corona region relatively higher than the flaring site. In this study, we analyzes 54 SPEs observed in the energy band over 25 MeV from 2009 to 2013, where STEREO observations as well as SOHO can be utilized. From the multi-positional observation, we determine the exact time at which the Sun-Earth magnetic field line meets the CME shock structure by considering 3-dimensional structure of CME. Also, we determine the path length by considering the solar wind velocity for each event, so that the SPE onset time near the sun is obtained more accurately. Based on this study, we can get a more understanding of the correlation between CME progression and proton acceleration in the solar coronal region.

[구 SS-08] Comparison of CME mean density based on a full ice-cream cone structure and its corresponding ICME one

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For space weather forecast, it is important to determine three-dimensional parameters of coronal mass ejections (CMEs). To estimate three-dimensional parameters of CMEs, we have developed a full ice-cream cone model which is a combination of a symmetrical flat cone and a hemisphere. By applying this model to 12 SOHO/LASCO halo CMEs, we find that three-dimensional parameters from our method are similar to those from other stereoscopic methods. For several geoeffective CME events, we determine CME mass by applying the Solarsoft procedure (e.g., cme_mass.pro) to SOHO/LASCO C3 images. CME volumes are estimated from the full ice-cream cone structure. We derive CME mean density as a function of CME height for these CMEs, which are approximately fitted to power-law functions. We find that the ICME mean densities extrapolated from the power law functions, are correlated with their corresponding ICME ones in logarithmic scales.

[구 SS-09] Magnetic and kinematic characteristics of very fast CMEs

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It is important to understand very fast CMEs which are the main cause of geomagnetic storms and solar particle events (SPEs). During this solar cycle 24, there are 10 very fast CMEs whose speeds are over 2000 km/s. Among these, there were only two fronside events (2012 January 23 and 2012 March 7) and they are associated with two major flares (M8.7 and X5.4) and the most strong SPEs (6310 pfu and 6530 pfu). They have a similar characteristics: there were successive CMEs within 2 hours in the same active region. We analyze their magnetic properties using SDO HMI magnetograms and kinematic ones from STEREO EUVI/COR1/COR2 observations. We can measure their speeds and initial accelerations without projection effects because their source locations are almost the limb. Additionally, we are investigating magnetic and kinematic characteristics of 8 backside events using AI-generated magnetograms constructed by deep learning methods.

[구 SS-10] Statistical study on the kinematic classification of CMEs from 4 to 30 solar radii

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In this study, we perform a statistical investigation on the kinematic classication of 4264 coronal mass ejections (CMEs) from 1996 to 2015 observed by SOHO/LASCO C3. Using the constant acceleration model, we classify these CMEs into three groups; deceleration, constant velocity, and acceleration motion. For this, we devise four dierent classication methods by acceleration, fractional speed variation, height contribution, and visual inspection. Our major results are as follows. First, the fractions of three groups depend on the method used. Second, about half of the events belong to the groups of acceleration and deceleration. Third, the fractions of three motion groups as a function of CME speed classied by the last three methods are consistent with one another. Fourth, according to the last three methods, the fraction of acceleration motion decreases as CME speed increases, while the fractions of other motions increase with speed. In addition, the acceleration motions are dominant in low speed CMEs whereas the constant velocity motions are dominant in high speed CMEs.

[구 SS-11] Estimation of Halo CME's radial speeds using coronal shock waves based on EUV observations

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