Geophysical Research Abstracts
Vol. 20, EGU2018-10919, 2018
EGU General Assembly 2018

A quantum leap in precision of solar corona electron density models determined from Very Long Baseline Interferometry data

Benedikt Soja (1), Oleg Titov (2), Anastasiia Girdiuk (3), Jamie McCallum (4), Stas Shabala (4), Lucia McCallum (4), David Mayer (3), Matthias Schartner (3), Alet de Witt (5), Fengchun Shu (6), Alexey Melnikov (7), Sang-Oh Yi (8), and Sebastien Lambert (9)

(1) Jet Propulsion Laboratory, California Institute of Technology, Pasadena, United States (bsoja@jpl.nasa.gov), (2) Geoscience Australia, Canberra, Australia, (3) Technische Universität Wien, Vienna, Austria, (4) University of Tasmania, Hobart, Australia, (5) Hartebeesthoek Radio Astronomy Observatory, Krugersdorp, South Africa, (6) Shanghai Astronomical Observatory, Shanghai, China, (7) Institute of Applied Astronomy, Saint Petersburg, Russia, (8) National Geographic Information Institute, Space Geodetic Observatory, Sejong, South Korea, (9) SYRTE, Observatoire de Paris, Paris, France

The solar corona is a dispersive medium for electromagnetic waves. The effect depends on the electron density, which can be determined by multi-frequency measurements. For example, geodetic Very Long Baseline Interferometry (VLBI) measurements were successfully used to estimate electron densities of the solar corona based on twelve VLBI experiments conducted by the International VLBI Service for Geodesy and Astrometry in 2011 and 2012. Parameters of a radial power law describing the solar corona electron density were estimated simultaneously with parameters for the Earth's ionospheric electron content and instrumental delays. The minimum angular distance between radio sources and the Sun resulting in successful observations during the VLBI experiments in 2011/2012 was just below four degrees. Observations with smaller solar elongations failed due to turbulent nature of the corona.

The VLBI experiment AUA020 during May 1-2, 2017, was another attempt to obtain observations at very small solar elongations. Due to the high sensitivity stemming from a recording rate of 1 Gbps and the low solar activity during the experiment, observations at angular distances between 1.15° and 2.6° from the Sun were successfully performed.

In this paper, we present the resulting electron density model of the solar corona from the AUA020 data. The strong coronal signal contained in the observations allowed for a determination of the electron density with unpreceded precision. It was for the first time possible to estimate both power-law parameters (hypothetical electron density at the Sun's surface N0 and the radial falloff parameter β) at the same time. In previous attempts to estimate such a model from VLBI data, the parameter β had to be fixed due to the strong correlation between N0 and β. In a test where the parameter β was fixed like it was done for the data from 2011/2012, the 1-σ formal error for N0 was about an order of magnitude smaller than what had been achieved previously. A comparison of the electron density model from VLBI data with estimates from spacecraft tracking data showed good agreement.