

Solar activity in the end of October 2003 and possible contributions to the study of the space weather with the SMART

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In the end of October 2003, large-scale sunspot groups, such as NOAA 0484, 0486, 0488, 0492, appeared on the solar surface one after another, and many active phenomena including intense flares etc. occurred around the active regions.

On the other hand, in the Hida observatory of the Kyoto university, the Solar Magnetic Activity Research Telescope (SMART) was built at the beginning of 2003.

The main purpose of the SMART is the acquisition of the vector magnetogram on the full solar disk of the photosphere and of the full solar disk image of the chromosphere at H-alpha absorption line. When we want to derive the solar vector magnetic field, we have to measure the polarization components in the sunlight. The SMART-magnetograph was made improvements on various sides, in order to be able to measure the solar original polarization components with high accuracy (0.1%) (S.UeNo et al. SPIE 5492, 958, 2004). Moreover, this full-disk magnetograph was designed to have the highest spatial resolution (1.58 arcsec) among full-disk magnetographs all over the world. The H-alpha chromospheric image with the SMART also currently has the highest spatial resolution (0.83 arcsec) among full-disk H-alpha images all over the world. Therefore, we can observe all filament eruptions and all emerging magnetic structures and the whole process of the generation and the development of flares in detail on the whole chromosphere. Since we had already started experimental observations with the SMART at October 2003, we could fortunately obtain some limited amount of photospheric magnetograms and H-alpha data that included above-mentioned active regions in this period.

In this talk, I introduce characteristics of the SMART and the outline of the solar activity in this period by showing optically observed data of the solar surface which were obtained with the SMART, the Flare Monitoring Telescope (FMT) at Hida observatory and SoHO/MDI etc. Moreover, I introduce various important informations for the space weather, which can be extracted from such optical data generally. For example, as concerns the vector magnetic field, H.Kurokawa et al. (ApJ 572, 598, 2002) used the strength of the longitudinal magnetic field and the rotation velocity of the magnetic neutral line as indices, H.Li et al. (PASJ 52, 465&483) defined four kinds of average shear angles along the magnetic neutral line, T.Sakurai and M.Hagino (AdSpR 32, 1943, 2003) defined the magnetic helicity, and K.Kusano et al. (ApJ 577, 501, 2002) defined the magnetic helicity injection. Then, they have respectively discussed the relation between the indices and the occurrence of solar flares or the soft X-ray energy flux. As concerns the velocity field on the photosphere, many investigation of the relation between the horizontal velocity field, its gradient and the formation, change of magnetic structures have been studied (T.Magara and R.Kitai ApJ 524, 469, 1999; S.UeNo et al. AdSpR 26, 1793, 2000; H.Kozu and R.Kitai PASJ in printing; etc.), moreover, the studies of the temporal variation of structures under the photosphere around sunspot regions by using time-distance helioseismology which was advanced by T.L.Duvall et al. and A.G.Kosovichev in 1996 (Kosovichev, AN 323, 186, 2002) are very epoch-making. On the other hand, by using the multi-wavelength observation at H-alpha absorption line, we can know the 3-dimensional velocity field structure of filament eruptions that influence the solar-terrestrial environment, like the study by Morimoto & Kurokawa (PASJ 55, 505, 2003).

Then finally, I intend to propose the matters in which the SMART will especially be able to contribute to the space weather research in the future.

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