# Induced gravitational waves from a universe filled with primordial black holes

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**Abstract**

As recently argued in the litterature, there may exist some transient matter domination era in the early universe, before Big Bang Nucleosynthesis (BBN), driven by light primordial black holes. These light primordial black holes (PBHs) should have evaporated by BBN and the only way to constrain them is through the gravitational waves produced due to second order gravitational interactions. Thus, in this work we compute the induced second order gravitational wave spectrum sourced by scalar perturbations due primordial black hole formation. In order to do so, we assume randomnly initially distributed primordial black holes, i.e. Poissonian distribution of their number density, and by coarse-graining the PBH energy density field we extract the matter power spectrum upon formation time. Then, we solve the equation of motion for the tensor modes sourced at second order by scalar perturbations and compute the energy density spectrum of gravitational waves, $\Omega_{\rm GW}$, at evaporation time. As we see, the second order gravitational waves are so abundantly produced that primordial black holes should not have formed in the early universe and driven the universe energy content.