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INFRARED LIGHT CURVES OF THE BINARY SYSTEM HY Vir

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HY Vir (SAO 139174, HD 114125, BD $-1°2777$) was firstly discovered as a variable star by Rodríguez *et al.* (1988). Later Casas and Gómez–Forrellad (1989) confirmed that HY Vir is a detached eclipsing binary from observations carried out at Observatorio del Teide (Canary Islands, Spain) in the V band. They also gave the first ephemeris. This ephemeris and the original physical elements were improved from new observations (V band) of HY Vir during several nights in April 1995 using the 0.4–m telescope at Observatorio de Mollet (Spain) (García–Melendo *et al.* 1995). The new calculated ephemeris suggests a shorter period for HY Vir, but they claimed for more timings of minima in order to discern whether it was due to a lack of accuracy in the initial period estimate or real period changes. The combined spectrum of HY Vir is F2 V (SAO Catalogue). In the Hipparcos archive HY Vir is identified as a chemically peculiar variable at a distance of about 120 pc. (Paunzen and Maitzen, 1998). Strömgren indices are given in Hauk and Mermilliod (1998).

The observations presented in this paper were performed during 12 nights over the period 26 April to 13 May 1999, with the 1.5 m Carlos Sanchez Telescope at the Observatorio del Teide (Canary Islands, Spain) (Table 1). We used a CVF photometer with a focal plane chopper, an InSb detector cooled with liquid nitrogen and standard broadband J, H and K filters. Both the chopping amplitudes and the aperture diameter were 15. The estimated photometric errors were less than 0.01 mag. More than 550 observations were obtained in each band. The main comparison star was SAO 139131 (48 Vir). Orbital phases were calculated using the ephemeris given by García–Melendo *et al.* (1995): HJD Min.I = $2447240.97128 + 2\overset{d}{.}73236 \times E$.

From the published Strömgren indices at the maxima, using the relations of Grøsbol (1978), we derive a mean effective temperature $T_{eff} \approx 6900$ K for HY Vir. The colour indices $(V-J)=0\overset{m}{.}73$, $(V-H)=0\overset{m}{.}85$ and $(V-K)=0\overset{m}{.}93$ in the maxima are in agreement with Johnson (1966) and Koornneef (1983) colour index– spectral type determinations of F2 V stars.

In order to determine new geometrical elements from our IR light curves, we used the code developed by Budding & Zeilik (1987). The program, based on the Information Limit Optimization Technique (ILOT), takes into account ellipticity, gravity darkening and reflection effects, and gives equivalent spherical radii to describe the sizes of the distorted stellar components. It has been shown that this code produces geometrical parameters in good agreement with those derived using other existing light–curve fitting

codes even for contact binaries (see Banks 1993 and references therein). A circular orbit was assumed, as emerged from the duration and orbital phases of both eclipses. The limb darkening coefficients were interpolated from the values given by Claret, Díaz–Cordovés & Giménez (1995).

Light curve elements have been computed from the V observations using the EBOP code by Giménez and Casas (1990) and later by García–Melendo *et al.* (1995). From these works the overall picture of HY Vir is a detached binary with similar spectral type components. In fact García–Melendo *et al.* determined a mass ratio $q = m_2/m_1$=0.95, T_1=7200 K and T_2=6900 K supposing very different radii values with $k = r_2/r_1 \approx 0.60$. With these values as initial set of parameters different fits were performed to our J, H and K light curves. The radii ratio $k = r_2/r_1$ has been varied from 0.50 to 1.15.

Our IR light curve analysis yields values in agreement with the published V light curve determinations, except the ratio $k = r_2/r_1$. But the solution with smaller χ^2 in the three J , H and K fits, gives a final $k = r_2/r_1 \approx 0.85$ pointing to a larger secondary star. Tables 2 and 3 gives the resulting parameters of both solutions and in Figure 1 the synthetic light curves with $k = r_2/r_1 \approx 0.85$ are plotted together with the observations. As a future work, spectroscopic observations and radial velocity curves are necessary in order to give a definitive determination of the physical parameters of this new bright binary.

Table 1: Observing run

Observation date	Observed Filters
27–28 April 1999	H,K
28–29 April 1999	J,H,K
1–2 May 1999	J,H,K
2–3 May 1999	J,H,K
3–4 May 1999	J,H,K
4–5 May 1999	J,H,K
5–6 May 1999	J,H,K
6–7 May 1999	J,H,K
7–8 May 1999	J,H,K
8–9 May 1999	J,H,K
9–10 May 1999	J,H,K
9–11 May 1999	J,H,K

Table 2: *ILOT* light curves solutions

	J filter	H filter	K filter
L_1	0.721 ± 0.002	0.672 ±0.002	0.675 ±0.002
L_2	0.279 ± 0.002	0.328 ± 0.002	0.325 ± 0.002
r_1	0.201 ± 0.001	0.211± 0.001	0.208± 0.001
r_2	0.141 ± 0.001	0.147 ± 0.001	0.148 ± 0.001
k	0.70	0.70	0.71
i	79.°9± 0.°1	80.°7± 0.°1	79.°7± 0.°1
χ^2	286	376	439
ϵ	0.01	0.01	0.01
N.Points	564	589	586

Table 3: *ILOT* light curves solutions

	J filter	H filter	K filter
L_1	0.581 ± 0.002	0.579 ±0.002	0.581 ±0.002
L_2	0.419 ± 0.002	0.421 ± 0.002	0.419 ± 0.002
r_1	0.191 ± 0.001	0.192± 0.001	0.190± 0.001
r_2	0.164 ± 0.001	0.165 ± 0.001	0.162 ± 0.001
k	0.86	0.86	0.85
i	79°.6± 0°.1	80°.1± 0°.1	79°.9± 0°.1
χ^2	263	345	420
ϵ	0.01	0.01	0.01
N.Points	564	589	586

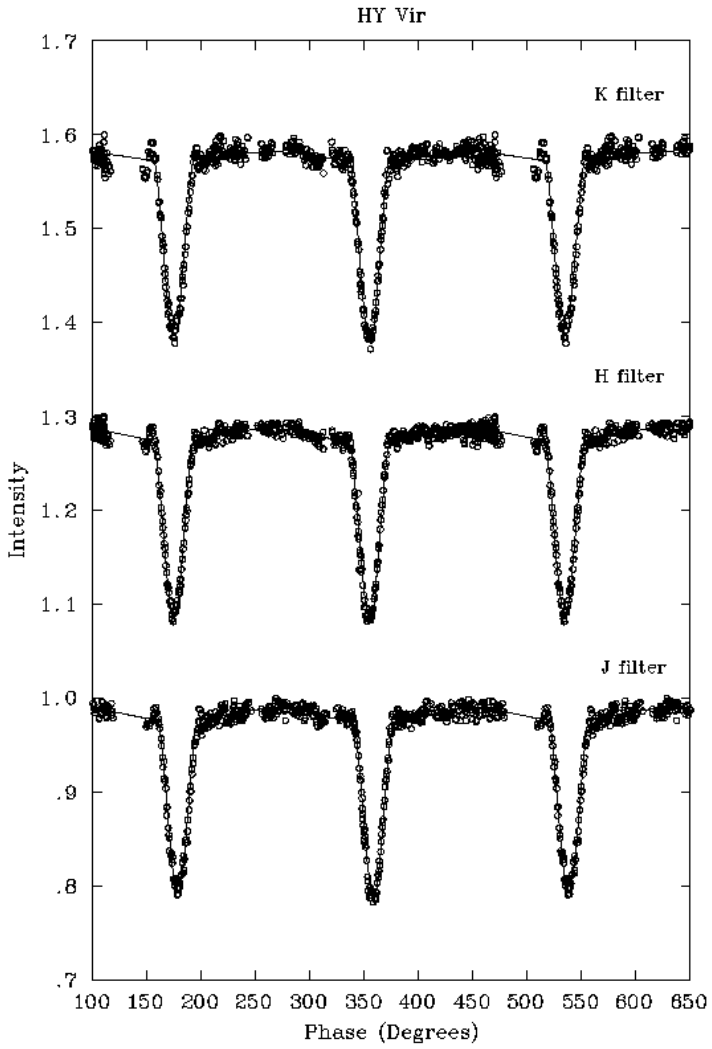

Figure 1. Observed light curves and the fits obtained with *ILOT*. The H and K filter intensities are shifted by $0^m.3$ and $0^m.6$, respectively.

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