

Thermoelectricity in superconducting nanotechnologies

Alessandro Braggio

*Istituto Nanoscienze CNR, NEST, Scuola Normale Superiore Pisa, Piazza San Silvestro 12,
Pisa 56127, Italy*

Thermoelectricity is a basic example of a thermodynamic engine which transforms thermal gradients into electrical power. However, many quantum machines and quantum thermodynamic electronic circuits[1] are realized with hybrid superconducting platforms which are expected with limited thermoelectrical properties, due to the particle-hole symmetry. However, thermoelectricity may be also generated in these systems [2,3], flux vortex systems[4] or, non-locally, due to helical properties of the topological edge states[5] or even to the emergence of Bogoliubov-Fermi points[6]. However, we have shown that photon-assisted tunnelling could even impact in some measure on the thermoelectricity[7]. In this contribution, we will explore how previous examples could be influenced by Coulomb blockade[8], time-dependent drivings or other interactions with the circuit's electrical environment.

A.B. acknowledge MUR-PRIN 2022 Grant No. 2022B9P8LN-(PE3)-Project NETheQS "Non-equilibrium coherent thermal effects in quantum systems" in PNRR Mission 4 - Component 2 - Investment 1.1 "Fondo per il Programma Nazionale di Ricerca e Progetti di Rilevante Interesse Nazionale (PRIN)" funded by the European Union - Next Generation EU.

- [1] J. P. Pekola, *Nature Phys.* 11 (2015) 118.
- [2] G. Germanese, F. Paolucci, G. Marchegiani, A. Braggio, F. Giazotto *Nature Nanotech.* 17 (2022) 1084.
- [3] C. Guarcello, A. Braggio, F. Giazotto, R. Citro *Phys. Rev. B* 108 (2023) L100511.
- [4] A. N. Singh, B. Bhandari, A. Braggio, F. Giazotto, A. Jordan unpublished
- [5] G. Blasi, F. Taddei, L. Arrachea, M. Carrega, A. Braggio *Phys. Rev. Lett.* 124 (2020), 227701.
- [6] J. H. Mateos, L. Tosi, A. Braggio, F. Taddei, L. Arrachea arXiv preprint arXiv:2404.07734.
- [7] A. Hijano, F. S. Bergeret, F. Giazotto, A. Braggio *Phys. Rev. Applied* 19 (2023) 044024.
- [8] S. Battisti, G. De Simoni, L. Chirolli, A. Braggio, F. Giazotto *Phys. Rev. Research* 6 (2024) L012022