The Sparsest Clusters With O Stars

J. B. Lamb(1), M. S. Oey(1), J. K. Werk(1,2), L. D. Ingleby(1)

(1) University of Michigan
(2) Columbia University

There is much debate on how high-mass star formation varies with environment, and whether the sparsest star-forming environments are capable of forming massive stars. To address this issue, we have observed eight apparently isolated OB stars in the SMC using HST's Advanced Camera for Surveys. Five of these objects appear as isolated stars, two of which are confirmed to be runaways. The remaining three objects are found to exist in sparse clusters, with <10 companion stars revealed, having masses of 1-4 solar mass. Stochastic effects dominate in these sparse clusters, so we perform Monte Carlo simulations to explore how our observations fit within the framework of empirical, galactic cluster properties. We generate clusters using a simplistic -2 power-law distribution for either the number of stars per cluster (N_*) or cluster mass (M_cl). These clusters are then populated with stars randomly chosen from a Kroupa IMF. We find that simulations with cluster lower-mass limits of M_cl,lo >20 solar mass and N_*,lo >40 match best with observations of SMC and Galactic OB star populations. We examine the mass ratio of the second-most massive and most massive stars (m_max,2/m_max), finding that our observations all exist below the 20th percentile of our simulated clusters. However, all of our observed clusters lie within the parameter space spanned by the simulated clusters, although some are in the lowest 5th percentile frequency. These results suggest that clusters are built stochastically by randomly sampling stars from a universal IMF with a fixed stellar upper-mass limit. In particular, we see no evidence to suggest a m_max - M_cl relation. Our results may be more consistent with core accretion models of star formation than with competitive accretion models, and they are inconsistent with the proposed steepening of the integrated galaxy IMF (IGIMF).

Reference: ApJ, 725, 1886-1902
Status: Manuscript has been accepted

Weblink: http://adsabs.harvard.edu/abs/2010ApJ...725.1886L

Comments: 17 pages, 12 figures

Email: joellamb@umich.edu