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Super Massive Black Holes pairing during galactic mergers

We present the results of galactic merger simulations in which each galaxy contain a central Super Massive Black Hole (SMBHs). They have been performed with the AMR hydrodynamical code RAMSES (Teyssier 2002) with enough dynamical range to survey the black holes from hundreds of kiloparsecs down to sub-parsec scales. Due to tidal torques, a strong gas inflow produces a turbulent and massive (10^8-10^9 Msun) nuclear disk at the center of the remnant galaxy. We investigated how the thermodynamics of this turbulent nuclear disk affect the black hole pairing process during the few Myrs after the merger of the two galaxies. We reproduced the simulations presented in Mayer et al. 2008 which were performed with a SPH code. At first, we adopted a high-density polytropic (gamma=5/3) equation of state for the gas and a black hole binary system in which the two black holes have a relative separation of 60-80 pc rapidly form at the center of the nuclear disk.
These results are quite similar to the ones obtained with the SPH simulations of Mayer et al. 2008, in which the gas was considered adiabatic. Calculations that include radiative transfer show that the thermodynamic state of a solar metallicity gas heated by a sarburst can be well approximated by an ideal gas with adiabatic index γ = 1.3 – 1.4 (Spaans and Silk 2000). Consequently, we used for the gas a gamma=7/5 polytropic equation of state at high density in a second model. The two black holes rapidly shrink toward each other down to a relative separation of a few 0.1 pc. We investigated how different values of the entropy in the nuclear disk affect its stability and the black hole paring process.