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A tensor product state approach to spin-1/2 square J1-J2 antiferromagnetic Heisenberg model: evidence for deconfined quantum criticality[1] LING WANG, Beijing Computational Science Research Center, ZHENG-CHENG GU, Perimeter Instititute, FRANK VERSTRAETE, University of Vienna, XIANG-GANG WEN, Massachusetts Institute of Technology — We study this model using the cluster update algorithm for tensor product states (TPSs). We find that the ground state energies at finite sizes and in the thermodynamic limit are in good agreement with the exact diagonalization study. At the largest bond dimension available $D = 9$ and through finite size scaling of the magnetization order near the transition point, we accurately determine the critical point $J_2^{c_1} = 0.53(1)J_1$ and the critical exponents $\beta = 0.50(4)$. In the intermediate region we find a paramagnetic ground state without any static valence bond solid (VBS) order, supported by an exponentially decaying spin-spin correlation while a power law decaying dimer-dimer correlation. By fitting a universal scaling function for the spin-spin correlation we find the critical exponents $\nu = 0.68(3)$ and $\eta_s = 0.34(6)$, which is very close to the observed critical exponents for deconfined quantum critical point (DQCP) in other systems. Thus our numerical results strongly suggest a Landau forbidden phase transition from Neel order to VBS order at $J_2^{c_1} = 0.53(1)J_1$.

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