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Analytic time evolution, random phase approximation, and Green functions for matrix product states JESSE M. KINDER, Case Western Reserve University, CLAIRE C. RALPH, Cornell University, GARNET KIN-LIC CHAN, Princeton University — Drawing on similarities in Hartree-Fock theory and the theory of matrix product states (MPS), we explore extensions to time evolution, response theory, and Green functions. We derive analytic equations of motion for MPS from the least action principle, which describe optimal evolution in the small time-step limit. We further show how linearized equations of motion yield a MPS random phase approximation, from which one obtains response functions and excitations. Finally, we describe site-based Green functions associated with MPS. Using the fluctuation-dissipation theorem, we analyze the correlations introduced by the random phase approximation relative to the ground state wave function.

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