Triggered Star Formation in a Turbulent ISM
Proceedings IAU Symposium No. 237, 2006
B. G. Elmegreen & J. Palouš, eds.

doi:10.1017/S1743921307001962

From young massive star clusters to old globulars: long-term survival chances

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Young, massive star clusters (YMCs) are the most notable and significant end products of violent star-forming episodes triggered by galaxy collisions and close encounters. The question remains, however, whether or not at least a fraction of the compact YMCs seen in abundance in extragalactic starbursts, are potentially the progenitors of ($\gtrsim$ 10 Gyr) old globular cluster (GC)-type objects. If we could settle this issue convincingly, one way or the other, the implications of such a result would have far-reaching implications for a wide range of astrophysical questions, including our understanding of the process of galaxy formation and assembly, and the process and conditions required for star (cluster) formation. Because of the lack of a statistically significant sample of YMCs in the Local Group, however, we need to resort to either statistical arguments or to the painstaking approach of case-by-case studies of individual objects in more distant galaxies.

A variety of methods have been employed to address the long-term survival issue. The most promising and most popular approach aimed at establishing whether a significant fraction of an entire *population* of YMCs (as opposed to individual objects) might survive for any significant length of time (say, in excess of a few $\times 10^9$ yr) uses the "cluster luminosity function", or its equivalent mass function (CLF, CMF), as a diagnostic tool. In essence, the long-term survival of dense YMCs depends sensitively on the low-mass section (below a few $M_\odot$) of their stellar initial mass function (IMF). Clearly, assessing the shape of the stellar IMF in unresolved extragalactic clusters is difficult, potentially ambiguous and riddled with pitfalls. Nevertheless, and despite these difficulties, an ever increasing body of observational evidence lends support to the scenario that GCs, which were once thought to be the oldest building blocks of galaxies, are still forming today.

By focusing on the shape of their *initial* mass distribution, we concluded that the CMF at the time of starbirth in the starburst galaxy M82 (de Grijs *et al.* 2003, 2005), and possibly also in the Large Magellanic Cloud (de Grijs & Anders 2006) and the Antennae interacting system (P. Anders *et al.*, in prep.), may not have been a power-law function of mass, as often assumed. Instead, we have uncovered evidence for a significant flattening of the initial CMF towards lower cluster masses, most significantly and robustly so among the M82 YMCs. This result lends strong support to evolutionary scenarios that start from initial log-normal CMFs, e.g., as proposed by Vesperini (1998). This scenario is attractive, because it is based on as few restricting assumptions as physically possible. Other popular scenarios often need to invoke significant, sometimes unrealistic assumptions on, e.g., the dynamics of the cluster populations in their host galaxies.

References

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