N-BODY SIMULATIONS OF OPEN CLUSTERS

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The dynamical evolution of open star clusters has been followed by numerical N-body simulations. These computations have been done considering both the interactions between stars in the cluster, and the effect of a linearized galactic tidal field, assuming circular orbits in the solar neighbourhood. Models have been studied for 250, 500 and 1000 stars, and two initial mass spectra (α=2.35 and α=2.75). We adopt a mean mass $\bar{M}=0.5M_\odot$ and a mass ratio of 50:1 between the heaviest and the lightest star. A simple scheme for instantaneous mass-loss from stellar evolution (neutron stars and white dwarfs) is incorporated into the models using published parameters. The models with 250 stars are found to be relatively insensitive to the adopted value of $\bar{R}$ (the virial theorem scale factor) in the range of $1<\bar{R}<3$ pc. The disruption half-lifes ($T_{1/2}$) are about 1.7 x 10^8y for models with 250 stars, and 4.6 x 10^8 y for 1000 stars and α=2.75. Preliminary work including successive encounters of clusters with interstellar clouds appears to give shorter disruption times. Two effects play an important role in the dynamical evolution of the cluster: the formation of one or two massive and energetic binaries ($\simeq$50 per cent of the total energy) during the first few crossing times, and their disruption by mass-loss.

The time evolution of the density distribution for the 1000 star model is shown in Figure 1. Core collapse for the inner 5 or 10% of the total mass does not occur due to mass-loss and binary activity. Figure 2 gives a plot of the spatial number density at $T_{1/2}$ for the same model, for stars heavier and lighter than $\bar{M}$. The relative depletion of light stars from the central region is in qualitative agreement with observations (van Leeuwen, this Symposium). This feature is due to the preferential effect of the galactic tidal torque on the angular momentum of the relatively more distant light stars, which prevents them from returning to the central regions.

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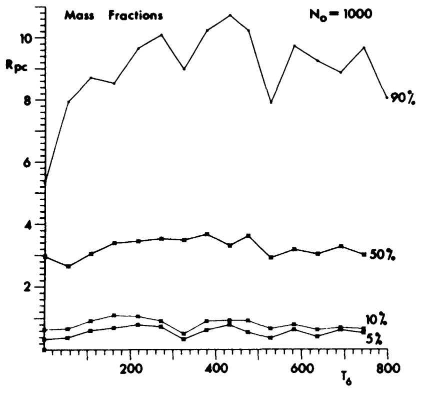

Figure 1. Time evolution of the density distribution for the 1000 star model.

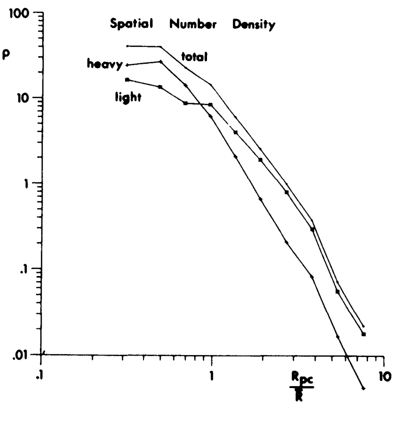

Figure 2. Saptial number density for the 1000 star model.

DISCUSSION

KEENAN: You say that the outer circle was twice the tidal radius, is that correct? Were those stars beyond the tidal radius escaping or were they still bound to the cluster?

TERLEVICH: I suppose that they are escaping. We still consider them inside our calculations, but the number of stars remaining in that range between one and two tidal radii was almost constant in our calculations and it was about four tidal radii.

KING: Do you have any idea why only the thousand star model developed a faster escape rate for the low mass stars?

VAN LEEUWEN: The luminosity gradient was steeper, wasn't it?

TERLEVICH: Well, it was steeper, I didn't say that, but for the steeper luminosity gradient the lifetime of the cluster was even longer.

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