

Exact General Relativity contrasted with cosmological perturbations and Newtonian gravity

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We examine the relation between non-perturbative General Relativity, cosmological perturbations (linear and non-linear) and Newtonian gravity by means of an exact non-spherical solution of Einstein's equations (the Szekeres models) that allows for a non-trivial modeling of realistic cosmic structure. We show that the exact dynamics of cosmological perturbations for dust sources (at all approximation orders and in the isochronous gauge) is fully contained in the exact dynamics of the models. We also show that the models provide a fully relativistic (and exact) generalization of the Zeldovich approximation that is widely used in Newtonian dynamics. These comparison and equivalences can be very useful to assess the role of relativistic corrections to many cosmological calculations to fit observations that are done by perturbations and by Newtonian gravity.

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