

King I R. The structure of star clusters. III. Some simple dynamical models.

Astronomical J. 71:64-75, 1966.

[Berkeley Astronomy Department, University of California, Berkeley, CA]

Using a near-Gaussian velocity distribution similar to the one that should be produced by stellar encounters, models are calculated for star clusters whose outer limits are imposed by the tidal force of the Milky Way. Their projected density distributions are similar to those observed in open clusters, globular clusters, and elliptical galaxies. [The *SCI*® indicates that this paper has been cited in over 435 publications.]

Ivan R. King
Astronomy Department
University of California
Berkeley, CA 94720

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This article resulted from a series of probings into the structure of globular star clusters. I had always been intrigued by the simplicity of their appearance and was convinced that underlying it there had to be corresponding dynamical simplicity. Finding this structure was another matter, however. It came to me through a series of fortunate diversions from a lesser task.

For certain calculations of the rate at which stars escape from clusters, I needed density profiles of star clusters, but I could find no adequate ones in the literature: I decided to get some myself. At that time there were no observational facilities at the University of Illinois, Urbana-Champaign, so I arranged to spend some time at Palomar Observatory, taking Schmidt-telescope photographs of clusters on which to do star counts. The result of this study with wide-angle photographs was immediate; the very first star count showed that clusters are limited by the gravitational tidal field of the Milky Way, and this turned out to make all the difference.

Other researchers had previously tried to model star clusters by quite properly assuming a nearly Maxwellian velocity distribution and then finding the density distribution that corresponded to it. Introducing the tidal limit led to an entire family of models that turned out to be quite similar to the set of density profiles that I had derived from the observational study. I found it extremely satisfying that a simple approach had uncovered a simplicity in the clusters themselves. (For a more recent review of this rationale, see reference 1, which was written for a broader audience.)

The calculation of the models was started during a sabbatical at the University of California, Berkeley, and continued at Mount Wilson Observatory. It was completed back at the University of Illinois and was finally published after I moved permanently to Berkeley.

The models were soon accepted as a reasonable representation of star clusters, but their real use dates, I believe, from the realization that they also mimic, in a quite tolerable way, the density distributions in many elliptical galaxies and in clusters of galaxies as well. (The "King models" simply represent the profile of a self-gravitating stellar system that has a near-Gaussian velocity distribution. In nature this type of model is quite common.)

The paper is cited frequently because the models are a useful dynamical starting point (rather than just a density formula) for many calculations in stellar dynamics and because the models are easy to calculate. The National Academy of Sciences referred to the "King models" when I was elected a member.

The models are still used today, although in a somewhat elaborated version. They now represent systems containing a mixture of stellar types that each have a different velocity dispersion. I find them useful for treating the modern problem of representing globular clusters that have dynamically collapsed cores.

1. King I R. The dynamics of globular clusters. *Quart. J. Roy. Astron. Soc.* 22:227-43, 1981.