Postdoctoral researcher in quantum neuromorphic computing with superconducting circuits

Neuromorphic Physics group
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Quantum neuromorphic computing leverages analog quantum systems to implement neural networks, exploiting their quantum properties for more efficient learning [1] and learning directly on quantum states as inputs [2,3]. Utilizing superconducting circuits, we employ various learning schemes with bosonic modes, offering a vast Hilbert space for encoding neurons. We train the amplitudes of different parametric processes to achieve learning. Our previous results, published in npj Quantum Information [4], have demonstrated the system's capability to perform complex classification tasks requiring nonlinearity and memory. Furthermore, we have shown that these systems can be trained using Gaussian boson sampling probabilities to analytically calculate gradients for gradient descent optimization [5].

This postdoctoral project is a part of the ERC project QDYNNET. Initial experimental results have already been obtained, focusing on harnessing Kerr nonlinearity. The postdoctoral project will specifically explore nonlinearity provided by the measurement. The successful candidate will collaborate closely with two PhD students who have been involved in the project for two years, alongside partners from Alice & Bob for theoretical models and Thales for sample fabrication.

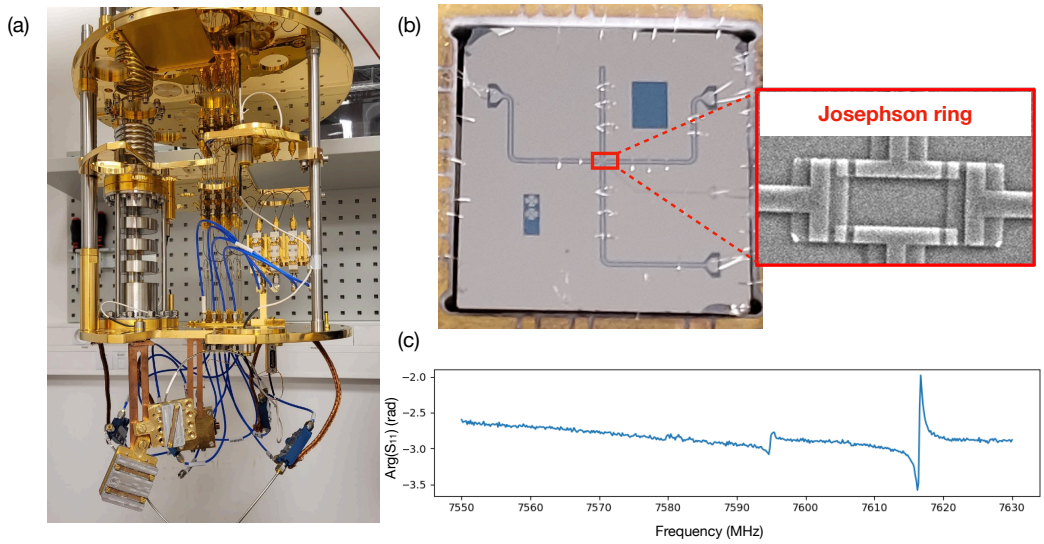

Figure 1 *(a) Dilution refrigerator. (b) Two Nb resonators coupled by a ring of Al Josephson junctions, fabricated in our cleanroom facility. (c) Spectroscopy of a cavity dressed by a transmon qubit.*

The candidate should have a PhD in condensed matter physics, quantum optics or related field, preferably experience with mesocopic physics, superconductivity, microwave measurements, cryogenics and nano-fabrication.

References:

1. Fujii & Nakajima, *Phys Rev Appl* **8**, 024030 (2017)
2. Rudolph *et al*, *Phys. Rev. X*, **12**, 31010 (2022)
3. Huang *et al*, *Science*, **376**, 1182–1186 (2022)
4. Dudas *et al*, *Npj Quant. Inf.*, **9**, 64 (2023)
5. Marković *et al*, *APS March Meeting* (2024)