4th URSI AT-RASC, Gran Canaria, 19-24 May 2024

Radio Investigations for Space Environment Research (RISER): an overview of aims and preliminary results

B. Forte* [(1)], M. M. Bisi[(2)], R. A. Fallows[(2)], S. Milan[(3)], D. Jackson[(4)], B. V. Jackson[(5)], D. Odstrcil[(6,7)], O. Chang[(2)], D. Barnes[(2)], M. Bracamontes[(5)]

(1) Department of Electronic and Electrical Engineering, University of Bath, United Kingdom, email: b.forte@bath.ac.uk

(2) RAL Space, United Kingdom Research and Innovation (UKRI) – Science & Technology Facilities Council (STFC) – Rutherford Appleton Laboratory (RAL), Harwell Campus, United Kingdom, e-mails: mario.bisi@stfc.ac.uk, richard.fallows@stfc.ac.uk, Oyuki.Chang@stfc.ac.uk, David.Barnes@stfc.ac.uk

(3) School of Physics and Astronomy, University of Leicester, Leicester LE1 7RH, United Kingdom, email: steve.milan@leicester.ac.uk

(4) Met Office, FitzRoy Road, Exeter, EX1 3PB, United Kingdom, email: david.jackson@metoffice.gov.uk

(5) Department of Astronomy and Astrophysics, University of California, San Diego, La Jolla, California 92093-0424, USA, emails: bvjackson@ucsd.edu, mtbracam@ucsd.edu

(6) George Mason University, Department of Physics and Astronomy, Fairfax, VA, USA. email: dusan.odstrcil@gmail.com

(7) NASA Goddard Space Flight Center, Heliophysics Division, Greenbelt, MD, USA.

Radio wave scintillation arises from the propagation through small-scale plasma density irregularities drifting across the ray path. Scintillation allows to deduce properties about plasma density irregularities that form as a consequence of instability mechanisms, thus allowing to monitor the presence of irregularities during adverse space weather conditions. Due to the variation of scintillation with the radio wave frequency, scintillation observed across a range of radio wave frequencies allows the deduction of properties of irregularities forming over various spatial scales. The observation of scintillation over time provides a monitoring of the temporal variation of plasma density irregularities. Radio telescopes (such as those forming the Low Frequency Array, LOFAR) observe radio wave scintillation from radio waves emitted from radio objects over a wide range of VHF frequencies.

This contribution illustrates the project Radio Investigations for Space Environment Research (RISER), funded by the UK Natural Environment Research Council (NERC). RISER focuses on the diagnostics of the space environment by means of radio wave scintillation observed by LOFAR (Low Frequency Array) radio telescopes at various radio wave frequencies. It aims at improving the accuracy of space weather forecasts by ingesting information about plasma density irregularities occurring at various spatial scales in the inner-heliosphere, as deduced from scintillation observations. The investigation on the coupling between the inner-heliosphere and the magnetosphere-ionosphere system is instrumental to the improvement of space weather forecasts.

This contribution discusses the use of LOFAR VHF scintillation observations as a tool to deduce properties about plasma density irregularities occurring in the inner-heliosphere as well as in the ionosphere. The discussion includes an analysis of various scintillation mechanisms that can characterize the observations, which influence the deduction of properties of plasma density irregularities.