Shot noise in superconducting sub gap states

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Majorana bound states are promising building blocks of forthcoming technology in quantum computing. Chains and islands of magnetic impurities in superconductors have attracted considerable attention recently as such systems may host Majorana bound states. However, their non-ambiguous identification has remained a difficult issue because of the concomitant competition with other topologically trivial fermionic states, which poison their detection in most spectroscopic probes. I will theoretically show that the Fano factor, which is the ratio between shot noise and the current, turns out to be a very interesting and distinctive tool in that respect. In particular, the Fano factor tomography displays a spatially constant Poissonian value equal to one for Majorana bound states while it is strongly spatially dependent and exceeds one as a direct consequence of the local particle-hole symmetry breaking for other trivial fermionic in-gap states such as Yu-Shiba-Rusinov or Andreev ones [1]. I will also show how shot noise can be used to reveal coherent and incoherent dynamics of an in-gap bound state associated to the presence of a magnetic impurity in a superconductor which sets the stage for a comparison with experimental shot noise data measured by our experimental colleagues [2].

[1] V. Perrin, M. Civelli, P. Simon, Phys. Rev. B 104, 121406 (2021).

[2] U. Thupakula et al., Physical Review Letters 128, 247001 (2022).