An exploration of Cygnus OB2 and perspectives for the upcoming WEAVE High-Resolution Cygnus Survey

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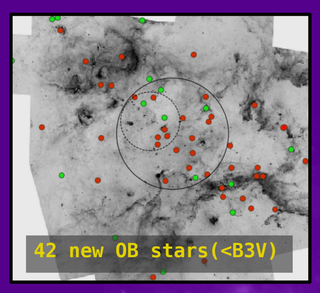
Previously in Cygnus OB2

The Cygnus-X complex represents the most powerful star-forming region at less than 2 kpc from us. Its core, Cygnus OB2, contains nearly 100 O-stars 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).

COMPLETING THE CENSUS OF OB MEMBERS

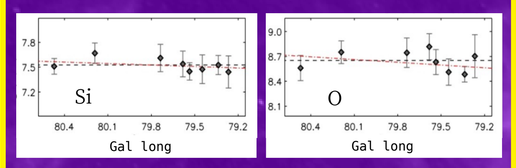


The age distribution suggests that **massive star formation has proceeded from lower to higher Galactic long** from Cygnus OB9, continuing in the southern part of Cyg OB2 and increasing in its northern part.

LOOKING FOR SELF-ENRICHMENT

Could the correlation between ages and Galactic longitudes be associated with a chemical composition gradient?

(that could evidence star formation from self-enrichment processes)

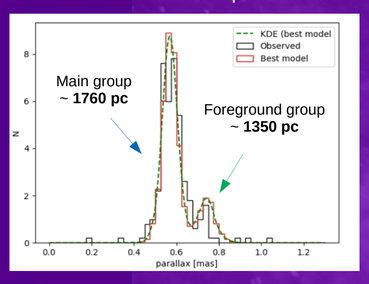


but ..

The effect of self-enrichment by stellar winds and SNe is small enough to be beyond the accuracy of our analyses. We need to extend the sample and/or increase the quality of the spectra.

EXPLORING THE PARALLAX DISTRIBUTION

Gaia DR2 + MCMC sampler *emcee*



We find **two stellar groups** superposed in Cygnus OB2 but **separated by ~400 pc.**

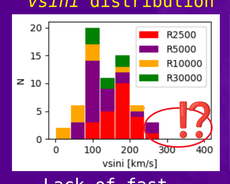
Yellow points indicate the blue massive star candidates based on Gaia, 2MASS and IGAPS selection criteria.

Circles are the WEAVE pointings or tiles (for some of them, we foresee two different fiber configurations). Each fiber configuration will be observed between 10 and 13 times, allowing for high S/N and **multiepoch** information.

Other targets like RSGs, B-A-F stars or ISM will be added.

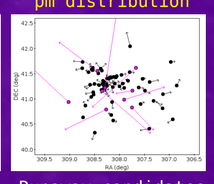
DETERMINING THE MAIN STELLAR PARAMETERS

vsini distribution



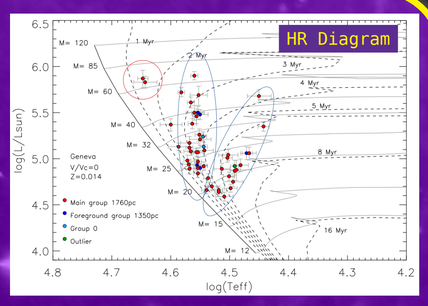
Lack of fast rotators

pm distribution



Runaway candidates

From spectroscopic parameters and Gaia distances we find star formation during the last 1–6 Myr, with **two main bursts centred at ~3 and ~5 Myr.**

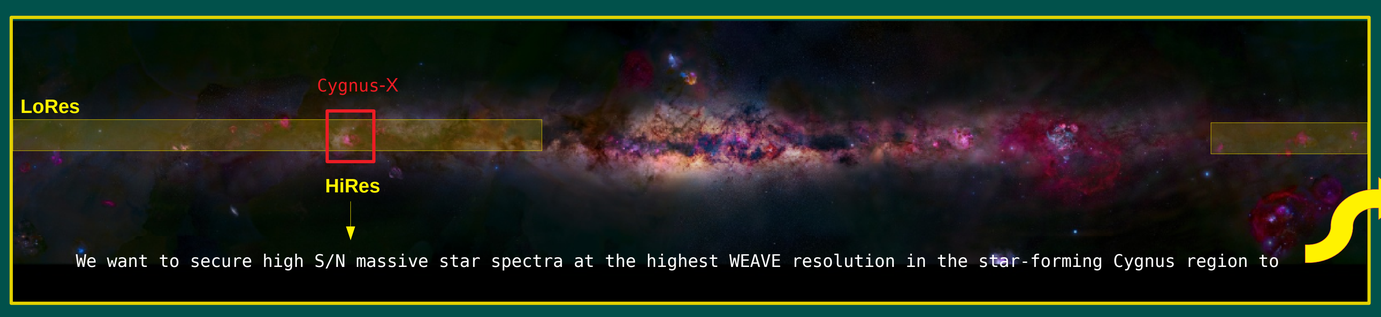


A third smaller group of stars at ~1.5 Myr containing the hottest stars of our sample may be products of fast rotation evolution or mergers after binary interaction.

Coming soon.. The WEAVE HiRes Cygnus Survey

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 northern Galactic plane (**LoRes Survey, R=5000**) and, specifically, in several rich Cygnus OB associations (**HiRes Survey, R=20000, S/N > 120**).

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.



- Obtain **rotational velocities** and their distributions, especially in the low vsini region (< 100 km/s)
- Determine binary fractions and **stellar multiplicity** (multiepoch!)
- Determine accurate **stellar parameters**, particularly gravity, improving those obtained from the LR survey and allowing more precise radii and masses with the help of Gaia data
- 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 dynamica**l status of the stars in the region
- But OB stars are not the only targets: We will include BAF stars (age extensión, ZAMS anchor point, kinematics, dynamics, structure), BA stars (TAMS characteristics), PMS and YSO (kinematics, star formation activity), ISM (abundances, kinematics), Individual targets (Cepheids, WDs, RSGs)

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.

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