Advancements on the matrix product state excitation ansatz

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Matrix product state (MPS) numerics are the state of the art for studying ground state properties in low-dimensional quantum many-body systems. For studying low-lying excitations, there are two complementary approaches we may use: statics, where we find the low-lying eigenstates directly, and dynamics, where we simulate the time evolution of a non-stationary state. In this talk, we shall discuss the static approach in the form of the MPS excitation ansatz [1,2]. In particular, we shall show that the excitation ansatz and its extensions can be expressed as an MPS with a special block-triangular structure, analogous to matrix product operators, which we can use to easily solve for expectation values [3]. We shall also highlight some of our recent work in finding stable single-particle excitations inside of a multi-particle continuum, studying spectra of bound-state excitations, and using the excitation ansatz to construct real-space wave packets to study particle collisions.

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