The Challenge of Modeling Dense Stellar Systems

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Galaxy nuclei and the cores of globular clusters are regions where the density of stars can reach millions per cubic parsec. Modeling the dynamical evolution of such systems is critical for understanding a number of fundamental processes, including core collapse, the creation of massive black holes, and the generation of gravitational waves. But the computational challenges are severe, due to the large range in time scales; the steepness of gravitational force gradients near a massive compact object; the need to include relativistic corrections to the equations of motion; and finite-size (collisional) effects, among other factors. This talk reviews recent progress in this area, with a highlight on the extreme-mass-ratio inspiral (EMRI) problem.