

# Continuous time cluster algorithm for the spin-boson model

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The paradigmatic model for a simple quantum mechanical degree of freedom coupled to a dissipative bath is the spin-boson model [1]. Its partition function can be expressed as a path integral over imaginary time world lines of an Ising spin in a transverse field with a weight that contains retarded self-interactions decaying algebraically in time. We implemented a continuous imaginary time cluster algorithm that samples directly this path integral without Trotter-discretization and applied it to various forms of the bath spectral function. We find that the quantum phase transition occurring at a critical spin-bath coupling strength is for all low frequency powers  $s$  of the spectral function in the same universality class as the classical Ising chain with  $1/r^{1+s}$  long range interactions, which is at variance with a recent RG prediction [2].

[1] A.J. Legget *et al.*, Rev. Mod. Phys. **59**, 1 (1987).

[2] M. Vojta, N.-H. Tong, R. Bulla, Phys. Rev. Lett. **94**, 070604 (2005).