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# HD 6628: A NEW ACTIVE, SINGLE-LINED SPECTROSCOPIC BINARY

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The variable star HD 6628 (SAO 166806, CPD −23° 130, HIP 5227, *IRAS* 01043−2307, RE J010649 −225156; listed by *Simbad* as CS Ceti) has been previously listed (SAO catalogue) as a G5 IV single star, $M_V = 7.9$ and $d = 75$ pc. The *Hipparcos* magnitude and parallax (Schrijver 1997) are $M_V = 7.77$ and $\pi = 0''.00756 \pm 0''.00108$ ($d = 132 \pm 22$ pc). Schrijver (1997) lists HD 6628 as a variable single star with an amplitude of variation in $V$ of 0.10 mag. and a period of 4.50 days, and a light curve has been fitted (Grenon, 1997) to the data. That HD 6628 is chromospherically active was shown by EUV emission in both the ROSAT (Pounds *et al.*, 1991; Pounds *et al.*, 1993; Mason *et al.*, 1995; Pye *et al.*, 1995; Kreysing *et al.*, 1995) and EUVE (Bowyer *et al.*, 1994; Malina *et al*, 1994; Bowyer *et al.*, 1996) surveys, and has been confirmed by medium-resolution spectra of the H and K lines (Figure 1) obtained at the Mount John University Observatory (MJUO) at Lake Tekapo, New Zealand.

High-resolution CCD spectra of HD 6628 were obtained at MJUO between August 1993 and August 1996 using the 1 m McLellan telescope (Nankivell and Rumsey, 1986) and échelle spectrograph (Hearnshaw, 1977 and 1978). Most of the data are at H$\alpha$ which shows strong and variable emission, the line often appearing entirely in emission. A Th-Ar calibration spectrum was obtained immediately after each stellar spectrum. The spectra were reduced using the ESO Munich Image Data Analysis System (*MIDAS*), the dispersion solutions being computed using standard *MIDAS* procedures in the "échelle" context. Radial velocities were measured from metal lines, principally from the $\lambda$6200, $\lambda$6219, $\lambda$6394, $\lambda$6569 and $\lambda$6750 lines of Fe I, and the $\lambda$6768 line of Ni I. The mean velocities for the individual spectra are listed in Table I. The radial velocities were analysed using the *Orbsol* program as modified and supplied to MJUO by Tsevi Mazeh of Tel Aviv University. A period of $27.3316 \pm 0.0079$ days was found and Figure 2 shows the radial velocities of Table 1 plotted against the periodic phase. The best-fit orbital parameters as determined by the *Orbsol* program are listed in Table 2.

The *Hipparcos* parallax and $V$ magnitude imply an absolute magnitude for the HD 6628 system of $M_V = 2.16 \pm 0.29$. Such a magnitude is consistent with the presence of two G5 IV stars of $M_V = 2.91$ each, but the fact that the spectra are single-lined and not double-lined implies that one of the stars is several magnitudes fainter than the other. We therefore prefer the interpretation that the star responsible for the observed metal lines is a G5 IV star of magnitude in the range $M_V = 2.5$ to 2.3, for example a star of greater than solar mass which is now a bright subgiant, and its companion is a main sequence star, possibly a spectral type F star.

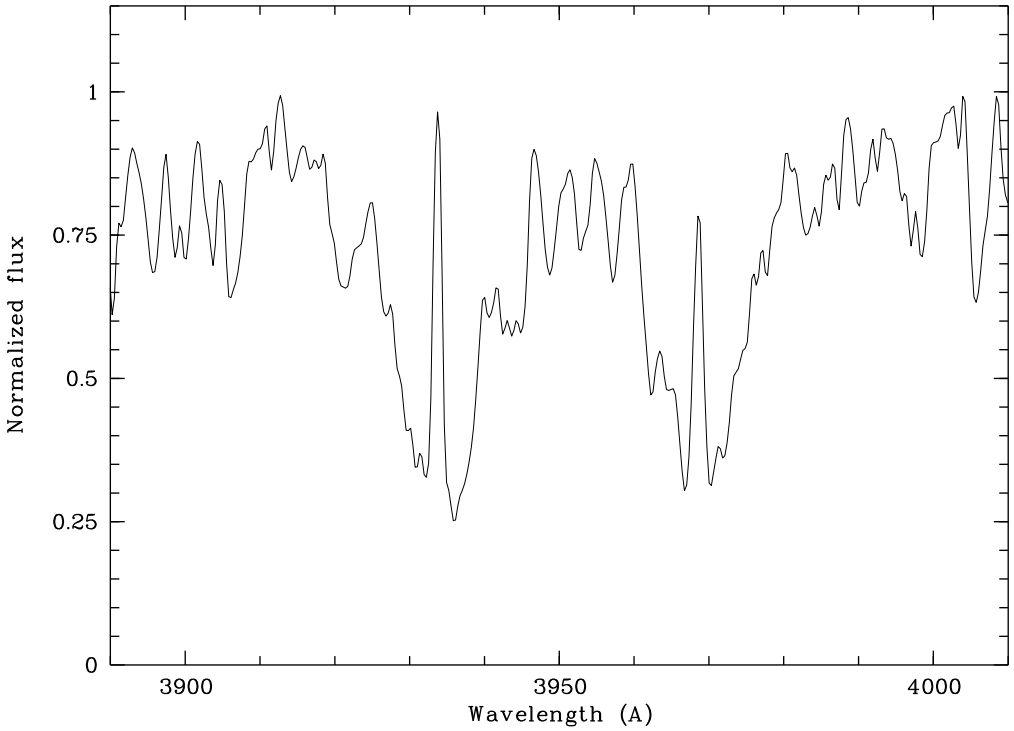


**Figure 1.** Medium-resolution spectrum of the H and K lines of HD 6628, obtained at MJUO, 1995 December 30.

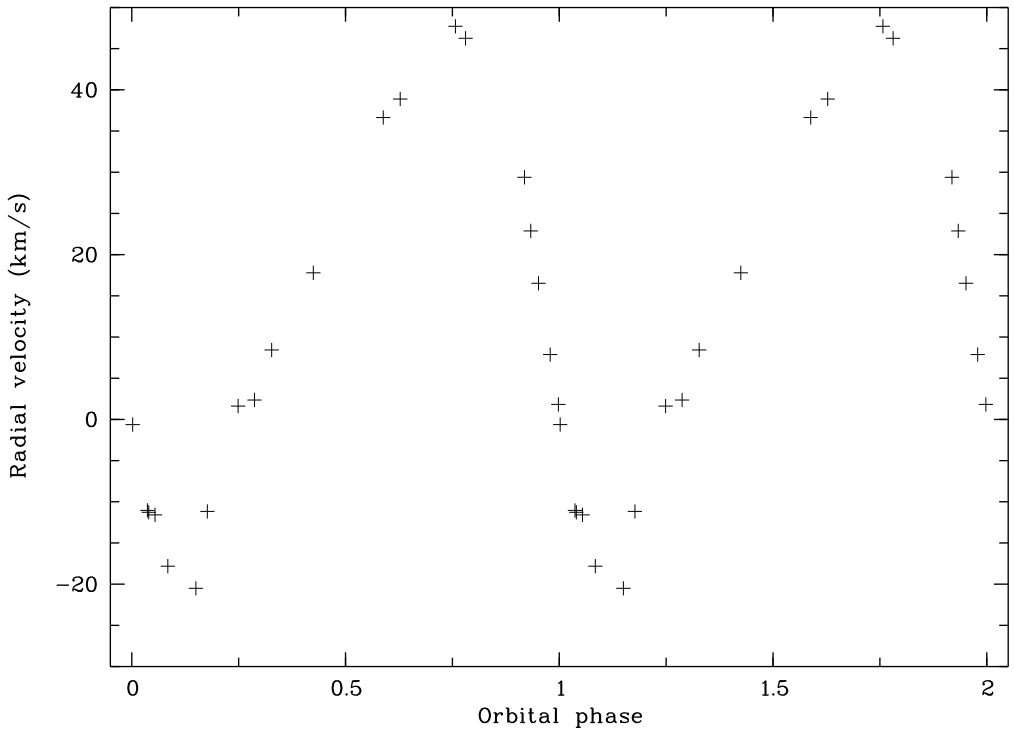


**Figure 2.** Phased radial velocities of HD 6628.

Table 1: Radial velocities of HD 6628, computed from high-resolution spectra obtained at MJUO.

| H.J.D. | Mean velocity (km/s) | Standard deviation (km/s) |
|---|---|---|
| 2449204.20136 | −11.058 | 0.548 |
| 2449290.02947 | −11.173 | 1.285 |
| 2449539.02793 | +2.355 | 0.360 |
| 2449579.20077 | +47.712 | 0.967 |
| 2449622.11782 | +8.425 | 0.905 |
| 2449639.92354 | +7.869 | 0.544 |
| 2449641.99194 | −11.588 | 0.511 |
| 2449859.21730 | −0.627 | 0.540 |
| 2449860.24754 | −11.270 | 0.954 |
| 2449916.12831 | −17.814 | 0.205 |
| 2449941.09675 | +1.822 | 0.102 |
| 2450011.89198 | +36.646 | 0.588 |
| 2450012.97834 | +38.892 | 0.072 |
| 2450075.98908 | +22.879 | 1.375 |
| 2450081.91063 | −20.505 | 3.043 |
| 2450111.94092 | +1.621 | 2.029 |
| 2450263.14307 | +46.259 | 2.251 |
| 2450294.23803 | +29.388 | 1.042 |
| 2450295.13675 | +16.519 | 1.781 |
| 2450308.07385 | +17.792 | 1.032 |

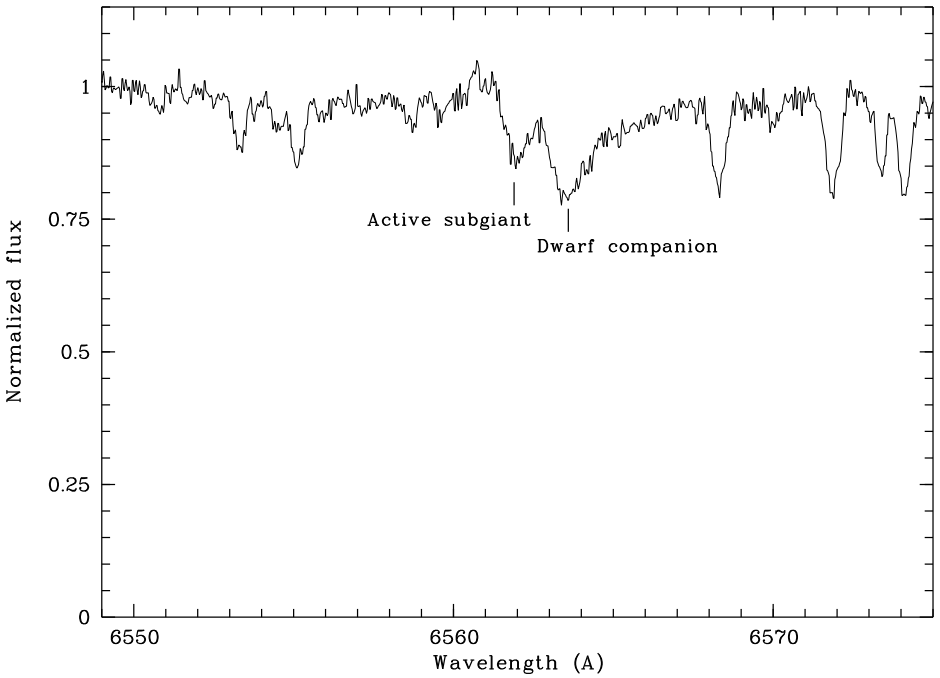


**Figure 3.** High-resolution spectrum of the H$\alpha$ line of HD 6628, obtained at MJUO, 1995 July 17.

Table 2: Orbital parameters of HD 6628 as computed by the *Orbsol* program

| Parameter | Value |
|---|---|
| $P$ (days) | $27.3316 \pm 0.0079$ |
| $\gamma$ (km/s) | $18.38 \pm 0.59$ |
| $K$ (km/s) | $13.99 \pm 0.80$ |
| $e$ | $0.293 \pm 0.026$ |
| $\Omega$ (°) | $116.1 \pm 4.0$ |
| Mass function ($M_\odot$) | $0.078 \pm 0.012$ |
| $a \sin i$ (Gm) | $11.49 \pm 0.30$ |

A high-resolution H$\alpha$ spectrum (Figure 3), obtained at orbital phase 0.08 referred to Figure 2, shows the red wing of an H$\alpha$ absorption line having a radial velocity approximately 70–80 km/s greater than that of the metallic lines of the spectrum ($-17.814$ km/s) and, blueward of it, emission almost filling in a second absorption line. The radial velocity of the latter is measurable only very imprecisely, but it is of the same order as that of the metal-lines spectrum, and confirms that the observed metal lines and the H$\alpha$ emission belong to the G5IV subgiant. The unfilled-in red absorption wing has a profile characteristic of an F-type dwarf and is attributed to the companion star.

References:

Bowyer, S., *et al.,* 1994, *Astrophys. J. Suppl.,* **93**, 569
Bowyer, S., *et al.,* 1996, *Astrophys. J. Suppl.,* **102**, 129
Grenon, M., 1997, *The Hipparcos Catalogue* vol. 12, ESA Publications, Noordwijk.
Hearnshaw, J. B., 1977, *Proc. ASA,* **3**, 102
Hearnshaw, J. B., 1978, *Sky and Telescope,* **56**, 6
Kreysing, H.-C., *et al.,* 1995, *Astron. & Astrophys. Suppl.,* **114**, 465
Malina, R. F., *et al.,* 1994, *Astron. J.,* **107**, 751
Mason, K. O., *et al.,* 1995, *Mon. Not. R. Astron. Soc.,* **274**, 1194
Nankivell, G. R., and Rumsey, N. J., 1986, *Instrumentation and Research Programmes for Small Telescopes, IAU Symposium 118* ed. J. B. Hearnshaw and P. L. Cottrell, Reidel, Dortrecht, 101
Pounds, K. A., *et al.,* 1991, *Mon. Not. R. Astron. Soc.,* **253**, 364
Pounds, K. A., *et al.,* 1993, *Mon. Not. R. Astron. Soc.,* **260**, 77
Pye, J. P., *et al.,* 1995, *Mon. Not. R. Astron. Soc.,* **274**, 1165
Schrijver, H., 1997, *The Hipparcos Catalogue* vol. 5, ESA Publications, Noordwijk.