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International collaborative studies of the solar wind with IPS and SMEI

M. KOJIMA[1], A. BREEN[2], A. GONZALEZ[3], B. V. JACKSON[4] and P. K. MANOHARAN[5]
[1]*STE Lab., Nagoya University, Japan*
[2]*Institute of Mathematical and Physical Sciences, University of Wales, U.K*
[3]*Instituto de Geofisica,UNAM, Ciudad Universitaria, Mexico*
[4]*CASS, University of California at San Diego, U.S.A.*
[5] *Radio Astronomy Centre, NCRA, TIFR, Ooty, India*

The interplanetary scintillation (IPS) technique is one of the few that can be used to observe the solar wind in three-dimensional space. IPS has several advantages over in situ spacecraft measurements. It can be used consistently for a long-term study of solar wind structure over the solar cycle. In addition, when a large number of IPS sources are available, vast regions of interplanetary space can be probed in a relatively short time. However, because observations are line-of-sight integrations of solar wind conditions, IPS measurements are difficult to interpret spatially. In the late 1990s sophisticated methods of IPS observation and analysis were developed in order to deconvolve the line-of-sight integration effect. These techniques retrieve not only three dimensional solar wind parameters but also provide high spatial resolution than previously possible. Nowadays IPS measurements are greatly improved qualitatively from earlier ones.

The Solar Mass Ejection Imager (SMEI) measures Thomson scattered light globally around the earth, and potentially provides line of sight brightness in nearly every square degree of sky beyond 20º from the sun. These relatively recent measurements are synergistic with IPS since they can measure approximately the same region of space. Like the IPS they are line of sight integrals; they give measurements of bulk density changes along the line of sight. They can be used alone or combined with IPS measurements to determine deconvolved solar wind structures.

The IHY and CAWSES provide an international collaboration of IPS facilities operated at different frequencies and SMEI to cover the full range of distances from the sun to the earth. Another important collaboration is made among different geographical sites. SMEI can view CMEs on each 102-minute orbit, but IPS observations must collaborate among different geographical sites at Mexico, Japan, India, and UK in order to monitor the solar wind over 24 hours.

Capitalizing on the IPS advantages and SMEI, we have studied solar wind properties and the 3D structure and dynamics of a CME over all heliographic latitudinal ranges. Here, we introduce these studies.