



Call 2019

# SiUCs

Superinductor-Based Quantum  
Technologies with Ultrastrong Couplings

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<https://siucs.ifae.es/>



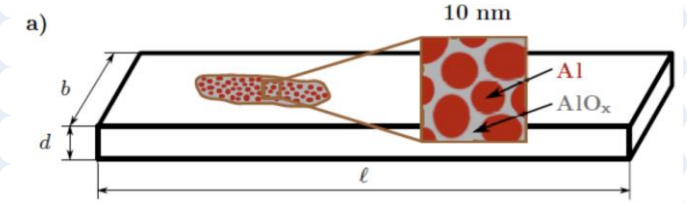
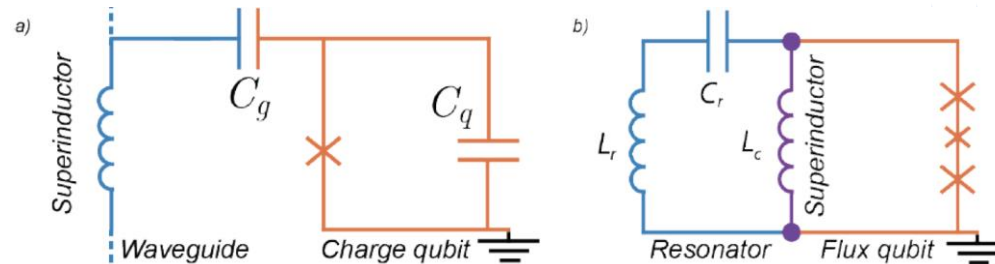
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# PROJECT PROGRESS (highlights)



**CHALLENGE** – Using novel materials known as superconductors, realize proof-of-principle implementations of use-cases for quantum technologies, focusing on ultrastrong light-matter couplings.



Disordered superconductors exhibit good properties as superconductors, such as granular aluminum.



**SOLUTION** – Proposal divided in three main fronts:

- 1) Investigate new superinductive materials (e.g. InOx, AlNx) and improve quality of existing ones (GrAl, MoC).
- 2) Develop new theoretical methods to characterize devices and control qubit-resonator systems in the USC regime.
- 3) New circuit implementations: protected qubit type, microwave photon counter.

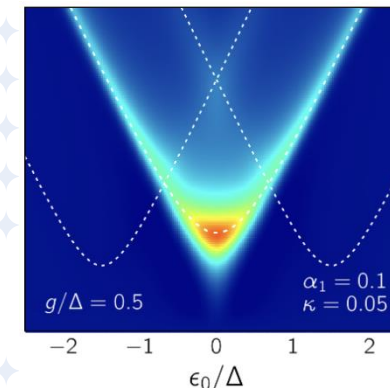


**IMPLEMENTATION** – Main project achievements:

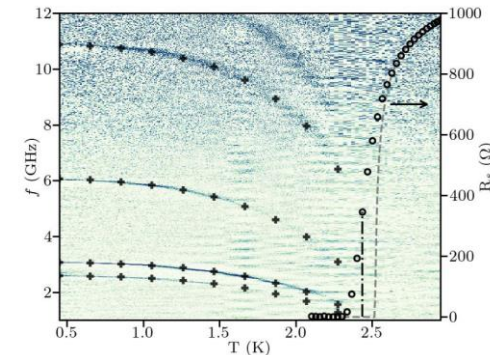
- New materials: new superinductor characterization method, lower fluctuations in GrAl with quasiparticle protection.
- Qubit-resonator simulation framework, dynamic techniques for optimal qubit operations in multi-level system.
- 11 peer reviewed, 3 under revision. 25% experimental works.
- 25 talks at conferences, schools, workshops. 8 invited talks.



**HURDLES** – hiring difficulties due to covid, low fabrication facility access during covid pandemic. 1-year extension granted.



Qubit-resonator calculated spectrum in the USC.



Measured superinductance MoC as function of T.

# IMPACT (RRI aspects)



**GENDER:** High gender balance in the field of quantum technologies:

PIs (W/M): 2/4, 33%.

PhDs (W/M): 2/3, 40%.



Encouraged participation of researchers at dissemination events to promote gender balance.

**OPEN SCIENCE:**

-Created Zenodo portal for open data and project material: <https://zenodo.org/communities/siucs/>

-All project publications and preprints available at arxiv.org



**SCIENCE EDUCATION:**

-Lead project PhDs and postdocs from partners presented findings at international events.

-Organized an internal project workshop together with QuCos to be held in February 2023 to give PhDs and postdocs visibility and leadership in their respective projects.

-PIs participated at summer schools (Quantum Tech Schools in Slovakia, Napoli, “Crazy about physics program” in Barcelona) for high-school/undergraduates to promote scientific careers.



**PUBLIC ENGAGEMENT:**

-SiUCs partners participated at public events: European Research Night, Pint of Science, Science Day, World Quantum Day, Italian Quantum Weeks, local science fairs.

-Social networks: Twitter @SiUCs1, Website (<https://siucs.ifaes.es>).

-Upcoming representation of project SiUCs at FET Open project AVaQus workshop held in April 2023.



**ETHICS:** environmental protection and safety through the use of nanolithographic fabrication techniques and cryogenics.



# QUANTERA

ERA-NET Cofund in Quantum Technologies



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