Formation, evolution, and survival of massive star clusters
Proceedings IAU Symposium No. 316, 2015
C. Charbonnel & A. Nota, eds.

doi:10.1017/S1743921316008747

A starburst region around $l = 347° - 350°$

A. Marco[1], I. Negueruela[1], M. Monguió[1], C. González-Fernández[2], J. Maíz Apellániz[3], R. Dorda[1] and J. S. Clark[4]

[1]Departamento de Física, Ingeniería de Sistemas y Teoría de la Señal. Escuela Politécnica Superior. University of Alicante. Apdo.99 E-03080. Alicante, Spain
email: amparo.marco@ua.es

[2]Institute of Astronomy, University of Cambridge, Madingley Road, Cambridge CB3 0HA, United Kingdom

[3]Centro de Astrobiología, CSIC-INTA, campus ESAC, apartado postal 78, 28 691 Villanueva de la Cañada, Madrid, Spain

[4]Department of Physics and Astronomy, The Open University, Walton Hall, Milton Keynes, MK7 6AA, United Kingdom

Abstract. Very recently, a number of obscured massive open clusters have been identified in the Milky Way. A very significant fraction of them lie either close to the base of the Scutum Arm or towards Galactic longitude of 350°. We are studying these clusters and their neighbourhoods, finding very good evidence for a major starburst region close to the near tip of the Galactic Long Bar.

Keywords. open cluster and associations:VdBH 222 and Teutsch 85, supergiant, Galactic structure

1. Introduction

In the past few years, several clusters with masses around or above 10 000 $M_\odot$ have been discovered in the Milky Way. Clusters rich in red supergiants (RSGs) cover the age range 10 - 25 Ma, while younger clusters are mostly signposted by OB supergiants (SGs), which are much fainter in the infrared, and so, more difficult to detect through the Galactic plane extinction. The clusters rich in RSGs are concentrated towards $l = 26° - 28°$, including two large associations, one connected to Stephenson 2 and the other one to RSGC 3 (Negueruela *et al.* (2011), Negueruela *et al.* (2012) and González-Fernández & Negueruela (2012)). We are currently studying whether these two associations (with an estimated distance of $\sim$ 6 kpc) are separate or part of a single structure. Large-scale star formation there has been confirmed by the parallax distance of 5.5 kpc to the giant star-forming complex W43 (Zhang *et al.* (2014)).

Towards the other tip of the Long Bar, distances are much more difficult to measure. We have found a gap in the extinction towards $l = 350°$, where we find two massive clusters, VdBH 222 and Teutsch 85, in an association containing $\sim$ 50 RSGs. Although our knowledge of Galactic structure seemed to favour a location close to the far end of the Bar, our ongoing spectroscopic studies rule out such a long distance. Even so, these clusters are excellent laboratories for stellar astrophysics, providing a unique opportunity to check the relative fraction of RSGs to blue SGs (BSGs). On average, BSGs outnumber RSGs by a factor $\sim$ 3 in Galactic open clusters (Eggenberger *et al.* (2002)).

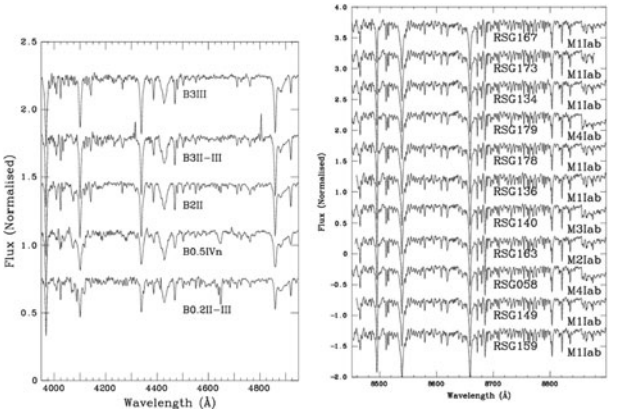

Figure 1. Left. Spectra of the brightest blue members of VdBH 222 and Right. Spectra of red supergiants in and around the open cluster Teutsch 85

2. Results

2.1. *The open cluster VdBH 222*

VdBH 222 ($l = 349.13°$; $b = -00.44°$) is a young massive cluster with a likely mass greater than 10 000 $M_{\odot}$. Its population of massive evolved stars is comparable to that of large associations, such as Per OB1. Marco *et al.* (2014) identified a large population of luminous cool SGs confirmed as cluster members via radial velocity measurements. They found nine RSGs (plus one other candidate) and two yellow SGs and a large population of OB stars. Ten of them are bright enough to be BSGs. The cluster lies behind ~ 7.5 mag of extinction for the preferred value of $R_V = 2.9$. Isochrone fitting allows a narrow range of ages between 12 and 18 Ma. The cluster radial velocity is compatible with distances of ~ 6 and ~ 10 kpc. To characterize with more precision the population of OB stars and limit the value of R_V, we took spectra of the stars in the upper main sequence with FORS2 at the UT1 in the Paranal Observatory in June 2015. These new data place the open cluster at ~ 6 kpc with an age around 18–20 Ma. We found no BSGs (see Fig. 1), against a complement of 2 yellow and 10 red SGs. This result is at odds with the statistics mentioned above.

2.2. *The open cluster Teutsch 85*

The second open cluster in this starburst region is Teutsch 85. It is located 1.8° (190 pc at 6 kpc) away from VdBH 222. We have identified ~ 14 RSGs with similar radial velocities within 7′ of the cluster center an important number of RSGs with approximately the same radial velocities in the region connecting the two clusters (see Fig. 1). We are analyzing deep $UBVR$ photometry and FORS2 spectroscopy of this cluster. Based on a preliminary analysis it seems to have an age of $25 - 30$ Ma, but only one or two BSGs against 14 RSGs. This result is again at odds with the statistics for the Milky Way.

References

Marco, A., Negueruela, I., González-Fernández, C., *et al.* 2014 *A&A*, 567, A73
Eggenberger, P., Meynet, G., & Maeder, A. 2002, *A&A*, 386, 576
Zhang, B., Moscadelli, L., & Sato, M., Reid M. J., *et al.* 2014, *ApJ*, 781, A89
Negueruela, I., González-Fernández, C.; Marco, A., & Clark, J. S. 2011, *A&A*, 528, A59
Negueruela, I., Marco, A., González-Fernández, C., *et al.* 2012 *A&A*, 547, A15
González-Fernández, C. & Negueruela, I. 2012 *A&A*, 539, A100

https://doi.org/10.1017/S1743921316008747 Published online by Cambridge University Press