Thomas R. Metcalf SPD Travel Award 2018 Conference Report
Graham S. Kerr
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Bio: Dr Graham S. Kerr is a NASA Postdoctoral Fellow (NPP), based at NASA Goddard Space Flight Center, working with Dr. Joel Allred. He completed his PhD in 2017, under the supervision of Prof. Lyndsay Fletcher at the University of Glasgow, with a thesis titled "Observations and Modelling of the Chromosphere During Solar Flares." Dr. Kerr's research focuses on understanding energy, mass, and radiation transport through the solar atmosphere, using a combination of observations (Hinode/SOT, IRIS, RHESSI, SDO/AIA, SDO/EVE), and numerical modelling (RADYN, RH, MULTI). This includes an interest in white light flares, the formation of optically thick spectral lines, and how we can use advanced modelling of the solar chromosphere to study the impact of energy deposition during flares.

Invited oral contribution at IRIS-10: Dr. Kerr was invited to present an overview of flare modelling in the context of observations from the IRIS spacecfraft. There are currently three state-of-the-art 1D flare loop models that are commonly used by the flare community: RADYN, HYDRAD, and FLARIX. Each has somewhat different features and is suited to a particular task. An overview of the differences between these numerical resources was presented, along with an example of how well they compare to each other. Examples of the synergy between flare modelling and IRIS data using the RADYN code were then presented, highlighting that these loop models can help interpret IRIS observations and extract diagnostic information, and that (perhaps more importantly) IRIS observations present a vital resource with which to critically interrogate the output of flare models. If a model fails to stand up to observational scrutiny, additional ingredients to the model, or alternate models, must be considered. The examples presented included recent results that: **(1)** Si IV emission can become optically thick in moderate-large flares. This has consequences on the interpretation of that data, and indicates a geometrically extended chromosphere at T~40-80kK is present; **(2)** that non-equilibrium ionisation is in fact important in the initial heating and cooling phases of solar flares but that it is generally sufficiently close to the equilibrium solution. This means that the typical approach of using equilibrium radiation transfer codes that include PRD is acceptable until a code capable of non-equilibrium and PRD is available; **(3)** that observations of white light flares using combined SOT/IRIS observations present a challenge to flare models. Models predict optically thin chromospheric emission with Balmer edges in the spectra, but some observations show sources where no Balmer jump is present. Finally some in-progress work that aims to bridge the gap between 1D loop models and 3D flare arcades was presented. We took observed active region loops and grafted RADYN DEMs onto the observed structures in a time-dependent manner to mimic ribbon progression. Synthetic Fe XXI emission as would be observed by IRIS was produced from that model, and it was demonstrated that the viewing angle on the disk and loop geometry plays an important role in the interoperation of Doppler motions.

Benefits of the Meeting: I am very grateful to the AAS/SPD travel awards committee, and also the IRIS-10 SOC/LOC for providing accommodation in India. This award enabled me to both update the IRIS community on the current state of flare loop models, and to present our recent work with these models. I was fortunate to have many fruitful discussions while attending the meeting.

Below I show synthetic Fe XXI (formed ~11MK) emission from our flare arcade model. The emission as would be observed by IRIS is shown in four example slit positions. The derived Doppler motions are shown also, for two different positions on the disk, illustrating that viewing angle can lead to quite different results.