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Variational Ground-State of the One-Dimensional Heisenberg Model J.D. MANCINI, Kingsborough College of CUNY, V. FESSATIDIS, Fordham University, R.K. MURAWSKI, Drew University, W.J. MASSANO, SUNY Maritime, S.P. BOWEN, Chicago State University — We wish to study the ground state of a spin system described by the Heisenberg Hamiltonian

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

where $\sigma^{\pm} = \sigma_x \pm i\sigma_y$ and J is the interaction strength. We choose as our trial ket $|\psi_0\,(\lambda)\rangle = e^{\lambda \hat{S}}\,|\phi_0\rangle$ where $|\phi_0\rangle$ is chosen to be the ferromagnetic state with all spins aligned downward, and $\hat{S}$ is the operator $\hat{S} = \sum_l \sigma_l^+ \sigma_{l+1}^+$ with λ a variational parameter. We then construct our variational basis by systematically taking derivatives of $|\psi_0\,(\lambda)\rangle$ with respect to λ: $|\psi_N\,(\lambda)\rangle = \partial_\lambda^N\,|\psi_0\,(\lambda)\rangle$. The lowest eigenvalue of the Hamiltonian matrix $E_0\,(\lambda)$ is then minimized with respect to λ. Comparisons are then made with other approximation schemes.

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