Quantum Fokker-Planck equation with positive definiteness condition via path integral influence functional formalism

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Quantum Fokker-Planck equation (QFPE) offers a well-defined way to extend classical Brownian motion for quantum regime, but microscopic derivation of a satisfactory form of QFPE remains challenging. Best known form of QFPE is the one derived long time ago by Caldeira and Leggett (CL) employing the Feynman-Vernon influence functional formalism. While this CL-QFPE has served as a key theory for a wide range of condensed phase quantum dynamical processes and for understanding quantum decoherence, its non-positivity has remained an important theoretical issue to be improved upon. This talk presents a recent generalization [1] of the CL-QFPE for photo-induced nonequilibrium processes and for intermediate temperature regime. This is achieved through consistent expansions of the paths of the influence functional up to the second order with respect to time and Gaussian integration complex domain. The resulting equation can account for non-equilibrium effects of the bath through time dependent kernels and additional terms, and has clear positive definiteness condition. The steady state limit of this QFPE also provides corrections of CL-QFPE for the quantum and non-Markovian effects of the bath.

References

1. Seogjoo Jang, *J. Chem. Phys.* **144** (2016), 214102.