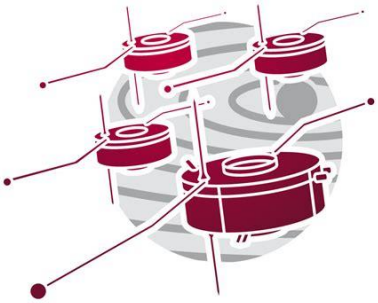
Master project in computing & space plasma physics

3D visualization of ions in the Earth's magnetosphere using Cluster satellite data

Supervisor: Audrey Schillings
Contact: audrey.schillings@umu.se



Aims & Purpose

The Cluster mission, launched by the European Space Agency (ESA) in 2000, aimed to comprehensively study the Earth's magnetosphere. Over the years, numerous studies and breakthroughs have emerged from analyzing Cluster data. Notably, Cluster was among the pioneering missions to operate multiple identical spacecraft, allowing detailed observations of fine magnetospheric structures. Throughout its operational lifespan, Cluster collected more than 20 years of data.

This project focuses on creating a 3D representation of the ions within the Earth's magnetosphere using the extensive Cluster dataset. The project is a collaborative effort between Umeå University, the University of Helsinki and ESA. You will collaborate closely with the student in Helsinki to achieve the project's goals.

This pilot project serves as a steppingstone toward a larger initiative aimed at promoting space exploration and understanding. Our goal is to represent ions within Earth's magnetosphere and the surrounding space, for scientific purposes and for a larger audience.

What will you do?

- **Data Source**: You will use oxygen and proton ions data collected by the Cluster spacecraft for 20 years.
- **Existing 2D Plots:** Numerous 2D plots already exist for various magnetospheric regions and solar wind conditions over the 20 years (2000-2020).
- **Transition to 3D:** Your initial task involves transforming these 2D plots into 3D representations. Initially, we'll focus on using data from a single spacecraft.
- **Collaboration:** You'll collaborate with a student from the University of Helsinki. While they work on developing a model, your role will involve fitting measured data points onto that model.
- **Potential Expansion**: If time permits and progress is favorable, we may incorporate data from all four spacecraft simultaneously.
- **Creative Exploration**: There are many ways to combine and represent this big data set, allowing for different visualizations and perspectives.
- **Videos and Animations**: Consider creating engaging videos and animations to enhance understanding.

Requirements

- Knowledge in computing science (essential).
- Preference for students enrolled in a master's program.
- Basic understanding of space plasma and magnetospheric physics (advantageous but not mandatory).
- Project will be conducted in English.

Interested??

Feel free to reach out if you have any further questions or need additional details. Interested? Drop an email to Audrey Schillings at audrey.schillings@umu.se . Looking forward to hearing from you!