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***Dissertation Summary***

# Dynamical Evolution of Open Star Clusters

RAÚL DE LA FUENTE MARCOS

Current address: Faculty of Science and Mathematics, St. Louis University—Spain Campus, Avda. del Valle 34, E-28003 Madrid, Spain; marcosr@axa.slu.edu
Thesis work conducted at Departamento de Astrofísica, Facultad de Ciencias Físicas, Universidad Complutense de Madrid, E-28040 Madrid, Spain
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Stars are not formed independently, but instead they form in clusters. The influence of the initial mass function (IMF) on the evolution of open star clusters is analyzed using numerical integrations of *N*-body systems by the code NBODY5 (S. J. Aarseth, in Multiple Time Scales, ed. J. U. Brackbill & B. I. Cohen [New York: Academic, 1985], p. 377), which include tidal effects, mass loss due to stellar evolution, the realistic fraction of primordial binaries, and the formation of multiple systems. Five different IMFs (E. E. Salpeter, ApJ, 121, 161 [1955]; L. G. Taff, AJ, 79, 11 [1974]; G. E. Miller & J. M. Scalo, ApJS, 41, 513 [1979]; P. Kroupa, C. A. Tout, & G. Gilmore, MNRAS, 262, 545 [1993]; J. M. Scalo, Fundam. Cosmic Phys., 11, 1 [1986]) are used for generating stellar masses. The results confirm significant differences with single-mass models and allow us to distinguish between the standard power-law models and modern ones. An approximate analytic expression for the escape rate is derived in order to fit the data obtained. When stellar evolution is included, the results show that for all the IMF's studied, the evolution of the cluster is slowed down and the initial core collapse loses importance because of an expansion of the inner regions of the cluster. We find that the total disruption time is very IMF dependent because of different numbers of massive stars and also depends on the richness of the cluster. A differential behavior is found between poor and rich systems with respect to mass loss. Poor systems disrupt earlier than homologous ones without mass loss; the opposite is found for rich systems. The transition population is about $N = 300$. The binary escape rate seems preferentially due to close encounters in poor clusters, but it seems mainly exponential for populated clusters. It suggests that ejection is the main mechanism for binary escape in poor clusters and evaporation is the dominant one for rich clusters. The formation and evolution of hierarchical systems is also considered in detail. Some questions concerning multicomponent clusters, such as the preferential evaporation of light stars, are reviewed. The global results are compared with the observational data of actual clusters from The Database for Stars in Open Clusters: BDA[1] (J.-C. Mermilliod, in ASP Conf. Ser. 90, The Origins, Evolution, and Destinies of Binary Stars in Clusters, ed. E. F. Milone & J.-C. Mermilliod [San Francisco: ASP, 1996]).

The likely observational properties of the final stages of the evolution of open clusters are also investigated, and the results are compared with the available observational data (L. O. Lodén, Ap&SS, 199, 165 [1993]; R. P. Stefanik, J. R. Caruso, G. Torres, S. Jha, & D. W. Latham, Baltic Astron., 6, 137 [1997]). It is found that they depend on the membership of the cluster, the abundance of primordial binaries, and the initial mass function. The final cluster remnant is very rich in binaries and hierarchical systems. Remnants of poorly populated clusters are relatively easy to identify because they contain early-type stars. Remnants of rich open clusters are difficult to detect and might exist in large numbers. The detection of rich open clusters' remnants (OCRs) is a great challenge for the largest available telescopes because they contain only faint stars. It is possible that some of the oldest known open clusters are in fact remnants of densely populated ($N \approx 40{,}000$) clusters. The existence of a large number of OCRs may be relevant for dark matter in the Galactic disk. This hypothesis could be tested by using the capabilities of the proposed global astrometry mission Global Astrometric Interferometer for Astrophysics (GAIA).

[1] See the BDA homepage at http://obswww.unige.ch/bda/.