Efficient Calculation of Energy Expectation Values in the Path Integral Formalism

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Abstract. A newly developed analytical method has made it possible to systematically accelerate numerical calculation of generic transition amplitudes in the path integral formalism by many orders of magnitude by constructing a hierarchy of effective actions SN(p) for N-fold discretized theory where level p effective actions improves convergence of discretized transition amplitudes to the continuum limit from 1/N to 1/Np [A. Bogojević, A. Balaž, A. Belić, Phys. Rev. Lett. 94 (2005) 180403, Phys. Rev. B 72 (2005) 064302, Phys. Lett. A 344 (2005) 84]. Here we extend the applicability of the above method to the calculation of energy expectation values by constructing analytical expressions for energy estimators of a general theory for each level p. As a result of this, energy expectation values converge to the continuum as 1/Np. By performing a series of Monte Carlo simulations on several different models we demonstrate that the analytical results do indeed hold.

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