# Project Details

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**Topic:** Advances Toward a Near Real Time Description of the Solar Atmosphere and Inner Heliosphere

**Project Title:**
A NASA Focused Science Topic to Combine World IPS Data and Standardize its Analysis

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**Summary:**
We propose a Living With a Star Focused Science Topic to promote interplanetary scintillation (IPS) investigations by the Worldwide IPS Stations (WIPSS) group. Groups using IPS techniques have recently agreed to adopt a more uniform data analysis system whose results can supplement and enhance those from NASA spacecraft. These cross-disciplinary studies already use ground-based data to modify and improve models that estimate plasma-parameter values for density, velocity, and magnetic-field components at L1 and globally throughout the heliosphere.

Present-day individual IPS systems are deficient in that each views near the Sun only while that portion of the sky is overhead. Thus, at one Earth location on any given day, much of the observing time is spent not viewing near the Sun. Given that the fastest Coronal Mass Ejections (CMEs) take less than a day to reach Earth, these can escape detection at a single location. The problem is mitigated when IPS observations from different geographic longitudes are combined. Moreover, the resulting enlarged data set covers more sky and has more redundancy than that from any single radio site.

Our heliospheric effort is centered on time-dependent 3D reconstruction modeling developed at the University of California, San Diego (UCSD). This imposes uniform processing of IPS data from each institution. The analysis reconstructs the heliosphere globally in near real time, allowing visualization and characterization of both Stream Interaction Regions (SIRs) and CMEs. Currently designed to incorporate radio arrays dedicated to IPS analyses, this effort also spurs development of remote sensing heliospheric techniques from the newest ground-based radio arrays; MWA and LOFAR, and space-based heliospheric imagers.

Results of this modeling provide a forcing input to the magnetospheres and atmospheres of the terrestrial planets, as well as a characterization of how they are bombarded by high-energy particles. The overall intent is to advance a near real time description of the solar atmosphere and inner heliosphere ; great progress has been made in this effort to date. IPS analyses, as do results from observations/measurements by NASA spacecraft and ground-based facilities, provide an appropriate data input for a variety of solar wind models that characterize the global heliosphere.

Current tomographic analysis uses a kinematic modeling kernel that iterates rapidly and updates heliospheric conditions every six hours. The full analysis can employ ENLIL, and other first-principle 3D-MHD global prediction models. ENLIL also operates at several space weather prediction centers worldwide. Early versions of both the UCSD tomography and ENLIL operate independently at the NASA-Goddard Community Coordinated Modeling Center (CCMC) and characterize space weather effects throughout the inner heliosphere. UCSD tomography also drives the ENLIL model in near real time at several additional

institutions worldwide, including the UK Rutherford Appleton Laboratory, the Korean Space Center, and George Mason University.

In this NASA LWS Focused Science Topic, we propose to exploit the IPS analyses to explore the large-scale heliospheric structure of the background solar wind and CMEs. The primary Decadal Survey science goal, of locating the origin of different types of solar activity, and the prediction of variations in the space environment are expected to be met by our determination of the:

* 3D locations of CIR structures and more transient features that modify them,

* 3D origin, location, and speeds of different CMEs, and

* Enhancement of 3D modeling efforts to verify and provide mid-course corrections of CMEs and other heliospheric structures being observed and modeled in near real time.

Ultimately, this effort will relate global IPS reconstructions to NASA analyses from Solar Orbiter and Solar Probe Plus data, by providing 3D locations for structures viewed in detail from these spacecraft.

## Publication References:

no references