

Equal and Unequal-Mass Mergers of Disk and Elliptical Galaxies with Black Holes

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We present binary galaxy merger simulations of gas-rich disks (Sp-Sp), of early-type galaxies and disks (E-Sp, mixed mergers), and mergers of early-type galaxies (E-E, dry mergers) including radiative cooling, star formation, black hole (BH) accretion, and the associated feedback processes. The numerical simulations include cooling, star formation, supernova feedback, and BH accretion modeled following a Bondi-Hoyle accretion parameterization. The maximum accretion rate is limited to the Eddington rate, with a total of 0.5% of the accreted rest-mass energy distributed as thermal energy to the surrounding gas.

We calculate the line-of-sight stellar velocity dispersion σ and the total bulge mass M_{bulge} within the effective radius. Johansson *et al.* (2009a) compare the BHs of our simulated final merger remnants to the observed relations, whereas Johansson *et al.* (2009b) study the evolution of the BHs in the $M_{\text{BH}}-\sigma$ and $M_{\text{BH}}-M_{\text{bulge}}$ planes during the merger. In Figure 1, we compare our simulated 1:1 (circles) and 3:1 (triangles) merger samples with the observed $M_{\text{BH}}-\sigma$ (left) and $M_{\text{BH}}-M_{\text{bulge}}$ (right) relations. The normalizations for both relations are well fitted for all our simulation samples, whereas the simulated slopes for the $M_{\text{BH}}-M_{\text{bulge}}$ relations are slightly steeper relative to the observations. This discrepancy could plausibly be solved by employing a more aggressive feedback model that would primarily lower the stellar mass of the lower mass systems, bringing the simulated slopes in better agreement with the observations.

References

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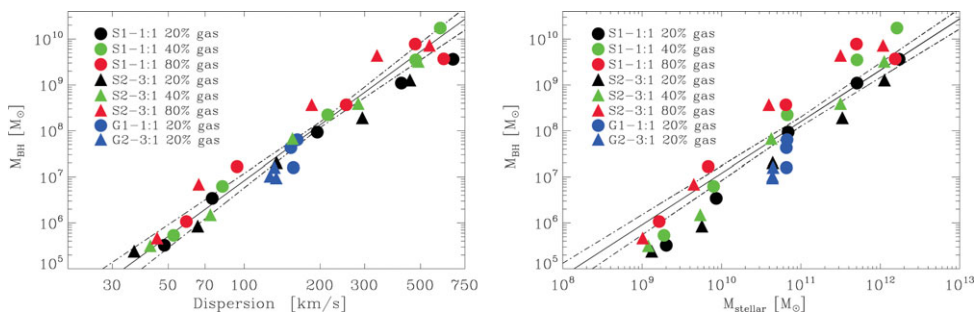


Figure 1. Simulated data (symbols), overplotted by observed relations (lines).