



**Monthly Newsletter of International URSI Commission J – Radio Astronomy**  
January 2018

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**News Items**

Greetings Commission J Members!

Reminder - the abstract deadline for the 2018 URSI Atlantic Radio Science Conference (2018 AT-RASC) is January 10, 2018! We encourage you to present your research findings or project updates at the AT-RASC in May. A limited amount of travel support is available for students and Young Scientists - please see the AT-RASC article and website for details. If you have questions or concerns regarding a particular session please feel free to contact the session convener.

The “Book Shelf” this month features a new release by Jaap Baars and Hans Kärcher. A brief synopsis of the book’s content is included in the Newsletter.

This month, we highlight *Radio Science*, the journal that is co-sponsored by URSI. Its origin dates back to the *Journal of Research of the National Bureau of Standards* (now NIST) that has been published since 1904. Its Section D (Radio Propagation, 1959-1963, *Radio Science*, 1964-1965; ) was continued as the journal *Radio Science* since 1966. Over the past several years, quite a few radio astronomy papers have appeared in *Radio Science* spanning a wide range of topics. Phil Wilkinson, Editor in Chief of *Radio Science*, gives us an overview of the journal and provides a listing of recently published papers that may be of interest to Commission J members. Please keep *Radio Science* in mind when considering where to publish your latest research findings!

All this and a photo, too! I hope you’re finding the Newsletters both interesting and informative - your comments and suggestions are always welcome.

*Submitted by R. Bradley*

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## **2018 URSI Atlantic Radio Science Conference (2018 AT-RASC)**

28 May – 1 June 2018, ExpoMeloneras Convention Centre, Gran Canaria

Submission deadline: January 10, 2018

<http://mailchi.mp/intec/submission-for-at-rasc-2018-is-now-open-pprh9v00w2?e=6dc54cab9b>

### **J.1 *Software Enabled Radio Astronomy***

Richard Prestage, Cedric Viou, Alessandra Zanichelli

The worldwide astronomy community is pushing forward on an unprecedented scale to create large aperture and dense low frequency arrays. Single-dish telescopes are being equipped with phased array feeds, ultra-wideband receivers, real-time fast radio burst detectors, and other advanced digital instrumentation. This new generation of telescopes and instrumentation share the need for exceptionally sophisticated signal processing algorithms, and we are entering the era of “software enabled radio astronomy”. This session will focus on the research challenges and latest approaches in the field of heterogeneous FPGA / CPU / GPU software development, including algorithms for array calibration, beamforming, imaging, and radio frequency interference mitigation.

### **J.2 *Large N Aperture Arrays***

Eloy de Lera Acedo, Kris Zarb Adami

This session will cover different aspects on the design and operation of large N arrays for modern radio astronomy in the era of SKA (eg. SKA1-LOW, HERA, MWA, LOFAR, etc). The session will cover aspects of both the antenna arrays, RF chains, digital beam forming, science data processing and science goals of these instruments.

### **J.3 *Pattern Recognition Applications in Radio Astronomy***

Abhi Datta, David Rapetti

With the advent of next generation radio telescopes like the Hydrogen Epoch of Reionization Array (HERA), the Square Kilometer Array (SKA) and the next generation Very Large Array (ngVLA), we expect the radio sky to be surveyed at unprecedented sensitivity. While observations with these telescopes should bring in a paradigm shift in our knowledge of the radio sky, this also comes with unprecedented data volume. For example, the SKA is expected to produce more than tens of terabytes of data per second at its fullest capability. Manual processing of this amount of data is not feasible. Hence, automation in data processing and the use of pattern recognition and machine learning techniques to extract the wealth of scientific information from such a Big Data set are critical. Machine learning algorithms such as support vector machines (SVM), K-nearest neighbors (KNN), decision trees, neural networks and deep neural networks are already in use in radio astronomy. This session will focus on the recent advances, challenges and future prospects of this field of research.

### **J.4 *Novel Instrument Concepts and Observational Challenges***

Douglas Bock, Richard Bradley

This session is designed to capture new work that may NOT fit into other sessions. Novel ideas that can be applied to instruments, signal processing, or observational strategies that have the potential for improving measurements are welcome, including requests for specialized instrumentation or techniques that could solve a challenging astronomical measurement requirement.

### J.5 *Detecting Hydrogen Near and Far*

Jackie Hewitt, Eloy de Lera Acedo

The first detection of radio emission from neutral hydrogen in an astronomical source, in this case our Galaxy, was accomplished through the pioneering work of Ewen and Purcell in 1951. Since then, the 1.4 GHz line of neutral hydrogen has served as a tracer of astronomical phenomena on many scales. With the recent development of large low frequency radio arrays, there is renewed interest in using this technique to explore a variety of topics at a wide range cosmological redshifts, including for example detecting the first generation of stars and characterizing dark energy. This session will focus on the design and construction of instrumentation aimed at neutral hydrogen studies in the modern cosmological context.

### J.6 *Instruments for Education*

Glen Langston, Kevin Bandura

Progress in radio communications and radio astronomy depends on education of the next generation of engineers and scientists. This session is focused on new and existing instruments enabling students to study the universe with radio techniques. Emphasis is placed on simple instrument designs the students can build. Presenters will describe groups operating these instruments, providing strong connections between technology development and scientific discoveries. The session covers topics of hardware design, curricula for education, student motivation, observing plans and large-scale research projects enabled by distributed groups of researchers.

### J.7 *Mm wave / sub-mm Wave Science and Technology*

Pepe Cernicharo, Juan Daniel Gallego, Rolf Gusten

### **Special Sessions:**

#### *S-JACEFG – Applications for pattern recognition methodologies*

This special interdisciplinary session, dedicated to an important new area of study, is designed to share ideas and experiences among the URSI Commissions. We would like to have one or two presentations from each of the participating Commissions that provide an overview or tutorial on how pattern recognition methodologies are being used or the types of problems for which it might be applied to areas of research within the Commission.

#### *S-EACFJ - Spectrum Management and Utilization*

### **Workshops:**

JB - *Polarimetry of advanced antenna systems in radio astronomy*

JG - *3-D ionospheric models for radio interferometric calibration*

GJEFH - *Space Weather*

The AT-RASC will also include a Young Scientist Program and Student Paper Competition. Please see <http://www.atrasc.com/homepage.php> for additional information.

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## **2019 URSI Pacific Radio Science Conference (2019 AP-RASC)**

*9 -15 March 2019, New Delhi, India*

Plans are underway for the 2019 AP-RASC in New Delhi, India. Please see <http://aprasc2019.com/> for details.

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## **2020 URSI General Assembly and Scientific Symposium (2020 URSI GASS)**

*Rome, Italy*

The site for the next URSI General Assembly and Scientific Symposium has been chosen! Stay tuned for details. If you like to organize a session or workshop at the 2020 URSI GASS please let me know.

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### **Book Shelf**

Jacob W.M. Baars and Hans J. Kärcher

#### **Radio Telescope Reflectors - Historical Development of Design and Construction.**

Published by Springer. 01.12.2017: Astronomy and Space Science Library, vol. 447, 275 pp.

ISBN 978-3-319-65147-7

From the publisher's page:

“This book demonstrates how progress in radio astronomy is intimately linked to the development of reflector antennas of increasing size and precision. The authors describe the design and construction of major radio telescopes as those in Dwingeloo, Jodrell Bank, Parkes, Effelsberg and Green Bank since 1950 up to the present as well as millimeter wavelength telescopes as the 30m MRT of IRAM in Spain, the 50m LMT in Mexico and the ALMA submillimeter instrument. The advances in methods of structural design and coping with environmental influences (wind, temperature, gravity) as well as application of new materials are explained in a non-mathematical, descriptive and graphical way along with the story of the telescopes. Emphasis is placed on the interplay between astronomical and electromagnetic requirements and structural, mechanical and control solutions. A chapter on management aspects of large telescope projects closes the book. The authors address a readership with interest in the progress of engineering solutions applied to the development of radio telescope reflectors and ground station antennas for satellite communication and space research. The book will also be of interest to historians of science and engineering with an inclination to astronomy.”

*Submitted by R. Bradley and J. Baars*

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### **Activities Spotlight**

Radio Science and Commission J

#### **Background for Radio Science**

Radio Science is a journal published by AGU and Co-sponsored by URSI

Radio Science publishes original scientific contributions on radio-frequency electromagnetic-propagation and its applications. Contributions covering measurement, modelling, 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.

It can be accessed at: [http://agupubs.onlinelibrary.wiley.com/hub/journal/10.1002/\(ISSN\)1944-799X/](http://agupubs.onlinelibrary.wiley.com/hub/journal/10.1002/(ISSN)1944-799X/). Papers two calendar years and older are available, free, for download. More recent papers are available on subscription, or on payment of a small fee.

### Past Commission J related papers appearing in Radio Science

Between 2014 to the present (November 2017): there have been 23 papers published in Radio Science of potential interest to Commission J people covering planetary, meteors and antenna arrays. Six of these papers featured on the Journal cover.

Below are the 23 paper titles published in Radio Science 2014 – 2017 (November).

1. March 2014: All-sky imaging of meteor trails at 55.25 MHz with the first station of the Long Wavelength Array
2. April 2014: The 2013 Chelyabinsk meteor ionospheric impact studied using GPS measurements
3. July 2014: Simulation of radar echoes from Mars' surface/subsurface and inversion of surface media parameters
4. July 2014: Greenland telescope project: Direct confirmation of black hole with sub-millimeter VLBI  
**COVER:** Conceptual drawing of the beam optics in the receiver cabin for the Greenland telescope project.
5. August 2014: Meteor radar wind over Chung-Li (24.9°N, 121°E), Taiwan, for the period 10–25 November 2012 which includes Leonid meteor shower: Comparison with empirical model and satellite measurements
6. November 2014 Monitoring motion and measuring relative position of the Chang'E-3 rover
7. January 2015: Understanding instrumental Stokes leakage in Murchison Widefield Array polarimetry  
**COVER:** A photo of an MWA tile
8. July 2015 Power spectrum analysis of ionospheric fluctuations with the Murchison Widefield Array  
**COVER:** A sample output from the MWA array ionospheric power spectrum analysis.
9. July 2015: Measuring phased-array antenna beampatterns with high dynamic range for the Murchison Widefield Array using 137 MHz ORBCOMM satellites
10. October 2015: A first demonstration of Mars crosslink occultation measurements  
**COVER:** Mars occultation geometry and profiles.

11. February 2016: A new model of amplitude fluctuations for radio propagation in solar corona during superior solar conjunction
12. February 2016: A comparison of atmospheric effects on differential phase for a two-element antenna array and nearby site test interferometer
13. April 2016: On the feasibility of detecting the ionospheric effects of solar energetic particle events at Mars using spacecraft-spacecraft radio links
14. June 2016: A new angle for probing field-aligned irregularities with the Murchison Widefield Array  
**COVER:** MWA geometry for observing ionospheric irregularities
15. July 2016: Probing ionospheric structures using the LOFAR radio telescope
16. July 2016: The Five-hundred-meter Aperture Spherical Radio Telescope (FAST) project
17. October 2016: Juno model rheometry and simulation  
**COVER:** An aerial view of FAST under construction on 26 September 2015
18. February 2017: Chang' E-3 spacecraft surface reflection causes turbulence on VLBI delay
19. April 2017: Development of wideband feed for Kashima 34 m antenna
20. July 2017: Characterizing transient radio-frequency interference
21. September 2017: CLUSIM: A Synthetic Aperture Radar Clutter Simulator for Planetary Exploration
22. October 2017: Temperature Distribution and Influence Mechanism on Large Reflector Antennas under Solar Radiation
23. November 2017: First Detection of Two Near-Earth Asteroids with a Southern Hemisphere Planetary Radar System (Not yet published).

And currently the seventh most cited paper in Radio Science, "The Processing of Electron Density Profiles from the Mars Express MARSIS Topside Sounder" was published in 2013.

### The Invitation

Clearly, radio astronomers are familiar with Radio Science, as the articles above testify. This note is a reminder that Radio Science is interested in radio astronomy; in fact, we seek publications on any application of new science that makes use of the radio spectrum. For instance, more recently, as radio astronomy embraces lower operating frequencies the ionosphere is becoming progressively more important and methods to mitigate its effects will be of immediate interest to the ionospheric community. This highlights the wide range of people who will see papers appearing in Radio Science although, granted, these days visibility in search engines is more important. In that respect, *Radio Science is now abstracted in IEEE Xplore giving Radio Science papers wider visibility.*

Here are some examples of topics that fit well in Radio Science; the list is certainly not exhaustive.

- Any papers that have an ionospheric orientation, either exploring the ionosphere in novel ways using radio astronomy techniques, or seeking to avoid ionospheric degradation (scintillation is a strong theme in Radio Science papers);
- RFI mitigation is a pervasive theme across all disciplines represented in Radio Science and the radio astronomy community has wide experience in dealing with it;
- New and innovative antenna array techniques for improved astronomical observations and the development of new radio astronomical facilities;
- New radio techniques for making solar observation, especially including making observations of the solar wind;
- Novel applications of occultation observations exploring planetary atmospheres;
- Propagation applications from deep space to exploring planetary surfaces.

In addition to research papers, Radio Science accepts review papers that emphasize radio science research applications (in radio astronomy for instance) and in October, Radio Science commenced seeking technical papers. These are shorter papers that describe hardware developments, technology, and experimental methods and other technical advances, including computer programs and instrumentation that represent a significant advance and enable new research.

I look forward to receiving many more papers from the radio astronomy community for publication in Radio Science.

Phil Wilkinson  
Editor in Chief, *Radio Science*

## Photo from the Field



The Greenland Telescope Project has successfully retrofitted its 12-m sub-millimeter antenna at Thule Air Base (TAB) in northwest coast of Greenland. The telescope is completely rebuilt, with many new components, from the ALMA North America Prototype antenna and equipped with a new set of sub-millimeter receivers operating at 86, 230, and 345 GHz, as well as a complete set of instruments and VLBI backends. The telescope is currently under intense testing and will be commissioned for the upcoming global VLBI observations on supermassive blackholes.

*Submitted by Ming-Tang Chen*

If you have an interesting photograph that you wouldn't mind sharing with others in the public domain I encourage you to please send a copy to me along with a brief caption and the person's name to whom I should credit.

