Contribution ID: **9**   Type: **Oral Presentation**

Matrix product state methods for excitations

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. 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. We shall also highlight some of our recent work in finding stable single-particle excitations inside of a multi-particle continuum, and using the excitation ansatz to construct real-space wave packets to study particle collisions.

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Session Classification: B - Contributed Talk