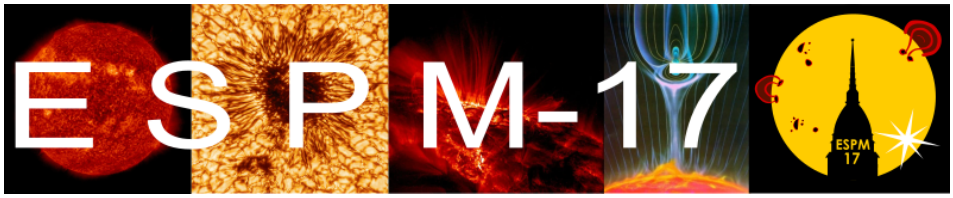

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Signature of Self-organized Criticality in Flaring Current Sheets

In solar flares, magnetic reconnection is key to restructuring the coronal magnetic fields and converting magnetic free energy into other forms of energies. The footpoints of newly reconnected magnetic flux tubes are mapped by chromospheric flare ribbons. The ribbons hence provide clues for structures of, and reconnection processes in, the coronal current sheet, which are still poorly understood. Here we adopt the UV (1600 Å and 1700 Å) filters of the Atmospheric Imaging Assembly (AIA) on-board the Solar Dynamics Observatory (SDO) to study the detailed evolution of flare ribbons for a sample of 10 two-ribbon flares. We extract flare ribbons based on the variances of AIA 1600/1700 filter ratio. We find that the frequency distribution for waiting times of the identified pixels on the flare ribbons is well described by a power law of index about 1.5, consistent with the theoretical expectation of the self-organized criticality (SOC) model, but the frequency distributions for flaring duration, peak intensity, area under the light curve, and magnetic field strength of the identified pixels generally deviate from power laws as well as from the SOC expectations. These results suggest that time-wise an avalanche process might be ongoing in the flaring current sheet, but in other aspects, e.g., space- and energy-wise, this avalanche is likely modulated by other physical processes.

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