

IMAGING AND SPECTROSCOPY OF ABELL 63 (UU SGE)

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Abstract. UU Sge, the eclipsing binary central star (Bond et al, 1978) of the low-surface-brightness planetary nebula (PN) Abell 63, has been observed spectroscopically in the visible throughout its 11.2 hour period and especially during the minimum. A spectral determination of the binary system has been made. The primary hot central star is an 'O' type PN nucleus of temperature $\approx 40,000$ K, consistent with the low excitation of the nebular spectrum (e.g. no He II 4686Å nebular emission detected). From the spectrum at minimum light, the secondary star appears to be a cool dwarf star around G7. Measurement of the magnitude of the secondary during the eclipse of the primary enabled the distance to the PN to be directly determined as 3.6 kpc. For this distance the luminosity of the hot star is approximately $4320 L_{\odot}$, in good agreement with evolutionary tracks for (single) PN nuclei. Deep CCD images of Abell 63 show it has a 'butterfly' morphology implying that the close binary central system may have had a strong effect on the nebula shaping. The paper describing this work has been submitted (Walton et al, 1992).

The cool star : No strong features are seen in the dereddened spectrum of the secondary star at zero phase, but weak absorption at Ca II H and K, Fe I 4325Å, H γ , 5170Å (Mg I) and 5270Å (Ti II) is noted. Comparing with the Jacoby et al (1984) spectral library, the best fit to the secondary star spectrum is of a G7V spectrum with an uncertainty of three spectral subclasses. The dereddened V mag. of the secondary star (at zero phase), corrected for the hot star, is $m_v = 18.1 \pm 0.2$ mags. For an absolute mag., $M_v = 5.3$ for a G7V star (Lang 1992) the distance is 3.6 kpc (with uncertainty range of 2.9–5.0 kpc).

The hot star : The best fit N-LTE model atmosphere to the spectra of the primary together with IUE archive spectra, was of temperature 40 000 K, $\log g = 5.0$. The dereddened V mag. of the hot primary of UU Sge, corrected for the cool secondary, is $m_v = 13.56 \pm 0.10$ mags. The luminosity of the central star of Abell 63 is then $4320 L_{\odot}$ (with an uncertainty range of 2230–6610 L_{\odot}). The primary star is of spectral type 'O'. The location of the central star of Abell 63 on the H-R diagram, from comparison with theoretical single star evolutionary tracks (Schönberner, 1981), shows that it is consistent with the $0.6 M_{\odot}$ model track.

References

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