M32a Rotational Sunspot Motions in Flare-productive Active Regions

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We studied what is the key process to trigger the major solar flares using observational data of active region evolution. In our previous studies, we have examined the processes of magnetic shear development in many sunspot groups using high resolution Hα images obtained with the 60 cm Domeless Solar Telescope (DST) at Hida Observatory, Kyoto University. We have constructed schematic models of emerging magnetic flux bundles to explain observed sunspot proper motions, and found several examples of sunspot groups, where the emergence of twisted magnetic flux tubes triggered the major flares (Ishii et al. 1998, Ishii et al. 2000, Kurokawa et al. 2002).

We applied our method to the magnetograms obtained by the Solar and Heliospheric Observatory (SOHO) / Michelson Doppler Imager (MDI) and white light images by the Transition Region and Coronal Explorer (TRACE) which have been observed during the current solar maximum (cycle 23). We studied ative region evolutions for all regions that have produced at least one X-class flare and have been observed by SOHO (total 24 active regions from 1996 through 2001). We recognized a rotational sunspot motion as a common characteristic of these flare-productive active regions (e.g. vortex-like motions in NOAA 8210, 8731, 8910, 9236, 9684; rotation of magnetic neutral line of delta-type sunspots in NOAA 9026, 9393, 9415, 9591, 9661). These motions suggest that the emergence of twisted magnetic flux bundles are the energy source for strong flares.