

## NEAR-IR PHOTOMETRIC AND OPTICAL SPECTROSCOPIC STUDY OF THE FU ORIONIS OBJECT V582 AURIGAE

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### ABSTRACT

We carried out near-IR photometric and optical spectroscopic observations of V582 Aur, which is a FU Orionis type object, to investigate any periodic and/or aperiodic variations. We obtained light curves on the scale of a night and a year, in J, H and Ks bands with KASINICS (KASI Near Infrared Camera System) attached to the BOAO (Bohyun-san Optical Astronomy Observatory) 1.8-m reflector in Youngcheon, South Korea and examined photometric variations on the two time scales. So far we have not found any periodic brightness variations on the scale of a night. On the other hand, we have found that there seems to be a periodic brightness variation with a period of approximately 45 days. In addition, high-resolution optical spectroscopic observations of V582 Aur were performed from February 2013 to May 2014 with the high-resolution echelle spectrograph BOES attached to the BOAO 1.8-m reflector. We analyzed several spectral lines to understand the physical state of V582 Aur. The P Cyg profiles are clearly shown in the H $\alpha$  line and Na I D line.

*Key words:* Pre-main sequence variables: FU Orionis type object: Periodic brightness variation: P Cyg profile

## 1. INTRODUCTION

V582 Aur, which is located in an active star formation region near the Auriga OB2 association, is a new FUor object candidate. The increase in brightness of this object began in late 1984 or early 1985 and it reached a maximum brightness in January 1986. After the maximum light, the brightness of this star has remained in a state of maximum brightness. The light variation of V582 Aur was first reported by Anton Khruslov (Samus, 2009) and it was confirmed as an FUor object by Semkov et al. (2011; 2013). An FUor object is a low-mass pre-main sequence star defined by Herbig (1977). FUors go through an outburst with an amplitude of  $\Delta V \approx 4-6$  mag. They are located in star forming regions and are associated with reflection nebula. In addition, they show the spectra of F-G supergiants during the outburst, a strong Li I 6707Å absorption line, and near-infrared CO band (Herbig, 1977; Reipurth & Aspin, 2010). One of the most important spectroscopic features of FUors is the P Cyg profile, which is commonly displayed in the Na I D and H $\alpha$  lines, occurring due to strong winds from the center of star. Some FUors were found to exhibit periodic spectroscopic (Herbig et al., 2003; Powell et

al., 2013) or low amplitude photometric (Kenyon et al., 2000; Green et al., 2013; Siwak et al., 2013) variability on a short timescale of days.

## 2. OBSERVATIONS, RESULTS AND DISCUSSION

### 2.1. Light Curves and Brightness Variation

We have plotted the near-infrared photometry results for V582 Aur, observed for about 15 months from February 2013 to May 2014, in Figure 1. Each point represents an observed night. We combined 80 images to improve the signal-to-noise ratio for each filter in order to find any short periodic variation during the night of January 1, 2014. They are shown in a small box in the upper left in Figure 1. We could not find short periodic variation on a night scale because the data points are too widely scattered to detect such a small variation. The right panel of Figure 1 is the periodogram of the long-term light curves for each filter. With three periodograms for each filter, the period of light variation seems to be about 45 days. However, additional observations are needed to obtain a more reliable period.

### 2.2. Spectral Lines

Since the brightness of V582 Aur is very low in the optical, the intensity of most lines was weak and some lines were not detected. However, it was possible to detect a

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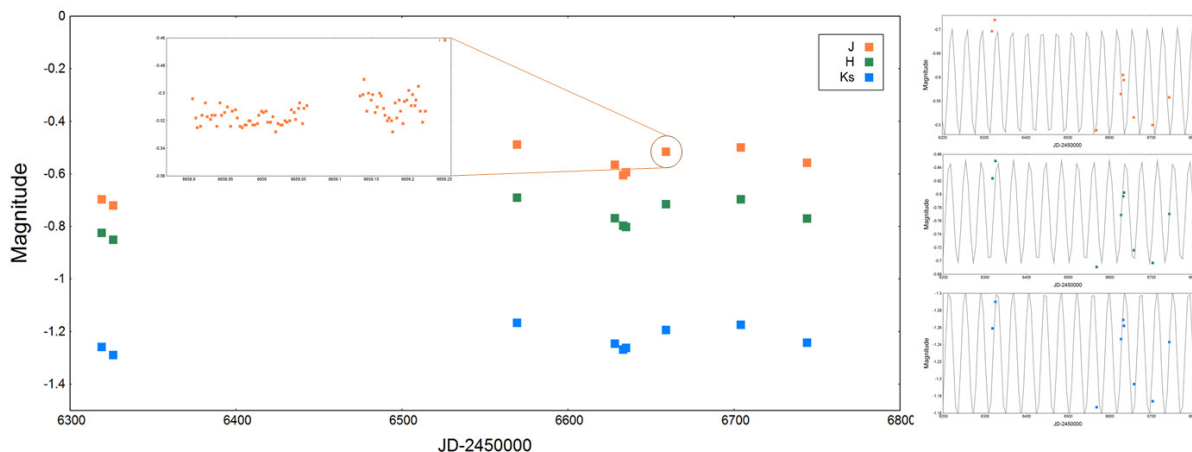


Figure 1. The light curves of V582 Aur in near-infrared bands (left), and the period fitting in each band (right).

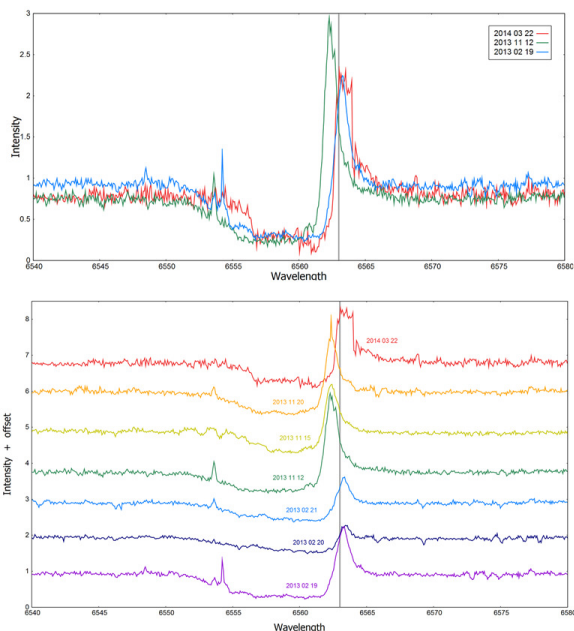


Figure 2. Variation of the  $H\alpha$  line profile.

P Cyg profile for the Na I D and  $H\alpha$  lines. We could also confirm the variation of the  $H\alpha$  line profile. The  $H\alpha$  line profiles over the observed period are shown in Figure 2. The slope of profile becomes steeper and the width of profile narrowed over time. This feature could be interpreted as the evidence of a strong and time-variable outflow driven by the central FUor object (Semkov et al., 2013).

### 3. SUMMARY

We summarize our observational study as follows.

- We found a small amplitude photometric variation in the near infrared photometric observations of V582 Aur, and the period seems to be about 45 days.
- We could not find short period brightness variations on the scale of a night.

- We confirmed P Cyg profiles for the  $H\alpha$  and Na I D lines from the optical spectroscopic observations, which is one of the most important features of FUor. We also measured a change of profile in the  $H\alpha$  line.
- In order to better understand the nature and the variation of V582 Aur, on-going photometric and spectroscopic monitoring are needed.

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