to 0.6 and those of Shue et al. (1998) are slightly higher than those of the other models. Fourth, the predicted magnetopause radius based on Lin et al.(2010) well match the observed one within one earth radius, while that on Shue et al. (1998) overestimate the observed one by about 2 earth radii. Fifth, the PoD and CSI values of all the models are better for the solar maximum phase than those for the other phases, implying that the models are more optimized for the phase.

[구 SS-03] Collisionless Magnetic Reconnection and Dynamo Processes in a Spatially Rotating Magnetic Field

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Spatially rotating magnetic fields have been observed in the solar wind and in the Earth's magnetopause as well as in reversed field pinch (RFP) devices. Such field configurations have a similarity with extended current layers having a spatially varying plasma pressure instead of the spatially varying guide field. It is thus expected that magnetic reconnection may take place in a rotating magnetic field no less than in an extended current layer. We have investigated the spontaneous evolution of a collisionless plasma system embedding a rotating magnetic field with a two-and-a-half-dimensional electromagnetic particle-in-cell (PIC) simulation. In magnetohydrodynamics, magnetic flux can be decreased by diffusion in O-lines. In kinetic physics, however, an asymmetry of the velocity distribution function can generate new magnetic flux near O- and X-lines, hence a dynamo effect. We have found that a magnetic-flux-reducing diffusion phase and a magnetic-flux-increasing dynamo phase are alternating with a certain period. The temperature of the system also varies with the same period, showing a similarity to sawtooth oscillations in tokamaks. We have shown that a modified theory of sawtooth oscillations can explain the periodic behavior observed in the simulation. A strong guide field distorts the current layer as was observed in laboratory experiments. This distortion is smoothed out as magnetic islands fade away by the O-line diffusion, but is soon strengthened by the growth of magnetic islands. These processes are all repeating with a fixed period. Our results suggest that a rotating magnetic field configuration continuously undergoes deformation and relaxation in a short time-scale although it might look rather steady in a long-term view.

[구 SS-04] Dependence of spacecraft anomalies at different orbits on energetic electron and proton fluxes

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In this study we investigate 195 spacecraft anomalies from 1998 to 2010 from Satellite News Digest (SND). We classify these data according to types of anomaly : Control, Power, Telemetry etc. We examine the association between these anomaly data and daily peak particle (electron and proton) flux data from GOES as well as their occurrence rates. To determine the association, we use two criteria that electron criterion is >10,000 pfu and proton criterion is >100 pfu. Main results from this study are as flows. First, the number of days satisfying the criteria for electron flux has a peak near a week before the anomaly day and decreases from the peak day to the anomaly day, while that for proton flux has a peak near the anomaly day. Second, we found a similar pattern for the mean daily peak particle (electron and proton) flux as a function of day before the anomaly day. Third, an examination of multiple spacecraft anomaly events, which are likely to occur by severe space weather effects, shows that anomalies mostly occur either when electron fluxes are in the declining stage, or when daily proton peak fluxes are strongly enhanced. This result is very consistent with the above statistical studies. Our results will be discussed in view of the origins of spacecraft anomaly.

[구 SS-05] Prediction of Long-term Solar Activity based on Fractal Dimension Method

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Solar activity shows a self-similarity as it has many periods of activity cycle in the time series of long-term observation, such as 13.5, 51, 150, 300 days, and 11, 88 years and so on. Since fractal dimension is a quantitative parameter for this kind of an irregular time series, we applied this method to long-term observations including sunspot number, total solar irradiance, and 3.75 GHz solar radio flux to predict the start and maximum times as well as expected maximum sunspot number for the next solar cycle. As a result, we found that the radio flux data tend to have lower fractal dimensions than the sunspot number data, which means that the radio emission from the sun is more regular than the solar activity expressed by sunspot number. Based on the relation between radio flux of 3.75 GHz and sunspot number, we could calculate the expected maximum sunspot number of solar cycle 24 as 156, while the observed value is 146. For the maximum time, estimated mean values from 7 different observations are January 2013 and this is quite different to observed value of February 2014. We speculate this is from extraordinary extended properties of solar cycle 24. As the cycle length of solar cycle 24, 10.1 to 12.8 years are expected, and the mean value is 11.0. This implies that the next solar cycle will be started at December 2019.

[구 SS-06] Spatial and Statistical Properties of Electric Current Density in the Nonlinear Force-Free Model of Active Region 12158

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The formation process of a current sheet is important for solar flare from a viewpoint of a space weather prediction. We therefore derive the temporal development of the spatial and statistical distribution of electric current density distributed in a flare-producing active region to describe the formation of a current sheet. We derive time sequence distribution of electric current density by applying a nonlinear force-free approximation reconstruction to Active Region 12158 that produces an X1.6-class flare. The time sequence maps of photospheric vector magnetic field used for reconstruction are captured by a Helioseismic and Magnetic Imager (HMI) onboard Solar Dynamic Observatory (SDO) on 10th September, 2014. The spatial distribution of electric current density in NLFFF model well reproduce observed sigmoidal structure at the preflare phase, although a layer of high current density shrinks at the postflare phase. A double power-law profile of electric current density is found in statistical analysis. This may be expected to use an indicator of the occurrence of a solar flare.

[구 SS-07] Comparison of the Damped Oscillations in between the Solar and Stellar flares

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We explore the similarity and difference of the quasi-periodic pulsations (QPPs) observed during the solar and stellar X-ray flares. For this, we identified 59 solar QPPs in the X-ray observed by the Reuven Ramaty High-Energy Solar Spectroscopic Imager (RHESSI) and 52 stellar QPPs from X-ray Multi Mirror Newton observatory (XMM-Newton). The Empirical Mode Decomposition (EMD) method and least-square-fit with the damped sine function are applied to obtain the periods and damping times of the QPPs. We found that (1) the periods and damping times of the stellar QPPs are 7.80 and 13.80 min, which are comparable with those of the solar QPPs 0.55 and 0.97 min. (2) The ratio of the damping times to the periods observed in the stellar QPPs are found to be statistically identical to the solar QPPs, (3) The damping times are well describe by the power law. The power indices of the solar and stellar QPPs are 0.891 ± 0.172 and 0.953 ± 0.198, which are consistent with the previous results. Thus, we conclude that the underlying mechanism responsible for the stellar QPPs are the natural oscillations of the flaring or adjacent coronal loops as in the Sun.

[구 SS-08] Simulation of a solar eruption with a background solar wind

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We construct a solar eruption model with a background solar wind by performing three-dimensional zero-beta magnetohydrodynamic (MHD) simulation. The initial configuration of a magnetic field is given by nonlinear force-free field (NLFFF) reconstruction applied to a flux emergence simulation. The background solar wind is driven by upflows imposed at the top boundary. We analyzed the temporal development of the Lorentz force at the flux tube axis. Based on the results, we