government, the solar and space weather group of Korea Astronomy and Space Science Institute (KASI) has been researching towards the prevention of hazardous effects on Korean satellites, the stability of wireless telecommunications, and the safety of polar route aviation. So far, we have expanded the ground observation system, made space data more accessible, developed more advanced models for space weather forecasting, from which we have been providing forecasting services to a satisfied domestic clientele. Alongside that, we have continued our research on solar activities and the Sun-Earth connection. In this talk, I will summarize our contributions to space weather over the past 10 years and discuss future plans for next decade.

[구 SS-14] 우주환경 예보를 위한 VAP 데이터 처리 시스템 및 실시간 데이터 표출

JongKil Lee[1] Jaejin Lee[2] KyungChan Kim[2]
[1]*University of Science&Technology,*
[2]*Korea Astronomy&Space Science Institute*

근지구 우주환경 예측을 위해서는 태양의 주기, 흑점, 그리고 코로나의 방출과 함께 Van Allen Belt에 붙잡힌 고에너지 입자의 상태 변화가 우주 환경의 예보를 위한 중요 요소가 된다. 이런 고에너지 입자를 측정하기 위해서는 Van Allen Belt를 통과하는 VAP 위성의 데이터를 살펴보는 것이 매우 중요하다. 이 연구에서는 한국천문연구원에서 APL과 공동으로 VAP 위성의 실시간 데이터를 송수신하는 시스템을 구축하고, 그 실시간 데이터를 우주환경감시실에서 표출하여 Van Allen Belt의 변화를 바로 알아보는 과정을 기술 하였다. 이를 통해 데이터의 경향성을 바로 파악하여 특정 이벤트의 발생을 알아 낼 수 있을 뿐만 아니라 과거의 데이터를 손쉽게 찾아볼 수 있었다. 별도의 프로그램을 개발하여 데이터의 표출 비교를 가능하게 함으로써 다른 위성의 데이터나 태양 이미지를 보지 않아도 자체 비교를 통해 이벤트의 발생을 찾아 볼 수 있게 되었다.

[구 SS-15] Development of three-dimensional global MHD model for an interplanetary coronal mass ejection

Jun-Mo An[1], Tetsuya Magara[1], Satoshi Inoue[2], Keiji Hayashi[3], Takashi Tanaka[4]
[1]*School of Space Research Kyung Hee University,*
[2]*Nagoya University,* [3]*National Astronomical Observatory of China,* [4]*Kyushu University*

We developed a three-dimensional magnetohydrodynamic (MHD) code to reproduce the structure of a solar wind, the properties of a coronal mass ejection (CME) and the interaction between them. This MHD code is based on the finite volume method incorporating total variation diminishing (TVD) scheme with an unstructured grid system. In particular, this grid system can avoid the singularity at the north and south poles and relax tight CFL conditions around the poles, both of which would arise in a spherical coordinate system (Tanaka 1994). In this model, we first apply an MHD tomographic method (Hayashi et al. 2003) to interplanetary scintillation (IPS) observational data and derive a solar wind from the physical values obtained at 50 solar radii away from the Sun. By comparing the properties of this solar wind to observational data obtained near the Earth orbit, we confirmed that our model captures the velocity, temperature and density profiles of a solar wind near the Earth orbit. We then insert a spheromak-type CME (Kataoka et al. 2009) into the solar wind to reproduce an actual CME event. This has been done by introducing a time-dependent boundary condition to the inner boundary of our simulation domain. On the basis of a comparison between a simulated CME and observations near the Earth, we discuss the physics involved in an ICME interacting with a solar wind.

[구 SS-16] Full ice-cream cone model for halo coronal mass ejections

Hyeonock Na, Yong-Jae Moon
School of Space Research, Kyung Hee University, Yongin, Korea

The determination of three dimensional parameters (e.g., radial speed, angular width, source location) of Coronal Mass Ejections (CMEs) is very important for space weather forecast. To estimate these parameters, several cone models based on a flat cone or a shallow ice-cream cone with spherical front have been suggested. In this study, we investigate which cone model is proper for halo CME morphology using 33 CMEs which are identified as halo CMEs by one spacecraft (SOHO or STEREO-A or B) and as limb CMEs by the other ones. From geometrical parameters of these CMEs such as their front curvature, we find that near full ice-cream cone CMEs (28 events) are dominant over shallow ice-cream cone CMEs (5 events). So we develop a new full ice-cream cone model by assuming that a full ice-cream cone consists of many flat cones with different heights and angular widths. This model is carried out by the following steps: (1) construct a cone for given height and angular width, (2) project the cone onto the sky plane, (3) select points comprising the outer

boundary, (4) minimize the difference between the estimated projection points with the observed ones. We apply this model to several halo CMEs and compare the results with those from other methods such as a Graduated Cylindrical Shell model and a geometrical triangulation method.

[구 SS-17] RADIAL AND AZIMUTHAL OSCILLATIONS OF HALO CORONAL MASS EJECTIONS

Harim Lee[1], Y.-J. Moon[1], V. M. Nakariakov[1,2]
[1]*School of Space Research, Kyung Hee University, Yongin, Korea,*
[2]*Centre for Fusion, Space & Astrophysics, Physics Department, Univ. of Warwick, UK*

We present the first observational detection of radial and azimuthal oscillations in full halo coronal mass ejections (HCMEs). We analyze nine HCMEs well-observed by LASCO from Feb 2011 to Jun 2011. Using the LASCO C3 running difference images, we estimated the instantaneous apparent speeds of the HCMEs in different radial directions from the solar disk center. We find that the development of all these HCMEs is accompanied with quasi-periodic variations of the instantaneous radial velocity with the periods ranging from 24 to 48 mins. The amplitudes of the instant speed variations reach about a half of the projected speeds. The amplitudes are found to anti-correlate with the periods and correlate with the HCME speed, indicating the nonlinear nature of the process. The oscillations have a clear azimuthal structure in the heliocentric polar coordinate system. The oscillations in seven events are found to be associated with distinct azimuthal wave modes with the azimuthal wave number m=1 for six events and m=2 for one event. The polarization of the oscillations in these seven HCMEs is broadly consistent with those of their position angles with the mean difference of 42.5°. The oscillations may be connected with natural oscillations of the plasmoids around a dynamical equilibrium, or self-oscillatory processes, e.g. the periodic shedding of Alfvenic vortices. Our results indicate the need for advanced theory of oscillatory processes in CMEs.

[구 SS-18] Algorithm for Detection of Solar Filaments in EUV

Anand D Joshi, Kyung-Suk Cho
Korea Astronomy and Space Science Institute

In today's age when telecommunications using satellite has become part of our daily lives, one has to be employ preventive measures to avert any possible danger, of which solar activity is the major cause. Coronal mass ejections (CMEs) heading towards the Earth can lead to disturbances in the Earth's magnetosphere, if their magnetic field is oriented southward. Monitoring of solar filaments in this case becomes very very crucial, as their eruption is associated with most of the CMEs. Monitoring of solar filaments in this case becomes very very crucial, as their eruption is associated with most of the CMEs. Also, filaments show activation up to a few hours prior to launch of a CME and thus can provide advance warning. In this study, we present an algorithm for the detection of solar filaments seen in the extreme ultraviolet (EUV) from Atmospheric Imaging Assembly (AIA) on board the Solar Dynamics Observatory (SDO). Various morphological operations are employed to identify and extract the filaments. These filaments are then tracked in order to determine their size and location continuously.

[구 SS-19] Where is the coronal loop plasma located, within a flux rope or between flux ropes?

Daye Lim (임다예), G. S. Choe (최광선), and Sibaek Yi (이시백)
School of Space Research, Kyung Hee University, Yongin 446-701, Korea

Without scrutinizing reflection, the plasma comprising a coronal loop is usually regarded to reside within a flux rope. This picture seems to have been adopted from laboratory plasma pinches, in which a plasma of high density and pressure is confined in the vicinity of the flux rope axis by magnetic tension and magnetic pressure of the concave inward magnetic field. Such a configuration, in which the plasma pressure gradient and the field line curvature vector are almost parallel, however, is known to be vulnerable to ballooning instabilities (to which belong interchange instabilities as a subset). In coronal loops, however, ideal MHD (magnetohydrodynamic) ballooning instabilities are impeded by a very small field line curvature and the line-tying condition. We, therefore, focus on non-ideal (resistive) effects in this study. The footpoints of coronal loops are constantly under random motions of convective scales, which twist individual loop strands quite randomly. The loop strands with the axial current of the same direction tend to coalesce by magnetic