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Giant shot noise in superconductor/ferromagnet junctions with orbital-symmetry- controlled spin-orbit coupling

Abstract-

By measuring the shot noise, a consequence of charge quantization, in super-conductor/insulator/ferromagnet (V/MgO/Fe) junctions, we discover a giant increase, orders of magnitude larger than expected. The origin of this giant noise is a peculiar realization of a superconducting proximity effect, where a simple superconductor influences its neighbors. Our measurements reveal largely unexplored implications of orbital-symmetry-controlled proximity effects. The importance of orbital symmetries and the accompanying spin-orbit coupling is manifested by an unexpected emergence of another superconducting region, strikingly different from the parent superconductor. Unlike vanadium’s common spin-singlet superconductivity, the broken inversion symmetry in V/MgO/Fe junctions and the resulting interfacial spin-orbit coupling lead to the formation of spin-triplet superconductivity across the ferromagnetic iron. Here, we show that the enhanced shot noise, known from Josephson junctions with two superconductors, is measured even in a single superconductor. This discovery motivates revisiting how the spin-orbit coupling and superconducting proximity effects can transform many materials.

Index Terms-

Citation: