SPECTROSCOPIC STUDIES OF THE PULSATING SDB BINARY PG1336-018

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The subdwarf B star PG1336–018 (=NY Vir) is a pulsating star in a very short-period (0.101 d) eclipsing binary system [4]. The secondary is thought to be a late-type dwarf of type ∼M5. The star pulsates with principal periods of 141 and 184 s and has been the subject of intensive photometric campaigns [5] in efforts to use pulsations as an asteroseismological probe of the stellar interior. As part of our efforts to identify the binary companions of subdwaf B stars spectroscopically [1], and to measure the radial-velocity amplitudes of the non-radial oscillations in pulsating subdwarf B stars [2],[7] we have obtained several observations of PG1336–018.

Intermediate dispersion spectra ($R \sim 5\,000 - 8\,000$) were obtained on 1998 May 18 at the Isaac Newton Telescope (IDS: 27 observations over 3 h at 799–884 nm), 1998 December 25 at the William Herschel (ISIS: 8 observations over 2 h at 339–518 nm and 8 at 612 – 693 nm) and 2000 May 12 at the Anglo-Australian Telescope (RGO spectrograph: 345 observations in time-series mode over 3.4 h at 405–445 nm, starting at HJD=2451677.8465). They were reduced using standard procedures [1],[2],[7].

The infrared triplet of ionized calcium was recognised as a good indicator of a late-type companion in composite sdB spectra [1]. If present in PG1336–018 it would assist in identifying the secondary and provide the system mass ratio directly by tracing the orbital motion. We obtained 27 repeated observations over a three-hour interval, sufficient to cover the orbital period. However, we found *no* evidence of the infrared calcium triplet, either in individual spectra, in the coadded sum, or by cross-correlation with a standard star spectrum (BD+26°2606) showing these lines. There was also no evidence for the Na I line at 819.4 nm, which is normally seen in absorption in K and early M stars and often in cataclysmic variables.

In addition to showing both eclipses and pulsations, the light curve is characterised by reflected light from the heated hemisphere of the M dwarf. Either the reprocessing of radiation by the cool-star atmosphere or prominences may lead to an independent signature from Hα (cf. HW Vir [6]). A series of eight spectra obtained over approximately one half of the orbit showed little evidence for displaced Hα, except for a tentative sharp absorption in one spectrum at ~ -300km s^{-1}. This appears close to eclipse, rather than quadrature, and therefore at too large a displacement to be real.

AAT spectra obtained in time-series mode were used to study radial velocity changes in the sdB star. The summed PG 1336–018 spectrum was used as a cross-correlation template. Velocities were measured by fitting a Gaussian to the cross-correlation function.

The orbital velocity was estimated by fitting a sine wave to our data with a period of 0.101015999 d [3]. We obtained a semi-amplitude of 64 ± 1kms^{-1}. This contradicts earlier estimates [4] which range from 47 ± 4 to 79 ± 4kms^{-1}. Although 345 data points cover 1.4 orbits, the data contains a gap at second quadrature and probably underestimates the orbital amplitude.

The orbital velocity was subtracted from the AAT velocity curve. A Fourier analysis of the corrected velocity curve did not show significant peaks at frequencies where peaks are seen in photometric data [5].

The spectroscopic signature of the ~M5 companion in PG1336–018 has avoided detection, so its precise spectral-type and the mass ratio of the system remain to be measured directly. Our high-speed spectroscopy can provide an improved partial solution for the binary orbit, but one quadrature was missed. Substantially more high-speed spectroscopy, i.e. $\sim$ 30 h from at least two sites, will be necessary to resolve the surface motion due to pulsations.

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