Swedish Institute of Space Physics
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Project plan for Degree Project (Examensarbete, 20 p): "Modelling plasma measurements from the Rosetta flybys of Earth and Mars"

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Background

Rosetta is an ESA (European Space Agency) spacecraft, launched towards a comet in March 2, 2004. To be able to catch up with the comet, Rosetta has to take a long route through the planetary system, including three flybys of Earth and one of March. At the Swedish Institute of Space Physics in Uppsala, we have built an instrument called LAP (Langmuir probe) to study the ionized gas (plasma) close to the comet. However, this instrument and its companion instruments in the Rosetta Plasma Consortium, RPC, can be used also for exploring space around Mars and Earth during the flybys. The Mars flyby is highly interesting, as very few spacecraft with reasonable plasma instrumentation have ever visited Mars. As an example, none of the spacecraft now at Mars have anything to match the RPC instrumentation.

While the Mars flyby is of obvious scientific interest, the Earth flybys may at first sight seem to be less fun. Around Earth, there are of course a lot of measurements made by instruments on spacecraft specifically constructed to observe the near-Earth space environment. However, there are several reasons for doing plasma science with RPC during the flybys: (1) calibration of instruments in a reasonably known environment; (2) rehearsal for the Mars flyby -- do the operational modes we want to use really give the desired results, or should we change them slightly?; and (3) a real scientific interest also at Earth: during the flybys, Rosetta will be an extra measurment point around Earth, and multispacecraft studies are vital for understanding geospace.

In order to get the most out of the Earth and Mars flybys, careful planning is needed, including modelling of the environment. This is the topic of the present work.

Project

Study the Rosetta trajectory (well defined already) during the Earth and Mars flybys. Use models of the near-Earth and near-Mars plasma environment to model how parameters like plasma density, plasma density and magnetic field will vary during the flybys. Check also for environmental hazards, i.e. radiation -- do we want to be off part of the time when inside the radiation belts? Possibly include instrument properties in the models, to see what we can expect to observe using different operational modes and different spacecraft attitude (orientation in space). Possibly analyze data from the first Earth flyby (March 3, 2005) and compare the results to what was expected from the model.

Plan

The work will mainly be carried out at the Swedish Institute of Space Physics (IRF) in Uppsala, but may possibly include a stay at some other Rosetta plasma team (e.g. Technishe Universität Braunschweig, Germany, or LPCE Orléans, France). The work is to start at October 27, 2004, and end in June 2005 (see table below). The work will run at 50% intensity during the first part (approximately 20 weeks at 50%, effectively 10 weeks of work) and at 100% in its latter part (approximately the last 10 weeks). Two interim project reviews are planned, for December 2004 and March 2005, to monitor progress and finetune planning.

Start date	Task	Effective number of weeks	Intensity of work
27 Oct 2004	Start of work. Practical arrangements, computer setup, software. Survey of useful models. Plot tracetories. Invesitgate coordinate systems	1	50%
8 Nov 2004	Initial Earth flyby modelling	3	
17 Dec 2004	Review of initial work and detailed planning of further work		
10 Jan 2005	Further modelling of Earth flybys and/or mars flyby modelling.	5	
18 Mar 2005	Review of results and detailed planning of further work		
29 Mar 2005	Further modelling OR deriving inputs for operations planning of Mars flyby OR analysis of Earth flyby data.	8	100%
23 May 2005	Wrapping up, inalizing report and preparing presentation.	3	
Mid-June 2005	Work completed. Presentation at seminar.		