would occur before core helium exhaustion. We perform binary system evolution for various primary masses ($20M_\odot < M_1 < 60M_\odot$) and initial periods under same mass ratio $M_2/M_1 = 0.9$, and follow the evolution and mass transfer of the primary star. If binary mass transfer occurs during post main sequence, the primary star does not evolve into naked helium star and still contain significant hydrogen in the envelope. During the post mass transfer phase, the primary star evolves redward, and does not become sufficiently hot to enhance the number of ionizing photons, compared to the case of single star evolution for a given initial mass. This result implies that primary stars of massive Pop III binary systems would have little contribution to the reionization in the early universe. Given the large hydrogen content (0.326 - $1.793M_\odot$), the primary stars that underwent stable mass transfers would explode as a Type IIb supernova, and it would be difficult for Pop III binary stars to produce Type Ib/c supernovae that look similar to those found in the local universe.

[포 ST-08] Searching for Eccentricity Preserving Mass Transfer Mechanism during Binary Star Evolution

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상호작용 하는 쌍성계의 진화과정 중 질량이동에 의한 궤도 변화에는 아직 풀리지 않은 수수께끼가 남아있다. 예를 들면 바륨별 (Ba Star)의 경우, 관측된 궤도 이심률은 평균 0.2, 1000일 단위의 주기를 보여주고 있다. Population Synthesis시뮬레이션으로 이를 재현할 경우 관측된 궤도 성질을 맞추지 못하거나, 바륨별의 형성 개수를 맞추지 못하는 문제점이 있다. 비슷한 문제가 청색낙오성 (Blue Straggler Star)의 시뮬레이션 결과에서도 나타나고 있는데, 이 문제의 핵심은 Roche Lobe Over Flow (RLOF)를 통한 질량 이동이 결과적으로 Common Envelope (CE)으로 이어지기 때문에 각운동량을 크게 잃게 되어 궤도가 원형화 되기 때문인 것으로 판명이 되었다. 따라서 이번 연구에서는 RLOF를 통한 질량이동 중 CE 과정을 효과적으로 피해갈 수 있는 질량이동 과정을 제안하고, 이를 시뮬레이션에 적용하여 관측자료를 설명할 것이다. 최종적으로는, 위의 질량이동 과정을 오픈 소스 항성진화 프로그램인 MESA에 포함시켜, 쌍성계 궤도와 그 별들의 표면 원소 분포 사이의 상관관계를 정량적으로 설명하려고 한다.

[포 ST-09] Removing Telluric Absorbtion lines for IGRINS spectra

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There are many telluric absorption lines which are laid on the science spectrum in ground based spectroscopic observations. In especial, the IR region spectra are considerably contaminated by telluric lines. Therefore, many scientists have a difficulty in removing the telluric effect. We thus tried removing telluric lines with IGRINS data by two methods. One is using the standard stellar spectrum as telluric lines. The other adopt calculated synthetic telluric spectrum. Here we present the results of test for precise removing telluric lines on IGRINS spectra.

[포 ST-10] KIC06118779 and KIC08682849: Extremely low mass ratio contact binaries with quasi-cyclically varying O'Connell effects and strong anti-correlations in their ETV diagrams

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The Kepler mission of NASA has enabled to discover a lot of new W UMa-type binaries with continuous light curves measured with unprecedented accuracy. Interestingly, their eclipsing time variation (hereafter ETV) diagrams show anti-correlation between primary and secondary minima, presumably occurred by continuous spot variation (Tran et al. 2013; Balaji et al. 2014). Two active Kepler binaries (KIC06118779 & KIC08682849), reported as showing the anti-correlation in ETV diagram, were investigated to see that the anti-correlations are correlated with time-variable O'connell effects appeared in their light curves. As a result, it was found that the O'connell effects for two binary stars have varied in quasi-sinusoidal ways similar to the patterns of their anti-correlation variations. In addition, our light curve syntheses of two binary stars with the latest version of the Wilson-Devinney code (Wilson & devinney 1971) show that they are very deep-contact binary system with extremely low mass ratios.

[포 ST-11] Meta-analysis for the studies on extrasolar planets using Kepler mission data

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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