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Introducing the VariableTNG Simulation: Impact of Baryon Physics on Galaxy Formation

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Cosmological hydrodynamical simulations are one of the most important methods to understand galaxy formation and evolution. Current hydro-simulations are able to produce many observables in the galaxy surveys. However, detailed comparisons between simulations and observations indicate apparent discrepancies. This raises the question whether the discrepancy is caused by the wrong physical mechanisms or inaccurate subgrid model parameters. Therefore, we propose the VariableTNG project by varying the model parameters of IllustrisTNG. Running with the resolution similar to that of TNG-100, we are able to use VariableTNG simulations to investigate the effect of different physical mechanisms. We have applied this set of simulations to study the morphological evolution of galaxies and the origins of the little red dots. We find that the morphology of galaxies is closely related to the star-formation density threshold and strength of AGN feedback. We also produce realistic little red dots SEDs in the VariableTNG simulations to check their density distribution as well as the stellar-black hold mass relations.

Author: Prof. GUO, Hong (Shanghai Astronomical Observatory)

Presenter: Prof. GUO, Hong (Shanghai Astronomical Observatory)

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