An e-h superposition created on demand

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I discuss single-particle emission from the quantum dot with superconducting correlations, which hosts an Andreev's level. Like an ordinary quantum level, the Andreev's level emits a single-particle state. Unlike a conventional quantum level, the Andreev's level emits a superposition state of an electron and a hole **[1]**, rather than an electron or hole state. Surprisingly, the heat carried by a superposition state is ultimately related to its charge, see **Figure** 1, and not to the number of particles, as in the case of a single-particle electron or hole state, or in the case of a two-particle electron-hole state. The presence of superconducting correlations makes it possible to electrically manipulate the single-particle quantum state. By varying the electrostatic potential, it is possible to move the state of a superposition from one orthogonal state to another, which is confirmed by HOM-like noise, see **Figure** 2. Interestingly, in this case the effect of the electrostatic gate potential is identical to the effect of the superconducting phase difference if the two colliding states were created using different superconductors.

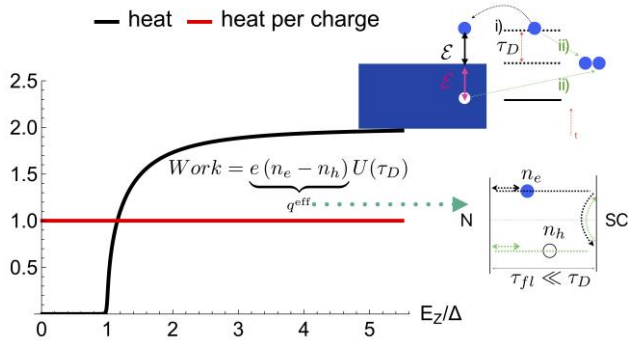

Figure 1: Heat generated by a driven Andreev's quantum dot as a function of the Zeeman field suppressing super-conducting correlations

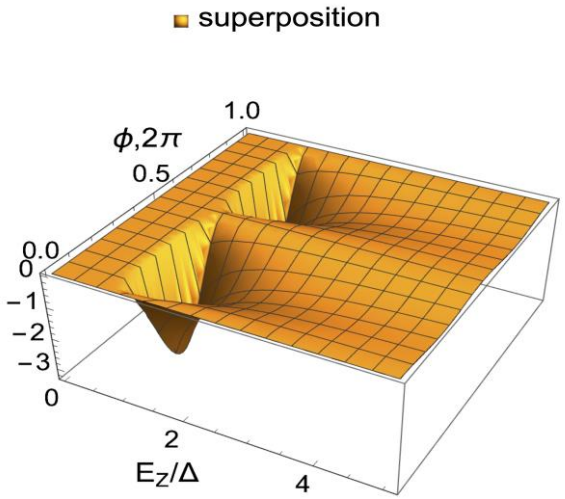

Figure 2: Two-particle noise, when one of the superpositions is subject to an electrostatic potential inducing phase 2πφ.

References

[1] Pablo Burset, Benjamin Roussel, Michael Moskalets, Christian Flindt. Tunable Andreev-Conversion of Single-Electron Charge Pulses, arXiv:2312.13145

Figures