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स्नातक अध्ययन मंडल Board of Graduate Studies.

STUDENT SEMINAR
(Part of Comprehensive Examination)

Speaker: Mr. Saurabh Tripathi

Title: Geoeffective Coronal Mass Ejections: Origins, Evolution, and Forecasting

सार Abstract

Coronal Mass Ejections (CMEs) are large-scale eruptions from the solar atmosphere that can trigger severe geomagnetic storms (GMS), causing serious disruptions to space- and ground-based technologies. Therefore, understanding their origin, propagation, and evolution through the interplanetary medium is essential for early forecasting. In this study, we present a statistical analysis of geoeffective CMEs from 1997 to 2024. We investigate their solar sources, heliospheric propagation, and subsequent evolution into Interplanetary CMEs (ICMEs), detected at L1 via in-situ signatures. Using multi-instrument observations and established catalogs, we examine source-region properties and explore the relationship of stroms intensity with flare class, CME speed, and longitudinal dependence. Although the background solar wind strongly influences the CME transit time from the Sun to L1, we find that CME and ICME speeds remain tightly correlated. Our detailed investigation shows that transit time follows a hyperbolic dependence on velocity, in contrast to the earlier suggested linear relations, yielding more accurate arrival-time estimates. Our results further reveal a clear longitudinal asymmetry, with geoeffective CMEs more likely to originate from the western hemisphere. Storm intensity depends moderately on flare class and speed, with faster CMEs producing stronger GMS. Interestingly, the declining phases of Solar Cycles 23 and 24 produced more intense storms than their rising phases, primarily associated with fast CMEs and possibly linked to large-scale magnetic restructuring during the Sun's polarity reversals. Building on this framework, we applied machine-learning models such as logistic, LASSO, and RIDGE regression for storm prediction in the next project. We found that logistic regression performed best, achieving ~90% test accuracy. These results highlight that regression-based approaches, supported by CME/ICME dynamics, can forecast GMS occurrence and contribute to operational space-weather prediction.

बुधवार Wednesday 17, सितम्बर September 2025

Venue: प्रेक्षागृह Auditorium

Time: 11:00 AM

सभी का स्वागत है All are welcome.