RSPP seminars

Dr. Robert Fear

University of Southampton

“How much flux does a flux transfer event transfer?”

Flux transfer events are bursts of reconnection at the dayside magnetopause, which give rise to characteristic signatures that are observed by a range of magnetospheric/ionospheric instrumentation. Spacecraft situated near the magnetopause observe a bipolar variation in the component of the magnetic field normal to the magnetopause (BN); auroral instrumentation (either ground- or space-based) observes poleward moving auroral forms which indicate the convection of newly-opened flux into the polar cap, and ionospheric radars similarly observe pulsed ionospheric flows or poleward moving radar auroral forms. One outstanding problem is the fact that there is a fundamental mismatch between the estimates of the flux that is opened by each flux transfer event – in other words, their overall significance in the Dungey cycle. Spacecraft-based estimates of the flux content of individual FTEs correspond to each event transferring flux equivalent to approximately 1% of the open flux in the magnetosphere, whereas studies based on global-scale radar and auroral observations suggest this figure could be more like 10%. In the former case, flux transfer events would be a minor detail in the Dungey cycle, but in the latter they could be its main driver. We argue that this mismatch occurs because implicit assumptions about flux transfer event structure lead to a major underestimate of the flux content based on spacecraft observations. If longer X-line models are explicitly considered, the calculated flux content depends on the X-line length, resulting in a higher flux estimate. To demonstrate this, we present observations of conjunctions between flux transfer events observed by the Cluster spacecraft, and pulsed ionospheric flows observed by the SuperDARN network. In the first case, FTEs are observed by Cluster and the Prince George radar, which are separated by 6 hours of magnetic local time. If we make the assumption that reconnection occurs coherently across this local time sector, we find a very good match between the flux content determined from SuperDARN observations and that determined from Cluster observations (if a long X-line structure is assumed). However, the large separation between the spacecraft and ionospheric observations means it is difficult to infer a one-to-one link between the two sets of FTE signatures. Therefore, we present supporting observations from closer conjunctions; as the same Xline length is used in the ionospheric and spacecraft calculation, the consistency of the flux estimate (for a given MLT extent) can still be checked at the expense of knowledge about the X-line length and hence the total flux transfer. Overall, we conclude that if the implicit assumptions about FTE structure are removed from the calculation of flux content based on spacecraft observations, a much better match is found between spacecraft and ionospheric calculations.

UNIVERSITY OF LEICESTER

Wednesday, March 15th at 2 pm in Physics LTD