Swedish Institute of Space Physics
Uppsala

Department of Astronomy and Space Physics
Uppsala university

Project plan for Degree Project (Examensarbete, 20 p)
"Plasma flow along transpolar arcs"

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Background

Due to the interaction between the solar wind and the Earths magnetic field, a drop-shaped cavity is formed around the Earth, called magnetosphere. The magnetosphere acts in some sense like a huge dynamo, driven by the solar wind. The emerging current system closes via the ionosphere (partly ionized layer above the atmosphere) at the polar regions of the Earth. Due to the high resistivity of the ionosphere, it acts as a load in the solar-wind-magnetosphere coupling system of which the aurora is the visible signature. The aurora appears in huge ovals around the magnetic poles.
The region poleward of the auroral oval is called polar cap and is magnetically connected to the interplanetary magnetic field (open field lines). In rare cases, auroral arcs appear even inside the polar cap, these are usually sun-aligned. Auroral arcs that reach over the entire polar cap, connecting the nightside with the dayside auroral oval, are called transpolar arcs. It is known that transpolar arcs have similar particle characteristics as the main auroral oval. They lie on closed magnetic field lines (connecting one hemisphere with the other) and have their source region in the plasma sheet or its boundary layer.
Many aspects of transpolar arcs are not very well understood. There are contradicting results regarding plasma flow, electric field, and field-aligned currents causing transpolar arcs. A detailed analysis of ionospheric signatures near transpolar arcs is necessary to investigate possible connections between these.

Project

The objective is to find out how field-aligned currents and plasma flows along transpolar arcs are related to each other. The study starts with a search for conjunctions between transpolar arcs and ionosphere crossings by the Cluster satellites. The main part of the work includes downloading data and creating time-series plots of E-field, B-field and density measurements as well as field-aligned currents and plasma transport. A detailed examination of the results will enable the student to interpret the results with respect to previous findings and give possible new interpretations.

Plan

The work will be carried out at the Swedish Institute of Space Physics (IRF) in Uppsala during a 5 month period, starting at August 29, 2005.

Data sources:
Cluster via ISDAT, solar wind data (ACE) and global auroral images (IMAGE) from the WEB.

Division of available time:

2005, week 35+36	getting started, gathering background knowledge
2005, week 37	search for transpolar arc-Cluster conjunction
2005, week 38	download and document auroral images
2005, week 39-49	download Cluster data and produce plots
2005, week 50-51	data analysis
2005, week 52	holidays
2006, week 1-3	report writing