Massive Stars Near and Far
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An exploration of Cygnus OB2 and perspectives for the upcoming WEAVE High-Resolution Cygnus Survey

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Abstract. During the last years we have carried out different studies in the Cygnus OB2 association based on new spectroscopic data and benefiting from the unprecedented Gaia astrometry. They include membership, chemical and structure studies, that allowed us to discern for the first time ever between two stellar groups separated by several hundred parsecs within the association and find at least two star-forming bursts at $\sim$3 and $\sim$5 Myr. Using these studies as a template and combining upcoming spectroscopic WEAVE data and the expected accuracy that Gaia will reach in the Cygnus-X area (DR3 and forthcoming releases), we will be able to perform the deepest multi-dimensional study ever done before in a massive star-forming complex. The results of this project will lead to an important improvement of our knowledge of star formation and evolution of star-forming regions and clusters, including our understanding of the dynamics and kinematics of OB associations and stellar groups.

Keywords. stars: massive – stars: early-type – stars: abundances – stars: fundamental parameters – open clusters and associations: individual: Cygnus-X

1. Previously in Cygnus OB2

The Cygnus-X complex represents the most powerful star-forming region at less than 2 kpc from us (Schneider et al. 2006). Its core, Cygnus OB2, contains nearly 100 O-stars (Knödlseder 2000) and can be used as a laboratory for massive star evolution and a proxy for massive clusters. Its distance allows observations at all wavelengths and accurate Gaia measurements. During the last years we have carried out different studies in the Cygnus OB2 association based on new spectroscopic data and benefiting from the unprecedented Gaia astrometry. We have (I) updated the Cygnus OB2 massive OB-star census (Berlanas et al. 2018a); (II) looked for self-enrichment processes and studied the implications of its abundance gradient (Berlanas et al. 2018b); (III) performed the first study of its spatial substructure using Gaia DR2 data (Berlanas et al. 2019); (IV) combined the DR2 data with our spectroscopic analyses to determine the main stellar parameters of the O-type population and explore the recent star formation history (Berlanas et al. 2020).

Figure 1. All-sky Milky Way map as seen by GALACTICA (Astroaula Project, IAC). Yellow and red lines indicate the Galactic plane LoRes and the Cygnus HiRes areas covered by WEAVE, respectively.

2. Coming soon

WEAVE is the next multi-object spectrograph at the 4.2m William Herschel Telescope, whose first light is planned for early summer 2022. It will provide high-quality spectra over the coming years for thousands of massive stars in the Galactic plane (LoRes Survey, R=5000) and, specifically, in several rich Cygnus OB associations (HiRes Survey, R=20000, S/N $>$ 120, see Fig. 1). The HiRes Cygnus project is driven by the study of the massive star population of Cygnus-X to explore different scenarios of single and massive star formation and evolution. Our aim is to secure high S/N massive star spectra at the highest WEAVE resolution in the star-forming Cygnus region to:

- obtain rotational velocities and their distributions, focusing on the low vsini region.
- determine binary fractions and stellar multiplicity.
- determine accurate stellar parameters, particularly gravity, improving those obtained from the LoRes survey and allowing more accurate radii and masses with the help of Gaia.
- obtain accurate abundances and spatial abundance patterns for O3-B9 stars in the region for targets with 11$<$B$<$16.5.
- determine the kinematical and dynamical status of the stars in the region, checking individual proper motions in order to identify runaway stars or co-moving stellar groups.

Using the studies presented in Sect. 1 as a template and combining upcoming spectroscopic WEAVE data and the expected accuracy that Gaia will reach in the Cygnus-X area (DR3 and forthcoming releases) we will be able to perform the deepest multi-dimensional study ever done before in a massive star-forming complex. Thanks to its close distance, Gaia will provide a complete 3D dynamical plus a 3D spatial picture of the region, being the first time ever we can obtain such a precise spatial resolution along the line of sight for any of the main massive star-forming regions in the Milky Way.

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Supplementary material

To view supplementary material for this article, please visit http://dx.doi.org/10.1017/S1743921322002484.

References

Berlanas, S. R., Herrero, A., Comerón, F., Pasquali, A., Bertelli Motta, C., & Sota, A. 2018a, A&A, 612, A50

Berlanas, S. R., Herrero, A., Comerón, F., Simón-Díaz, S., Cerviño, M., & Pasquali, A. 2018b, A&A, 620, A56
Berlanas, S. R., Wright, N. J., Herrero, A., Drew, J. E., & Lennon, D. J. 2019, MNRAS, 484, 1838
Berlanas, S. R., et al. 2020, A&A, 642, A168
Knödlseder, J. 2000, A&A, 360, 539
Schneider, N., Bontemps, S., Simon, R., Jakob, H., Motte, F., Miller, M., Kramer, C., & Stutzki, J. 2006, A&A, 458, 855