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Computing excitations in a matrix product state with block Lanczos

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Matrix product state methods are known to be efficient for computing ground states of local, gapped Hamiltonians, particularly in one dimension. We introduce the multi-targeted method that acts on a bundled matrix product state, holding many excitations. The use of a block or banded Lanczos algorithm allows for the simultaneous, variational optimization of the bundle of excitations. The method is demonstrated on a Heisenberg model and other cases of interest. A large number of excitations can be obtained at a small bond dimension with highly reliable local observables throughout the chain. Applications to several models and other cases are also discussed.

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