Binary open cluster Collinder 135 and UBC7

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Abstract

The use of highly accurate Gaia DR2 data [3] allowed us to obtain new estimates of the astrometric and kinematic parameters of the open clusters, supplement them with faint members, and also investigate new OCs. Thus, it was found that another cluster of UBC-7, which contains more faint stars, is located near the well-known Colllinder 135 open cluster, which was the reason that it was not detected according to other catalogues. Both of these clusters have similar kinematic parameters and are close in age. The purpose of this work is to understand whether these clusters were born in one place or were accidentally close to each other in space.

Member selection and parameter definition

Col135 is a fairly close (300 pc) and rarefied cluster located in the southern sky near Puppis constellation. It is poorly studied, mainly because of its obscurity. UBC7 is located at 2.3 deg [1] far from center of Col135, but the authors describing this cluster do not claim exactly that this is a new cluster, leaning towards the fact that this may be the result of Gaia measurement errors and be part of Col 135. We in turn, prove that UBC7 found by [1] in vicinity of Col 135 is a separate cluster. In order to better study their structure, we made our sample of the members of the cluster and obtain parameters for both cluster. The spatial proximity of clusters causes difficulty in the separation of their members and the belonging of some stars to a particular cluster can be controversial.

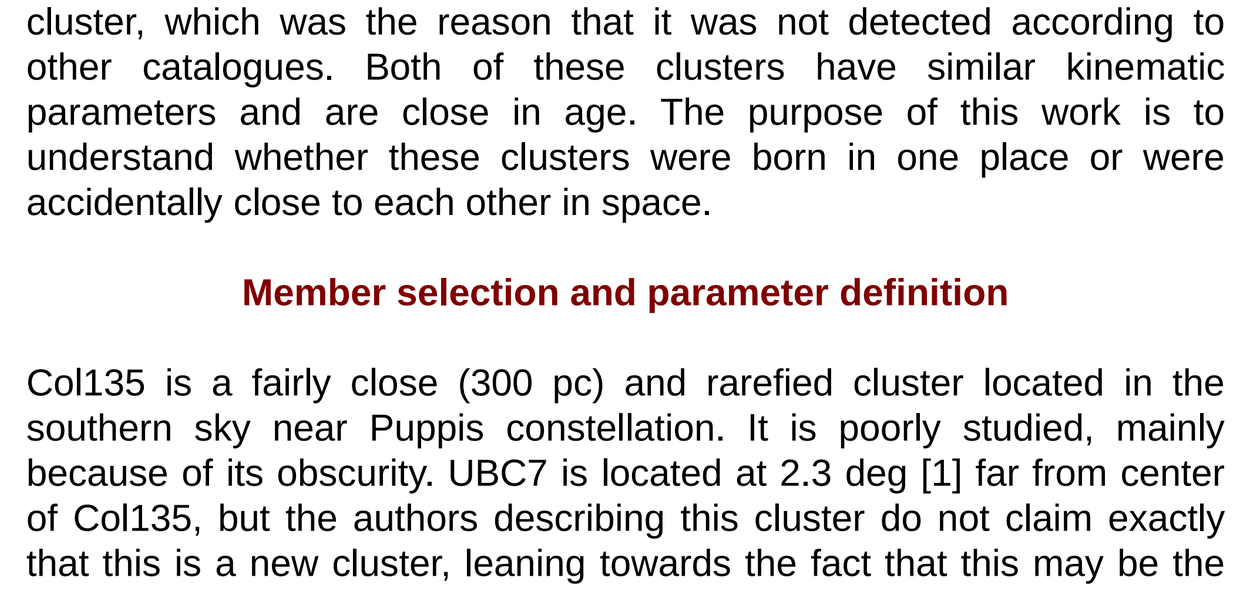

Fig.1. *Location of clusters on the celestial sphere (left panel) and on VPD(right panel). Red dots – Col 135, blue dots– UBC7, gray dots – field stars.*

On the vector-point diagram of proper motions (VPD) of stars in an open cluster the density concentration is visible, which is due to the fact that the stars of the cluster have the same spatial velocity. In our case there are two very close condensations, different from the stars of the field. Based on this data, we can determine that the average proper motion of the Col 135 cluster and UBC7, defined in our article, is corresponds to estimates made by other authors [1].

Table 1. *The parameters obtained in our work for clusters Col135 and UBC7 from sample membership with a probability P> 60%. In parentheses are the errors of determining the value.*

Cluster	RAJ2015.5, deg	DECJ2015.5, deg	Parallax, mas	pmRA, mas/yr	pmDEC, mas/yr	Vr, Km/s
Collinder 135	109.342	-37.073	3.30 (0.08)	-10.17(0.74)	6.16(0.65)	18.95(3.51)
UBC 7	107.301	-37.409	3.56 (0.06)	-10.02(0.84)	6.90(0.61)	12.59(3.94)

Age determination

To determine the age, “infallible members” were used - those whose membership in the cluster was determined by spatial and kinematic parameters. All diagrams contain only astrometrically clean (low_ruwe) stars and selected by flux_excess filter [4], restricted by photometric error (flows in photometric bands RP, BP exceed their errors by at least 10 times) and have a relative parallax error less than 10%, which makes our sample the most reliable.
The stars were superimposed on the isochrones using the photometry calibration correction by [5], and the absorption was determined by ZAMS to be 0.05 mag in BP-RP. Since we have no data on the metallicity of the cluster, all the assumptions about its age were made with the guess that it is close to solar. We determined that the age of the clusters is also close to each other and lies in the range of log(t) = 7.6-7.7

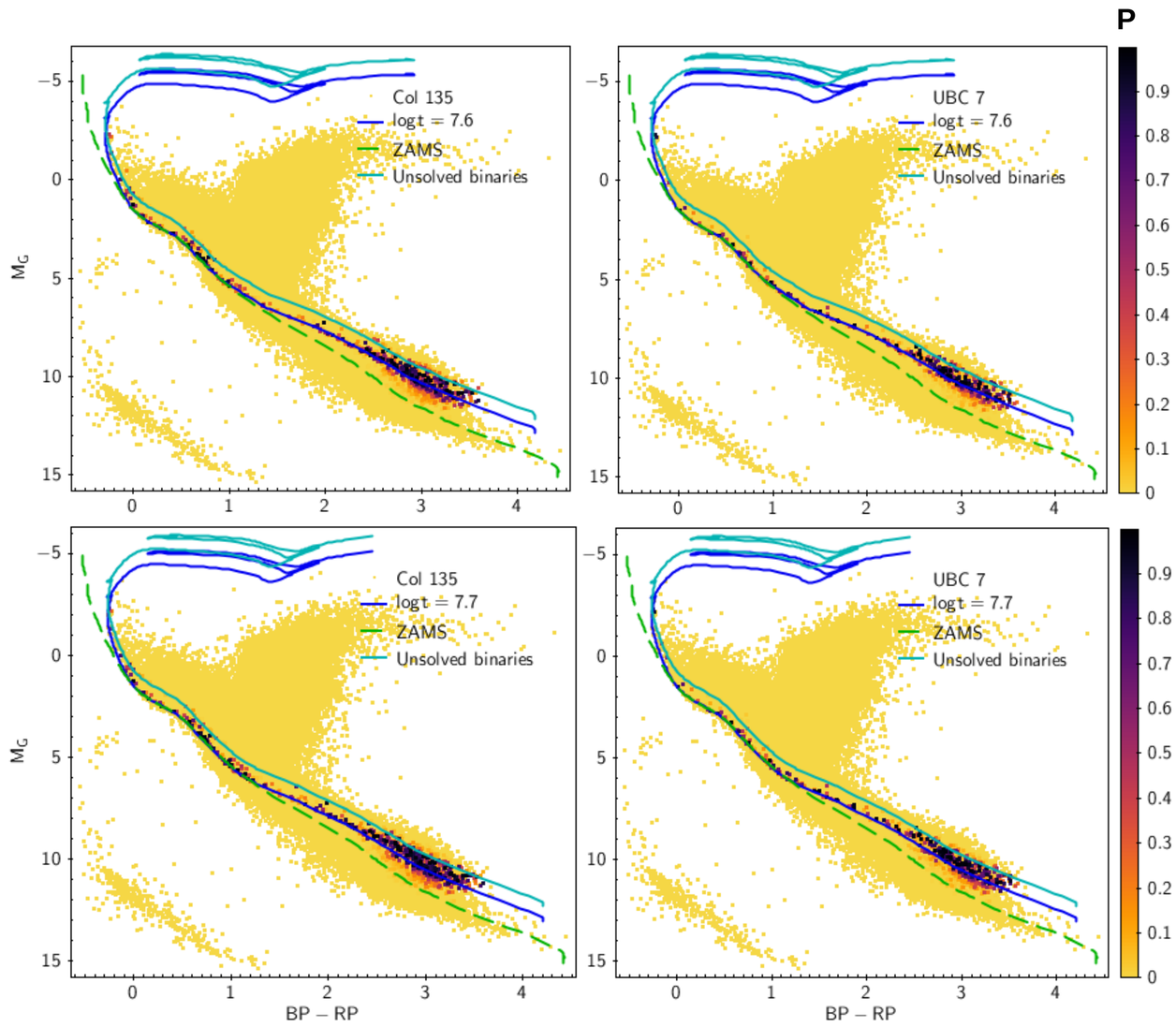

Fig.2. *The HR diagram for the stars of the Col135 (left panel) and UBC7 (right panel) under the assumption of age is log (t) = 7.6 (top) and log (t) = 7.7 (bottom). The stars fit well on both of these isochrones, with slight differences in the pre-MS region. Unresolved binaries and ZAMS are also shown on the plot.The color of the point corresponds of the minimum in all three probabilities by photometry, kinematics and parallax*

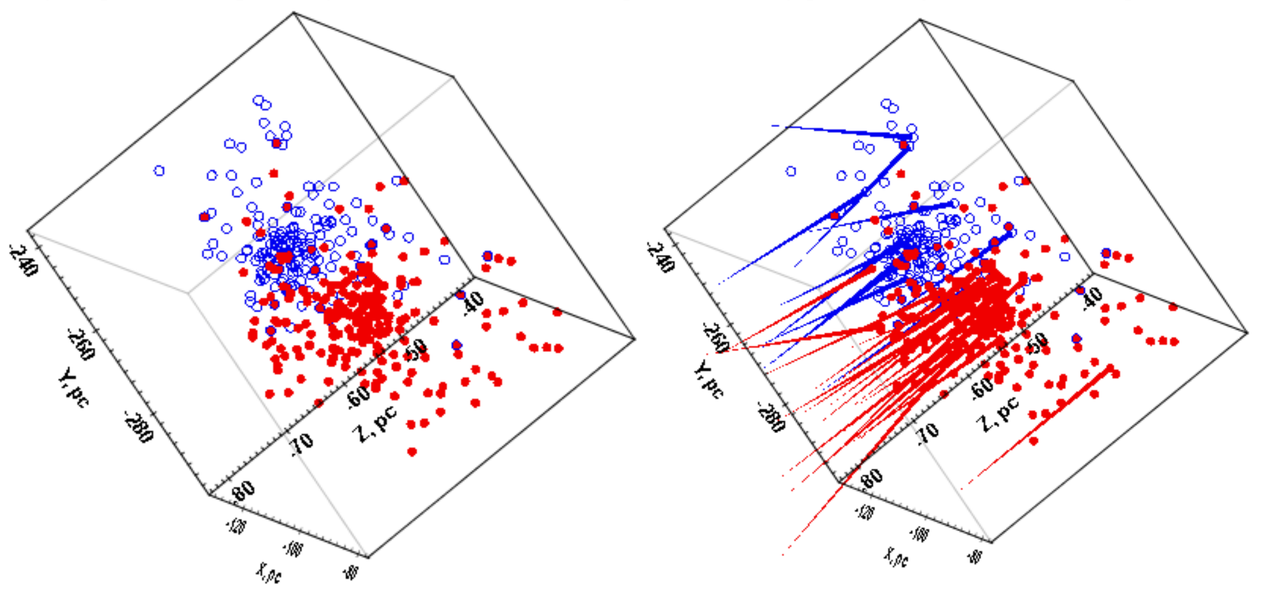

Fig.3. *Location of clusters in space in the heliocentric Cartesian coordinate system. Red points – stars of Col 135, blue points - UBC7(left panel) and their direction in space(right panel), according to the U, V, W velocity components.*

Unfortunately, in Gaia DR2, the radial velocities are not present for all members of the cluster, but according to the data that are available, we can conclude that both clusters move into space in a similar way.We integrated back in time to the log (t) = 7.6 and log (t) = 7.7 yr, the position of the stars in the cluster, and found that the clusters continue to be grouped, although more crowding is visible on log(t)=7.6

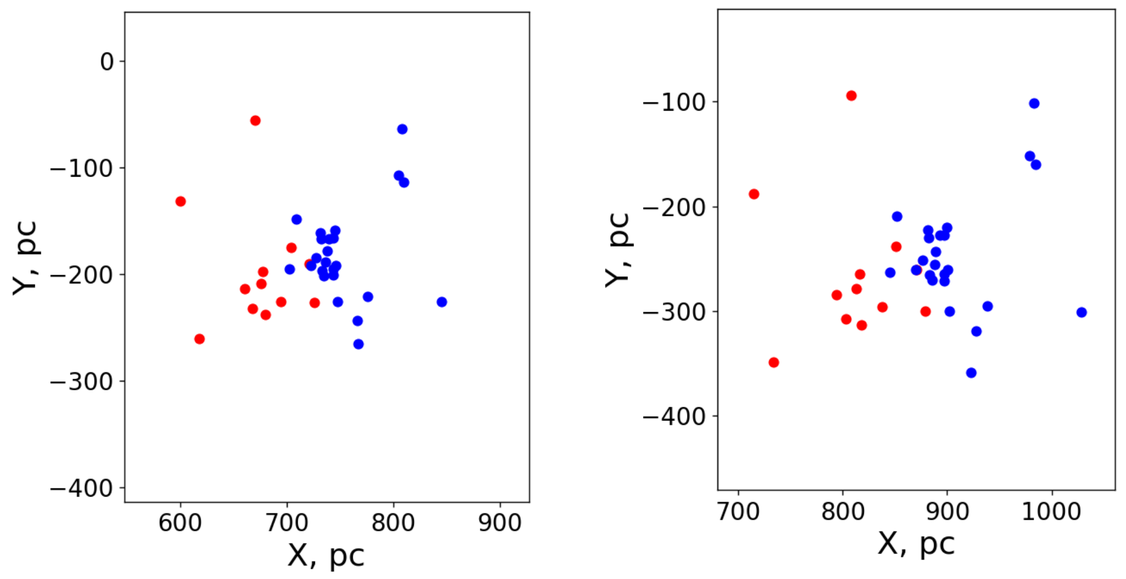

Fig.4. *Location of clusters in space in the heliocentric Cartesian coordinate system after integrate its position to the log(t)=7.6(left pannel) and 7.7(right pannel). Only those members that have radial velocities were taken.*

According to our data, the Col 135 cluster contains 201 members under assumption that its age log(t)=7.6 and 248 members if its age log(t)=7.7, and 162 the UBC7 cluster contains 180 members and respectively.

References

[1]. Castro-Ginard A , C. Jordi , X. Luri , et al. (2018) A&A Vol. 618, A.59
[2] Evans, D. W., Riello, M., De Angeli, F., et al. 2018, A&A, 616, A4
[3] Gaia Collaboration (Babusiaux, S., et al.) 2018, A&A, 616, A10 (Gaia 2 SI)
[4] Lindegren, L., Hernández, J., Bombrun, A., et al. 2018, A&A, 616, A2
[5] Maiz Apellaniz J. and M. Weiler, VizieR Online Data Catalog, 361, 2018.

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