PLATINUM

PLAnetary plasma Turbulence and Intermittency – coupling with interplanetary transients from data analysis and NUmerical Modelling

DURATION
1/09/2022 – 1/12/2025

BUDGET
458 737€

PROJECT DESCRIPTION

The project PLATINUM is devoted to investigate the planetary plasma turbulence and complexity and the response to variability and turbulence induced by interplanetary extreme events and transients (e.g., Corotating Interaction Regions - CIR, Coronal Mass Ejections – CME). It considers two prototypical planetary plasma systems: the Earth (dense atmosphere, strong inner magnetic field) and Mars (rarefied atmosphere, almost vanishing, remnant inner magnetic field). The project deploys advanced data analysis tools (statistical analysis based on Probability Density Functions - PDFs, multifractal analysis, information theory based approaches) on plasma and electromagnetic field data provided by planetary and terrestrial space missions. The data analysis is complemented by advanced numerical simulations (particle–in-Cell, test kinetic) tailored to describe the couplings between planetary plasma turbulence and intermittency and the interplanetary variability. The key planetary regions to be investigated include the magnetosheath and, if data availability and quality allows, the inner boundary regions (e.g., the plasma sheet boundary layer). The project targets the scientific investigation of the topology and properties of the planetary plasma turbulence and complexity and the response to nonlinear couplings with the external driving. PLATINUM benefits from state-of-the art satellite data provided by the European missions Cluster and Solar Orbiter, and NASA missions MMS, THEMIS and MAVEN. The project can also be seen as a preparatory activity for on-going European initiatives (e.g. SMILE, Bepi Colombo). The project team provides a strong interdisciplinarity and scientific complementary. Dr. Marius Echim and the team at BIRA-IASB brings expertise with spacecraft data analysis, solar system plasmas data bases for turbulence and complexity, terrestrial and planetary plasma environments. M. Echim coordinated a recent review paper on turbulence and complexity of magnetospheric plasmas. KUL provides expertise with numerical simulations and theoretical insight for space plasmas. ROB provides expertise with in-situ observations of solar wind and studies and data bases for solar wind transients. ISS provides expertise with advanced data analysis approaches and numerical simulations for planetary plasma environments. The theme of the project has multiple implications on space exploration and space science as it is relevant for fundamental as well as applicative research (e.g., space weather).

The project targets a large spectrum of satellite data, has the ambition to apply systematically an advanced package of analysis data and to complement the data analysis with tailored numerical simulations performed by teams with strong expertise in the field. Such a methodological approach was never attempted in Belgium, nor in Europe. The fundamental scientific questions addressed by PLATINUM are: how the energy is transferred and dissipated in different planetary plasmas during transient and extreme solar wind events? Which are the main characteristics of planetary plasma complexity and the role of the couplings with the external driver – the solar wind?

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The scientific objectives of the project can be summarized as follows: (1) To characterize, from data analysis and simulations, the turbulence and complexity of key planetary plasmas regions like the magnetosheath at the interface with the solar wind or the boundary layers between plasmas with different properties (e.g. the plasma sheet boundary layer); (2) To quantify the role of the turbulent external forcing during interplanetary transients and extreme events; (3) To characterize, from data analysis and numerical simulations, the active scales "excited" by turbulence and complexity in planetary plasmas and how they depend on the external forcing during interplanetary transients; (4) To evidence similarities and differences between the planetary turbulence and complexity for different types of interaction with the solar wind, at Earth and Mars.

CONTACT INFORMATION

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LINKS

http://platinum.aeronomie.be