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Ultrafast quantum nondemolition measurement based on diamond-shaped artificial atom BRUNO KÜNG, ETIENNE DUMUR, IGOR DINIZ, ALEXEY FEOFANOV, THOMAS WEISSL, CÉCILE NAUD, WIEBKE GUICHARD, ALEXIA AUFFÈVES, OLIVIER BUISSON, Institut Néel, CNRS-Université Joseph Fourier, Grenoble, France — We present a theoretical study of a quantum nondemolition readout scheme based on a superconducting artificial atom with two internal degrees of freedom [1]. In comparison with the most widely employed readout scheme for superconducting qubits, the dispersive readout in a circuit quantum electrodynamics architecture, our approach promises a significantly stronger measurement signal. This should allow for a high-fidelity readout in a single shot. Our device consists of two transmons (i.e., small capacitively shunted Josephson junctions) coupled via a large inductance. The resulting circuit exhibits a symmetric and an antisymmetric oscillation which we use as a logical and ancilla qubit, respectively. The Josephson non-linearity leads to a cross-Kerr-like coupling of the two oscillations. This allows us to read out the logical qubit state by measuring the ancilla qubit frequency. To measure the ancilla qubit frequency, we couple it to a superconducting microwave resonator, allowing for a large amplitude and a fast response of the transmitted microwave signal. At the same time, the logical qubit remains weakly coupled and far detuned from the resonator, preventing qubit relaxation due to the Purcell effect.

[1] I. Diniz et al., Phys. Rev. A **87**, 033837 (2013)

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