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The cluster initial mass function of the M82 disk Super Star Clusters

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Super Massive Clusters (SSCs) are thought to be the progenitors of Globular Clusters (GCs) due to their similar masses and densities. One way to test such a link is via the Cluster Mass Function (CMF), related to the Cluster Luminosity Function (CLF) via the mass-to-light ratio. We analyze the CMF of SSCs in the M82 disk, exploring the potential initial conditions that reproduce it, known as the Cluster Initial Mass Function (CIMF). M82 is an excellent candidate for this study as it harbors approximately 400 nearly coeval SSCs. Using EMACSS, we perform dynamical simulations on a set of simulated CIMFs and find that a power-law CIMF with an index of 1.8, combined with a power-law galactocentric distribution function, best reproduces the observed CMF. The observed turnover in the CMF is attributed to observational incompleteness rather than intrinsic properties or dynamic effects.

The CIMF can be established from studies of young clusters (age∼ 1—10 Myr). Several studies have reported a power-law CIMF with an index of 2. However, several galaxies display shallower values suggesting that the CIMF index value might not be universal. For instance, M82 has a CIMF index value of 1.8. To delve into this difference, we use the semi-analytical dynamical evolution code (EMACSS, Alexander et al. (2014)) to carry out the dynamical evolution of the CIMF, assuming clusters move in circular orbits under the gravitational potential of M82. We explore two power-law ($\alpha = 2.0$ and $\alpha = 1.8$) and three log-normal functions ($\log \overline{\mathrm{M}}$ of 4.23, 4.5 and 5 $\mathrm{M}_{\odot}$) for the CIMFs and populate the clusters in the disk assuming uniform, power-law, and exponential radial distribution functions. We evolve the CIMFs for up to 100 Myr, and apply a mass completeness function (Cuevas-Otahola et al., 2023) derived from the luminosity completeness function in Mayya et al. 2008. We show the observed CMF for the M82 disk SSCs (Mayya et al., 2008) along with the evolved and completeness-corrected CMFs in Fig. 1. The upper left panel illustrates the best agreement with the observed CMF, particularly for the solid and dashed lines

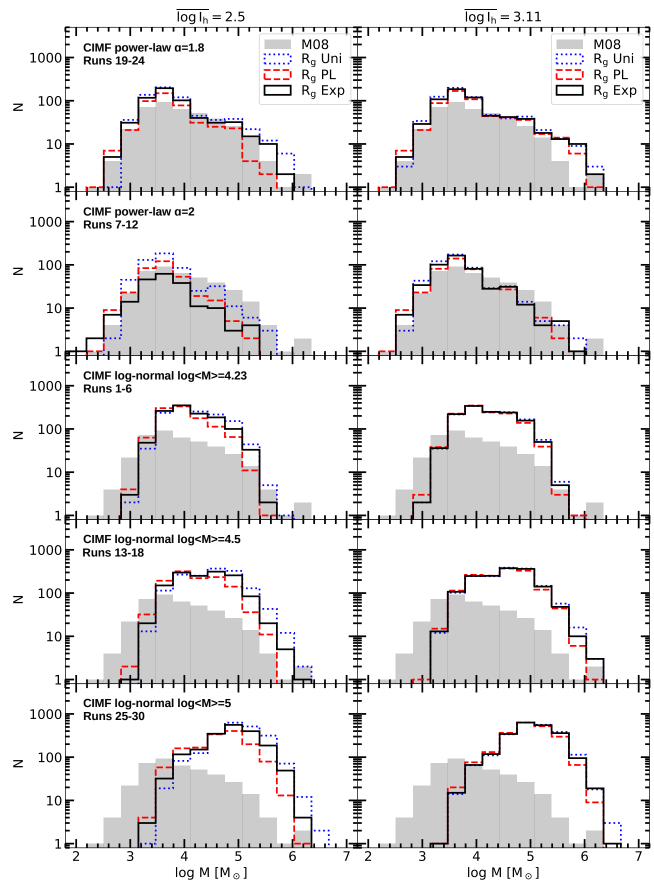

Figure 1. Evolved CIMFs, for lower and higher surface densities (left and right panels respectively) through 100 Myr with EMACSS (see Cuevas-Otahola et al. (2023)).

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(representing exponential and power-law galactocentric radii distributions) with CIMFs having an index of 1.8.

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