A Massive Star Odyssey, from Main Sequence to Supernova
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Classification of Wolf-Rayet stars in NGC 595 in M 33 through high-spatial resolution observations

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Abstract. NGC 595 is, after NGC 604, the second most luminous H II region in the Milky Way's neighbouring spiral galaxy M 33. Its Wolf-Rayet star content has mainly been unveiled by two different channels. On the one hand, the stellar population of NGC 595 has been resolved and its WR stars identified through on-line/off-line He II λ4686 observations realised with the *HST*. Nevertheless, due to the limited number of filters used, this did not give any information on the WR spectral subtypes. On the other hand, spectroscopic observations of NGC 595, realised at optical and ultraviolet wavelengths, have enabled the determination of some spectral subtypes, but this time, the lack of angular resolution did not allow to resolve the whole population. Thanks to our photometric technique, based on five dedicated narrow-band filters, we present here a determination of the spectral subtypes of NGC 595 WR stars which for the first time combines high-angular resolution and high-'spectroscopic' discrimination capabilities.

1. Introduction

There is now scant, though growing evidence that the evolution of Wolf-Rayet stars is strongly dependent on environmental parameters. Among these, metallicity is certainly critical, but it is not the only active parameter (*e.g.*, Massey & Johnson 1998, hereafter MJ98). Disentangling environmental effects from evolutionary effects is nevertheless very difficult to achieve, since it requires large, uniform and complete samples of WR stars to be observed, covering a great variety of environments, where complete not only means that all WR stars have to be unveiled, but also that detailed spectroscopic classification is needed. There is currently no such sample available. This is partly due to the surveying techniques used up to now: either two or three passbands on-/off-line photometry, limited to the WN/WC spectral types, or slitless spectroscopy, limited in spatial resolution, hence poorly constraining the WR population of the densest clusters, where these stars often reside. To overcome these difficulties, we have defined a five-filter narrow-band photometric system dedicated to these WR populations studies. This is discussed in detail in Royer, Vreux & Manfroid (1998). We present here observations of NGC 595 realised with this photometric system.

Table 1. Spectral types of the WR stars in our field around NGC 595. The two first columns refer to names and spectral types published by MJ98; the third column gives the spectral types, determined here with DAOPHOT. The notation '(w?)' in the third column indicates that, if these objects are single systems, they have relatively weak emission lines.

WR	spectral type MJ98	this work	WR	spectral type MJ98	this work
M 33-WR 38	WC5-6	WCE	M 33-WR 51	WNL	WN8
M 33-WR 41	WNL	WNE(w?)	M 33-WR 52	WC	WCE
M 33-WR 42	WNL	WN7	M 33-WR 61	WC4-5	WCE
M 33-WR 43	WNL	WN7-8	M 33-WR 64	WN	WNE
M 33-WR 44	WNL?	non-WR	M 33-WR 65	WC	WCE
M 33-WR 45	WC	WCE	M 33-WR 68	WN	WNE(w?)
M 33-WR 46	WN	WNE	M 33-WR 69	WC6-7	WCE
M 33-WR 48	WN	WNE(w?)	M 33-WR 70	WN	WN8
M 33-WR 49	WNL	WN8	M 33-WR 47	WNL	D 2AB WNE D 9 WN

2. Discussion

The observations were performed with the Nordic Optical Telescope in September and November 1998 (Royer, Lundstrom & Vreux 2002). NGC 595 is known to harbour 11 WR stars and our field around it another 10. These WR stars have mainly been unveiled in two different ways. On the one hand, the stellar population of NGC 595 has been resolved and its WR stars identified through on-/off-line He II λ4686 *HST* observations (Drissen, Moffat & Shara 1993). Nevertheless, due to the use of only one narrow-band filter, this did not give any information on the spectral subtypes. On the other hand, spectroscopic observations of NGC 595 have enabled the determination of some spectral subtypes, but this time, the lack of angular resolution did not allow to resolve the whole population (MJ98 and references therein). Table 1 shows the results of our photometry, obtained with the classical PSF fitting algorithm DAOPHOT. Improved spectral subtypes are provided for nearly all WR stars in the field. Also noteworthy is the spatial resolution of M 33-WR 47 in two of its WR components: Object 9 (noted D 9, the numeration is from Drissen *et al.* 1993), and Objects 2A and 2B together (D 2AB). Object 11 of Drissen *et al.* didn't show emission lines in our photometry. This is due to the extreme crowding around it, since this object could be resolved, identified as a WR star and receive a spectral subtype thanks to image deconvolution (Royer *et al.* 2002).

References

Drissen, L., Moffat, A.F.J., Shara, M.M. 1993, AJ 105, 1400
Massey, P., Johnson, O. 1998, ApJ 505, 793 (MJ98)
Royer, P., Vreux, J.-M., Manfroid, J., 1998, A&AS 130, 407
Royer, P., Lundström, I., Vreux, J.-M., 2002 in preparation

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