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The relationship between solar flare ribbons and magnetic field changes in the solar photosphere

The changing magnetic field in solar flares has a complex association with the UV emissions of the flare ribbons. These ribbons appear as visual markers indicating the sites where magnetic field lines go through a coronal reconnection processes, which has been determined to be the driving process of flare formation. However, this process is not entirely clear. We aimed to investigate the magnetic field behaviour exclusively within the flare ribbon regions. In this work, we studied six M- class flares to understand the temporal relationship between the line-of-sight magnetic field changes in the photosphere using high-cadence (45 s) magnetograms obtained from the HMI/SDO, and the flare ribbons'UV emission (1600 Å) obtained from the AIA/SDO. We found that in 5 out of 6 flares, the positive-field ribbons showed a negative time lag Δt between field changes and ribbon UV brightening indicating that changes in the magnetic field started before the AIA peak time. Similarly, the negative-field ribbons showed a negative time lag. This time delay was determined to be between two and forty-two minutes. Moreover, the average magnitude of the change was around 100 G. Our result suggests that a magnetic field change before the UV emission is consistent with the scenario of magnetic implosion, which is associated with the release of magnetic energy, field contraction and bending of the field at the photosphere. This energy release would cause UV emission after the magnetic field line has changed, however, the size of the time delay remains to be explained.

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