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Modelling inhomogeneous cosmologies with Numerical Relativity

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Building accurate, multi-scale models of the Universe is a complex but necessary task in the era of precision cosmology, when observational data demands a thorough understanding of all effects which are expected to contribute at the 1% level, among which the full role of General Relativity. This task has recently been tackled with a variety of approaches, which range from the study of toy models [1], to analytical expansions [2] and hybrid analytical-numerical methods where relativistic effects are superimposed on classical, Newtonian N-body systems [3][4][5].

In this presentation, I will describe recent work carried out in Numerical Relativity to describe the relativistic Universe exactly, integrating Einstein's equation in three dimensions. This approach is the only one that can account for the full extent of the theory, and has already yielded significant results in several scenarios, such as black-hole lattices [6] and scalar-field collapse in cosmological settings [7].

References:

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[4] Adamek, J. et al, "N-body methods for relativistic cosmology", http://arxiv.org/abs/1408.3352

[5] Adamek, J. et al, "General relativity and cosmic structure formation", http://arxiv.org/abs/1509.01699

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