FAR-ULTRAVIOLET SPECTROPHOTOMETRY OF TWO DO WHITE DWARFS FROM *VOYAGER*

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While the observed number of hot, helium-rich degenerates is noticeably larger than that of their hydrogen-rich counterparts, the calibration of their effective temperatures has been comparatively much less trustworthy. The spectroscopic classification scheme introduced three years ago by Wesemael, Green, and Liebert (1985, hereafter WGL), and the crude temperature domains associated with each class remain, to this date, the only comprehensive effort at defining a temperature scale for DO stars. The current uncertainty in this is perhaps best epitomized by two objects, HD149499B and PG1034+001. The former belongs to a binary system which also contains a K0 V primary, 2" away. The temperature determined for the degenerate secondary ranges from 85,000±15,000 K (Wray, Parsons, and Henize 1979) to 55,000±5000 K (Sion, Guinan, and Wesemael 1982, hereafter SGW). PG1034+001, on the other hand, is the prototype of the so-called hot DO spectroscopic class; WGL assign an uncertain temperature of 80,000±20,000 K to this object.

The large uncertainty associated with these temperature determinations is perhaps not overly surprising. For these hot stars, measured energy distributions — even from the *IUE* — sample only the Rayleigh-Jeans tail, and thus cannot constrain effectively the temperature. Furthermore, the optical spectrum of hot, high-gravity helium-rich stars tends to be rather sparse, with apparently HeII λ4686 the only transition not broadened out of existence. Of course, the case of HD149499B is not helped by the presence of its companion, which tends to outshine the degenerate star at optical wavelengths (Wegner 1978). The situation is not desperate, however, as the ultraviolet spectrometers on board the *Voyager* probes have recently made it possible to sample the energy distribution of both these bright objects nearer its peak by extending observations to regions shortward of Lyα. We report here on a preliminary analysis of far-ultraviolet data (900–1200 Å) on both objects obtained with *Voyager 2* which should, eventually, provide tighter constraints on the atmospheric parameters of these stars.

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HD149499B and PG1034+001 were observed with the ultraviolet spectrometers on board the *Voyager 2* spacecraft. Coverage extends from ~950 Å to 1200 Å at a resolution of 25 Å. Additional details of these observations will be provided elsewhere. The calibrated *Voyager 2* spectra, augmented with archival *IUE* low-dispersion observations longward of 1150 Å are shown in Figure 1. The normalization at 1950 Å reveals that the energy distribution of PG1034+001 is clearly steeper than that of HD149499B. This is already an important result, which suggests that HD149499B and PG1034+001 cannot *both* have effective temperatures near 80,000 K (see above): either HD149499B is cooler or PG1034+001 is hotter than that value, or both.

The issue of an absolute temperature calibration is somewhat more delicate as it requires input from suitable model atmosphere calculations. We use here a improved grid of LTE, pure-helium models at log g=8.0 based on earlier work (Wesemael 1981). However, rather than to present preliminary fits to the complete energy distribution of both stars, we first consider here the consistency of previous temperature determinations with the new *Voyager* data.

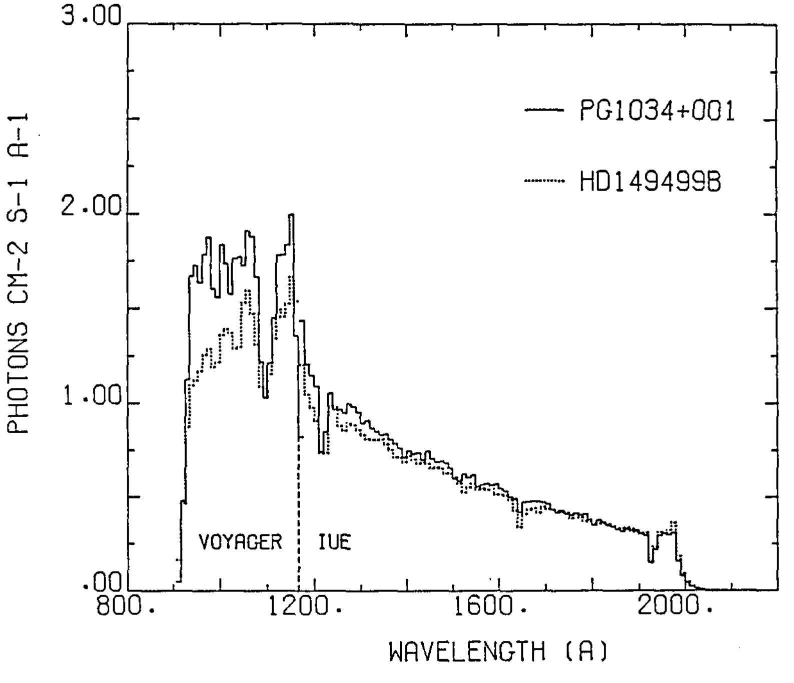

Fig.1 The far-ultraviolet spectra of HD149499B and PG1034+001. Both sets of data are normalized at 1950 Å.

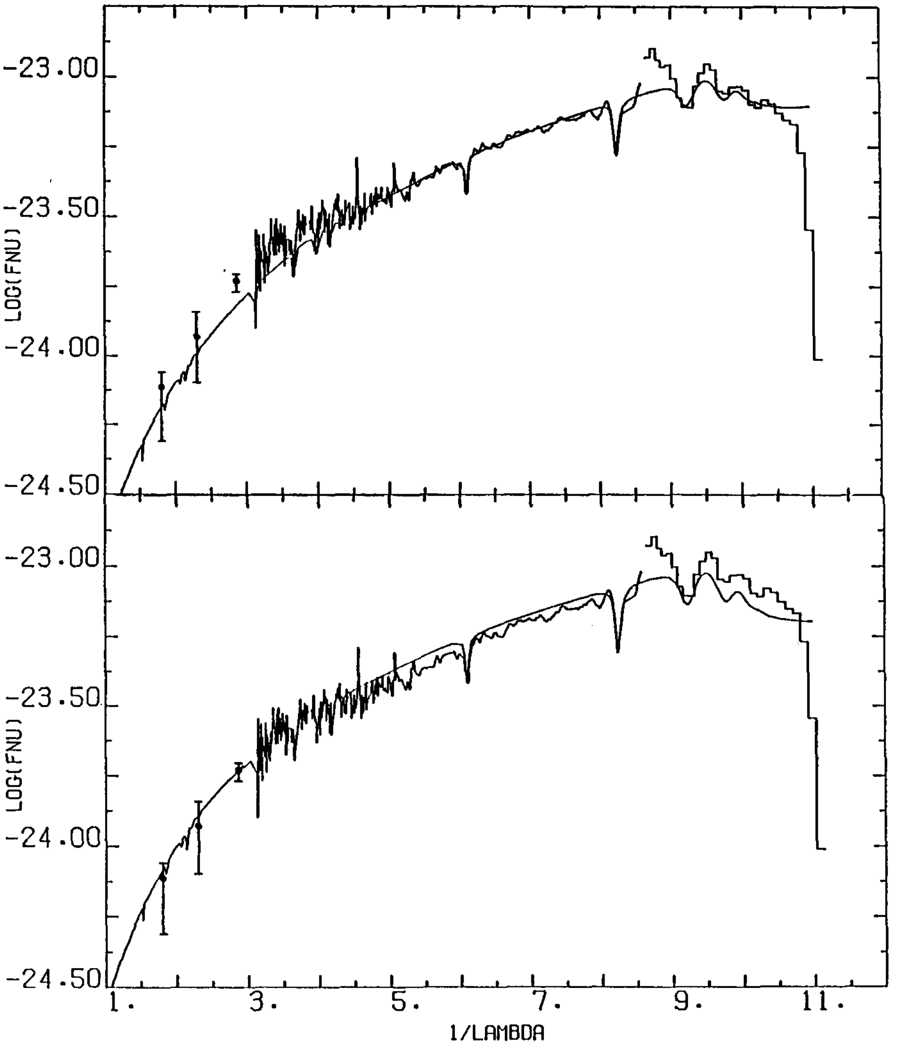

Fig.2 Preliminary fits to the energy distribution of HD149499B obtained by normalizing at 1900 Å (T_e=80,300 K; top panel) and at U (T_e=54,200K; bottom panel).

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Figure 2 shows the composite energy distribution of HD149499B. The *Voyager 2* and *IUE* data are now augmented with the broad-band data discussed by Wegner (1978). The large error bar at V reflects the fact that the visual magnitude difference between the primary and white dwarf remains uncertain. We adopt here ΔV=2.95 based on Rossiter's (1955) estimates, but take into account in the error the independent estimate of Holden (1977; ΔV=3.5). At B, the error is dominated by the uncertain spectral type of the primary, which we take here to be K0 ± one subclass. Furthermore, the contribution of the primary to the light longward of ~2800 Å has been subtracted as well from the *IUE* data, following the procedure of SGW. The bottom panel shows the preliminary fit we obtain by normalizing at U, as was done by SGW. No reddening is included in our fits to this nearby object (d~34 pc; Ianna, Rhode, and Newell 1982). Our fit to the *IUE* is comparable to that achieved by SGW, although the model fluxes appear somewhat low in the *Voyager* range. The effective temperature is 54,200 K, in agreement with that determined by SGW. The top panel shows an alternate fit to the data, obtained by normalizing at 1900 Å and by *ignoring* the LWR and broad-band optical data. This fit, at 80,300 K, provides better agreement with the far-ultraviolet data, but appears inconsistent both with the long-wavelength *IUE* data and with the U magnitude, presumably the most accurate among the derived colors of the secondary.

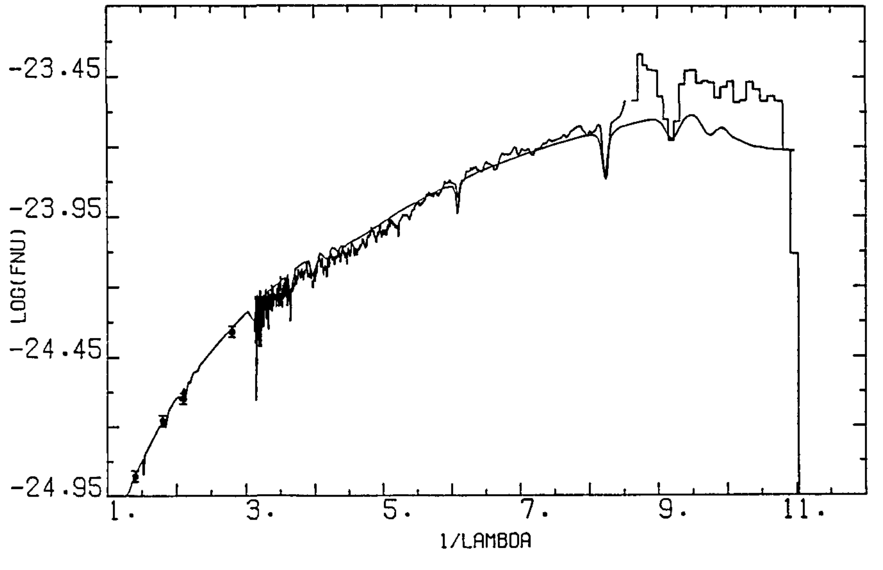

Fig.3 The energy distribution of PG1034+001, together with a model at 80,000 K, E(B−V)=0.02, the values derived by VGL.

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Figure 3 shows similar data for PG1034+001. The optical photometry, from Green, Schmidt, and Liebert (1986), is again shown together with low-dispersion *IUE* data and *Voyager* flux points. Superposed on this is a model at 80,000 K, normalized at V, and reddened by a color excess of E(B−V)=0.02. These are the values derived by WGL on the basis of *IUE* and optical data only. Not unexpectedly, the agreement is quite good above 1200 Å, but the fit becomes marginal in the *Voyager* range. The suggested temperature appears hotter than this nominal value, but the competing influences of effective temperature and small amounts of reddening must be fully understood before a value of the effective temperature can be derived.

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