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Simulating Jet/Outflow Behavior in Massive Galaxies: A New Black Hole Feedback Model in NIHAO Simulations

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Our study introduces a new algorithm for black hole feedback in the Numerical Investigation of a Hundred Astrophysical Objects (NIHAO) project of galaxy simulations. We present two modes of black hole feedback based on both theoretical models and observational evidence highlighting the importance of kinetic AGN outflows in massive galaxies. To account for high Eddington accretion rates, we implement a thermal feedback model that heats the surrounding gas by converting the accreted rest-mass energy. For low-accretion rates, we develop a new kinetic feedback model that converts accreted energy to pure momentum, imparting it to the nearby gas surrounding the supermassive black hole in a direction perpendicular to the black hole spin to simulate jet/outflow behavior. This allows us to study high-mass, elliptical galaxies, where feedback from the central black hole significantly affects their evolution. In this presentation, we focus on testing and calibrating the algorithms against the stellar mass versus halo mass relation and the black hole mass versus stellar mass relation to demonstrate the effectiveness of our models.

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