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Simulations of Quantum Spin Chains with Translationally Invariant Matrix Product States

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ABSTRACT:

We will present several new algorithms for the simulation of strongly correlated quantum spin chains, followed by an analysis of their properties and performance. The algorithms are based on a special class of variational states called Matrix Product States (MPS). MPS are known to be particularly well suited to represent states with a finite amount of entanglement, thus they can be used to accurately simulate non-critical systems. We will show that by applying the correct scaling analysis, MPS can also be used to simulate critical systems faithfully. We will mainly talk about algorithms for the approximation of translationally invariant ground states. On top of these results we will present an algorithm for excited states with well defined momentum. This ansatz will turn out to be very well suited to approximate one-particle excitations.