THE DYNAMICS OF OPEN CLUSTERS

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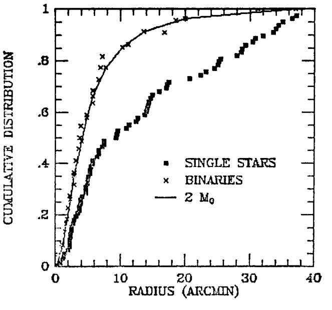
Many of the "observations" of dark matter involve the application of the virial theorem or more sophisticated dynamical models to bound gravitational systems. Such studies often adopt a certain mass function and assume that the system is in a state near equipartition. In many cases though the data are not sufficient to determine the mass function or justify the equipartition assumption. Open clusters provide excellent case studies of systems which are relaxed and which have a large observable stellar-mass range, approaching an order of magnitude in the nearest young clusters. As a result open clusters have recently been the subject of extensive dynamical study.

A comprehensive review has recently been given by Mathieu (1985). The essential results are two-fold. First, open clusters do show substantial mass segregation. Furthermore, the stellar surface-density profiles (as a function of stellar mass) are well-fit by multi-mass equipartition King models. The mass segregation is thus consistent with these clusters being in equipartition. Secondly, the observed velocity dispersions agree well with the predictions of the dynamical models; there is no need to invoke dark matter in these clusters to explain large internal motions. However, dark matter in the form of 1 $M_\odot$ objects or less would not have been detected if the total mass in such dark matter were less than the observed cluster mass.

A new result not shown in Mathieu (1985) is given in Fig. 1, where we show the radial distribution of the 1.2 $M_\odot$ single stars in M67 and the spectroscopic binaries with 1.2 $M_\odot$ primaries. Notice the marked central concentration of the binaries and the excellent agreement with the theoretical density profile for a 2 $M_\odot$ component in equipartition. Presumably any dark matter in the form of similarly massive objects would be distributed in a similar fashion.

Mathieu, R.D. 1985, Dynamics of Star Clusters, (eds. J. Goodman and P. Hut), p. 427, (Dordrecht: Reidel).

Fig. 1



J. Kormendy and G. R. Knapp (eds.), Dark Matter in the Universe, 35.