Coherent control of a carbon nanotube-based gatemon qubit

Hannes Riechert*†[1], Samy Annabi[1], Hadrien Duprez[1], Maxime Hantute[1], Ambroise Peugeot[1], Everton Arrighi[1], Joël Griesmar[1], Jean-Damien Pillet[1], and Landry Bretheau[1]

[1]Laboratoire PMC – Ecole Polytechnique, Centre National de la Recherche Scientifique – Route de Saclay 91128 PALAISEAU CEDEX, France

Résumé

The standard transmon qubit may be modified by using a Josephson junction based on a quantum conductor with few well-transmitted channels instead of a tunnel junction. Via a gate the electronic properties and thus qubit frequency become tunable. Previous works have shown coherent measurements in such gatemon qubits with nanowire or graphene-based junctions. We present a qubit design using as junction material an ultraclean single carbon nanotube, an intrinsically one-dimensional conductor, within a hybrid cQED architecture. The measured gate-dependent qubit spectrum exhibits clear features associated with charge parity change of the fermionic Andreev bound states that are at the heart of the Josephson effect in the carbon nanotube. Going further, we demonstrate coherent control of this gatemon qubit through Rabi and Ramsey protocols, with coherence times up to 200ns. This work paves the path towards coherent manipulation of superconducting fermionic qubits in carbon nanotubes.

*Intervenant

†Auteur correspondant: hannes.riechert@polytechnique.edu