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This study aims to overview research articles on extrasolar planets using Kepler mission data during the period of 2009-2015 in order to discover research trends in them. Kepler space observatory is a NASA space observatory for extrasolar planet expedition launched in March 2009, contributed to the discovery and tracking of extrasolar planets and its candidates. In order to achieve the goal of this study, we classified research subjects from studies on Kepler mission data year by year and found the most frequent research topics each year. We also conducted a comparative analysis on the research subjects based on time series and examined any changes with respect to the goal of Kepler mission. Statistical meta-analysis is employed as the analysis method for the key words presented in the research articles.

This study is a part of on-going research to find the correlation between the physical parameters of the host star and extrasolar planets. The results of this study could offer new directions in researches utilizing Kepler mission data as those meta-analyses in social sciences often suggest new opportunities. We have high expectations that more extrasolar planet studies will follow as we make further progresses in various analyses.

[포 ST-12] Orbital stability study and transit-timing variations of the extrasolar planetary system: K2-3

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We investigated the dynamical properties of the K2-3 multi-planet system. Recently three transiting planets are discovered using the extended Kepler2 (K2) mission (Crossfield et al. 2015). We extended their preliminary stability study by considering a substantial longer integration time. Since planet mass is not known from photometry we calculated exoplanets masses using empirical mass-radius relations (Weiss & Marcy 2014). Forward numerical integration was done using the MERCURY integration package (Chambers 1999). Our results demonstrate that this system is stable over a time scale of 10^8 years. Furthermore, we investigated the dynamical effects of a hypothetical planet in the semi-major axis vs eccentricity space. For stable orbits of the hypothetical planet we calculated transit-timing variation (TTV) and radial velocity signals. We find that for a hypothetical perturber with mass 1-13 Mjup, semi-major axis 0.2 – 0.8 AU and eccentricity 0.00-0.47 the following timing signals for the planet K2-3 b is ~ 5 sec, K2-3 c is ~ 130 sec and for K2-3 d is ~ 190 sec. The radial velocity signal of the hypothetical planet is ~ 4 m/s. Using typical transit-timing errors from the K2 mission, we find that the above hypothetical planet would not be detectable. Its radial velocity signal, however, would be detectable using the APF 2.4m telescope or HARPS at the ESO/La Silla Observatory in Chile.

[포 ST-13] Low-Resolution Spectroscopy of Red Giant Branch stars in the Globular Cluster NGC 2808

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The presence of multiple stellar populations is now well established in most globular clusters (GCs) in the Milky Way. The origin of this, however, is yet to be understood. In this respect, the study of NGC 2808, a GC which hosts five sub-populations differing only in light-element abundances, would help to understand the origin of this multiple stellar populations. In order to investigate CN, CH, and Ca abundances among different populations in NGC 2808, we have performed low-resolution spectroscopy for the red giant branch (RGB) stars in this GC. Here we report preliminary results from this spectroscopic analysis.

태양 및 우주환경

[포 SS-01] Relative contribution of geomagnetic and CO2 effects to global temperature anomaly

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We have investigated the correlation analysis

between global temperature anomaly and two main factors: geomagnetic activity (aa index) of Earth external factor and CO2 of Earth internal factor. For this, we used NOAA Global Surface Temperature anomaly (Ta) data from 1868 to 2015. The aa index indicates the geomagnetic activity measured at two anti-podal subauroral stations (Canberra Australia and Hartland England) and the CO2 data come from historical ice core records and NOAA/ESRL data. From the comparison between (Ta) and aa index, we found several interesting things, First, the linear correlation coefficient between two parameters increases until 1985 and then decreases rapidly. Second, the scattered plot between two parameters shows a boundary of the correlation tendency (positive and negative correlation) near 1985. A partial correlation of (Ta) and two main factors (aa index, CO2) also shows that the geomagnetic effect (aa index) is dominant until about 1985 and the CO2 effect becomes much more important after then. These results indicate that the CO2 effect become very an important factor since at least 1985. For a further analysis, we simply assume that Ta = Ta(aa)+Ta(CO2) and made a linear regression between (Ta) and aa index from 1868 to 2015. A linear model is then made from the linear regression between energy consumption (a proxy of CO2 effect) and Ta-Ta(aa) since 1985. Our results will be discussed in view of the prediction of global warming.

[포 SS-02] Evaluation of a Solar Flare Forecast Model with Value Score

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There are probabilistic forecast models for solar flare occurrence, which can be evaluated by various skill scores (e.g. accuracy, critical success index, heidek skill score, and true skill score). Since these skill scores assume that two types of forecast errors (i.e. false alarm and miss) are equal or constant, which does not take into account different situations of users, they may be unrealistic. In this study, we make an evaluation of a probabilistic flare forecast model [Lee et al., 2012] which use sunspot groups and its area changes as a proxy of flux emergence. We calculate daily solar flare probabilities from 2011 to 2014 using this model. The skill scores are computed through contingency tables as a function of forecast probability, which corresponds to the maximum skill score depending on flare class and type of a skill score. We use a value score with cost/loss ratio, relative importance between the two types of forecast errors. The forecast probability (y) is linearly changed with the cost/loss ratio (x) in the form of y=ax+b: a=0.88; b=0 (C), a=1.2; b=-0.05(M), a=1.29; b=-0.02(X). We find that the forecast model has an effective range of cost/loss ratio for each class flare: 0.536-0.853(C), 0.147-0.334(M), and 0.023-0.072(X). We expect that this study would provide a guideline to determine the probability threshold and the cost/loss ratio for space weather forecast.

[포 SS-03] Dependence of solar proton events on their associated activities: solar and interplanetary type II radio burst, flare, and CME

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We investigate the dependence of solar proton events (SPEs) on solar and interplanetary type II bursts associated with solar flares and/or CME-driven shocks. For this we consider NOAA solar proton events from 1997 to 2012 and their associated flare, CME, and type II radio burst data with the following subgroups: metric, decameter-hectometric (DH), and meter-to-kilometric (m-to-km) type II bursts. The primary findings of this study are as follows. First, about half (52%) of the m-to-km type II bursts are associated with SPEs and its occurrence rate is higher than those of DH type II bursts (45%) and metric type II bursts (19%). Second, the SPE occurrence rate strongly depends on flare strength and source longitude, especially for X-class flare associated ones; it is the highest in the central region for metric (46%), DH (54%), and m-to-km (75%) subgroups. Third, the SPE occurrence rate is also dependent on CME linear speed and angular width. The highest rates are found in the m-to-km subgroup associated with CME speed 1500 kms−1: partial halo CME (67%) and halo CME (55%). Fourth, in the relationships between SPE peak fluxes and solar eruption parameters (CME linear speed, flare flux, and longitude), SPE peak flux is mostly dependent on SPE peak flux for all three type II bursts (metric, DH, m-to-km). It is noted that the dependence of SPE peak flux on flare peak flux decreases from metric to m-to-km type II