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Comparative Study of Observations and Simulations on Flare Trigger Process

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Although it is widely accepted that solar flares are explosive phenomena driven by magnetic energy stored in active regions, the onset mechanism of flares is not yet well understood. Recently, Kusano et al. (2012) revealed with the numerical simulations that there are two different types of flare onset, in which magnetic reconnection between large-scale sheared magnetic field and small-scale magnetic fields of two different orientations may trigger solar flares, respectively. In this study, we analyzed four major flares (X3.4 on 2006 Dec. 13, X1.5 on 2006 Dec. 14, M6.6 on 2011 Feb. 13, X2.2 on 2011 Feb. 15) obtained by Hinode/SOT, to examine their model. We analyzed the spatio-temporal correlation between the Ca II H line emission and the magnetic field, in particular for the structure of polarity inversion lines. Moreover, we measured the magnetic shear angle in the flaring site and the azimuth of small scale magnetic structure which triggered the flares. As a result, we can find that all the flares had the flare trigger regions, and that all the flares could be classified to the two types of flare onset scenarios, which were presented by Kusano et al. (2012). It is also shown that not only the magnetic structure of the trigger region but also the structure of pre-flare brightening are well consistent with their simulation results. We also discuss about the critical amount of small magnetic flux for triggering solar flares.