Topology of magnetic structures in solar wind plasma

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In most astrophysical plasmas collisions between plasma particles are rare and do not lead to a considerable loss of kinetic and magnetic energy through viscous and resistive heating. Instead, the energy dissipation relies on nonlinear processes, namely *plasma turbulence* and *magnetic reconnection*. These fundamental mechanisms transfer energy across scales and between electromagnetic fields and particles. Stretched turbulent vortices and thin reconnecting current sheets are prime sites of plasma heating and particle acceleration. *Magnetic field line topology* is central to both these processes. The project will explore these processes using multi spacecraft observations, which allow for the reconstruction of the local magnetic field line topology in the solar wind. The Cluster and the Magnetospheric Multi-Scale (MMS) missions provide data for such reconstruction on different spatial scales. The impact of unstable current sheets on the turbulent energy cascade in the solar wind will be explored, beyond the usual signatures observed in the power spectra of fluctuations. Detecting current sheet-like topology and characterising its stability will provide essential validation for recent theories. Small reconnecting current sheets generated by the Kelvin-Helmholtz instability in the Earth magnetosphere will be studied to understand the topological evolution of these structures via plasmoid generation. Reconnection events will also be studied to assess the validity of the quasi two-dimensional magnetic field configurations used in the models and theories. Current magnetic field reconstruction methodology will be improved based on the additional constraint due to directly observed current.

The successful candidate will be based in the Centre for Fusion, Space and Astrophysics (CFSA). Research at CFSA focuses on plasma physics applied to the grand challenges of fusion power, space physics, solar physics, and astrophysics. Our work spans fundamental theory, observation, and the analysis of experimental data, combined with high performance computing. For more details of the CFSA see http://www.warwick.ac.uk/go/cfsa/

We plan to interview in person at Warwick University in late February but please get in touch before that with any informal enquires, if you have any questions or if you'd like to know more about the project.