

## atmosphere

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The Mars Atmosphere and Volatile (MAVEN) mission has been providing valuable information on the atmospheric loss of Mars since its launch in November 2013. The Neutral Gass and Ion Mass Spectrometer (NGIMS) onboard MAVEN, was developed to analyze the composition of the Martian upper atmospheric neutrals and ions depending on various space weather conditions. We investigate a variation of upper atmospheric ion densities depending on the interplanetary coronal mass ejections (ICMEs). It is known that the Mars has a very weak global magnetic field, so upper atmosphere of Mars has been strongly affected by the solar activities. Meanwhile, a strong crustal magnetic field exists on local surfaces, so they also have a compensating effect on the upper atmospheric loss outside the Mars. The weak crustal field has an influence up to 200km altitude, but on a strong field region, especially east longitude of 180° and latitude of -50°, they have an influence over 1,400km altitude. In this paper, we investigated which is more dominant between the crustal field effect and the ICME effect to the atmospheric loss. At 400km altitude, the ion density over the strong crustal field region did not show a significant variation despite of ICME event. However, over the other areas, the variation associated with ICME event is far more overwhelming.

## 항성/항성계

### [초 SA-01] Variable stars in Galactic open clusters of the outermost VVV disk tiles

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We present the preliminary results obtained from the search of variable stars in the fields of open clusters located in the direction of the Galactic disk. The current study is based on J, H and Ks photometric data obtained in the near-infrared (NIR) VVV Survey. A first classification of the newly found variable stars is performed based on their light curves, periods and amplitudes. We also show the (Ks, J-Ks) color-magnitude decontaminated diagrams of the selected open clusters and examine the location of the variable stars in these diagrams. Available proper motion data are also used to analyze the possible membership of the discovered variable stars to the corresponding clusters, as well as to redetermine with more accuracy the parameters of the poorly studied clusters.

### [구 SA-02] A new catalogue of galactic eccentric eclipsing binary stars

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우리 은하에 있는 618개 이심궤도 식쌍성의 카타로그를 제작하였다. 그 이심 식쌍성들은 우리의 극심시각 database에 수록된, 또는 여러 천천 탐사 자료에서 수집된 측광 자료로부터 새롭게 결정된, 또는 우리가 직접 관측하여 얻은 약 13만개의 극심시각 자료의 식시각도 분석을 통하여 편집된 것이다. 618개의 이심 식쌍성 중에서 근성점 운동을 보이는 시스템은 모두 170개이며, 이 중에서 30개의 쌍성이 근성점 운동과 광시간 효과가 동시에 일어난다. 근성점 운동을 보이는 별들의 근성점 운동 변수들을 일관된 방식으로 산출하여 카타로그에 수록하였다. 우리가 작성한 최신의 카타로그는 기존 카타로그에 비해 양과 내용에 있어 가장 방대하다. 우리 은하 근성점 운동 쌍성들과 소마젤란 성운과 대마젤란 성운에서 발견된 근성점 운동 쌍성들을 모아 근성점 운동 변수들의 통계적 분포를 살펴 보았고, 그 결과들을 논의한다.

### [구 SA-03] A Photometric Investigation of KIC6118779 with Phase Smearing Effect

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KIC6118779 is an over-contact binary system having a short orbital period of about 0.36 days. The photometric data for this system are acquired

by the observations of Kepler mission in the long cadence mode having a time resolution of about 30 minutes. It means that the Kepler light curves of the system may be strongly affected by phase smearing effect and the analysis of them without consideration of the phase smearing effect may result in wrong stellar properties. Additionally, this system also shows dynamical variation of light curve resulting from spot activity. For all those reasons, it is difficult to investigate KIC6118779, and the investigation should be carried out carefully. In this presentation, we introduce the phase smearing effect and carry out the light curve modeling with the 2015 version of the Wilson-Devinney binary code considering the phase smearing effect. Our results show that the system is a deep over contact binary system and has extremely low mass ratio of about 0.12. Moreover our spot modeling implies the cyclic migration of a big cool spot on the massive component.

#### [구 SA-04] The Photometric Analysis Of The W Subtype Contact Binary EK Comae Berenices

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접촉쌍성 EK Com은 0.2667일의 짧은 주기를 가진 만기형 식쌍성으로 광도곡선의 변화로 인해 연구자마다 이계의 하위 유형을 다르게 언급하여 하위유형의 혼동이 있는 천체이다. 우리는 소백산천문대에서 2009년 5월 VR 필터로, 2013년 2 ~ 5월 사이 BVRI 필터로, 2016년 1 ~ 4월 사이 R 필터로 CCD 측광 관측하여 3개의 새로운 광도곡선을 획득하였다.

우리의 관측 자료와 SuperWASP의 공개된 자료로부터 40개의 새로운 극심시각을 산출하였다. 이 극심시각을 포함하여 155개의 극심시각을 여러 문헌에서 수집하여 주기 연구를 수행한 결과, EK Com의 공전주기는 영년 주기 증가와 더불어 8.2년의 주기적인 변화가 겹쳐 변화함을 발견하였다. 이러한 주기 변화 원인에 대하여 살펴본 결과, 영년주기변화는 질량이 작은 별에서 큰 별로의 질량이동에 의하여 일어나고, 주기적인 변화는 질량이 큰 주성의 자기 활동에 의해 발생할 수 있음을 보였다. Wilson-Devinney code를 이용한 광도곡선 분석을 통하여 EK Com은 개기식이 부식에 있는 하위 유형 A라기 보다 주식에 있는 W형에 속하며, 모든 광도곡선에서 1개의 Hot spot과 1개의 Cool spot을 가진 모형이 가장 관측치를 잘 설명한다. W UMa형 별들의 HR도, 온도비, 질량의 그래프에서 EK Com은 W형 Group들이 있는 위치에 존재한다. 이는 광도곡선에서 유추한 EK Com의 하위 유형과도 일치한다.

#### [구 SA-05] The role of massive Population III binary systems in the formation of gravitational wave radiation source and in the cosmic reionization

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Abstract in either English or Korean

The Population III (Pop III) stars are thought to be massive. If massive Pop III stars form binary system and they experience mass transfer via the Roche lobe overflow, this may significantly change the properties of the system. For example, mass transfer in such system may shorten the period of the system, forming short period binary black hole (BBH) system, which is the most promising candidate for recently detected gravitational wave radiation sources. Also, there is an expectation that due to the stripped envelope of donor star by mass transfer, this system can play a significant role in the cosmic reionization by emitting more UV photons. However, this outcome highly depends on the initial properties of the system. We perform grid calculation on Pop III binary models with various initial primary masses (20 ~ 100 solar mass), initial separations, and initial mass ratios ( $q = 0.5 \sim 0.9$ ). We find that 1) in most cases binary models show no increase in the number of ionizing photons and 2) formation of short period BBH system via mass transfer is highly unlikely.

#### [구 SA-06] Feature engineering with Wavelet transform for Transient detection in KMTNet Supernova Project

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For the detection of transient sources in optical wide field surveys like KMTNet Supernova Project, difference imaging technique is commonly used. As this method produces a fair amount of false positives, it is also common to utilize machine learning algorithms to screen likely true positives. While deep learning methods such as a convolutional neural network has been successfully applied recently, its application can be limited if the size of the training sample is small. I will discuss a variation of more conventional method that adopts the wavelet transform for feature engineering and its performance.