Highlight

IllustrisTNG: the new frontier to understand the co-evolution of dark-matter and galaxies with cosmological simulations of structure formation

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I will describe the numerical efforts to simulate galaxies with the code AREPO across an unprecedented range of halo masses, environments, evolutionary stages and cosmic times. In particular, I will focus on the IllustrisTNG project (www.tng-project.org), a collaboration among Heidelberg, Munich, New York and Boston. There we are aiming to simulate a series of three gravity+magnetohydrodynamics cosmological volumes (50, 100, 300 Mpc a side, respectively) capable of both resolving the inner structures of galaxies as small as the classical dwarfs of the Milky Way, as well as of sampling the large scale structure of the Universe with thousands among groups and clusters of galaxies. I will briefly review what is explicitly and empirically solved in gravity+magnetohydrodynamics simulations for galaxy formation in a cosmological context and what is required and what it means to "successfully" reproduce populations of galaxies which resemble the real ones. I will therefore show preliminary results from the IllustrisTNG simulations, by focusing on the assembly of the most massive structures in the Universe, the build up and characterisation of the faint stellar envelopes around galaxies, the connections of the latter to their host DM haloes, and our theoretical expectations for the distribution of dark matter (DM) and stars on large scales and within galaxies.