Solar Heliospheric Ionospheric (SHI)

Solar-Heliospheric-Ionospheric (SHI) Science is one of the primary goals of the MWA development. The main objective is to improve our understanding of the interaction of the Sun with the heliosphere and the terrestrial atmosphere, with particular emphasis on the effects of solar disturbances such as bursts and coronal mass ejections. Innovative remote sensing techniques will be applied for the MWA to track the disturbances from the solar surface to the Earth's environment. The MWA specifications are ideally suited for these techniques, particularly its frequency coverage, wide field of view, and multi-beaming capabilities. The results of the planned observations and demonstrations will make an important contributions to the US and International National Space Weather Programs.

A summary of the MWA characteristics they relate to its application for space weather studies is given in: Salah et al., Space weather capabilities of low frequency radio arrays, 2005.

The first community workshop on SHI science was held at MIT on 1 November 2006. The agenda and links to the papers presented at that workshop can be found at SHI Workshop (Nov 06).

A review of the SHI science goals, measurement techniques and analysis plans was conducted on 5-6 December 2007, as part of the MWA project review at Waikaloa, Hawaii. The agenda and links to the papers presented at that workshop can be found at SHI Review (Dec 07). A summary of the review and the resulting action items are documented at SHI Review Summary and Action Items.

There are four major components of the SHI Science, as outlined below. These include:

1. **Faraday Rotation (FR)**: This component is aimed at observing the Faraday rotation of radio sources that are occulted by heliospheric plasma to provide a measure of the magnetic fields in this plasma, with primary emphasis on Coronal Mass Ejections (CME).
2. **Inter-Planetary Scintillations (IPS)**: This component is aimed at measuring the scintillations of radio sources to provide a measure of the density and velocity of heliospheric plasma.
3. **Solar Burst Imaging (SBI)**: This component is aimed at imaging solar bursts with primary emphasis on Type II bursts to connect their development and evolution with heliospheric plasma disturbances such as CMEs. Type III bursts will also be imaged.
4. **Ionospheric Structure (IS)**: This component is aimed at exploiting the results of the MWA calibration which must accurately account for ionospheric distortions of the signals it receives at its low frequencies of its operations. The calibration is expected to result in information about small scale fluctuations in the Earth's ionosphere. In addition, the use of dual-frequency GPS receivers will provide information to help in the MWA calibration and the FR subsystem calibration, and will be used in the IS studies. The MWA ionospheric byproducts will be pursued on a best effort basis.

The SHI science collaboration is outlined in an organizational document which describes the terms of reference for this activity, the membership, and coordinating committee: SHI Collaboration document

A list of SHI tasks and the primary schedule milestones are described in: SHI Tasks and Schedule Milestones

An assessment of SHI risks is given in: SHI Risk Assessment

SHI Science Project Proposals

1. A follow up study of the weak impulsive quiet sun emissions - Divya Oberoi, 10 July, 2020
2. Radio exploration of a weak long duration X-ray flare observed by the XSM payload on board Chandrayaan-2 - Divya Oberoi, 07 Dec, 2020
3. Absolute flux density calibration of the Sun using in-field sources with the MWA - Divya Oberoi, 07 Dec, 2020