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Block-block entanglement and quantum phase transition in the one-dimensional extended Hubbard model at 1/2-filling[1] SHUSA DENG, SHI-JIAN GU, HAI-QING LIN, The Chinese University of Hong Kong — Entanglement, as one of the most intriguing feature in the quantum mechanics, is found to have a deep relation to the macroscopic quantum phenomena in condensed matter physics, such as quantum phase transition. In this work, we study the block- block entanglement of the ground-state of the one-dimensional extended Hubbard model (EHM) and its relation to quantum phase transition. The ground state of the half-filled EHM $|\phi>$ is non-degenerate, we therefore can use the Von Neumann entropy of the reduced density matrix of one block (size b) as a measurement of the entanglement between the block and the rest of the system (size $L-b$): $S = -tr(\rho_b \log \rho_b)$, where $\rho_b = tr_{L-b}\rho, \rho = |\phi><\phi|$. The simplest case is the entanglement between one site ($b = 1$) and all of the rest, which we call it local entanglement. We found that one can use the local entanglement to identify three main phases of the EHM, such as the spin-density-wave, the charge- density-wave, and the region of phase separation. If the block includes two or more sites, we found a richer diagram on the $U - V$ plane. Finite size scaling analysis shows that the entanglement as measure of pure quantum correlation can be used to identify different phases in a class of electronic model.

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