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Quantum-entanglement aspects of polaron systems VLADIMIR STOJANOVIC, Carnegie Mellon University, MIHAJLO VANEVIC, University of Basel, Switzerland — We describe quantum entanglement inherent to the polaron ground states of coupled electron-phonon (or, more generally, particle- phonon) systems based on a model comprising both local (Holstein-type) and nonlocal (Peierls-type) coupling. We study this model using a variational method supplemented by the exact numerical diagonalization on a system of finite size. By way of subsequent numerical diagonalization of the reduced density matrix, we determine the particle-phonon entanglement as given by the von Neumann and linear entropies. Our results are strongly indicative of the intimate relationship between the particle localization/delocalization and the particle-phonon entanglement. In particular, we find a compelling evidence for the existence of a non-analyticity in the entanglement entropies with respect to the Peierls-coupling strength. The occurrence of such non-analyticity – not accompanied by an actual quantum phase transition – reinforces analogous conclusion drawn in several recent studies of entanglement in the realm of quantum- dissipative systems. In addition, we demonstrate that the entanglement entropies saturate inside the self-trapped region where the small-polaron states are nearly maximally mixed.

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