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태양 / 우주과학

[구 SS-07] Determination of coronal electron density distributions by DH type II radio bursts and CME observations

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In this study, we determine coronal electron density distributions by analyzing DH type II radio observations based on the assumption: a DH type II radio burst is generated by the shock formed at a CME leading edge. For this, we consider 11 Wind/WAVES DH type II radio bursts (from 2000 to 2003 and from 2010 to 2012) associated with SOHO/LASCO limb CMEs using the following criteria: (1) the fundamental and second harmonic emission lanes are well identified; (2) its associated CME is clearly identified in the LASCO-C2 or C3 field of view at the time of type II observation. For these events, we determine the lowest frequencies of their fundamental emission lanes and the heights of their leading edges. Coronal electron density distributions are obtained by minimizing the root mean square error between the observed heights of CME leading edges and the heights of DH type II radio bursts from assumed electron density distributions. We find that the estimated coronal electron density distribution ranges from 2.5 to 10.2-fold Saito's coronal electron density models.

[구 SS-08] Three-dimensional evolution of a solar magnetic field that emerges, organizes and produces a flare and flare-associated eruptions of a flux rope and plasmoid

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Solar flare is one of the energetic phenomena observed on the Sun, and it is often accompanied with eruptions such as global-scale eruption of a flux rope (filament/prominence eruption) and small-scale eruption of a plasmoid. A flare itself is a dissipative phenomenon where accumulated electric current representing free magnetic energy is dissipated quickly at a special location called a current sheet formed in a generally highly conductive solar corona. Previous studies have demonstrated how a solar magnetic field placed on the Sun forms a current sheet when magnetic shear is added to the field. Our study is focused on a self-consistent process of how a subsurface magnetic field emerges into the solar atmosphere and forms a current sheet in the corona. This study also gives light to a relation among a flare and two types of flare-associated eruptions; flux-rope eruption and plasmoid eruption.

[구 SS-09] Characteristics of Four SPE Classes According to Onset Timing and Proton Acceleration Patterns

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In our previous work (Kim et al., 2015), we suggested a new classification scheme, which categorizes the SPEs into four groups based on association with flare or CME inferred from onset timings as well as proton acceleration patterns using multienergy observations. In this study, we have tried to find whether there are any typical characteristics of associated events and acceleration sites in each group using 42 SPEs from 1997 to 2012. We find: (i) if the proton acceleration starts from a lower energy, a SPE has a higher chance to be a strong event (>5000pfu) even if the associated flare and CME are not so strong. The only difference between the SPEs associated with flare and CME is the location of the acceleration site. For the former, the sites are very low (~1Rs) and close to the western limb, while the latter has a relatively higher and wider acceleration sites. (ii) When the proton acceleration starts from the higher energy, a SPE tends to be a relatively weak event (<1000pfu), in spite of its associated CME is relatively stronger than previous group. (iii) The SPEs categorized by the simultaneous proton acceleration in whole energy range within 10 minutes, tend to show the weakest proton flux in spite of strong related eruptions. Their acceleration heights are very close to the locations of type II radio bursts. Based on those results, we suggest that the different characteristics of the four groups are mainly due

to the different mechanisms governing the acceleration pattern and interval, and different condition such as the acceleration location.

[구 SS-10] Dependence of solar proton peak flux on 3-dimensional CME parameter

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In the present study, we examine the dependence of solar proton peak flux at SOHO and STEREO on 3-D CME parameters (radial speed, angular width, and longitudinal angular separation between its source region and the magnetic footpoints of spacecraft). For this we consider 38 proton enhancements of 16 SEP events observed by SOHO, STEREO-A, and/or B from 2010 August to 2013 June. As a result, we find that the enhancements are strongly dependent on these three parameters. The correlation coefficient between proton peak flux and CME speed is about 0.42 for the cases the footpoints are located inside the lateral boundaries of angular widths, while

there is no correlation for the events outside the boundaries. The correlation coefficient between peak flux and angular separation is −0.51. We find that most of strong proton events occur when their angular separations are closer to zero, supporting that most of the proton fluxes are generated near the CME noses rather than their flanks.

[구 SS-11] Stereoscopic observations of front-side halo CMEs by SOHO and STEREO from 2009 to 2013

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We present a comprehensive catalog of 307 front-side halo (partial and full) CMEs during 2009 and 2013 observed by both SOHO and STEREO. This catalog includes 2D CME properties from single spacecraft (SOHO) as well as 3D ones from multi-spacecraft. To determine the 3D CME properties (speed, angular width, and source location), we use the STEREO CME analysis tool based on a triangulation method. In this paper, we compare between 2D and 3D CME properties, which is the first statistical comparison between them. As a result, we find that 2D speeds tend to be about 20% underestimated when compared to 3D ones. The 3D angular width ranges from 15° to 109°, which are much smaller than the 2D angular widths with the mean value of 225°. We also find that a ratio between 2D and 3D angular width decreases with central meridian distance. The 3D source locations from the triangulation method are similar to the flare locations. The angular width-speed relationship in 3D is much stronger than that in 2D.

[구 SS-12] Development of daily solar flare peak flux forecast models for strong flares

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We have developed a set of daily solar flare peak flux forecast models for strong flares using multiple linear regression and artificial neural network methods. We consider input parameters as solar activity data from January 1996 to December 2013 such as sunspot area, X-ray flare peak flux and weighted total flux of previous day, and mean flare rates of McIntosh sunspot group (Zpc) and Mount Wilson magnetic classification. For a training data set, we use the same number of 61 events for each C-, M-, and X-class from Jan. 1996 to Dec. 2004, while other previous models use all flares. For a testing data set, we use all flares from Jan. 2005 to Nov. 2013. The best three parameters related to the observed flare peak flux are weighted total flare flux of previous day ($r = 0.51$), X-ray flare peak flux ($r = 0.48$), and Mount Wilson magnetic classification ($r = 0.47$). A comparison between our neural network models and the previous models based on Heidke Skill Score (HSS) shows that our model for X-class flare is much better than the models and that for M-class flares is similar to them. Since all input parameters for our models are easily available, the models can be operated steadily and automatically in near-real time for space weather service.

[초 SS-13] KASI's contributions to Space Weather over the past 10 years

Kyungsuk Cho, Young-Deuk Park, and Solar and Space Weather Group
Korea Astronomy and Space Science Institute

For the past decade, supported by the Korean