Constraints on feedback models in galaxy formation from their density slope, mass-size and star formation efficiency in EAGLE

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State-of-the art hydrodynamical simulations with improved stellar and AGN feedback can reproduce the cosmic star formation history of the Universe and the galaxy stellar mass function. Hydrodynamic simulations are currently working only above certain mass and spatial resolutions, however, and physical processes on smaller scales are implemented via analytic prescriptions known as 'sub-grid physics'. EAGLE suite of hydro-simulations with several galaxy formation scenarios empowers us to systematically explore the impact of varying feedback prescriptions on large representative populations of stellar systems. Strong gravitational lensing is one of the most robust and powerful techniques to measure the total mass and its distribution in galaxies on kpc scales allowing their inner structure and evolution over cosmic time to be studied in detail. I will present and discuss impact of nine different theoretical model in EAGLE (see Mukherjee et al. 2019) on the mass-density and mass-size scaling relation, possible observational systematics (e.g. differences in model-fitting methodologies, differences in filters/bands of the observational surveys, possible lens selection biases, etc.) as well as resolution effects in the simulations, that might affect their comparison. We find that models in which stellar feedback becomes inefficient at high gas densities, or weaker AGN feedback with a higher duty cycle, produce strong lenses with total mass density slopes close to isothermal and mass-size relation agreeing with strong lensing observations. I will also demonstrate the differences in comparison of mass-size relation of EAGLE galaxies with strong lensing and non-lensing galaxies from observations. In later part of my talk, I will present our recent analysis of the stellar-to-halomass relation of EAGLE galaxies, which connects the stellar mass $M_\star$ of a galaxy to its dark matter halo of mass M_h along with their morphology and internal kinematics of galaxies. The star formation efficiency and its correlations with kinematics and morphology provides as means to classify the galaxy population and infer aspects of its evolution over cosmic time. We find that very massive (elliptical) galaxies are triaxial and a clear gradient of sSFR with M_*/M_h at low mass, which completely vanishes at 10^{10} Msun where sSFR seems to depend only on M_*.