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Probing Current Sheet Instabilities from Flare Ribbon Dynamics

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In the standard eruptive flare model, magnetic reconnection originates in a thin current sheet; created by the inflow of oppositely orientated magnetic fields under a rising magnetic flux rope. The current sheet is notoriously difficult to observe directly, primarily due to the small size of the region. However, insights into current sheet dynamics can be revealed by the behaviour of flare ribbon substructure, as magnetic reconnection accelerates particles down reconnected field lines to the chromosphere to mark the flare footpoints. Behaviour in the ribbons can therefore potentially be used to probe processes occurring in the current sheet. Motivated by a similar study on the Earth's magnetosphere (Kalmoni et al 2015, 2018), we exploit this magnetic connectivity between the current sheet and magnetic footpoints to probe for signatures of waves and instabilities at the current sheet during the pre-impulsive phase of a small B-class solar flare (Jeffrey et al 2018). We use Fast Fourier Transforms of high-cadence (1.7 s) IRIS slit-jaw observations, back mapping observed spatial frequency scales and growth rates to the reconnection site. We compare these parameters to those expected from theoretical current sheet processes, such as the tearing mode or Kelvin-Helmholtz instabilities. This provides an observational constraint (for a single flare case-study) on the current sheet processes contributing towards the small-scale breakdown of ideal MHD needed to trigger the onset of fast magnetic reconnection on the Sun.

Student poster?

Authors: FRENCH, Ryan (UCL Mullard Space Science Laboratory); Dr MATTHEWS, Sarah (UCL MSSL); Prof. RAE, Jonathan (Northumbria University); Dr SMITH, Andrew (UCL MSSL)

Presenter: FRENCH, Ryan (UCL Mullard Space Science Laboratory)

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