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Characterizing low contrast Galactic open clusters with GAIA DR2

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ABSTRACT

In this study, we characterized 16 objects previously classified as faint or low contrast Galactic open clusters (OCs). We employed parameters associated to the OCs dynamical evolution: core (r_c), tidal (r_t) and half-mass (r_{hm}) radii, age and crossing time (t_{cr}). Relations among these parameters were exploited to draw some evolutionary connections. We also included 11 OCs with previous characterizations to provide wider coverage of the parameters space. The investigated sample spans a considerable range in age ($\log(t\,\mathrm{yr}^{-1}) \sim$7.0–9.7) and Galactocentric distance ($R_G \sim 6-11\,\mathrm{kpc}$). Most of them present solar metallicity. We employed GAIA DR2 astrometry and photometry and selected member stars through a decontamination algorithm which explores the 3D astrometric space ($\mu_\alpha, \mu_\delta, \varpi$) to assign membership likelihoods. Previous studies of most of these objects were based mostly on photometric information. All investigated OCs were proved to be real stellar concentrations and relations among their parameters indicate a general disruption scenario in which OCs tend to be more concentrated as they evolve. Internal interactions sucessively drive OCs to develop more dynamically relaxed structures and make them less subject to mass loss due to tidal effects. Tidal radius tends to increase with R_G in accordance with the strength of the Galactic tidal field. Besides, the correlation between the r_c and the dynamical ratio $\tau_{\mathrm{dyn}} = \mathrm{age}/t_{cr}$ suggests two distinct evolutionary sequences, which may be consequence of different initial formation conditions.

Key words: Galactic open clusters – technique: photometric.

1 INTRODUCTION

Open clusters (OCs) presenting low stellar density contrast against the Galactic disc field population are particularly challenging to investigate. There are a number of reasons why OCs can be barely distinguishable from the field: (*i*) they can be projected against a very dense stellar background (e.g., Ferreira et al. 2019), (*ii*) they can be severely obscured by interstellar absorption (e.g., Bianchin et al. 2019), (*iii*) they can be intrinsically poorly populated (e.g., Pavani et al. 2011; Angelo et al. 2019a) due to the loss of stars during their dynamical evolution.

In this context, the publication of high precision astrometric and photometric data available in the GAIA DR2 catalogue (Gaia Collaboration et al. 2018) has inaugurated a new era in astronomy. The use of such data allows to circumvent the difficulties arising mainly from points (*i*) and (*iii*) above, since the search for statistically significant concentration of stars in the astrometric space can be used to unambigously distinguish cluster from field population. This strategy has led to an increase in the number of OCs discovered and has also allowed more precise characterization of already known ones (e.g., Cantat-Gaudin et al. 2018a; Castro-Ginard et al. 2018; Monteiro & Dias 2019; Ferreira et al. 2019). For OCs strongly affected by interstellar extinction, the GAIA visible bands are of limited help, and studies of this kind of object usually require an analysis in conjunction with longer wavelengths.

In the last decade, an effort has been made in the construction of databases compiling lists of OCs and their fundamental parameters. Two of them are WEBDA (Netopil et al. 2012), containing ~ 1200 clusters, and DAML02 (Dias et al. 2002, version 3.5 as of 2016 January), containing $\sim$2200 clusters. Kharchenko et al. (2013) determined struc-

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