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Controllable coupling of superconducting flux qubits¹

EVGENI IL'ICHEV, Institute for Physical High Technology, P.O. Box 100239, D-07702

As a first step, by making use of conventional niobium technology, we have implemented controllable flux coupling between two qubit prototypes (in our case single junction interferometers) by using a third one as the coupler. The fabricated qubit prototypes operate in the hysteretic mode, where the screening parameter >1 , which provides double degenerate state for an external flux equal to half a flux quantum. The coupler parameters were chosen so that it operates in the non-hysteretic mode with a screening parameter of 0.9. The coupling amplitude is proportional to the derivative of the coupler's current-flux relation. By changing the coupler's magnetic flux, we have shown ferromagnetic as well as anti-ferromagnetic coupling between the interferometers. In particular, we have demonstrated that the coupling could also be switched off. As the next step of our investigation we implemented similar ideas in to our Al shadow-evaporation technology. Recently, we have also demonstrated a tuneable coupling between three junctions persistent current qubits in the quantum regime. A possible combination of Al and Nb technologies is discussed.

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