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Infrared Spectra of WC10 Planetary Nebulae Nuclei

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The 5.2 - 8.0 micron spectra are presented for two planetary nebulae nuclei Hen1044 (He2-113) and CPD-56 8032 (Figure 1). The unidentified infrared (UIR) emission bands at 6.2 microns, 6.9 microns, 7.7 microns are present in the spectra of Hen1044 and in CPD-56 8032, and the 8.6 micron band is present in the long wavelength shoulder of the 7.7 micron band in the spectrum of CPD -56 8032. The 8-13 micron spectra of these two stars by Aitken et. al. (1980) (Figure 1 - dots) clearly show the presence of the 8.6 micron band in He2-113 while weakly resolving this feature in the spectra of CPD-56 8032. In their spectra the 11.3 micron band is also clearly detected in both objects. (The observation of the 2.8-3.6 micron region in these two objects has been made using the Australian National University's infrared spectrometer at the 2.3 meter telescope at Siding Spring Observatory. The broad 3.3 micron feature is seen along with fainter emission features longward of 3.3 microns in both objects and this data will be presented later.)

The 6.2 micron and 7.7 micron bands are characteristic of the infrared active C-C stretching modes in polycyclic aromatic hydrocarbons (hereafter PAHs); the 3.3 micron, 8.6 micron, and 11.3 micron bands are respectively assigned to the in-plane stretching mode, the in-plane bending mode, and the out-of-plane bending mode of the aromatic CH bond (Leger and Puget 1984). The weak 6.9 micron emission feature is attributed to the UIR spectrum by Bregman et. al. (1983).

The IRAS LRS spectra of He2-113 (IRAS 14562-5406) and CPD-56 8032 (IRAS 17047-5650) are presented (Figure 2). Cohen et. al. (1985) identify the broad plateau from 11.3 to 13.0 microns in the spectrum of He2-113 with increased hydrogenation of PAHs (Figure 3). This broad plateau is not seen in the LRS spectrum of CPD-56 8032. Also, He2-113 has greater infrared excess emission in the 17-22 micron region than does CPD-56 8032.

The optical spectra of He2-113 have been reported by Carlson (1968), Webster and Glass (1974), and Carlson and Henize (1979) to be dominated by the strong emission lines of H, CII and [NII] on an underlying continuum, with fainter emission lines of HeI, CIII, OII, [SII] and [OII]. P Cygni line profiles yield a velocity difference between emission and absorption of about 200 km/s. The dominance of the CII lines in the low excitation surrounding nebulae have led to a spectral classification of WC10 (and WC11 by van der Hucht and Conti 1981). Cowley and Hiltner (1969) discussed the optical spectrum of CPD-56 8032 and consider it to be hydrogen poor. Webster and Glass (1984) also report on the optical spectrum of CPD-56 8032 and remark that spectroscopically "-56 8032 and He2-113 are essentially identical except for the H line strength, which suggests that excitation may not be solely responsible for the hydrogen line behavior." CPD-56 8032 is also assigned to the very late type Wolf-Rayet WC10 class. The ultraviolet spectrum of CPD-56 8032 is reported by Houziaux and Heck (1982) and a carbon abundance is derived using $N(C)/N(H)=2.46 \times 10^{-3}$ to be log[C]=9.39 compared to log[C]=8.55 for the Sun.

In support of the assignment of the UIR bands to PAH emission we note that while the 6.2 micron and 7.7 micron bands attributed to the C-C stretching modes are very similar, the greater strengths of both the 8.6 and 11.3 micron features and the presence of the 11.3-13.0 micron plateau in He2-113 as compared with CPD-56 8032 indicates that the PAHs in He2-113 maybe more hydrogenated than those in CPD-56 8032, possibly reflecting a difference in hydrogen abundance in the zone in which the UIR emission arises.

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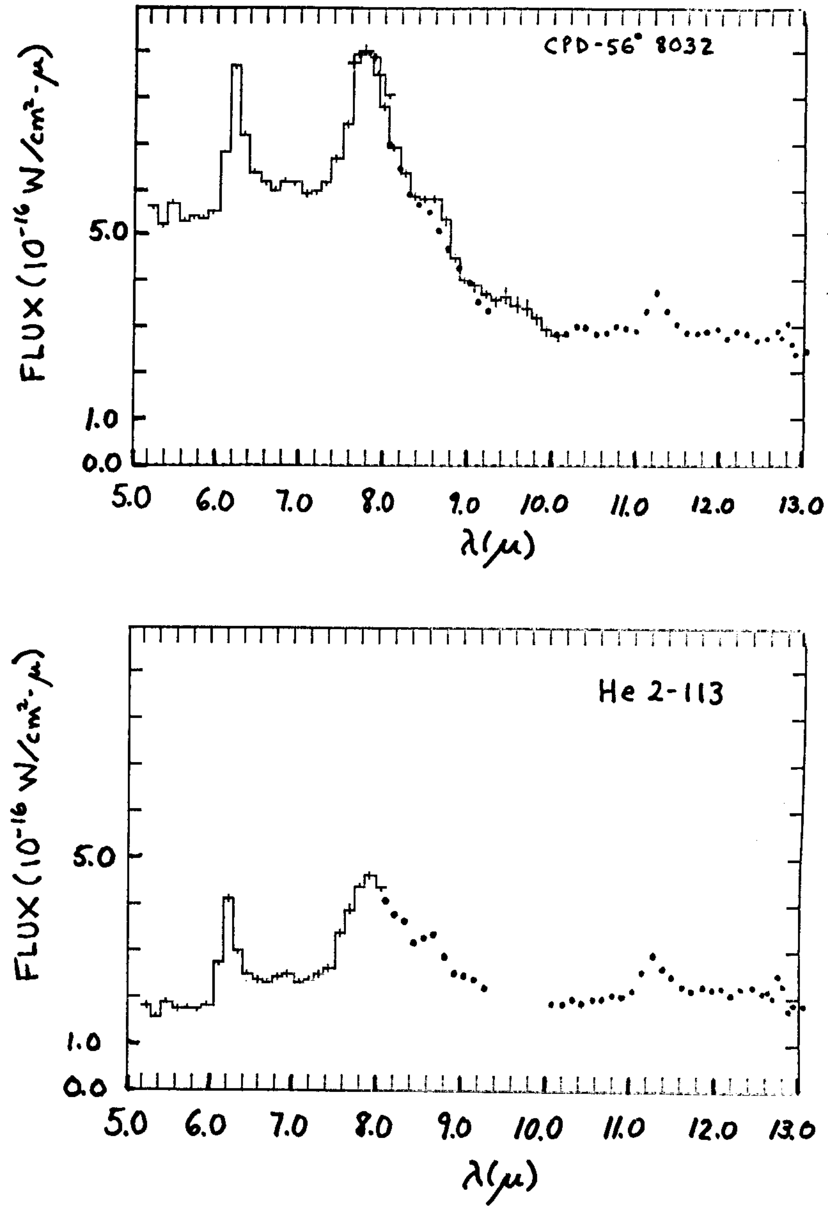
FIGURE 1



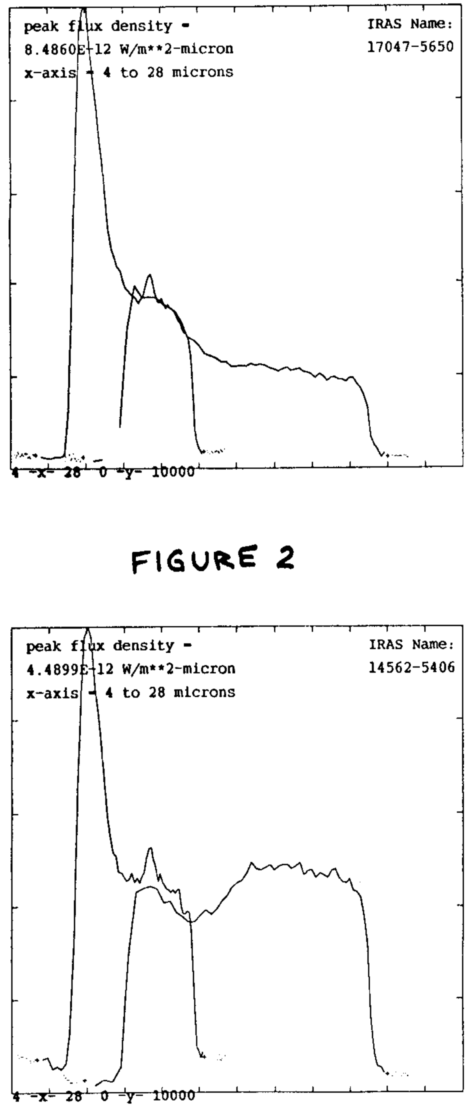


FIGURE 2

COHEN, TIELENS, AND ALLAMANDOLA

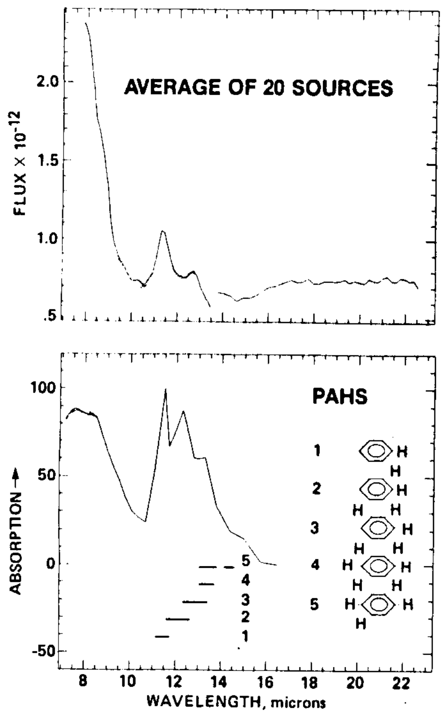


FIGURE 3