



Contribution ID: 222

Type: **Talk**

Initial conditions for simulations of arbitrary modified gravity, beyond quasi-static approximations

Monday, 7 December 2015 15:24 (21 minutes)

I will present a novel description for setting initial particle displacements and field values under arbitrary metric theories of gravity, for perfect and imperfect fluids with arbitrary characteristics. We extend the Zel'dovich Approximation to nontrivial theories of gravity, and show how scale dependence implies curved particle paths, even in the entirely linear regime of perturbations. Initial conditions set at high redshifts are affected at the level of up to 5% at Mpc scales, which exemplifies the importance of going beyond Λ CDM initial conditions for modifications of gravity outside of the quasi-static approximation. Our description paves the way for simulations and mock galaxy catalogs under theories of gravity beyond the standard model, crucial for progress towards precision tests of gravity and cosmology.

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Session Classification: 03 - Modifications of gravity