Array의 개선된 실리콘 검출기와 이온, 전자, 중성입자를 분리할 수 있는 정전장 편향기, 그리고 신호를 처리하는 전자회로로 구성되어있다. 설계된 전자회로는 매우 작은 검출기 기판, 아날로그 기판과 디지털 기판으로 이루어져 있고, 475mW 이하의 저 전력으로 동작한다. 또한 2~100keV의 에너지를 1keV이하의 해상도로 30,000event/sec/pixel 까지 관측 할 수 있도록 회로를 설계하였다. 센서로 들어온 입자로 인해 발생한 펄스의 신호는 4개의 아날로그 회로가 담당하게 되는데, Folded cascode amplifier 를 배치하여 증폭률을 높인 Charge sensitive amplifier를 통해 신호를 증폭하고, 2μs unipolar gaussian shaping amplifier를 통해 읽기 쉽게 처리된 신호를 상한파고선별기와 하한파고 선별기를 통해 유효 값 여부를 판단하고, 피크 검출기를 통해 피크의 타이밍을 측정한 뒤 신호를 아날로그-디지털 변환 회로를 통하여 8bit의 값으로 나타내어, 입자들의 Spectrum을 측정하게 된다. 크기와 소비전력이 적음에도 검출성능이 우수하기 때문에 이 시스템은 향후 우주탐사 시스템에 있어 매우 중요한 역할을 수행 할 것으로 생각한다.

[Ⅴ-2-4] DEM(Digital Elevation Model)이 적용된 Direct Sensor Modeling을 이용한 고해상도 위성 가상영상 생성

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고해상도 위성들로부터 최상의 영상을 획득하기 위해서는 설계 단계에서 운용 조건이 반영된 위성 영상 품질 예측이 필수적이다. 이 발표에서는 실질적인 위성 궤도 및 자세 정보와 정사영상, DEM(Digital Elevation Model)으로부터 공선조건식을 기반으로 하는 Direct Sensor Modeling을 이용하여 고해상도 가상영상을 생성하는 방법을 제시하였다. Target으로 사용된 정사영상은 19951×21055 size의 USA Wisconsin주의 1m 해상도 영상이며, 이 영상으로부터 0.7m 해상도의 가상영상을 생성하였다. 이 연구를 통하여 위성의 설계 단계에서 궤도상 영상 품질 예측할 수 있으며, 운영 과정에서는 실제 촬영된 영상과 비교 분석을 통하여 위성 및 탑재체의 상태 파악 및 보정이 가능할 것으로 기대된다.

■ Session : 우주환경 Ⅰ
4월 30일(금) 09:00 - 10:40 제3발표장

[Ⅲ-3-1] On the development of an empirical proton event forecast model based on the information of flares and CMEs

Yong-Jae Moon and Jinhye Park
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We have examined the occurrence probability of solar proton events (SPEs) and their peak fluxes depending three flare parameters (X-ray peak flux, longitude, and impulsive time). For this we used NOAA SPEs from 1976 to 2006, and their associated X-ray flare data. As a result, we selected 166 proton events that were associated with major flares; 85 events associated with X-class flares and 81 events associated with M-class flares. Especially the occurrence probability strongly depends on these three parameters. In addition, the relationship between X-ray flare peak flux and proton peak flux as well as its correlation coefficient are strongly dependent on longitude and impulsive time. Among NOAA SPEs from 1997 to 2006, most of the events are related to both flares and CMEs but a few fraction of events (5/93) are only related with CMEs. We carefully identified the sources of these events using LASCO CME catalog and SOHO MDI data. Specifically, we examined the directions of CMEs related with the events and the history of active regions. As a result, we were able to determine active regions which are likely to produce SPEs without ambiguity as well as their longitudes at the time of SPEs by considering solar rotation rate. From this study, we found that the longitudes of five active regions are all between 90°W and 120°W. When the flare peak time is assume to be the CME event time, we confirmed that the dependence of their rise times (proton peak time - flare peak time) on longitude are consistent with the previous empirical formula. These results imply that five events should be also associated with flares which were not observed because they occurred from back-side. Now we are examining the occurrence probability of SPEs depending on CME parameters. Finally, we will discuss the future prospects on the development of an empirical SPE forecast model based on the information of flares and CMEs.

[Ⅲ-3-2] Onset time comparison of solar proton event with coronal mass ejection, metric type II radio burst, and flare

Kyung-Suk Cho, Junga Hwang, Su-Chan Bong, Katsuhide Marubashi, Su-Lyun Rho, and Young-Deuk Park
Korea Astronomy and Space Science Institute, Korea

While major solar proton events (SPEs) come from the coronal mass eject (CME)-driven shocks in solar wind, there are many evidences that potentiality of CMEs to generate SPEs depends on its early evolution near the Sun and on different solar activities observed around the CME liftoff time. To decipher origin of SPE release, we have investigated onset time comparison of the SPE with CME, metric type II radio burst, and hard X-ray flare. For this, we select 30 SPEs observed from 1997 to 2006 by using the particle instrument ERNE onboard SOHO, which allows proton flux anisotropy measurement in the energy range ~10 - 50MeV. Onset time of the SPEs is inferred by considering the energy-dependent proton transport time. As results, we found that (1) SPE onset time is comparable to that of type II but later than type III onset time and HXR start time, (2) SPE onset time is mostly later than the peak time of HXR flare, (3) almost half of the SPE onsets occurred after the

HXR emission, and (4) there are two groups of CME height at the onset time of SPE; one is the height below 5 Rs (low corona) and the other is above 5Rs (high corona). In this talk, we will present the onset time comparison and discuss about the origin of the SPE onset.

[III-3-3] Relationships between solar/interplanetary (IP) parameters and Dst index, according to IP sources

Eun-Young Ji[1], Yong-Jae Moon[2], and Dong-Hun Lee[2]

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We have investigated interplanetary (IP) structures of 82 intense geomagnetic storms (Dst ≤ −100 nT) that occurred from 1998 to 2006. According to their interplanetary origins, we classified them as four groups: 20 sMC events (IP shock and MC), 19 SH events (sheath field), 12 SH+MC events (Sheath field and MC), and 8 nonMC events (non-MC type ICME). For each group, we examined the relationships between Dst index and solar/IP parameters, namely, direction parameter (DP), CME speed (V_{CME}), solar wind speed (V_{SW}), minimum of IMF B_z component(Bz_{min}), and maximum of E_y component (Ey_{max}).We found that the relationships strongly depend on their IP source. Our main results can be summarized as follows: 1) The correlation between Dst and DP is the best for the SH+MC events (r = −0.61). 2) The relationship between Dst and V_{CME} gives the best correlation for the sMC events (r = −0.56). 3) There is the best correlation between Dst and V_{SW} for the sMC events (r = −0.61), while there is a very weak correlation (r= −0.17) for the SH events. 4) The relationship between Dst and Bz_{min} gives the best correlation (r = −0.87) for the SH+MC events. 5) The correlation between Dst and Ey_{max} is the best for the SH+MC events (r = −0.87). Summing up, the sMC and SH+MC events give us good correlations, but the SH events, weak correlations. From this study, we suggest that this tendency should be caused by the characteristics of IMF southward components, e.g., smooth field rotations for the MC events and highly IMF fluctuations for the SH events.

[III-3-4] Three-Dimensional Magnetohydrodynamic Simulations of Nonlinear Field Line Resonances

KYUNG-IM KIM[1], Dong-Hun Lee[1], Dongsu Ryu[2]

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Field line resonances (FLRs) observed in the magnetosphere often have the amplitude of a few nT, which indicates that dB/B roughly satisfies ~0.01. It is well known that the FLRs are excited by compressional waves via mode conversion, but there has been no apparent criterion on the maximum amplitude in the regime of linear approximations. Such limited range of amplitude should be understood by including nonlinear saturation of FLRs, which has not been examined until now. In this study, using a three-dimensional magnetohydrodynamic (MHD) simulation code, we examine the evolution of nonlinear field line resonances (FLRs) in the cold plasmas. The MHD code used in this study allows a full nonlinear description and enables us to study the maximum amplitude of FLRs. When the disturbance is sufficiently small, it is shown that linear properties of MHD wave coupling are well reproduced. In order to examine a nonlinear excitation of FLRs, it is shown how these FLRs become saturated as the initial magnitude of disturbances is assumed to increase. Our results suggest that the maximum amplitude of FLRs become saturated at the level of the same order of dB/B as in observations. In addition, we discuss the role of both linear terms and nonlinear terms in the MHD wave equations.

[III-3-5] Sea-Level Pressure Response to the Fast Solar Wind Stream

Il-Hyun Cho[1], Young-Sil Kwak[1], Katsuhide Marubashi[1], Heon-Young Chang[2], Kyung-Suk Cho[1], Yeon-Han Kim[1], Young-Deuk Park[1], and Ho-Sung Choi[1,3]

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Solar-terrestrial links in short-time scales(daily ~monthly) are extensively explored in recent years: such as a response of low cloud amounts to the Forbush decrease, a response of Northern Atlantic oscillation index to sudden increase in electric field intensity of solar wind and so on (e.g., Svensmark et al., 2009; Boberg & Lundstedt, 2002). In this study, we perform the superposed epoch analysis to see any possible response of the sea-level pressure over Korean peninsula to the fast solar wind stream. Data sets are daily values, and zero days are determined to be days when the solar wind velocity exceeds 800km/s. Average profile of superposed sea-level pressure shows a gradual increase during the first 2 days and a decrease afterward below the normal level with a low pressure condition maintained for a few days. This result indicates that the sea-level pressure may respond to the fast solar wind stream. In other words, the average profile of sea-level pressure mimics the average velocity profiles. The correlation coefficient between two average profiles is 0.80, with 2 day lag.