Transport properties of electron-hole bilayer/superconductor hybrid junction

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Abstract

We investigate the transport properties of an electron-hole bilayer contacted with two normal and two superconducting leads. We assume that the electron-hole bilayer hosts an exciton condensate described by a BCS-like model with a gap in the quasiparticle density of states.

The setup we propose differs from the standard Coulomb drag measurements for detecting the existence of the excitonic phase [1].

We show that the existence of the condensate via transport measurements revealed in the sub-gap regime. At this energy scale, the transport properties are determined on the one hand by the standard Andreev reflection at the interface between the superconductor and the exciton condensate, and on the other hand, by a crossed reflection at the semi-metal/exciton-condensate. The latter converts electrons from one layer to the other [2]. Specifically, we show that the existence of a finite gap manifests in a minimum of the conductance at low voltage bias [3]. [1] A. F. Croxall *et al.*, Phys. Rev. Lett. **101**, 246801 (2008).

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D. Bercioux, F. Bergeret, and T. Klapwijk, submitted (2017).

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