Clustering properties of Herbig Ae/Be stars

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Abstract We study Herbig Ae/Be (HAeBe) stars which are optically visible pre-main sequence stars of intermediate-mass. They represent the most massive objects to experience an optically visible pre-main sequence phase, bridging the gap between low- and high-mass stars. Building on the ideas from Testi et al. (1997, 1998, 1999), we are investigating the presence of clusters around previously known and newly discovered intermediate-mass pre-main sequence HAeBe stars with the detailed astrometric data offered by Gaia. This will enable us to determine the position of the HAeBe stars in the HR diagram and allow us to detect and confirm the presence of the clusters around them. In the poster, we outline the preliminary results obtained with Gaia DR2 through the algorithm we developed for the detection and analysis of the clusters and clustering properties of the HAeBe stars.

Do HAeBe stars form in clusters?

Testi et al. (1997, 1998, 1999) analyzed the occurrence of young stellar clusters around HAeBe stars from near-infrared images. As a first sample, we took their targets and performed a similar analyzed with the Gaia DR2 data. Figure 1 represents the density profile obtained with Gaia DR2 data for MWC137 and MWC595.

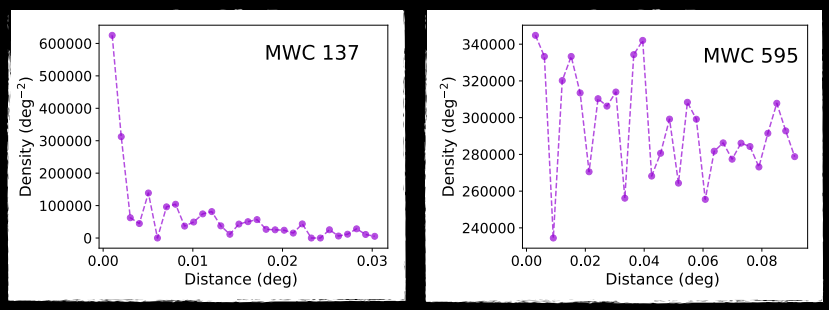
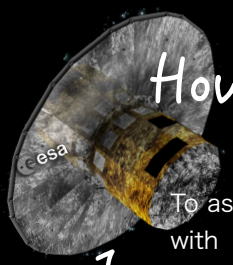


Fig. 1 Density profile of two HAeBe stars. **Left.** Density profile of MWC137, this star appears to be surrounded by a large number of companions. **Right.** Density profile of MWC595 , it seems like this star appear single and isolated.



How does it work?

1 To assess if a HAeBe star is associated with a cluster or not, we develop an algorithm (HERbig star in a Colour-Magnitude Diagram code; HERCMD). This code can detect a cluster given the known value of the astrometric parameters (Table 1). Which means that, HERCMD will perform a selection of the low mass stars around the HAeBe star. For example, we took Gaia DR2 data in a circular area with a radius of 0.2 degree around the centre of MWC137, and we found a significant number of low mass stars (filled-in circles in Figure 2) who share similar astrometric parameters with this HAeBe star.

2 We represent the results obtained by HERCMD in a colour-magnitude diagram. Figure 3, is an example where we compare our results with the ones reported by Mehner et al. 2016.

Table 1. Astrometric parameters from Gaia DR2 for MWC137.

Parallax (mas)	Pmra (mas/yr)	Pmdec (mas/yr)
0.109±0.054	-0.260±0.086	-0.408±0.072

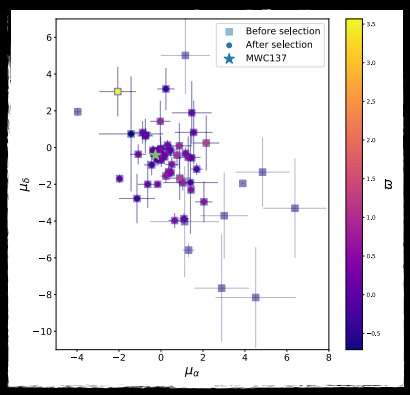


Fig. 2 Proper motion distribution for MWC137. The light green star is MWC137, the small square represents Gaia DR2 data before the selection with HERCMD and the filled-in circles represent the data after the selection with HERCMD, both data set are in function of the parallax (colour bar).

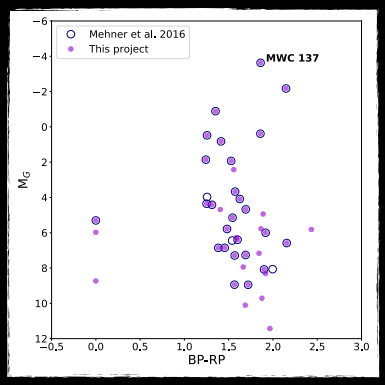


Fig. 3 Colour-Magnitude diagram of the HAeBe star MWC137. The blue open circles represent the data from Mehner et al. 2016 and the purple filled-in circles are the data select with HERCMD for MWC137 (same filled-in circles as in figure 2).

Summary

This is an example of the clustering detection around a HAeBe star using astrometric parameters from Gaia DR2. We planned to apply this algorithm to our sample of approximately 200 HAeBe stars to increase the number of object study by Testi et al. (1997, 1998, 1999). In the future, we will analyze these results to obtain the clustering properties for those HAeBe stars.

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