RELATION BETWEEN THE PROPERTIES OF GLOBULAR CLUSTER SYSTEM AND THE MASS DISTRIBUTION ON THE GALACTIC DISK

V.G. Surdin
Sternberg Astronomical Institute, Moscow, USSR

As it is was shown by Ostriker et al. (1972), one of the factors controlling the dynamical evolution of a globular cluster is the compressive gravitational shocks (or "tidal shocks") i.e., gravitational perturbations resulting from the passage of a clusters through the galactic disk. Actually, this is an important evolutionary factor, so far as it gives us the possibility to explain the relation between the mass concentration parameter $C = \log(r_t/r_c)$ and the galactocentric distance R of a globular cluster (Surdin, 1979). Therefore we may use this property of the globular cluster system as a tool for the determination of the mass distribution in the galactic disk.

The characteristic time for the destruction of a globular cluster under the action of compressive shock in the impulsive approximation (Ostriker et al., 1972) is

$$t_{sh} = \frac{3GMPV_z^2}{20r_h^3 g_m^2} \tag{1}$$

where M, r_h, and P are respectively the mass, the spatial half-mass radius, and the orbital period of a cluster; V_z is Z-velocity when the cluster is approaching the galactic plane, and g_m is the maximum value of the gravitational Z-acceleration due to the galactic disk.

We must take into consideration that (Fall and Ross, 1977)

$$r_h \simeq 0.7 \cdot \sqrt{r_c r_t} \tag{2}$$

and that (Rastorguev and Surdin, 1978)

$$r_t = R_p \left(\frac{M}{(1+\nu) M_G(R_p)} \right)^{1/3} \tag{3a}$$

$$\nu = \frac{2e}{(1+e)^2 \ln\left(\frac{1+e}{1-e}\right)} \tag{3b}$$

where e is the eccentricity of the cluster orbit, and $M_G(R_p)$ is the mass of the Galaxy inside the perigalactical distance of the cluster orbit (R_p). Orbital period is connected with apogalactic distance of the orbit (R_a):

$$P \simeq \left[\frac{R_a^3}{GM_G(R_a)} \right]^{1/2}, \tag{4}$$

G. Longo et al. (eds.), Morphological and Physical Classification of Galaxies, 457–458.

and the gravitational acceleration depends on the surface density of the galactic disk (σ) near the perigalactic region of the cluster's orbit:

$$g_m = 2\pi G\sigma(R_p). \tag{5}$$

For exponential disk

$$\sigma(R_p) = \sigma_\circ \exp(R_\circ/h) \cdot \exp(-R_p/h) \tag{6}$$

where $\sigma_\circ$ is the surface density near the Sun, h is the radial scale, and $R_\circ$ is the distance to the galactic center.

For the Galaxy with constant rotational velocity (220 km/s), and values $R_\circ = 9$ kpc, $t_{sh} = 2 \cdot 10^{10}$ yrs, and $\sigma_\circ = 54\ M_\odot\ \mathrm{pc}^{-2}$ (Gould, 1990) we have calculated from equation (1)–(6) the conditions for low bound. The curves are drawn in figure 1 for different values of the scale parameters (van der Kruit, 1987). Distribution of globular clusters (dots in figure 1; data by Chernoff and Djorgovski, 1989; Peterson and Reed, 1987) prove that the value $h = 5$ kpc is more sufficient for the requirements of the dynamical evolution of the clusters.

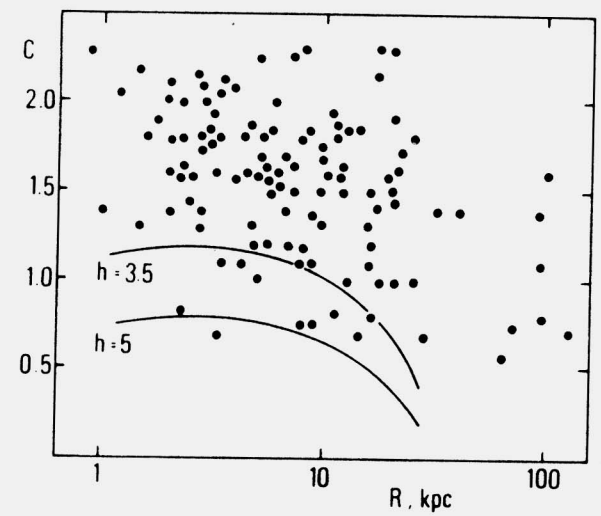

Figure 1.

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