PAP301
Seminar in Particle Physics and Astrophysical Sciences
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The Impact of AGN Feedback on Galaxy Formation in Gas-Rich Mergers at z~1-2

Supermassive black holes (SMBHs) are found in the cores of most massive galaxies and play a crucial role in galaxy evolution, as they heat and accrete gas in their vicinity and eject stars from the central regions of their host galaxies. Hence, in order to understand galaxy evolution, accurate models for the interaction between SMBHs and their host galaxies are necessary.

When supplied with a large reservoir of material, the accretion disks around SMBHs become incredibly luminous – such SMBHs are called active galactic nuclei (AGNs). The accretion rate, mass consumed per unit time, is self-regulated through a process called *AGN feedback*: the energy released via accretion acts to disperse the remaining gas surrounding the AGN. Hence, with a high enough accretion rate, all the material is dispersed and the accretion shuts down. AGN feedback is typically implemented using one of two models: thermal and kinetic AGN feedback, in which nearby gas particles are either heated or 'kicked', respectively.

Furthermore, galaxies are not isolated and interact frequently with each other. Galaxy mergers are another key process in galaxy evolution. As said mergers take place over astronomical timescales, numerical N-body simulations are a key component in modeling them. Additional gas dynamics, such as smoothed particle hydrodynamics, are required to model the AGN feedback (among other processes). In my thesis, I perform such simulations using two N-body codes: *GADGET* and *KETJU*, which is an extension to GADGET and yields more accurate SMBH dynamics.

In addition to mergers and AGN feedback, galaxies evolve through a multitude of other astrophysical phenomena. For example, GADGET and KETJU simulations also include gas cooling, star formation, and stellar feedback. Galaxies in the early Universe (high z) contained vast amounts of gas, which enabled rapid star formation and high accretion rates. Thus, it is especially interesting to study the effects of AGN feedback at redshifts z~1-2, which correspond to a reasonably early Universe and the period of peak star formation. A further advantage of z~1-2 is that there exists an ample amount of observational data, which can be compared with results from the aforementioned numerical simulations. Such comparison suggests that both AGN feedback models produce realistic merger remnants, but are not perfect.