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NGC 1605 is not a binary cluster

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ABSTRACT

The open star cluster NGC 1605 has recently been reported to in fact consist of two clusters (one intermediate-aged and one old) that merged via a flyby capture. Here we show that *Gaia* data does not support this scenario. We do, however, find another open-cluster candidate nearby.

INTRODUCTION

Gravitational captures of star clusters by other clusters are very rare and elusive events that can serve as laboratories for the destruction of star clusters (e.g. Soubiran et al. 2018; Casado 2022). Recently, Piatti & Malhan (2022) presented a promising candidate for an open cluster collision of the nearby ($d \sim 330$ pc) objects IC 4665 and Collinder 350. Some months earlier, Camargo (2021) reported the existence of a possible binary cluster, dubbed NGC 1605a/b, and suggested that it origined from a flyby capture. The author argued that the long-known cluster NGC 1605 actually consists of two components that have vastly different ages (2 Gyr and 600 Myr). Here we report that all commonly used clustering analysis techniques show no hint for multiple populations in these clusters.

Although relatively distant, close to the Galactic plane, and little studied, NGC 1605 has been included in the Galactic open cluster census since the 1970s. In the first deep photometric analysis, Fang (1970) remarks that "the cluster does not show much concentration but it is detached clearly from the background of a small stellar density which is probably caused by large interstellar absorption". The object is also listed in the *Gaia* DR2 open cluster catalogue of Cantat-Gaudin et al. (2020), with 95 bona-fide members, an age of 190 Myr, a distance of 3.07 kpc, and a foreground extinction of 2.21 mag.

GAIA EDR3 ANALYSIS

In this work we reanalyse the *Gaia* EDR3 data (Gaia Collaboration et al. 2021) down to magnitude $G < 19$ in a 30 arcmin circle around the centre of NGC 1605. Our analysis[1] uses the three state-of-the-art clustering techniques that have been introduced in the field: The DBSCAN algorithm employed by Castro-Ginard et al. (2022), the pyUPMASK code (Pera et al. 2021), and HDBSCAN, the preferred method of Hunt & Reffert (2021). While the former algorithms yield only one cluster in the considered region (NGC 1605), HDBSCAN does find another candidate close by - located about 20 arcmin northwest of NGC 1605 and clearly visible as an overdensity in proper-motion space (see Fig. 1).

We also confirm that the stellar density on the sky looks slightly irregular (it seems to be missing stars in its centre). The density profile of NGC 1605, however, is consistent with a typical King profile. There are also no irregularities in proper motion or in parallax space. We find no evidence for the tidal streams claimed by Camargo (2021) - their claimed location would also be dynamically inconsistent with the proper motion of the putative sub-clusters. The second sequence that Camargo (2021) found in the infra-red colour-magnitude diagram of the region (their Fig. 6) is produced by poorly removed field-star contamination (see Sect. 4 of Cantat-Gaudin & Anders 2020 for a discussion).

[1] reproducible at https://github.com/fjaellet/ngc1605

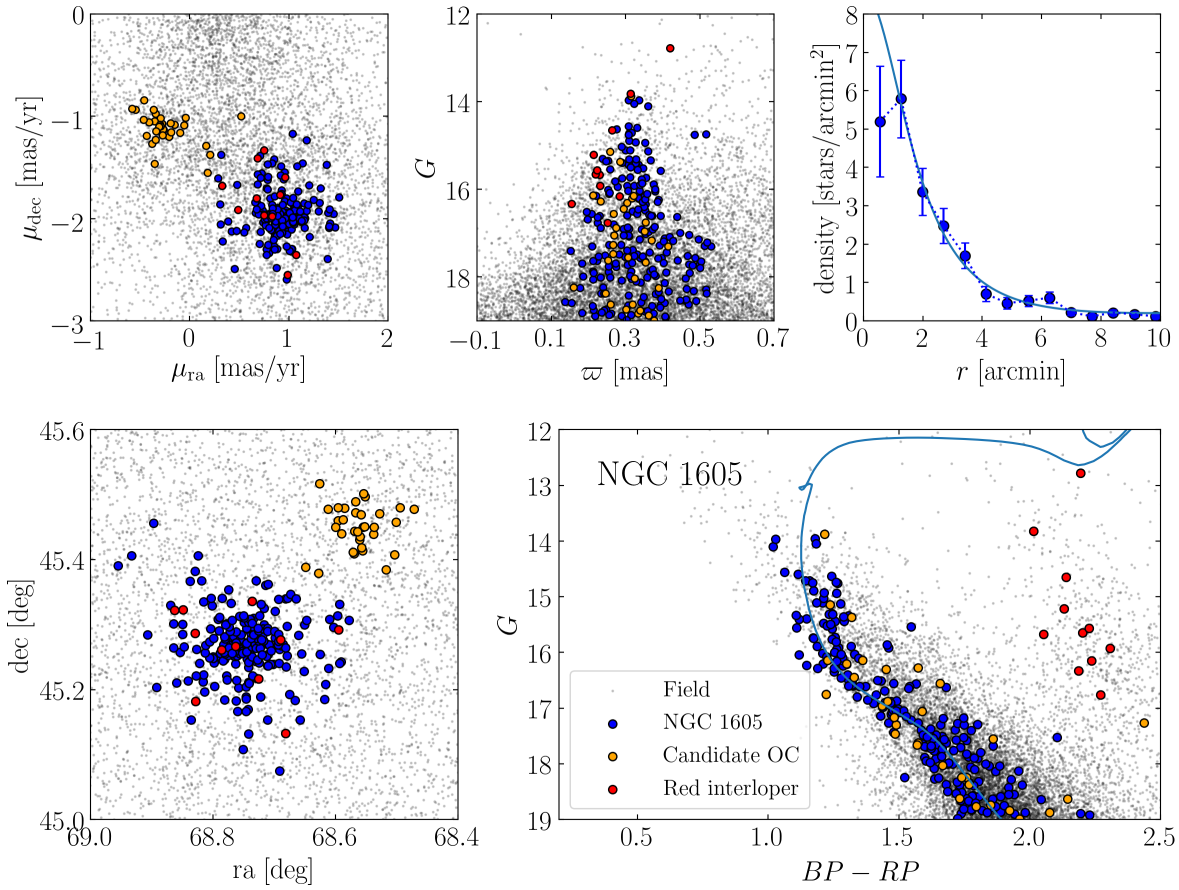

Figure 1. Results of the HDBSCAN analysis of the putative binary cluster NGC 1605. In each panel, the cluster members are highlighted in blue. Other symbols are explained in the legend. Bottom left panel: Sky distribution of *Gaia* EDR3 stars ($G < 19$) in the region of NGC 1605. Upper left panel: Proper motion diagram. Top middle: Parallax versus magnitude. Top right: density profile (including a King profile for comparison). Bottom right panel: Colour-magnitude diagram. Also shown is a PARSEC isochrone, shifted by $A_V = 2.8$ mag and $(m - M)_0 = 12.1$ mag.

In summary, we find no evidence for NGC 1605 being a genuine binary cluster. Nevertheless, NGC 1605 is an intriguing cluster showing signs of disintegration as well as differential reddening. Its large Galactocentric distance (~ 11 kpc) also makes it an interesting target for spectroscopic follow-up observations.

REFERENCES

Camargo, D. 2021, ApJ, 923, 21, doi: 10.3847/1538-4357/ac2835

Cantat-Gaudin, T., & Anders, F. 2020, A&A, 633, A99, doi: 10.1051/0004-6361/201936691

Cantat-Gaudin, T., Anders, F., Castro-Ginard, A., et al. 2020, A&A, 640, A1, doi: 10.1051/0004-6361/202038192

Casado, J. 2022, Universe, arXiv:2110.03587. https://arxiv.org/abs/2110.03587

Castro-Ginard, A., Jordi, C., Luri, X., et al. 2022, A&A, accepted. https://arxiv.org/abs/2111.01819

Fang, C. 1970, A&A, 4, 75

Gaia Collaboration, Brown, A. G. A., Vallenari, A., et al. 2021, A&A, 649, A1, doi: 10.1051/0004-6361/202039657

Hunt, E. L., & Reffert, S. 2021, A&A, 646, A104, doi: 10.1051/0004-6361/202039341

Pera, M. S., Perren, G. I., Moitinho, A., Navone, H. D., & Vazquez, R. A. 2021, A&A, 650, A109, doi: 10.1051/0004-6361/202040252

Piatti, A. E., & Malhan, K. 2022, MNRAS, 511, L1, doi: 10.1093/mnrasl/slab130

Soubiran, C., Cantat-Gaudin, T., Romero-Gómez, M., et al. 2018, A&A, 619, A155, doi: 10.1051/0004-6361/201834020