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Series-Expansion Thermal Tensor Network Approach for Quantum Lattice Models[1] WEI LI, BIN-BIN CHEN, YUN-JING LIU, ZIYU CHEN, BeiHang University — In this work we propose a series-expansion thermal tensor network (SETTN) approach for efficient simulations of quantum manybody systems. This continuous-time SETTN method is based on the numerically exact Taylor series expansion of equilibrium density operator $e^{-\beta H}$ (with H the total Hamiltonian and β the imaginary time), and is thus Trotter-error free. We discover, through simulating the XXZ spin chain and square-lattice quantum Ising models, that not only the Hamiltonian H, but also its powers H^n, can be efficiently expressed as matrix product operators, which enables us to calculate with high precision the equilibrium and dynamical properties of quantum lattice models at finite temperatures. Our SETTN method provides an alternative to conventional Trotter-Suzuki renormalization group (RG) approaches, and achieves an unprecedented standard of thermal RG simulations in terms of accuracy and flexibility.

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