

Progress on Solar Radio Burst Observations with MUSER

Yihua Yan^(1,2,3), Wei Wang^(1,2), Linjie Chen^(1,2), Zhichao Zhou^(1,3), Chengming Tan^(1,2)

(1) National Space Science Center, Chinese Academy of Sciences, Beijing, China; yanyihua@nssc.ac.cn

(2) National Astronomical Observatories, Chinese Academy of Sciences, Beijing, China; yyh@nao.cas.cn

(3) School of Astronomy & Space Science, University of Chinese Academy of Sciences, Beijing, China

Mingantu Spectral Radioheliograph (MUSER), a new generation of radioheliograph capable of observing the Sun with high time, angular, and frequency resolution, is located in Inner Mongolia of China [1,2]. MUSER is operating on multiple frequencies in dm to cm range to get images and measure Stokes I and V parameters simultaneously at many frequencies in a wide band. Observations by MUSER during 2014-2019 including the quiet Sun and 94 solar radio burst events have been presented [3]. It was found that there were 81 events accompanied with GOES soft X-ray (SXR) flares, with the smallest flare class B1.0. There were 13 events with no recorded flares and the smallest SXR intensity during the radio burst period is equivalent to level-A. Quiet Sun observations have also been done. It can be seen that there were many radio bursts with a fine structure corresponding to not only powerful flares, but also faint ones, demonstrating the powerful ability of MUSER to capture the valuable information of the solar non-thermal processes and the importance for space weather [3].

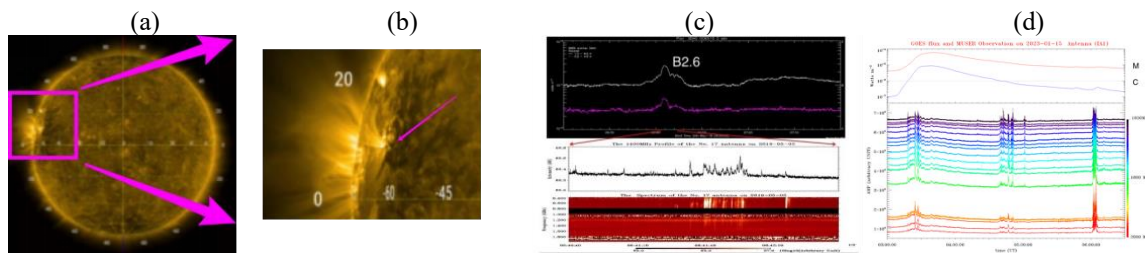


Figure 1. (a) SDO EUV image at 171A, (b) B2.6 flare location, (c) GOES SXR B2.6 flare and MUSER Spectral and time profile of the radio bursts on 5 May 2019. (d) GOES SXR M6.0 flare and MUSER time profiles of the multi-frequency radio bursts on 15 Jan 2023.

Figure 1 shows a B2.6 flare event on 5 May 2019 observed by MUSER-I in 0.4-2 GHz range and a M6.0 flare on 15 Jan 2023 by MUSER-I in 1.6-2 GHz range. There was a CME event automatically detected by the Computer Aided CME Tracking software package: CACTUS for the later event during the same period.

MUSER is now upgrading to have a new calibrating antenna of 16 m diameter for MUSER-II in 2-15 GHz range, and a new array: MUSER-L with 224 log-periodic dipole antennas in 40-400 MHz range [2]. The MUSER data will be made available following the open data policy to the solar and heliospheric physics community through the Data Center for the Meridian Project at NSSC of CAS. The progress on MUSER for solar and space weather observations is presented.

References

- [1] Yan, Y. H., Zhang, J., Wang, W., et al. (2009). "The Chinese Spectral Radioheliograph—CSRH," *Earth Moon Planets*, **104**, pp. 97-100, doi:10.1007/s11038-008-9254-y.
- [2] Yan, Y. H., Chen, Z. J., Wang, W., Liu, F., Geng, L. H., Chen, L. J., Tan, C. M., Chen, X. Y., Su, C., & Tan, B. L. (2021). Mingantu spectral radioheliograph for solar and space weather studies. *Frontiers in Astronomy and Space Sciences*, **8**, 584043(13pp). doi:10.3389/fspas.2021.584043.
- [3] Zhang, M., Zhang, Y., Yan, Y. H., & et al. (2021). Observational results of MUSER during 2014–2019. *Research in Astronomy and Astrophysics*, **21**, 284 (12pp). doi:10.1088/1674-4527/21/11/284