MUSER Imaging-Spectroscopic Observations of Solar Radio Bursts for Space Weather

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Solar eruptive phenomena have great impact to solar–terrestrial system and may cause severe space weather. Radio technique can detect radio emissions corresponding to the solar eruptive processes all the way from the Sun through interplanetary space to the Earth environment. To address the processes how solar eruptive events generate and propagate into interplanetary space, it is important to have imaging-spectroscopy observations covering wide frequency range.

The Mingantu Spectral Radioheliograph (MUSER) is an aperture-synthesis imaging telescope, dedicated to observe the Sun, operating on multiple frequencies in dm to cm range [1,2]. MUSER is composed of two arrays of 40 4.5m antennas covering 400MHz -2 GHz, and 60 2m antennas covering 2 - 15 GHz including outdoor devices with antennas, LNBs, and indoor devices including receivers, and correlators, etc. The building constructions at Mingantu Observing Station have just finished in 2019. During 2014-2019, about 94 solar radio burst events have been registered by MUSER including 1 X-class, 10 M-class, 37 C-class, 29 B-class flares, etc.[3]. Figure 1 shows some different radio fine structure observations by MUSER. The radio imaging-spectroscopic facilities are very important tools for monitoring solar disturbances from the Sun to the Earth environment and will play fundamental role for space weather studies and monitoring. The MUSER data will be integrated into the International Meridian Circle Program (IMCP) and be available following the open data policy to the solar and heliospheric physics community.

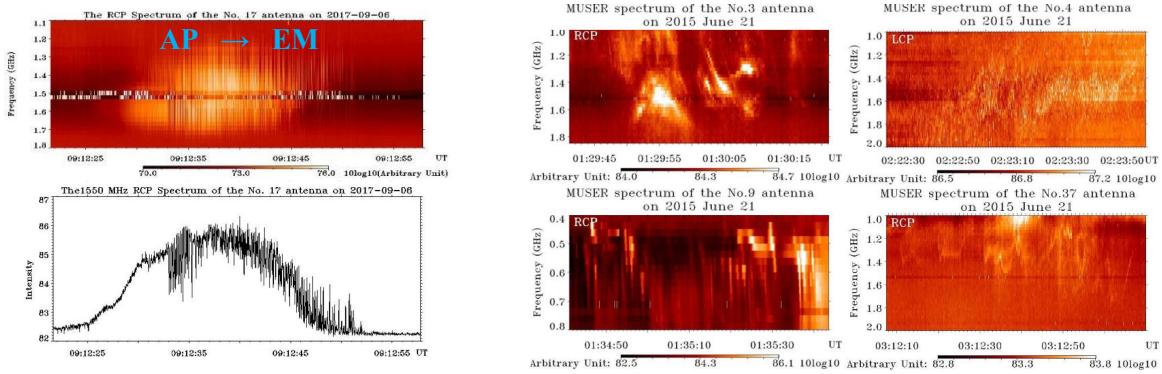

Figure 1. *Left panels:* MUSER observation showing an interesting transition from absorption (AP) to emission (EM) bursts in fast quasi-periodic pulsations during an X2.2 flare event on 6 Sept 2017 (*upper:* radio dynamic spectra in 0.4-2 GHz, *lower*: time profile at 1.55 GHz). *Right panel*: Different radio fine structures observed by MUSER including unusual bursts, narrowband type III bursts, spikets and lace bursts on 21 June 2015.

References

[1] Yan, Y. H., Zhang, J., Wang, W., Liu, F., Chen, Z. J., and Ji, G. "The Chinese Spectral Radioheliograph—CSRH," *Earth Moon Planets,* **104,** 1-4, April 2009, pp. 97-100, doi:10.1007/s11038-008-9254-y.

[2] Yan, Y., Chen, Z., Wang,W., Liu, F., Geng, L., Chen, L., Tan, C., Chen, X., Su, C., & Tan, B. (2021). Mingantu spectral radioheliograph for solar and space weather studies. *Frontiers in Astronomy and Space Sciences,* **8,** 584043. doi:10.3389/fspas.2021.584043.

[3] Zhang, M., Zhang, Y., Yan, Y., & et al. (2021). Observational results of MUSER during 2014–2019. *Research in Astronomy and Astrophysics,* **21**, 284. doi:10.1088/1674-4527/21/11/284.