HST FOS OBSERVATIONS OF KPD0005+5106: A SUBLUMINOUS WN-WC DESCENDANT WITH ONGOING MASS OUTFLOW?

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Abstract: We report the results of spectroscopic observations of the ultra-high excitation, helium-rich, pre-white dwarf KPD0005+5106 obtained with the Hubble Space Telescope Faint Object Spectrograph (FOS) in 1991 May and July with the red (FOS/RD) and blue (FOS/BL) Digicon detectors. The data reveal a rich line spectrum both in absorption and in emission with ultra-high excitation species present including O VIII, N V, possibly C V, Fe VI, Fe VII and numerous weaker high n, low l, transitions of C IV and O VI as well as the predominant He II (3 $\rightarrow$ n) and He II (Balmer α) absorption lines. There is a strong emission complex at 2981A which we identify primarily as three transitions of N V commonly seen in WN Wolf-Rayet spectra. We present evidence that high ionization species in emission (O VIII, N V, C IV, Si IV) and in absorption (He II, Fe VI, Fe VII) are *longward-shifted* relative to the far UV resonance (circumstellar) absorption lines by 25-50 km/s. Based upon the detected species, line velocities, line widths and emission features, we conclude that (1) KPD0005 is the very likely the evolutionary descendant of a WN-WC subluminous Wolf-Rayet progenitor and (2) has ongoing, possibly episodic, mass outflow.

If KPD0005 is the progeny of a post-AGB star which has suffered a late helium thermal pulse, then the nitrogen should have been rapidly destroyed in the triple-α runaway. Werner and Heber (1992) have recently summarized theoretical mechanisms (based upon work by Iben and Renzini) whereby nitrogen could survive this event. KPD0005 could indeed be a descendant of the WN-WC progenitor Abell 78 and PG1144+005 but at higher gravity. Thus the strong He II spectrum would be due to the surviving He from a late thermal pulse, which has diffused upward (and is possibly undergoing radiative acceleration leading to ejection), giving eventually a canonical DO photosphere. On the other hand, it cannot be ruled out that KPD0005 is an evolved, WN-WC Wolf-Rayet central star with its nebula no longer optically detectable, and which has left the AGB for the *first time*. It has not yet begun its re-trace of the AGB for the second time via a late He thermal pulse but is losing mass due to radiative or mechanical driving at a significant rate. This issue could be settled with NLTE modelling and wind analysis of the peculiar emission/absorption spectrum of KPD0005 along the lines of those advanced by the K. Werner and collaborators at Kiel.

This research was supported in part by NSF grant AST90-16289 to Villanova University.

References

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https://doi.org/10.1017/S0074180900172316 Published online by Cambridge University Press