Spectroscopic and kinematic study of blue and red supergiants in Per OB1

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We aim to perform a complete empirical characterization of the (massive) blue- and red-supergiant star population of Per OB1 using modern high resolution multi-epoch spectroscopy complemented with data about parallaxes and proper motions provided by the Gaia mission. In this contribution we describe the sample of stars under study and investigate its membership and kinematics, including the detection of binaries and runaway stars.

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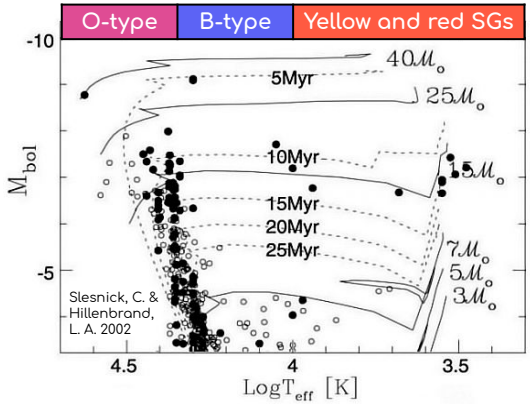
Content:

Importance of Massive Stars → Understanding their properties and evolution is crucial for our understanding of the Universe. →

- Impact in star forming regions
- Chemical enrichment ISM
- Extragalactic studies
- Testing evolutionary models

Most massive stars are within or linked to young open clusters and OB associations. Therefore, these stellar groupings are perfect laboratories for their study.

The Perseus OB1 association, in the Milky Way, is a region of great interest for the investigation of stellar evolution in massive stars thanks to the combination of the presence of a large number of massive stars in different evolutionary stages, its relative proximity, and low extinction.



Despite all the information we have, we still lack a complete homogeneous empirical characterization of the full sample of massive stars, taking also into account environmental and kinematic information.

- Age: 13 - 14 Myrs
- Distance: 2.2 - 2.5 Kpc
- Av: 1.0 - 2.7

Goal: to use this unique group of stars to step forward in our understanding of massive star evolution, also dealing with some long-standing and new open questions in the field of stellar physics.

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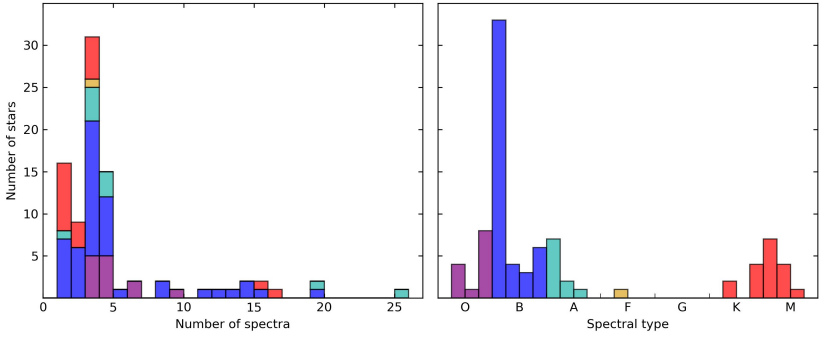
Methodology:

- We perform a bibliographic search of **suitable candidates around** 4.5° from the center of **Per OB1**:
  Humphreys 1978; Garmany & Stencel 1992; Currie et. al. 2010; Gazak et al. 2014,+
- We gather a total of 405 high resolution multi-epoch spectra for **88** of them.
- We compile astrometric/photometric data from Gaia DR2 for all the stars in the sample.
- We looked into individual spectra and the radial velocity curves to find SB1/SB2 binaries.
- We establish a criteria for membership based on:
  - The Gaia parallaxes and proper motions.
  - High precision radial velocity estimations.
- We searched for general properties of Per OB1:
  - Distance, sub-groups, runaways...

FIES NOT HERMES Mercator

We took special care to not mix up with their intrinsic variability due to pulsations, which was also analyzed for each spectral type.



We took into account:

- The reliability of Gaia astrometry by via RUWE parameter
- Reliability of parallax in the case of RSGs due to their large size and different local brightness

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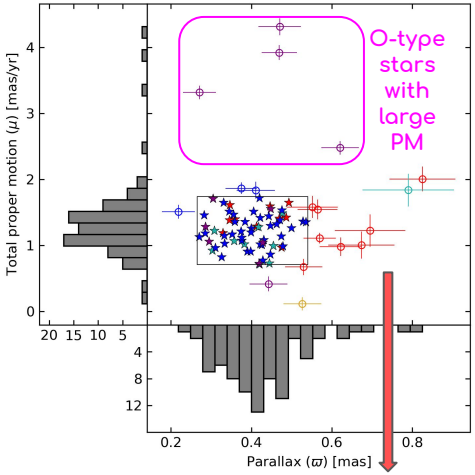
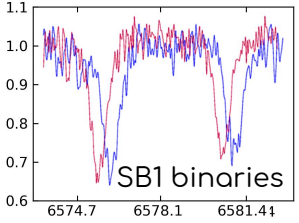
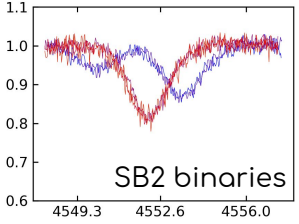
Results:

Parallax: 0.40 ± 0.07 mas
Total proper motion: 1.22 ± 0.26 mas/yr



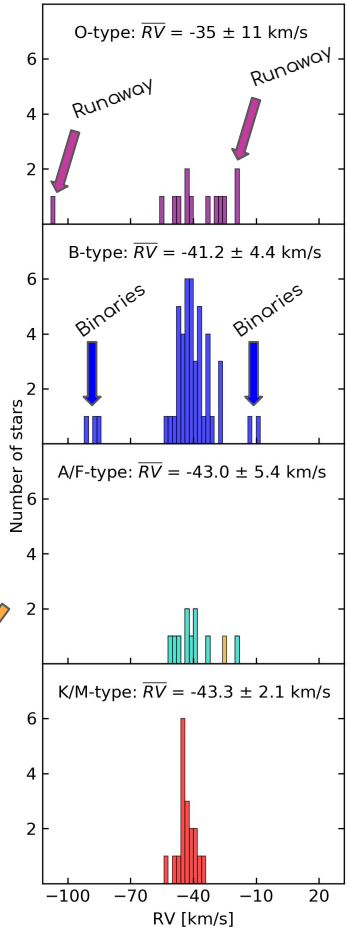


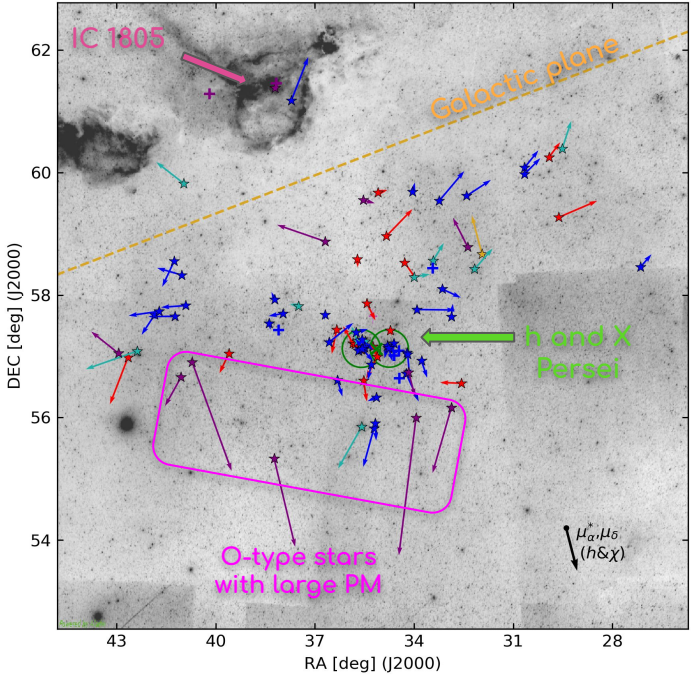


M-type parallaxes affected by their large sizes and inhomogeneities

Intrinsic variability due to pulsations decreases with SpT

Radial velocities:





Sample of stars in the sky

- Proper motions respect to h and χ Persei.
- Distances and proper motions from the center of the double cluster are compatible.
- Some O-type stars are dynamically separated.
- Stars in IC 1805 likely have a different history.

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Results:

We determined **membership** to the association for our sample of 88 stars:

- We found 67 members, 10 potential members, and another seven member candidates that require further investigation.
- In total we obtain 84 members and four non-members that belong to IC 1805

We found 29 confirmed/potential **binaries**:

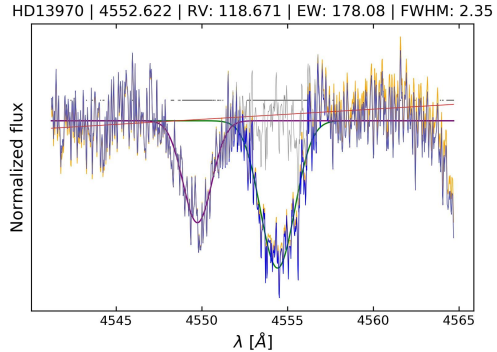
- Five correspond to SB1 and five to SB2. Of those, four are NEW binaries.
- Up to 19 potential SB1 ⟵ Their variation could be due to long period variability

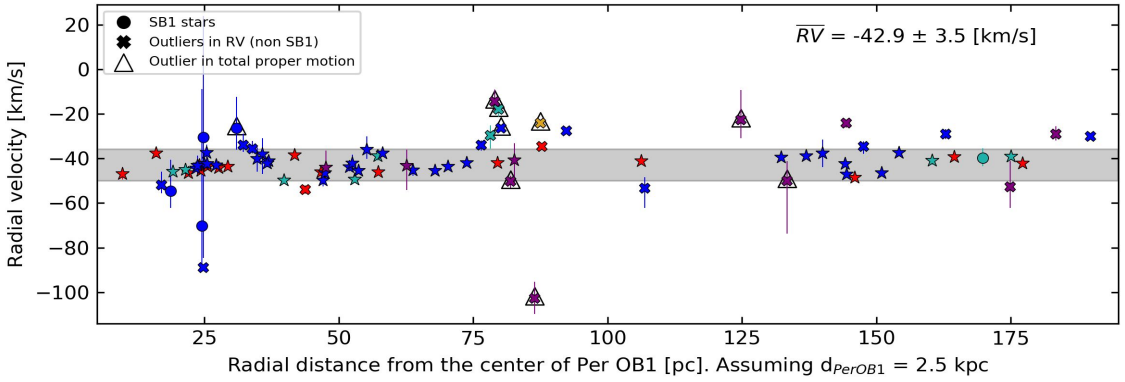
We also found three binaries in the literature

By looking at the **kinematics** we found:

- A total of 18 **confirmed/potential** runaways
- A distance between: 2.3 to 2.5 kpc
- Mean radial velocity of: -42.9 ± 3.5 km/s
- No RV gradient with distance to the center

Individual components from SB2





Prospects for the future:

- First step achieved to complete an homogeneous empirical characterization of the massive population of Per OB1.
- We have proved that the majority studied population belongs to the same dynamical group.
- The results from this study will be used for the interpretation of the next upcoming work, which will be focused in the full quantitative spectroscopic analysis of the found members.
- The results will be confronted with the predictions of evolutionary models.

We will try to complete the sample with missing massive stars found in the literature.

We will also benefit from the Gaia DR3 improved astrometric data.

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