

Abstract

I: Generation of second order gravitational waves from an early matter era: Prof David Wands and I investigate the generation of gravitational waves due to the gravitational instability of primordial density perturbations in an early matter-dominated era which could be detectable by experiments such as LIGO and LISA. We use relativistic perturbation theory to give analytic estimates of the tensor perturbations generated at second order by linear density perturbations. We find that large enhancement factors with respect to the naive second-order estimate are possible due to the growth of density perturbations on sub-Hubble scales. However very large enhancement factors coincide with a breakdown of linear theory for density perturbations on small scales. II: Constraints on the primordial density perturbation from second order gravitational waves: We consider second order gravitational waves as a constraint on the primordial density perturbation for modes much smaller than those probed by the cosmic microwave background (CMB). Generation of induced gravitational waves during the radiation era or reheating after inflation is considered. We determine an upper bound for the density perturbation at the present time and we are able to determine that if second order gravitational waves are not detected with the future detectors such as BBO the upper bound for the primordial density perturbation on small scales will become similar to the density perturbation on the CMB scale. III: Also if I will have enough time, I would like to address the gauge dependency of second order gravitational waves.