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Constraining cosmology and astrophysical feedback processes with CAMELS simulations

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Cosmology and astrophysical processes (like Supernovae and AGN feedback) both influence the formation and evolution of galaxies in different ways.
By comparing scaling relations among size, dark matter and stellar mass from thousands of CAMELS simulations with observations, we demonstrate that it is possible to constrain the cosmological parameters ($\Omega_{\rm m}$ and, with less accuracy, $_{8}$) and supernovae feedback-related parameters.
CAMELS simulations calibrated to the original IllustrisTNG simulation cannot reproduce the observed scaling relations for SPARC late-type galaxies. Results show that a lower value of wind energy per unit SFR than the one proposed in the fiducial IllustrisTNG simulation is required to correctly reproduce the observations.
I will also show, extending the procedure to early-type galaxies, what are the key differences between late- and early-type galaxies in simulations and what is the sensitivity of the method to the observational sample, by considering observations from different galaxy samples (SPIDER, $\rm ATLAS^{3D}$ and MaNGA DynPop). I will point out the difficulties in finding a simulation which can coherently reproduce the scaling relations for late- and early-type galaxies.
The comparison of observed and simulated scaling relations with such a level of detail provides a promising method to validate the capacity of sub-grid physical processes in cosmological simulations to reproduce correctly real data encompassing different galaxy types and masses.

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Galassie e Cosmologia

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