Abstract

Supermassive black holes (SMBH) are found in centres of massive galaxies at all epochs. Furthermore, they have been invoked as an important element of the galaxy evolution models. It still remains unclear how the feedback from accretion-powered SMBH, known as Active Galactic Nucleus (AGN), can shape the evolution of its host galaxy. It is believed that AGN reduce or even completely quench star formation and are responsible for ejecting dense gas far out of the galactic disc. Moreover, compelling observational evidence suggests that SMBHs coevolve with their hosts, self-regulating their own growth. With the recent advances in observational techniques of these exotic objects, like the Laser Interferometer Space Antenna or the Event Horizon Telescope, it is a high time to improve our understanding of SMBH-galaxy coevolution.

In this Thesis, I use adaptive mesh refinement hydrodynamical simulations in which I study SMBHs formation, growth, dynamics and feedback in order to understand how they coevolve with their massive, gas-rich, clumpy hosts at the peak of star formation epoch. I examine this connection from two perspectives. Firstly, I focus on the growth of a SMBH and its subsequent dynamical evolution within a supernovae-dominated interstellar medium. In this line of research I propose a new model in which SMBH is embedded within a dense and compact nuclear star cluster. This additional stellar component, supported by observations, locks SMBH in the centre of a galaxy, fostering its subsequent growth. Secondly, I switch the perspective to a galaxy as a whole. I demonstrate how does the AGN feedback impact star formation and argue, that massive molecular outflows seen in observations of high-redshift galaxies can be explained by the cooperation between AGN and supernovae feedbacks. Furthermore, I also show the impact of numerical modelling of hydrodynamics on the AGN feedback efficiency in idealised clusters of galaxies, which are important cosmological testbeds.