Poster session 2
Monday May 20

• *Phil Travis (UCLA)*

Turbulence and transport in mirror geometries in the LAPD

Measurements of turbulence and transport in varying magnetic mirror ratios, including multi-celled configurations, have been performed using the flexible magnetic geometry of the Large Plasma Device (LAPD). Fluctuations in density (ion saturation current), floating potential, and magnetic field were recorded, with amplitudes peaking, as expected, on the edge pressure gradient. Planar correlation functions of single-celled mirror cases were also recorded. In a single-celled mirror, density and magnetic field fluctuation amplitudes decreased with increasing mirror ratio, while potential fluctuation amplitudes remained similar. The cross-phase between potential and density fluctuations varies with increasing mirror ratio, suggesting a shift in the underlying linear instability as the mirror ratio is increased and magnetic curvature is introduced. Differences in the spectra and cross-phases of floating potential and ion saturation current were also observed with increased cell count. Changes in energy confinement, zonal flows, and turbulence as a function of mirror ratio, cell count, and geometry will be presented.

• *Alice Giroul (Queen Mary)*

Characterising the Earth's magnetosheath far downstream

Debye is a proposal for an ESA mission to be launched together with ARIEL in 2028 and will be in orbit around the Sun-Earth L2 point. This gives an incentive to form a better picture of the plasma environment in the less-explored distant magnetosheath around 200 RE downstream of the Earth. WIND magnetic field and plasma data from its L2 pass in late 2003 - early 2004 are used to characterise the turbulence in this region. A comparison is made with the types and properties of waves seen in the near-Earth magnetosheath (mirror modes, etc.), and their dependence on upstream solar wind conditions.

• *Laura Bercic (LESIA)*

The role of Coulomb collisions in the solar wind acceleration region: Kinetic simulations

The solar wind is, being a weakly collisional plasma, difficult to completely capture by commonly used fluid or kinetic numerical models. To be able to reproduce suprathermal, non-maxwellian velocity distribution functions so commonly observed for the solar wind electrons, we have to apply a fully kinetic approach, usually computationally highly demanding. Aiming to reduce the complexity of the model capable of well reproducing the observed solar wind parameters, we use a fully kinetic model of radially expanding solar wind taking into account binary collisions between the particles (Landi et al.,2001). With it we are able to study the importance of Coulomb collisions in shaping the velocity distributions in the solar wind, but are in turn neglecting any wave particle interactions. The model has been already used to study the evolution of the electron velocity distribution functions and macro quantities in the expanding solar wind between 0.3 to 3 au (Landi et al., 2012, Landi et al.,2014). Besides these works, Zouganelis et al. (2004) used the same model to quantify the importance of the presence of suprathermal electrons within the solar corona on the maximal reached solar wind velocity. As a continuation of the above studies we simulate acceleration region up to 35 Rs, the distance reached during the first two perihelions of the new solar mission the Parker Solar Probe. We explore how important is the role of expansion and collisions compared to the role of initial conditions in producing a complex electron velocity distribution functions observed further from the Sun.

• *Christopher Bert (University of Michigan)*

Simple Dependence of Proton Density and Temperature on Solar Wind Speed and Compression

Simple trends between solar wind speed and both temperature and density have long been reported and studied. We show that both parameters are also smooth functions of the radial gradient of solar wind speed (calculated in an Eulerian frame) across many observed timescales, incorporating more than two decades of observations made by the Wind spacecraft. Performing this calculation at a fixed point, as opposed to evaluating the acceleration through space of a particular parcel of plasma, provides a measurement of slope that we use to determine the extent of each parcel's change in volume due to local stream interaction effects along its propagation through the inner heliosphere. This systematic discrimination between compression (slower wind followed by faster wind) and rarefaction (faster wind followed by slower wind) of all magnitudes forms the basis of a spherical shells model of the solar wind, revealing an adiabatic coupling of temperature and density with change in volume at these scales. It is important to report this as an additional driver of variability in the solar wind, consistent with ideal gas approximations that have been used in literature and models. There is significant potential for this study to inform space environment predictions in preparation for Parker Solar Probe and other missions, and continued operation at the first Lagrange point opens the door to simultaneous work with those future experiments.

• *Barbora Bezdekova (Charles University)*

Simultaneous observations of quasiperiodic emissions by spacecraft and ground-based instruments

Quasiperiodic emissions are electromagnetic waves observed in the inner magnetosphere at frequencies between about 0.5 and 4 kHz both by ground-based instruments and satellites, which exhibit a nearly periodic temporal modulation of the wave intensity (typical periods on the order of minutes). We present an analysis of 26 events observed simultaneously by the Kannuslehto station in Finland (L~5.46) and Van Allen Probes spacecraft. We use the multipoint observations to estimate the spatial extent of the events, finding out that they typically expand less than 3 hours in magnetic local time. The events appear to be systematically confined to within the plasmasphere, with maximum event intensities occurring at about 2 Earth radii inward from the plasmapause location. This indicates a probable position of their source region. Finally, we analyze the event propagation parameters as a function of relevant controlling factors, most importantly the distance from the plasmapause.

• *Beatriz Zenteno (Universidad de Chile)*

Analysis of the dispersion properties of Kinetic Alfven Waves in the Solar Wind

Kinetic Alfvén Waves (KAW) are plasma waves that propagate oblique to the mean magnetic field, have frequencies in the proton gyrofrequency and require such plasma conditions that the wavelength is similar to the ions' gyroradius [1]. One of the main properties of these waves is that they have a right-handed polarization in the plasma frame [2], which differs from the Alfvenic cyclotron left-handed modes. KAWs have been proposed as a possible mechanism that allows energy transference towards electron scales [3] because, in general, KAW wave-particle interactions are resonant with electrons and non-resonant with ions. Most of the dispersion properties of KAW have been studied in proton-electron plasmas, however, most astrophysical and space plasmas are multispecies. Then, it is expected that in these systems, the properties of the KAW will not depend only on protons and electrons, but also on the parameters of heavier ions. In this work, we solve the Vlasov linear dispersion relation for KAW in a solar-wind-like plasma, composed of protons, electrons and helium ions (He+2). We also study dispersion properties such as polarization, electric field perturbations and growth rate for different sets of parameters. We focus our attention on the changes introduced in these properties by drift velocities between species and anisotropic distribution functions for the helium ions. [1] J. V. Hollweg. Kinetic Alfvén wave revisited. J. Geophys., 104(A7): 14,811?14,819, 1999 Res Phyz. Rev. Lett. 118, 190603 (2017) [2] S. P. Gary. Low frequency waves in a high beta collisionless plasma: Polarization, compressibility and helicity. J. Plasma Phys, 35(03): 431-447,1986. [3] P. Nandal, N. Yadav, R. P. Sharma and M. L. Goldstein. Potential role of kinetic Alfvén waves and whistler waves in solar wind plasmas. Astrophys. Space Sci., 361(7):239-, 2016.

• *Jesse Coburn (Queen Mary)*

Solar wind measurements of the interaction between turbulence and pressure anisotropy

The incorporation of an anisotropic pressure into linear kinetic theory and magneto-fluid models has provided key results in our understanding of plasma behavior. The evolution of the pressure anisotropy is generated/suppressed by various nonlinearities and instabilities, the former has not been studied in detail. This research effort seeks to understand the relationship between the turbulence and pressure anisotropy. We present measurements from THEMIS and WIND, and discuss the statistical aspects of the pressure anisotropy in reference to the turbulent nature of the solar wind.

• *Michaël Geeraerts (KU Leuven)*

Effect of electrical resistivity on the damping rate of fast and slow sausage modes

The effect of electrical resistivity on the damping of fast and slow magnetosonic waves is studied analytically. First, we briefly analyse the simple case of an infinite homogeneous cartesian plasma and look at how it affects the damping time of the wave. In a second, more complicated case we look at axisymmetric modes of a cylindrical flux tube with a discontinuous profile in the equilibrium density, plasma pressure and magnetic field (representative for a pore in the solar photosphere e.g.). Analytical dispersion relations are found in both cases under the assumption of very small electrical resistivity, which converge to the corresponding dispersion relation from the ideal case when taking the limit of a vanishing electrical resistivity. We solve our generalised dispersion relation to study the dependence of the sausage mode damping rate on the electrical resistivity.

• *Manuela Sisti (Aix-Marseille Université)*

Satellite data-based 3D simulation of Kelvin-Helmholtz and magnetic reconnection at the Earth's magnetosphere

Kelvin-Helmholtz instability plays a key-role in regulating the plasma transport from the solar wind into Earth's magnetosphere, in particular when the magnetic field advected by the solar wind is mainly parallel to the Earth's dipole axis. Vortices, which develop at the magnetospheric flanks, perturb and fold the magnetopause inducing reconnection events there. Their 3D dynamics induces reconnection to occur in the equatorial region, where vortices are, but also at mid-latitudes. Measurements of equatorial and mid-latitude reconnection acting at the same time have been reported by Cluster, Themis and MMS. We present a 3D two-fluid simulation using plasma parameters as measured by MMS on September 8th 2015 describing the non-linear development of the Kelvin-Helmholtz instability at the Earth's magnetopause. We observe an extremely rich non-linear dynamics driven by the Kelvin-Helmholtz vortices distributed asymmetrically in latitude. Equatorial and mid-latitude reconnection coexist and cooperate in producing an asymmetric distribution of magnetic reconnection events. The results are in good agreement with MMS observations on that day. The effective diffusion coefficient associated to the dynamics turns out to be large enough to account for the observed transport at the magnetospheric flanks.

• *Muni Zhou (MIT)*

Magnetic island merger as a mechanism for inverse magnetic energy transfer

How large scale magnetic fields in the universe are formed is unclear. One possible mechanism is the transfer of magnetic energy from seed fields generated at kinetic scales to system scales. We investigate this inverse transfer of magnetic energy in a system of parallel current filaments (corresponding to flux ropes or magnetic islands). A solvable analytical model is introduced and shown to correctly capture the evolution of the main quantities of interest, as borne out by numerical simulations. Magnetic reconnection is identified as the key mechanism enabling the inverse transfer, and setting its properties: magnetic energy decays as $\tilde t^{-1}$, where $\tilde t$ is time normalized to the (appropriately defined) reconnection timescale; and the correlation length of the field grows as $\tilde t^{1/2}$. The magnetic energy spectrum is self-similar, and evolves as $\propto \tilde t ^{-3/2}k^{-2}$, where the k-dependence is imparted by the formation of thin current sheets.

- *Simon Vincent (ENS Lyon)*

Non-linear interactions of low frequency waves in a magnetically confined plasma column

Low frequency waves turbulence developing in magnetized plasma columns are well known to trigger important radial transport, a major issue for fusion devices. We present here analysis from very fast imaging of low frequency waves in a magnetically confined plasma column, as well as the impact of an emissive cathode on their dynamics. Our experimental set-up consists in a cylindrical chamber containing an Argon plasma column of 10 cm diameter of ionization rate 20% and at low pressure ($\sim$ 1 mTorr) generated via an electromagnetic induction source of power 1 kW. The plasma is confined by a magnetic field ranging from 0.01 T to 0.15 T. A very fast camera records images of spontaneous radiated light fluctuations in a plane transverse to the plasma column axis, at a 200 kfps rate, showing the presence of azimuthally rotating waves at frequencies of order the kHz. These images are analysed using a Proper Orthogonal Decomposition technique which is compared to 2D axisymmetric Fourier transform analysis. The POD results exhibit m-modes closely following the $e^{im\theta}$ spatial form of the modes extracted by 2D Fourier transform. The non-linear interactions between the modes can then be observed, and well as the dominant mode present in an experiment while increasing the magnetic field (a well known control parameter for drift waves turbulence). Finally the modification of the detected m-modes is investigated when an emissive cathode is placed at the center of the plasma column.