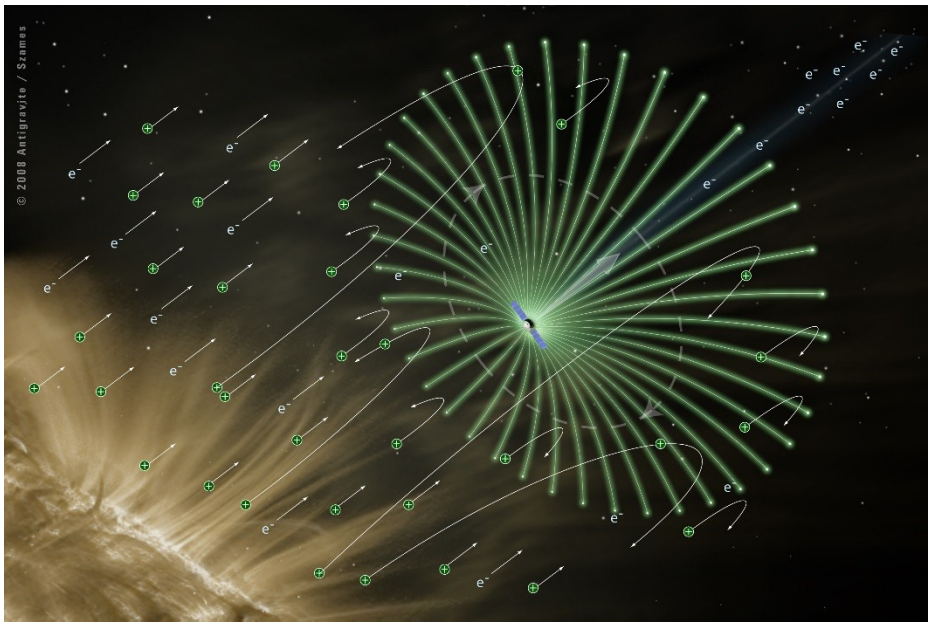
Space Science Seminar
Wednesday, 2014 December 3
10:30 a.m.
NSSTC/2096

Electric Solar Wind Sail (E-sail) Spacecraft Propultion

Dr. Pekka Janhunen/Finnish Meteorological Institute (FMI)



The **electric sail** is a new space propulsion concept which uses solar wind momentum for producing thrust (Janhunen, P., Electric sail for spacecraft propulsion, AIAA Journal of Propulsion and Power, 20, 4, 763-764, 2004, Janhunen, P. and A. Sandroos, Simulation study of solar wind push on a charged wire: solar wind electric sail propulsion, Ann. Geophys., 25, 755-767, 2007). The electric sail is somewhat similar to the more well-known solar radiation pressure sail which is often called simply the **solar sail**. A full-scale electric sail consists of a number (50-100) of long (*e.g.*, 20 km), thin (*e.g.*, 25 microns) conducting tethers (wires). The spacecraft contains a solar-powered electron gun (typical power a few hundred watts) which is used to keep the spacecraft and the wires in a high (typically 20 kV) positive potential. The electric field of the wires extends a few tens of meters into the surrounding solar wind plasma. Therefore the solar wind ions "see" the wires as rather thick, about 100 m wide

obstacles. A technical concept exists for deploying (opening) the wires in a relatively simple way and guiding or "flying" the resulting spacecraft electrically.

The main limitation of the electric sail is that since it uses the solar wind, it cannot produce much thrust inside a magnetosphere where there is no solar wind. Although the direction of the thrust is basically away from the Sun, the direction can be varied within some limits by inclining the sail. Tacking towards the Sun is therefore also possible.

The electric sail won the 2010 Finnish Quality Innovation Prize among Potential innovations. The prize was handed out by the President of Finland **Tarja Halonen** on November 11, 2010.

http://solarscience.msfc.nasa.gov/colloquia/