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SERENDIPITOUS DISCOVERY OF δ SCUTI PULSATION IN THE EARLY A STAR HD 127 269

The Edinburgh-Cape Survey is a search for blue stellar and quasi-stellar objects lying at high galactic latitude in the southern hemisphere. On 24/25 February 1993 while testing the white dwarf EC 14276-2508 for pulsational light variations, we serendipitously found δ Scuti variations in an early A star, HD 127269. HD 127269 is classified A2 in the HD catalogue; Houk & Smith-Moore (1988) classify it A3V. It has V = 7.8 and B = 7.9, consistent with its early A spectral type. We monitored the brightness of HD 127269 in the second channel of the two-channel University of Cape Town photometer attached to the 1-m telescope at the Sutherland observing station of the South African Astronomical Observatory. This star was selected because of its proximity to the target white dwarf and its apparent brightness.

Observations were made through a Johnson B filter using continuous 10-s integrations with interruptions for guiding and sky measurements. The observations were corrected for coincidence losses, sky background and extinction. The times were corrected to Heliocentric Julian Date to an accuracy of 10^{-5} d. We then averaged groups of 6 observations to give 60-s integrations.

Table 1 gives the HJD and magnitudes normalized in the mean to zero for HD 127269. Fig. 1 shows the 2.5-hr long light curve. While high-speed photometry is not the best way to observe δ Scuti stars, on good photometric nights, it can detect even small light variations with confidence. We judge the night of 24/25 February 1993 to have been good enough for this at Sutherland. We thus claim that the variations seen in Fig. 1 are not atmospheric in origin, but are characteristic of HD 127269. The observations of EC 14276-2508 obtained in channel 1 cannot be used to verify this; that star is so faint that the photon statistics give the observations much more scatter than the amplitude of HD 127269.

We performed a Discrete Fourier Transform on the data listed in Table 1 which shows a clear peak at 30 d^{-1}. A least-squares fit of that frequency to the data, and then a non-linear least-squares optimization give: f = 29.93 ± 0.15 d^{-1} (P = 48.1 ± 0.2 minutes); A = 4.92 ± 0.14 mmag; ϕ = -2.774 ± 0.059 radians; and σ = 1.06 mmag per 60-s observation, where these parameters fit the relation

$$\Delta B = A \cos [2\pi f (t - t_0) + \phi]$$

where t_0 = 9043.50000. The solid line fitted to the data in Fig. 1 has those parameters.

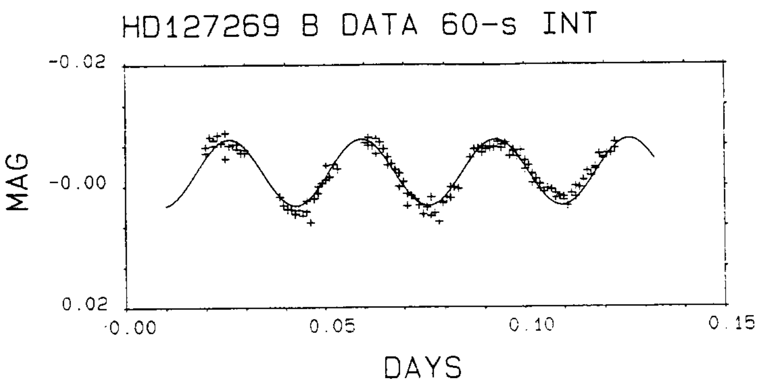

Fig. 1. The light curve of HD 127269. The plotted points are given in Table 1; the fitted curve is constructed from the parameters given in this note.

Table 1. Johnson B observations of HD 127269 normalized in the mean to zero.

HJD	B	HJD	B	HJD	B	HJD	B
9043.49179	-0.0040	9043.52142	0.0014	9043.55059	0.0071	9043.57525	0.0008
9043.49249	-0.0031	9043.52212	0.0009	9043.55129	0.0042	9043.57594	0.0016
9043.49318	-0.0055	9043.52281	-0.0012	9043.55198	0.0044	9043.57664	0.0023
9043.49388	-0.0042	9043.52351	0.0005	9043.55268	0.0035	9043.57733	0.0027
9043.49461	-0.0050	9043.52428	-0.0014	9043.55337	0.0036	9043.57803	0.0022
9043.49538	-0.0058	9043.52501	-0.0007	9043.55407	0.0020	9043.57888	0.0024
9043.49608	-0.0046	9043.53207	-0.0046	9043.55476	0.0020	9043.57965	0.0030
9043.49677	-0.0061	9043.53277	-0.0054	9043.55545	0.0022	9043.58034	0.0036
9043.49746	-0.0023	9043.53346	-0.0042	9043.55904	-0.0024	9043.58104	0.0033
9043.49816	-0.0042	9043.53416	-0.0042	9043.55974	-0.0037	9043.58173	0.0040
9043.49885	-0.0044	9043.53485	-0.0052	9043.56043	-0.0038	9043.58242	0.0035
9043.49955	-0.0037	9043.53558	-0.0030	9043.56113	-0.0032	9043.58312	0.0048
9043.50036	-0.0044	9043.53636	-0.0047	9043.56182	-0.0041	9043.58381	0.0030
9043.50105	-0.0031	9043.53707	-0.0037	9043.56251	-0.0037	9043.58451	0.0019
9043.50175	-0.0031	9043.53786	-0.0025	9043.56321	-0.0039	9043.58520	0.0035
9043.50244	-0.0036	9043.53856	-0.0013	9043.56390	-0.0041	9043.58590	0.0021
9043.51089	0.0034	9043.53925	-0.0015	9043.56460	-0.0040	9043.58659	0.0010
9043.51159	0.0047	9043.53994	-0.0006	9043.56529	-0.0048	9043.58733	0.0010
9043.51228	0.0052	9043.54064	-0.0001	9043.56599	-0.0044	9043.58810	-0.0003
9043.51297	0.0053	9043.54133	0.0019	9043.56680	-0.0039	9043.58879	0.0004
9043.51367	0.0053	9043.54203	0.0012	9043.56761	-0.0047	9043.58949	-0.0009
9043.51436	0.0059	9043.54272	0.0030	9043.56830	-0.0027	9043.59018	-0.0006
9043.51506	0.0060	9043.54342	0.0048	9043.56900	-0.0036	9043.59087	-0.0029
9043.51575	0.0054	9043.54411	0.0032	9043.56969	-0.0034	9043.59157	-0.0022
9043.51645	0.0062	9043.54481	0.0038	9043.57039	-0.0026	9043.59226	-0.0024
9043.51714	0.0040	9043.54550	0.0047	9043.57108	-0.0035	9043.59296	-0.0030
9043.51783	0.0056	9043.54666	0.0060	9043.57178	-0.0020	9043.59365	-0.0030
9043.51855	0.0072	9043.54781	0.0050	9043.57247	-0.0007	9043.59435	-0.0046
9043.51934	0.0037	9043.54851	0.0035	9043.57317	-0.0012	9043.59481	-0.0037
9043.52003	0.0029	9043.54921	0.0063	9043.57386	0.0000		
9043.52073	0.0019	9043.54990	0.0058	9043.57456	0.0014		

An A3V star has β = 2.871 and M_V = 2.4 (Crawford 1979). It is easy to rearrange the pulsation equation

$$P(\rho/\rho_{\odot})^{1/2} = Q$$

to

$$\log Q = -6.454 + \log P + \tfrac{1}{2} \log g + 0.1\, M_{bol} + \log T_{eff},$$

where P is measured in days, g is in cgs units and T_{eff} in K. The β index implies T_{eff} = 8800 K; the luminosity class implies $\log g \approx 4$. Applying the above equation gives

$Q = 0.018$ for T_{eff} = 8800 K and $\log g = 4.0$, or

$Q = 0.027$ for T_{eff} = 9000 K and $\log g = 4.3$.

These Q-values indicate pulsation in a low overtone - probably not the fundamental mode. That they are reasonable for an early A star supports the contention that Fig. 1 does demonstrate light variability in HD 127269 and is not an artifact. This star lies near the observed blue border of the δ Scuti instability strip where there is a tendency for the stars to pulsate in overtones higher than the fundamental (see Breger 1979).

As the reader has probably guessed, we did not expect to find δ Scuti pulsation in our comparison star. We selected it at the eyepiece of the telescope (in lazy ignorance) as the brightest convenient guide and comparison star for the program star. In retrospect, it is no surprise that we found such variability in an A3V star, since δ Scuti variability is extremely common in the instability strip.

It would be interesting to know what fraction of stars in the instability strip with normal spectra do *not* show variability when observed with the accuracy of the HD 127269 data presented here.

D. O'Donoghue and D. W. Kurtz
Department of Astronomy
University of Cape Town
Rondebosch 7700
South Africa

email: dod@uctvax.uct.ac.za and dkurtz@uctvax.uct.ac.za

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