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Solid matter with zero shear modulus in flat universe

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For a perfect fluid, the quantity defined through mixed components of the stress-energy tensor $\widetilde{w} = (T_i{}^i/3)/(-T_0{}^0)$ is independent on the choice of coordinates only for two values of the pressure to energy density ratio $w = p/\rho$: for radiation with $w = 1/3$, and for dark energy with $w = -1$. With other choices of w, the quantity $\widetilde{w}$ is coordinate dependent, and $\widetilde{w} = w$ only in the local rest frame of the fluid. We show that the same is true also for solid matter with shear stress Lamé coefficient set to zero in a flat Friedmann-Lemaitre-Robertson-Walker universe with perturbed metric as well as stress-energy tensor. We call the two different solids with coordinate independent $\widetilde{w}$ radiation-like solid and dark energy-like solid, and we restrict ourselves to these two special cases. By analysing second order perturbations we discover two one parametric sets of such solid matter models containing special cases of radiation and dark energy as perfect fluids. We also study equations for perturbations up to the second order for both sets of models.

Reference to paper (DOI or arXiv)

https://arxiv.org/abs/2102.06051

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