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Solar Radio Observations with Low Frequency Radio Spectrometer and Heliograph

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To detect the solar intense activities in the interplanetary space, such as the solar flare, Coronal Mass Emission(CME), interplanetary shock wave, non-thermal particles, solar winds, etc., some low frequency radio instruments have been built recently in China, including a spectral radio heliograph and a radio spectrometer, as shown in Figure 1. The spectral radio heliograph can achieve daily the solar imaging at the frequency range from 30 to 400 MHz with the high-temporal, high-spectral and high-spatial resolutions [1]. The radio spectrometer operates at the frequency band between 1 to 70 MHz, and it can observe the solar radio bursts of type II and III with high spectral and temporal resolutions [2]. Solar radio observations with these instruments will signally improve the studies on solar physics and space weather.

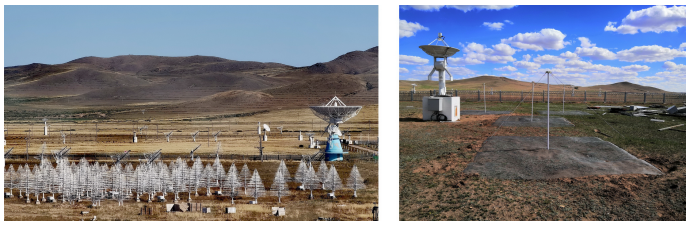

Figure 1. The meter to decameter wave spectral radio heliograph (MDRH) (left) and the very low frequency radio spectrometer (right).

The radio heliograph contains 100 steerable Log Periodic Dipole Array (LPDA) antennas. Radio signals of both polarizations sensed by the antennas will be transmitted via optical fibers to indoor receivers including analog receiver and digital receiver. The receivers processes the radio signals with a bandwidth of 100 MHz every 25 ms, thus it will take 100 ms to cover the whole frequency band of $\sim$ 400 MHz. The observing data produced by this instrument will be around 13 TB per day. The radio spectrometer includes four antennas operating in the very low frequency (VLF) range 1-70 MHz. Along with them, an eight-channel analog and digital receivers are employed to amplify, digitize and process the radio signals received by the antennas. The total 2048 frequency channels are implemented to get the high resolution dynamic spectrum with the minimum integration time of 10 ms.

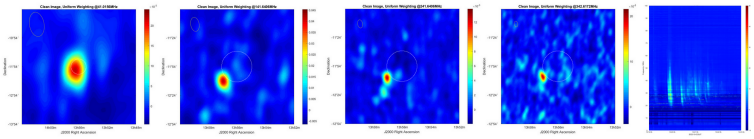

Figure 2. Solar radio images and spectra observed by MDRH(left) and the VLF radio spectrometer (right).

The solar imaging results demonstrate the capability of this radio heliograph, and the dynamic spectra also show the radio spectrometer has a good sensitivity (Figure 2). Currently, these two instruments are making the daily observations, which can be used to perform the study of solar activity and space weather through a continuous monitoring solar radio burst activity associated with the energetic electrons from the solar flares and CMEs.

References

[1] L. Chen, Y. Yan, W. Wang, F. Liu and L. Geng, "Meter to Decameter Wave Spectral Radio Heliograph," *XXXIIIrd General Assembly and Scientific Symposium of the International Union of Radio Science*, Rome, Italy, 2020, pp. 1-4, doi: 10.23919/URSIGASS49373.2020.9231998.

[2] L. Chen, Y. Yan, Q. Fan, L. Geng and S. K.Bisoi, "An agile very low frequency radio spectrum explorer," *RAA*, 2021 Vol. 21 No. 4, 85(10pp) https:// doi.org/10.1088/1674-4527/21/4/85.