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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Propagating speeds of coronal mass ejections (CMEs) have been calculated by several geometrical models based on multi-view observations (STEREO/SECCHI and SOHO/LASCO). But in 2015, we were unable to obtain radial velocity of a CME because the STEREO satellites were located near the backside of the sun. As an alternative to resolve this problem, we propose a method to combine a coronal shock front, which appears on the outermost of the CME, and an EUV-wave that occurs on the solar disk. According to recent studies, EUV-wave occurs as a footprint of the coronal shockwave on the lower solar atmosphere. In this study, the shock, observed as a bubble shape, is assumed as a perfect sphere. This assumption makes it possible to determine the height of a coronal shock, by matching the position of an EUV-wave on the solar disk and a coronal shock front in coronagraph. The radial velocity of Halo-CME is calculated from the rate of coronal shock position shift. For an event happened on 2011 February 15, the calculated speed in this method is a little slower than the real velocity but faster than the apparent one. And these results and the efficiency of this approach are discussed.

고에너지 천체물리학

[구 HA-01] Timing analysis for the magnetar-like pulsar, PSR J1119-6127

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Studies on rotation-powered pulsars with strong surface magnetic field may help us clarify the unclear link between magnetars and canonical radio pulsars because the magnetar-like emission is expected to be observed. PSR J1119-6127 associated with SNR G292.2-0.5 has a high magnetic field of 4.1x1013 gauss, and a young characteristic age of ~1700 years can be served as the good candidate to compare with magnetars and rotation-powered pulsars. The glitch accompanied by the radiative changes detected in 2007 is the first case we observed for a rotationally powered radio pulsar. This pulsar experienced magnetar-like outbursts in mid. 2016, similar to the 2006 transition occurred on the other radio-quiet rotation-powered pulsar with strong surface magnetic field, PSR J1846-0258.

In this talk, I'll report the investigation with X-ray and gamma-ray data of this magnetar-like pulsar. A sudden decrease in the gamma-ray emission at the GeV band was detected immediately after the X-ray outburst. Accompanying with the disappearance of the radio pulsation, the gamma-ray pulsation cannot be resolved as well after the outburst. We tried to derive the timing behavior and some intriguing features of this pulsar in this work corresponding to the outburst using the Swift data, NuSTAR and XMM observations.

[석 HA-02] Measuring Timing Properties of PSR B0540-69

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Neutron stars (NS) are rapidly spinning compact objects. Their rotation energy is released by particles, electromagnetic waves, and even gravitational waves. The source of the energy is of course the rotation, so by studying the rotational properties of neutron stars, we can gain some insights into matter under extreme conditions. In particular, it is known that the braking index n is sensitive to the moment of inertia and/or NS winds. The neutron star PSR B0540-69 exhibits interesting timing behavior; previous measurements of the braking index for this pulsar may suggest a change in time. In order to see if the change is real, We investigate the timing properties of B0540-69 using recent ~1000-days Swift satellite data

[석 HA-03] Search for new magnetar candidates in Galactic plane.

Woochan Park, Hongjun An
Chungbuk National University

Magnetars are neutron stars powered by strong magnetic field ($B > 10^{14}$ G). Their spin period is in the range of 2 – 12s. The magnetic stress in the star may distort the crust (observed as outbursts), so magnetars (especially in outbursts) may emit gravitational waves. There are 29 magnetars known (potential gravitational waves sources), and increasing the number will increase the chance of detecting low-frequency gravitational waves. In addition, magnetars can be used for studying matter under extreme condition. In this study, we searched for more magnetars using extensive Chandra archival data and found 11 candidates. Due to the limited sensitivity of Chandra, form identification cannot be made, and more sensitivity X-ray data are needed.