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A statistical study of flare ribbon spatial evolution with IRIS

Due to the magnetic connectivity between the flaring current sheet and magnetic footpoints, flare ribbon behavior must reflect current sheet processes at flare onset. In recent years, attention has turned to the role of the tearing mode instability in breaking down the current sheet at flare onset. The instability allows energy release to accelerate via the reconnection of progressively smaller magnetic island structures, theorized to produce a rate of energy release close that observed in solar flares. In French et al 2021, IRIS 1.7 second cadence slit-jaw observations of a small B-class flare were analyzed to explore the timing and growth rates of spatial scales along flare ribbons. The initialization of exponential growth from a specific spatial scale to all spatial scales was indicative of the tearing-mode instability, and power laws in the spatial domain matched those predicted by simulation work of the tearing-mode induced plasma turbulence. The analysis, however, was just for one small, confined flare. In this work, we expand this methodology of French et al 2021 for a wider selection of eruptive and non-eruptive solar flares, ranging in size and complexity. We utilize high-cadence IRIS SJI observations of the ribbons, (with spectra when available), and compare the behavior of spatial scales along/across the ribbons with simulations of magnetic reconnection, to shed further light on the role of plasma instabilities during the onset of flares and eruptive events. Included in the flare list are observations from the new IRIS sub-second observing program.

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