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Indian astrophysicists develop forecasting model for solar wind

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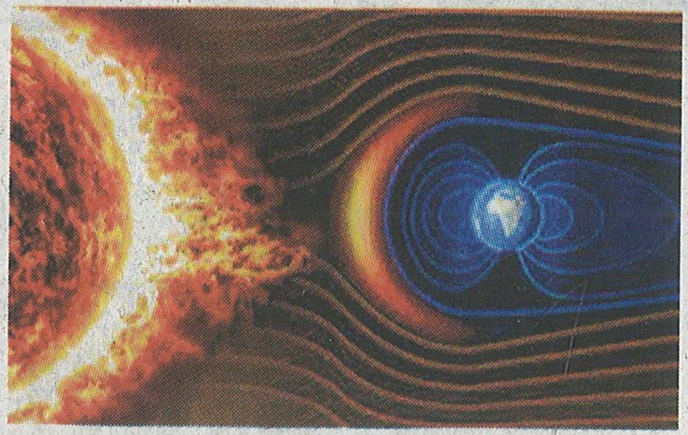
A team of astrophysicists from IIT Indore and Physical Research Laboratory Ahmedabad has created a state-of-the-art solar wind model that can predict the properties of solar wind in space.

Solar wind streams, acting as background, govern the propagation of space weather drivers in heliosphere, which induce geomagnetic storm activities.This indigenous work was funded by the ISRO RESPOND programme and will contribute to the success of the future ISRO mission Aditya-L1.

Researchers made this model based on observations of the solar surface. These observations come from the GONG observatory, which has stations throughout the world in six different cities, including the solar observatory in Udaipur.



The genesis of high-speed solar wind and its interaction with slow streams is driven by dynamic solar activity. The interaction of high-speed wind with slow-speed wind forms a compressed and turbulent Stream Interaction Region (SIR), which is chiefly responsible for weak to moderate geomagnetic storms. Such occurrences can adversely influence the terrestrial technological infrastructure and can be hazardous to the health of astronauts and satellites.

Furthermore, the model has synthesized the potential multi-directional observations of SWIS, which is a sub-system of in-situ instrument, ASPEX, of the upcoming Aditya-L1 mission. Once deployed at L1, SWIS will continuously measure the proton and alpha particles individually in the radial and azimuthal directions, as well as the integrated flux in the meridional direction.

The propagation, arrival, and duration of solar wind features are computed on Earth as well as on Mars, Venus, and Mercury using a sophisticated modular architecture made up of multiple sub-models."We have developed and successfully validated the solar wind module of SWASTi: Space Weather Adaptive Simulation framework. This data-driven and 3D physics-based model has been optimized with an intention to run on a personal workstation in reasonable computational time with adequate accuracy." said Prateek Mayank, PMRF PhD student and first author of the work, which has been accepted for publication in The Astrophysical Journal Supplement Series (ApJS).

"In this work, we have studied some peculiar characteristics of SIRs in the azimuthal and meridional directions. ASPEX payload has that three directional observation capability and can detect those features and provide a better SIR detection functionality." said Prof Dibyendu Chakrabarty, co-author and principal investigator of ASPEX payload at Physical Research Laboratory, Ahmedabad.

"SWASTi is truly an indigenous numerical framework that will play a vital role in the assessment of in-situ data from Aditya L1. The support from ISRO RESPOND program for such an initiative is a prime example of ISRO's drive in involving the Indian institutes and universities towards shaping the Indian space program." said Dr Bhargav Vaidya, project leader, and faculty at the Department of Astronomy, Astrophysics, and Space Engineering, IIT Indore.

The upcoming ISRO mission to study the Sun from space, Aditya-L1, has seven payloads that are developed by different Indian institutes.