Graphene based superconducting quantum circuits

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In the last decades, important efforts were made to improve the building blocks used in superconducting quantum technologies. The key elements are the quantum bit and the parametric amplifier, that allows to measure weak signals at the quantum limit in the microwave regime. Traditionally, these devices integrate a tunnel Josephson junction as a dissipation-free and magnetically tunable source of non-linearity. Recently, new platforms have been proposed to leverage an electrically tunable semiconductor weak link (graphene, InAs nanowire).
In this talk, I will present the first realization of a gate tunable Josephson parametric amplifier by using a graphene Josephson junction [1, 2]. The amplifier shows performances that are comparable to the ones obtained with tunnel junctions, i.e. an operation close to the quantum limit and a gain above 20dB (see Figure).
For Qubits, the most advanced gate tunable platforms is based on InAs nanowires and 2DEGs,
with coherence times reaching several µs [3, 4, 5]. I will present our efforts in developing a gate tunable graphene based transmon and show the specificity of this system, for instance a gate tunable anharmonicity.

References

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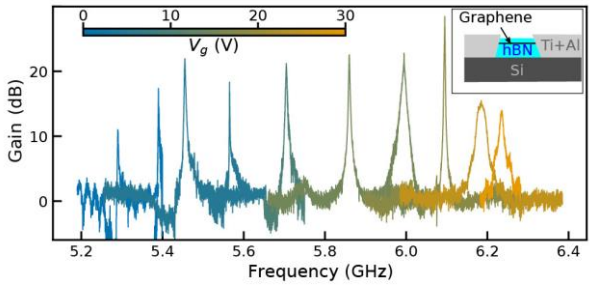

Figure 1: Gate voltage tuning of a Graphene Josephson Parametric Amplifier