Draft version February 17, 2022
Typeset using LaTeX **RNAAS** style in AASTeX631

NGC 1605 is not a binary cluster

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Keywords: open clusters — NGC 1605 — Gaia EDR3 — data analysis

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 2021). 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 this 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. (2021), the pyUPMASK code (Pera et al. 2021), and HDBSCAN, the best-performing clustering technique according to Hunt & Reffert (2021). While the former algorithms yield only one cluster (NGC 1605) in the considered region, HDBSCAN does find another candidate close by - located about 20 arcmin northeast of NGC 1605 and clearly visible as another overdensity in proper-motion space.

We also confirm that the stellar density profile of NGC 1605 is indeed slightly bimodal/irregular. This bimodality, however, is reflected neither in proper motion nor in parallax space, nor in the colour-magnitude diagram. 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.

In summary, we find no evidence for NGC 1605 being a genuine binary cluster. 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

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

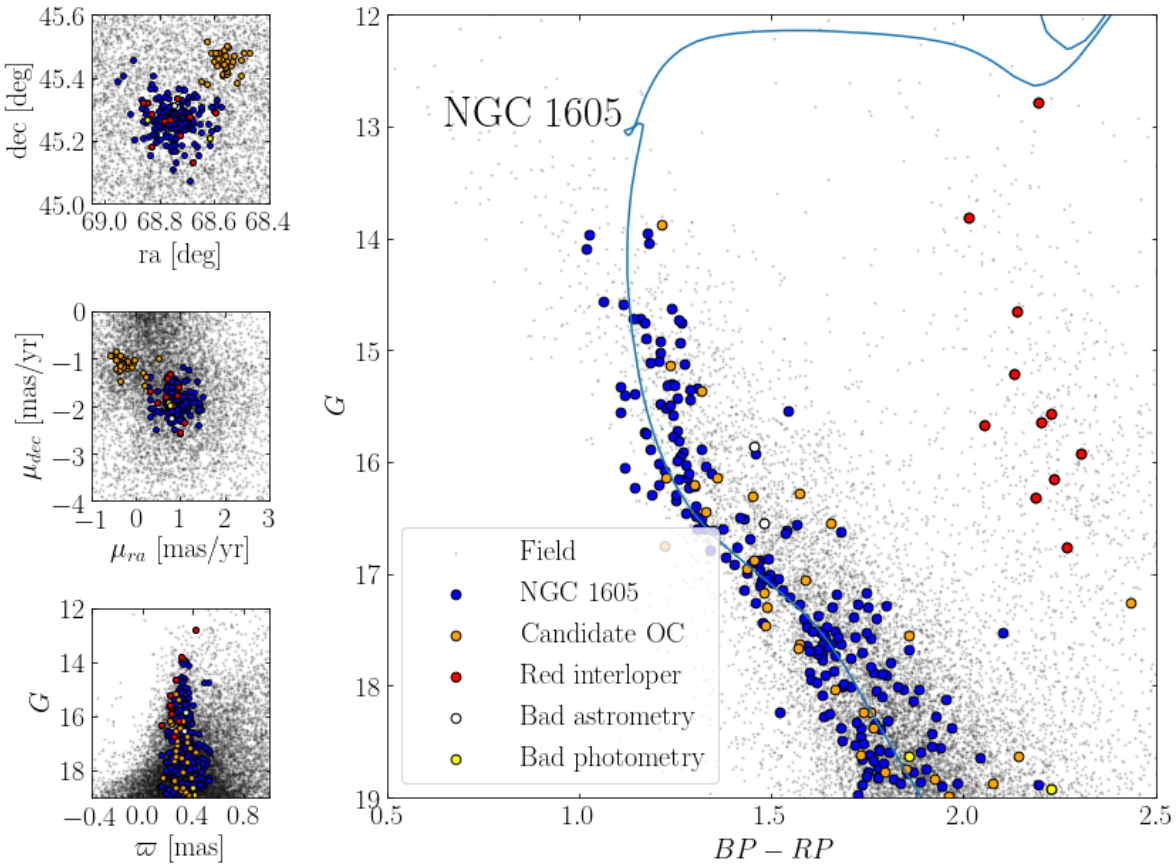

Figure 1. Results of the HDBSCAN analysis of the putative binary cluster NGC 1605. In each panel, the cluster members are highlighted in blue. Other symbols are explained in the legend. Top left panel: Sky distribution of *Gaia* EDR3 stars ($G < 19$) in the region of NGC 1605. Centre right panel: Proper motion diagram. Bottom left: Parallax versus magnitude. 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.

field-star contamination (see Sect. 4 of Cantat-Gaudin & Anders 2020 for a discussion). Nevertheless, NGC 1605 is an intriguing cluster with a peculiar density profile showing clear 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.

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