PhD/Postdoctoral position in multimode quantum electrodynamics

The Hybrid Quantum Circuit laboratory (HQC) in EPFL is looking for an outstanding candidate for a PhD/Postdoctoral position in the field of experimental multimode quantum electrodynamics, where we aim to study many-body interactions in extreme coupling regimes and qubits coupled to a chiral topological waveguide.

The project:

In this project we aim to develop analog quantum simulation platforms to emulate quantum impurity models in the ultra-strong coupling regime [1] and complex spin-spin Hamiltonians using atom-photon bound states [2]. Both platforms can be enabled by the coupling of one or several quantum emitters to a multimode photonic environment. The multimode environment is implemented in the form of a coupled cavity array consisting of a microwave superconducting metamaterial composed of high-impedance non-linear LC resonators. Moreover, working with a metamaterial allows engineering a non-trivial photonic dispersion relation, where one can obtain modes displaying topological properties [3] and chirality [4], which recently attracted a lot of interest in the community [5].

Scientific environment

During this project, the applicant will have access to multiple low temperature (10 mK) measurement setups and a state-of-the-art cleanroom facility. The applicant will also benefit from interaction with collaborators in and outside of the EPFL community.

Qualifications

The applicant must hold a Master/PhD in physics with a solid background in quantum physics. Ideally, you have hands-on experience in at least some of the following: mesoscopic physics, quantum physics, nanofabrication, cryogenics, microwave design, microwave measurements. You see yourself as pursuing a career in research & development or education, either in academia or in the industry.

Terms of employment: This project is funded by SNSF: “High Impedance Metamaterials for Quantum Simulation with Semiconductor/Superconductor Hybrid Circuits”.

The application must be done in English.

Please include:

- CV
- Diplomas (Master and PhD)
- Complete publication list
- A short description of your work relevant to the research field
- 1 or more reference letters.

Contact

Prof. Pasquale Scarlino: Pasquale.scarlino@epfl.ch

References:

[1] Le Hur, Karyn, et al. "Driven dissipative dynamics and topology of quantum impurity systems." Comptes Rendus Physique 19.6 (2018): 451-483.

[2] Scigliuzzo, Marco, et al. "Extensible quantum simulation architecture based on atom-photon bound states in an array of high-impedance resonators." *arXiv preprint arXiv:2107.06852* (2021).

[3] Su, W_P, J. R. Schrieffer, and Ao J. Heeger. "Solitons in polyacetylene." *Physical review letters* 42.25 (1979): 1698.

[4] Bello, Miguel, et al. "Unconventional quantum optics in topological waveguide QED." Science advances 5.7 (2019): eaaw0297.

[5] Kim, Eunjong, et al. "Quantum electrodynamics in a topological waveguide." *Physical Review X* 11.1 (2021): 011015.