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Digital quantum simulation of Heisenberg spin systems in circuit QED MARKUS OPPLIGER, YVES SALATHE, MINTU MONDAL, JOHANNES HEINSOO, PHILIPP KURPIERS, ANTON POTOCNIK, STEFAN FILIPP, ANDREAS WALLRAFF, ETH Zurich, Switzerland, ANTONIO MEZZACAPO, URTZI LAS HERAS, LUCAS LAMATA, ENRIQUE SOLANO, University of the Basque Country, Bilbao, Spain — A Quantum simulator realized by a well-controlled quantum system allows to simulate a wide range of complex quantum systems that are very difficult to study with classical computing. We use a promising quantum simulator based on circuit quantum electrodynamics (QED) to digitally simulate the isotropic Heisenberg XYZ interaction between two spin 1/2 particles. Since the XYZ interaction does not occur directly in the Jaynes-Cummings Hamiltonian, the interaction is decomposed into a set of single- and two-qubit gates. The resulting evolution of the quantum state is analyzed by state tomography for different interaction times after each step. As our approach can be generalized further, this experiment is a first step towards simulating large spin systems in a circuit QED architecture.

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