Molecular Gas, Dust, and Star Formation in Galaxies
Proceedings IAU Symposium No. 292, 2012
T. Wong & J. Ott, eds.

doi:10.1017/S1743921313001415

Expulsion of Dust from Young Stellar Clusters

P. Grosbøl[1] and H. Dottori[2]

[1]European Southern Observatory, Karl-Schwarzschild-Str. 2, D-85748 Garching, Germany
email: pgrosbol@eso.org

[2]Instituto de Física, Univ. Federal do Rio Grande do Sul, Av. Bento Gonçalves 9500, 91501-970 Porto Alegre, RS, Brazil
email: dottori@ufrgs.br

Abstract. Young stellar clusters were identified on deep near-infrared images of 6 nearby, grand-design spirals observed with HAWK-I/VLT. A 90% completeness was reached for cluster complexes with M_K = -11.5^m (corresponding to masses around 10^4 $M_\odot$) while the linear resolution was around 40 pc. The distribution of clusters in the (H-K)–(J-H) diagrams revealed two groups of clusters. Comparing with Starburst99 model tracks, the groups could be interpreted as one old population of clusters with low extinction and one consisting of young clusters with visual extinction as high as $A_V = 7^m$. The clear separation between the two groups suggests a rapid expulsion of dust from the young clusters.

Monte-Carlo models were made assuming a cluster distribution function $g(M_c, \tau) = M_c^{-a}\tau^{-\gamma}$ where M_c and τ are cluster mass and age, respectively. Fitting such models to the observed NIR color distributions, it was concluded that the cluster mortality had to be significant with γ = 0.8-1.0. Further, the star formation phase of clusters has to extend over several Myr. Young clusters have high extinctions at least the first 3 Myr but then lose their reddening over a period of around 5 Myr, depending on the exact evolutionary tracks used.

Keywords. galaxies: star clusters — infrared: galaxies — techniques: photometric

1. Summary

The stellar clusters in 6 nearby, grand-design spiral galaxies (Grosbøl & Dottori 2012) were analyzed using deep, near-infrared (NIR) images observed with HAWK-I/VLT. Each of the galaxies had more than 2000 clusters which showed a characteristic bimodal structure in their NIR color distributions. Monte-Carlo models were fitted to the observed distributions using Starburst99 cluster tracks (Leitherer *et al.* 1999) and a distribution function $M_c^{-a}\tau^{-\gamma}$ depending on cluster mass M_c and age τ. NIR colors change fast only during the first 10-20 Myr which makes α and γ degenerate. Fixing α to the values determined by Grosbøl & Dottori (2012) for clusters with ages <10 Myr, the range of γ could be estimated to 0.8-1.0. The separation and relative population of the bimodal NIR color distribution depend on both duration of star formation and extinction. The models suggest that the formation of the clusters takes several Myr during which they have high extinction. The clear separation between the two branches in the (J-K)–M_K diagrams indicates a rapid expulsion of dust, and decrease in extinction, over a period of around 5 Myr possibly triggered by supernovae or stellar winds from O-type stars.

References

Grosbøl, P. & Dottori, H. 2012, *A&A*, 542, A39
Leitherer, C., Schaerer, D., Goldader, J. D., *et al.* 1999, *ApJS*, 123, 3