, as well as the application of radio frequency electromagnetic techniques to remote sensing of the Earth and other bodies in the solar system.

The journal does not publish papers on propagation in biological media, nor optical phenomena. The journal does not publish papers on the geophysics of space plasmas which are better suited for publication in *JGR: Space Physics*.

The journal addresses most of the URSI Commissions, but there are restrictions: notably, signal processing (for its own sake) and engineering papers (without any radio science).

As of 2018, a new type of paper was introduced under the heading of 'Technical Reports: Method" submissions. These papers provide new analytical or experimental methods, data, and other technical advances, including computer programs and instrumentation, if applicable, that represent a significant advance and enable new science. These papers should not exceed 13 Publication Units and will typically include at least one illustrative example application.

4.2.2 Editorial Comments

There are currently 18 non-special-section Associate Editors (AEs). One of the AEs was elected Fellow of the AGU in its 2018 ceremony. Two AEs are URSI Early Career Representatives. (AGU AEs are usually older than this). The registration fees for AEs attending the AGU Fall Meeting are now paid by AGU, and this is an advantage for about a third of the AEs.

The editorial board was reviewed and new AEs have been appointed based either on nominations from AEs or through direct self-nomination to the EiC, with particular attention to extending the reach of the journal in China and to encouraging more submissions in radio communications.

4.2.3 Centennial Papers

AGU has been collecting papers together to mark its centennial in 2019. Each journal was committed to producing several papers. Originally, it was envisaged that *Radio Science* would provide three to four possible papers. However, thanks to the efforts of AEs, a total of seven papers was received, with four papers already published/ ready for publication and three under review.

- 1. "The Case for Combining a Large Low-Band VHF Transmitter with Multiple Receiving Arrays for Geospace Research: A Geospace Radar," David Hysell leading author, published.
- 2. "Whole Atmosphere Coupling on Intra- and Inter-Seasonal Time Scales: A Potential Source of Increased Predictive Capability," Fabrizio Sassi leading author, published.
- 3. "Upper Atmospheric Responses to Surface Disturbances: An Observational Perspective, Xing Meng leading author, published.
- 4. "Unusual Lessons Learned from the SL9 Radio Observations and Their Potential Consequences to Earth's Radiation Belts," Imke de Pater leading author, published.
- 5. "Investigating Transport and Dissipation in the Sub-Auroral E Region with Ionospheric Modification Experiments and VHF Radar Backscatter," David Hysell leading author, published.
- 6. A Numerical Model of CPR of Rough Surface with Volumetric Scatterers for Analysis of Mini-RF Data, Ya-Qiu Jin leading author, published.

4.2.4 Special Sections

Over the years, special sections have contributed to the number of papers published in *Radio Science*. More recently, URSI has provided many of these papers through its various meetings. Special issues of current hot topics are welcome as they are likely to further improve the impact factor of the journal.

A summary of recent special sections:

- "THz Propagation Characterization, Modeling, and Wireless Link Design:" two submitted, one under revision, and one rejected.
- "Air-Sea Coupling and its Effect on Electromagnetic Propagation in the Marine Atmospheric Boundary Layer:" three papers submitted so far, with two under revision.
- "Beacon Satellite Symposium 2019:" eight papers published and one under review.
- "Advances in Electromagnetics, Photonics, Signal Processing, and Communication Technology:" nine submitted, seven published, one rejected, one under revision.
- "The 33rd General Assembly and Scientific Symposium (GASS) of the International Union of Radio Science (URSI):" 10 submitted, two accepted, six under review, and two rejected.

- "Radio Channel Modeling for 5G Millimeter Wave Communication in Built Environments:" eight accepted/published.
- "Radio Channel Measurements and Modeling for Future High-Speed Railway Communications:" six papers accepted/published.
- "Special Issue of the 2019 URSI Commission B International Symposium on Electromagnetic Theory:" five accepted, two under revision/review.
- "Special Issue of the 2019 URSI Asia-Pacific Radio Science Conference:" 26 papers submitted, 12 published.
- "Special Issue of the 2019 URSI-Japan Radio Science Meeting: six papers submitted and all accepted.

4.2.5 Performance

Table 1 provides all the various statistics, most of which have fallen over the review period. The 2020 impact factor was 1.431, the five-year impact factor was 1.541, and the total cites were 5181 (two years of citations in 2020 of papers published in 2018 and 2019). Table 1 shows 2019 and 2018 values for additional context. The 2020 impact factor represents an overall decrease since 2018.

Table 2 compares *Radio Science* with generic journal disciplines judged relevant in content to it. Overall, the rank of *Radio Science* has slightly improved. Rich Bradley has been promoting URSI radio astronomy and, by association, *Radio Science* in this

Metric Source	Metric	2019 Values	2018 Values	Change
JCR	%Self-Citation	9.09%	13.67%	-33.5%
JCR	Article Influence	0.445	0.523	-14.9%
JCR	Cited Half-Life	17.3	10.3	68.0%
JCR	Eigenfactor	0.00334	0.00382	-12.6%
JCR	Five-Year IF	1.472	1.684	-12.6%
JCR	Immediacy Index	0.297	0.342	-13.2%
JCR	Impact Factor	1.305	1.658	-21.3%
JCR	Total Articles	74	114	-35.1%
JCR	Total Cites	4,888	5,484	-10.9%
Scopus	CiteScore	3.300	2.900	13.8%
Scopus	SJR	0.474	0.501	-5.4%
Scopus	SNIP	0.931	1.123	-17.1%

Table 1. Statistics for Radio Science.

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Competitor Journal	2019 Impact Factor 2017 Outpu	ıt 2018 Output	2019 Output	
ADV SPACE RES	2.177	486	492	510
ANN GEOPHYS-GERMANY	1.49	111	130	86
GPS SOLUT	3.61	170	112	130
IEEE TRANS ANTENNAS PROPAGAT	4.371	854	869	840
IEEE TRANS GEOSCI REMOT SEN	5.855	558	564	777
IEEE TRANS MICROWAVE THEORY	3413	507	544	486
IET COMMUN	1.664	351	328	426
RADIOSCI	1.305	125	114	74

Table 2. The ranking of *Radio Science* with other journals in different categories.

area. However, the ranking of *Radio Science* has not changed and cannot realistically compete with mainstream astronomy, although these papers should have AGU interest, so it is bound to rate low here.



Figure 3. The impact factors of competitor journals.



Figure 4. Published articles in Radio Science.

Figure 3 displays the history of the impact factor of the main competitors of *Radio Science*. Three of *Radio Science*'s competitor journals are close to its impact factor, while the higher-ranking journals, such as the *IEEE Transactions on Antennas and Propagation* and *IEEE Transactions on Geoscience and Remote Sensing*, are significantly ahead. More can therefore be achieved to promote the journal in antennas and radio propagation for radio communication applications and radar, either via special issues or invited review papers.

Overall, the research output of *Radio Science* has decreased since 2016, but with a slight increase in 2020 compared to 2019, as illustrated in Figure 4.

The rate of open-access publications stands at 7% for 2020, and 27% of papers are the product of international collaboration.

4.2.5 Zero Citations

A large number of *Radio Science* papers are not cited in the two years after they are published. This number has fluctuated over time, and currently sits near 45% (for the 2019 impact-factor period, as these data for 2020 impact factor were not yet analyzed as of the writing of this report). This is high, and is generally higher than the majority of its competitor journals, as shown in Figure 5.



Figure 5. Competitor publication citation rates.

4.2.6 Some Statistics

4.2.6.1 Quarterly Decision Tables

Table 3 provides some insight into paper handling by *Radio Science* Editors and Associate Editors. The main message is that for all stages of paper processing, the handling times fluctuate, and were generally higher than 2018. Different AEs have different handling times, and the issue was discussed in the editorial board meeting. Some delays are related to the staffing at AGU.

4.2.6.2 Country of Origin

Figure 6 shows the distribution of authors by country of origin. China had the highest number of authors, but the USA had a higher acceptance rate, as shown in Figure 7. To increase the contributions from China, two AEs were recently appointed from China.

T 11 3	TEL 1	C 1 4	•			• 1	I 4
Table 3.	. I ne number	of days to	various	stages in	naper	processing	ov quarter.
		01 000 000		8.00	p "p	P-00000	· · · · · · · · · · · · · · · · · · ·

Radio Science	2018	2019	2020	2021 01&02
Days to review	12	19	16	18
Days to 1 st decision	63	81	86	78
Days to acceptance	139	178	215	231



Figure 6. Authors in *Radio Science* by region.

4.2.7 Outlook and Issues

Below are some issues that are either of interest or ongoing.

• *Radio Science* has appeared in IEEE Xplore since the beginning of 2017. We look forward to this improving the visibility of *Radio Science* articles. AGU is encouraging promotion of papers.

Figure 7. Acceptance rates and total papers by region of submitting (corresponding) author.



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- Gender balance in AGU publications needs to be addressed. It can be shown that males are over-represented among reviewers compared to the AGU gender profile, and editors are encouraged to keep this in mind when nominating reviewers.
- The AGU data policy has been further updated, clarifying the wording in GEMS. Earth and space science data should, to the greatest extent possible, be stored in appropriate data repositories that follow leading practice and can provide additional data services. AGU supports (endorsed November 18, 2015) referencing data sets using the Force 11 data-citation principles (https://www.force11.org). A directory of repositories has been built so publishers can assist authors finding a site that suits their needs. Data sets should have a DOI. Data statements are checked at the quality control (QC) stage, and usually papers stay at this stage until their data statement satisfies QC (with reasonable caveats). It is not proving difficult to resolve some of the associated problems they encounter.

4.2.8 Can URSI Do More?

There is an argument that AGU members should seek to publish in journals such as *Radio Science* to increase the impact factor and general status of the journal, thereby assisting lower- level institutes publishing there.

However, the obvious group to contribute these papers is not the AGU Fellows, who are not radio-science oriented, but URSI. It would be very helpful if URSI decided to support the publication of strong reviews, say the Commissions B, C, E, F, G, and maybe J (when relevant) tutorials in *Radio Science* by providing the page-charge costs to the authors as part of the incentive. As cosponsor for *Radio Science*, this seems like the type of support URSI could very effectively provide.

It is also observed that some journals are targeting academics and Commission representatives of URSI to promote special issues in their journals by offering free publication fees. One strategy would be to encourage special issues of the Commissions in *Radio Science* instead of these journals.

URSI STANDING FINANCE COMMITTEE

Prof. Paul Smith and Dr. W. Ross Stone examined the report prepared by Prof. Ari Sihvola (Treasurer) of the URSI Finances covering the period 2017-2020. They noted that the accounts had been audited by EY Bedrijfsrevisoren BV who stated that, in their opinion, the Financial Statements give a true and fair view of the financial position of URSI as of 31 December 2020.

Prof. Paul Smith and Dr. W. Ross Stone noted that the financial and budgetary measures initiated in the triennium 2014-1016 have been largely successful in bringing URSI finances to a reasonable steady state with income matching expenditure. The administration costs of the organisation have been well and prudently managed. It is highly desirable, if not essential, that the practice of charging a delegate levy for each attendee at URSI Flagship meetings be sustained and fully implemented for future meetings.

They would observe that the disruption experienced in 2020 has brought some financial and organisational challenges for the next triennium due to (1) the cancellation or deferment of the usual cycle of URSI meetings (thus representing a loss of income), and (2) the necessity to run hybrid meetings (combining in-person and online components) that incur costs additional to those incurred in running an inperson meeting without an on-line component. In their opinion, hybrid meetings will be the norm for the foreseeable future and may even become the permanently established practice for scientific meetings, once the pandemic has passed, for a variety of reasons, including individual disinclination to travel, restriction of travel and travel funding by universities and research organisations, and so on. It is highly desirable that URSI seeks to anticipate these trends in its organisational and budgetary planning. As one aspect, the practice adopted at the GASS 2021 of the same registration fee for participants, whether they attend in person or on-line, should be continued.

URSI STANDING COMMITTEE ON YOUNG SCIENTISTS

1. Background

The Young Scientist Awards are presented at URSI Flagship meetings : the General Assemblies of URSI, the URSI Atlantic Radio Science Conferences (AT-RASC) and the URSI Asia-Pacific Radio Science Conferences (AP-RASC) to recognize an international group of individuals who have made innovative contributions and discoveries in multidiscipline research related to electromagnetic fields and waves.

In general, the 3 URSI Flagship meetings are held in a 3-year cycle to review current research trends, present new discoveries and make plans for future research and special projects in all areas of radio science, especially where international cooperation is desirable. Young researchers can apply for a Young Scientists Awards at any of these 3 URSI Flagship meetings. A Young Scientists Award is primarily a recognition of the scientific value of the work presented in the paper submitted by the young researcher. It links to financial support through waiving registration fees, in some cases also providing accommodation or even travel support when originating form specific and selected countries.

To qualify for an award the applicant:

- must be less than 35 years old on September 1 of the year (2021) of the URSI General Assembly and Scientific Symposium;
- should have a paper, of which he or she is the principal author, submitted and accepted for oral or poster presentation at a regular session of the General Assembly and Scientific Symposium.

Applicants should also be interested in promoting contacts between developed and developing countries. Applicants from all over the world are welcome, including from regions that do not (yet) belong to URSI. All successful applicants are expected to participate fully in the scientific activities of the URSI Flagship Meetings.

Applications are assessed by the URSI Young Scientist Committee taking account of the national ranking of the application and the technical evaluation of the abstract by the relevant URSI Commission. During the selection process, application or granted Young Scientists Awards at the occasion of previous URSI Flagship meetings are not taken into account, except in the final stage when a proper balance is sought between Commissions and geographical spreading.

2. Time schedule

- 31-01-21: paper submission deadline
- 12-02-21: extended paper submission deadline
- 07-03-21: technical review by URSI Commissions and conveners completed
- 07-03-21: ranking by URSI Commissions completed
- 31-03-21: ranking by URSI Member Committees completed
- 26-04-21: final selection by URSI Young Scientist Panel completed
- 30-04-21: notifications sent out
- 15-05-21: deadline for acceptance of Young Scientists Award

3. YS Applications

After the call for the Young Scientist Awards, 179 applications from 30 countries were received through an online application procedure.

Australia	Greece	Russian Federation
Belgium	India	Saudi Arabia
Brazil	Indonesia	Spain
Canada	Iraq	Sweden
China	Ireland	Switzerland
Czech Republic	Italy	The Netherlands
Egypt	Japan	Turkey
Finland	Malta	Ukraine
France	New Zealand	United Kingdom
Germany	Pakistan	USA

4. Selection process

The selection process is carried out in 4 steps:

- The Secretariat checks eligibility (1st author, age limit, submission of required documents,..). 8 candidates were removed from the list in this step as they were not eligible.
- Then the Chair, Vice-Chair and ECRs of each of the 10 URSI Commissions were asked, to rank the applicants who submitted a paper in one of the sessions organized in their Commission, purely based on the scientific merit of the work presented in the paper.
- In parallel the Member Committees were asked to rank the applicants originating from their country based on local, practical, technical or other issues.
- The rankings by the Commissions and the Member committees were combined in a score by the Young Scientist Panel to come to a final selection, taking into account

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a proper balance over the 10 URSI Commissions, a proper geographical spreading as well as a gender balance. During this final step, It was always made sure that the selected awardee had a paper of significant technical value, and in some specific cases the Young Scientist Panel also considered the comments provided by the reviewers during the reviewing process for all submitted papers at the GASS 2021.

Finally, the Young Scientists Panel submitted a list of 95 awardees to the URSI Board. After careful consideration, the URSI Board approved the proposed selection and all awardees were contacted. The deadline for acceptance of the Young Scientist Award was set on 15 May 2021.

5. Young Scientist Awardees

95 applicants were as selected Young Scientists awardees and were announced on the URSI Website.

5.1 Distribution per Commission

The following table provides an overview of the distribution per Commission indicating the applications received, the selected Awardees and the acceptance rate.

Commission	Total app	Selected	Acc. Rate
Α	9	3	33,3%
В	53	27	50,9%
C	9	6	66,7%
D	17	9	52,9%
E	5	4	80,0%
F	27	13	48,1%
G	17	10	58,8%
н	17	9	52,9%
J	9	6	66,7%
К	16	8	50,0%
Total	179	95	53,1%

5.2 Distribution per Region

To give a view of the geographical spread of the Young Scientist Awards, each of them is assigned to a region, as shown below. To allow a better interpretation some countries from which a large number of Young Scientists originate are listed separately from their region (in casu China, India, Russian Federation,..)

Region	Total app.	Selected	Acc. Rate
Asia-Pacific	10	6	60,0%
China	22	10	45,5%
Europe	64	39	60,9%
India	49	21	42,9%
Middle East	7	5	71,4%
Americas	27	14	51,9%
Total	179	95	53,1%

5.3 Gender Balanace

Based on the information provided by the applicants, the following gender balance is obtained.

Gender	Total app.	Selected	Acc. Rate
Male	120	64	53,3%
Female	59	31	52,5%
Total	179	95	53,1%



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6. Follow-up of Young Scientist Selection

Names, as well as pictures, affiliations and a link to the submitted paper will become available on the URSI website. Starting from the 1st day of the GASS 2021, an extra link will be provided to each of the presentations by the Young Scientists.

To improve the quality of the presentation by the Young Scientists, they will all be contacted in due time and offered the possibility to pre-record their presentation.

The Young Scientists certificates will be handed over to the Young Scientists at the GASS 2021 for those who can be physically present or will be mailed to those who cannot be present. This will be done after the GASS 2021, when all presentations have been recorded.

As a reminder it was decided that as the GASS 2020 Young Scientists are deprived from any financial rewarding linked to their award, the URSI Board decided that if they attend GASS 2021, GASS 2020 Young Scientists can register as Student (reduced fee) and will be invited to the YS Party in GASS 2021.

7. Conclusion

The report above provides a summary of the process and the outcome of the selection for the GASS 2021 Young Scientists. Being aware of the specific situation with respect to the postponement of the GASS 2020 as a physical conference and the fact that GASS 2021 will be a hybrid meeting, the URSI Board has taken specific measures to try to keep the Young Scientists programme active, as this is one of the pillars and activities within URSI which distinguishes us for other scientific unions.

By providing these awards and publicizing this information and these awards through the website and the social media, the URSI Board has the intention to keep young researchers interested in URSI and the events organised and supported by URSI. The Board wishes to thank all the individuals involved in this programme and selection process and wishes to congratulate all Young Scientists Awardees.

DETAILED REPORT ON THE SCIENTIFIC PROGRAM

1. GASS 2021 vs. GASS 2020

GASS 2020 reminder

- 1900 papers submitted in Feb 2020
- Reviewing process finalized early April
- YSA & SPC (virtual) maintained as GASS 2020
- SPC held virtually
- YSA: reduced fee and YS party in 2021, possibility to re-submit
- Authors of accepted papers requested to choose between GASS 2020 IEEE/URSI repository publication, transfer to GASS 2021, or withdraw
- 712 authors declaring to resubmit in 2021, 572 withdrawn

2. Process toward GASS 2021

- Re-use as much material as possible from GASS 2020
- Very similar calls
- Session proposals (at end of Oct. 2021) close to GASS 2020 sessions

Commission	A	B	С	D	E	F	G	Н	J	K		
Initial Oct. 2020	17	29	14	12	13	15	16	8	13	20	41	198
Final Aug. 2021	13	28	9	15	10	12	16	8	12	15	39	177

3. Submission statistics



Feb. 18, 2021	Actual submissions (total)	Nominal number of slots	Missing submissions	Thursday 18/02	
				New	Accepted
				Submissions	from 2020
А	88	95	7	54	34
В	408	245	-163	287	121
С	64	117	53	37	27
D	137	128	-9	96	41
E	81	95	14	53	28
F	143	158	15	111	32
G	311	273	-38	180	131
н	139	220	81	94	45
J	202	118	-84	116	86
К	138	150	12	86	52
	1711	1599	-112	1114	597

~equal to Montreal!



4. Final program status

Key figures

- 597 papers accepted from the GASS 2020 call have been resubmitted and transferred to 2021
- 1114 papers have been submitted on Feb. 10, 2021
- 1356 papers are on the final scientific program
- 1171 overall as fully oral presentations
- 185 in « Flash Interactive Presentations (FIP) »

Pre-conference program

- 2 workshops
- WS1, WS3 (4H)
- 12 short courses
- SC1 SC12 (3H or 6 H), including Commission B school (8 H)
- 4 ECR tutorials (1H)

	Short courses/workshops	eak	Short courses/workshops	Lunch Short courses/worksh			eak	Short courses/workshops
541	Secretariat	Bre	Board	Lunch	Co	ordinating committee	Bre	Coordinating committee
	WS3	eak	WS3	Lunch		WS3	ak	Short courses/workshops
SUN	Secretariat	Bre	Board	Lunch	EII.	Council 1	ő	Council 1

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Week program (Monday > Saturday)

- 188 regular oral paper sessions
- 2 FIP sessions (Tuesday-Thursday, morning-afternoon)
- 10 commission tutorials
- 1 workshop
- 1 working group
- 3 General Lectures
- 1 Public Lecture

5. Conclusions, lessons learnt

- Commission contributions : Good overall, useful recent memory from GASS 2020 effort
- Deadlines partly respected
- Benefits from the hybrid/virtual scheme : all SC are open (hoping for a true participation)
- 350 papers withdrawn or without registration, including ~ 1 FIP out of 2 accepted
- Excellent interactions with LOC & URSI secretariat

REPORTS ON ACTIVITIES OF INTER-UNION ORGANISATIONS

IUCAF, THE SCIENTIFIC COMMITTEE ON FREQUENCY ALLOCATIONS FOR RADIO ASTRONOMY AND SPACE SCIENCE

1. Introduction

IUCAF's Annual Reports are regularly published in the URSI Radio Science Bulletin; for 2017 see RSB #364 (March 2018); for 2018, RSB #370 (September 2019); for 2019, RSB #371 (December 2019). The Annual Report for 2020, in press, can be found at http://ftp.cv.nrao.edu/NRAO-staff/hliszt/URSI/IUCAF-AnnualReport2020_Final.docx.

The Annual Reports describe IUCAF member attendance at innumerable ITU-R and other spectrum regulatory and other meetings. After a brief overview of IUCAF, the focus here will be on a few major activities that came to fruition since 2017.

2. About IUCAF

The Scientific Committee on Frequency Allocations for Radio Astronomy and Space Science, IUCAF, originally the Inter-Union Committee on Allocation of Frequencies, was formed in 1960 by its adhering Unions, IAU, URSI, and COSPAR at the behest of URSI. IUCAF celebrated its 60th anniversary during the spectrum management school that was held during this period and is described below. IUCAF is online at <u>http://www.iucaf.org</u>.

IUCAF operates as an Inter-Disciplinary Body under the auspices of the International Science Council. Its brief is to study and coordinate the requirements of radio frequency spectrum allocations for passive radio sciences (radio astronomy, space research and remote sensing) and to make these requirements known to national/international bodies that regulate use of radio spectrum. Its terms of reference, composition and operating practices can be found at <u>http://www.iucaf.org/IUCAF_Terms_Of_Reference.pdf</u>.

Dr. Haiyan Zhang	China
Dr. Steven Reising	USA
Dr. Ingemar Häggström	Sweden
Dr. Anastasios Tzioumis	Australia
Dr. Wim van Driel	France
Dr. Harvey Liszt (Chair)	USA
Dr. Masatoshi Ohishi	Japan
Dr. Adrian Tiplady	South Africa
Dr. Yasuhiro Murata	Japan
Dr. Vadim Nozdrin	ITU-R SG7
	Dr. Haiyan Zhang Dr. Steven Reising Dr. Ingemar Häggström Dr. Anastasios Tzioumis Dr. Wim van Driel Dr. Harvey Liszt (Chair) Dr. Masatoshi Ohishi Dr. Adrian Tiplady Dr. Yasuhiro Murata Dr. Vadim Nozdrin

The IUCAF membership from the three adhering Unions is:

IUCAF is a Sector Member of the International Telecommunication Union's Radiocommunication Sector (ITU-R) with observer status at the Space Frequency Coordination Group (SFCG) where, since May 2021, it participates in the Lunar Martian Steering Group. IUCAF members participate in the activities of many other national and regional spectrum management bodies as noted in the Annual Reports.

3. 94 GHZ Coordination Agreement with ESA

Since 2005, JPL has operated the 94.05 GHz CloudSat cloud profiling radar in the middle of a broad swath of spectrum that is allocated to and heavily used by radio astronomy. The powerful beam of this nadir-pointing radar saturates any receiver over which the satellite passes during its 16-day repeating orbital cycle, independent of the radio astronomy antenna pointing. More seriously, the radar could burn out the radio astronomy receiver in the worst case. A variety of modifications to radio astronomy operations and instruments have been made on this account, especially for moveable array antennas that are transported in a zenith-pointing orientation with their supercooled electronics operating.

To forestall this situation when ESA, with JAXA participation, launches the EarthCare mission in 2023 with an even higher-power 94.05 GHz radar, IUCAF has for many years participated in SFCG meetings where EarthCare was discussed. This 15-year effort bore fruit in April 2021 when ESA and IUCAF signed a Memorandum of Understanding under which the nadir-pointing EarthCare radar will be silenced when its beam passes close enough to a radio astronomy antenna that the radio astronomy receiver could be damaged.

IUCAF is grateful to ESA for agreeing to modify the EarthCare radar's operation, and to JAXA for designing the radar in such a way that such an accommodation was possible.

4. The Fifth International IUCAF School on Spectrum Management for Radio Aastronomy and other Outreach

IUCAF maintains its **World Map of Radio Astronomy Sites and Radio Quiet Zones that has been viewed 64,200 times, see** <u>http://tinyurl.com/yrvszk</u>. IUCAF distributed its exceptionally popular IUCAF-logo fidget spinner, thanks to a continuing grant from an anonymous donor.

IUCAF's main outreach activities have been the international spectrum management schools it organized in 2002 (Green Bank, West Virginia, USA), 2005 (Castel San Pietro Terme, Italy), 2010 (Mitaka, Japan) and 2014 (Santiago, Chile). These events are necessary to maintaining a knowledge base for spectrum management inside radio astronomy, and for acquainting spectrum regulators with the very particular concerns of radio astronomy.

Through a magnificent stroke of good luck, the Fifth IUCAF International School on Spectrum Management (illustrated above) took place in Stellenbosch, South Africa during the period 2-6 March 2020, shortly before the world shut down. The attendance by 55 participants was far larger than usual. This meeting could not have occurred or been so successful without the strong financial and logistical support of the South African Radio Astronomy Observatory (SARAO) and a substantial financial subvention of European participation on the part of CRAF. Owing to this generosity and in respect of the venue, the meeting was held without fees for registration and meals, including the traditional banquet, and participants were provided with a spectrum management textbook written by one of the non-IUCAF lecturers. Presentations from this and the previous IUCAF schools are available on the IUCAF website at http://www.iucaf.org.

5. WRC-19

IUCAF's main ongoing activity since 1960 has been participation as a Sector Member at the ITU-R in Geneva. Owing to its long history, IUCAF's work protecting radio astronomy and passive radio science are accorded a high degree of recognition.

Indeed, most of IUCAF's technical work during the period covered by this report was preparation for the two-week 2019 February ITU-R 2nd Conference Preparatory Meeting (CPM-2) of WRC-19 in Geneva, and WRC-19 that was held 28 October – 22 November 2019 in Sharm El-Sheikh (Egypt) and attended by 5 IUCAF members for periods ranging from 10 days to 4 weeks. IUCAF strove to acquire a thorough knowledge of the WRC-19 agenda by participating in the spectrum sharing and compatibility studies conducted in ITU-R Study Groups 1, 4, 5 and 7 during the period 2015-2019 and by participating in the treaty text drafting sessions in those Groups. This effort culminated in the January 2019 submission of five CPM-2 input documents describing suggested modifications of the draft WRC-19 treaty text and another document summarizing IUCAF's views of methods proposed to satisfy relevant items on the WRC-19 agenda. The consequential items in this work package were adopted into the final report of the CPM to WRC-19, especially for Agenda Item 1.14 concerning High Altitude Platform Systems (HAPS) where the unmodified CPM text would not have protected radio astronomy sites registered after May 2020. Radio astronomy bands at 153 and 322 MHz received additional protection, including in the latter case from the harmonics of emissions around 160 MHz, an unusual recognition of this kind of spurious emission.

[25]	Proposed modification to the draft CPM text Chapter 5 - Agenda items 1.8 (Issue B), 1.9.1, 1.9.2	Scientific Committee on Frequency Allocations for Radio	2019-01-28
		Astronomy and Space Science	
[24]	Proposed modifications to the draft CPM text Chapter 4 - Agenda item 1.7	Scientific Committee on Frequency Allocations for Radio	2019-01-28
		Astronomy and Space Science	
[23]	Proposed modifications to the draft CPM text Chapter 3 - Agenda items 1.6 and 9.1.9	Scientific Committee on Frequency Allocations for Radio	2019-01-28
		Astronomy and Space Science	
[22]	Proposed modifications to the draft CPM text Chapter 2 - Agenda item 1.13	Scientific Committee on Frequency Allocations for Radio	2019-01-28
		Astronomy and Space Science	
[21]	Proposed modifications to the draft CPM text Chapter 1 - Agenda items 1.11, 1.14 and 1.15	Scientific Committee on Frequency Allocations for Radio	2019-01-28
		Astronomy and Space Science	
[20]	IUCAF views on WRC-19 agenda items of concern to Radio Astronomy	Scientific Committee on Frequency Allocations for Radio	2019-01-28
		Astronomy and Space Science	
[22] [21] [20]	Proposed modifications to the draft CPM text Chapter 2 - Agenda item 1.13 Proposed modifications to the draft CPM text Chapter 1 - Agenda items 1.11, 1.14 and 1.15 IUCAF views on WRC-19 agenda items of concern to Radio Astronomy	Scientific Committee on Frequency Allocations for Radio Astronomy and Space Science Scientific Committee on Frequency Allocations for Radio Astronomy and Space Science Scientific Committee on Frequency Allocations for Radio Astronomy and Space Science	2019-01- 2019-01- 2019-01-

These IUCAF positions were incorporated in the outcome of WRC-19. Modification of footnote 5.208A eventually resulted in a direct reference in the Radio Regulations to Recommendation ITU-R RA.769 containing the basic radio astronomy service protection thresholds. An effort initiated by IUCAF and presented to WRC-19 by Japan succeeded to remove a pejorative historical remark weakening protection of radio astronomy in the English language text of Article 4.6 of the Radio Regulations.

6. New Directions

Until recently, improved access to spectrum for science ran through the radio frequency spectrum regulatory regime, by procuring and protecting spectrum allocations. But allocations to science have been static while the rest of the spectrum fills in with new communication systems using broad swaths of previously-allocated but unused spectrum. Adequate regulatory limits are not always placed on unwanted emissions into bands intended for science.

One of the most impactful recent developments has been the authorization of mega- constellations of satellites in low Earth orbit (LEO) by radio spectrum regulators. Radio astronomy and LEO satellite sidelobes will make the sky uniformly quite bright in the satellite downlink bands. Even beyond this, satellite trails from reflected sunlight are increasingly affecting optical/infrared astronomy, even the Hubble Space

Telescope, and distorting the appearance of the night sky. Radio spectrum regulators have no brief to consider such "negative externalities." To counter this trend, optical and radio astronomers (strongly represented by IUCAF members) and other stakeholders convened a series of Workshops (<u>http://research.iac.es/congreso/quietdarksky2021/pages/home.php</u>) on Dark and Quiet Skies and took their concerns to the Legal and Scientific and Technical Subcommittees of the Committee on Peaceful Uses of Outer Space (COPUOS) in April 2021. The output of the first Workshop, including the Radio Astronomy Working Group's report, is available from the IAU at <u>https://iau.org/news/announcements/detail/ann21002/</u>

Closer to home, succession planning and matters of engagement continue to be of concern. Several nations with major investments in radio astronomy and/or strong histories of participation are not currently represented by astronomers in spectrum management despite IUCAF prodding.

7. Acknowledgements

IUCAF is grateful for the organizational and financial support that has been given by ICS, IAU, URSI and COSPAR, especially the URSI Secretariat that so efficiently and helpfully manages IUCAF's finances and logistics. IUCAF also recognizes the support given to individual IUCAF members by their home institutions, allowing them to participate in the vital work of the committee. IUCAF especially appreciates the contributions of the organizations and individuals who made the spectrum management school such a resounding success in March 2020, as the world was about to shut down.

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REPORT ON URSI AND THE IAU

There is not very much to report. The only active collaboration is the joint IAU-URSI Working Group on Historical Radio Astronomy (WGHRA) that I currently chair until early September. The only direct contact I've had with IAU Secretariat in my seven years as URSI Representative was in 2015-16 to establish formal IAU recognition of the joint IAU-URSI status of the WG HRA.

As far as the IAU itself is concerned, six or seven years ago, it reorganised its internal structure into Divisions, each of which has one or more Commissions, and in addition created a new program for Astronomy for Development alongside its other programs of Astronomy for Education and Astronomy for the Public. The Astronomy for Development initiative may be of interest to URSI Board members; more information can be found at https://www.iau.org/

A few remarks on the WG for Historical Radio Astronomy (WGHRA). It was first established in 2003 under the auspices of IAU Commission 40 (Radio Astronomy). It has continued in the new IAU structure as a Joint Commission B4 (Radio Astronomy)-C3 (History of Astronomy) WG. Since the URSI General Assembly in 2014 it has been a joint WG of the IAU and URSI. Its aims are to

- maintain an ongoing bibliography of publications relevant to the history of radio astronomy,
- document the careers of deceased radio astronomers in biographical memoirs, and
- document and preserve surviving historically-significant radio telescopes and associated instrumentation.

Its membership and the results of its activities are documented on the WG website (<u>https://rahist.nrao.edu</u>). The WG has organised sessions on historical radio astronomy themes at the IAU General Assemblies in 2015 and 2018, and URSI General Assemblies in 2017 and 2021 (Session J09).

Richard Schilizzi (URSI Representative to the International Astronomical Union) July 2021

XXXIVth GASS, Rome, ITALY, 28 August - 4 September 2021

URSI ACTIVITIES IN RELATION TO ISC AND OTHER UNIONS

1. ICSU and its transition into ISC

For many years, the International Council for Science (abbreviated ICSU for historical reasons) was the international umbrella organisation for pure and applied science and URSI was one of the affiliated scientific unions.

The mission of ICSU was to strengthen international science for the benefit of society. ICSU was above all else a policy driven organisation and it supported and lobbied for evidence driven decision making by governments. ICSU also coordinated international science initiatives in specific thematic fields, such as INGSA, CODATA, COSPAR, SCAR, SCOR, SCOSTEP, IUCAF and WDS some of which are within ToR of URSI. URSI representation to ICSU was through the President and/or the past-President.

ICSU managed its affairs through a structure similar to URSI with a Council and Board and General Assembly every three years. The last ICSU GA took place in Taipei Taiwan in October 2017 when the merger with the International Social Science Council (ISSC) to form the International Science Council was agreed and to which URSI became affiliated. ISC came into existence on 4 July 2018.

The merger was driven by a number of factors but the most important was a recognition that science policy can only be meaningful and effective (for example in the context of the United Nation Sustainable Development Goals (SDGs) for 2030) in an interdisciplinary and even transdisciplinary context. Collaboration across natural and social science was recognised as indispensable. In the space that ISC works the societal implications of science are often as important as the science itself.

2. Why URSI approved the merger

During the period 2014-17 ICSU and ISSC were active in planning the merger and in December 2016, Paul Cannon (Past President) was appointed to a Strategy Working Group (SWG) of ICSU to help plan this transition. Paul Cannon on behalf of URSI voted in favour of merger because:

- 1. the two organisations were subcritical in staff numbers and budgets and a merger might provide more momentum.
- 2. ICSU was simply not important and relevant to most scientists and URSI hoped that this merger would provide an opportunity to restart, broaden and enhance its activities. Throughout this process, Paul Cannon emphasized the need for the new Council to provide membership benefits to the Unions and its member scientists, though this is not so easy, given that the Council is policy based and the Unions are science based. Note that only because URSI is affiliated to ISC does it automatically receive subscriptions paid by the Member Committees.

3. The GeoUnion cluster

For historical and management purposes ICSU Unions were grouped into clusters. URSI was a member of the GeoUnion cluster which had a common interest in earth sciences (appropriate for Commissions G, H and J, but not for the other Commissions). The GeoUnion was an interdisciplinary consortium of nine ICSU International Scientific Unions; the International Astronomical Union (IAU), the International Cartographic Association (ICA), the International Geographical Union (IGU), the International Union of Quaternary Research (INQUA), the International Society for Photogrammetry and Remote Sensing (ISPRS), the International Union of Geodesy and Geophysics (IUGG), the International Union of Sciences (IUSS), and The International Union of Radio Sciences (URSI).

Clusters do not exist in ISC, but an informal GeoUnions cluster remains. It remains to be seen whether this will continue when the personal contacts are lost.

4. ISC Action Plan 2019-2021

In September 2019 and after consultation with its membership, ISC published the ISC Action Plan 2019-2021, Advancing Science as a Global Public Good. It consists of four domains: 1: the 2030 Agenda for Sustainable Development, 2: The Digital Revolution, 3: Science in Policy and Public Discourse and 4: Evolution of Science and Science Systems. The full version, and a mobile friendly version, can be accessed at: <u>https://council.science/actionplan</u>. The annual reports are available at <u>https://council.science/publications/</u>.

ISC inherited from ICSU many initiatives, most of which are co-sponsored by other international scientific partners, including UNESCO and other specialized UN agencies. These include projects which intersect with the ToR of URSI.

These initiatives include the following.

- The International Network for Government Science Advice (INGSA) provides a forum for policy makers, practitioners, and scientists to advance the theory and practice of using scientific evidence to inform policy at all levels of government. https://www.ingsa.org/
- Future Earth <u>http://www.futureearth.org/</u>. Remote sensing forms a key part of the Future Earth initiative. To date, no clear path for engagement has been identified, partly because Future Earth appears to be built around existing programmes that do not intersect with URSI. At this stage it is proving difficult to identify how URSI can provide its valuable input to this initiative.
- Integrated Research on Disaster Risk Programme (IRDR) <u>http://www.</u> irdrinternational.org/

International Scientific Committees coordinate international science in specific thematic fields.

- Antarctic Research (SCAR) <u>https://www.scar.org/</u>
- Frequencies for Radio Astronomy and Space Science (IUCAF) <u>http://www.iucaf.</u> org/
- Oceanic Research (SCOR) https://scor-int.org/
- Space Research (COSPAR) <u>https://cosparhq.cnes.fr/</u>
- Solar Terrestrial Physics (SCOSTEP) http://www.yorku.ca/scostep/ International Data Bodies develop and promote global policy in data science, build data science capacities, and bring together and make openly available relevant global data sets to enable scientific analysis across scientific domains.
- Committee on Data for Science and Technology (CODATA) <u>http://www.codata.org/</u>
- World Data System (WDS) <u>https://www.icsu-wds.org/</u>

5. Draft ISC Action Plan 2022-2024

A draft ISC Action Plan 2022-2024, *Science and Society in Transition*, is now under consultation with members. Five months into the implementation of the 2019-2021 Action Plan, the World Health Organisation declared COVID-19 a global pandemic and this is influencing this new action plan.

The ISC's 2022-2024 Action Plan is an evolution of the 2019-2021 Plan, rather than a radical departure with the framework of four domains of action used in the 2019-2021 Plan being slightly amended. For example, digital processes, which formed Domain 2 in the first Action Plan, are now pervasive through all areas of scientific concern, such that a broader framework for fast moving, inter-related science and technology in the digital era now seems more appropriate. In addition, a fifth domain subsumes the growing set of activities overseen by the ISC's Committee for Freedom and Responsibility in Science (CFRS).

The ISC's 2022-2024 domains of action are, 1: Global Sustainability, 2: Converging Science and Technology in a Digital Era, 3: Science in Policy and Public Discourse, 4: Changing Practices in Science and Science Systems and 5: Freedom and Responsibility in Science.

6. ISC Extraordinary General Assembly (on-line)

In February 2021, ISC held an Extraordinary GA on-line to consider four groups of proposed changes to the Statutes and Rules of Procedure, these being, 1: Membership (categories and application), 2: Governing Board (composition and role of Officers and Chief Executive Officer), 3: Elections (Committee and procedure), 4: Other. The second group was raised by IUGG. The third group sought to set up of Election Committee in preparation for the 2nd GA.

The new version of the ISC Statutes and Rules of Procedure is now available on the ISC website via <u>https://council.science/publications/statutes-and-rules-of-procedure/</u>.

7. URSI Inputs to ISC

Environmental Monitoring and Risk Management

In 2017 URSI Council resolved to establish a joint (bilateral) ISPRS and URSI standing committee to encompass the knowledge and studies of all aspects on Environmental Monitoring and Risk Management. In this triennium Paul Cannon (Past President) initially led the development of this activity on behalf of the Board. This turned out to be much more difficult than might be imagined because ISPRS knew nothing about this joint standing committee (2018). However, a further meeting in 2019 resolved this issue. Subsequently, and independently, ISPRS initiated an inter-commission working group on Natural and Human Induced Hazards and Disasters (2019) which URSI chose to join. Through this period and today the various incarnations of these inter-union committees were led by Orhan Altan from ISPRS. Tullio Tanzi was the ISPRS representative and Madhu Chandra was the URSI representative. Madhu Chandra, amongst other activities, provided radar courses at the associated Gi4DM meetings run by ISPRS, but there has been little integration with URSI as a whole. In order to overcome this problem Paul Cannon proposed (2019) a parallel URSI Risk and Disaster Management WG with all URSI Commissions represented if possible. In 2020 Ondrej Santolik was appointed to continue this initiative for the Board.

Future Scientific and Scholarly Publishing

In July 2020, W. Ross Stone on behalf of URSI, provided comments to the ISC Survey on the Future of Scientific and Scholarly Publishing, forming part of Domain 4 of the ISC Action plan 2019-2021. This project will be continued in 2022-2024.

Meetings Attended by either Paul Cannon or Makoto Ando

- GeoUnion Steering Committee, Potsdam, Sept. 2017
- GeoUnion Steering Committee, Taipei, Oct. 2017
- ICSU General Assembly, Taipei, Oct. 2017
- GeoUnion Steering Committee. Paris, July 2018
- ISC 1st General Assembly, Paris, July 2018
- GeoUnion Steering Committee, Istanbul, Nov. 2018
- GeoUnion Steering Committee, Paris, July 2019
- IUGG 100th Anniversary, UNESCO Paris, July 2019
- Ad hoc Disaster Risk Management (Virtual) July, 2020
- GeoUnion Steering Committee, (Virtual) Dec. 2020
- ISC Extraordinary General Assembly (Virtual) 2021

It is perhaps worth pointing out that these physical meetings with other Unions provide valuable opportunities to understand how the other Unions are run and this in turn helps the Board develop URSI.

8. Recommendations

- 1) URSI representation in the interdisciplinary bodies can be costly and it is recommended that URSI Secretariat makes clear to these interdisciplinary bodies that URSI representation may sometimes be limited and may be via email or on-line meetings.
- 2) The role of and requirements on the URSI representatives to ISC and its bodies should be made clear by the Board. One role is to develop sessions and bring delegates to the URSI Flagship Meetings.
- 3) Almost all of the ISC activities revolve around the UN SDGs. COVID19 is but one disaster risk for humankind. We, therefore, recommend that the new URSI Risk and Disaster Management WG proposed by Paul Cannon is pursued with vigour to ensure that URSI is better able to contribute to ISC.
- 3) The requirement for evidence-informed policy has heightened during the pandemic as governments have repeatedly claimed to be "following the science". Scientific understanding has played a central role in public discourse. How the enhanced standing achieved by science during the pandemic can be maintained as a "new normal" in addressing other major challenges, such as the global climate risk, rather than its effect being ephemeral, is a critical issue. Council is invited to consider the role of the new URSI Risk and Disaster Management WG in this context.

Makoto Ando (President) Paul Cannon (Past President)

URSI REPORT

SCAR 2017 - 2021

Giorgiana De Franceschi (Istituto Nazionale di Geofisica e Vulcanologia, Rome, Italy) has been appointed as URSI delegate to SCAR from October 2014. Within URSI she has been nominated Commission G vice-chair (URSI GASS2017). Within SCAR, Giorgiana De Franceschi acts as the Chief Officer of the Expert Group GRAPE (GNSS Research and Application for Polar Environment, http://grape.rm.ingv.it/). GRAPE aims to intensify the international efforts to build and coordinate a robust network of collaborations in order to answer a variety of weather and space weather related needs at high latitudes and polar regions (Arctic and Antarctica), through ad hoc data sharing and models development.

The activity carried out since the last URSI GASS 2017 at Montreal (Canada) is summarized below, thanks to the efforts within SCAR of the GRAPE community as a whole and to the URSI Commission G in particular. It is worth noticing the difficulties imposed by COVID19 pandemic to the polar community, not only for the conferences and workshops planned and cancelled in 2020 and 2021, but for the consequence at longer period for the Antarctic campaigns, most of them annulled or strongly reduced till now and for the next future. Few national programs are organizing the next expeditions. Therefore, the risk of damaging/losing experimental ground based monitoring infrastructures is high, with the consequence of loss of useful data for studying and modelling the geospace at high latitude.

Among the activities carried out, here the following are highlighted:

- 2018 Coordination of the School "The Polar Upper Atmosphere: From Science to Operation Issues" within the International School of Space Sciences (ISSS) program at L'Aquila (Italy), September 2018 (https://www.scar.org/scar-news/grape-gnss-news/ isss-2018/).
- 2019 Refinement and submission of the ReSourCE (Radio Sciences Research on Antarctic AtmospherE) Project Planning Group (PPG) to SCAR (to be discussed for approval during the SCAR OSC 2020 delegates meeting, cancelled and postponed to 2022). The core membership of the PPG currently consists of colleagues from Argentina, Belgium, Brazil, Canada, China, Finland, Germany, Hungary, Italy, Korea, Norway, Russia, South Africa, Sweden, UK, Ukraine, USA.
- **2020** On line workshop- In light of the cancellation of the SCAR Open Science Conference 2020 due to the COVID-19 pandemic, an **online workshop** has been

organized on topics related to the SCAR Expert Group GRAPE and to the new Program Planning Group (PPG) RESOURCE "Radio Sciences Research on AntarCtic AtmosphEre". The workshop has been taken place on 1-3 July 2020, 13:00-15:00 GMT each day, via Google Meet. The workshop registration was free of charge. The workshop received about 100 registrations. On the average about 70 colleagues from all over the world participated to the workshop along the three days, many of them had the possibility to interact actively by chat and by microphone. Several Early Career Researchers/Students followed the workshop as well. (see Annex A for the full report).

- 2020- Publication of the White Paper "Polar atmosphere and Geospace: Present knowledge, infrastructures and future research directions, September 2020, available here https://www.scar.org/scar-library/search/science-4/physical-sciences/grape-2/5539-grape-white-paper-2020/
- 2021 Participation to the SCAR 2021 Delegates Meeting as URSI representative (March 2021). The meeting was organized on line thanks to the positive interactions and consultations with delegates (see Appendix B for the letter from URSI to SCAR to this scope). The meeting was successful, with the possibility to vote for accepting changes of some rules allowing the on line form, and for electing the new SCAR board.
- 2021- Preparation of the paper "Review of environmental monitoring by means of radio waves in the (Ant)Arctic: from atmosphere to geospace", authored by the component of the PPG ReSourCE, to be submitted for publication within 2021.

SCAR/GRAPE joint URSI actions 2017-2021

- Coordinate GRAPE Contributions to SCAR webpages,
- Coordinate GRAPE Outreaches to general public,
- Support publications. The list is available at http://www.grape.scar.org/resources.html
- Coordinate GRAPE contribution to the annual SCAR Reports (http://www.grape.scar. org/resources.html)
- Organize scientific sessions linking URSI and SCAR within the following conferences and symposia: URSI GASS2017 (Montreal, Canada), SCAR OSC 2018 (Davos, Switzerland), SCAR OSC 2020 (Hobart, Tasmania, cancelled), on line GRAPE workshop 2020, URSI GASS 2021 (Rome, Italy).
- Present URSI poster at SCAR OSC 2018 (Davos) available at http://www.grape.scar. org/resources.html
- Participate to the SCAR 2018 Delegates Meeting as URSI representative (Davos, Switzerland, 2018)

Appendix A

GRAPE on line workshop, 1-3 July 2020 REPORT

Giorgiana De Franceschi (INGV, Italy), Nicolas Bergeot (ROB, Belgium)

In light of the cancellation of the SCAR Open Science Conference 2020 due to the COVID-19 pandemic, an **online workshop** has been organized on topics related to the SCAR Expert Group **GRAPE** (www.grape.scar.org/) and to the new Proposal Planning Group (PPG) RESOURCE "Radio Sciences Research on AntarCtic AtmosphEre". The workshop has been taken place on 1-3 July 2020, 13:00-15:00 GMT each day, via Google Meet. The workshop registration was free of charge. The workshop received about 100 registrations. On the average about 70 colleagues from all over the world participated to the workshop along the three days, many of them had the possibility to interact actively by chat and by microphone. Several Early Career Researchers/ Students followed the workshop as well.

The workshop program included an Opening Plenary Session during which participants informed about upcoming polar campaigns in relation to the worldwide difficulties due to COVID-19 pandemic. Unfortunately, most of the planned Antarctic campaigns in the summer 2020-2021 will be stopped and hopefully postponed to 2021-2022. New contributions on polar observational infrastructures from Finland, Norway, Turkey, have been presented and welcomed from the GRAPE community. Presentations by three invited Early Career Researchers/Students closed the Opening Plenary Session. Shreedevi P. R., from Beihang University, Beijing-China, presented the response of the high-mid latitude ionosphere during two geomagnetic storms in June 2015 driven respectively by Coronal Mass Ejection (CME) and Co-Rotating Interaction Region (CIR), using Total Electron Content (TEC) measurements derived from Global Positioning System (GPS). The role of storm time electric fields and neutral winds causing the ionospheric storm effects captured on TEC during both the storms was presented in detail. Tsige Atilaw, from Rhodes University, Grahamstown, South Africa & SANSA Space Science, Hermanus, South Africa, presented a study on the characteristics of Traveling Ionospheric Disturbances (TIDs) observed from the SANAE and Halley radars over Antarctica. Most TID events were observed at similar time from both radars, i.e., post-midnight, during geomagnetically quiet time. The frequency of the dominant wave of the TIDs were evaluated by using cross-spectral analysis of the backscatter power data from different locations in the radar field of view. Emanuele Pica, from Istituto Nazionale di Geofisica e Vulcanolgia, Rome, Italy, presented the SWIT (Space Weather Information Technology) infrastructure that coupled with the eSWua (electronic Space Weather upper atmosphere) web-platform provide Findable, Accessible, Interoperable, Re-usable (FAIR) ionospheric data in real
time from the INGV network in polar region. In addition, the SWIT-eSWua system ensures the access to operational products related to the nowcasting and forecasting of different ionospheric parameters.

The second day, during the three parallel Sessions, invited and contributing presentations within GRAPE topics highlighted current gaps in data/knowledge, next steps beyond the state of the art, and potential of international collaborations to facilitate and support the next steps.

Finally, the third day, the **outcomes from the parallel Sessions** have been presented by the Sessions Conveners and wrapped up in the **Closing Plenary Session**. The parallel sessions were:

Session 1 - Short and long-term variations of the neutral atmosphere (including Water Vapour, AGWs, airglow, mesosphere, thermosphere, low-high latitude connections). *Conveners: José Valentin Bageston (INPE, BR) & Monia Negusini (INAF, IT).* The number of Session 1 participants was around 20 (reaching 22 at some moments).

Session 2 - Short and long-term variations of the ionosphere and plasmasphere (including multi-instruments and modelling). *Conveners: Nicolas Bergeot (ROB, BE) & Emilia Correia(INPE,BR).* The number of Session 2 participants was around 20 (reaching 24 at some moments).

Session 3 - Space weather impact on radio measurements at high latitudes (including multi-instrument data analysis). *Conveners: Pierre Cilliers (SANSA, ZA) & Luca Spogli (INGV, IT)*. The number of Session 3 participants was up to 33.

Sessions outcome by Conveners are detailed below.

Session 1

1.1 Mesosphere/Thermosphere & Ionosphere

The first invited talk was done by **Tracy Moffat-Griffin** (BAS, UK) bringing the topic of Gravity Waves in Antarctica, defining this type of phenomena, explaining its importance, and then presenting the ANGWIN scientific group, their goal, and the mains results based on examples of observations and modelling studies. **José V. Bageston** (INPE, BR) focused on the main instrumentation used at Comandante Ferraz Station for mesospheric and lower thermosphere studies: all-sky airglow imager, camera to capture noctilucent clouds (and gravity waves), and a meteor radar. Results have been shown on Travelling Ionospheric Disturbances, Auroral Arc observed in the upper thermosphere/ionosphere, gravity waves, and an example of recent result (winds) from the Ferraz meteor radar. **Lourivaldo Lima** (State University of Paraíba-UEPB, BR), presented interesting results on planetary waves observed over Ferraz station, by using

meteor radar winds, and also some aspects of non-linear interaction between tides (mainly the semi-diurnal tide) and planetary waves. **Edith L. Macotela** (University of Oulu, Finland) showed periodic and sporadic perturbations of long periodicity in the northern hemisphere (Finland) by using the VLF (Very Low Frequency) data, and concluded that atmospheric parameters (e.g. Ne of the sporadic e-layer and NO between 80 and 90 km), appear to modulate the sensitivity of the daytime VLF perturbations. **Loredana Perrone** (INGV, IT) showed a method to obtain thermospheric parameters (O, O2 and N2), exospheric temperature (Tex), vertical plasma drift W, and total solar EUV flux from ionosonde observations, by using a physical model of the F region and mathematical techniques that can be applied at polar regions providing ionosonde data.

1.2 Troposphere

Eric Pottiaux (ROB, BE), invited, focused on GNSS-derived water vapor observations at high latitudes. The first part was devoted to long-term Integrated Water Vapor (IWV) variability. Different datasets were used: ground-based (GPS), satellite-based (GOMESCIA), and NWP model (ERA-Interim) data. There is an overall agreement between datasets in both Arctic (better) and Antarctic (worst) regions. Normalized linear trends were presented: the highest moistening over Antarctica was found, but a closer agreement between mean moistening values of different techniques was found in the Arctic. The Antarctic moistening seems driven by surface warming, while the Arctic IWV variability can be explained by a combination of Surface Temperature, Tropopause pressure, precipitation, and the North Atlantic Oscillation. The second part of the talk was on the Operational GNSS Processing as a contribution to weather models. GNSS data was analysed providing hourly-updated monitoring of the water vapor in the Arctic and Antarctic zones, and these products are used for data assimilation in global NWP models (via E-GVAP). Higher quality products can be made available upon request for specific studies in the Arctic and Antarctic zones. Noelia Santos (Universidad de Buenos Aires, AR) focused on how atmospheric conditions affect the cosmic ray observations from the Marambio LAGO site. Due to the geomagnetic field, lowest-energy cosmic rays reach the Antarctic atmosphere and can carry information about the Heliosphere and possible transient events. A cosmic ray detector was installed in the Argentinian Antarctic base in 2019, to measure the flux of secondary cosmic rays. By analysing the long-term raw data, correlation with atmospheric parameters has been found and effects removed. A seasonal modulation was found in the flux. Data is available in real-time for Space Weather aims. Suchithra Sundaram, an independent researcher, presented studies of the sea ice variability at high latitudes as contribution to the climate change. Changes in ocean/atmosphere/ cryosphere parameters affect the global climate and can be explained through teleconnection mechanisms. An analysis of circulation and precipitation data has been carried out for the Indian Ocean and Southern Ocean region to understand their impact on the Antarctic sea ice and preliminary results have been shown. A teleconnection is proposed between Indian summer monsoon - Indian ocean subtropical high - Antarctic precipitation, and its impact on sea ice over the Indian Ocean Sector of the Antarctic is proposed.

During the closing discussion, some aspects of the talks with the speakers were deepened. Possible collaborative works were discussed, and there are possibilities of increasing raw data and techniques to retrieve IWV in polar regions putting together groups and trying to involve other experts to join in a common effort (Eric Pottiaux and Monia Negusini); there are possibilities of integrating water vapour measurements in the troposphere (Eric Pottiaux) with tropospheric gravity waves sources and the observed waves in the mesosphere (José V. Bageston and Tracy Moffatt-Griffin) since the occurrence of deep clouds, (inferred by integrated water vapor) are known as potential wave sources via convective processes. Also, joint studies between the upper mesosphere (José V. Bageston) and the lower thermosphere/ionosphere (Edith L. Macotela) are possible by using VLF data to identify oscillations associated with gravity waves in the D ionosphere region.

Session 2

2.1 Plasmasphere

An invited talk was given by János Lichtenberger from the Eötvös University (Hungary), on the different structures (small and large in the plasmasphere) as seen by Arase satellite and ground VLF network. The main conclusions are that the plasmasphere is not a smooth region as the models suggest and that plasmasphere contains both large scale (e.g. plums, shoulders, notches) and small scale structures (Corotating Plasmaspheric Irregularities, density cavities/Inner trough), not only at the plasmapause. Fabien Darrouzet (Royal Belgian Institute for Space Aeronomy, BE) showed that the plasmasphere electron density can be studied in a bi-polar approach by using ground VLF network and Cluster satellite data. Also, 3D numerical models are useful tools to provide average values of the plasmasphere density. However, more data needs to be interpreted using the multi-instrumental approach. Romain Maggiolo (Royal Belgian Institute for Space Aeronomie, BE) showed the influence of the planetary magnetic field on the ion escape from terrestrial planets. Romain, made a comparison of the ion escape from Venus, Earth and Mars, to investigate the importance or not of a magnetise body on ion escape as determine by satellite missions. One of the main conclusions is that he estimated similar loss rate for magnetized and un-magnetized planets. One open question is: does these ions come back into the system, and where do they come from? The paper by C.P. Anil Kumar, was withdrawn.

2.1 Ionosphere

Adriana Gulisano (invited) from the Instituto Antártico Argentino (Argentina), presented the different activities done in Antarctica concerning ionospheric parameters (foF2, TEC,). She introduced the new TEC map products based on multi-GNSS constellations

(GPS, GLONASS, Galileo, Beidou), which cover the entire South America sector, south Atlantic, South West Africa, and the Antarctica peninsula (http://wilkilen.fcaglp.unlp. edu.ar/ion/latest.png). She also highlighted the data gaps in the southern hemisphere in Bindu Mangla (Manav Rachna International University, India) focused on general. the daily and seasonal variations of ions at the F2 layer (O+, O2+) during the 1995 solar minimum. This study has been done using the SROSS C2 satellite data, launched in 1994. The data are available for the period 1995-2001. Christian Gutiérrez (UBA-FCEN-DCAO, AR) showed the correlations in between Interplanetary Coronal Mass Ejections (ICME) inducing solar wind parameters changes monitored by ACE satellite (|B|, density, Vx) and the galactic cosmic rays intensity as measured by neutron monitors from ground stations. He showed that faster ICMEs cause larger decreases in the flux of galactic cosmic rays (up to 20%) than slower ICMEs (2%). Finally, Haixia Lyu (UPC-IonSAT, ES) presented the use of UQRG global TEC maps to study the features of vertical electron content distribution over polar regions and to characterize the climatology of the representative features. She showed different features obtained from these global products such as the Tongue of Ionization, the trough, flux transfer events, theta-aurora, ionospheric convection patterns and storm enhanced density. The closing discussion focused on the need to investigate the connection between the ionosphere and plasmasphere. Cluster mission is a useful tool for the interhemispheric

ionosphere and plasmasphere. Cluster mission is a useful tool for the interhemispheric comparison of the plasmasphere. Generally speaking, there is still the lack of ground based stations: e.g. to complement the VLF network new deployments in Finland and Alaska are planned. Same conclusion can be argued for the digisondes and GNSS IGS stations. The impact of the geomagnetic storms on plasmaphere need to be deeply investigated as well the contribution of the plasmasphere to ions loss. Comparisons between the occurrence frequency of plasmaspheric and ionospheric plumes, shoulders, notches, should be investigated. All available satellites data for ionospheric purposes need to be take into account, e.g. the SROSS-C2 satellite (India) data from 1995 to 2001, and data from COSMIC- GRACE – CHAMP satellites missions. F. Darrouzet and A. Gulisano could act as leaders for plasmapshere and ionosphere joint studies.

Session 3

The session started with the invited paper by **Paul Prikryl** from Natural Resources, Canada. Paul demonstrated the benefit of using an array of instruments and models to better understand the dynamics of the high latitude ionospheric during auroral substorms. Using data from the Canadian High Arctic Ionospheric Network (CHAIN) and real-time GPS receivers of RT-IGS network that are monitored by the Canadian Geodetic Survey, he showed that large GPS signal phase variations map to regions of strong westward electrojet and to the poleward edge of the eastward electrojet. He also introduced the use of the spherical elementary currents systems to investigate the variations of the ionospheric currents and the corresponding changes in the formation of ionospheric

irregularities. Wojciech Miloch (Department of Physics, University of Oslo, Norway), was invited to present results from recent coordinated efforts in Antarctica and in the Arctic for the studies of dynamics of plasma irregularities and related GNSS scintillations. Miloch showed the synergism of combining ground-based observations with the in-situ measurements made by sounding rockets and satellite observations by the polar orbiting Swarm satellites. The key outcome was that this approach gives a comprehensive understanding of processes in the polar ionosphere and this is an important step in developing physics-based models for plasma irregularities. The invited talk by P. T (Jay) Jayachandran (Physics Department, University of New Brunswick, Canada) challenged the notion that the scintillation measurements (S4 and $\sigma \phi$ and spectral slope p), now being routinely used for ionospheric parameter estimation (IPE), can distinguish between different types of polar ionospheric structures that give rise to ionospheric scintillation, e.g. Sporadic E, Arcs, and Patches. Using 100 Hz sampling rate data from CHAIN GPS receivers and other instruments (ionosondes, incoherent scatter radars and all-sky imagers) he demonstrated that the spectral slope distribution of the raw amplitude and phase of GPS measurements is similar for these different structures with an average spectral index of -2. The key outcome of the work he presented is the need for multi-instrument observations to understand the underlying physical mechanisms that produce scintillation. Iurii Cherniak (COSMIC Program Office, UCAR, USA) showed the usefulness of data from a dense array of ground-based GNSS receivers combined with LEO GPS (Occultation) observations, for measuring the amplitude and phase of GNSS signals to investigate the ionospheric responses to Space Weather drivers. Space Weather driven auroral and equatorial irregularities caused strong amplitude and phase scintillations of GPS/GNSS signals which seriously affected the performance of precise positioning and navigation-based services on a global scale like EGNOS and WAAS. The key outcome of their work is proof of the benefit of GNSS being a preferred tool to address concerns about the operational performance of navigation systems in polar regions. Stefan Lotz (SANSA, ZA) showed that, combining data from the SuperDARN, magnetometers, riometers, VLF stations, ionospheric scintillation receivers and GNSS receivers deployed at SANAE-IV, Gough Island, Marion Island and on the SA Agulhas II polar research ship, provide an excellent opportunity for synergic observations of Space Weather impacts on the polar ionosphere. Integration of the Space Weather data from SANAE-IV with that of other stations in the Queen Maud Land region will enhance our capability to provide Space Weather products related to air traffic navigation to and in Antarctica. Using VLF and scintillation observations on 29 May 2020 from some of the South African high latitude observatories, Stefan demonstrated the impact of the first M-class flare of solar cycle 25 and the need for multi-instrument observations to better understand the spatial distribution of the impact of the storm. Olga Maltseva (Research Institute for Physics, Southern Federal University, Russia) by using GNSS data from five Antarctic stations, presented disturbances of the diurnal TEC during the geomagnetic storm period 7-17 March, 2012 and the dependence of

these disturbances on solar parameters and geomagnetic indices. The almost complete identity of the correlation coefficients of TEC with the indices AE, PC, and Kp provided a sound basis for the prediction of such disturbances from predicted values of either of these parameters. She also demonstrated how data gaps in foF2 can be filled using TEC observations, thus illustrating the synergism of multi-instrument observations in the Antarctic. Vanina Lanabere (Universidad de Buenos Aires, Dept Ciencias de la Atmósfera y los Océanos, AR) gave an overview of the Space Weather activities of LAMP (Argentinian Space Weather Laboratory) since 2014, including the designation of LAMP as the Argentina Regional Space Weather Warning Centre of the International Space Environment Service. LAMP deployed several instruments including a solar telescope, ionosondes, magnetometers and an all-sky imager in Southern Argentina, and manages a particle detector at the Marambio base on the Antarctic Peninsula and a magnetometer at the year-round Belgrano II base on the Confin Coast, Coats Land in Western Antarctica. Members of LAMP are actively involved in Space Weather research. LAMP has a number of operational Space Weather products which it is willing to share with other research institutions.

The concluding discussion involved the speakers and several of the participants, expressing enthusiastic support for collaboration on a research paper which would demonstrate the application of diverse observations to the study of the polar ionosphere. The proposed topic of the paper is an analysis of the 25-26 August 2018 geomagnetic storm, through an integration of the bi-polar ionospheric response, using data from ground-based instruments (including SuperDARN & VLF) and space-borne instruments (Swarm, DMSP, Cluster, Van Allen Probes) of which the data is readily available and for which the participants have demonstrated substantial expertise. The paper will combine spectral (and multiscale) analysis, ROTI, scintillation, DPR analysis, SECS analysis and focus on the Impact of ionospheric disturbances on navigation.

Appendix B

UNION RADIO-SCIENTIFIQUE INTERNATIONALE President: Prof. M. Ando Past President: Prof. P.S. Cannon Vice-Presidents: Prof. W. Baan Prof. O. Santolik Prof. A. Sihvola Prof. P.I.E. Uslenghi Secretary General: Prof. P. Van Daele



INTERNATIONAL UNION OF RADIO SCIENCE URSI Secretariat Universiteit Gent - INTEC Technologiepark-Zwijnaarde 126 B-9052 Gent, Belgium Tet. +32 9 264 3320 E-mail: info@ursi.org http://www.ursi.org

Rome, May 28th 2020

Re: SCAR Delegates Business Consultation

Dear President and Executive Committee Members,

Thank you for your letter of April 24. It's a pity that Hobart SCAR Assembly and associated events will not take place as expected due to the COVID 19 pandemic. I would like to thank the Australian colleagues and the LOC in Hobart that have dedicated considerable work and time for this Hobart Assembly, that is now cancelled.

I reply to your message after consultation with the URSI Board.

I agree with you that it is very difficult to organize and run the Delegates meeting via teleconference due to the number of people involved (about 100) operating in different countries and different time zones. So I agree with your proposal to run the next SCAR Assembly and usual Biennial business, primarily through a set of Resolutions each dealing with a specific aspect of SCAR's business.

As URSI delegate to SCAR, I will be happy to cooperate the success of this initiative. To the scope, please I would like to suggest the following:

- The procedure should provide all needed information for each of the Resolutions that will be proposed, so that all delegates can give careful consideration before an approval.
- The difficult situation we are facing would require that all resolutions are well understood by all and so
 please evaluate that the text is clear but synthetic.
- 3) Rather than a simple majority agreement of SCAR's delegates, in order for a Resolution to be approved, the 75% agreement would be desirable for all Resolutions if possible, not only for the Special Resolutions.
- 4) The Resolutions should include the possibility to valuate/approve new actions eventually submitted (e.g. Proposal Planning Groups) and capacity building activities benefitting ECRs. This is to me extremely important to mitigate the difficulties of the COVID 19 pandemic that will impact negatively not only the upcoming Antarctic and Arctic Campaigns but also the international coordination and training activities.
- The Resolutions should include the possibility to use the remaining funds 2020 (that probably will not be spent) in 2021-2022 by the existing Groups.

For what concerns the regular turnover of SCAR Executive Committee, I understand that solicitors (Birketts) have suggested an in person meeting for electing SCAR's Executive Committee Members; it seems appropriate to postpone the elections, but of no more than 1 year. If time to recover would be more than 1 year, please examine, if possible under the rules of the UK law, to organize the Director elections online.

Looking forward to recover the in person SCAR meetings as soon as possible,

I wish you all the best

Jim Shul

Giorgiana De Franceschi URSI delegate to SCAR

Peter Van Daele URSI Secretary General

REVIEW OF SCOR ACTIVITIES OF POTENTIAL INTEREST TO URSI

1. Introduction

The Scientific Committee on Oceanic Research (SCOR) was formed by ICSU in 1957 as the first of its interdisciplinary bodies. SCOR is a non-governmental body that fosters and facilitates international cooperation in the fields of ocean science and marine technology. The Home Page of SCOR is at <u>http://www.jhu.edu/~scor/</u>.

2. Organization

Executive Committee President, Sinjae Yoo (Korea) Secretary, Paul Myers (Canada) Past President, Marie Alexandrine Sicre (France) Vice-President, Jing Zhang (Japan) Vice-President, Bradley Moran (USA) Vice-President, Stefano Aliani (Italy)

3. SCOR Activities of Interest to URSI

Activities concerning oceans in URSI are related to remote sensing in Commission F. Present challenges include:

- Use of spaceborne and airborne microwave sensors (synthetic aperture radar (SAR), altimeter, radiometer and scatterometer) to estimate surface wind and sea state
- Use of SAR to study ocean currents, waves and weather radar observations of Atmosphere-Sea Interface
- Use of altimetry to provide information about the topography of the world's oceans
- Use of radiometers to provide information on sea surface temperature
- Use of visible/infrared spectrometers for providing information on sea surface temperature, ocean color, algae, coral reefs and water quality
- Remote sensing related to global change and ocean-atmosphere coupling
- Remote sensing of coastal areas
- Development of new methods (e.g. GPS-based methods) for estimating ocean characteristics.

In the following various SCOR activities are listed.

4. SCOR Activities

The two main types of activities of SCOR are Working Groups and planning of long-term, large-scale international research programs.

4.1. Current Working Groups

The Working Groups are small (no more than 10 members) and short-lived (no more than 4 years), formed to address specific ocean science topics. All working groups are expected to produce a final report, organize a workshop, or otherwise make a significant contribution to advancing understanding of their topic. Their final output is often a book or a special issue of a journal.

Group	Title of Working Group	Chair/Co-chair
WG 162	Developing an Observing Air-Sea Interactions Strategy (OASIS)	Meghan Cronin (USA), Sebastiaan Swart (Sweden)
WG 161	Respiration in the Mesopelagic Ocean (ReMO): Reconciling ecological, biogeochemical and model estimates	Carol Robinson (UK), Iris Kriest (Germany), Javier Arístegui (Spain)
WG 160	Analysing ocean turbulence observations to quantify mixing (ATOMIX)	Cynthia Bluteau (Canada), Ilker Fer (Norway), Yueng- Djern Lenn (UK)
WG 159	Roadmap for a Standardised Global Approach to Deep-Sea Biology for the Decade of Ocean Science for Sustainable Development (DeepSeaDecade)	Kerry Howell (UK) and Ana Hilario (Portugal)
WG 158	Coordinated Global Research Assessment of Seagrass System (C-GRASS)	J. Emmett Duffy (USA), Lauren V. Weatherdon (UK)
WG 157	Toward a new global view of marine zooplankton biodiversity based on DNA metabarcoding and reference DNA sequence databases	Ann Bucklin (USA)
WG 156	Active Chlorophyll fluorescence for autonomous measurements of global marine primary productivity	David Suggett (Australia) and Philippe Tortell (Canada)
WG 155	Eastern boundary upwelling systems (EBUS): diversity, coupled dynamics and sensitivity to climate change	Ruben Escribano (Chile) and Ivonne Montes (Peru)
WG 154	Integration of Plankton-Observing Sensor Systems to Existing Global Sampling Programs (P-OBS)	Emmanuel Boss (USA) and Anya Waite (Canada)
WG 152	Measuring Essential Climate Variables in Sea Ice (ECV-Ice)	Daiki Nomura (Japan), François Fripiat (Germany), and Brent Else (Canada)
WG 148	International Quality Controlled Ocean Database: Subsurface temperature profiles (IQuOD)	Catia Domingues (Australia) and Simon Good (UK) - formerly Matt Palmer (UK)

4.2. Research Programs

International research programs address the issues of the role of the ocean in global climate change. Present research programs are listed below.

Linking Ocean-Atmosphere Interactions with Climate and People

The global and multidisciplinary research project Surface Ocean - Lower Atmosphere Study (SOLAS) was established to provide international science coordination and capacity building.

Ocean Sustainability under Global Change for the Benefit of Society

IMBeR – Integrated Marine Biosphere Research – is a large global research project which focuses on ocean sustainability in the context of global change. We want to understand past, present and future changes to the ocean. In particular, we want to know how we can achieve a sustainable ocean for the benefit of society.

IMBeR supports collaborative, disciplinary, interdisciplinary, transdisciplinary and integrated research that addresses key ocean science issues generated by and/or impacting society. Such research is required to provide evidence-based knowledge and guidance, along with options for policy-makers, managers and marine-related communities, to help achieve sustainability of the marine realm under global change.

Second International Indian Ocean Expedition (IIOE-2)

The Second International Indian Ocean Expedition (IIOE-2) is a major global scientific program which will engage the international scientific community in collaborative oceanographic and atmospheric research from coastal environments to the deep sea over the period 2015-2020, revealing new information on the Indian Ocean (i.e. its currents, its influence upon the climate, its marine ecosystems) which is fundamental for future sustainable development and expansion of the Indian Ocean's blue economy. A large number of scientists from research institutions from around the Indian Ocean and beyond are planning their involvement in IIOE-2 in accordance with the overarching six scientific themes of the program. Already some large collaborative research projects are under development, and it is anticipated that by the time these projects are underway, many more will be in planning or about to commence as the scope and global engagement in IIOE-2 grows.

4.3. General Meeting

SCOR 2021 Annual Meeting (Virtual) Date: 25 October 2021 - 29 October 2021

5. Commission F activities related to Ocean

We have been engaged in ocean deployment of weather radars to study sea-atmosphere interaction.

A major publication in this regard is

Rutledge, S. A., Chandrasekar, V., Fuchs, B., George, J., Junyent, F., Dolan, B., Kennedy, P. C., & Drushka, K. (2019). SEA-POL Goes to Sea, Bulletin of the American Meteorological Society, 100(11), 2285-2301.

Photo of SEA-POL mounted on the 02 deck of the R/V Roger Revelle in San Diego before departing on the cruise.



6. Conclusions

While the topics of the current SCOR Working Groups often contain some remote sensing component, the large-scale programs, the Advisory Panel on Ocean Science and development of the ocean component of IGBP are of potential interest to URSI. The scientific publications (books and special issues of journals) by the Working Groups concentrate on narrow well-defined topics and produce new scientific knowledge; they also increase visibility of SCOR. This could be of interest to URSI. We continue to keep a tab on the activities to be engaged.

V. Chandrasekar, URSI Representative to SCOR 25 July August 2021

REPORT ON WHO AND EMF

As part of its charter to protect public health and in response to public concern over health effects of EMF exposure, the WHO established the International EMF Project in 1996 to assess the scientific evidence of possible health effects of EMF in the frequency range from 0 to 300 GHz. The EMF Project encourages focused research to fill important gaps in knowledge and to facilitate the development of internationally acceptable standards limiting EMF exposure.

Key objectives of the EMF Project are to:

- provide a coordinated international response to concerns about possible health effects of exposure to EMF,
- assess the scientific literature and make a status report on health effects,
- identify gaps in knowledge needing further research to make better health risk assessments,
- encourage a focused research programme in conjunction with funding agencies, incorporate the research results into WHO's Environmental Health Criteria monographs where formal health risk assessments will be made on exposure to EMF,
- facilitate the development of internationally acceptable standards for EMF exposure, provide information on the management of EMF protection programmes for national and other authorities, including monographs on EMF risk perception, communication and management, and provide advice to national authorities, other institutions, the general public and workers, about any hazards resulting from EMF exposure and any needed mitigation measures.

Oversight of the Project is provided by an International Advisory Committee (IAC). The IAC is composed of members of international organizations, WHO collaborating centres, and national authorities from all regions of the world. The IAC meets once a year to discuss national activities, current research programmes, legislation and public concern, and advises the International EMF Project on its activities.. Every year since 1996 International Advisory Committee are organized. (https://www.who.int/initiatives/ the-international-emf-project). URSI is part of IAC

The objectives of the IAC are

- to provide oversight on the conduct of the Project: review outputs of the Project, including scientific information related to public and occupational health, and management of the EMF issue
- to provide a forum for peer discussion on dealing with the health concerns raised by exposure to EMF fields.

In 2019 WHO called for expressions of interest to undertake systematic reviews of radiofrequency fields (RF) and health research in 10 priority areas. These areas had been chosen following input from 167 RF experts and reflected both scientific evidence and public concerns. A second call was made for some areas to ensure that suitable teams were engaged to undertake the work.

- Technical report as a scoping review of the literature on the studied health outcomes.
- The systematic reviews, which will be published in a special issue of Environment International.

The EHC monograph on RF which will elaborate on the outcomes highlighted in the review process. It will follow the procedures given in the WHO's Handbook for Guideline Development. Professor Hajo Zeeb from University of Bremen, Germany has been appointed as Task Group chair. The EMF section of the website is being redesigned. Member States are encouraged to update information in the EMF Standards database. The EMF-Portal has proposed developing a newsletter. 5G has received much media attention, with the level of concern varying a lot between countries. WHO has published a Q&A.

Because of the covid 19 the work was delayed.

Joe Wiart

GASS 2021 COMMISSION REPORTS

COMMISSION A - ELECTROMAGNETIC METROLOGY

1. Elections of Commission Officers

Former Vice-Chair, Prof. Nuno Borges Carvalho, took over the position of Commission A Chair until GASS2023. The new Vice-Chair, Dr. Amitava Sen-Gupta, will work with the new Chair to organize various activities of the Commission A and will become the chair at GASS2023.

Two Early Career Representatives (ECR) work with the Chair and the Vice-Chair to ensure that the Commission is attractive to their early-career peers. Dr. Nosherwan Shoaib will continue his term until GASS2023. The new ECR will take over the outgoing ECR of Dr. Pedro Cruz until 2026, and the most voted one was Dr. Giovanna Signorile.

Dr. Nosherwan Shoaib, Dr. Demetrios Matsakis and Dr. Giovanna Signorile and Dr. Amitava Sen Gupta are the new RSB Associate editors from commission A.

2. Review of Terms of Reference

The Terms of Reference of the Commission A was reviewed during the 2nd Business Meeting and some changes were proposed and agreed. The revised Terms of Reference were then submitted to the Council and were approved for the triennial term of 2021-2023. The new Terms of Reference are as the following.

ELECTROMAGNETIC METROLOGY, Electromagnetic measurements and standards.

The commission promotes research and development of the field of measurement standards and physical constants, calibration and measurement methodologies, improved traceability, accuracy and reduced uncertainty, and the inter-comparison of such. Areas of emphasis are:

- 1) the development and refinement of new measurement techniques and calibration standards
- 2) primary standards, including those based on quantum phenomena

- 3) realization and dissemination of reference time and frequency standard
- 4) characterization of electromagnetic properties of materials, physical constants, and properties of engineered materials, including nanotechnology
- 5) methodology of electromagnetic dosimetry/measurements for health diagnostics, applications, and biotechnology, including bio-sensing
- 6) measurements in advanced communication systems, space metrology and other applications, including antenna and propagation measurement techniques

The commission fosters the best practices and training for accurate and consistent measurements needed to support research, development, and exploitation of electromagnetic technologies across the spectrum and for all commissions.

3. Working Group

Following the discussions at Business Meeting in GASS2014, a Working Group for Education and Training has been set up. The name and the Terms of Reference of the Working Group were introduced and new members were solicited. Before the GASS2017, the status of the Working Group was ad-hoc, but it was formally established at the GASS2017.

Name of the Working Group

Working Group for Education and Training

Terms of Reference

Electromagnetic metrology attracts students and trained specialists from a wide variety of fields, such as biophysics, electrical engineering, health sciences, materials science, physics, radio science, and statistics. The purpose of this Working Group is to promote the education of both students and actively working professionals by collecting information about available training resources on the techniques and fundamental principles involved in the work of Commission A, and to promote education in metrology by disseminating the information gathered and making it available on a public web page.

Members

Demetrios Matsakis (Chair), Charles Bunting, William Davis, Tian Hong Loh Alreza Motevasselian, Patrizia Tavella, Yasuhiro Koyama, and Amitava Sen Gupta

Commission A, also decided to support the new group proposal on "URSI Risk and Disaster Management Working Group".

4. Technical Advisory Committee

The Technical Advisory Committee of the Commission A was created at the time of GASS2014 following a suggestion by the Board. 21 individuals joined the committee responding to the solicitation. The committee was very helpful in the process of organizing AT-RASC2015, AP-RASC2016, and GASS2017. It was proposed to continue the committee and members will be solicited again from the scratch after the GASS2017, and this proposal was agreed. The list of members of the Technical Advisory Committee for the new triennial term of 2021-2023 is shown in Appendix 1.

5. Preparation of Future Meetings

In the process of organizing GASS2023, the members of Technical Advisory Committee were asked for suggestions of sessions and each member was asked to convene at least one session. The same approach was proposed for the GASS2023 and this proposal was agreed. The list of sessions for AT-RASC2022 was discussed and the list of special sessions with conveners were proposed. After the GASS2021, the coordination of the AT-RASC2022 sessions was continued and finalized.

6. Proposed sessions and conveners for AT-AP-RASC 2022

- A.1 Antenna and Propagation Measurement Techniques (Tian Loh, Pedro Pinho)
- A.2 Measurements in Advanced Communication Systems (Tian Loh)
- A.3 Characterization of Electromagnetic Properties of Materials (Nosherwan Shoaib)
- A.4 Properties of Engineered Materials including Nanotechnology
- A.5 Physical Constants
- A.6 Primary Standards
- A.7 Realization and Dissemination of Time and Frequency Standards (Demetrios Matsakis, Jose Mauricio Lopez, Ashish Agarwal, Amitava Sen Gupta)
- A.8 Methodology of Electromagnetic Dosimetry
- A.9 Measurements for Health Diagnostics, Applications and Biotechnology, including Bio-sensing (Nuno Carvalho)
- A.10 Space Metrology (Liu Min)
- A.11 Calibration, Traceability, and Inter Comparisons of Instruments and Measurements (Demetrios Matsakis)
- A.12 Quantification of Accuracy and Uncertainty
- A 13 Smart City as a measurement hub (Nuno Carvalho)
- A14 Metrology Techniques and Solutions enabled by Artificial Intelligence (Pedro Cruz)
- A15 Quantum Metrology (Alirio Boaventura, , Ekkehard Peik (Not confirmed yet), Amitava Sen Gupta)
- A16 Precision Metrology Practice, Education and Prospects (Demetrios Matsakis, Steven Weiss (Not confirmed yet))

- A17 Microwave and Optical Frequency Standards (Paulo Monteiro, Ekkehard Peik (Not confirmed yet), Amitava Sen Gupta)
- A18 Time and Frequency Metrology (Amitava Sen Gupta, Archita Hati)
- A19 Advanced Time & Frequency Transfer Techniques and Precision Geolocation -(Parameswar Banerjee, Giovanna Signorile and , Amitava Sen Gupta)
- A20 Metrology in Telecommunication Systems (Nuno Carvalho, Tian Loh)

Appendix 1: Commission Officials and Members of Technical Advisory Committee.

Chair: Nuno Borges Carvalho, University of Aveiro, Portugal (<u>nbcarvalho@ua.pt</u>)

- Vice-Chair: Amitava Sen-Gupta, National Physical Laboratory (CSIR), New Delhi, INDIA (<u>sengupta53@yahoo.com</u>)
- ECR: Nosherwan Shoaib, National University of Sciences and Technology, Pakistan (<u>nosherwan.shoaib@seecs.edu.pk</u>) and Giovanna Signorile, INRiM, Turin, Italy (<u>g.signorile@inrim.it</u>)

RSB Associate Editors :

Nosherwan Shoaib, National University of Sciences and Technology, Pakistan (<u>nosherwan.shoaib@seecs.edu.pk</u>), Giovanna Signorile, INRiM, Turin, Italy (<u>g.signorile@inrim.it</u>) and Demetrios Matsakis, United States Naval Observatory, USA (<u>demetrios.matsakis@usno.navy.mil</u>), Amitava Sen Gupta, NPL (CSIR), India, (<u>sengupta53@yahoo.com</u>)

Technical Advisory Committee :

Felicitas Arias, BIPM, France (farias@bipm.org) Nuno Borges Carvalho, University of Aveiro, Portugal (nbcarvalho@ua.pt) Pedro Miguel Cruz, CONTROLAR, Portugal (pedro.cruz@controlar.pt) Yasuhiro Koyama, NICT, Japan (koyama@nict.go.jp) Chen Kunfeng, The 41st Institute of CETC, China (ckf-006@163.com) Demetrios Matsakis, US Naval Observatory, USA (demetrios.matsakis@usno.navy.mil) Rowayda Sadek, Helwan University, Egypt (rowayda sadek@yahoo.com) Dominique Schreurs, KU Leuven, Belgium (Dominique.Schreurs@esat.kuleuven.be) Amitava Sen Gupta, The NorthCap University, India (sengupta53@yahoo.com) Nosherwan Shoaib, National University of Sciences and Technology, Pakistan (nosherwan.shoaib@seecs.edu.pk) Patrizia Tavella, INRIM, Italy (tavella@inrim.it) Emmanuel Van Lil, KU Leuven, Belgium (Emmanuel.VanLil@esat.kuleuven.be) Steven Weiss, Army Research Lab, USA (sweiss7@jhu.edu) Dr Ekkehard Peik, PTB, Germany (Ekkehard.Peik@ptb.de) Dr J Mauricio Lopez, Cinvestav, Mexico (jm.lopez@cinvestav.mx) Archita Hati, NIST, USA (archita.hati@nist.gov) Pedro Pinho, IT, Aveiro, Portugal (ptpinho@av.it.pt) Alíio Boaventura, NIST, USA (alirioboaventura@gmail.com)

COMMISSION B - FIELDS AND WAVES

Commission B held three business meetings during the URSI GASS 2021 conference in Rome, chaired by Kazuya Kobayashi (Chair of Commission B) and John Volakis (Vice Chair of Commission B), assisted by Andrea Michel (ECRs of Commission B)

CCA-I Meeting	Monday August 30, 2021 (19 in presence, 19 online)
CCA-II Meeting	Wednesday September 1, 2021 (20 in presence, 17 online)
CCA-III Meeting	Friday September 3, 2021 (9 in presence, 21 online)

1. Results of Election of Vice-Chair and ECR

Three candidates were running for the position of Commission B Vice Chair (2021-2023) and two candidates were running for the position of Commission B ECR (2021-2023). Electronic voting was concluded on Monday at 16:00. Dr. Wallen and D. Tzarouchis were later confirmed on Tuesday by as the incoming Vice Chair and ECR by Council, respectively.

Comm B Vice-Chair	
Henrik Wallén (Finland)	25
Debatosh Guha (India)	19
Ahmed A. Kishk (Canada)	19
Comm B ECR	
Dimitrios Tzarouchis	38
Okan Yurduseven (UK)	25

2. Appointment of Associate Editor for Radio Science Bulletin

Both the new Vice-Chair, Henrik Wallen, and the new ECR, Dimitrios Tzarouchis, were appointed as Associate Editors for the *Radio Science Bulletin*.

3. Updates/Status of Working Groups

At present, there are no Working Group in Comm B.

5. Updates to Terms of Reference of Commission

No revisions have been recommended during the CCA-III held on Friday.

6. Meetings proposed to be supported in the coming triennium

During the Commission B CCA-I meeting on Monday, Prof David Michelson presented a proposal for holding the EMTS 2025 meeting in Vancouver, Canada. After some discussion among the attendees, the proposal was approved. The budget will be reviewed by Profs. Kobayashi (URSI Comm B Past Chair), Volakis (Comm B Chair) and Ross Stone for finalization.

During the Commission B CCA-III meeting on Friday, Prof Shestopalov presented updates on the organization and venue of the EMTS 2023 (May 22-26, 2023). It was proposed and approved to move the venue of the EMTS 2023 conference from Moscow to Sochi.

7. Report and comments on the scientific program of the Commission for the current GASS

Here below a summary of the Comm B papers actually present in the conference Proceedings stored into the USB thumb drive.

In all, the 29 Commission B sessions and 5 sessions joint with other commissions (see below) had 357 papers presented. These were inserted into the conference proceedings. That is, 89.25% of the submitted and accepted papers were presented and inserted in the conference proceedings. So far, no information about *no shows* is available.

	REGULAR SESSIONS							
	# Barte	Title	Conveners	# oral	# FIP	invite #	d papers %	
B01	12	Antenna theory, design, and measurement	J. Volakis; D. Guha, A. Michel	36	20	5	9%	
B02	2	Memorial session for Prof. Thomas B. A. Senior	J. Volakis, K. Kobayashi, P. Smith	6		6	100%	
B03	5	Propag. & scattering: adv., trends & new applic.	Burkholder; Erricolo; Lombardi; Riva	15		5	33%	
B04	4	Advanced algorithms in computational electromagnetics	S. Ohnuki, V. Okhmatovski, Q. Liu	12	1	4	31%	
B05	2	Memorial session for Prof. Jean Van Bladel	P. Van Daele, G. Uslenghi, A. Sihvola	5	0	5	100%	
B06	3	Inverse scattering and imaging	L. Li, M. Pastorino, S. Kidera	9	9	2	11%	
B07	3	Integral equation, hybrid, and fast methods	F. Andriulli, T. Eibert	9	4	6	46%	
B08	4	Novel mathematical methods in electromagnetics	K. Kobayashi, Y. Shestopalov	12	3	7	47%	
B09	3	Mathematical modelling of EM problems	P. Smith, G. Uslenghi	9	2	7	64%	
B10	4	Scattering and diffraction	L. Klinkenbusch, G. Manara	11	2	4	31%	
B11	4	Electromagnetic theory	D. Sjöberg, H. Wallén	12		8	67%	
B12	3	Materials in electromagnetics	A. Osipov, P. Smith	8		1	13%	
B13	3	Electromagnetics of time-varying scatterers & materials	S. Tretyakov, A. Díaz-Rubio, V. Asadchy	8	3	7	64%	
B14	3	Waves in nonlinear and inhomogeneous media	Y. Shestopalov, E. Smolkin	6		4	67%	
B15	2	Forward scattering and propagation	C. Ponti, A. Randazzo	5		2	40%	
B16	3	Antennas & microwave devices inspired by electromagn. band gap	Karu. P. Esselle, L. Matekovits	9	4	6	46%	
B17	2	Optimization techniques in electromagn.: new trends& novel applic.	S. Rengarajan,A. Hoorfar	6	1	5	71%	
B18	3	Millimeter-wave antennas/5G communications	J. Volakis, J. Hirokawa	9	1	2	20%	
B19	3	Women's contributions in inverse electromagn. Problems	M.Bevacqua, R.Scapaticci, M.Maisto	8		1	13%	
B20	2	High-frequency and hybrid methods	P. Pathak, G. Manara, L. Klinkenbusch	5		3	60%	

B21	3	URSI 100 years of history and achievements of Comm.B	Y. Rahmat-Samii, R. Stone, A. Sihvola	6		6	100%
B22	3	Advanced metamaterial concepts for electromagn.	A. Alù, N. Engheta, D. Sounas	9	2	2	18%
B23	2	Spat. corr. estim.& chann. model. for massive MIMO&nearfield communic. syst.	D. Sarkar, S. Mikki, Y. Antar	5			0%
B24	3	Electromag. methods for direct&inverse scatt. involving stratified media	verse scatt. involving M. Pastorini, Schettini 9			3	33%
B25	3	Semi-analytical modeling techniques in electromagnetics & photonics	N. Tsitsas, G. Zouros	9	2	9	82%
B26	3	Electromagnetics at the nanoscale and quantum effects	A. Boag, A. Natan	9	4	5	38%
B27	2	Inverse problems in antenna & scattering in complex environm.	R. Solimene; D. Lesselier; A. Randazzo	6	2	3	38%
B28	2	Innovative Electromagn. Solutions for Modern Sensing & Inform. Systems	Canestri, Monorchio	6	1	3	43%
B29	1	Other			6		0%

	JOINT SESSIONS							
	#	Title	Conveners	# oral	# FIP	invited papers		
	Parts			papers on		#	%	
BD	2	Symmetries in artificial materials: theory and applications	G. Valerio, S. Horsley	io, S. Horsley 6 1		4	57%	
BE1	2	Near-field coupling in wireless communications	A. Michel, G. Gradoni, P. Nepa	3	60%			
BE2	1	Reconfigurable Intelligent Surfaces for Wireless Communic. & Sensing	P. del Hougne, G. Gradoni	3	1	1	25%	
BG	2	High-frequency wave propagation in highly disturbed ionosphere N. Zernov, V. Gherm, C. Carrano		5			0%	
вк	3	Innovative methods and devices for microwave medical applications - supported by COST MyWAVE	Lorenzo Crocco, Francesca Vipiana, Kosmas	8	2	4	40%	
				Total Oral				
				286	71			
			TOTAL	357				

Submissions			On Conference Proceedings			
Number of submitted papers	Rejected		Contained into thee conference proceedings		Not registered or withdrawn	
409	9		357	89.25 %	43	10.75%

8. Proposed sessions for the next GASS

No discussion.

9. Proposed sessions for the AT-AP-RASC (Gran Canaria, Spain, 30 May – 4 June 2022)

Prof. Volakis (Comm B Chair) proposed the following new topics, but a more detailed discussion will be done among Commission B Officers.

- As additional topics, the following have been discussed
- Antennas for CubeSats (Cubesats and applications)
- Satellite Imaging using CubeSats and NanoSats (Satellite imaging)
- Imaging of lunar and Mars surfaces
- Simultaneous transmit receiver front ends
- Flexible and wearable RF-Front ends
- Antenna array Beam formers
- Millimeter and THZ propagation
- Wide bandgap surface applications
- Sensor and Sensing links
- Smart RF front ends for efficient spectrum utilization
- AI for RF-front end design
- RF front ends for software radios
- Antennas and microwave imaging for biomedical applications
- Addictive Manufacturing, Novel composites and Metastructures
- Vehicular and automotive RF links

After further discussion following the GASS 2021 meeting, the following topics have been proposed for the AT-AP-RASC 2022 flagship meeting:

B01: Antenna theory, design, and measurement

- B02: Simultaneous transmit receiver front ends
- B03: Propagation and scattering: advances, trends and new applications
- B04: Advanced algorithms in computational electromagnetics
- B05: Antennas and microwave imaging for biomedical applications
- B06: Inverse scattering and imaging
- B07: Integral equation, hybrid, and fast methods
- B08: Mathematical methods in electromagnetics
- B09: Mathematical modelling of EM problems
- B10: Scattering and diffraction
- B11: Electromagnetic theory
- B12: Materials in electromagnetics
- B13: Electromagnetics of time-varying scatterers and materials

- B14: Waves in nonlinear and inhomogeneous media
- B15: Quantum techniques for Electromagnetics
- B16: Additive Manufacturing, Novel composites and Metastructures
- B17: Optimization techniques in electromagnetics: new trends and novel applications
- B18: Millimeter-wave antennas/5G communications
- B19: Women Radio Science Contributions
- B20: High-frequency and hybrid methods
- B21: Vehicular and automotive RF links
- B22: Metamaterial concepts for electromagnetics
- B23: RF front ends with MIMO
- B24: Electromagnetic methods for direct and inverse scattering involving stratified media
- B25: Innovations in electromagnetics and photonics
- B26 Terahertz Antenna Systems
- B27 Foldable Antennas and Antennas for CubeSats
- B28: Electromagnetic Solutions for Modern Sensing and Information Systems
- B29: Open session

10. Other business

Prof. Kobayashi (Comm B Past Chair) showed the budget of the last 2018-2021 triennial and the total budget proposed for the next 2021-2023 triennial.

COMMISSION C - RADIO-COMMUNICATION SYSTEMS AND SIGNAL PROCESSING

1. Results of Election of Vice-Chair

Four candidates applied for the Vice-Chair position (2021-2023):

Debashis De (India) Hesham M. El-Badawy (Egypt) Kumar Vijay Mishra (India) Caiyun Wang (China)

Kumar Vijay Mishra has been elected as the new Vice-Chair.

2. Results of Election of Early Career Representative

Four candidates applied for the ECR position (2021-2026):

Krzysztof K. Cwalina (Poland) Pape Abdoulaye Fam (Senegal) Yongzhe Li (China) Anwesha Mukherjee (India)

Krzysztof Cwalina has been elected as the new ECR

3. Appointment of Associate Editor for Radio Science Bulletin

Three members of Comm. C will serve Radio Science Bulletin as Associate Editors:

Pape Abdoulaye Fam (Senegal) Ruisi He (former ECR of Comm C) (China)

Alberto Tarable (Italy)

4. Updates/Status of Working Groups

Two Working Groups have been set up during GASS 2021: Quantum communications (Yves Louet, France ; Alberto Tarable, Italy) Efficient & Green Wireless Comm (Pape Abdoulaye Fam, Senegal; Yves Louet, France)

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5. Updates to Terms of Reference of Commission C

The updated list of the Terms of Reference of Commission C is:

Information theory, coding, modulation & detection Massive Multi-Input Multi-Output antenna systems Waveform for radar & communications Smart radio-communications: cognitive radio, software defined radio Reconfigurable intelligent surfaces Radar, sonar, navigation systems & positioning Artificial intelligence and machine learning efficient communications wireless transfert Energy and power Security & privacy in communications **Ouantum communications** Wireless networks 6G and future high frequency radio systems

6. Meetings proposed to be supported in the coming triennium

So far (8th of Sept. 2021), no meeting has been proposed for the two upcoming years to be supported by Comm. C

7. Report and comments on the scientific program of the Commission for the current GASS

53 Commission C papers were presented in 9 regular sessions, 3 joint sessions and two FIP Sessions (https://www.ursi.org/proceedings/procGA21/prog-com.html)

Sessions :

C01: Resource Management in Future Wireless Communications

- C02: Application of Machine Learning in Wireless Communications
- C03: 5G Wireless Communications and IoT

C05: Optimization of Wireless Power Transfer

C06: Internet of Things for licensed and unlicensed spectrum

- C09: Radar and Communications Co-Design
- C10: Multi-antenna technologies and massive MIMO
- C12: Global Navigation Satellite System
- C14: Age of Information in Wireless Networks and its Applications
- CB: Functional Metasurfaces for Communication and Radar Systems
- CFH: Radio Science Measurements from Spacecraft Telecom. Signals

CK: Over-the-Air testing: State-of-the-Art & Future of Technology & Apps

Tutorial

Cognitive Radar, presented by Mishra, Kumar Vijay, United States Army Research Laboratory (USA)

General remarks

The attendance in the room dedicated to Comm. C was variable (max 7 people). Most of the attendees were on-line (max 15). Almost all speakers up-loaded their video and thanks to the help of the students in the room, it worked very good.

The session on "Space-craft signals" and GNSS worked very good.

The tutorial of Comm. C was given by Kumar Vintay Mishra, incoming Vice-Chair of Comm. C

The Commission Coordinated Meetings gave birth to many good proposals (sessions for AT-RASC, tutorials, RSB editors, ...). Around 10-15 people attended (on-site and on-line).

The Italian chair of Comm C was on place (Fortunato Santuci).

8. Proposed sessions for the next GASS

It is a little soon to precisely list the sessions for next GASS. Nevertheless, this is almost sure that the following topics will constitute the earth of the program:

- Quantum communications (output of the Working Group set up at GASS 2021)
- Wireless Power Transfer
- 6G and high-frequencies radio-communication systems
- Satellite-mobile communications
- Security & privacy of communications

9. Proposed sessions for the AT-RASC

The following sessions will be given in AT-AP RASC 2022:

- Radar & communication co-design (Amir Zaghloul, Kumar Vijay Mishra)
- Concepts and ideas for consumer wireless communications paradigms (Máirtín O'Droma, Ivan GANCHEV, Dr Zhanlin JI, Jacqueline Walker)
- 6G and future wireless systems (Haijun Zhang, Satoshi Tsukamoto)
- Reconfigurable Intelligent surfaces (Alberto Tarable, Kumar Vijay Mishra, Amir Zaghloul)
- Advanced digital communications schemes (Yves Louet, Alberto Tarable)
- Wireless Power Transfer (Satoshi Tsukamoto, Guillaume Villemaud)
- Satellite Systems & positioning (Sanat K Biswas, Amitava Sen Gupta)
- Efficient & Green Communications (Pape Abdoulaye Fam, Yves Louet)

- AI & Machine learning in communications (Krzysztof Cwalina, Kumar Vijay Mishra)

In addition, Comm. C would like to propose two short-courses:

- Hybrid beamforming for massive MIMO communications: From optimization to deep learning (Dr Kumar Vijay Mishra)
- High energy-efficient waveforms for radio-communications: from theory to applications (Prof. Yves Louet)

10. Other business

Nothing special to add.

COMMISSION D - ELECTRONICS AND PHOTONICS

1. Results of Election of Vice-Chair

There were three candidates for the position of the Vice Chair. In this year, voting was 100% online and no paper ballots. Deadline of voting was until the end of Monday's CCA meeting.

Atsushi Kanno (Japan) : 14 votes Hossein Asghari (USA) : 13 votes Young-Kai Chen (USA) : not enough and no voting date from URSI secretariat After discussion of election results of all commission in URSI council II on Tuesday, Atsushi Kanno was elected Vice Chair.

2. Results of Election of Early Career Representative

There were two candidates for the position of the ECR. The election rule was the same as VC.

Valentina Palazzi (Italy) : 21 Ricardo Correia (Portuguese) : 12 As a result of the election and discussion, Valentina Palazzi was elected ECR.

3. Appointment of Associate Editor for Radio Science Bulletin

Atsushi Kanno accepted to act as Associate Editor for Radio Science Bulletin.

4. Updates/Status of Working Groups

- D.1 RFID Technologies and Privacy of data Chair : Smail Tedjini (France) Vice-Chair : Gaetano Marrocco (Italy)
- D.2 Wireless Power Transfer Technologies and Applications Chair: Dr. N. Shinohara (Japan)
 Vice-Chair: Dr. A. Georgiadis (Netherland)

We wish to continue and expect to produce a document/report for the next triennium. There is no change in the representative of this WG, but we plan to organize workshop in next URSI flagship meeting.

5. Updates to Terms of Reference of Commission

New terms, last sentence. was proposed and accepted.

The Commission promotes research and reviews new developments in :

- Electronic systems that push beyond current frontiers;
- Microwave, millimeter wave and THz devices, circuits and systems;
- Nanotechnologies and nanoelectronics;
- Combined and hybrid photonic and electronic systems;
- Photonic devices, systems, and their applications;
- Photonic signal processing schemes, regardless of frequency of signal processed;
- Optoelectronic systems, plasmonics, and electro-optics;
- Physics, theoretical modeling, and numerical simulation of all of the above.

The commission focuses on electronic and photonic devices, circuits, systems and wireless solutions to address applications in particular 6G and beyond, IoT, Sensors, Artificial Intelligence, energy harvesting, WPT, Pandemics/disaster management.

La Commission tend à promouvoir les recherches et à faire le point des nouveaux développements dans les domaines :

- Des systèmes électroniques qui repoussent les frontières actuelles;
- Des dispositifs, circuits et systèmes au fréquences micro-ondes, millimétriques et THz;
- Des nanotechnologies et de la nanoélectronique;
- Des systèmes photoniques et électroniques combinés et hybrides;
- Des dispositifs et systèmes photoniques ainsi que leurs applications;
- Des nouveaux principes de traitement des signaux photoniques, quelle que soit la fréquence du signal traité;
- Des systèmes optoélectroniques, plasmoniques et électro-optiques;
- Relevant de la physique, de la modélisation théorique et de la simulation numérique de tout ce qui précède;

La Commission se concentre sur les dispositifs, circuits et systèmes électroniques et photoniques dans le but de mettre en œuvre des technologies relevant de la 6G et des futures générations de téléphonie mobile, de l'intelligence artificielle, des capteurs sans fils et de l'Internet des objets, de la récupération d'énergie et du transfert d'énergie sans fil, des technologies quantiques, et pour la gestion des pandémies et catastrophes.

6. Meetings proposed to be supported in the coming triennium

We discussed the meetings which Commission D should support. Based on past triennium information, we choose the following meetings to be supported.

- Metamaterials 2021, 15th International Congress on Artificial Materials for Novel Wave Phenomena, New York, USA, 20-25 Sep. 2021, https://congress.metamorphose-vi.org/
- ISAP2021, Oct.19-22, 2021, Taipei, http://www.isap2021.org/
- ISAP2022, Sydney, https://isap2022.org/
- IEEE RFID-TA2021, Oct.6-10, 2021, Delhi, India, https://2021.ieee-rfid-ta.org/ patrons/
- URSI-JRSM2022, Tokyo, Japan, Sep.1-2, 2022
- APMC2021, Nov.28-Dec.1, Brisbane, http://apmc2021.org/
- APMC2022, Tokyo

7. Report and comments on the scientific program of the Commission for the current GASS

N/A

8. Proposed sessions for the next GASS

All attendees agreed to propose special session proposals and suggestions related to their field of expertise and based on past URSI flagship meetings. After AT-AP-RASC2022, we agreed to start to make proposal of sessions for GASS2023.

9. Proposed sessions for the AT-RASC

AT-RASC2022 was renamed AT-AP-RASC2022 hybrid. For the AT-AP-RASC2022, the following sessions and workshops will be proposed.

- [Workshop D1] RFID Technologies and Privacy of Data Conveners: Smail Tedjini, Université Grenoble-Alpes, France, Gaetano Marrocco, University of Rome Tor Vergata, Italy
- [Workshop D2] Wireless Power Transfer Technologies and Applications Conveners: Naoki Shinohara, Kyoto University, Japan, Apostolos Georgiadis, Netherland
- [Session D1] Convergence of photonics and radio systems Towards 6G Conveners: Hiroshi Murata, Mie University, Japan, Toshimasa Umezawa, NICT, Japan
- [Session D2] Photonic signal processing, real-time instruments and biomedical imaging

Convener: Hossein Asghari, Loyola Marymount University, USA, Masayuki Suzuki, Doshisha University, Japan, Chao Wang, University of Kent, UK

 [Session D3] Harmonic Transponders Conveners: Valentina Palazzi, Univ. of Perugia, Italy, Smail Tedjini, Université Grenoble-Alpes, France

- [Session D4] "Multiphysics modelling in radio frequency nanoelectronics", Conveners : Prof. Qiwei Zhan, Zhejiang University, Prof. Wei Sha, Zhejiang Universit, and Prof. Qing Huo Liu, Duke University
- [Session D5] Plasmonics Conveners: Maurizio Burla, ETHZ, Switzerland, Prof. David Marpaung, University of Twente, the Netherland
- [Session D6] Photonics and electronics for space applications Conveners : Morio Toyoshima, NICT, Japan, Kyriaki Minoglou, ESA/ESTEC, Netherland
- [Session D7] Electronic and photonic components for THz Communications Conveners : Thomas Kurner, Univ. Braunscweig, Germany, Tetsuya Kawanishi, Waseda University, Japan
- [Session D8] [Session D8] Energy Harvesting for IoT Applications
 Conveners: Kyriaki Niotaki, Télécom Paris, Paris, France, Valentina Palazzi, Univ. of Perugia, Italy
- [Session D9] Open Session
 Conveners: Naoki Shinohara, Kyoto University, Atsushi Kanno, NICT, Japan

10. Other business

N/A

COMMISSION E - ELECTROMAGNETIC ENVIRONMENT AND INTERFERENCE

1. Results of Election of Vice-Chair

There were three available candidates for the position of Vice Chair: Prof. Carlo Carobbi (Italy), Dr. Gabriele Gradoni (United Kingdom), and Prof. Yasuhide Hobara (Japan). The vote was cast online and the results transmitted by the URSI board. Prof. Carlo Carobbi was declared elected as the Vice Chair of Commission E for the upcoming triennium.

2. Results of Election of Early Career Representative

For the position of second Early Career Representative, only one candidate was available: Dr. Riccardo Trinchero (Italy). The vote was also cast online and Dr. Riccardo Trinchero was declared elected as the second Early Career Representative of Commission E for the upcoming triennium.

The Early Career Representative of the last triennium, Dr. Chaouki Kasmi, agreed to also serve as Early Career Representative for the upcoming triennium.

3. Appointment of Associate Editor for Radio Science Bulletin

The Vice Chair elect, Prof. Carlo Carobbi, was appointed as the Associate Editor for the *Radio Science Bulletin* and will benefit of the support of Dr. Chaouki Kasmi.

4. Updates/Status of Working Groups

The subject of Electromagnetic Environment and Interference is of concern within many disciplines of Radio Science. This is reflected in a number of working groups with focus on particular topics. These are outlined below with the names of contact persons and, where available, a brief description of the relevant topics. Typical activities of the working groups involve the organization of sessions for various conferences, workshops, and meetings.

There were no fundamental changes during this General Assembly, except for the replacement of A. Zeddam (retired) by V. Deniau in the WG E7. However, the people in charge of the different WGs will be contacted in the year to

However, the people in charge of the different WGs will be contacted in the year to check if any changes need to be made.

4.1. E1. Terrestrial and Planetary Electromagnetic Noise Environment

Co-Chairs: C. Price (Israel), Y. Hobara (Japan), A.P. Nickolaenko (Ukraine), and K. Hattori (Japan)

This WG deals with the study on the characteristics of natural electromagnetic noise taking place not only in the terrestrial, but also in the planetary environment. The most well-known EM noise is the atmospheric radio noise from the lightning discharges (socalled sferics in a wide frequency range from DC to VHF). Some examples of topical subjects on sferics are (1) monitoring of global lightning activity as studied by high frequency noise and Shumann resonance phenomena in the ELF band and (2) ELF transients related with the optical emissions in the mesosphere due to the lightning. Higher frequency lightning emission provides us with the information on the fine structure of lightning electrical structure, while lower frequency noise provides us with the macroscopic nature of lightning. The noise coming from the ionosphere/ magnetosphere will be discussed as well; micro pulsations in the ULF range, VLF/ ELF emissions and HF emissions due to the plasma instabilities in the space. The radio noise environment on other planets is also of interest to this group. We are particularly interested in using natural EM observations in monitoring, detecting, and forecasting natural hazards, such as thunderstorms, severe weather, space weather and seismic events.

4.2. E2. Intentional Electromagnetic Interference

Co-Chairs: M. Bäckström (Sweden) and W. Radasky (USA)

This WG studies the area of intentional electromagnetic interference (IEMI), which is defined by the IEC as the "Intentional malicious generation of electromagnetic energy introducing noise or signals into electric and electronic systems, thus disrupting, confusing or damaging these systems for terrorist or criminal purposes." In particular, this WG focuses on the electromagnetic threat weapons, the coupling to electronic systems, the vulnerability of systems to these types of transients, and the protection of systems from the IEMI threat.

4.3. E3. High Power Electromagnetics

Co-Chairs: R.L. Gardner (USA) and F. Sabath (Germany)

The objective of this WG is to encourage research in high power electromagnetics (HPE). The technical area of HPE consists of the physics and engineering associated with electromagnetic sources where nonlinear effects associated with high-field regions

(and air breakdown) must be included in the analysis and design. This includes (but is not limited to) EMP simulators, high-power narrowband and meso-band sources and antennas, and hyperband (impulse) sources and antennas. It also includes the environment near lightning channels and in nuclear EMP source regions. In some cases it includes the high field regions on, or in targets because of local field enhancement.

4.4. E.4. Lightning Discharges and Related Phenomena

Co-Chairs: V. A. Rakov (USA) and S. Yoshida (Japan)

The lightning discharge is one of the two natural sources of electromagnetic interference (EMI), the other one being the electrostatic discharge. Electric and magnetic fields generated by lightning represent a serious hazard to various systems, particularly those containing sensitive electronics. This WG focuses on the characterization of lightning and its interaction with engineering systems and with the environment, as well as on lightning detection and testing. It covers all aspects of lightning research, including observations, field and laboratory experiments, theoretical studies, and modeling.

4.5. E.5. Interaction with, and Protection of, Complex Electronic Systems

Co-Chairs: F. Gronwald (Germany) and J-P. Parmantier (France)

This WG studies the various electronic and electromagnetic aspects related to the interaction with, and protection of, complex electronic systems. The focus is on the analysis of the various coupling paths and their associated transfer functions into complex electronic systems, as formalized in the framework of electromagnetic topology. Analytical, numerical, and measurement techniques are used to characterize the electromagnetic fields and currents in a complex environment. In the analysis, special attention is placed on the emergence of new technologies, and the inclusion of advanced materials and communication systems.

4.6. E.6. Spectrum Management

Co-Chairs: J. P. Borrego (Portugal) and R. Struzak (Poland)

The focus of this WG is on sound scientific spectrum management for improved utilization of the radio frequencies for protection wireless communications service and radio sciences. The goal is to assure further development of radio sciences and communication services, unobstructed by potential radio interference due to unwanted energy in the form of out-of-band and in-band encroaching and deleterious in-band and out-of-band emissions. The electromagnetic spectrum is treated as a limited natural

resource with a multitude of competing demands for access to it and use of it. Spectrum management seeks innovative means and technologies for adequate co-existence of all of them taking into account the need of protection of new and incumbent wireless and wired communication services, systems and equipment, with special focus on science services and those that use passive technologies.

4.7. E.7. Electromagnetic Compatibility in Wired and Wireless Systems

Co-Chairs: F. Rachidi (Switzerland), V. Deniau (France), and F. Gronwald (Germany)

The intensive use of the electromagnetic spectrum for communications has resulted in issues of compatibility and interoperability between different users. In addition the continual increase in operating frequency of products and higher frequency sources of disturbances (such as Ultra-Wide Band systems) resulted in an increase of potential EMC problems in communication systems and the use of power lines for carrying data is adding to interference problems. Within the framework of this WG, we have regularly organized special sessions at URSI GASS This session focusing on theoretical and experimental EMC aspects in both wire and wireless communication systems. Potential remedies are also addressed.

4.8. E.8. Stochastic Techniques in EMC

Co-Chairs: L. Arnaut (UK), S. Pignari (Italy), and R. Serra (Netherlands)

4.9. Joint Working Groups

4.9.1. EB Chaos and Complexity in EM

Co-Chairs: G. Gradoni (UK), and A. Sihvola (Finland)

Wave complexity underpinned by fully developed, partial and transient chaos is becoming permanent in multi-component electromagnetic systems operating at electrically large scales. Statistical methods have been developed to tackle those systems and their specific engineering structures occurring in electromagnetic compatibility, electronics circuits as complex sources of radiated emissions, wireless communications including massive MIMO systems, etc. Recent studies in wave chaos have attracted researchers in electromagnetic theory and universal statistical properties have been used to study large electromagnetic systems without solving the full-wave problem. Hybrid methods combining full wave algorithms with newborn statistical methods are emerging in the EM wave modeling arena. System specific components need detailed treatment while deformed and irregular parts of EM environments can be treated statistically because of their mixing behavior. Furthermore, statistical sources can be treated through semi-classical as well as random matrix theories. Novel theoretical models have been developed describing fields through complicated electromagnetic environments - including electromagnetic reverberation chambers - also accounting for coupling through apertures and including losses at both microwave and mmWave regimes, as well as complex placement of wires and cables within EM environments. Uncertainties arising within cabling and radiating systems can be described through the polynomial chaos method.

4.9.2. EHG Solar Power Satellite

Chair: H. Matsumoto (Japan), Co-Chair for Commission E: J. Gavan (Israel), Co-Chair for Commission H: K. Hashimoto (Japan)

4.9.3 GEH Seismo Electromagnetics (Lithosphere-Atmosphere-Ionosphere Coupling)

Co-Chair for Commission G: S. Pulinets (Russia), Co-Chair for Commission E: M. Y. Hobara (Japan), Co-Chair for Commission H: H.Rothkaehl (Poland)

4.9.4. GJFEH Interdisciplinary Space Weather

Co-Chair for G: I. Stanislawska (Poland), Co-Chair for J: R. Fallows (Netherlands)

4.9.5. URSI/IAGAVLF/ELF Remote Sensing of the Ionosphere and Magnetosphere (VERSIM)

Chair for URSI (Commissions E,G,H): M. Clilverd (UK), IAGA Chair: J. Bortnik (USA)

EGH Radio Diagnostics of Space Weather Plasma Processes Chair: M. Messerotti (Italy, Commission H). Co-Chair for Commission G: D.Themens (Canada) Co-Chair for Commission E: Y. Hobara (Japan)

FCGEH Risk and Disaster Management

Chair: T. Tanzi (France, Commission F) Participants Commission G: C. Cesaroni (Italy), A. Ippolito (Italy)

EFGHJ RFI Mitigation and Characterization

Chairs for Commission F: A.K. Mishra (South Africa), D. Le Vine (USA) Chair for Commission G: T. Bullett (USA) Co-Chair for Commission H: H. Rothkaehl (Poland) Chairs for Commission J: R. Bradley (USA), W. Baan (Netherlands)

5. Updates to Terms of Reference of Commission

There were no updates to the Terms of Reference. The current Terms of Reference are as follows:

Commission E promotes research and development in:

a. Terrestrial and planetary noise of natural origin, seismic-associated electromagnetic fields;

- b. Man-made electromagnetic environment;
- c. The composite noise environment;
- d. The effects of noise on system performance;
- e. The effects of natural and intentional emissions on equipment performance;
- f. The scientific basis of noise and interference control, electromagnetic compatibility;
- g. Spectrum management."

However, during the commission meetings, several members expressed their mixed feeling about these terms. The terms chosen, although they basically contain the main aspects of Commission E, are not very contemporary and may not be very attractive and meaningful to new generations of researchers.

We have therefore asked the Technical Advisory Committee to work on updating these terms, taking into account the suggestions made during the commission E meetings.

6. Meetings proposed to be supported in the coming triennium

Commission E will support the following meetings in the current triennium:

- Third URSI Atlantic & Asia-Pacific Radio Science Conference (URSI AT-AP-RASC), May 30th – June 4st, 2022, to be held in the ExpoMeloneras Convention Centre, Gran Canaria, Spain.
- RFI 2022 Workshop that will take place on February 14-18, 2022, at the European Centre for Medium-Range Weather Forecasts (ECMWF) in Reading, United Kingdom
- XXXVth URSI General Assembly and Scientific Symposium (URSI GASS), August 2023, to be held in Sapporo, Japan in 2023.

7. Report and comments on the scientific program of the Commission for the current GASS

Commission E offered 12 sessions (including FIP sessions) at the URSI GASS in Roma (2021), most of them consisting of several parts. In addition, there were nine sessions, organized and co-organized with other Commissions. It is intended to have a similar session structure for the next GASS.
Commission E also offered an "ECR Tutorial on **High Power Electromagnetics: Effects on analogue and digital electronics**", and a "Tutorial on **Monitoring and predicting terrestrial and space environments using electromagnetic methods**" and three "Short Courses" on:

- Uncertainty quantification for electromagnetic applications
- Introduction to electromagnetic reverberation chambers Theory, Applications and Research
- Machine Learning approaches with GNU radio

8. Proposed sessions for the next GASS

It is proposed to use the session structure of the last URSI GASS in Roma as a basis for the next URSI GASS in Sapporo (2023). Of course, in particular the special sessions, short courses, tutorials, and workshops will be updated according to current topics of interest. Proposed sessions, at the time of writing, include the following:

Sessions of Commission E only:

- E.1: EMC Analytical and Numerical Modeling
- E.2: EMC in Complex Systems
- E.3: EMC Measurement techniques and Standards
- E.4.: High-Power Electromagnetics and IEMI
- E.5: Stochastic/Statistical Techniques in EMC
- E.6: EMC in Wired and Wireless Systems
- E.7: Lightning and Related Phenomena
- E.8: Geomagnetic Disturbances (GMD) and Effects
- E.9: Time Reversal in Electromagnetics
- E.10: Machine learning & signal processing to analyze & mitigate EMI
- E.11: Interferences and coupling

Joined Sessions organized by Commission E:

EBC: Wave modelling of novel wireless systems EC: EM Security of Cyber-physical systems and Wireless Technologies ECJ: Spectrum management EFGH: Natural Electromagnetic Noise & Radio Sensing Applications in Terrestrial & Planetary Environment

9. Proposed sessions for the AT-AP-RASC

E.1: EMC Analytical and Numerical Modeling and stochastic analysis E.2: EMC in Complex Systems E.3: EMC Measurement techniques and StandardsE.4: HPEM, Intentional EMI, Radiation Hazards, LightningE.5: Machine learning & signal processing to analyze & mitigate EMIE.6: Time Reversal in ElectromagneticsE.7: Open Session

Joined Sessions organized by Commission E:

EFGH: Natural Electromagnetic Noise & Radio Sensing Applications in Terrestrial & Planetary Environment EABK: Wave Chaos of Complex Systems EC.1: EMC and EMI in Wired and Wireless Communications EC.2: EM Security of Cyber-physical systems and Wireless Technologies EACFJ: Spectrum management and Utilization JE: EMC issues in integration of analog and digital electronics

In relatively recent times, in several areas of radiofrequency engineering, a process is taking place aimed at replacing analog conditioning circuits of receivers with digital counterparts. Advantages are in terms of storage and retrieval of detected signals, sophisticated and fast signal processing, overall stability and accuracy of receivers. A notable recent example of this process is in radio astronomy, where there is a trend to move digitisation of the received analog signals, and even some processing, closer to the highly sensitive receivers. The price to pay is in terms of the issues inherent to cohexistence, in close proximity, of sensitive analog radiofrequency circuits with high-speed and relatively high signal level, digital circuits. The session is open to contributions, from any field of application, devoted to the mitigation of interference arising from the integration of analog and digital electronics. Session topics include appropriate layout of circuits and interconnections, grounding, shielding, filtering, processing and other EMC techniques aimed at minimizing interference effects.

ECR Tutorial Ricardo Trinchero: **DEMYSTIFYING MACHINE LEARNING FOR EMC AND SI/PI APPLICATIONS**

Early Career Networking HEG In the pre-program, co-chair : chaouki Kasmi #1 Early Career Networking HGE, #2 Meet the Experts HGE.

10. Other business

None.

COMMISSION F - WAVE PROPAGATION AND REMOTE SENSING

Not available yet

COMMISSION G - IONOSPHERIC RADIO AND PROPAGATION

The Coordinating activities meetings for Commission G were held on Monday, Wednesday and Friday – August 30, September 01 and September 03, from 15.00 to 16.00 Rome CEST.

Prof. Patricia Doherty, Chair of Commission G 2017-2021, led the first two meetings and turned over the last meeting to Giorgiana De Franceschi, Chair for the 2021-2023 biennium. It is important to note that, because the hybrid format of the GASS2021, part of the members was on site and part on line, reaching however a high number of attendees of more than 50 in total for each of the three meetings.

The Commission G Coordinating activities meeting n.1 commenced with a brief remembrance and moment of silence for the following friends and colleagues who passed away during the triennium:

William Burke, 1935-2020, USA Don Farley, 1933-2018, USA Bengt Hultqvist, 1927-2018, Sweden Edward S. Kazimirovsky, 1937-2018, Russia Leo McNamara, 1940–2021, USA Aleksandr P. Potekhin, 1951 – 2019, Russia Karl Rawer, 1913-2018, Germany Alan Rodger, 1951-2020, UK Charlie Rush, 1942-2020, USA Yuri Ruzhin, passed away in 2021, Russia Bill Wright, 1929-2018 USA

1. Results of Election of Vice-Chair

Commission G held the election for Vice Chair during the 1nd meeting. Three eminent scientists were nominated including:

Keith Groves, Boston College, USA Ivan Galkin, UML, USA John Bosco Habarulema, SANSA, South Africa We are pleased to announce that Dr. Keith Groves was elected Vice Chair of Commission G for the 2021-2023 biennium. We thank all of the candidates for their generous offer to lead the Commission.

2. Results of Election of Early Career Representative

Commission G also held the election for Early Career Representative. Three dynamic and enthusiastic young scientists were nominated including:

Dario Sabbagh, INGV, Italy Bruce Fritz, US Naval Research Lab., USA Kshitija Deshpande, ERAU. USA

Because the resulting ex aequo between Sabbagh and Fritz, both have been elected as ECR of Commission G 2021-2026 together with Sean Elvidge that will finish his action in 2023.

3. Appointment of Associate Editor for Radio Science Bulletin

Dr. Iwona Stanislawska, past Chair of Commission G 2014-2017, will serve as the Associate Editor for the RSB.

4. Updates/Status of Working Groups

The full WG's status is included in the report by Patricia Doherty (2017-2021). Summarizing, the following WGs will continue their activities:

G1: Ionosonde Network Advisory Group (INAG)

Chair: I.A. Galkin (USA); Vice-Chairs: J.B. Habarulema (RSA), Baiqi Ning (China); INAG Bulletin Editor: K. Wang (Australia).

INAG deals with the monitoring of the ionosphere by means of High-Frequency (HF) radio sounding. Recognizing the accomplishments over the past 90 years, INAG notes strengthening role of the HF ionosonde as a fully autonomous instrument for accurate and prompt specification of the ionospheric weather.

G2: Studies of the ionosphere using beacon satellites

Chair: P. Doherty (USA); Vice Chairs: B. Nava (Italy), A. Krankowski (Poland) The Beacon Satellite Group (BSG) is interdisciplinary, servicing science, research, applications, and engineering interests. The prime objective is to study the ionosphere using beacon satellite signals.

G3: Incoherent Scatter

Chair: A. J. Kavanagh (UK); Vice Chair: TBD[2021-] ISWG main task is coordinating the combined "World Day" operations of all the global incoherent scatter radar facilities around the world.

GEH: Seismo Electromagnetics (Lithosphere-Atmosphere-Ionosphere Coupling) Co-chairs: S. Pulinets (Russia), M.Y. Hobara (Japan), H. Rothkaehl (Poland)

The main activity would include:

- 1. Further development of the physical mechanisms of pre-earthquakes ionospheric anomalies generation
- 2. Statistical confirmation of the pre-earthquake ionospheric anomalies existence
- 3. Development of the technologies of automatic identification of the pre-earthquake ionospheric anomalies

GJFEH: Interdisciplinary Space Weather

Co-chairs: I. Stanislawska (Poland), R. Fallows (Netherlands), Patricia Doherty (USA) This inter commission group is devoted to advancements on monitoring, studying, modelling, forecasting, mitigating space weather phenomena and impacts on the near-Earth. The activity foreseen efforts in investigating planetary ionospheres.

IRI task force (URSI/COSPAR).

The task force will continue the international efforts on models for the International Reference Ionospehere.

The **WG:** Middle Atmosphere is inactive and Commission G decided to close this group. Moreover, the past chair J. Roetteger passed away, Paul Cannon gave to the community this info during the third meeting.

There have been proposals, accepted, of new WGs as follows:

G4 Capacity Building and training

Chair C. Cesaroni (Claudio.cesaroni@ingv.it, Italy), co-Chairs J. Owlendo (j.olwendo@pu.ac.ke, Kenya), B. Nava (bnava@ictp.it), P. Doherty (patricia. Doherty@bc.edu)

The "Capacity building and training" working group deals with the activities related to the training of students and young scientists especially from developing countries. The main objectives of the working group are:

- Organize international workshops especially for young scientists from developing countries
- Facilitate visits exchange for young scientists by spreading news about opportunities and by putting in place action for funds raising
- Organize periodical webinar for sharing new research among the commission G community

FCGEH- Risk and Disaster Management (Inter URSI Commissions)

Chair (T. Tanzi, France, COMM F),...co-chairs Commission G (C. Cesaroni, Italy; A. Ippolito, Italy)

The suggested scientific topics are:

- Identifying precursors based on seismic events, lightening events.
- Application of weather radars (fast scans...).
- Space-weather with regard to its impacts on satellite communications and highlatitude power transmission (Geomagnetically Induced Currents)

HGE Radio Diagnostics of Space Weather Plasma Processes

Chair: M. Messerotti (INAF, Italy), co-chair Commission G (David Themens, Canada), Commision E (Y. Hobara (Japan)

The activities range from Solar and Heliospheric Weather to Interplanetary and Planetary Space Weather.

This Working Group is aimed at constituting a forum for the community of radio physics theoreticians and radio emission observers from space and ground, in order to promote the joint study of plasma processes in the framework of Space Weather. The main role of this forum consists of synergising the establishment of robust theoretical and observational frameworks by fostering the refinement of existing radio physics models and radio observation techniques as well as the development of new ones

5. Updates to Terms of Reference of Commission

The Terms of Reference of Commission G have been slightly modified as described below:

The Commission deals with the study of the ionosphere in order to provide the broad understanding necessary to support space and ground-based radio systems. Specifically, the Commission addresses the following areas:

- Global morphology and modelling of the ionosphere;
- Ionospheric space-time variations and the impacts of space weather on systems;
- Development of tools and networks needed to measure ionospheric properties and trends;
- Theory and practice of radio propagation in and through the ionosphere;
- Application of ionospheric information to radio systems.

To achieve these objectives, the Commission co-operates with other URSI Commissions, corresponding bodies of the ISC family (IUGG, IAU, COSPAR, SCOSTEP, SCAR, etc.) and other organisations (ITU, IEEE, etc.).

6. Meetings proposed to be supported in the coming triennium

The Commission anticipates providing support to URSI centered meetings in the coming biennium. As funds permit, this includes young scientist support to attend the flagship meetings AT-AP-RASC2022 and GASS2023. Funds permitting, we may also support the Beacon Satellite Symposium in August 2022 (Boston, USA), IRI meetings, RFI (URSI Inter-commission), in February 2022, UK, Eastern Africa GNSS and Space Weather capacity building workshops" in Kenya (or at ICTP-Italy) 2022, 2023.

7. Report and comments on the scientific program of the Commission for the current GASS

Commission G organized 16 scientific sessions, 5 joint sessions leaded by Commission G and a workshop for a total of 311 papers submitted, 13% of them as "invited presentation".

This list of GASS sessions include:

G01: Data Assimilation for Space Weather

- G02: Advances on High Accuracy GNSS solution
- G03: International Reference Ionosphere: Improvement, Validation and Usage
- G04: Science with Modern Ionosondes and Associated Instrumentation and Models
- G05: Advances in Irregularities and Scintillation Studies
- G06: Innovations in Geospace Science Using Incoherent Scatter Radar Techniques
- G07: Design and Application of HF and OTH Radar Systems
- G08: Ionospheric Space Weather
- G09: Radio Occultation and Reflectometry: ionosphere compensation, monitoring and modelling
- G10: Radio Studies of Mid and Low Latitude Aeronomy
- G11: International Beacon Satellite Studies
- G12: Long-term Ionosphere Forecasting: State of the Art and Recent Advances
- G13: Open Session
- G14: Predictability of the Earth's Ionosphere and Space Weather Dynamics
- G15: PRESTO: The New SCOSTEP Space Weather and Space Climate Program
- G16: Space Weather impacts on GNSS
- GH1: Meteors, Collisional EMPs & other Highly-transient Space Plasma Events
- GH2: Plasma Instabilities in the Ionosphere
- GH3: Lessons learned from Ground-based Active Ionospheric Experiments
- GHE1: Seismo Electromagnetics (Lithosphere-Atmosphere-Ionosphere Coupling)
- GHJ1: The Polar Environment and Geospace
- WS3: Radio Science in Space Weather

The Commission G congratulates with the LOC of GASS2021 for the successful organization of the Conference in the hybrid form. The virtual platform was well working and intuitive, allowing papers and FIPs presentation and, most important, the platform offered the same opportunity to on site and on line attendees to actively participate, although some difficulties for the not optimal time zone in some part of the globe, depending on the scheduled CEST time sessions, that however cannot be avoid in case of hybrid form. Moreover, there were comfortable rooms on site and technical assistants able to solve rapidly eventual difficulties arising sometime with the on line speakers.

Most of the sessions were well attended. There was considerable interest in the Workshop on Radio Science in Space Weather. Unfortunately, some of the conveners were not able to attend but chair and vice chair were able to replace them in time. The Commission thanks Ivan Galkin for the impressive tutorial offered "Ionospheric Imaging with Assimilative IRI".

The Commission also would suggest the following for the future events: FIP's should be organized as flash sessions with 3 min presentation for each FIP, followed by discussion moderated by a chair. Oral slot could be reduced to 10 min presentation + 2 minute for question in order to decrease the number of parallel sessions. It is suggested to increase FIP's (flash oral) sessions, much more dynamic than oral slots.

8. Proposed sessions for the next GASS 2023

All agreed that it was too early to consider program development for special sessions, considering the urgent need to consolidate sessions for AT-AP RASC 2022. Thus, we will simply hold the discussion later and within the next AT-AP-RASC 2022. Meanwhile, for a placeholder we will use our general interest sessions listed below for the AT-AP RASC 2022 under G1 – G6, and some special sessions (S-G) particularly in case that some of them will be postponed to GASS2023.

9. Proposed sessions for the AT-AP-RASC 2022

The sessions planned for the AT-AP RASC 2022 include historical topics related to the Commission G terms of reference and special sessions focusing on selected aspects in the field of the ionosphere and radio propagation. Commission G Officers (Chair, V-Chair, ECRs) will act as chairs of the historical sessions (G1-G6).

- G1 Global morphology and modelling of the ionosphere
- G2 Ionospheric modelling, imaging and data assimilation
- G3 Ionospheric effects of Space Weather

- G4 Radar and radio techniques for ionospheric diagnostics
- G5 Transionospheric radio propagation and systems effects
- G6 Open Session This session welcomes all papers related to the Commission G terms of reference, particularly those not covered by the G special sessions.

To date (September 7 2021), the list of special sessions to be consolidated within September 20 include:

- S-G1 OTHR/HF Radar (including SuperDarn), Paul Cannon, Todd Parris, Trevor Harris
- S-G2 GNSS Radio Occultation: Measurements, data assimilation and models, Riccardo Notarpietro, Mainul Hoque, Manuel Hernandez-Pajares
- S-G3 Novel radio instruments and techniques for Space Weather model validation and testing, David Themens, Alessio Pignalberi, Fabricio Dos Santos Prol.
- S-G4 Ionospheric Space Weather: effects on navigation and communication (I. Stanislawska, V. Romano.....)
- S-G5 Recent advances on ionospheric perturbation indices and scales, Luca Spogli, et al
- S-G6 Machine Learning methods for ionospheric modelling: state of the art and future actions, Claudio Cesaroni, Ryan McGranaghan, Enrico Camporeale,...
- S-G7 Advances in Incoherent Scatter Radars and its techniques, Ingemar Häggström, Yue Xinan, Yin Chen yin.chen@egi.eu
- S-G8 Data Assimilation and Modelling, S. Elvidge....
- S-G9 Space weather risks, mitigation, services, predictions, P. Doherty, G. De Franceschi,....
- S-G10 Modern ionosonde research and weather operations, Ivan Galkin, John Bosco Habarulema

10. Other business

Commission G Officers for the 2021-2023

- Chair: Giorgiana De Franceschi, INGV, Italy, Email: giorgiana.defranceschi@ingv.it
- Vice-Chair: Keith Groves, Boston College, USA, Email: keith.groves@bs.edu
- ECR (2nd term): Sean Elvidge, University of Birmingham, UK, Email: s.elvidge@ bham.ac.uk
- ECR (1st term): Dario Sabbagh, INGV, Italy, Email: Dario.sabbagh@ingv.it
- ECR (1st term): Bruce Fritz, US Naval Research Lab., USA, Email: bruce.fritz@nrl. navy.mil

Technical Advisory Committee (TAC)

The following people have agreed to support Commission G as part of the technical advisory committee (TAC). Commission G members are welcome to advise the Chair, Vice Chair and ECRS at any time.

The TAC includes:

Giorgiana De Franceschi, Chair Keith Groves, Vice Chair Sean Elvidge, ECR Dario Sabbagh, ECR Bruce Fritz, ECR Luca Spogli (Italy), luca.spogli@ingv.it Paul Cannon (UK), P.Cannon@bham.ac.uk David Themens (Canada), david.themens@gmail.com Mike Warrington (UK), emw@leicester.ac.uk John Bosco Habarulema (SA), jhabarulema@sansa.org.za Iwona Stanislawska (Poland), <u>stanis@cbk.waw.pl</u>

> Giorgiana De Franceschi Commission G Chair (2021-2023)

COMMISSION H - WAVES IN PLASMAS

1. Results of Election of Vice-Chair

The call for nominations for the new Commission H Vice Chair was sent out (again) on 15 January , 2021. Two excellent candidates have been nominated are (in alphabetical order):

Robert Marshall and Craig Rodger Results: Robert Marshall 31 votes Craig Rodger 34 votes

Prof. Craig Rodger won the election and URSI Council confirmed the result on 1 September 2021.

2. Results of Election of Early Career Representative

The call for nominations for the second Commission H Early Career Representative was (again) sent out on 15 January , 2021. Two excellent candidates have been nominated.

Satoshi Kurita and Evgenii Shirokov Results: Satoshi Kurita 32 votes Evgenii Shirokov 34 votes

Dr. Evgenii Shirokov won the election and URSI Council confirmed the result on 1 September 2021.

3. Appointment of Associate Editor for Radio Science Bulletin

Traditionally Comm H has appointed the new vice chair as the Associate Editor for Radio Science Bulletin. So, our new Associate Editor is Prof. Craig Rodger.

4. Updates/Status of Working Groups

Reports of Working Groups may be included in the Appendix1. One new Working Group was proposed. It will be joint WG with Commissions H, G, and E : **Radio diagnostics of space weather plasma processes**, Comm H representative is prof. Mauro Messerotti, Comm G representative is David R. Themens, and Comm E representative is Yasuhide Hobara

5. Updates to Terms of Reference of Commission

The goals of the Commission are :

- To study waves in plasmas in the broadest sense, and in particular :
 - the generation (e.g. plasma instabilities), propagation, and detection of waves in plasmas,
 - wave-wave and wave-particle interactions,
 - plasma turbulence and chaos,
 - spacecraft-plasma interaction,
 - instabilities, heating, and diagnostics of laboratory plasmas;
- To encourage the application of these studies, particularly in the areas of solar/ planetary plasma interactions, space weather, and an increased exploitation of space as a research laboratory.

There were not any comments or proposed changes to above mentioned text.

6. Meetings proposed to be supported in the coming triennium

So far, only meeting that was known is the 10th VERSIM Workshop in Finland

7. Report and comments on the scientific program of the Commission for the current GASS

We have experienced problems where

- 1) speakers could not share their screen we had to prompt IT to give permission
- 2) problems with no sound in the room in Rome,
- 3) problems with the microphone for speakers in Rome where the sound is very quiet for online listeners.
 - Delays due to the above problems put the session behind and it was very difficult to catch up. We are aware that if the session ends late it means the next session cannot start. We did manage to keep to the timetable just by reducing time for questions.
 - The break between sessions was essential very good.
 - It needs to be stated clearly that everyone online must click on the online link that starts before the session. Even then sometimes this has not been activated and we had to click directly on the session.
 - It is difficult to manage questions in person in Rome when the session chairs

are all online and cannot see anything. Thanks to the session hosts in Rome for helping.

- We kept encouraging people online to put questions in chat but the number of questions online was disappointing maybe only 1 or 2 per speaker.
- Generally it is clear that there is a problem with different time zones. Generally people in Europe and Asia joined the sessions, but very few people from USA I think due to the different time zone.
- We had about 25 people joined online for H04-05 and maybe 10 in the Room in Rome.

Online audience members cannot see the list of participants (and of course don't know who's there in person). This pretty much kills any semblance of participating in a meeting. The setup was much better for AGU, GEM, and VERSIM last year. Another thing that helped a lot in some of those meetings was an independent Slack channel for extended discussion (once people were convinced to join Slack).

8. Proposed sessions for the next GASS

- 1) Open Session
- 2) Radio Diagnostics of Space Weather Plasma Processes
- 3) External/internal natural boundary layers in terrestrial/planetary environments: interplay between macro and microscopic processes
- 4) Multipoint & ground-based observations of magnetospheric wave phenomena, remote sensing of plasma
- 5) Wave-particle interactions

However, these are just the sessions that have been discussed in Comm H CCA meetings. Number will be higher, but now we have put our efforts to AT-AP-RASC2022.

9. Proposed sessions for the AT-RASC

Pre-conference

Early Career Researchers HGE Networking Event requested for the Sunday afternoon

Scientific Sessions - Confirmed

- Recent advances in geospace research from multi-point observations
- Radio Diagnostics of Space Weather Plasma Processes
- Commission H open session
- Meet the HGE Experts (Commissions HGE)
- Celebrating the legacy of Richard Thorne: plasma waves, wave-particle Interactions,

and their multifold effects on planetary radiation belts dynamics

- Atmospheric, Ionospheric, Magnetospheric & High Energy Effects of Lightning Discharges
- Machine learning techniques and their application to plasma waves

There are some joint sessions still under development, but those will be proposed by leading Commission.

There is a full list with Title of the session, names of conveners and co-conveners, and short description of the sessions in the Appendix2.

10. Other business

There was no other business

Jyrki Manninen, chair Craig Rodger, vice chair Frantisek Nemec, ECR1 Evgenii Shirokov, ECR2

COMMISSION J - RADIO ASTRONOMY

The Commission J business meeting at GASS 2021 was held during three scheduled sessions on 30 August, 1 September, 3 September, 2021

Attendees

On-site: Pietro Bolli, Max Hawkins, Alex Kraus, Gundolf Wieching, Stefan Wijnholds Online: Willem Baan, Richard Bradley, Douglas Bock, Claudia Cicone, Les Deutsch, Jacki Gilmore, Assaf Horesh, Lucas Hunt, Devojyoti Kansabank, Brian Kent, Yuri Kovalev, Joseph Lazio, Michael Lindqvist, Hiroshi Matsuo, Vanessa Moss, Ann Njeri, Sara Salem, David Skellern, Melissa Soriano, Jan-Willem Steeb, Tasso Tzioumis, Sravani Vaddi, Jeff Wagg.

1. Results of Election of Vice-Chair

Prof. Stefan J Wijnholds (ASTRON, Netherlands) was elected Vice-Chair from the end of GASS 2021 until the end of GASS 2023, in a process overseen by the URSI secretariat.

2. Results of Election of Early Career Representative

Dr. Danielle Fenech (University of Cambridge, UK) was elected ECR representative from the end of GASS 2021 until the end of GASS 2026, in a process overseen by the URSI secretariat.

3. Appointment of Associate Editor for Radio Science Bulletin

Dr. Rich Bradley (National Radio Astronomy Observatory, USA) was the only nominee for the Commission J Associated Editor of the Radio Science Bulletin. Dr. Bradley was elected.

4. Updates/Status of Working Groups

The commission heard reports from three working groups. The commission also participates in the Interdisciplinary Space Weather WG (GJFEH) and the Computer Simulations in Space Plasmas WG (HJ).

4.1 RFI Mitigation and Characterization (FGHJ)

Chairs for Comm. F: A.K. Mishra (South Africa), D. Le Vine (USA) Chair for Commission G: T. Bullett (USA) Chair for Comm. H: H. Rothkaehl (Poland) Chairs for Commission J: R. Bradley (USA), W. Baan (Netherlands)

Willem Baan provided a brief update on the activities of the WG, which included an RFI workshop, and planning for the upcoming RFI 2022 workshop in February.

4.2 Interdisciplinary Space Weather (GJFEH)

Co-Chair for G: I. Stanislawska (Poland) Co-Chair for J: R. Fallows (Netherlands)

Written report was tabled (attachment 1)

4.3 URSI/IAU Inter-Union Working Group on Historical Radio Astronomy *Chair: Richard Schilizzi, Vice-Chair: Leonid Gurvits, Past Chair: Richard Wielebinski, Secretary: Ken Kellermann*

Richard Schilizzi gave a presentation that reminded the commission of the goals of the WG, provided an update on its publications and conferences, and gave an overview of the memoirs added to the archive of the WG in the last triennium. The material of the WG is collected on <u>http://rahist.nrao.edu</u>. The working group intends to continue its activities in the next triennium and has, e.g., 10 books already in press or in preparation. The presentation was tabled (attachment 2).

4.4 URSI/IUCAF Inter-Union Working Group on Radio Science Services

Chair: H. Liszt (USA)

Harvey Liszt gave an update on the Scientific Committee on Frequency Allocations for Radio Astronomy and Space Science (IUCAF). IUCAF was set up by URSI, IAU and COSPAR and is chartered by the ISC. He then went through the main points of the quadrennial report of WG over the period 2017-2021. A written report on IUCAF was tabled (attachment 3).

5. Updates to Terms of Reference of Commission

The current Terms of Reference were reviewed. No changes were proposed.

6. Meetings proposed to be supported in the coming triennium

The Commission will support RFI 2022 (14-18 February, Reading UK) with \notin 600. Support for further meetings will be considered at URSI-AT in May, or between meetings as necessary, with a preference to support young scientists where possible.

7. Report and comments on the scientific program of the Commission for the current GASS

The scientific program was successful and well received. However, convenors had the impression that total (local and remote) participation in individual sessions was less than might have been expected in the traditional format. Possibly this is because people outside the European timezone joined only for key talks.

Commission J has had feedback that the cost charged for virtual participation is out of step with what is charged by other meetings attended by Radio Astronomers, and that convenors struggled to retain participants who were price-sensitive. Further, a "hybrid" format that requires most virtual participants worldwide to participate during the night for several days does not appear attractive in comparison to a virtual format that is timezone independent.

Commission J understands that some participants may be attracted by the possibility of a refereed IEEE Conference paper and willing to pay a higher registration fee on this basis. However, this does not appear to be a factor for Commission J authors. URSI may wish to consider a lower fee for those whose primary interest is sharing ideas with peers at the meeting and who do not publish in the proceedings.

One suggestion is to target some meetings (e.g. GASS) at in-person attendance (with "back up" virtual participation) while others (perhaps URSI-AT?) are entirely virtual with lower registration fees and a format conducive to multiple timezones. URSI may also wish to benchmark proposed future meetings against competing events such SPIE Telescopes and Instrumentation, the American Astronomical Society or the USNC URSI meeting in Boulder.

Detailed feedback on the meeting format has already been forwarded to the Secretariat by the outgoing Chair.

8. Proposed sessions for the next GASS

Preliminary list of topics (to be finalised, with convenors, at AT-RASC)

- New Telescopes
- Radio Astronomy from Space
- Single Dish Telescopes and Instrumentation
- Very Long Baseline Interferometry
- Antennas and Receivers
- Scientific data processing in Radio Astronomy
- Digital systems for Radio Astronomy
- One or two topical sessions on science themes and related techniques (HI, early universe, time-domain astronomy, etc)
- Mitigation of Radio Frequency Interference
- Latest News and Observatory Reports

9. Proposed sessions for the AT-RASC

The following sessions are proposed for AT-RASC

J01: New Telescopes (C. Ferrari, T. Bourke)

- J02: VLBI (F. Colomer, T. Venturi)
- J03: Time-domain astronomy observations and instrumentation (S. Bhandari)
- J04: Cosmological HI observations and instrumentation (N. Razavi-Ghods, D. Price)
- J05: Wide-field radio astronomy (G. Heald, D. Fenech, I. Prandoni)
- J06: Space-based radio astronomy (M. Bentum, M. Klein Wolt)
- J07: Calibration and instrumentation (T. Carozzi, J. Gilmore)
- J08: CEM method for radio astronomy (P. Bolli, D.B. Davidson)

J09: Receiving systems and their components (E. De Lera Acedo, D. Prinsloo)

J10: Big Data and AI in radio interferometry (S.J. Wijnholds, U. Rau, G. Hellbourg, N. Gupta)

J11: Latest new and observatory reports (open session) (D. Bock, S.J. Wijnholds)

JE: EMC issues in integration of digital and analog electronics (C. Carobbi, K. Buch, A. Tzioumis)

JG: Mutual Benefit between radio astronomy and ionospheric science (M. Mevius, C. Cesaroni)

JH: Solar, heliospheric and planetary physics (P. Zucca, P. Galopeau)

10. Other business

The meeting :

- Thanked Dr. Bradley and Prof. Wijnholds for their service as Chair and ECR representative, respectively, and welcomed the incoming officers.
- Supported the establishment of the URSI Women in Radio Science Committee and the opportunities for increasing diversity broadly in radio science.
- Discussed the hybrid format of the meeting and agreed that Dr. Bradley would provide feedback to URSI Presidency.
- Reviewed the existing arrangement whereby the Chair convening ad hoc specialise working groups as necessary and agreed this remained appropriate. A standing technical advisory committee is not required at this time.
- Noted that Commission J participated in drafting an URSI resolution to support the elimination of leap seconds to correct UT1 UTC.

COMMISSION K - ELECTROMAGNETICS IN BIOLOGY & MEDICINE

1. Results of Election of Vice-Chair

There were two candidates for the position of Commission K Vice Chair: Prof. Francesca Apollonio (Sapienza University of Rome, Italy) and Dr. Lars Ole Fichte (Helmut Schmidt University, Germany). An online voting tool was used for elections this time. Total 14 Official Members participated in the voting. After the voting tool was closed, the URSI Secretariat announced the results that Prof. Francesca Apollonio received 28 votes and Dr. Lars Ole Fichte received 14 votes. The Council confirmed on August 31 that Prof. Apollonio was elected Vice Chair.

2. Results of Election of Early Career Representative

There was one candidate for the position of Commission K ECR: Dr. Emily Porter (University of Texas at Austin, USA). An online voting tool was used for elections this time. Total 14 Official Members participated in the voting. After the voting tool was closed, the URSI Secretariat announced the results that Dr. Emily Porter received 28 votes. The Council confirmed on August 31 that Dr. Porter was elected ECR.

Dr. Kensuke Sasaki (NICT, Japan), the incumbent ECR, agreed to continue serving ECR for his second term.

3. Appointment of Associate Editor for Radio Science Bulletin

Dr. Emily Porter, newly elected ECR, was appointed as Associate Editor for *Radio Science Bulletin*.

4. Updates/Status of Working Groups

Commission K has no working groups at the moment. We may create working groups if necessary.

5. Updates to Terms of Reference of Commission

The current Commission K terms of reference are as follows: The Commission is charged with promoting research and development in the following domains:

- Physical interaction of electromagnetic fields (from static to optical) with biological systems;
- Biological effects of electromagnetic fields;
- Mechanisms underlying the effects of electromagnetic fields;
- Exposure systems of experimental electromagnetic fields;
- Assessment of human exposure to electromagnetic fields;
- Medical applications of electromagnetic fields.

Commission K has no changes to the current terms of reference at this moment. However, they have not been updated since 2008.

At our Commission Coordinating Activities meetings during GASS 2021, we had intensive discussion on this issue, but finally it is concluded that we will carry over the discussion to further meetings, particularly Technical Advisory Committee meetings.

6. Meetings proposed to be supported in the coming triennium

Besides URSI flagship conferences, namely, AT-AP-RASC 2022 and GASS 2023, we may propose to support meetings relevant to Commission K, if we deem necessary or appropriate.

7. Report and comments on the scientific program of the Commission for the current GASS

Commission K organized 15 scientific oral sessions (70 papers in total) and 2 FIP (Flash Interactive Poster) sessions (22 papers in total). Commission K served the lead Commission in 5 oral sessions (21 papers in total) that were jointly organised with Commission B (KB1 and KB2), Commissions B and E (KBE), Commission D (KD), and Commission E (KE). In addition, Commission K participated in 4 other joint sessions led by Commissions B, C, D, and F.

Moreover, Commission K organized a Workshop "Pulsed electric fields: from molecular interactions to medical treatments" as a Pre-Conference activity during the whole day of Saturday, August 28, which had a good level of attendance. Total 10 papers were presented.

The Commission K Tutorial "ICNIRP guidelines on RF EMF human exposure limitations" was presented by Prof. Rodney Croft of University of Wollongong, Australia. The organized sessions have covered conventional topics of Commission K; e.g., biological effects of electromagnetic fields, assessment of human exposure for nonionized radiation protection, and medical applications of electromagnetic fields. In addition, Commission K newly convened sessions of animal and cell experiments by exposure to electromagnetic fields and of healthcare and rehabilitative application.

Overall, the sessions organized by Commission K were considered to be successful with high-quality presentations as well as session chairs with expertise in the area of research on each session topic.

Despite the hybrid organization of the whole conference allowing both on-site and on-line participants, the physical presence was considered satisfactory reaching for some sessions the number of around 20 attendees in presence.

All the oral and FIP sessions have been recorded and are available from the Virtual Platform (https://ursigass2021.livebit.it/index.php) in the section "On Demand".

8. Proposed sessions for the next GASS

Regarding scientific sessions to be organized for the next GASS 2023, we will have to take into account the importance of joint sessions with other Commissions. So far, no specific sessions have been proposed for the next GASS since our discussion was mainly on the proposed sessions for AT-AP-RASC 2022.

Furthermore, we need to bear in mind that we are discussing updates to the terms of reference and the next GASS 2023 will be held in Japan.

9. Proposed sessions for the AT-AP-RASC 2022

For organizing scientific sessions, Commission K has enhanced cooperation with other organizations/ communities and has also emphasized joint sessions with other Commissions. These points must be advantages of URSI.

Having said that, we need to bear in mind that two major international conferences, whose topics are partly similar to the scope of Commission K, are scheduled in Asia just one week before and two weeks after the AT-AP-RASC 2022.

- 2022 IEEE MTT-S IMBioC, 19–21 May 2022, China
- BioEM2022, 19–24 June 2022, Japan

In our meetings held during URSI GASS 2021, ten provisional topics of scientific sessions and candidates of conveners for AT-AP-RASC 2022 were proposed in addition

to an open session. Potential conveners are supposed to provide brief session descriptions for contributors' convenience.

10. Other business

(1) Information about upcoming major international conferences/events relevant to Commission K

Prof. Jianqing Wang (Nagoya Institute of Technology, Japan) briefly introduced BioEM 2022 to be held in Nagoya, Japan, in June 2022 as one of Co-Chairs. He also requested participants to submit their papers to the conference.

(2) Discussion on the relationship between international conferences and URSI flagship conferences

After the introduction of BioEM 2022, a participant pointed out that kind of coordination should be made between URSI flagship conferences and such major international conferences relevant to Commission K. Some discussion was made on how to coordinate or harmonize these conferences.

Finally, it is concluded that we will carry over the discussion to Technical Advisory Committee meetings.

Contact information for new Commission K Officers (2021-2023)

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ECR 2: Dr. Emily Porter Assistant Professor Department of Electrical and Computer Engineering The University of Texas at Austin EER 4.810, C0803 2501 Speedway, Austin, TX 78712 USA E-mail: emily.e.porter@ieee.org Tel: +1-512-232-8114

RESOLUTIONS AND RECOMMENDATIONS OF THE COUNCIL

R1. Resolution on the need for a continuous reference time scale

The URSI Council,

considering that

- a) the current practice of maintaining the Coordinated Universal Time (UTC) within 0.9 s of the Earth's rotation angle (UT1) by occasional leap second adjustments has been under discussion since the late 1990s;
- b) the Radiocommunication Sector of the International Telecommunication Union (ITU-R) discussed the realization of time scales and dissemination of time signals via radiocommunication systems during its World Radio Conference 2015 (WRC-15) and resolved in Resolution 655 to further and more widely study the various aspects of current and potential future reference time scales, including their impacts and applications, in cooperation with URSI and other relevant international organizations;
- c) in 2018 the 26th General Conference of Weights and Measures (CGPM) formally confirmed in its Resolution 2 the definitions of International Atomic Time (TAI) and Coordinated Universal Time (UTC), and asked all relevant scientific unions and organizations to work together to develop a common understanding on reference time scales and their realization and dissemination, with a view to considering the present limitation on the maximum magnitude of UT1 UTC so as to meet the needs of the current and future user communities;
- d) URSI Commission A organized a wider consultation with experts from various fields to request their opinions on the adoption of a continuous reference time scale,

noting that

a) the insertion of leap seconds has led to serious problems and breakdowns in contemporary applications, such as satellite navigation, distributed measurement systems, and computer networks, that require a continuous time reference.

- b) in an attempt to minimize these problems, several actions have been put into practice by different users, either using a non-standard continuous time reference (i.e., GPS time), or adopting different procedures to synchronize to UT1.
- c) these actions have in turn caused confusion and errors for the users;
- d) due to ambiguity during the insertion of a leap second, the metrological traceability to UTC that is required by some users is frequently not realized;
- e) there are still concerns about unforeseeable effects caused by changing the current method of maintaining UTC to agree with UT1 within 0.9 s;
- f) UT1 is necessary for applications in the space industry, Earth-based observations, for transformation between fixed and rotating reference systems, and for these applications real-time UT1 signal dissemination is needed;
- g) the definitive values of UT1 UTC are provided by the International Earth Rotation and Reference Systems Service (IERS) on the internet, and are also available via other time dissemination techniques by radio signals, Global Navigation Satellite Systems, and Internet time protocols;
- h) TAI should not be considered as an option to achieve a continuous reference time scale since in its present form it provides only a frequency reference and is not disseminated by clocks,

recognizing that

- a) URSI passed the URSI Resolution of Strengthening the URSI and ITU relationship in its General Assembly in Lille, 1996, and resolved that the board shall work with ITU in the identification of topic areas of mutual concern, and prepare URSI statements on such topics in an appropriate form;
- b) an URSI-wide working group was formed in 2002 and the risks that the occasional leap-second adjustments might cause were identified;
- c) Commission A (Electromagnetic Metrology) of URSI expressed its opinion in 1999 that the procedure of leap-second insertions should be stopped and thus UTC should become a continuous reference time scale, and that this position was confirmed in 2014 by a Resolution of Commission A,

resolves for URSI to make the following statements:

1) All Global Navigation Satellite Systems are requested to consider broadcasting UT1 - UTC to a precision of a millisecond or better, within the constraints of their available funding and development latencies. In addition, systems providing UT1 - UTC over the Internet should be hardened against cyber-attacks and should be supplemented with additional secondary sources for users who only require annual knowledge of UT1 - UTC;

- 2) There are various risks caused by the adjustment of leap seconds on UTC that are not predictable over the long term.
- 3) A unique and continuous reference time scale is essential for scientific research and related activities in Radio Science.
- 4) Many of the technological concerns associated with adapting systems and software can be solved, and that challenge can be justified in comparison to the scientific and operational benefits of a continuous reference time scale.
- 3) Therefore, the present limitation on the maximum magnitude of UT1 UTC should be withdrawn after a suitable period of public notice provided that real-time UT1 – UTC dissemination is achieved and that no currently unforeseen problem is identified before 2023.

R2. Resolution on the Strengthening of the URSI and ITU relationship

The URSI Council,

considering

- a) that URSI should play a role in the advancement of telecommunications science in general;
- b) that the activities of URSI include the study of topics relevant to the advancement of telecommunications, some of which are of direct interest to the International Telecommunications Union (ITU);

resolves

that the Board shall form an URSI-ITU Inter-Commission Working Group that will:

- 1) work within the ITU organisation to identify those areas that may influence the evolution of telecommunications in the long term;
- 2) keep the URSI community informed on specific questions posed by ITU study groups and WRC Agenda items and particularly those falling under the purview of expertise within the URSI Commissions;
- 3) stimulate and coordinate studies, collaborations, and symposia that will address these ITU questions and prepare URSI statements on such topics in an appropriate form;
- 4) establish task groups or other mechanisms as appropriate to undertake the above tasks.

R3. Resolution on renaming the Auger effect

The URSI Council,

Considering

- a) that Lise Meitner made many fundamental contributions to our knowledge of atomic physics, including but not limited to the discovery of nuclear fission,
- b) that her contributions were important to the development of atomic physics, which is basic to the work of many URSI Commissions,
- c) that in 1922 she discovered and published the fact that electrons could be expelled from their orbitals as a byproduct of the expulsion of an inner-shell electron,
- d) that one year later, Pierre Auger discovered the same effect, which was named after him, along with the related terms Auger electrons and Auger peaks,
- e) that the Auger effect is defined by in the International Union of Pure and Applied Chemistry as "The emission of an <u>electron</u> from an <u>atom</u> accompanying the filling of a vacancy in an inner electron shell" (<u>https://goldbook.iupac.org/terms/view/A00520</u>)
- f) that the Auger effect is routinely used in fields of concern to URSI (R.F. Martin and L.E. Feinendegn, "The quest to exploit the Auger effect in cancer radiotherapy, a reflective review", *International Journal of Radiation Biology*, **92**, 2016)
- g) that a resolution was passed by Commission A in 2018 supporting the consideration of renaming the Auger effect to include Meitner's name;
- h) that in September 2019 a refereed letter was published in *Physics Today* suggesting that the Auger effect be renamed the Auger-Meitner effect,
- that a refereed article by Heinz-Eberhard Mahnke has appeared in the September 9, 2020, issue of *Notes and Records: the Royal Society's Journal of the History of Science*, arguing that the primary energy source was a radiationless atomic transition and, on this basis, that it is better that Meitner's name be attached only to electrons of radiationless origin, which could be named Meitner-Ellis electrons to honour also the contributions of the physicist Charles Ellis.
- j) and that the corollary of Dr. Mahnke's assertion is that the definition of the Auger effect would need to be revised to exclude the possibility of renaming it to recognize Lise Meitner's contribution.

Whereas

It is universally agreed that Meitner's basic contribution, irrespective of the excitation source, was to recognize that the energy spectrum of the electrons she observed carries the signature of the binding energies of the orbital electrons.

resolves

That it shall communicate to the appropriate professional organizations, including but not limited to the American and European Physics Societies, that they consider appropriate action be taken to recognize Lise Meitner's contributions. Our preference is to rename the Auger effect the Auger-Meitner effect, but Dr. Mahnke's counter-proposal is also worthy of serious consideration.

R4. Recommendation for the Establishment of Women in Radio Science Committees

The URSI Council,

Considering

- a) That women have played and continue to play an important role in radio science, but have generally been under-represented in proportion to men in the field;
- b) That it is in the best interest of URSI to encourage and support more women in pursuing careers in radio science;
- c) That the US National Committee for URSI has formed a Women in Radio Science (WIRS) Committee with the stated vision "To promote inclusivity, gender diversity, and technical excellence in the radio-science community;"
- d) That the formation of similar committees to mentor and support women in areas of science and engineering has been successful in such endeavours in other learned organizations;

recommends

That the URSI Board and Council strongly encourage and support the establishment of Women in Radio Science committees under all URSI Member Committees, with a similar URSI Women in Radio Science Committee to coordinate such activities across the Member Committees.

R5. Membership dues

The URSI Council,

Considering,

- 1. that the previous Council's decision specifies that Member dues shall be adjusted for inflation each year;
- 2. that annual inflation in many Member Committees has been in the range of 1% to 3% over the past triennium;

resolves

that URSI shall increase the membership dues by 1% per annum.

R6. Membership Status of Argentina, Bulgaria, Chile, Greece, Iraq, Singapore, and Ukraine

The URSI Council,

Considering,

- 1. that Argentina, Bulgaria, Chile, Greece, Iraq, Singapore, and Ukraine are currently Associate Members of URSI;
- 2. that Singapore requested to keep its current Associate status;
- 3. that URSI would like to continue relations with them;

resolves

to maintain Argentina, Bulgaria, Chile, Greece, Iraq, Singapore, and Ukraine as Associate Members of URSI.

R7. 36th General Assembly and Scientific Symposium

The URSI Council, having considered the invitation for the 36th General Assembly and Scientific Symposium that was submitted by the URSI Member Committee from Poland (Krakow),

resolves

to accept the invitation of the Polish URSI Committee to hold the 36th General Assembly in Krakow in August 2026.

R8. Vote of thanks to Italian committee

The URSI Council,

resolves unanimously to convey to the Italian Member Committee its warm thanks and appreciation for the organization of the 33rd and 34thGeneral Assemblies and Scientific Symposia in Rome during the difficult times of a worldwide pandemic.

RÉSOLUTIONS ET RECOMMANDATIONS DU CONSEIL

R1. Résolution sur la nécessité d'une échelle de temps de référence continue

Le Conseil de l'URSI,

Considérant que

- a) la pratique actuelle de maintien du Temps universel coordonné (UTC) à moins de 0,9 s de l'angle de rotation de la Terre (UT1) par des ajustements occasionnels de secondes intercalaires est en discussion depuis la fin des années 90;
- b) le secteur des Radiocommunications de l'Union internationale des télécommunications (UIT-R) a discuté de la réalisation d'échelles de temps et de la diffusion de signaux horaires à travers les systèmes de radiocommunications lors de la Conférence mondiale des radiocommunications en 2015 (CMR-15) et a décidé dans sa Résolution 655 de poursuivre plus largement l'étude des divers aspects de l'échelle de temps de référence actuelle et des échelles de temps potentielles futures, y compris leurs impacts et applications, en coopération avec l'URSI et d'autres organisations internationales pertinentes ;
- c) en 2018 la 26[°] Conférence générale des poids et mesures (CGPM) a officiellement confirmé dans sa Résolution 2 les définitions du Temps atomique international (TAI) et du Temps universel coordonné (UTC), et a demandé à toutes les organisations et Unions scientifiques de travailler ensemble afin de parvenir à une compréhension commune des échelles de temps de référence, de leur réalisation et de leur dissémination, l'objectif étant d'examiner les limites actuelles de l'amplitude maximale de UT1 UTC afin de répondre aux besoins des communautés d'utilisateurs actuelles et à venir ;
- d) la Commission A de l'URSI a organisé une large consultation d'experts dans les divers domaines pour connaître leur avis sur l'adoption d'une échelle de temps de référence continue,

remarquant que

- a) l'insertion de secondes intercalaires a conduit à des problèmes sérieux et à des pannes dans les systèmes contemporains qui ont besoin d'une référence de temps continue, telles que la navigation par satellites, les systèmes de mesures distribués et les réseaux informatiques ;
- b) A titre de tentative pour minimiser ces problèmes, plusieurs actions ont été mises en œuvre par divers utilisateurs, soit par l'usage d'une référence de temps continue non standard (i.e., temps du GPS), ou en adoptant diverses procédures pour se synchroniser à UT1;
- c) ces actions ont de leur côté créé de la confusion et des erreurs pour les utilisateurs ;
- d) en raison de l'ambiguïté portant sur l'insertion d'une seconde intercalaire, la traçabilité métrologique à l'UTC qui est exigée par certains utilisateurs n'est souvent pas réalisée ;
- e) il y a encore des inquiétudes sur des effets non prévus causés par la modification de la méthode actuelle de maintien de l'UTC pour rester en accord avec UT1 à moins de 0,9 s;
- f) UT1 est nécessaire pour des applications dans l'industrie spatiale, les observations à partir de la Terre, pour la transformation entre les systèmes de référence fixes et rotatifs ; et que pour ces applications la dissémination de UT1 en temps réel est nécessaire ;
- g) les valeurs définitives de UT1- UTC sont fournies par le Service International des Systèmes de Références et de la Rotation de la Terre (IERS) sur internet, et sont aussi disponibles à travers d'autres techniques de dissémination par signaux radio, par des systèmes de navigation globale par satellites, et par des protocoles de temps internet;
- h) le TAI ne devrait pas être considéré comme une option pour réaliser une échelle de temps de référence continue puisque sous sa forme actuelle il ne fournit qu'une référence de fréquence et n'est pas disséminé par les horloges,

reconnaissant que

- a) l'URSI a fait passer la Résolution URSI de renforcement des relations entre l'URSI et l'UIT dans son Assemblée Générale à Lille, 1996, et a décidé que le Bureau travaillerait avec l'UIT sur l'identification de sujets précis d'intérêt mutuel, et préparerait des déclarations de l'URSI sur de tels sujets sous forme appropriée ;
- b) un groupe de travail élargi de l'URSI a été formé en 2002 et les risques que les ajustements occasionnels de secondes intercalaires pourraient causer ont été identifiés;
- c) la Commission A (Métrologie Electromagnétique) de l'URSI a exprimé en 1999 l'avis que la procédure d'insertion de secondes intercalaires devrait être stoppée et donc que l'UTC devrait devenir une échelle de temps de référence continue, et cette position a été confirmée en 2014 par une Résolution de la Commission A,

décide de faire au nom de l'URSI les déclarations suivantes :

- Il est demandé à tous les systèmes de navigation globale par satellites de prendre en considération la diffusion large de UT1 – UTC avec une précision d'une milliseconde ou mieux, compte tenu de leurs contraintes financières et de leurs temps de développement. De plus, les systèmes fournissant UT1 – UTC sur Internet ont besoin d'être renforcés contre les cyber-attaques et devraient être complétés de sources secondaires additionnelles qui répondraient aux besoins des utilisateurs de connaître l'écart UT1 – UTC sur une base annuelle ;
- 2) il y a divers risques causés par l'ajustement de secondes intercalaires sur l'UTC qui ne sont pas prédictibles sur le long terme ;
- 3) une échelle de temps de référence unique et continue est nécessaire pour la recherche scientifique et les activités connexes en Sciences de la Radio ;
- 4) de nombreuses inquiétudes technologiques associées avec le besoin d'adapter les systèmes et les logiciels peuvent être résolus, et le défi est justifié compte tenu des bénéfices scientifiques et opérationnels d'une échelle de temps de référence continue ;
- 5) en conséquence, la limitation actuelle de l'amplitude maximale de UT1 UTC devrait être retirée, après une période souhaitable d'information publique pour autant que la dissémination en temps réel de UT1 – UTC soit réalisée et qu'aucun problème rédhibitoire ne soit constaté d'ici 2023.

R2. Résolution sur le renforcement des liens entre l'URSI et l'UIT

Le Conseil de l'URSI,

considérant

- a) que l'URSI devrait jouer un rôle dans les progrès de la science des télécommunications en général;
- b) que les activités de l'URSI incluent l'étude des sujets relatifs aux progrès des télécommunications, certains étant d'intérêt direct pour l'Union Internationale des Télécommunications (UIT);

décide

que le Bureau mettra en place un Groupe de Travail Inter-Commissions URSI-UIT qui:

- 1) travaillera au sein de l'UIT pour identifier les domaines qui peuvent impacter l'évolution des télécommunications sur le long terme ;
- 2) tiendra la communauté URSI informée des questions spécifiques posées par les

groupes d'études de l'UIT et des points à l'agenda de la Conférence Mondiale des Radiocommunications, particulièrement ceux qui s'inscrivent dans les domaines d'expertise des Commissions de l'URSI ;

- stimulera et coordonnera les études, les collaborations et les symposiums qui concerneront ces sujets de l'UIT et préparera les déclarations de l'URSI sur de tels sujets sous forme appropriée ;
- 4) établira des groupes dédiés à certaines tâches ou d'autres mécanismes appropriés pour réaliser ces tâches.

R3. Résolution sur le changement de nom de l'effet Auger

Le Conseil de l'URSI,

Considérant

- a) que Lise Meitner a effectué de nombreuses contributions fondamentales pour nos connaissances en physique atomique, incluant, mais pas seulement, la découverte de la fission nucléaire,
- b) que ses contributions ont été importantes pour le développement de la physique atomique, qui est essentielle aux travaux de nombreuses Commissions de l'URSI,
- c) qu'en 1922 elle découvrit et publia le fait que des électrons pouvaient être expulsés de leur orbitale comme sous-produit de l'expulsion d'un électron d'une couche interne,
- d) qu'un an plus tard, Pierre Auger découvrit le même effet, qui fut intitulé d'après son nom, en même temps que les termes connexes électrons Auger et pics Auger,
- e) que l'effet Auger est défini par l'Union Internationale de Chimie Pure et appliquée comme "L'émission d'un <u>électron provenant d'un atome</u> accompagnant le remplissage d'une lacune dans une couche électronique interne" (<u>https://goldbook.iupac.org/terms/view/A00520</u>)
- f) que l'effet Auger est couramment employé dans des domaines d'intérêt pour l'URSI (R.F. Martin and L.E. Feinendegn, 'The quest to exploit the Auger effect in cancer radiotherapy, a reflective review', *International Journal of Radiation Biology*, 92, 2016)
- g) qu'une résolution a été passée par la Commission A en 2018 soutenant la prise en considération de changement de nom de l'effet Auger pour inclure le nom de Meitner;
- h) qu'en septembre 2019 une lettre a été publiée dans la revue à comité de lecture *Physics Today*, suggérant que l'effet Auger soit renommé l'effet Auger-Meitner,
- i) qu'un article de revue à comité de lecture par Heinz-Eberhard Mahnke a été publié dans le numéro du 9 septembre 2020, provenant des *Notes and Records: the Royal Society's Journal of the History of Science*, argumentant que la source d'énergie primaire était une transition atomique non rayonnante et que, sur cette base, il était préférable que le nom de Meitner soit attaché seulement aux électrons d'origine non

rayonnante, qui pourraient être intitulés électrons Meitner-Ellis pour honorer aussi les contributions du physicien Charles Ellis.

 j) et que le corollaire de l'affirmation du Dr. Mahnke soit que la définition de l'effet Auger aurait besoin d'être revue pour exclure la possibilité de le renommer dans le but de reconnaître la contribution de Lise Meitner.

Tandis que

Il est universellement accepté que la contribution principale de Meitner, indépendamment de la source d'excitation, a été de comprendre que le spectre énergétique des électrons qu'elle a observés portait la signature de l'énergie de liaison des électrons orbitaux.

décide

qu'il demandera aux organisations professionnelles appropriées, incluant mais pas seulement les sociétés de physique américaines et européennes, que celles-ci étudient des actions adaptées pour reconnaître les contributions de Lise Meitner. Notre préférence est de renommer l'effet Auger 'effet Auger-Meitner', mais la contre-proposition du Dr. Mahnke mérite également une réelle prise en considération.

R4. Recommandation pour faire participer les femmes dans les comités sur les Radiosciences

Le Conseil de l'URSI,

Considérant

- a) que les femmes ont joué et continuent de jouer un rôle important dans les sciences de la radio, mais qu'elles ont en général été sous-représentées en proportion des hommes dans les domaines concernés ;
- b) qu'il est de l'intérêt bien compris de l'URSI d'encourager et de soutenir un nombre plus grand de femmes à poursuivre des carrières en radiosciences ;
- c) que le comité national américain pour l'URSI (USNC-URSI) a établi un comité pour les femmes dans les sciences de la radio (WIRS) avec comme philosophie de "promouvoir l'inclusion, la diversité de genre, et l'excellence technique dans la communauté des radiosciences";
- d) que la création de comités similaires pour accompagner et soutenir les femmes dans les radiosciences et l'ingénierie a été couronnée de succès pour ces entreprises dans d'autres organisations connues ;

recommande
que le Bureau et le Conseil de l'URSI encouragent fortement et soutiennent la création de comités de femmes en radiosciences dans tous les comités membres de l'URSI, avec l'aide d'un comité pour les femmes en radiosciences au niveau de l'URSI qui en coordonnerait les activités.

R5. Cotisations des membres

Le Conseil de l'URSI,

considérant,

- 1. que la précédente décision du Conseil précise que les cotisations des membres doivent être réévaluées chaque année pour la prise en compte de l'inflation
- que l'inflation annuelle, pour une majorité de pays membres a été de l'ordre de 1% à 3% au cours de la dernière période triennale;

décide

que l'URSI augmentera les cotisations de 1% par an.

R6. Statut de l'Argentine, du Chili, de la Grèce, de l'Irak et de Singapour au sein de l'URSI

Le Conseil de l'URSI,

Considérant,

- 1. que l'Argentine, la Bulgarie, le Chili, la Grèce, l'Irak, Singapour et l'Ukraine sont actuellement membres associés de l'URSI ;
- 2. que Singapour a demandé à conserver son statut actuel de membre associé ;
- 3. que l'URSI souhaite poursuivre les relations avec eux ;

décide

de maintenir l'Argentine, la Bulgarie, le Chili, la Grèce, l'Irak, Singapour et l'Ukraine comme membres associés de l'URSI.

R7. 36ème Assemblée générale et symposium scientifique

Le Conseil de l'URSI, ayant examiné la proposition d'organiser (à Cracovie) la 36ème Assemblée générale au Symposium scientifique qui a été soumise par le Comité polonais, membre de l'URSI,

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décide

d'accepter la proposition du Comité polonais de l'URSI à tenir la 36ème Assemblée générale à Cracovie en août 2026.

R8. Remerciements au comité italien

Le Conseil de l'URSI,

décide à l'unanimité de transmettre au comité membre italien ses chaleureux remerciements et sa reconnaissance pour l'organisation des 33ème et 34ème Assemblées générales et symposiums scientifiques à Rome, dans les moments difficiles d'une pandémie mondiale.