Wolf-Rayet Phenomena in Massive Stars and Starburst Galaxies
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A prominent Wolf-Rayet feature in a high-excitation H II region of NGC 4258

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Abstract. We report the observation of a prominent Wolf-Rayet feature in the high excitation H II region 74C (Courtés *et al.* 1993) of the spiral galaxy NGC 4258. In order to reproduce the observed He II λ4686 Å line luminosity, around 38 Wolf-Rayet stars in this region are needed.

Long-slit observations of eight H II regions in the spiral galaxy NGC 4258 were obtained with the 4.2-m *William Herschel Telescope* at the Roque de los Muchachos Observatory, using the ISIS double spectrograph. The region 74C was identified on the long-slit spectrum taken at position angle 133°. This region is located in the SE inner spiral arm of NGC 4258,with isophotal fractional radius: 0.5 (Oey & Kennicutt 1993), and X,Y center-offsets are +37″,–169″ (Courtés *et al.* 1993). Assuming a distance to NGC 4258 of 5.5 Mpc (Martin *et al.* 1989) and a constant extinction value through this region, $c(H\beta) = 0.48$ as derived from the Balmer and Paschen recombination lines, the total luminosity of the broad He II feature, without the contribution of the [FeIII] λ4658 Å line, is $(1.1 \pm 0.1) \times 10^{38}$ erg s^{-1}. This comprises the broad features of both N III $\lambda\lambda$4634,4640 Å and He II λ4686 Å. Assuming the contribution of the N III lines to the WR bump to represent 0.4 times the total emission (Terlevich *et al.* 1996), we obtain for the He II line luminosity: $L(\text{He II } \lambda4686) = (6.6 \pm 0.6) \times 10^{37}$ erg s^{-1}. The non-detection of N V $\lambda\lambda$4604,4620 Å suggests that the WR stars are of late N or intermediate type. Using the calibration of Vacca & Conti (1992), we find 38 ± 5 WN stars in this region.

The presence of these stars could lead to large temperature fluctuations through the nebula (Pérez 1997). It has been possible to measure the weak auroral [SIII] λ6312 Å line which, together with the observed intensities of the nebular lines at $\lambda\lambda$9069,9532 Å, can be used to obtain a value for the electron temperature. A value of 8600 ± 400 K is found. On the other hand, a value of 8000 ± 700 K is found by measuring the Paschen discontinuity at 8200 Å, which agrees with that derived from the [SIII] lines within the errors. Therefore, we can conclude that, despite the presence of WR stars, no important temperature fluctuations exist in this region.

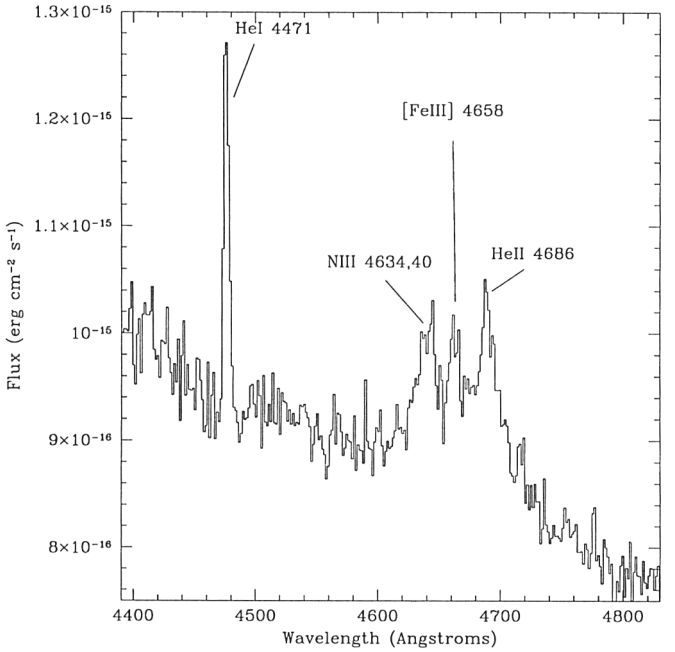

Figure 1. The Wolf-Rayet bump in the region 74C of NGC 4258

Finally, we have used single star (N-LTE Mihalas stellar atmospheres) photo-ionization models to constrain the mean effective temperature of the ionizing stars in this region. Consistency is found for effective temperatures of around 35 000 K. So, the presence of these stars does not seem to imply a hardening of the ionizing radiation. A quantitative analysis of the number ratio of O- to WR-type stars found is in progress, to test different stellar evolution models.

References

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