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The evolution of magnetic structure of NOAA AR11158 and M-class flare on February 13, 2011

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We investigate the evolution of magnetic structure of NOAA AR 11158 and the corresponding M6.6 flare occurred on February 13, 2011.

Solar flare, a large energy release in the solar outer atmosphere, has a great influence on the geosphere. Spatially- and temporally-resolved observational data have been obtained by the recently-launched satellites Hinode and Solar Dynamics Observatory (SDO). The solar activity started to rise again in 2011 and a lot of flare data are now going to be accumulated.

NOAA 11158 emerged on the solar surface on February, 2011. It produced a lot of flares including X-class one. Hinode and SDO observed this region in detail from its emergence. Spectro-polarimetric data on the photosphere was obtained by Solar Optical Telescope (SOT) on board Hinode in the vicinity of M6.6 flare. We analyze the time-evolution of the magnetic structure of this region, especially the trigger region of M6.6 flare, and compare the structure with the numerical calculation by Kusano. First we investigate the magnetic field data obtained by Hinode/SOT and SDO/HMI. It is found that this region is formed by a collision of the two emerging fluxes, and that they make a strongly sheared polarity inversion line (PIL), on which a lot of flares occurred. We also found a discriminating magnetic structure on the PIL before the M-class flare. The horizontal field, which has the same direction as the potential field, is formed after the flare. We interpret this relaxation as a result of the magnetic energy release through the flare. Next we investigate Ca images, and find a continuous Ca brightening just above the discriminating magnetic structure. This is similar to the character of pre-flare brightening, which is seen in the ”reverse shear type” flare model suggested by Kusano. Further we make comparison of this brightening with current density in the numerical calculation by Kusano. The spatial distributions of the Ca brightening in the observation and the current density in the simulation are coincided with each other. The relaxed horizontal field continues to be sheared again by the motion of the whole region. We consider this sheared field as a pre-flare coronal arcade of the following X-class flare.

We present a brief summary of the flare observations in 2011 and show detailed results of the comparison between the M6.6-flare observation and the numerical results by Kusano.

Keywords: Sun, Solar Flare, Active Region, Magnetic Field