# Close causal relation between emergence of twisted flux rope and strong flares

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Solar flares are considered to occur in the solar corona by magnetic field reconnection (Shibata 1995). The flare energy, which is stored in the twisted magnetic field, is supplied to the corona through the photosphere from the convection zone. For this reason, observations of evolutional changes in the magnetic field configuration of flare-productive regions are fundamentally important for the flare energy build-up study and the forecast of strong flares. Hagyard (1984) showed that flares occurred along the neutral line of strong magnetic shear. The magnetic shear is, however, not a sufficient condition for strong flare occurrence, and it is important to study the active region evolutions and examine which type of magnetic shear development produces strong flares. Until now several works made detailed studies of magnetic shear developments in flare-productive sunspot regions and suggested that the emergence of a twisted magnetic flux rope, which is originally formed in the convection zone, must be the source of the strong magnetic shear development in a sunspot region to produce a strong flare activity ( Kurokawa 1987, Tanaka 1991, Ishii et al. 1998, Kurokawa 2002).

In this paper we present our recent studies of energy build-up processes of flare-productive active regions. We studied the evolutional changes of 11 super active regions which produced more than three X-class flares observed from 1998 through 2005 during the 23 solar sunspot cycle in details. We found all these regions show some common magnetic evolutional features in the course of the production of X-class flares, and we conclude that all these features are explained by the emergence of twisted magnetic flux rope.

In this paper we also present a brief introduction of a new telescope named Solar Magnetic Activity Research Telescope (SMART) which has been recently installed at Hida Observatory.