Wolf-Rayet Stars
W.-R. Hamann, A. Sander, H. Todt, eds.
Potsdam: Univ.-Verlag, 2015
URL: http://nbn-resolving.de/urn:nbn:de:kobv:517-opus4-84268

A not so massive cluster hosting a very massive star

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We present the first physical characterization of the young open cluster VVV CL041. We spectroscopically observed the cluster main-sequence stellar population and a very-massive star candidate: WR62-2. CMFGEN modelling to our near-infrared spectra indicates that WR62-2 is a very luminous ($10^{6.4\pm0.2} L_\odot$) and massive ($\sim 80 M_\odot$) star.

The current census of Wolf-Rayet (WR) in the Milky Way is far from complete. For example, there are ∼640 WR stars reported in the online "Galactic Wolf Rayet Catalogue", but we expect over 1900 in our Galaxy (Rosslowe & Crowther 2015). It is also under debate the WR birth-place. We expect their formation in clustered environments, but it is unclear whether it happens in young clusters or associations. Trying to solve this question, we started a search of WR in the cluster candidates catalogue from Borissova et al. (2011), based on images from the ESO Public Survey VVV (Minniti et al. 2010).

Using VVV JHK_S photometry and H-, K-band spectroscopy we determine the cluster distance (via spectroscopic parallax; $d = 4.2 \pm 0.9$ kpc), radius ($r = 0.75'$), age (fitting Geneve-MS and PMS isochrones, Ekström et al. 2012; Siess et al. 2000; age=$1-5$ Myr), and total stellar mass (by integration of Kroupa-IMF, Kroupa 2001, fitted to the cluster mass function; $M_{CL} = (3.1 \pm 0.6) \cdot 10^3 M_\odot$).

The near-IR spectra also revealed part of the cluster main sequence population. We observe 8 stars, and we classify 6 of them as OB-type stars (between O4 V and early B-type). Spectrum of star #8, the brightest star in the decontaminated CMD, displays the Brackett series with strong and broad emission lines. The C IV and N III lines are clearly detected. The Brackett series in emission indicates that hydrogen is still present. Carbon lines are narrow and weak, confirming that it is not a WC. We assigned a spectral type WN8-9h to star #8 (hereafter, WR62-2).

Using the code CMFGEN (Hillier & Miller 1998), we estimate for WR62-2 the effective temperature ($T_{\rm eff} = 34000K$), which indicates a luminosity of ($10^{6.4\pm0.2} L_\odot$) and a initial mass of at least $80 M_\odot$, from the star position in the HR-diagram. The cluster and WR62-2 masses are incompatible with the ($M_{\rm ecl} - m_{\rm max}$) relation (Weidner et al. 2010). A binary merge is a probable mechanism to explain the presence of this very massive star in VVV CL041 and a gas remnant surrounding WR62-2 should be expected in mid-IR.

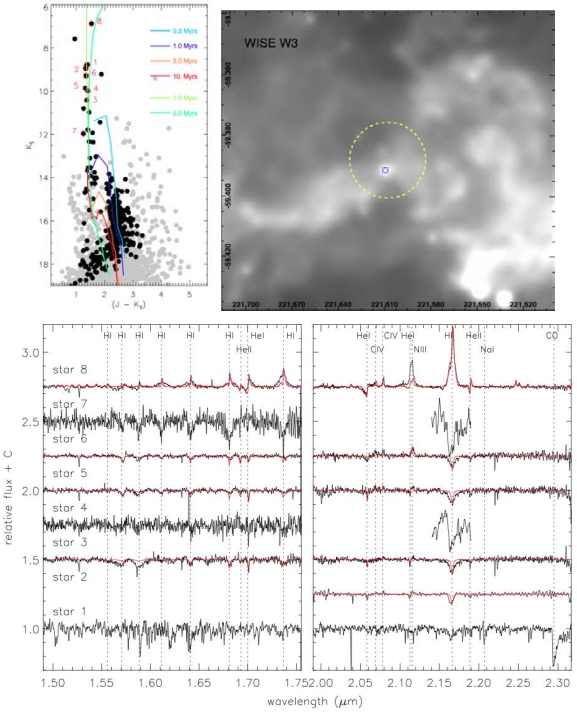

Fig. 1: *Top-left:* VVV CL041 field-star statistically decontaminated CMD. WR62-2 is shown on top of the cluster stellar population sequence. *Top-right:* VVV CL041 mid-IR WISE W3 image. The yellow circle and the blue square show the cluster's and WR62-2 positions. *Bottom:* Near-IR stellar spectra (WR62-2 is shown on top). The CMFGEN models are shown with red lines.

References

Borissova, J., Bonatto, C., Kurtev, R., et al. 2011, A&A, 532, A131
Ekström, S., Georgy, C., Eggenberger, P., et al. 2012, A&A, 537, A146
Hillier, D. J. & Miller, D. L. 1998, ApJ, 496, 407
Kroupa, P. 2001, MNRAS, 322, 231
Minniti, D., Lucas, P. W., Emerson, J. P., et al. 2010, New A, 15, 433
Rosslowe, C. K. & Crowther, P. A. 2015, MNRAS, 447, 2322
Siess, L., Dufour, E., & Forestini, M. 2000, A&A, 358, 593
Weidner, C., Kroupa, P., & Bonnell, I. A. D. 2010, MNRAS, 401, 275