THE BINDING-ENERGY DISTRIBUTION OF THE BINARIES IN A STAR CLUSTER

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SUMMARY

In order to study the development of the binding-energy distribution of hard binaries in a star cluster, solutions of the appropriate kinetic equation have been obtained, using the three-body encounter rates calculated by Heggie (1975). The binaries in a homogeneous, time-independent stellar medium are considered first. We calculate an analytical solution, of self-similar form, that can be applied to very hard binaries. Integrated forward in time from an initial state containing no hard binaries, a numerical solution of the kinetic equation rapidly approaches the equilibrium 'Saha' form of the energy distribution at small energies, while at high energies the numerical solution behaves like our analytical self-similar solution. The fluctuations in the distribution, due to the stochastic nature of binary creation and evolution, are analyzed. We calculate the rate of exchange encounters when stars of different masses are present; these rates are then combined with the other Heggie rates to find the binary distribution in a multi-mass environment. Next, the creation rate as a function of energy is obtained for the binaries that form in two-body, tidally dissipative encounters. This rate is combined with the three-body encounter rates to calculate how the energy distribution of the tidal binaries evolves. Finally, the binding-energy distribution of hard binaries is obtained in a more realistic inhomogeneous, time-dependent cluster model. Although the evolution of the cluster is governed primarily by the effects of two-body relaxation, the influence of the binaries on the cluster is considered as well. A detailed report of this study has been submitted to *The Astronomical Journal*.

REFERENCE

Heggie, D.: 1975, *Mon. Not. Roy. Astron. Soc.* 173, 729.

James E. Hesser (ed.), Star Clusters, 363–364.

DISCUSSION

COHEN: Am I to understand that you have explained the absence of binaries in globulars? What about primordial binaries, if there were any?

RETTERER: The small number of binaries that I found are only the ones that form by dynamical processes during the evolution of a cluster. I haven't yet considered the fate of any primordial binaries.

KEENAN: In addition to the evolution of the energies of the binaries, did you also take into account changes in angular momentum?

RETTERER: No, not at all.

KEENAN: I guess that the angular momentum of the binaries won't have much effect on the overall evolution of the cluster.

BLAAUW: I believe the smallest number that you considered was N=100. Would you care to extrapolate to still smaller numbers, say something like 10 or 20, which would get us models that would be comparable to what in the early days were done by van Albada and others. Would you still expect that the fraction of binaries would increase?

RETTERER: I think it would increase, but I would be very cautious about using my models to extrapolate to those cases.

https://doi.org/10.1017/S0074180900092184 Published online by Cambridge University Press