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Perturbation theory in bulk viscous cosmology

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The ΛCDM model is currently our best description of the universe. However, the model does not come without fault as discrepancies between theory and observation have emerged. Bulk viscosity has been proposed as a possible extension to the ΛCDM model as to account for these mismatches. We review two alternative scenarios for the study of relativistic dissipative hydrodynamics applied to cosmological uids, namely the Eckart and Muller-Israel-Stewart (MIS) theories. Our objective is to study the eects of bulk viscosity on the formation of large-scale structure via the evolution of the metric potential and dark matter density perturbations. After reviewing the results from standard cosmological perturbation theory, we compare the two competing theories for dissipative hydrodynamics. We investigate changes to the conservation equations as well as the Einstein equations with the introduction of the bulk viscous pressure. We will then discuss the numerical solutions found for the evolution of the metric potential as well as comment on the clustering properties of the dark matter density perturbations. We compare the results from the two competing theories. We see that for the metric potential, the Eckart and MIS theories deviated from the ΛCDM case. We comment on nature of current cosmic tensions in this context. Future work is also discussed.

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