M46a Evolution of Magnetic Twist in a Flare-Productive Active Region

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Active region with non-potential magnetic field in the region around the polarity inversion line (PIL) can accumulate huge amount of magnetic energy, which is necessary for producing solar flare. This non-potential magnetic fields can be manifested in the solar corona as a highly twist magnetic field lines. Therefore, understanding the characteristics of spatial and temporal distribution of magnetic twist of an active region is very important to clarify the mechanism of flare onset and also improve our capability of predicting a flare. In order to understand how the twist of magnetic fields is related to the onset of flare, we reconstructed the coronal model of AR NOAA 11158 and analyzed spatio-temporal evolution of magnetic twist. Non-linear Force-Free Field (NLFF) modeling is used to reconstruct coronal structure of AR 11158 during three consecutive days (2011-02-13 - 2011-02-15) when the active region crossed the area near the central meridian of the Sun and produced several flares. We calculated and analyzed the twist of magnetic field lines using the data from SDO/HMI. We found that the twist distribution for AR 11158 tend to increase during these three eruptive days. Twist distribution map also shows that the footpoints of the highly twisted field lines correspond well with the flare ribbons produced in several flares. Moreover, by discriminating this active region into several smaller different regions, we can show that each region may give different profile of twist that also correspond to the flare productivity. We also proposed a parameter that could be important to identify the region that is likely to produce a flare by analyzing its magnetic twist.