Tuesday, June 13 – 14:00

The role of the solar wind for the outer planet magnetospheres

Peter Delamere

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Abstract

Magnetospheric dawn/dusk asymmetries are, fundamentally, linked to the solar wind interaction. At Earth, the dominance of sunward, solar wind-driven flows via a Dungey cycle of reconnection leads to an asymmetric corotating plasmasphere contained within the magnetospheric cavity. Magnetospheric flows at Jupiter and Saturn, on the other hand, are dominated by corotation with the solar wind playing a minor role when adopting the terrestrial corotation/convection model. Nevertheless, Jupiter and Saturn exhibit significant dawn/dusk asymmetries. Following the New Horizons Jupiter flyby, the solar wind interaction at Jupiter and Saturn has been vigorously debated. Key aspects of this debate include large-scale magnetic reconnection vs. some unspecified tangential drag at the magnetopause boundary, generating a viscous-like interaction. Recent studies have demonstrated that the Kelvin Helmholtz instability causes tangential drag via intermittent and small-scale reconnection – a key component of mass, momentum, and energy transport at the magnetopause boundary. Burkholder et al., [2017] showed that reduced magnetosheath flows on Saturn's dawn flank are consistent significant momentum transport at the magnetopause boundary, confirming an active solar wind interaction. This tutorial presentation will present a broad overview of the solar wind interaction at Jupiter and Saturn, including different perspectives from data (including Juno observations), theory, and modeling.

Tuesday, June 13 – 14:30

The Evidence for Solar Wind Control of Auroral Processes at Jupiter and Saturn

John Clarke

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Abstract

There have now been a series of observations of Jupiter and Saturn tied either to nearby measurements of the solar wind or extrapolations from the Earth. The data show clear evidence for auroral brightenings that are correlated with the arrival of solar wind shocks, with a strong correlation for Saturn and occasional correlation at Jupiter. How should we interpret these data? Why is there a high degree of correlation at Saturn and only some correlated events at Jupiter? What is the most important controlling parameter in the solar wind? Correlations have been demonstrated for solar wind dynamic pressure, but this is easier to extrapolate than interplanetary magnetic field, and shock fronts are normally accompanied by large changes in the IMF. These questions will be discussed in view of our knowledge of the different conditions in the magnetospheres of Jupiter and Saturn.

Tuesday, June 13 – 14:45

Diurnal And Seasonal Variability of Uranus' Magnetosphere

Xin Cao, Carol Paty

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Abstract

The interaction between Uranus' intrinsic magnetic field and the solar wind is quite different from the magnetospheric interactions of other planets. Uranus' large obliquity, coupled with the fact that its dipole moment is off-centered and highly tilted relative to the rotation axis, leads to unique and seasonally dependent interaction geometries with the solar wind. We present results from adapting a multifluid MHD simulation to examine these seasonally dependent geometries in terms of the global magnetospheric structure, magnetopause and bow shock location, and magnetotail configuration. The Voyager 2 spacecraft encountered Uranus near solstice, and was able to observe the magnetic field structure and plasma characteristics of a twisted magnetotail [Behannon et al., 1987]. Auroral observations [Lamy et al.,2012] give some indication of the magnetospheric interaction with the solar wind. We use the magnetometer observations as a basis for benchmarking our simulations for the solstice scenario. We also demonstrate the structural difference of the magnetosphere between solstice and equinox seasons and the transition phase between solstice and equinox. The structure of Uranus' magnetosphere different seasons is quite distinct due to the orientation and rotation of the magnetic axis relative to the solar wind direction. We develop an analytical description of these boundaries based on the simulation to compare different seasons quantitatively.

Tuesday, June 13 – 15:00

Detection of the infrared aurora of Uranus

H. Melin, T. S. Stallard, L. N. Fletcher, R. E. Johnson, J. O'Donoghue, L. Moore, C. Tao

* University of Leicester

Abstract

The aurora of Uranus has only been observed a rare few times: by Voyager 2 and by the Hubble Space Telescope in the ultraviolet. At Jupiter and Saturn, observations of ground-based infrared H3+ emissions in the region of the magnetic poles has played an important role in advancing our understanding of the auroral process. Yet, at Uranus, no unambiguous detection of auroral H3+ emission has been made. Until now. We present NASA IRTF iSHELL observations from October 2016, which reveal highly localised emission at dawn, fixed in longitude. The intensity is driven by an increase in H3+ column density, rather than temperature, which is indicative of increased ionisation by auroral particle precipitation. This detection opens the doors for a full ground-based characterisation of Uranus' auroral morphology, thermospheric temperature, and ion wind structures in the upper atmosphere.

Thursday, June 15 – 14:20

Source locations of Jupiter's decametric radio emissions measured by the modulation lane method

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Abstract

Although there is a long history of Jupiter radio observations since the discovery in 1955, the emission mechanism of Jupiter's decametric radiation is not yet completely understood. The information of the radio source locations is a very important key to understand this emission mechanism. The modulation lanes in the dynamic spectra of Jupiter's decametric radio emissions were discovered by Riihimaa in 1968. We developed a model for the mechanism responsible for their production to provide a very close fit with the observations for the first time [Imai et al., 1992, 1997, 2002]. In this model, the slope of the modulation lanes provides important information to measure the radio source locations. By using the measured slope of modulation lanes it is possible to make precise calculations of the value of the lead angle based on Jupiter's magnetic field model. This lead angle is the angle between instantaneous Io's flux tube (IFT) and previously energized flux tube (PEFT) which corresponds to the real radio source locations. This remote sensing tool is called the modulation lane method [Imai et al., 1997, 2002, 2006]. Recently we are using this modulation lane method with data taken by the Long Wavelength Array Station 1 (LWA1). The high-sensitivity of the LWA1 allows us to measure source locations and beam parameters for many Io-related sources. In this analysis we found the existence of two independent radio sources in the case of Io-B and Io-C events.

Thursday, June 15 – 14:35

Io-Jupiter decametric arcs observed by Juno/Waves compared to ExPRES simulations

C. K. Louis, L. Lamy, P. Zarka, B. Cecconi, M. Imai, W.S. Kurth, G. Hospodarsky, S. L. G. Hess, X. Bonnin, S. Bolton, J. E. P. Connerney, S. M. Levin

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Abstract

We compare observations from the Juno/Waves radio experiment with simulations of radio « arcs » in the time-frequency plane resulting from the Io-Jupiter interaction, performed with the ExPRES code. We identify the hemisphere of origin of the observed arcs directly from simulations, and confirm this identification through comparison with Juno, Nançay and Wind observations. The occurrence and shape of observed arcs are well modeled, at low latitudes with their usual shapes as seen from Earth, as well as at high latitudes with longer, bowl-shaped, arcs observed for the first time. Predicted emission is actually observed only when the radio beaming angle θ=(k,B)$\geq$70°±5°, providing new constraints on the generation of the decameter emission by the Cyclotron Maser Instability. Further improvements of ExPRES are outlined, that will then be applied to Juno and Earth-based observations of radio emissions induced by other Galilean satellites or associated to the main auroral oval.