[GC-05] Nonlinear Effects of Dynamical Friction in a Gaseous Medium

Hyosun Kim and Woong-Tae Kim
Department of Physics and Astronomy, Seoul National University

Dynamical friction of orbiting objects is of great importance in various astronomical systems ranging from protoplanetary disks to galaxy clusters. In analytic studies of dynamical friction, it has been usually assumed that the density wake produced by a moving perturber has low amplitude and is thus in the linear regime. However, there are many astronomical situations such as in a merger of black holes near a galaxy center, where a perturber is so massive that the induced wakes are well in the nonlinear regime. In this work, we consider a perturber in a wide mass range, and study the nonlinear effects of dynamical friction by running high-resolution numerical simulations using the FLASH code. Unlike in the linear cases where Mach waves are attached to a perturber, a very massive perturber quickly develops nonlinear flows that produce a detached bow shock in front of the perturber. The flows behind the shock are initially non-steady, causing the detached shock distance to oscillate and vortex rings to form around the perturber. The vortex rings are eventually shed downstream and the flows evolve toward a quasi-steady state. Increasing the perturber mass enhances the detached shock distance and symmetrizes the density wake near the perturber, resulting in a diminished drag force on a massive perturber compared to the prediction of the linear analysis. This implies that the decay time of a perturber does not scale as the inverse of the perturber mass.

[GC-06] Dynamical Evolution of Globular Clusters within Mini Dark Matter Halos

Jihye Shin[1], Sungsoo S. Kim[1], Young-Wook Lee[2], and Hansung B. Gim[2]
[1]*Department of Astronomy and Space Science, Kyung Hee University*
[2]*Center for Space Astrophysics and Department of Astronomy, Yonsei University*

According to the primordial scenario of globular cluster formation, star clusters were formed within mini dark matter halos in the early universe. If globular clusters initially had a dark matter halo around them, their early dynamical evolution could be different from the case without the halo, which has been the usual assumptions made for the studies of the dynamical evolution of globular clusters. With the most advanced 2-dimensional Fokker-Planck models, we study the effects of the presence of the dark matter halo on the dynamical evolution and the present mass-to-light ratios of globular cluster systems. Moreover, we test a possibility of globular clusters as building blocks of galaxies using comparison between models and observations.