Experimental Study of Spatially Resolved Charge and Energy Imbalance in a Superconductor

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Spatially resolved relaxation of non-equilibrium quasiparticles in a superconductor at ultra-low temperatures was experimentally studied [1]. It was found that the quasiparticle injection through a tunnel junction results in modification of the shape of I-V characteristic of a remote 'detector' junction. The effect depends on temperature, injection current and proximity to the injector. The phenomena can be understood in terms of creation of quasiparticle charge and energy disequilibrium characterized by two different length scales $\lambda_Q \approx 5$ μm and $\lambda_T \approx 40$ μm. The findings are in good agreement with existing phenomenological models, while more elaborated microscopic theory is mandatory for detailed quantitative comparison with experiment. The results are of fundamental importance for understanding electron transport phenomena in various nanoelectronic circuits. In particular, the mechanism of relaxation of 'hot' electrons is of crucial importance for operation of various devices such as solid state coolers and hot/cold electron bolometers. [1] K. Yu. Arutyunov, H.-P. Auraneva, and A. S. Vasenko, Phys. Rev. B 83, 104509 (2011)