Development of 3D superconducting Qubit

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Abstract:

3D architectures with superconducting qubits are very attractive solutions for several quantum applications. We report here our recent progress in design and fabrication of such devices and in their characterization.

3D architectures with superconducting qubits have several advantages for those applications that don't require many qubits, such as photon detection. Surfaces of dielectrics are, in fact, generally much lossier than bulk cavities. Aluminum cavities reach up to 10 ms photon lifetime independent of the stored power and down to the single photon level [2]. Superconducting qubits hosted in a 3D cavity recorded coherence time T2 above 1 ms [1]. Moreover, superconducting microwave cavities coupled to one or more anharmonic elements in the circuit quantum electrodynamics architecture are today explored for hardware-efficient encoding of logical qubits.

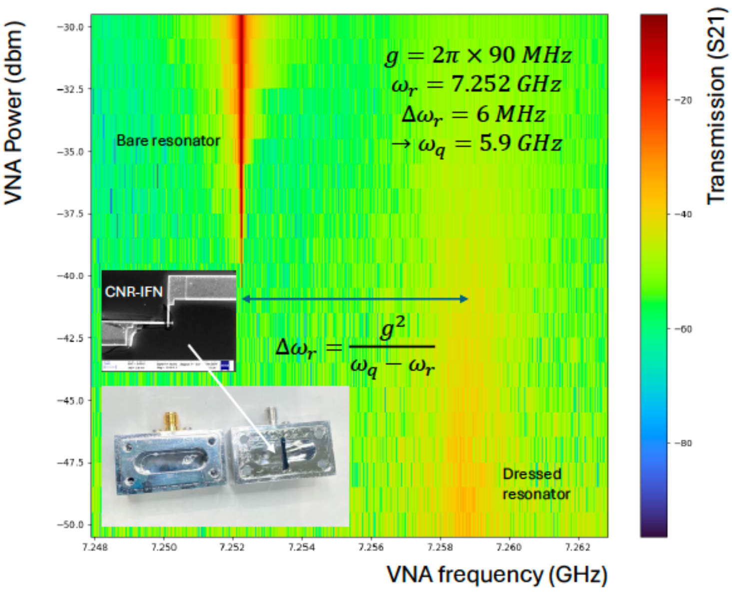

Fig. 1 Cavity spectroscopy

We report here the development of 3D qubits in our collaboration. First, we discuss the characterization at the National Laboratories of INFN in Frascati (LNF) of a transmon qubit coupled to a pure aluminum cavity, fabricated at the Institute of Photonics and Nanotechnology (IFN) of CNR in Rome and at the National

Laboratories of INFN in Legnaro (LNL). We also report on the first steps made toward the realization of a 3D ring resonator to be used as an all-to-all coupling elements for qubit networks [3] and the progress made toward the realization of 3D triple cavity to be used as two qubit photon counter.

References

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