Improved modelling of superconducting circuits

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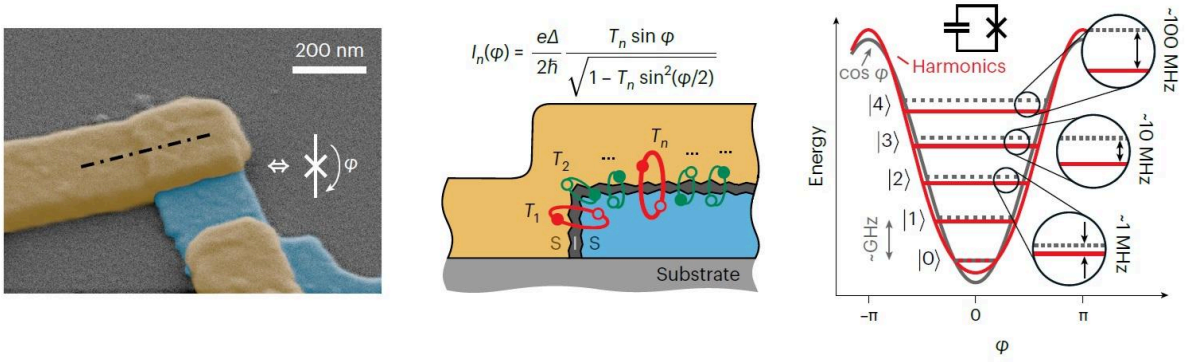

image from D. Willsch et al., Nat. Phys. 20, 815 (2024)

More accurate control and reduced losses are needed for superconducting circuits to move beyond the current NISQ era in quantum computing applications and to devise better detectors. In this talk I will discuss some recent advances and their impacts on designing superconducting devices. After briefly reviewing the standard tunnel model of a Josephson junction, I will introduce a more realistic model which is needed to accurately describe qubit spectroscopic data. Next, I will show how a form of so-called “gap engineering”, in which the values of the superconducting gap on the two sides of a junction are properly chosen, can mitigate errors related to quasiparticles. Finally, I will consider the role of pair-breaking photons in limiting a resonator quality factor.

Gianluigi Catelani received his Ph.D in Physics from Columbia University in the USA in 2005. His background is in theoretical mesoscopic physics and low-temperature superconductivity. In 2009, while at Yale University in the US, he started working on modelling the physics of superconducting devices, qubits in particular. He has continued this line of research in close collaboration with experimental groups since moving to Germany in 2012. While there, Dr. Catelani received a Marie Curie Career Integration grant from the EU in 2013 and a Feodor Lynen Research Fellowship from the Alexander von Humboldt foundation in 2017. At present, he is Research Scientist at the Jülich Research Center in Germany (on leave) and Lead Researcher in the Quantum Physics group at QRC.