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Alba Torras, IFAE (SiUCs) - Ultrastrong coupling regime in superconducting circuits using superinductor materials

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Superconducting circuits offer a versatile platform to control and study light-matter interaction beyond the strong coupling regime. In this context, qubits play the role of artificial atoms, LC resonators act as cavities and the shared capacitance or
inductance between elements define the level of coupling.
From a circuit design point of view, the coupling coefficient can be engineered to take values of the order of the bare frequencies of the qubit and the resonator ($0.1 < g/\omega < 1$), allowing the study of the so-called ultrastrong coupling (USC) regime.
The challenge of obtaining large inductive couplings can be overcome by using either shared Josephson junctions or superinductor materials showcasing large kinetic inductances such as granular aluminium.
In this study, we report the first experimental steps in building a light-matter platform in the USC regime using superinductors. In particular, we will present an experimental qubit-resonator platform that incoroporates superinductances as coupling elements. We will also show our parallel efforts investigating a novel superinducting material, nitridized aluminum (NitrAl), which may become an important qubit circuit element.