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Magic states in the Asymmetric Quantum Rabi Model

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The asymmetric quantum Rabi model (AQRM) is a modified version of the paradigmatic quantum Rabi model, which describes the interaction between a two-level system (qubit) and a quantum harmonic oscillator, typically a single mode of radiation field. The interplay of these degrees of freedom and its feasible experimental realizations in the context of quantum information setups make the AQRM a suitable hybrid system to study diverse phenomena such as correlations and hidden symmetries. In this work, we analyze the existence of magic states in the AQRM. Here, the quantum resource known as magic or non-stabilizerness is a critical ingredient that provides quantum computing an advantage over its classical counterpart. We study magic witnesses in the qubit subsystem of the AQRM and adapted measures for the same quantity in the bosonic subsystem, making, in this way, one of the first tryouts of magic within a different branch of physics besides fault-tolerant quantum computation.

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