ULTRA-LONG WAVELENGTH DIGITAL RADIO ARRAY-PATHFINDER

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Extended Abstract

In the last decade, many low frequency radio arrays have been developed to study some fundamental astronomical sciences, such as the dark ages and the epoch of reionization, ultra-high energy cosmic rays, heliophysics and space weather, etc. However, due to the man-made radio interferences and the ionospheric absorption and scattering, astronomical radio observations at the frequency range below 30 MHz (wavelengths longer than 10 m), also called Ultra-Long Wavelengths (ULW), are severely limited or impossible on the Earth, which make it remains the last virtually unexplored window in radio astronomy. Generally a straightforward solution for the ULW radio observations is placing an ULW astronomy facility in space. The latest studies show that the present solar activity cycle is a minimal period, the cutoff frequency of the Earth's ionosphere will decrease to few MHz around 2020 duo to the extreme low solar activities, which make it possible to observe the sky below 10 MHz with the Earth-based radio telescope [1]. We therefore presented a small agile Ultra-Long wavelength digiTal Radio Array-Pathfinder (ULTRA-P) to make the ULW radio observations on the ground. It will make best of the current resources of MingantU SpEctral Radioheliograph (MUSER), including software, hardware, and support facilities, etc., and thus can be built with very low cost.

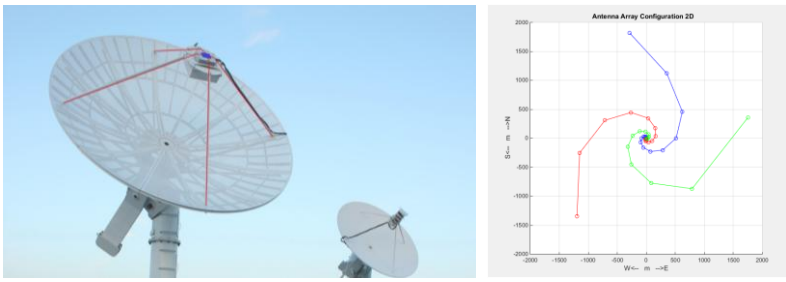

Figure 1. The deployment schematic darwing of ULTRA-P antenna (left) and array configuration (right). In the left the dish antenna is MUSER low frequency antenna, the red line denotes the ULTRA-P cross dipole antenna, and the bule box is the LNA for it. In the right the three color lines are the three spiral arms of the array, and each circle denote each antenna.

ULTRA-P consists of 40 cross dipole antennas, each cross dipole will be mounted on the four feed support poles of MUSER low frequency dish antenna as shown in Fig. 1, which provides it some pointing capabilities by moving with the dish antenna together. The induced radio signals on the each dipole will be converted to optical signals by a photoelectric conversion module, and the optical signals will then be transmitted to the indoor receiver by MUSER's redundant fibers underground. A digital receiver will be used to sample and process all the signals of the antennas. ULTRA-P will operate at the frequency range between 1 to 50 MH, its spatial resolution ranges from 0.12° to 6.0° since the longest baseline is 3 kilometers.

ULTRA-P will work with MUSER together simutaneously for the solar observations. It will make the ULW sky survey and observe the planetary ULW radio emissions. As a pathfinder array, ULTRA-P will also be used to study and demonstrate some key technologies for the furture space ULW radio array.

References

1. P. Janardhan, Susanta Kumar Bisoi, et al. "Solar and Interplanetary Signatures of a Maunder-like Grand Solar Minimum around the Corner - Implications to Near-Earth Space", 2015.