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Dephasing by a Continuous-Time Random Walk Process

Daniel M Packwood, Yoshitaka Tanimura

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Stochastic treatments of magnetic resonance spectroscopy and optical spectroscopy require evaluations of functions like <exp(i int_0^t Q(s)ds)>, where t is time, Q(s) is the value of a stochastic process at time s, and the angular brackets denote ensemble averaging. This paper gives an exact evaluation of these functions for the case where Q is a continuous-time random walk process. The continuous time random walk describes an environment that undergoes slow, step-like changes in time. It also has a well-defined Gaussian limit, and so allows for non-Gaussian and Gaussian stochastic dynamics to be studied within a single framework. We apply the results to extract qubit-lattice interaction parameters from dephasing data of P-doped Si semiconductors (data collected elsewhere), and to calculate the two-dimensional spectrum of a three level harmonic oscillator undergoing random frequency modulations.

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