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Exact results on the entanglement entropy of Abelian and non-Abelian topological states XIAOLIANG QI, HONG YAO — Quantum entanglement is essential for the purpose of quantum computing. The Kitaev model defined on trivalent lattices is one of the most important prototype models for topological quantum computation, which supports quasi-particle excitations with non-Abelian statistics. In this paper, we obtain an exact formula for the entanglement entropy of the ground state and all excited states with or without vison excitations of the Kitaev model. Interestingly, the entanglement entropy can be expressed in a simple separable form $S=S_G+S_F$, with S_F the entanglement entropy of a free Majorana fermion ("matter field") system and S_G that of Z_2 gauge fields. The Z_2 gauge field part contributes the universal "topological entanglement entropy" of the ground state while the fermion part is responsible for the non-local entanglement carried by the quasi-particles in the non-Abelian phase. We also studied the Reyni entropy of this system which distinguishes the Abelian and nonAbelian states. Our approach to the entanglement entropy can be generalized to a broad class of many-body wave functions.

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