COMMISSIONS 27 AND 42 OF THE IAU
INFORMATION BULLETIN ON VARIABLE STARS

Number 5629

Konkoly Observatory
Budapest
7 June 2005

HU ISSN 0374 – 0676

DISCOVERY OF A SHORT-PERIODIC PULSATING COMPONENT IN THE ALGOL-TYPE ECLIPSING BINARY SYSTEM IU Per

and Two New δ Scuti-Type Variables in the Vicinity of IU Per

KIM, S.-L.[1]; LEE, J. W.[2]; KOO, J.-R.[1]; KANG, Y. B.[1]; MKRTICHIAN, D. E.[3,4]

[1] Korea Astronomy & Space Science Institute, Daejeon, 305-348, Korea (e-mail : slkim@kasi.re.kr)

[2] Dept. of Astronomy and Space Science, Chungbuk National University, Cheongju, 361-763, Korea

[3] ARCSEC, Sejong University, Seoul, 143-747, Korea

[4] Astronomical Observatory, Odessa National University, Shevchenko Park, Odessa, 65014, Ukraine

Name of the object:
IU Per, GSC 02858-02449, GSC 02859-01458

Observatory and telescope:
Mt. Lemmon Optical Astronomy Observatory in USA, 1.0m telescope[1]

Detector:	2K CCD camera

Filter(s):	Johnson B

Date(s) of the observation(s):
December 16, 18, 19, 20, 21, and 22, 2004

Comparison star(s):	GSC 02859-00794

Check star(s):	GSC 02858-02003

Transformed to a standard system:	No

Availability of the data:
Upon request

Method of data reduction:
Standard CCD-frame reduction using the IRAF/DAOPHOT[2] package

[1]Korea Astronomy & Space science Institute (*KASI*) had installed the telescope and has been operating it by remote control from Korea via a network connection.

[2]IRAF is distributed by the National Optical Astronomy Observatories, which are operated by the Association of Universities for Research in Astronomy, Inc., under cooperative agreement with the National Science Foundation.

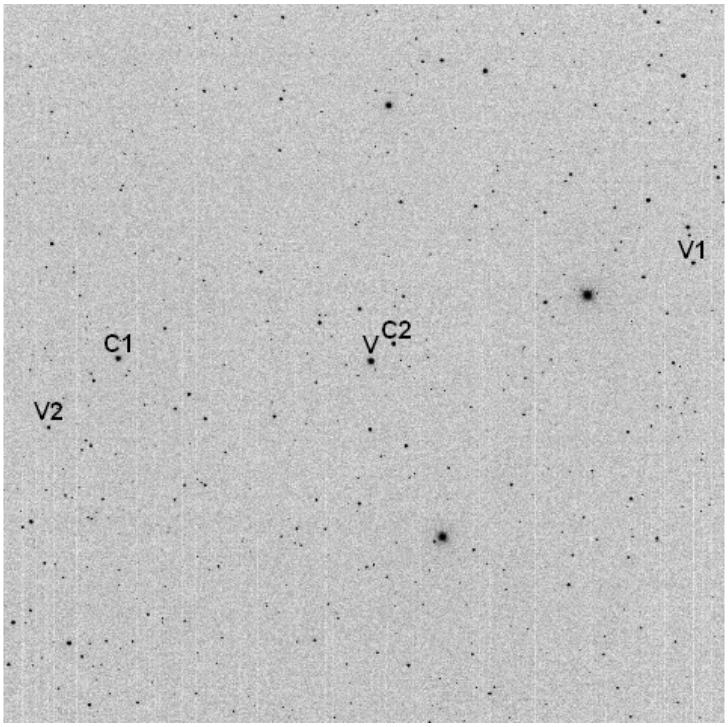

Figure 1. A B-band CCD image ($22'.2 \times 22'.2$) of the eclipsing binary IU Per (V). North is up and east is to the left. Two stars of GSC 02859-00794 ($B = 11^{m}.85$, $V = 11^{m}.36$; Kharchenko 2001) and GSC 02858-02003 ($B = 12^{m}.24$, $V = 11^{m}.88$; Kharchenko 2001) were chosen as the comparison (C1) and check (C2) stars, respectively. Two new variable stars, V1 = GSC 02858-02449 ($B = 13^{m}.8$, $R = 13^{m}.2$; Monet et al. 1998) and V2 = GSC 02859-01458 ($B = 13^{m}.9$, $R = 13^{m}.2$; Monet et al. 1998) are also marked.

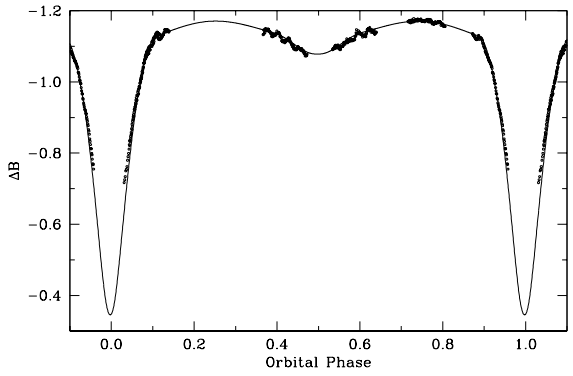

Figure 2. Phase diagram of IU Per in B-passband. The line is a synthetic eclipsing light curve which derived from the 1998-version of Wilson & Devinney (1971) code, taking into consideration of the light curve solution by Budding et al. (2004).

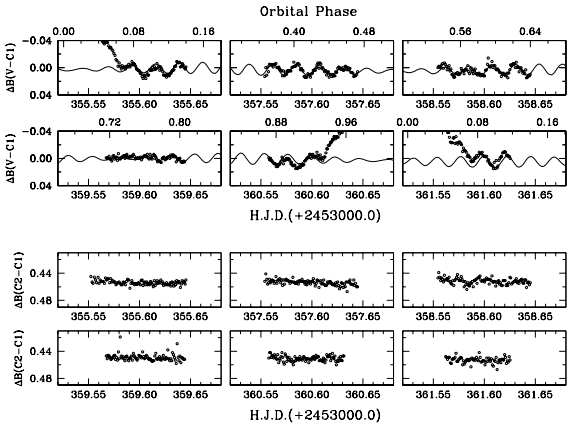

Figure 3. (Upper) Light variations of the residuals after subtracting the synthetic eclipsing light curve from the data. The lines are sinusoidal curves obtained from the multiple frequency analysis. (Lower) Differential magnitudes of the check star, ΔB(C2−C1), are displayed for comparison.

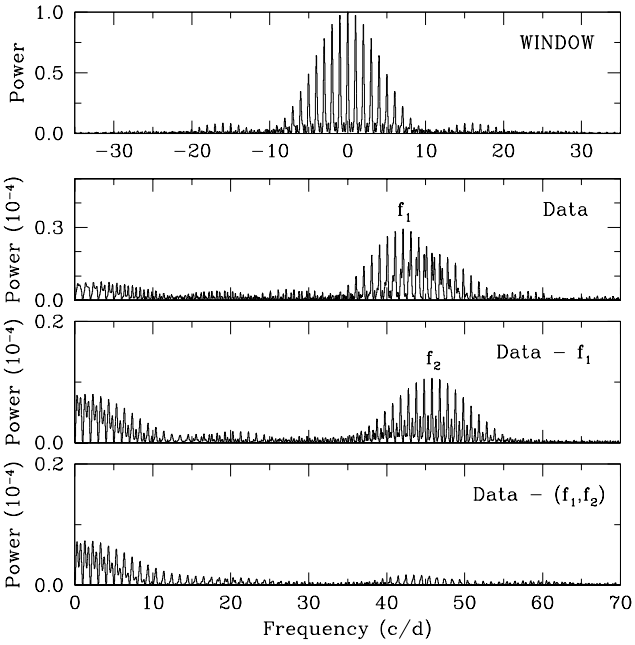

Figure 4. Power spectra of the residuals, except for the data around the primary minimum. The window spectrum is displayed in the top panel. We can detect two frequencies of f_1 = 42.103 c/d and f_2 = 45.806 c/d from the successive pre-whitening procedure (Kim & Lee 1996). Peaks at low-frequency less than 10.0 c/d may be originated from the incomplete fit of the synthetic eclipsing curve.

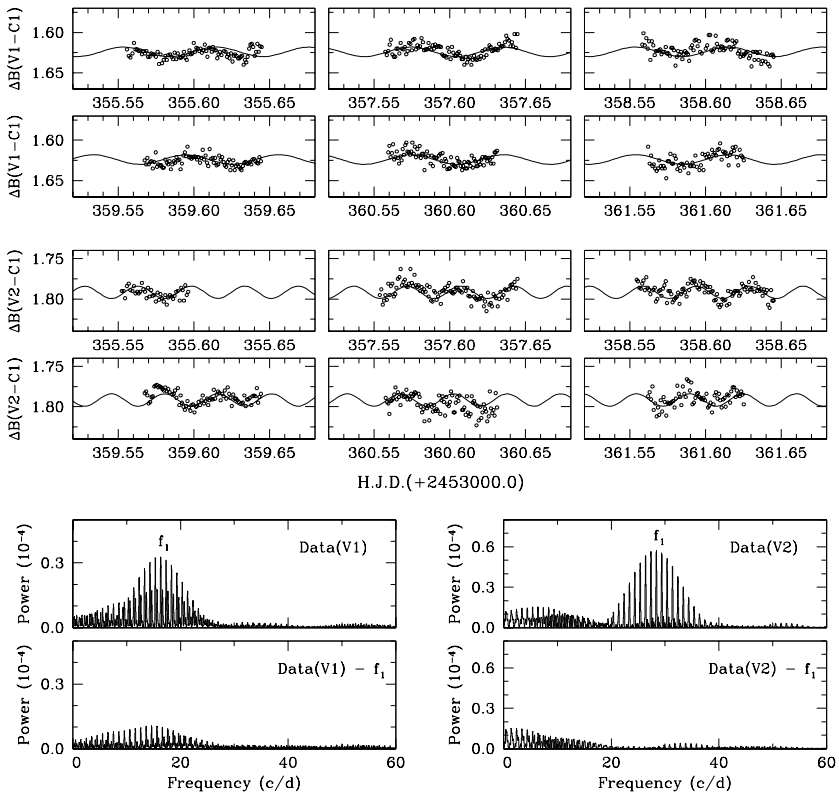

Figure 5. Light variations (upper) and power spectra (lower) of two new variable stars, V1 and V2. V1 has a dominant frequency of 16.332c/d and V2 of 28.375 c/d.

Remarks:

As a part of our photometric survey project to search for A-type pulsating components in eclipsing binary systems (Kim et al. 2003), we monitored the Algol-type semi-detached eclipsing binary IU Per. The observations were performed for six nights in December 2004, about 2 hours per night, with a 2K CCD camera. Simple aperture photometry was applied to get instrumental magnitudes with an aperture radius of 9 pixels (=5.″76); seeing size was about 2.″8 during the observing runs. We examined differential magnitudes of tens of stars in the observing field to check their variations. Phase diagram of IU Per is shown in Figure 2, where orbital phases were calculated with the orbital period of 0.8570257 day and the primary minimum epoch of $H.J.D.2452500.214$ (Kreiner 2004). We obtained residuals after subtracting a synthetic eclipsing light curve from the data. Amplitudes of their variations change from cycle to cycle (Figure 3), implying that the variable star has multiple periods. We applied the multiple frequency analysis (Kim & Lee 1996) to get power spectra of the residuals, displayed in Figure 4, and detected two frequencies f_1 = 42.103 c/d (cycles per day) and f_2 = 45.806 c/d.

Our observations show that the primary component of IU Per has δ Scuti-type pulsational characteristics such as periods of about 34 minutes, peak-to-peak amplitudes of about $0.^{m}02$ in B-passband, multi-periodicity, and spectral type of A4 (Samus et al. 2004). Considering these pulsational characteristics and the semi-detached binary configuration (Samus et al. 2004), we suggest that IU Per is a new member of the oscillating EA (oEA) stars, a group of mass-accreting pulsating components in Algol-type semi-detached eclipsing binary systems (Mkrtichian et al. 2004). Then the number of the oEA stars has increased eighteen (Mkrtichian et al. 2005; Kim et al. 2005).

We have also discovered two new variable stars, V1 = GSC 02858-02449 and V2 = GSC 02859-01458, in the observing field. Figure 5 shows their light variations and power spectra. Considering their short periods, small amplitudes, and color indexes, we suggest that these stars are δ Scuti-type pulsating variables.

Acknowledgements:

This research made use of the SIMBAD database, operated at CDS, Strasbourg, France

References:

Budding, E., Erdem, A., Cicek, C., et al., 2004, *A&A*, **417**, 263

Kharchenko, N.V., 2001, *All-sky Compiled Catalogue of 2.5 million stars* (ASCC-2.5, 2nd version)

Kim, S.-L., Lee, S.-W., 1996, *A&A*, **310**, 831

Kim, S.-L., Lee, J.W., Kwon, S.-G., et al., 2003, *A&A*, **405**, 231

Kim, S.-L., Lee, J.W., Kang, Y.B., et al., 2005, *IBVS*, 5628

Kreiner, J.M., 2004, *Acta Astronomica*, **54**, 207

Mkrtichian, D.E., Kusakin, A.V., Rodríguez, E., et al., 2004, *A&A*, **419**, 1015

Mkrtichian, D.E., Rodríguez, E., Olson, E.C., et al., 2005, Tidal evolution and oscillations in binary stars, eds., A., Claret, A., Gimenez and J.-P., Zahn, *ASPC*, **333**, in press

Monet, D., Bird, A., Canzian, B., et al., 1998, *The USNO-A2.0 Catalogue*

Samus, N.N., Durlevich, O.V., et al., 2004, *Combined General Catalog of Variable Stars* (GCVS4.2, 2004 Ed.)

Wilson, R.E., Devinney, E.J., 1971, *ApJ*, **166**, 605