GIANT PLANET MAGNETODISCS AND AURORAE

26-30 November 2012

Description

Magnetodiscs are large current sheets surrounding Jupiter and Saturn that are filled with plasma principally originating in the natural satellites. They are also solar system analogues for astrophysical discs. Magnetodiscs are special features of the fast rotating giant planets, a special feature of rotationally driven magnetospheres. They are driven by variability in their plasma sources and by the solar wind. Auroral signatures in the optical and radio allow a diagnostic of these dynamical processes and enable the visualisation of these large plasma and field structures.

Objectives

The objective of this workshop is to **address outstanding issues in the structure and dynamics of magnetodiscs using a comparative approach (see details under topics)**:

- Review current understanding of magnetodiscs and auroral responses to magnetodisc dynamics.
- Characterise and understand radial plasma transport in magnetodiscs.
- Determine how magnetic reconnection works in magnetodiscs, what are the effects on plasma transport, and what are the associated auroral responses to magnetic reconnection.
- Characterise how the solar wind influences magnetodiscs and the auroral responses to solar wind-driven dynamics.
- Characterise the spectral and spatial properties of auroral emissions produced by magnetodisc dynamics – are there significant differences between solar wind- and internally-driven dynamics?
- Determine the sources of local-time asymmetries in magnetodiscs.

Topics in detail

Radial plasma transport:

- How does plasma get from its (primary) sources near Io at Jupiter and Enceladus at Saturn into the magnetodisc and out of the magnetosphere?
- Of particular interest are the timescales for these transport processes, how they might vary with position, the physics of the transport process in the magnetodisc, and how radial transport varies with magnetospheric activity.

- To address this we will exploit the latest data, models and theory together with auroral observations.

Reconnection:

- Reconnection is a major process by which mass is lost from the magnetosphere and as such it is important to characterise reconnection in the magnetodisc. An important unanswered question is how reconnection is triggered in the magnetodisc and the interconnection between the Dungey and Vasyliunas cycles. As a remote diagnosis of reconnection, can specific details of the reconnection process (e.g., reconnection of closed or open flux) be identified in auroral observations?

Dynamics:

- Plasma production, radial transport, reconnection and solar wind influences are sources of dynamics in the magnetodiscs at Jupiter and Saturn. These and other dynamical events, such as injections, produce optical/radio auroral emissions. Here we will examine dynamical events in magnetodiscs, comparing and contrasting Jupiter and Saturn, and use auroral imaging and radio emissions as remote monitors of dynamics. Can the spectra and spatial distributions of various auroral emissions be used to diagnose different types of dynamic event? Can we develop an understanding of Space Weather at the giant planets using knowledge of variability in plasma production, radial transport, instability, and solar wind influences in very large systems?

Solar wind influences:

- Evidence for solar wind influences on the magnetodisc of Jupiter is substantial; Saturn’s magnetodisc appears to respond more strongly to the solar wind. The mechanisms behind these solar wind effects are not fully understood but involve a combination of Dungey cycle driving, angular momentum conservation and solar wind pressure effects. The dusk flank magnetosphere of Saturn has been studied in far more detail than the corresponding region of Jupiter’s magnetosphere and provides an excellent and unique dataset for the study of asymmetries.
- What can be learned about the solar wind influence by in situ observations and monitoring the location, spectra and strengths of auroral emissions? How much is the dynamics and the entire magnetosphere and the aurora of an outer planet influenced by the solar wind?

Sources of local time asymmetries:

- Magnetodiscs and aurorae at Jupiter and Saturn are known to asymmetric in local time. There are asymmetries in magnetodisc location, thickness, field structure, and presumably stress balance. It is not clear what generates this asymmetry. Is it purely driven by the solar wind or do internal processes such as mass-loss play a significant role?

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