Superconducting Quantum Processors
We develop superconducting quantum circuits for quantum information applications using Josephson junction technology. Our focus is on designing and fabricating circuits with the goal of implementing quantum algorithms and quantum simulations.

Summary

We build quantum processors out of superconducting quantum circuits. Superconducting qubits are built using Josephson junction technology, which behave as tunable capacitances with the additional property of tunneling of the superconducting wave function across it. In engineering language, it behaves as a nonlinear inductor.

Superconducting qubits are obtained out of two of the states of the Josephson circuit nonlinear spectrum. There exist multiple types of superconducting qubits, with different properties, depending on the gap energy. The most widely used qubits are the persistent current flux qubit and the Cooper pair box transmon qubit.

Superconducting qubits coupled to resonators are the on-chip analogue of single atoms coupled to single photons in a cavity, in the microwave regime of energies. In atom-photon cavity QED, the highest couplings achieved are $10^{-6}$ times smaller than the cavity frequency, while superconducting qubits can easily attain $10^{-2}$, entering regimes where unexplored physics take place. A nice and complete review of quantum optics with superconducting qubits can be found here.

Objectives

Our main goal is to build a small-sized quantum processor made of tens of superconducting quantum bits, or qubits. With such a processor we will implement the quantum algorithms specifically developed. For more details visit our group website [http://quantic.bsc.es](http://quantic.bsc.es)