भारतीय ताराभौतिकी संस्थान

INDIAN INSTITUTE OF ASTROPHYSICS

कोरमंगला Koramangala, बेंगलूरु Bengaluru – 560034.

THESIS COLLOQUIUM.

Name: Mr. Sahel Dey, IIA – JAP, Student

Title: "INSIGHTS INTO THE GENESIS AND DYNAMICS OF THE SOLAR SPICULE FOREST: AIDED BY LABORATORY EXPERIMENTS ".

Research Supervisor : Dr. Piyali Chatterjee, IIA
Dr. Tarun Deep Saini IISC

सार Abstract

Solar spicules are plasma jets that are observed in the dynamic interface region between the visible solar surface and the million-kelvin hot solar corona. It is estimated that about three million spicule jets are present at any given time over the entire solar disk. Due to their ubiquitous nature, they are believed to be a crucial candidate for conduiting mass and momentum flux to the solar wind, the primary driver of space weather. Despite the paramount importance, several physical processes, such as the formation mechanism, the highly dynamic nature, heating contribution of spicules at the corona, are not completely understood. In the first phase of the talk, I will present an intriguing parallel between the simulated spicular forest in a solar-like atmosphere and the numerous jets of viscoelastic (polymeric) fluids in laboratory experiments when both are subjected to harmonic forcing. In a radiative magnetohydrodynamics (rMHD) framework, solar global surface oscillations are excited similarly with sub-surface convection. These oscillations impinge on much less dense successive solar atmosphere layers, similar to a domino effect. This process can solely assemble a forest of spicules that matches very well with the observed quantitative features on the Sun. Fascinated by the visual similarity between these highly non-linear astrophysical and laboratory systems, we further explore the mathematical and phenomenological similarities and present four sufficient conditions to form a forest of jets on the Sun as well as in polymeric fluids. In the second part, we shed new light on the morphology of spicular jets: drapery of plasma against the cylindrical plasma column structure by utilizing three-dimensional rMHD simulation data sets. I will further describe various complex motions of spicules (spinning, swaying, splitting), which are reported by several high-resolution observation facilities, e.g., Hinode and IRIS spacecraft. We detect multiple episodes of rotation amongst clusters of synthetic spicules, similar to their observed counterparts, due to interaction with hot swirling plasma columns. Interestingly, some of these swirling columns are triggered by the spicular jets. Finally, we conclude the presentation by providing the mass and energy flux contribution of spicules and swirls to the solar wind, supporting their role as a significant mass and energy reservoir.

Thursday 14, December 2023

Venue: Online Time: 2:30 PM

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