

WHY IS IC 4642 OF SUCH HIGH-EXCITATION CLASS?

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We have observed IC 4642 with the AAT and the IUE. It is of exceptionally high-excitation class, as judged by ratios such as He II/H β and (Ne V)/He II.

We compare IC 4642 with the high-excitation planetary NGC 7662. They are found to have similar chemical compositions and both have central stars with T_z (He II) \approx 113 000 K. Values of T_z (H I) are much smaller indicating that they are optically thin for H I. We assume similar nebular masses. The two stars are then found to have similar luminosities and the ratio of nebular radii is found to be $R(\text{IC } 4642)/R(\text{NGC } 7662) = 1.35$.

That IC 4642 is of higher excitation class than NGC 7662 can be explained as a consequence of the difference in radii. The optical depths $\tau(\nu)$ for photo-ionization of He II are estimated using observed strengths of He I and He II lines and the following results obtained:

	NGC 7662	IC 4642
Threshold for He II photo-ionization	23	2.5
" " Ne IV " "	4	0.4 .

In both nebulae most quanta beyond the He II threshold are absorbed; it follows that the He II/H β ratios are proportional to R^3 which explains the difference in observed ratios. Beyond the Ne IV threshold NGC 7662 remains optically thick in the He II continuum but IC 4642 becomes optically thin; in consequence more quanta are available for the ionization of Ne IV in IC 4642 and the Ne V/Ne IV ratio is much larger.