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Overview of the Cassini in-situ magnetosphere measurements and solar wind modelling during the 2013 Saturn Aurora Campaign

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Abstract

The Saturn Aurora Campaign 2013 is a coordinated effort to provide a clearer understanding of Saturn's auroral emissions at multiple wavelengths in the upper atmosphere, and their associated magnetospheric signatures and dynamics. In addition, modelling and Earth-based observations of the solar wind conditions throughout the campaign provide an important insight to the way in which Saturn's magnetosphere responds to the changing conditions in interplanetary space. Structures such as Corotating Interaction Regions (CIRs) are thought to play a significant role in the modulation of Saturn's auroral emissions via abrupt changes in the dynamic pressure associated with forward shocks at the start of the CIR compression regions. Recent observations from the Cassini spacecraft at Saturn have also taught us that the "magnetosphere oscillations" observed in magnetic field perturbations in the northern and southern hemispheres, which are associated with the SKR modulations in each hemisphere, significantly affect the magnetosphere and auroral emissions.

During April and May 2013 a combination of the Hubble Space Telescope (HST) ultraviolet (UV) instrument the Advanced Camera for Surveys (ACS), and ground-based infrared (IR) telescopes observed the northern hemisphere auroras, whilst the Cassini spacecraft's remote sensing instruments (the Ultraviolet Imaging Spectrograph-UVIS, the Visual and Infrared Mapping Spectrometer-VIMS, and the Imaging Science SubSystem-ISS) made simultaneous (or near-simultaneous) observations of the UV, IR and visible auroras respectively, in one or other hemisphere. At the same time, the "in situ" instruments on board Cassini measured the magnetic field, plasma populations, and radio plasma wave emissions in Saturn's magnetosphere.

Here we present an overview of the in situ magnetosphere measurements during the campaign, along with an overview of the predicted solar wind conditions upstream of Saturn from modeling work. We will discuss the evidence for high-latitude field-aligned currents and plasma boundaries (e.g. the open-closed field line boundary) from the magnetic field data, their associated plasma signatures and/or auroral hiss observations (using the Cassini magnetometer-MAG, the Magnetospheric Imaging Instrument-MIMI, and the Radio Plasma Wave Science-RPWS instruments respectively) and attempt to understand their morphology and variable location as a function of the northern or southern magnetosphere oscillation phase (according to the location of the spacecraft). We will also focus on the relationship between the Saturn Kilometric Radiation (SKR) signatures, the field-aligned currents and open-closed field line boundary signatures compared with the predicted/modelled solar wind conditions at the time of the observations from (for example) the NASA GSFC Community Coordinated Modeling Center/Space Weather Research Center (CCMC/SWRC).