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Variational Study of a Finite Heisenberg Chain ERIC ASHENDORF, JOE WEINER, JAY D. MANCINI, Kingsborough College of CUNY, VASSILIOS FESSATIDIS, Fordham University, SAMUEL P. BOWEN, Chicago State University — Here we wish to study the ground-state of the $1D$ Heisenberg chain

$$H = -\frac{1}{2}J\sum_{l=1}^{N}\left[2\left(\sigma_l^+\sigma_{l+1}^+ + \sigma_l^-\sigma_{l+1}^-\right) + \sigma_l^z\sigma_{l+1}^z\right],$$

where the σ's are the usual Pauli spin matrices and J is the strength of the spin-spin interaction. The purpose of our revisiting such a well known system is to use it as a benchmark for our variational ansatz in which a trial vector is chosen $|\psi_0(\alpha)\rangle = \exp\left(\alpha\sum_{l=1}^{N}\sigma_l^+\sigma_{l+1}^z\right)|0\rangle_N$, where α is the variational parameter and $|0\rangle_N$ is an appropriately chosen initial array of spins. We then construct a basis according to the prescription $|\psi_m\rangle = \partial_\alpha^m|\psi_0(\alpha)\rangle$ creating an energy matrix with elements $h_{ij} = h_{ij}(\alpha, J)$ whose eigenvalues are then evaluated.

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