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Freezing-In Gravitational Waves

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The thermal plasma in the early universe produced a stochastic gravitational wave (GW) background, which peaks today in the microwave regime and was dubbed the cosmic gravitational microwave background (CGMB). In previous works only single graviton production processes that contribute to the CGMB have been considered. In this talk we also investigate graviton pair production processes and show that these can lead to a significant contribution if the ratio between the maximum temperature and the Planck mass, $T_{\rm max}/m_{\rm p}$, divided by the internal coupling in the heat bath is large enough. As the dark matter freeze-in production mechanism is conceptually very similar to the GW production mechanism from the primordial thermal plasma, we refer to the latter as "GW freeze-in production". We also show that quantum gravity effects arising in single graviton production are smaller than the leading order result by a factor $(T_{\rm max}/m_{\rm p})^2$.

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