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Title

Galaxy merger statistics and inferred bulge-to-disk ratios in cosmological SPH simulations

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Abstract

We construct merger trees for galaxies identified in a cosmological hydrodynamic simulation and use them to characterize predicted merger rates as a function of redshift, galaxy mass, and merger mass ratio. At $z = 0.3$, we find a mean rate of 0.054 mergers per galaxy per Gyr above a 1 : 2 mass ratio threshold for massive galaxies (baryonic mass above $6.4 \times 10^{10}\ M$), but only 0.018 Gyr^{-1} for lower mass galaxies. The mass ratio distribution is R for the massive galaxy sample, so high-mass mergers dominate the total merger growth rate. The predicted rates increase rapidly with increasing redshift, and they agree reasonably well with observational estimates. A substantial fraction of galaxies do not experience any resolved mergers during the course of the simulation, and even for the high-mass sample, only 50% of galaxies experience a greater than 1 : 4 merger since $z = 1$. Typical galaxies thus have fairly quiescent merger histories. We assign bulge-to-disk ratios to simulated galaxies by assuming that mergers above a mass ratio threshold R_{major} convert stellar disks into spheroids. With R_{major} values of 1 : 4, we obtain a fairly good match to the observed dependence of the early-type fraction on galaxy mass. However, the predicted fraction of truly bulge-dominated systems ($f_{bulge} > 0.8$) is small, and producing a substantial population of bulge-dominated galaxies may require a mechanism that shuts off gas accretion at late times and/or additional processes (besides major mergers) for producing bulges.

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