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Cosmological stimulated emission

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We study stimulated emission and absorption of gravitons in a squeezed vacuum state immersed in a thermal radiation bath. Employing one-loop interaction-picture perturbation theory, we track the time evolution of the graviton number operator and its expectation value in the squeezed vacuum, which characterizes the inflationary graviton state. In a Minkowski background with a thermal bath as a toy example, we demonstrate that the net graviton emission or absorption rate depends sensitively on the initial squeezing parameters. As a thought experiment, we consider LIGO/Virgo-like detectors operating in radiation at temperatures of order 0.1 GeV and find that graviton occupation numbers at frequencies of order 100 Hz can be significantly enhanced, suggesting a novel mechanism for amplifying gravitational-wave signals. Although these conditions exceed current experimental capabilities, they point toward potential future advances in detection. Extending our analysis to an expanding, radiation-dominated universe, we show that subhorizon gravitons undergo stimulated absorption, while superhorizon modes exhibit secular logarithmic growth, indicating the breakdown of perturbative methods and motivating further investigation. These findings open a new direction for exploring graviton coherence effects in realistic cosmological and laboratory settings.

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