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A new framework for analyzing the effects of small scale inhomogeneities in cosmology STEPHEN GREEN, ROBERT WALD, University of Chicago — While the universe is spatially homogeneous and isotropic on large scales, it is extremely inhomogeneous on small scales, where fractional density perturbations can be much larger than one. With this in mind, several authors have proposed that, when properly averaged, non-linear terms in the Einstein equation can mimic Dark Energy. We present a non-vacuum generalization of the "short-wave approximation", which takes such large density fluctuations on short scales into account in a mathematically rigorous manner. We prove that if the stress energy tensor of matter satisfies the weak energy condition, then the zeroth order "effective stress energy tensor" associated with the small scale density and metric fluctuations must be trace-free and satisfy the weak energy condition as well. We conclude from this that small scale density inhomogeneities cannot account for the acceleration of the scale factor. However, at first order, we find that linearized cosmological perturbation theory can be corrected to include small but non-zero backreaction effects of small scale density inhomogeneities.

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