M28b Changes in the Photospheric Non-potential Magnetic Fields during Solar Flares and their Correlation with Flare Ribbons

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Solar flares are highly energetic phenomena on the sun, driven by its dynamic magnetic field in active regions. Flares produce ribbon-shaped brightenings in the lower solar atmosphere, which are believed to correspond to the footpoints of magnetic reconnected field lines. Kusano et al. 2020 suggested that the flare triggering mechanism is likely contained within high free-energy regions (HiFERs), subdomains of active regions with strong non-potential magnetic fields. However, the spatial relationship between HiFERs and flare ribbons is not yet understood. Our research is focused on the correlation between the evolution of HiFERs and the development of flare ribbons.

We analyzed photospheric magnetic fields of flaring active regions, using vector magnetograms from the Helioseismic and Magnetic Imager (HMI) onboard the Solar Dynamics Observatory (SDO). We examined the evolution of spatial distribution and physical properties of HiFERs in the context of flare ribbons as detected by UV 1600Å images from the Atmospheric Imaging Assembly (AIA) onboard the SDO. We find that during flare onset, while the non-potential magnetic fields are typically enhanced overall near the magnetic polarity inversion lines, the major enhancement sites tend to be located specifically between the initial flare ribbons. This spatial association between HiFER changes and flare ribbon onset supports the causal relationship between these two phenomena.