Autumn MIST 2017 Programme

10:00		**Registration and Welcome Refreshments**
10:30	Emma Bunce	Recent magnetosphere science highlights from Cassini at Saturn and Juno at Jupiter
10:55	Gabrielle Provan	Planetary period oscillations in Saturn’s magnetosphere: New results from the Grand Finale
11:07	Arianna Sorba	The periodic flapping and breathing behaviour of Saturn's magnetodisc during equinox
11:19	Ewen Davies	Evidence for Return Flow Plasma Following Tail Reconnection in Dawnside High Latitude Regions of Saturn’s Magnetosphere
11:31	Greg Hunt	Field-aligned currents in Saturn’s magnetosphere: Observations from the F-ring orbits
11:43	Emma Woodfield	Radiation belts above the atmosphere of Saturn - a testbed for wave-particle acceleration of electrons.
11:55		**MIST Update and Lunch**
13:00	Thomas Bradley	Field-aligned currents in Saturn’s nightside magnetosphere: Subcorotation and planetary period oscillation components during northern spring
13:12	Yutian Cao	Observations of photoelectron energy peaks in Titan’s ionosphere
13:24	Rebecca Gray	Jupiter's UV and X-Ray Auroral Response to Co-rotating Interaction Regions
13:36	Rosie Johnson	H3+ Temperature Changes in Jupiter's Upper Atmosphere
13:48	Gianluca Carnielli	First 3D test particle model of Ganymede’s ionosphere
14:00	Robert Burston	Planetary Magnetotails as Non-linear Oscillators: Mercury, Earth, Jupiter, Saturn
14:12	Matt James	Field line resonant wave activity in the Hermean magnetosphere
14:24	Lloyd D. Woodham	The Role of Ion-Cyclotron Resonance as a Dissipation Mechanism in Solar Wind Turbulence
14:36		**Poster Session and Refreshments**
15:45	Imogen Gingell	MMS observations and hybrid simulations of a rippled and reforming quasi-parallel shock
15:57	Julia E. Stawarz	Observations of Magnetic Reconnection and Associated Flux Ropes in the Earth’s Magnetotail by the Magnetospheric Multiscale Mission
16:09	Samuel Wharton	A New Technique for Estimating Magnetospheric Eigenfrequencies and Implications for Magnetospheric Plasma Distributions
16:21	Stephen Browett	Effect of magnetospheric convection timescales on the correlation between the IMF and magnetotail flux rope By components
16:33	Alexandra Ruth Fogg	Quantitative Comparison of New SuperDARN Convection Maps
16:45	Jade Reidy	Interhemispheric survey of polar cap aurora
16:57	Daniel Billett	Diurnal variations in global Joule heating morphology and magnitude due to neutral winds
17:09	Lauren Orr	Dynamical Networks Characterization of Space Weather Events
17:21		**Meeting Adjourns**

Poster Presentations

Sarah Bentley	Parameterising ULF waves using solar wind parameters: a probabilistic model?
Martin Birch	Observations of electron content and velocity fluctuations in the F-region at very high latitude.
John Coxon	Filamentary currents in five FTEs observed by MMS
Ravi Desai	Cassini observations of nongyrotopic pickup ions at Saturn's largest icy moon Rhea
Xiangcheng Dong	Structure and evolution of flux transfer events near magnetic reconnection dissipation region
Gareth Dorrian	The influence of the neutral atmosphere on the ionosphere during polar darkness
Robert Fear	Global scale simulation of northward IMF magnetospheric dynamics: Vlasiator results
Georgina Graham	Investigating the effect of IMF path length on strahl beam width broadening
Rosie K. E. Hood	Correlations between Geomagnetic Disturbances and Field-Aligned Currents during the 22-29 July 2004 Storm Time Interval
Benjamin E S Hall	Preliminary Evaluation of MArtian Global Ionospheric Conductivities (MAGIC)
Caitriona Jackman	Assessing periodicities in Jovian X-ray emissions: techniques and heritage survey
Nadine M. E. Kalmoni	A diagnosis of plasma wave instabilities in the lead up to an auroral substorm
Allan Ross Macneil	Tests for coronal electron temperature signatures in suprathermal electron populations at 1 AU
Lars Mejnertsen	Global MHD Simulations of Flux Ropes on the Dayside Magnetopause
Beatriz Sanchez-Cano	Seasonal variability of the Martian total electron content as seen by the MEX-MARSIS-subsurface instrument
Jasmine Kaur Sandhu	Field Line Eigenfrequencies During Storms and Substorms
Robert Shore	A self-consistent method for deriving polar ionospheric convection from eigenanalysis of SuperDARN radar data
Andrew Smith	Evaluating Single Spacecraft Observations of Planetary Magnetotails with a simple Monte Carlo Simulation
David Stansby	The origin of number density structures in the slow solar wind
Liz Tindale	Quantifying variability in fast and slow solar wind: From turbulence to extremes
Sam Turnpenney	Exoplanet-induced radio emission from M-dwarfs
Daniel Verscharen	Large-scale Compressive Fluctuations in the Solar Wind: Kinetic Theory, MHD, and In-situ Observations
Maria-Theresia Walach	Characterising variability in speed and direction of ionospheric flows: How well do IMF conditions constrain variability in SuperDARN data?
Honghong Wu	Kinetic Alfvén Waves (KAWs) in the Solar Wind

Abstracts

Emma Bunce, University of Leicester

Recent magnetosphere science highlights from Cassini at Saturn and Juno at Jupiter

Since 2016, for the first time in space history, there have been two outer planet missions operating at Jupiter (NASA Juno) and Saturn (NASA-ESA Cassini) simultaneously. This has meant that over the last year, there has been a rapid increase in our knowledge of both of these rapidly rotating magnetospheres.

The end-of-Cassini mission sequence took place on Sept 15th 2017, after the Grand Finale orbits where the spacecraft plummeted between the inner edge of the ring system and Saturn itself. From a data gathering perspective, this dramatic end of mission sequence has taken us into completely unexplored regions of the Saturnian system. This adds to the previous 12 years of continuous operations at Saturn, yielding a 13 year continuous dataset that led to many discoveries and provided us with an unprecedented insight into the nature of Saturn's magnetosphere.

The Juno mission entered orbit at Jupiter in July 2016. The spacecraft is now in a 53 day orbit, exploring the polar regions of Jupiter's magnetosphere, providing unprecedented data from the various instruments on board. Each periapsis pass (every 53 days) provides a wealth of new information on the coupling between the magnetosphere and the ionosphere, and the dynamics of the planet's auroral emissions in the upper atmosphere.

This presentation will review a selection of the magnetosphere-related discoveries from both of these missions in our outer solar system.

Gabrielle Provan, University of Leicester

Planetary period oscillations in Saturn's magnetosphere: New results from the Grand Finale

Saturn's Planetary Period Oscillations (PPOs) have been one of the biggest mysteries of the Cassini mission. After all, how does a planet with a seemingly axi-symmetric magnetic field manage to produce two magnetic oscillation systems that are observed throughout the magnetosphere? Here we investigate the PPOs using Cassini magnetic field data during the high cadence F-ring and proximal orbits. Previous results have shown that there are two PPO systems, one in each hemisphere. The PPOs are believed to be driven by twin-cell convection patterns in the polar ionosphere/thermosphere regions, with two systems of field-aligned currents transmitting the PPO flows to the magnetospheric plasma. This new high-cadence data demonstrates that both the periods and amplitudes of the PPOs observed within the each polar region are modulated by the PPO system from the opposite hemisphere. We present a theoretical model showing that this coupling is due to the PPO flows from one hemisphere not just being communicated to the magnetosphere as previously assumed, but also to the opposite hemisphere. The result is inter-hemispheric coupling of the PPO flow systems within the ionosphere/thermosphere system. We will examine the implication of this new theoretical framework for the wider Saturnian system.

Arianna Sorba, University College London

The periodic flapping and breathing behaviour of Saturn's magnetodisc during equinox

Periodic variations are observed in many properties in Saturn's magnetosphere, modulated at a period close to the planetary rotation rate. Magnetic field observations by Cassini's magnetometer suggest that in the outer magnetosphere Saturn's equatorial current sheet is periodically displaced from the rotational equator, to a first approximation acting as a rotating, tilted disk, manifesting as a 'flapping' mode when observed by Cassini. Recent studies suggest the magnetosphere also has a 'breathing' mode, expanding and contracting with a period close to the planetary rotation rate. We model these modes in tandem by combining a global, geometrical model of a tilted and rippled current sheet with a local, force-balance magnetodisc model, accounting for magnetospheric size and hot plasma content. We simulate 'breathing' by introducing an azimuthal dependence of the system size. We fit Cassini magnetometer data acquired on equatorial orbits from October – December 2009 (Revs 120-122), close to Saturn equinox, such that seasonal effects on the current sheet are minimised. Our model characterises well the amplitude and phase of the oscillations in the magnetic field data, for those passes with clear periodic signatures. In particular, the meridional component can only be characterised when the breathing mode is included.

Ewen Davies, Imperial College London

Evidence for Return Flow Plasma Following Tail Reconnection in Dawnside High Latitude Regions of Saturn's Magnetosphere

Early during the Cassini Mission, an observation of a transient increase in the azimuthal magnetic field, accompanied by an increase in high-energy electron density was reported. It was suggested that this corresponded with return flow from tail reconnection. Such observations allow tail reconnection, and thus mass and energy transport within Saturn's Magnetosphere, to be indirectly studied. Building on that study, a survey of the pre-noon, post-dawn sector for transient instances of swept-forward field has been carried out. The observations were made by the Cassini Magnetometer in high latitude regions during the course of the entire mission. The instances were characterised by short-term increases in $B\phi$ such that the magnetospheric plasma accelerated towards co-rotation, dragging the field with it. 37 such signatures were observed. 32 of these were accompanied by signatures in the Cassini particle instrument data corresponding with high-energy electrons. We suggest that these signatures correspond with return flow plasma. 10 orbits present multiple consecutive signatures, allowing some characterisation of the timescales involved. We show that these consecutive events occur in integer multiples of ~10.6 hour periods. Evidence is presented for commonalities in the Planetary Period Oscillation phases associated with the signatures, suggesting a degree of internal control.

Greg Hunt, Imperial College London

Evidence for Return Flow Plasma Following Tail Reconnection in Dawnside High Latitude Regions of Saturn's Magnetosphere

We investigate the azimuthal magnetic field signatures associated with high-latitude field-aligned currents observed during Cassini's F-ring orbits. We show the overall ionospheric meridional current profiles in the northern and southern hemispheres which differ from previous results in the regions poleward and equatorward of the field-aligned currents, we discuss in terms of possible seasonal and local time differences. The F-ring observations are similar in form to the 2008 midnight dataset with a typical four-current sheet structure. We exploit this structure to investigate the properties of the boundaries and sheets, and show the expected modulation of currents by each hemisphere's "planetary period oscillations" (PPO) system. We separate the PPO-independent and PPO-related currents in both hemispheres by using their opposite symmetry. The PPO-independent currents peak at ~1.5 MA rad-1 just equatorward of the open closed field line boundary, similar to the 2008 observations. However, the PPO-related currents in both hemispheres are reduced by ~50% to ~0.4 MA rad-1, this may be evidence of reduced high-latitude PPO amplitudes, similar to the previously observed weaker equatorial oscillations at similar LT. We do not detect the PPO current system interhemispheric component, this is likely due to their closure within the magnetosphere.

Emma Woodfield, British Antarctic Survey

Radiation belts above the atmosphere of Saturn - a testbed for wave-particle acceleration of electrons.

The isolated region of radiation belts recently observed in the Cassini proximal orbits at Saturn has the potential to provide a critical test of the capabilities of wave-particle acceleration of electrons as a process in the Solar System. In this region at Saturn there are 4 possibilities for forming a population of energetic electrons: Cosmic Ray Albedo Neutron Decay (CRAND), radial diffusive transport, collisional ionisation and wave-particle acceleration. CRAND and collisional ionisation will only produce relatively low energy electron populations. Uniquely at Saturn, the seed population for inward radial diffusion is eradicated by absorption processes in the main rings rendering it also ineffective at generating a population of very energetic electrons. This leaves only wave-particle interactions as a possible candidate for producing high energy electrons very close to Saturn. Previous work has shown that Z-mode waves are very effective at accelerating electrons outside the A-ring at Saturn and Z-mode waves are indeed observed in the Cassini proximal orbits. Here we present a case study using Cassini wave data to look at the effects of Z-mode waves on the energetic electron population in this innermost region at Saturn.

Thomas Bradley, University of Leicester

Field-aligned currents in Saturn's nightside magnetosphere: Subcorotation and planetary period oscillation components during northern spring

We newly analyze Cassini magnetic field data from the 2012/13 Saturn northern spring interval of highly-inclined orbits and compare them with similar data from late southern summer in 2008, providing unique information on the seasonality of the coupling currents between Saturn's ionosphere and magnetosphere. Inferred meridional ionospheric currents in both cases consist of a steady component related to plasma subcorotation, together with the rotating currents of the northern and southern planetary period oscillations (PPO). Subcorotation currents during the two intervals show opposite north-south polar asymmetries, with strong equatorward currents flowing in the summer hemispheres, but only weak currents flowing to within a few degrees of the open-closed field boundary (OCB) in the winter hemispheres, inferred to be due to reduced polar ionospheric conductivities. PPO-related currents show no clear seasonal effects with principal upward and downward field-aligned current peaks collocated with the auroral upward current and are approximately equal in strength. The currents in both hemispheres were dual-modulated by both PPO systems during 2012/13, with approximately half the main current closing in the opposite ionosphere and half cross-field in the magnetosphere, while only the northern hemisphere currents were similarly dual-modulated in 2008.

Yutian Cao, Mullard Space Science Laboratory, UCL
Observations of photoelectron energy peaks in Titan's ionosphere

The strong solar He II (30.4nm) line generates photoelectrons with particular energies in planetary ionospheres. In Titan's ionosphere, a photoelectron peak near 24.1 eV is produced by ionizing N2 with the He II line. The Electron Spectrometer (ELS), part of the Cassini Plasma Spectrometer (CAPS), has observed these discrete energy peaks. As well as in the dayside ionosphere where neutral N2 particles are ionized by solar radiation, ELS observed photoelectron peaks in the nightside ionosphere and at larger distances from Titan. The lack of solar radiation in nightside ionosphere, and low neutral N2 density at high altitude, mean that the observed photoelectron peaks are less likely to be locally produced. The most likely explanation for detecting them here is that they travelled from the dayside ionosphere along magnetic field lines. We present a statistical survey of all photoelectron peaks, using an automatic finite impulse response algorithm to detect them in electron spectrometer data. We use this algorithm with a co-ordinate system (DRAP) that can help us understand the background Saturnian magnetospheric field in the vicinity of. This allows us to determine the spatial distribution of photoelectron peaks which reveals some characteristics of Titan's magnetic field environment.

Rebecca Gray, Lancaster University
Jupiter's UV and X-Ray Auroral Response to Co-rotating Interaction Regions

We present Jovian auroral observations from the Hubble Space Telescope in the UV and from Chandra in the X-Ray taken in 2007 during a Co-rotating Interaction Region incident on Jupiter's magnetosphere, and associated solar wind compression. We show the UV response to two solar wind structures and compare them to identify any common morphological features. We find that during the solar wind compression, the 'cusp spot' shows a periodic flashing followed ~ one rotation later by bifurcated emission around the typical 'main emission' region that also shows pulsation and a low-latitude enhancement. The X-Ray emission also shows an expansion to low-latitude regions within one rotation. We suggest that the observations in these two different wavebands are related and that they indicate modification of Jupiter's cusp region and the currents linking the outer magnetosphere to the ionosphere.

Rosie Johnson, University of Leicester
H3+ Temperature Changes in Jupiter's Upper Atmosphere

We present a detailed study of the H3+ auroral emission at Jupiter, which uses data taken on the 31 December 2012 with the long-slit echelle spectrometer CRIRES (ESO-VLT). From this data-set the rotational temperature of the H3+ ions in the upper atmosphere were calculated using the ratio of the v2 Q(1,0-) and v2 Q(3,0-) fundamental lines. The entire northern auroral region was observed, providing a highly detailed view of ionospheric temperatures, which were mapped onto polar projections. The temperatures we derive in the auroral regions are ~750-1000 K, which is consistent with past studies, although the temperature structure in the auroral region differs. We identify a local time change in temperature during the observations (over a short period of ~2 hours). This change in temperature could be due to a local time change in particle precipitation energy, or alternatively modelling has shown that temperature changes can arise due to the magnetospheric response to a transient solar wind compression. Using other derived properties, such as the H3+ line-of-sight velocity, column density and total emission, as well as propagated solar wind parameters, we discuss the potential heating mechanisms in Jupiter's auroral region.

Gianluca Carnielli, Imperial College London

First 3D test particle model of Ganymede's ionosphere

Our knowledge of the ionospheric plasma composition, density and dynamics inside Ganymede's magnetosphere is very limited and is currently constrained from few Galileo flybys. We have developed the first 3D test particle model of Ganymede's ionosphere to estimate these poorly constrained physical parameters. The model is driven by: (1) the number densities of neutral species from the exospheric model of Leblanc et al. (2017) (2) solar extreme ultraviolet radiation (Woods et al. 2005), (3) electron fluxes coming from the Jovian plasma around the moon (Mauk et al., 2004) and (4) the electromagnetic field from the hybrid model of Leclercq et al. (PSS, in revision).

We will present the first three-dimensional maps of number densities and bulk speeds of the main ion species produced in Ganymede's ionosphere. We will show and interpret our derived ion-impact 2D maps at the surface for both ionospheric ions and Jovian ions (coming from the Jovian plasma sheet), and provide sputtering rates of neutral molecule production resulting from these impacts. We will also quantify the importance of the charge-exchange process between the ions and exospheric species in terms of production of energetic neutrals, which is relevant for exospheric models.

Robert Burston, University of Bath

Planetary Magnetotails as Non-linear Oscillators: Mercury, Earth, Jupiter, Saturn

In 1979 Hones made an analogy between the formation and release of plasmoids in Earth's magnetotail and the dripping of a leaky tap. In 1984 Shaw demonstrated that the dynamics of leaky taps can be chaotic, by way of a non-linear oscillator model. In 1990, inspired by Shaw's work, Baker and Klimas created a relaxation oscillator model and applied it to Earth's magnetotail. This model also demonstrated chaotic behaviour and hinted that Hones' analogy was more than merely a pedagogical tool. A generalisation of the "leaky tap" non-linear oscillator approach to magnetotail dynamics is presented which separately includes the Dungey Cycle and the Vasyliunas Cycle, thus making the model applicable not just to Earth but to the magnetotails of Mercury, Jupiter and Saturn as well. The possibility of variable amounts of noise in the dynamics of each Cycle is also included in the model, in contrast to its predecessors, making it a useful tool for assessing whether the observed dynamics are dominated by deterministic or stochastic behaviour. Results show, in the absence of noise, chaotic behaviour is possible.

Matt James, University of Leicester

Field line resonant wave activity in the Hermean magnetosphere

A study of field line resonances (FLRs) in the Hermean magnetosphere is presented using data obtained from the MESSENGER mission between March 2011 and April 2015. A recently published study of ULF wave polarization characteristics at Mercury has shown that toroidally polarized waves are common on the dayside of Mercury's magnetosphere, where the polarization exhibited by the transverse wave population suggests driving by the Kelvin-Helmholtz instability [James et al., 2016]. This study uses peaks in transverse wave power and reversals of polarization to find FLRs as MESSENGER traverses through the magnetosphere. Using the wave frequency at the resonance alongside a magnetic field model, plasma mass density has been estimated for each event. The plasma mass density is mapped out for the dayside magnetosphere, where the highest plasma mass densities are predicted to exist very close to the planetary surface.

Lloyd D. Woodham, Mullard Space Science Laboratory, UCL

The Role of Ion-Cyclotron Resonance as a Dissipation Mechanism in Solar Wind Turbulence

The solar wind contains turbulent fluctuations that are part of a continual cascade of energy from large scales down to smaller scales. Close to ion-kinetic scales, this energy is dissipated, heating the particle velocity distributions, however the specific mechanisms are still poorly understood. We use magnetic field and particle data from the WIND MFI and SWE instruments to study the nature of the solar wind turbulence at these scales. Using a noise floor estimate of the MFI instrument, we analyse the spectral properties of the magnetic field fluctuations between 0.1-5.5 Hz over the course of 2012. We find that the spectral break observed at these frequencies is best associated with the proton cyclotron resonance scale, 1/kc, compared to other characteristic scales. This result holds in both slow and fast wind streams, although with a worse correlation in slow streams where the break is usually less well-defined. In addition, the coherent magnetic helicity signature observed at these scales is found to be bounded at low frequencies by 1/kc. We show for the first time that cyclotron resonance is the most common dissipation mechanism at ion-kinetic scales, although other mechanisms cannot be ruled out.

Imogen Gingell, Imperial College London
MMS observations and hybrid simulations of a rippled and reforming quasi-parallel shock

Surface ripples, i.e. deviations in the local shock orientation, are expected to propagate in the ramp and overshoot of collisionless shocks. Observations and simulations of ripples have typically been associated with quasi-perpendicular shocks. Here, we present observations of a crossing of the Earth's marginally quasi-parallel bow shock by MMS which are consistent with a rippled shock structure. In order to demonstrate the differences between ripples at a quasi-perpendicular and quasi-parallel shock configuration, we conduct hybrid simulations over a range of solar wind conditions. We show that for quasi-parallel shocks the generation of ripples is modulated by cyclic reformation of the shock ramp; ripples grow and propagate only during periods of the reformation cycle when the shock is locally quasi-perpendicular, and the upstream region is unaffected by turbulence in the foot. We conclude that a change in properties observed in the crossing of a surface ripple by MMS are consistent with the combination of surface ripples and cyclic reformation.

Julia E. Stawarz, Imperial College London
Observations of Magnetic Reconnection and Associated Flux Ropes in the Earth's Magnetotail by the Magnetospheric Multiscale Mission

We present recent observations of several ion-scale flux ropes observed by the Magnetospheric Multiscale (MMS) mission on 11 July 2017. The flux ropes are associated with a near-Earth magnetotail reconnection event located roughly 20 Earth radii downtail for which MMS encountered the electron diffusion region. Observations are found to be consistent with the axes of the flux ropes being tilted away from the cross-tail direction, indicative of 3D structure. The strongest electric field (~70 mV/m) within the entire reconnection encounter is found within one of the flux ropes and the interiors of all of the flux ropes contain enhanced fluctuations from their surroundings. The small spacecraft separation of ~20 km, which approaches the electron scales, allows for a detailed examination of the these structures and the reconnection event.

Samuel Wharton, University of Leicester
A New Technique for Estimating Magnetospheric Eigenfrequencies and Implications for Magnetospheric Plasma Distributions

The eigenfrequency of a magnetic field line is determined by its length, magnetic field strength and the plasma (mass density) distribution along it. Knowledge of the eigenfrequency can help us determine the plasma distribution of near-Earth space, which can potentially aid space weather forecasting.

The Cross-Phase technique can estimate these eigenfrequencies using two closely-spaced ground magnetometers. The advantage of this technique over using spacecraft measurements is we get continuous, uninterrupted measurements of the magnetosphere. We have developed a strategy based on the work of Sandhu (2016) [Thesis] and Berube et al. (2003), to perform automated Cross-Phase searches of magnetometer data for local eigenfrequency signatures, including harmonics. This algorithm was applied to a month of equinox data for five pairs of latitudinally-spaced magnetometers over L-shells 3-17. The results, binned by MLT and averaged over all solar wind conditions, suggest there are a clear set of preferred eigenfrequencies and harmonics on the dayside. The results show how the eigenfrequency changes with both L shell and MLT, and that there is an asymmetry between the morning and afternoon estimated eigenfrequencies. Finally, our attempts to fit a plasma model to the measurements will be discussed.

Stephen Browett, University of Southampton
Effect of magnetospheric convection timescales on the correlation between the IMF and magnetotail flux rope By components

Previous studies have presented conflicting results on the dependence of magnetotail flux rope core field orientation on IMF conditions. One possibility to explain this discrepancy is that it might be necessary to take into account the timescale for the IMF By component to penetrate into the magnetotail. Browett et al. (2017) showed the magnetotail plasma sheet is highly correlated with upstream IMF conditions when a lag of 2-4 hours is applied. The specific lag that showed the peak in correlation was dependent on the efficiency of dayside reconnection which is controlled by upstream conditions. Following the results of Browett et al. (2017), we have applied a time lag analysis to the observed IMF By component during times from a list of flux ropes previously published by Borg et al. (2012). However, preliminary results from this analysis suggest that applying an additional lag to the IMF provides no significant increase in correlation with the flux rope core fields in this list. This contrasts with the plasma sheet magnetic field measurements adjacent to the flux ropes, which do show the expected time dependence on IMF By. Reasons to explain these observations are explored.

Alexandra Ruth Fogg, University of Leicester
Quantitative Comparison of New SuperDARN Convection Maps

Since the development of the global map potential process by Ruohoniemi and Baker [1998], SuperDARN global convection maps have been used as a powerful tool to investigate magnetospheric and ionospheric dynamics. The implementation of new and old versions of software can output different electric potential solutions. Here we present quantitative comparisons between convection mapping from different versions of software, which are necessary to ensure consistent solutions are found. In recent years our understanding of SuperDARN backscatter has improved, allowing the position and properties of ionospheric irregularities to be determined with greater accuracy, using new methods of data processing. Similar quantitative investigation of the effect of these processing methods will also be done to see the effect of newer processing techniques on convection solutions.

Ruohoniemi, J. M. and K. B. Baker (1998), Large-scale imaging of high-latitude convection with Super Dual Auroral Radar Network HF radar observations, Journal of Geophysical Research, 103, pp. 20,797-20,811.

Jade Reidy, University of Southampton
Interhemispheric survey of polar cap aurora

This study investigates the interhemispheric nature of polar cap aurora via ultraviolet imaging, combined with particle data, to determine whether they occur on open or closed field lines. Data from the SSUSI (Special Sensor Ultra-Violet Spectrographic Imager) instrument on board the DMSP (Defence Meteorological Satellite Program) spacecraft are examined. The DMSP spacecraft are in 90 minute orbits, hence images of each hemisphere are separated by 45 minutes providing a good opportunity for inter-hemispheric study. 22 events from December 2015 had particle data from the SSJ/4 particle spectrometer associated with an arc in at least one hemisphere. Nine events are found to be consistent with a closed field line mechanism, i.e. they were seen in both hemispheres and had an ion signature in each hemisphere. Eight events had arcs that were consistent with an open field line mechanism, i.e. they were associated with electron-only precipitation. Events containing arcs that were not consistent with these expectations are also explored, including examples of the so called 'non-conjugate' theta aurora. Furthermore, an occurrence rate of at least 20% for polar cap arcs is found using four months of SSUSI data, with some arcs likely being missed due to daylight contamination.

Daniel Billett, Lancaster University
Diurnal variations in global Joule heating morphology and magnitude due to neutral winds

In the polar ionosphere, Joule heating is primarily controlled by sudden changes in plasma convection, such as that brought about by changes in the interplanetary magnetic field. However, another important consideration is the velocity difference between this plasma and the neutral thermosphere. Joule heating has often previously been calculated assuming that neutral velocities are small and can therefore be neglected. However, this does not take into consideration the UT dependence of the neutral wind, which varies due to changes in solar pressure gradients and Coriolis forces. As a result, Joule heating also varies with UT and can differ significantly from that calculated by neglecting the neutrals. In this study, we use an empirical model for the neutral wind, conductances and magnetic field to create patterns of Joule Heating for approximately 800,000 plasma convection patterns generated using data from the Super Dual Auroral Radar Network (SuperDARN). From this, a statistical analysis of how Joule heating varies in morphology and magnitude with UT is shown for differing levels of geomagnetic activity and season. We present results showing that neutral winds do play a significant role in the morphology and total energy output of Joule heating.

Lauren Orr, University of Warwick

Dynamical Networks Characterization of Space Weather Events

A central aspect of the earth's magnetospheric response to space weather events is large scale and rapid changes in ionospheric current patterns. The SuperMAG initiative collates ground-based vector magnetic field time series from over 100 magnetometers in the auroral region with 1-minute temporal resolution. This combined dataset is an ideal candidate for quantification using dynamical networks. Network properties and parameters allow us to characterize the time dynamics of the full spatiotemporal pattern of the ionospheric current system. We establish whether a given pair of magnetometers are connected in the network by calculating and dynamically normalizing their canonical cross correlation. Once the dynamical network has been obtained [1][2] from the full magnetometer data set it can be characterized by time dependent network parameters. We will discuss the effectiveness of different network parameters for tracking transient changes in inferred ionospheric currents.

[l] Dods et al, J. Geophys. Res 120, doi:10.1002/2015JA02 (2015).

[2] Dods et al, J. Geophys. Res. 122, doi:10.1002/2016JA02 (2017).

Sarah Bentley, University of Reading

Parameterising ULF waves using solar wind parameters: a probabilistic model?

Ultra-low frequency (ULF) waves in Earth's magnetosphere are involved in the energisation and transport of radiation belt particles and therefore play a role in the threat posed to satellites. ULF waves are strongly driven by the incoming solar wind. A parameter reduction on the highly interdependent solar wind properties indicates that solar wind speed v_{sw}, proton number density variance $var(N_p)$ and southward magnetic field B_z are the most ULF-effective solar wind parameters at geosynchronous orbit and are therefore suitable candidates for an instantaneous empirical model of ULF wave power. Speed v_{sw} remains the dominant driver but B_z and $var(N_p)$ still account for significant amounts of power. We observe that the distribution of power spectral density appears to be consistently lognormal across multiple magnetic local time (MLT) sectors and discuss the opportunities a probabilistic model could bring to radiation belt modelling.

Martin Birch, University of Central Lancashire

Observations of electron content and velocity fluctuations in the F-region at very high latitude.

Incoherent scatter radar observations at Svalbard have revealed field-aligned structures in the electron content of the F-region with a periodicity of about 20 minutes. Simultaneous velocity observations from the SuperDARN system show similar periodicities. This study investigates relationships between these two independent sets of observations, and presents initial results which reveal that there are significant associations between them.

John Coxon, University of Southampton

Filamentary currents in five FTEs observed by MMS

We present observations of five flux transfer events (FTEs) which were observed within a twenty-minute period on 3 October 2016. We employ magnetic field, electric field and plasma measurements from the Magnetospheric Multiscale (MMS) spacecraft located on the dusk flank of the magnetopause during a period of predominantly duskward IMF. The FTEs observed are of reverse polarity, indicating that they are moving towards the Southern Hemisphere. Of the events observed, we determine that two of our events are crater-type FTEs whereas the other three do not show crater-type signatures. We observe filamentary bidirectional field-aligned current signatures during all but one of the FTEs, similar to recent observations of signatures during a crater FTE (Trenchi et al, submitted). We also observe larger regions of unidirectional field-aligned current in the two crater FTEs. We examine our results in the context of previous observations linking crater FTEs to the separatrix.

Ravi Desai, Imperial College London

Cassini observations of nongyrotopic pickup ions at Saturn's largest icy moon Rhea

Saturn's largest icy moon, Rhea, hosts a tenuous sputter-induced surface bound atmosphere. Here, we examine Cassini Plasma Spectrometer pickup ion detections in Rhea's vicinity and demonstrate that Cassini detected O_2^+ during the R1 encounter and outflowing CO_2^+ during the R1.5 encounter. We use these observations to calculate O_2^+ and CO_2^+ mass loading rates within Saturn's middle magnetosphere. Negatively charged pickup ions, also detected during R1, are surprisingly shown to correspond to species of mass 23+/-2 u. These are consequently attributed to carbon-based compounds, such as C2- or C2H-, produced from carbonaceous material present on the moon's surface. We also discuss the competition between the Aflvén-cyclotron and Mirror Mode instabilities which complicate the direct interpretation of the magnetic signatures of mass loading in this environment.

Gareth Dorrian, Nottingham Trent University

The influence of the neutral atmosphere on the ionosphere during polar darkness

The ionosphere is a highly complex plasma containing electron density structures with a wide range of spatial scale sizes. Large-scale structures with horizontal extents of tens to hundreds of km exhibit variation with time of day, season, solar cycle, geomagnetic activity, solar wind conditions, and location. Whilst the processes driving these large-scale structures are well understood, the relative importance of these driving processes is a fundamental, unanswered question.
The dependence of these structures on the neutral atmosphere has never been fully established, despite the well-understood ionosphere-neutral coupling mechanism. The neutral atmosphere influences the vertical dynamics of the atmosphere which, in turn, alters the density profile of the thermosphere and hence the lifetime of the plasma density structures.
Ionospheric measurements from the EISCAT Svalbard Radar are correlated with neutral temperature and wind data from UCL's Fabry-Perot Interferometer, as well as proxies for the geophysical conditions. The data range spans parts of Solar Cycle 23 & 24, and are collected exclusively during periods of Northern hemisphere polar darkness. Generalised Linear Modelling is then used to determine the relative importance of the parameters tested. Initial results and potential mechanisms are discussed.

Robert Fear, University of Southampton

Global scale simulation of northward IMF magnetospheric dynamics: Vlasiator results

We present the first observations of magnetospheric dynamics under northward interplanetary magnetic field conditions in a global hybrid-Vlasov simulation, using results from the Vlasiator code. Vlasiator treats ions kinetically, evolving ion distributions in three velocity-space dimensions; electrons are treated as a fluid. The simulation is run in two spatial dimensions. Several observational phenomena associated with northward IMF are reproduced: reconnection occurs at the high latitude lobe magnetopause, initially in one hemisphere and subsequently in both; the reconnection process is bursty, resulting in the formation of flux transfer events (a structure topologically equivalent to that proposed under the single X-line mechanism, followed by flux ropes consistent with multiple X-line reconnection); a low level of magnetotail reconnection is present on the nightside (apparently triggered by the passage of a large flux transfer event at the magnetopause) which is followed by the growth of a 'wedge' of closed magnetotail flux. At first sight this appears consistent with the in situ observational signature of a transpolar arc, but more detailed analysis reveals it to be related to the removal of lobe flux and the 2D nature of the simulation run. Collectively, these observations allow us to investigate several aspects of solar wind/magnetosphere coupling.

Georgina Graham, Mullard Space Science Laboratory, UCL

Investigating the effect of IMF path length on strahl beam width broadening

Strahl is a strongly field-aligned, beam-like population of solar wind electrons. Strahl beam width increases with radial distance from the Sun and must be subject to in-transit scattering effects. A number of different energy relations for strahl beam width have been observed and modelled, hence there is much conjecture regarding the precise scattering mechanisms for strahl electrons. In this study, we estimate the path length travelled by the strahl along the interplanetary magnetic field. We do this by implementing methods, investigated in previous studies, that make use of solar energetic particle onset time observations at ~ 1 AU. We find that average strahl width broadens with distance travelled along the IMF, which suggests that the width of the strahl beam is related to the path length taken by the strahl from the Sun to 1 AU. We also find that strahl pitch angle width broadening per AU travelled along the IMF increases with strahl energy. Our pitch-angle broadening results provide a testable hypothesis for the upcoming Solar Orbiter mission, which is set to provide solar wind electron observations as close as ~ 0.3 AU.

Rosie K. E. Hood, University College London

Correlations between Geomagnetic Disturbances and Field-Aligned Currents during the 22-29 July 2004 Storm Time Interval

Using the CHAMP fluxgate magnetometer to calculate field-aligned current (FAC) densities and magnetic latitudes, with SuperMAG ground magnetometers analogously providing ground geomagnetic disturbances (GMD) magnetic perturbations and latitudes, we probe FAC locations and strengths as predictors of GMD locations and strengths. We also study the relationships between solar wind drivers and global magnetospheric activity, and both FACs and GMDs using IMF Bz and the Sym-H index. We present an event study of the 22-29 July 2004 storm time interval, which had particularly large GMDs given its storm intensity. We find no correlation between FAC and GMD magnitudes, perhaps due to CHAMP orbit limitations or ground magnetometer coverage. There is, however, a correlation between IMF Bz and nightside GMD magnitudes, supportive of their generation via tail reconnection. IMF Bz is also correlated with dayside FAC and GMD magnetic latitudes, indicating solar wind as an initial driver. The ring current influence increases during the final storm, with improved correlations between the Sym-H index and both FAC magnetic latitudes and GMD magnitudes. Sym-H index correlations may only be valid for higher intensity storms; a statistical analysis of many storms is needed to verify this.

Benjamin E S Hall, Lancaster University

Preliminary Evaluation of MArtian Global Ionospheric Conductivities (MAGIC)

The solar wind interacts directly with Mars' upper atmosphere, over time stripping it away. As the solar wind deposits energy into the Martian ionosphere, an ionized region of the upper atmosphere, currents flow due to the motion of charged particles around electromagnetic (EM) fields which redistributes the energy throughout the system. The readiness for these currents to flow can be quantified by the ionospheric conductivity. Unlike globally magnetised planets, the Martian ionosphere is embedded with magnetic fields of both external (interplanetary magnetic field) and internal (remnant crustal magnetic fields) origin, which significantly complicates the ionospheric electrodynamics. The golden age of Mars exploration has finally made it possible to elucidate the fundamental physical processes of this topic. I will present preliminary results that explore the readiness of current day models of the Martian magnetic, ionospheric, and neutral environment in describing the distribution of Martian ionospheric conductivities across the globe. Defining a reference MArtian Global Ionospheric Conductivity (MAGIC) model is an important first step in comparing with in situ observations, and ultimately describing the current systems that can flow throughout this complicated magnetic environment.

Caitriona Jackman, University of Southampton

Assessing periodicities in Jovian X-ray emissions: techniques and heritage survey

Jupiter produces the most powerful planetary X-ray emission in our solar system, and there has never been a better time to observe, with the Juno spacecraft taking in situ measurements, and powerful Earth-orbiting telescopes imaging coincident auroral emissions. There have been two particularly noteworthy papers which have reported periodic auroral X-ray emission from Jupiter: Gladstone et al. [2002] who noted 45-minute quasi-periodic oscillations from a hot spot in the northern auroral region, and Dunn et al. [2017] who noted ~11-minute quasi-periodic pulsations from a newly-discovered southern auroral hot spot. We revisit the large catalogue of jovian observations from 1999 to 2015 (the pre-Juno era) and highlight the best techniques for searching datasets of sparse, time-tagged photons for evidence of quasi-periodicities. We use Monte Carlo simulations alongside traditional Lomb periodogram analysis to extract information on periodicities and to deduce levels of significance. Overall, significant periodicities appear to be the exception rather than the norm and we examine possible physical reasons for the erratic driving of the jovian X-rays.

Nadine M. E. Kalmoni, Mullard Space Science Laboratory, UCL

A diagnosis of plasma wave instabilities in the lead up to an auroral substorm

During periods where the interplanetary magnetic field has a southward component, reconnection on the dayside magnetopause leads to a build up of magnetic flux in the magnetotail lobes, and the magnetotail acts as a reservoir of plasma and energy. During a substorm this energy is explosively released, leading to the deposition of large quantities of energy into the polar ionospheres and leading to the bright and dynamic substorm aurora. Auroral substorm onset is observed at the equatorward edge of the auroral oval, suggesting that at least some of the processes which play an important role in energy release occur on closed magnetic field lines. Recent work has highlighted that auroral beads, which are observed in over 90% of auroral substorms, grow exponentially through substorm onset, which indicates the action of a plasma instability in this near-Earth region.

We present a case-study of a substorm onset arc to extract the temporal and spatial characteristics of the instability. We estimate the location and prevailing magnetotail parameters. Using these properties we compare our observations with the solutions of the warm plasma dispersion relation and find overwhelming agreement. We therefore demonstrate that plasma instability can be diagnosed from purely its optical signature.

Allan Ross Macneil, Mullard Space Science Laboratory, UCL

Tests for coronal electron temperature signatures in suprathermal electron populations at 1 AU

In order to understand the Sun-heliosphere relationship it is vital to develop our knowledge of how solar wind origins affect its in-situ properties. We analyse ACE/SWICS and WIND/3DP data to test properties of solar wind suprathermal electron distributions for signatures of the coronal temperature at their origin. To do this we test for correlations with the oxygen charge state ratio O7+/O6+; an established proxy for coronal electron temperature. We find only a very weak but variable correlation between these parameters. We conclude, in contrast to earlier results, that an initial relationship between core electron temperature and suprathermal electron energy content may exist in the corona, but that in most cases no strong signatures remain at 1AU. We cannot yet confirm whether this is due to the effects of coronal conditions on the establishment of this relationship, or to alteration of the electron distributions by processing during transport to 1AU. Confirmation of this will be possible using Solar Orbiter to test whether the weakness of the relationship persists over a range of heliocentric distances. If the correlation strengthens when closer to the Sun, this would indicate an initial relationship which is being degraded en route to the observer.

Lars Mejnertsen, Imperial College London

Global MHD Simulations of Flux Ropes on the Dayside Magnetopause

Dayside magnetic reconnection between the interplanetary magnetic field and the Earth's magnetic field is an important process which allows for mass and energy entry into the magnetosphere. Coupled with the subsequent tail reconnection, it is known for causing adverse Space Weather effects. During favourable solar wind conditions, reconnection can occur at multiple points on the magnetopause, potentially forming twisted magnetic structures known as flux ropes: these structures have been observed on the dayside magnetopause, but little is known about their global effect on the magnetosphere since spacecraft provide local observations.

Global simulations allow us to capture the entire magnetospheric system at an instant in time, and thus reveal the interconnection between different plasma regions and dynamics on large scales. Using the Gorgon MHD code, we observe the formation of flux ropes during a real solar wind event. With a relatively strong solar wind dynamic pressure and southward IMF, the dayside region becomes very dynamic with evidence of multiple reconnection events. In this work, we discuss the nature of the flux ropes formed and impact on the magnetosphere. Furthermore, they exhibit complex topology, interlinking open field lines connected to the North and South poles, as well as closed field lines.

Beatriz Sanchez-Cano, University of Leicester

Seasonal variability of the Martian total electron content as seen by the MEX-MARSIS-subsurface instrument

The behaviour of the Martian ionosphere with respect to long and short term variability has largely been investigated thanks to recent missions such as Mars Global Surveyor, Mars Express, and MAVEN. In this work, we take advantage of the full solar cycle of near-continuous plasma measurements provided by Mars Express to analyse the seasonal variability in the Vertical Total Electron Content (VTEC) of the Martian ionosphere. Mars Express VTEC for this study was obtained from the Mars Advanced Radar for Subsurface and Ionosphere Sounding (MARSIS) in its subsurface mode, which provides the VTEC between the Martian surface and the spacecraft. Changes in the Mars Express orbit over time have allowed MARSIS to measure the VTEC at all latitudes and seasons over an 11 year period. The robustness of the observed seasonal variability in VTEC is investigated with three ionospheric models, an empirical model, a numerical simulation and a global circulation model (GCM). Similarities and differences between the Martian and Terrestrial ionospheres are also considered.

Jasmine Kaur Sandhu, Mullard Space Science Laboratory, UCL

Field Line Eigenfrequencies During Storms and Substorms

The eigenfrequencies of geomagnetic field lines provide a useful diagnostic for the large scale magnetic field configuration and the mass density distribution of plasma within the magnetosphere. By applying the cross phase technique [Waters et al., 1991, 1995] to ground magnetometer observations, the eigenfrequencies of field lines can be directly measured. We illustrate the capability of using measured eigenfrequencies to observe large scale structure and variability of the terrestrial magnetosphere during highly dynamic and not fully understood magnetospheric conditions, specifically during storm and substorm processes. Magnetic field observations from the CARISMA ground magnetometer array are analysed, providing simultaneous coverage over a large range of L shells. We present large scale statistical studies, which provide insight into how the magnetic field and mass density vary globally throughout storms and substorms. Furthermore, case studies have been identified that allow us to measure the Alfvén continuum prior to substorm onset. The results of this work offer further insight into the mechanics of these processes and the varied response of the magnetosphere, as well as highlighting the ability to probe large scale magnetospheric structure through measurements of field line eigenfrequencies.

Robert Shore, British Antarctic Survey

A self-consistent method for deriving polar ionospheric convection from eigenanalysis of SuperDARN radar data

We apply a meteorological analysis method called Empirical Orthogonal Functions (EOF) to month-long samples of polar ionospheric plasma velocity data from SuperDARN. The EOF method is used to characterise and separate contributions to the variability of plasma motion in the northern polar ionosphere. EOFs decompose the noisy and sparse SuperDARN data into a small number of independent spatio-temporal basis functions, for which no a priori specification of source geometry is required. We use these basis functions to infill where data are missing. This infill only converges when it reinforces patterns present in the original data, thus providing a self-consistent description of the plasma velocity at the original temporal resolution of the SuperDARN data set.

The leading modes of the EOF decomposition are found to be the two-cell Dungey-cycle convection pattern associated with IMF Bz, a single-cell perturbation to it associated with IMF By, and other modes. The relative importance of these modes (i.e., contribution to the total variance) is found to vary with season. These results are compared against previous results from an EOF analysis of equivalent currents from ground-based magnetometer data. Our study demonstrates the methodology which will be applied to SuperDARN data spanning a full solar cycle.

Andrew Smith, University of Southampton

Evaluating Single Spacecraft Observations of Planetary Magnetotails with a simple Monte Carlo Simulation

Surveys are often undertaken of spacecraft magnetometer data to locate various products of reconnection within planetary magnetotails (e.g. flux ropes). These surveys of in-situ data are constrained by both the orbits of the spacecraft and the numerical limits placed upon the required signatures (e.g. field deflections). We present the early results of a Monte Carlo approach designed to estimate the effects of spacecraft coverage on inferred distributions, and numerical thresholds on the properties of the identified structures.

David Stansby, Imperial College London

The origin of number density structures in the slow solar wind

The sources and generation mechanisms of slow solar wind are still unclear. 'Number density structures', one component of the slow solar wind, are discrete areas of increased proton number density. They have been previously observed with remote sensing measurements in the solar corona up to 0.3 AU and with in situ measurements at 1 AU. We fill this measurement gap with detailed in-situ observations of number density structures between 0.3 and 0.5 AU. This enables observation of the structures before the solar wind has been processed by stream-stream interactions and other transport effects.

The identified structures have no characteristic scale size, and last between 2 minutes to 2 hours which is significantly smaller than previously reported observations. Our analysis shows the structures are hotter, have higher plasma beta, and are pressure balanced compared to the surrounding plasma.

These properties suggest the structures originate from a hot, dense solar source compared to the surrounding slow wind plasma.

Liz Tindale, University of Warwick

Quantifying variability in fast and slow solar wind: From turbulence to extremes

The data quantile-quantile plot [Tindale and Chapman 2016, 2017] is a model-independent method used to explore the variability of fluctuations across all scales. We apply it to 20 years of Wind data, to study the evolution of the statistical distribution of the interplanetary magnetic field strength and its components in fast and slow solar wind. Below 8nT, turbulent fluctuations dominate the distribution, thus the approximately lognormal shape found by Burlaga [2001] is recovered under certain conditions. The mean of this core-turbulence region tracks solar cycle activity while its variance remains constant, independent of the fast or slow state of the wind. At IMF values above 8nT, we find a separate extremal distribution component, whose moments are sensitive to solar cycle phase, the peak activity of each cycle and the solar wind state. We further investigate these 'extremal' values using burst analysis, where a burst is defined as a continuous period of exceedance over a threshold. This form of extreme value statistics allows us to study the stochastic process underlying the observed time series.

Tindale, E., and S.C. Chapman (2016), GRL, 43(11)
Tindale, E., and S.C. Chapman (2017), JGR, 122
Burlaga, L.F. (2001), JGR, 106(A8)

Sam Turnpenney, University of Leicester

Exoplanet-induced radio emission from M-dwarfs

We consider the magnetic interaction of exoplanets orbiting M-dwarfs, calculating the expected Poynting flux carried upstream along Alfven wings to the central star. A region of emission analogous to the Io footprint observed in Jupiter's aurora is produced, and we calculate the radio flux density generated near the surface of the star via the electron-cyclotron maser instability. We apply the model to produce individual case studies for the TRAPPIST-1, Proxima Centauri, and the dwarf K2-22 systems. We predict flux densities of up to ~ 10 microJy from TRAPPIST-1 and Proxima Centauri, suggesting these systems may be detectable in the future with the Square Kilometre Array (SKA). For K2-22 we calculate a flux density between ~0.1 - 1 mJy, therefore potentially observable presently with the Low Frequency Array (LOFAR). For each case study we also estimate the maximum power and flux density from sporadic bursts of radio emission, and find that such events should be comfortably within the reach of the SKA.

Daniel Verscharen, Mullard Space Science Laboratory, UCL

Large-scale Compressive Fluctuations in the Solar Wind: Kinetic Theory, MHD, and In-situ Observations

The fast solar wind is a collisionless magnetised plasma. Therefore, deviations from thermodynamic equilibrium can develop, and a kinetic description of the plasma becomes necessary. We discuss the properties of the dispersion relations and polarisation properties of kinetic slow modes and magnetohydrodynamic slow modes. We compare theoretical predictions for the fluctuations in the three lowest velocity moments (density, bulk velocity, and pressure) of the proton distribution function associated with large-scale compressive slow modes to solar-wind observations at 1 au. We find that the predictions from magnetohydrodynamics (MHD) are in a better agreement with the data than the kinetic predictions, even at times when the collisionality of the plasma is low. This surprising result suggests that some unknown kinetic process assumes the role of collisions in suppressing fluctuations in heat flux. Possible candidates for such a process include fluctuating-moment effects, wave-particle scattering on small-scale fluctuations, and anti-phase-mixing. We also discuss the relation of the large-scale compressive plasma modes to the observed pressure-balanced structures in the solar wind.

Maria-Theresia Walach, Lancaster University

Characterising variability in speed and direction of ionospheric flows: How well do IMF conditions constrain variability in SuperDARN data?

The Super Dual Aurora Radar Network has been observing ionospheric flows at Earth near the geomagnetic poles for decades. The doppler shifted signals provide line-of-sight measurements of ionospheric velocities from the high frequency radars. In order to produce global maps of ionospheric flows the SuperDARN line-of-sight measurements are usually gridded and have spherical harmonic functions fitted to them. A baseline model, categorised by the interplanetary magnetic field (IMF) conditions is used to fit patchy data to in order to obtain global maps of convection. As the solar wind is highly variable, the ionospheric flows can also vary significantly with respect to the convection models. Thus it is important to isolate and study the variability in the flows to be able to produce improved convection maps. In this work, we look at the variability in the SuperDARN line-of-sight speeds and direction of flows. We characterise the variability within existing IMF categorisations and show that considerable variability still exists. In order to be able to understand better what controls the variability and how we can minimise variability in the models, we isolate locations and times when the variability is particularly high and study them in greater detail.

Honghong Wu, Mullard Space Science Laboratory, UCL
Kinetic Alfvén Waves (KAWs) in the Solar Wind

Kinetic Alfvén waves (KAWs) are the long-wavelength extension of the MHD Alfvén-wave branch under the assumption of highly-oblique propagation with respect to the background magnetic field. Observations in the solar wind show a strong wavevector anisotropy, suggesting that the small-scale turbulence is mainly in the KAW-like regime. However, many properties of these small-scale fluctuations remain unclear. We apply two theoretical approaches (collisional two-fluid theory and collisionless fully kinetic theory) to obtain predictions for the polarisation relations of KAWs. In the future, we will perform an analysis of solar-wind data to compare both theories with observations. We will determine which model describes KAWs in the solar wind more accurately. Previously published results suggest that large-scale fluctuations behave more fluid-like in the solar wind than expected, even under collisionless conditions. With this study we will investigate whether small-scale KAW-like fluctuations exhibit the same behaviour.