A Massive Star Odyssey, from Main Sequence to Supernova
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Wolf-Rayet stars at 1 - 2 Mpc

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Abstract. We present new narrow-band imaging and optical spectroscopy of Wolf-Rayet stars in the Local Group dwarf galaxy IC 10 (Gemini-N- GMOS) and Sculptor group spiral galaxy NGC 300 (VLT FORS2).

1. Gemini-N-GMOS observations of IC 10

IC 10 is a moderately reddened dwarf irregular (or blue compact dwarf) at a distance of ~ 0.9 Mpc, with a metal content of $\log(O/H) \leq 8.2$ and an unusually high WC/WN number ratio of 2, *vs.* < 0.1 in the SMC (*e.g.*, Massey & Armandroff 1995). In the light of recent suggestions that IC 10 also hosts WC9 stars (Royer *et al.* 2001), hitherto known only towards our Galactic Centre, we have obtained spectroscopy of candidate WR stars in IC 10, using GMOS mounted at Gemini-N during 2001 December - 2002 January. Together with recent CFHT-MOS spectroscopy from 2001 October, we have spectroscopically observed 28 - 30 WR candidates in IC 10, confirming 15 WC stars and 9 WN stars, such that the WC/WN ratio remains remarkably high. All of the WC stars have spectral type WC4, except for IC10-WR10 (Massey & Armandroff 1995) which has a WC7 spectral type, and unusually broad line widths, ~ 3000 km s^{-1} (but see Galactic equivalent WR 140, Williams *et al.* 1990). None of the three candidate WC9 stars are confirmed as genuine WR stars.

IC 10 is thought to have undergone a starburst ~ 5 Myr ago. This would explain the observed WC/WN ratio, but not the spatial location of the WR population, since four isolated WC stars lie at least 600 pc from the centre. Alternatively, IC 10 may have an anomalously flat initial mass function (IMF) amongst massive stars. However, given that no compelling evidence exists for such peculiarities, where IMF's have previously been surveyed in Local Group galaxies, this seems unlikely. Most probably, the total WR population of IC 10 has not yet been uncovered, with previous surveys preferentially favouring the detection of WC stars, due to their higher line fluxes, such that the total WN content is much greater than the current total of nine. Nevertheless, it seems unlikely that the WC/WN ratio of IC 10 will match the SMC, thus requiring a further 150 WN stars to be discovered!

2. VLT-FORS2 observations of NGC 300

NGC 300 is widely regarded as the Sculptor group's counterpart to M 33, lying a factor of three times more remote at ~ 2 Mpc. Previous surveys for WR stars have generally focused on its associations, revealing just 25 WR stars/candidates, in contrast with over 140 confirmed WR stars in M 33 (Massey & Johnson 1998). In order to search for additional WR candidates in NGC 300, we have obtained VLT-FORS2 He II ($\lambda_c = 4684$Å) and off-He II ($\lambda_c = 4781$Å) images in 2000 September, each with FWHM $\simeq 67$Å. A total of 58 WR candidates were identified with He II $\lambda4686$ excesses of 0.1 - 3.5 mag, of which 17 have previously been positively identified as WR stars (*e.g.*, Schild & Testor 1992; Breysacher *et al.* 1997). Including two previously known WR stars from outside the $6.8' \times 6.8'$ central field studied, plus 4 for which we obtained confirmatory spectroscopy with FORS2, a total of 61 WR candidates have been identified, comprising 13 confirmed WC stars and 10 WN's. Our sample includes the WN11 star B-16 in NGC 300, serendipitously discovered by Bresolin *et al.* (2002). Candidate WR continuum magnitudes, $m_{\lambda4781}$, lie in the range 17.9 - 23.6 mag. For typical extinctions towards NGC 300 of $E_{B-V} = 0.2$, we consider our survey to be complete for $M_{\lambda4781} > -3.6$ mag. From an inspection of the He II $\lambda4686$ excess *vs.* $m_{\lambda4781}$, we tentatively suggest a WC/WN ratio of $\sim 1/3$ for NGC 300 for $\rho/\rho_0 \leq 0.5$ where ρ/ρ_0 is the de-projected distance from the nucleus as a fraction of the Holmberg radius, corresponding to a metal content of $8.6 \leq \log(O/H) \leq 8.9$. For comparison, WC/WN = 0.6 - 0.7 for the inner regions of M 33, covering a similar metallicity range (Massey & Johnson 1998). Firmer conclusions await confirmatory spectroscopy. Given that the outer LMC-metallicity spiral arms of NGC 300 have not yet been deeply surveyed, we suspect that its total WR stellar content is higher still.

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