Summary of Involvement for the Thomas Metcalf SPD Travel Award

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Jack Carlyle

SDO Workshop 2016: Unraveling the Sun's Complexity
October 17-21, 2016 — Burlington, Vermont, USA

Bio

Jack is a research fellow at the European Space Agency at the ESTEC facility in the Netherlands, where his main area of research focuses on the mass determination of eruptive filaments. He also conducts numerical and analytic studies of the Rayleigh-Taylor instability in the context of erupted filament plasma, and was previously employed at the University of Oslo under the F-CHROMA project to perform radiative-hydrodynamic simulations of the chromospheric response to a solar flare. Jack received his PhD from University College London in January 2016, with joint funding from the Max Planck Institute for Solar System Research, with a thesis titled The Mass and Magnetic Field of Eruptive Solar Filaments.

Oral contribution: Mass Diagnostics of Eruptive Filament Material

Filament eruptions are stunning events that cast huge amounts of material into the solar atmosphere. Whilst these events are thought to be magnetically driven, the mass itself may also play an important role in any associated coronal mass ejection, or indeed, the lack thereof. Moreover, by examining the mass distribution and internal density structuring, it is possible to indirectly study the embedded magnetic fields themselves.

This research centers on the development of a technique that uses multi-wavelength EUV images captured by the Atmospheric Imaging Assembly (AIA) on board the Solar Dynamics Observatory (SDO) to determine the mass of any plasma that appears in absorption, as (eruptive) filament material does. The technique assumes photoionisation is the dominant process removing photons from the line of sight, so the optical depth of the material can be measured in order to obtain the column density. This technique has been successfully applied to two particularly interesting events: one double-eruption involving an intermediate filament that preceded an unexpectedly strong geomagnetic storm; and one semi-failed eruption in which large amounts of material fell back to the solar surface. The masses of several features are calculated for each event, and this information is used to further probe the dynamic morphology of the material.

The method is being continuously developed to not only increase the accuracy of the results, but also to widen the applicability to a broader spectrum of data (figuratively and literally). Through improved models of the unattenuated radiation field, it will be possible to apply the technique to less dynamic material (i.e. non-eruptive filaments), and this can be achieved by using co-spatial observations at wavelengths which are not occulted by bound-free absorption (and hence the filament material is transparent in). Not only is there plenty of pre-existing data that can be used to achieve this, but also there are several missions launching over the coming years that will allow the technique to be extended even further.

"The opportunity to attend the 2016 SDO workshop provided by the Thomas Metcalf award was invaluable. Not only did this allow me to present my research and receive illuminating feedback on my ideas, but also to discuss the broad subject of Solar Physics with many world-leading experts. I found this extremely enlightening, and the new connections I have made have opened new avenues for collaborative research. This will be hugely beneficial to my personal career, and I hope the resulting work will stimulate and strengthen the field as a whole."