

Deformation of the gravitational wave spectrum by density perturbations

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In recent years, the possibility of having large density perturbations at high wavenumbers has been actively studied, especially in the study of primordial black holes (PBHs). In this presentation, we point out that such density perturbations affect any pre-existing gravitational wave (GW) spectrum through CMB-like effects. Since GWs produced in the early universe propagate through the density perturbations before reaching the observer, GWs coming from each direction experience different evolution depending on the density perturbations. As a result, the observed (directionally averaged) GWs generally have a deformed spectrum compared to the original one. Therefore, by carefully comparing the observed spectrum with the theoretical GW spectrum at the time of production, we may be able to indirectly observe density perturbations at high wavenumbers. In this presentation, we explain how this effect shows up and estimate the maximum expected impact on the GW spectrum, taking into account the latest bound on density perturbations from PBH searches.

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