EVOLUTION OF THE GALACTIC GLOBULAR CLUSTER SYSTEM

E.VESPERINI
Scuola Normale Superiore
Piazza dei Cavalieri 7, 56126 Pisa-Italy

1. Introduction

Recent surveys of the observational properties of galactic globular clusters have shown the existence of interesting correlations and trends between structural parameters and between structural parameters and location inside the Galaxy (Chernoff & Djorgovski 1989, Djorgovski & Meylan 1994). The origin of most of these correlations is not clear yet and it is not clear to what extent they reflect the primordial conditions or the result of evolution. We have carried out a set of simulations following the evolution of the properties of a globular cluster system (mass function, spatial distribution, correlations between structural parameters) starting from given initial conditions. The evolution of each individual cluster has been followed by the same method applied by Chernoff *et al.* (1986) and Chernoff & Shapiro (1987). The effects of internal relaxation, disk shocking and dynamical friction have been considered. *The main goal of the analysis is that of establishing the role of initial conditions and evolutionary processes in determining the present observational properties.*

2. Initial conditions

Three different initial mass functions for the globular cluster system have been chosen in the survey carried out in this work.

1. A truncated power-law mass function $f(M) \propto M^{-2}$ with lower cut-off $M_{low} = 10^{4.5} M_{\odot}$ and upper cut-off $M_{up} = 10^6 M_{\odot}$ (POW).
2. A Gaussian distribution in the logarithm of the mass with mean value $< \log M >= 4.5$ and variance $\sigma^2 = 1.0$ (GAU1).
3. A Gaussian distribution in the logarithm of the mass with mean value $< \log M >= 5.0$ and variance $\sigma^2 = 0.25$ (GAU2).

P. Hut and J. Makino (eds.), Dynamical Evolution of Star Clusters, 401–402.

The number density profile of clusters in the Galaxy has been chosen to be $n(R_g) \propto R_g^{-3.5}$. As for the initial distribution of concentrations of clusters, $c = \log r_t/r_c$, both initial conditions with c correlated to the mass of clusters and with c and mass uncorrelated have been investigated in order to determine whether the present correlation between these two quantities observed for galactic globular clusters is primordial or the result of evolution.

3. Results

1. The observed correlation between concentration and mass of clusters is primordial and not induced by evolutionary processes (see also Bellazzini *et al.* 1995).
2. In the POW run evolutionary processes change the power-law initial mass function into a bell shaped mass function resembling a Gaussian in $\log M$ or into a two-component power-law distribution in M flatter for low values of mass.
3. In the GAU1 run the gaussian shape of the initial mass function is preserved but shifted to a higher mean value. The low-mass side is almost entirely destroyed by the evolutionary processes. The final mass function is very similar to the observed one.
4. In the GAU2 run the initial mass function is equal to the observed one. Although a significant disruption of clusters occurs also in this run, the shape and the parameters of the mass function are essentially preserved during the entire evolution showing that a significant effect of evolutionary processes does not necessarily imply a strong difference between initial and final mass function.
5. In all the runs evolutionary processes deplete significantly the number of clusters in the central regions of the Galaxy giving rise to a flattening of $n(R_g)$ in the inner regions.
6. Evolution gives rise to a trend for more concentrated clusters to dominate near the galactic centre.

A more detailed description of these results is in Vesperini (1994, 1995a,b).

References

Bellazzini M., Vesperini E., Ferraro F.R., Fusi Pecci F. (1995) *MNRAS* in press
Chernoff D.F., Kochanek C.S., Shapiro S.L. (1986) *Ap.J.* **309**, 183
Chernoff D.F., Shapiro S.L. (1987) *Ap.J.* **322**, 113
Chernoff D.F., Djorgovski S.G. (1989) *Ap.J.* **339**, 904
Djorgovski S.G., Meylan G. (1994) *A.J.* **108**, 1292
Vesperini E. (1994) Ph.D. Thesis, Scuola Normale Superiore
Vesperini E. (1995a) submitted to *MNRAS*
Vesperini E. (1995b) submitted to *MNRAS*