# A proposal for charge basis tomography of superconducting qubits

**Eran Ginossar**[1]
Elena Lupo[1,4], Daniel Long[2], Daniel Dahan[3], Konstantin Yavilberg[3], Malcolm Connolly[2], Eytan Grosfeld[3]

[1]*University of Surrey, Guildford, United Kingdom*
[2]*Imperial College London, London, United Kingdom*
[3]*Ben-Gurion University of the Negev, Beer-Sheva ,Israel*
[4]*Forschungszentrum Jülich, Jülich, Germany*

e.ginossar@surrey.ac.uk

Abstract

We introduce [1] a general protocol for obtaining the charge basis density matrix of a superconducting quantum circuit. Inspired by cavity state tomography, our protocol combines Josephson-energy pulse sequences and projective charge-basis readout to access the off-diagonal elements of the density matrix, a scheme we thus dub charge basis tomography. We simulate the reconstruction of the ground state of a target transmon using the Aharonov-Casher effect in a probe qubit to realise projective readout and show the Hilbert-Schmidt distance can detect deviations from the correct model Hamiltonian. Unlocking this ability to validate models using the ground state sets the stage for using transmons to detect interacting and topological phases, particularly in materials where time-domain and spectroscopic probes can be limited by intrinsic noise.

References

[1] E. Lupo et al., **arXiv:2502.07748** (2025)