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DSL: A Microsatellite Array for Ultra-low-frequency Radio Imaging

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This presentation describes the design and development of a linear microsatellite array orbiting the Moon named Discovering the Sky at the Longest wavelength (DSL). As a pioneering space-borne observatory at Ultra-Low Frequency (ULW) band, DSL aims at providing all sky images at the hitherto little explored frequency domain and opening the last astronomical window of the electromagnetic spectrum below 30MHz.

Three major scientific objectives of the DSL mission are 1) the detection of the redshifted global spectrum of the neutral hydrogen from the cosmic Dark Ages and Cosmic Dawn epochs; 2) all sky images at ULW; 3). Solar radio bursts imaging. Following above scientific requirements, a linear satellites array around the Moon's circular orbit is proposed. The concept was first suggested at the NSSC/CAS in 2014, and later, in 2015 developed as a Chinese-European proposal for a joint space science mission. In 2018, a pathfinder mission, a pair of microsatellites called Longjiang-1 and -2 was launched as the first demonstration of radio interferometry between satellites in space. Although only Longjiang-2 was inserted into the selenocentric orbit, valuable data on the RFI environment, spacecraft radio occultations by the Moon and behaviors of the ULW payload were obtained. In 2018, the Chinese Academy of Sciences granted a research project to study the scientific cases and key techniques in depth, a demo interferometric image was retrieved with formation flying by a drone array in 2020.

This presentation will introduce the design principles of ULW interferometry with a satellite array, such as the baseline configuration, rapid filling of the spatial frequency spectrum, determination of the variable baseline vectors, calibration within single satellite and between multiple satellites, etc. We will also introduce the measurements and analysis of the Longjing-2 data, and the interferometric image of the drone array.

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