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Probing the Solar Corona with VLBI

Benedikt Soja (1), Jing Sun (1), Robert Heinkelmann (2), Harald Schuh (2), and Johannes Böhm (1)
(1) Vienna University of Technology, Austria, (2) Geoforschungszentrum Potsdam, Germany

Radio observations close to the Sun are sensitive to the dispersive effects of the Sun corona. This has been used to determine (among other parameters) the electron density in the corona during solar conjunctions with spacecrafts. Although geodetic Very Long Baseline Interferometry (VLBI) observations close to the Sun have already been performed before 2002 (but suspended afterwards) they have not yet been used for calculations of corona electron densities. Almost 10 years later the International VLBI Service for Geodesy and Astrometry (IVS) decided to schedule twelve 24 hours VLBI sessions in 2011 and 2012 including observations closer than 15 degrees to the heliocenter. Both the recent and the earlier sessions are analysed in order to determine electron densities of the Sun corona. Based on the ionospheric delay corrections derived from two-frequency VLBI measurements, other dispersive effects like instrumental biases and, most important of all, the Earth's ionosphere effects are estimated and then eliminated. The residual delays are used to successfully determine power-law parameters of the electron density of the Sun corona for several of these sessions. In some cases, scheduled observations close to the Sun had failed, making it impossible to derive meaningful results from them. Both, the successful and the lost observations were analysed including external information like Sunspot numbers and flare occurrences. The estimated electron densities were compared to previous models of the Sun corona derived by radio measurements to spacecrafts during solar conjunctions. Our investigations show that it is possible to use geodetic VLBI sessions with observations close to the Sun to determine electron densities of the corona. The success depends on the geometry, i.e. the source position with respect to the Sun, and on the schedule, which can be optimized for such investigations. Unpredictable disturbances at the Sun's surface, such as flares, play also a role. So far, the VLBI-derived corona parameters have lower quality than those derived from spacecraft-bound measurements. However, the advantage of VLBI is the possibility to monitor the electron density on a regular basis and to create a homogenous time series. This could improve our understanding of time dependent Sun processes.