

Gravity and Thermodynamics. I. Fundamental principles

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Thermodynamics is very important in the dynamical evolution of globular clusters. The effects of the stellar encounters and the evaporation of stars due to the presence of the tidal forces of the galaxy suggest the possibility of considering a thermodynamical equilibrium and therefore a new treatment including the statistical mechanics. It is possible to construct equilibrium models with a different approach by applying thermodynamic principles to a Boltzmann distribution function, with an Hamiltonian which contains an effective potential depending on the kinetic energy of the stars. New relations for the thermodynamical equilibrium in presence of gravity are obtained and the concepts of thermodynamic and kinetic temperature and pressure are introduced. The models present regions with positive and negative specific heat, producing thermodynamic instabilities which drive the clusters towards the so called gravothermal catastrophe, first described by Lynden-Bell and Wood in the well known paper in 1968. The particular distribution of these regions can explain the existence of post-core-collapsed objects, without invoking special processes as the formation of binary systems.

Relatore: FRAGIONE, Giacomo (Univ. Sapienza)

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