DETECTION OF EVOLUTION OF THE NUCLEUS OF NGC 2392

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Abstract. Ultraviolet spectra taken with the IUE satellite indicate that the central star of the planetary nebula, NGC 2392, has declined in brightness by 7% per decade. We interpret this fading as a consequence of evolution toward higher temperature. With this interpretation, the rate of optical fading suggests that the stellar mass is 0.73 $M_{\odot}$.

Recently, two independent studies concluded that the nucleus of NGC 2392 is a relatively massive central star. From a non-LTE spectroscopic analysis, McCarthy *et al.* (1990) derived a stellar mass, $M = 0.77$ (+.10,-.03) $M_{\odot}$. In the second study, Pauldrach *et al.* (1988) showed that the anomalously low terminal velocity of the wind from the central star (V_{∞}=500 km s^{-1}, Heap 1986) can be matched by theoretical models only if the star has a mass as high as 0.87 ± 0.15 $M_{\odot}$.

Stars this massive should evolve to higher temperatures quite rapidly. Blöcker and Schönberner's (1990) evolutionary models indicate that the central star should increase in temperature by 243 °K per year if M=0.77 $M_{\odot}$ and 928 °K per year if M=0.87 $M_{\odot}$. Are such changes detectable by observation, and if so, how? Looking for direct signs of a temperature increase is a relatively coarse approach. A more sensitive test is optical fading. Since a central star evolves to higher temperatures at a constant bolometric luminosity, a larger fraction of its luminosity is emitted in the unobservable extreme ultraviolet, and a smaller fraction is emitted in the optical region of the spectrum.

Unfortunately, published estimates of stellar magnitude have been obtained in a variety of ways and are thus, not inter-comparable. Comparing ultraviolet fluxes measured by the IUE satellite is presently the most reliable way to detect optical fading in the central star of NGC 2392. The sensitivity of the short-wave spectrograph has been relatively stable and is well calibrated over its 14-year lifetime. IUE observations of NGC 2392 indicate that the flux from the central star has decreased by about 7% per decade in the wavelength interval, 1400-1900Å . The decline shows no significant wavelength dependence, which is to be expected, since this spectral region is on the Rayleigh-Jeans tail of the blackbody curve. The decline in apparent brightness over a decade corresponds to a 0.73 $M_{\odot}$ star.

References

Blöcker, T. & Schönberner, D. 1990 A & A, **240**, L11
Heap, S. R.: 1986 ESA SP-263, p. 291
McCarthy, J. *et al.*: 1990 Ap.J., **351**, 230
Pauldrach, A. *et al.*: 1988 A & A, **207**, 123