X42a AGN Jet Feedback Model for Galaxy Simulation

Abednego Wiliardy, Kentaro Nagamine (Osaka U.), Renyue Cen (Princeton U.)

Simulating the effect of AGN jet on cosmological-scale simulation has been a challenge for many years. Jets launched by a supermassive black hole (SMBH) in the galactic center are believed to quench the star formation in the galactic disk indirectly by heating up the galaxy halo through the ram pressure or stirring-up the circumgalactic medium (CGM). However, AGN jets tend to be ignored or oversimplified in cosmological simulation due to the difficulties of its implementation in Lagrangian-based codes which are typically used at such scale. In this research, we introduce a new method to treat the effect of AGN jet using SPH-based code GADGET3-Osaka. Here, we do not try to resolve the evolution of the jet, which is computationally expensive for large-scale simulations, but we attempt to simulate the evolution of jet cocoons and lobes instead. We solve the dynamics semi-analytically by balancing the jet thrust with the ram pressure of the CGM. The jet model is treated by the GHost particles which are gas (SPH) particles that host feedback information. Two types of GHosts are used here, i.e. the front GHost that represents the jet lobe, and the intermediate GHost that delivers feedback information from SMBH to the front GHost while distributing thermal energy along the path in proportion to the gas column density. In contrast to the intermediate GHost, the front GHost is actually moved at cocoon velocity exerting pressure on the CGM. Through this method, we are able to simulate collimated jet feedback that heats up the CGM and pushes away the gas producing outflow which eventually quenches the star formation by preventing gas from being recycled into the galactic disk.