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Graviton quantum noise on geodesic congruences and gravitational decoherence

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Using the Feynman-Vernon influence functional approach, we study the effects of quantum noise of gravitons on particles. These effects manifest as a stochastic tensorial force whose correlator is given by the graviton noise kernel associated with the Hadamard function of the quantized gravitational field. We solve the corresponding Langevin equation to obtain the fluctuations of particle separations due to this quantum noise for various states of the graviton. The influence of this force on the geodesic congruence through the Raychaudhuri equation is also presented. For the quantum case, we derive the master equation of the reduced density matrix of the particles and estimate the gravitational decoherence effect of gravitons on the quantum particles.

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