Space Weather Activities in México

J.A. Gonzalez-Esparza (Regional Coordinator)
E. Aguilar-Rodriguez (National Coordinator)

e-Callisto Solar Spectrometers

Two new e-Callisto (MEXICO-LANCE-A/B) are currently being tested with LWA antennas and are planned to be installed in Baja California state and Mérida City.

Callisto-MEXART is operating normally.

Callisto-FCFM-UANL is close to operating again.

New Digital Backend of MEXART for Space Weather Studies using the Interplanetary Scintillation (IPS) Technique

AGU ADVANCING EARTH AND SPACE SCIENCE
Radio Science
10.1029/2021RS007317

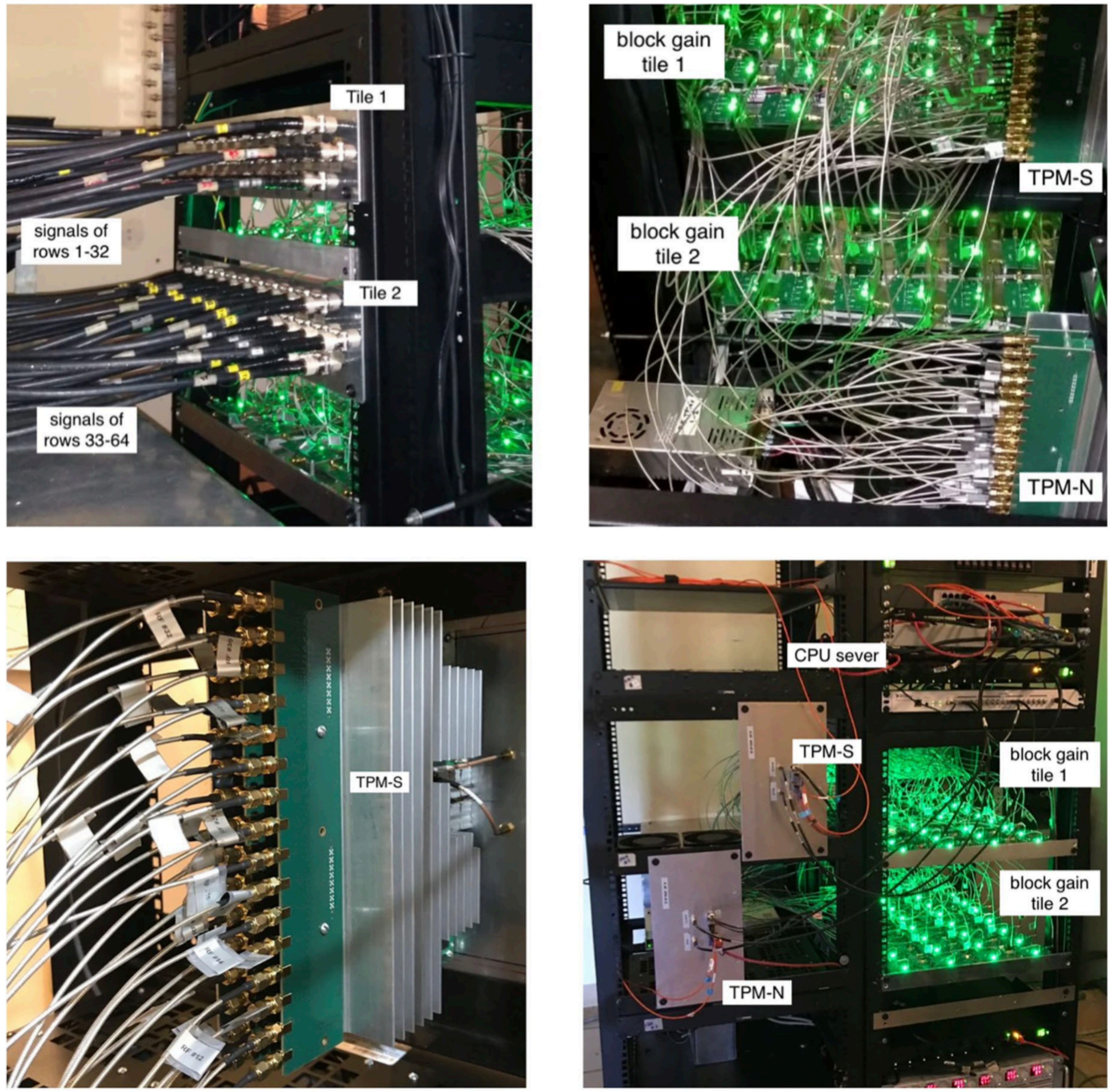

Figure 4. Pictures of the Mexican Array Radio Telescope's digital back-end at the control room.

Radio Science
RESEARCH ARTICLE
10.1029/2021RS007317

First Observations of the New MEXART's Digital System

J. A. Gonzalez-Esparza[1], J. C. Mejia-Ambriz[1,2], E. Aguilar-Rodriguez[1], P. Villanueva[1], E. Andrade[1], A. Magro[3], R. Chiello[4], D. Cutajar[3], J. Borg[3], and K. Zarb-Adami[3,4]

[1]LANCE, Instituto de Geofísica, Unidad Michoacán, Universidad Nacional Autónoma de México, Morelia, México, [2]CONACYT, Instituto de Geofísica, Unidad Michoacán, Universidad Nacional Autónoma de México, Morelia, México, [3]Institute of Space Sciences and Astronomy, University of Malta, Msida, Malta, [4]Department of Astrophysics, University of Oxford, Oxford, UK

Key Points:

- Radio telescope dedicated to the study of solar wind properties and space weather effects using the interplanetary scintillation technique
- The new digital backend has several beamforming configurations, increases the bandwidth, and improves the instrument's sensitivity
- With the new technical capabilities, the instrument can participate in space weather forecasting and other astrophysical studies

Correspondence to:

J. A. Gonzalez-Esparza,
americo@igeofisica.unam.mx

Citation:

Gonzalez-Esparza, J. A., Mejia-Ambriz, J. C., Aguilar-Rodriguez, E., Villanueva, P., Andrade, E., Magro, A., et al. (2022). First observations of the new MEXART's digital system. *Radio Science*, *57*, e2021RS007317. https://doi.org/10.1029/2021RS007317

Abstract The Mexican Array Radio Telescope (MEXART) is a transit instrument mainly dedicated to performing interplanetary scintillation (IPS) observations with a central operating frequency of 139.65 MHz. The main scientific objective is to perform studies of solar wind properties and space weather effects. MEXART initially operated with an analog beam former (16 × 16 Butler matrix), which produced 16 fixed latitudinal beams. MEXART began operations and reported the first measurements of IPS sources. MEXART's beam forming system had several problems, however. The North-South beams had poor directivity, with large side lobes, and the instrument did not achieve the expected performance. Therefore, we commissioned the design and construction of a digital back-end. The digital system solved the problems with the beam forming, increases the bandwidth, and significantly improves the instrument's sensitivity. In this paper, we present the first light of MEXART's digital system. We describe the new technical capabilities of the instrument, and we show some preliminary results: an estimation of the radio telescope's sensitivity ($\Delta S_{min} = 2.28 \pm 0.23$ Jy), the transit of the Galaxy at 140 MHz with the simultaneous tracking of 62 latitudinal beams, and an example of an IPS observation and the single-station methodology for calculating the solar wind speed. The new technical capabilities of the radio telescope will provide the potential for participating in several scientific studies. These include solar wind properties, space weather forecasting, ionospheric perturbations, and astrophysical aims such as the monitoring of repeating fast radio bursts and pulsars' observations.

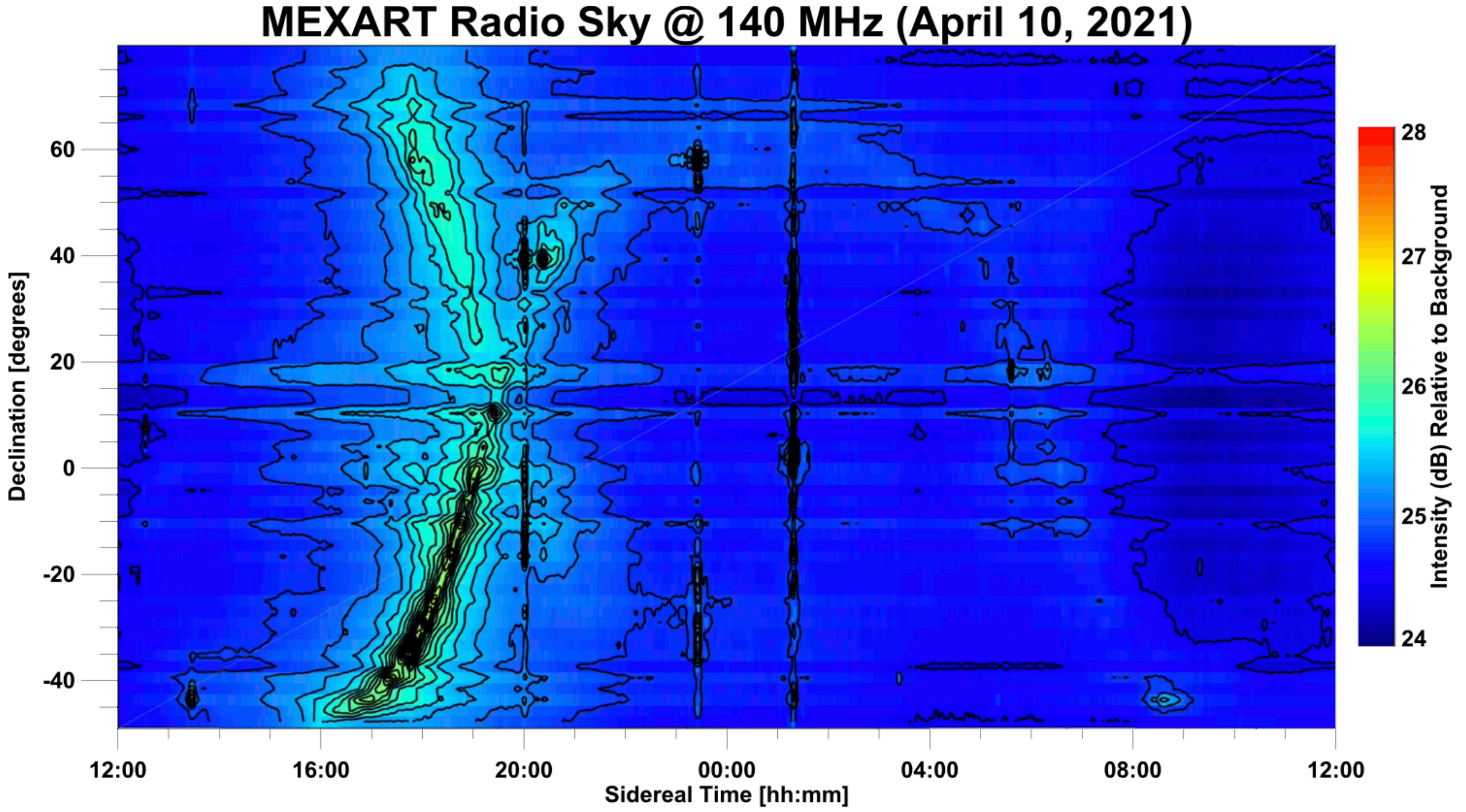

Figure 8. Transit of the Galaxy detected by Mexican Array Radio Telescope at 140 MHz on 10 April 2021. The horizontal axis is sidereal time (h:m), and the vertical axis is the radiation flux observation with 62 fixed latitudinal beams at different declinations (degrees).

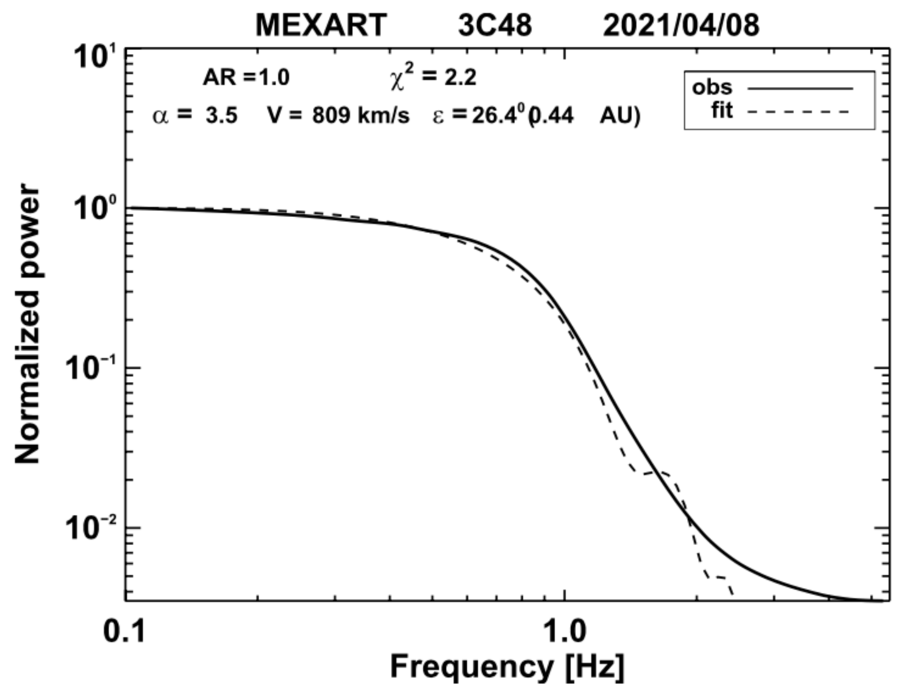

Figure 10. Single-station solar wind speed analysis for the observation of 3C48 on 8 April 2021. The single-station model fitting obtains a solar wind speed of 809 km/s.

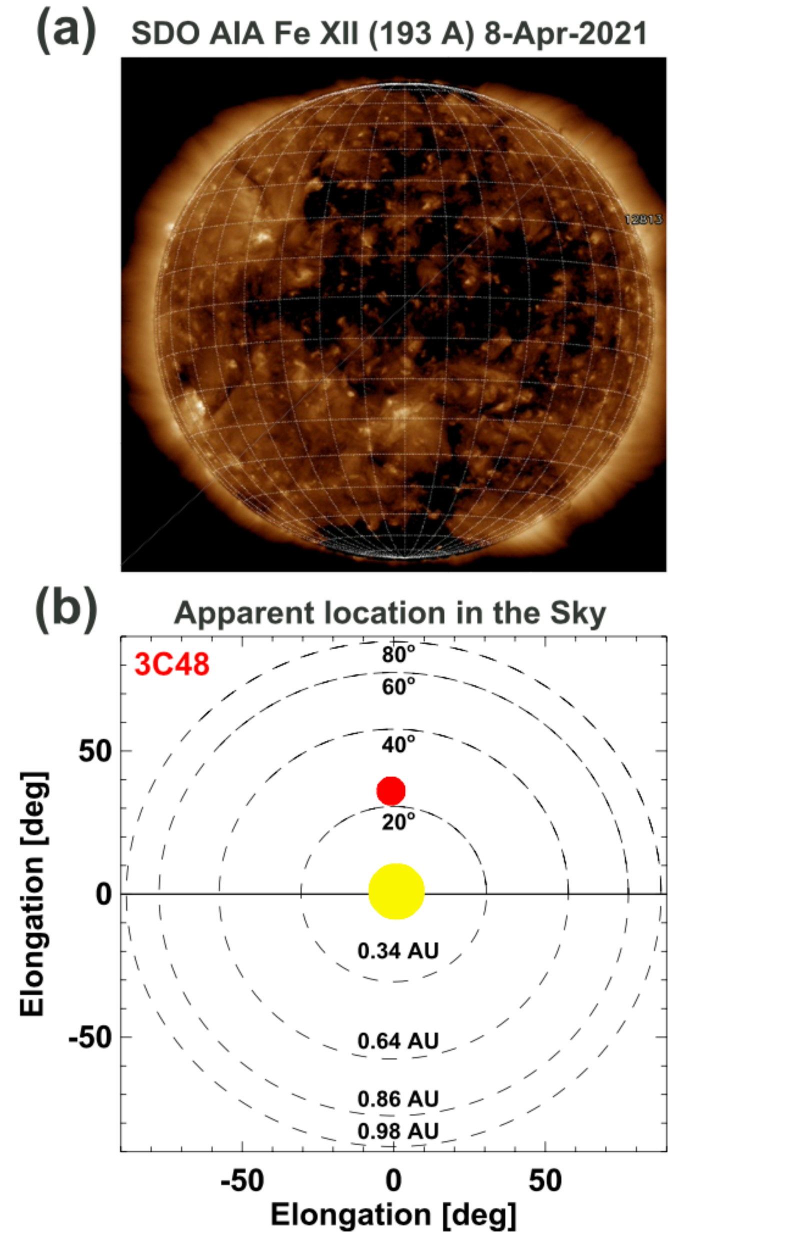

Figure 11. (a) The Sun observed on 8 April 2021, by the Atmospheric Imaging Assembly onboard the Solar Dynamics Observatory mission. (b) Relative position of 3C48 (red point) with respect to the Sun. The Earth's direction is perpendicular to the plane. The line of sight of the radio source was crossing the region covered by a fast solar wind stream from the northern coronal hole.