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STRUCTURES JOUR FIXE

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"Universe(s) in a box: towards numerical simulations of the Reionization"

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ABSTRACT

Within the goals of CP1, we plan to realize extremely high-resolution simulations of the first galaxies that appeared in the Universe, most probably during the so-called epoch of Reionization. In this talk, I will give an overview of the technical and scientific challenges for realizing such numerical models and will describe the starting point of the development, the IllustrisTNG project.

The IllustrisTNG simulations (www.tng-project.org) are a novel laboratory to explore galaxy physics and to quantify the assembly and evolution of galaxy populations across an unprecedented range of masses, environments, evolutionary stages and cosmic times. IllustrisTNG is an ongoing program of large cosmological volume simulations where gravity, magnetohydrodynamics, and prescriptions for star formation, stellar evolution, the enrichment of gas with chemical elements beyond Helium, cooling and heating of the gas, galactic outflows and feedback from the supermassive black holes are all taken into account within an expanding model Universe that complies with the standard cosmological paradigm.

In practice, in these simulations we simultaneously follow the co-evolution of cold dark matter, cosmic gas, stars, super massive black holes, and cosmic magnetic fields to resolve and model the structural details of thousands of galaxies together with the large-scale cosmic web. They are obtained with the moving-mesh code AREPO through computational investments of more than 100 million computing hours on thousands of computing cores and producing more than 1PB of data. In this talk, I will review our efforts to generate and effectively exploit such simulations, describe our strategies for dissemination, showcase some of the insights they are allowing us to uncover, and highlight what technical and conceptual steps are needed to model also the Reionization of the Universe.

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