M34a Study of the Critical Condition of Active Region Based on the Nonlinear Force-Free Field Analysis

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It is important to understand the onset mechanism of solar flares since it can give us crucial information to estimate the upcoming eruption in an active region (AR). In order to study the critical condition of solar flare in an AR, we analyse the evolution of coronal magnetic fields in ARs before and after several big flares. We reconstruct coronal magnetic field of flaring ARs by using Nonlinear Force-Free Field (NLFFF) extrapolation. From the reconstructed fields, we can estimate magnetic twist distribution in the ARs. We analyse the evolution of twist parameter during the flaring periods of ARs and find from the twist map distribution that the high-twist field area tend to be large before flares and then shrink after flares. We also propose a parameter to estimate the critical condition of flares by using a proxy of the critical condition parameter in the double-arc-instability (DAI) theory introduced by Ishiguro and Kusano (2017). This proxy parameter, which include the twist and high-twist flux information normalized by total flux, show consistent threshold for the eruption in an AR as the theoretical parameter. We believe that this initial study can give a foundation for further studies in evaluating critical condition for solar eruption based on the NLFFF analysis.