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Mass loss in open clusters

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Most stars are thought to be born in groups which later dissolve into the field population of their host galaxy. This dissolution and integration into the field population has long been a topic of interest. For example, Lamers et al (2005) explored this process using the open cluster (OC) age distribution derived from the Kharchenko et al. (2005) OC catalogue. With the advent of the Gaia mission, we have an exceptional opportunity to revisit and enhance these studies using high-quality data.

Given the absence of large scale, high-quality mass determinations for OCs, we have determined the luminous masses for 1724 OCs using the Dias et al. (2021) catalogue of cluster parameters and stellar memberships. In the process, we have also determined the cluster radii through King profile fits. We discuss the effect of the radii uncertainties on the derived masses.

We have implemented a model for the build-up and mass evolution of a population of OCs, following Lamers et al. (2005). By comparing our simulations with the observational data, we reproduced the disruption timescale and mass dependency parameters previously obtained in the literature. However, while there is a reasonable agreement for the age distribution, the simulated mass distribution does not match the observations for any combination of the parameters. We note that in the previous studies only age distributions had been considered. Not mass distributions.

We found, however that the mass distribution of young clusters does not follow the typically assumed power-law for the Cluster Initial Mass Function (CIMF); instead, it exhibits a log-normal behaviour. This motivated modifying accordingly the CIMF used in the model, which significantly improved the agreement between simulations and the observed mass distribution. These findings suggest that the mass distribution for non-embedded clusters, at the moment they emerge from their parent molecular clouds, may differ from the commonly adopted power-law CIMF, which is derived from embedded clusters. Moreover, our results also suggest a previously unexplored mass dependence associated with the disruption arising from cluster emergence from molecular clouds. These new insights pave the way for further investigations, offering valuable perspectives on the formation and evolution of stellar systems within the context of the Gaia mission.

References:
Dias et al. (2021)
Kharchenko et al. (2005)
Lamers et al (2005)

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