ON THE ROTATION PERIOD OF HD 39576

HD 39576 ($\alpha = 5^h52^m16^s$, $\delta = -28°39'23"$, 2000.0, $V = 9.05$ mag) is a rapidly rotating, single-lined spectroscopic binary with a G1V (Houk 1982) primary component. The star exhibits moderately strong Ca II H and K emission and variable X-ray emission in the 1-13 keV energy range (Buckley et al. 1987). No orbital information is available, nor is there any published photometry. HD 39576 is listed as star number 46 in the "Catalog of Chromospherically Active Binary Stars" (Strassmeier et al. 1988). In this paper we report the discovery of its light variability and determine a preliminary rotation period of 2.7 days.

Our photometry was obtained with the Danish 50cm-SAT telescope at ESO, LaSilla in January 1992. Standardized Strömgren $uvby$ measures were made differentially with respect to SAO 170938 (G0) as the comparison star, and to HD 39636 (G5) as the check star. Table 1 lists the differential $uvby$ values with respect to SAO 170938. The data were examined for periodicity with standard period-finding programs, and we found the greatest reduction of the sum of the squares of the residuals at a period of 2.70±0.02 days. However, there are two other possible periods, separated by one-day intervals, which result in approximately equally good fits. These are likely two aliases of the 2.7-day period. A periodogram is shown in Fig. 1. The formal values of the full amplitudes in u, v, b, and y, are 0.058, 0.054. 0.047, and 0.036 mag, respectively. Figure 2 shows the light and color curves phased together with the 2.7-day period with an arbitrary initial epoch (HJD 2,448,630).

One high-resolution spectrum centered at 6160 Å (Fig. 3) was obtained at Kitt Peak National Observatory with the coudé feed telescope in April 1992. Grating A and camera 5 were used in second order with a 800-pixel TI CCD and had an effective wavelength resolution of 0.18 Å and a S/N ratio of approximately 100:1. From comparison of several unblended photospheric lines of HD 39576 with sky spectra of the Sun ($v\sin i \leq 1.7$ km s^{-1}; Soderblom et al. 1989), and an empirical relationship between FWHM and line broadening (Fekel et al. 1986), we derive $v\sin i$ for HD 39576 of 20±2 km s^{-1}. This value is substantially smaller than the estimate of 65±10 km s^{-1} by Buckley et al. (1987) from lower resolution spectra. In our one "red" spectrum, there is no trace of a secondary component.

Table 1: ESO photometry of HD 39576

| HJD	Δu	Δv	Δb	Δy
8636.7567	-0.650	-0.647	-0.616	-0.617
8638.5512	-0.586	-0.605	-0.591	-0.579
8638.6255	-0.615	-0.609	-0.594	-0.586
8638.7666	-0.634	-0.630	-0.607	-0.599
8639.5451	-0.647	-0.649	-0.629	-0.609
8639.6344	-0.658	-0.647	-0.621	-0.602
8640.6358	-0.578	-0.590	-0.563	-0.561
8640.6992	-0.612	-0.603	-0.596	-0.594
8641.5461	-0.635	-0.634	-0.619	-0.595
8641.6317	-0.661	-0.640	-0.624	-0.603
8641.7465	-0.667	-0.659	-0.631	-0.601
8642.5469	-0.657	-0.635	-0.607	-0.588
8642.6572	-0.630	-0.634	-0.603	-0.603
8642.7575	-0.652	-0.634	-0.610	-0.617
8643.5458	-0.626	-0.607	-0.596	-0.577
8643.6608	-0.602	-0.610	-0.578	-0.562
8643.7294	-0.614	-0.593	-0.578	-0.576
8644.5477	-0.651	-0.644	-0.625	-0.606
8644.6451	-0.644	-0.644	-0.621	-0.609
8644.7559	-0.620	-0.631	-0.612	-0.595

Frequency (1/day)
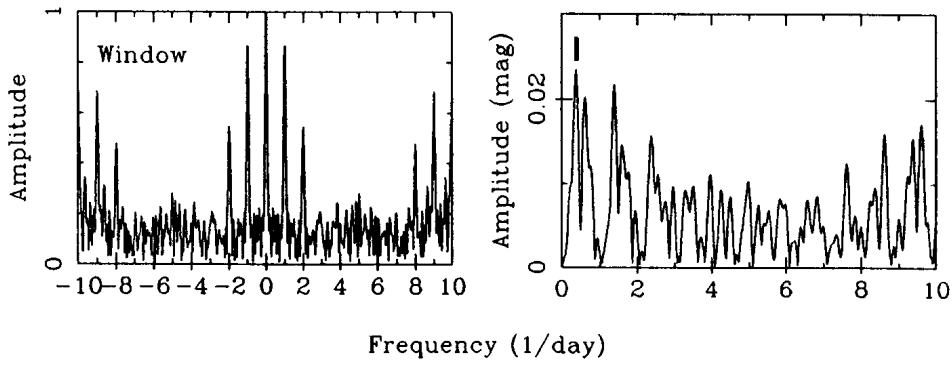
Figure 1: Periodogram for HD 39576 from b data (right panel). The left panel shows the window function. The period with the greatest reduction of the squares of the residuals is found at 2.7 days and is marked in the right panel.
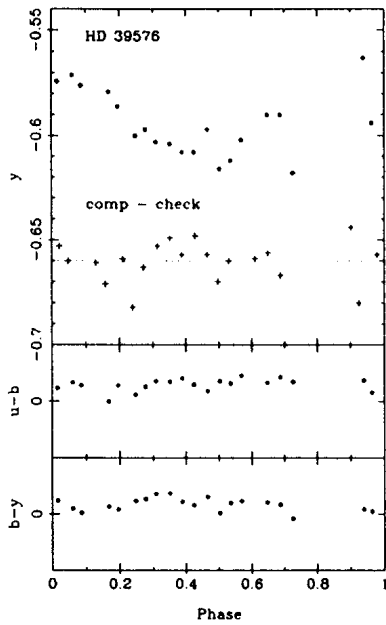
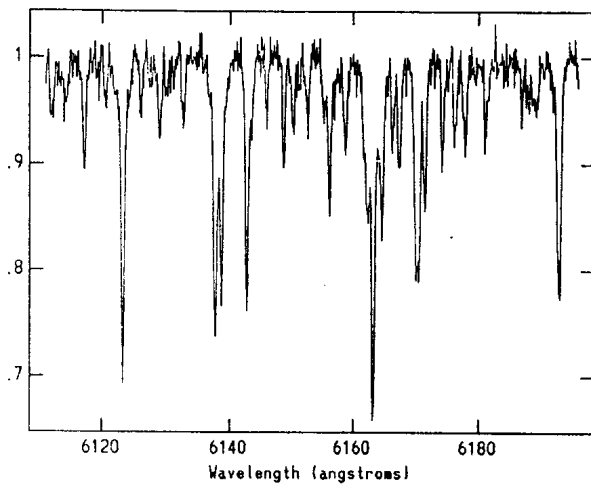Figure 2: Strömgren *uvby* light and color curves of HD 39576. The data are phased with the ephemeris HJD 2,448,630+2.7×E.

Figure 3: A high-resolution spectrum of HD 39576 centered at 6160 Å. $V \sin i$ is measured to be 20±2 km s^{-1}.

If we assume that the photometric period of 2.7 days is the rotation period, our $v \sin i$ measure translates into a minimum radius of 1.07 ± 0.12 $R_\odot$. Accordingly, a 0.7 or 1.7-day period results in a minimum radius of 0.29 or 0.67 $R_\odot$, respectively. Several sources quote a typical radius of ≈ 1.1 $R_\odot$ for a G1 dwarf (e.g. Schmidt-Kaler 1982), which would be in agreement with our determination from the 2.7-day period. Clearly, a subgiant classification must be ruled out if the photometric period is not just a spurious value and the star is not viewed at a very low inclination. Since the overall appearance of the spectrum of HD 39576 is rather well matched by the G0V "standard" β CVn, and the temperature sensitive line-depth ratio Ti l 6146/Si l 6145 of 0.11 ± 0.01 is exactly that of a G1 dwarf of $T_{eff} = 5900$ K (according to the calibration of Strassmeier et al. 1992), we believe that HD 39576 is indeed a dwarf star and that the 2.7-day period is likely to be the rotation period.

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