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Long-wavelength perturbations as a test of dark energy EDMUND BERTSCHINGER, MIT Department of Physics — Long-wavelength perturbations of a Robertson-Walker universe evolve like Robertson-Walker universes with perturbed spatial curvature or equation of state. This result, which is true in a much broader class of theories than general relativity, reduces the time-dependence of long-wavelength density perturbations to quadratures involving the Hubble expansion rate. Thus, measurements of the growth-rate of long-wavelength cosmological density perturbations, such as weak lensing or the abundance of galaxy clusters, should in principle provide no more information about dark energy than measurements of the expansion history made, e.g., by supernovae or baryon acoustic oscillations. Nevertheless, it is worthwhile to measure both the expansion history of the universe and the evolution of clustering because (1) the two methods have different systematic errors, (2) comparison of the two methods provides an independent test of the Cosmological Principle, and (3) comparison also provides information about long-wavelength entropy perturbations. A violation of the quadrature relation could signify the presence of new long-range forces.

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