# Evidence for a minigap in YBCO grain boundary Josephson Junctions

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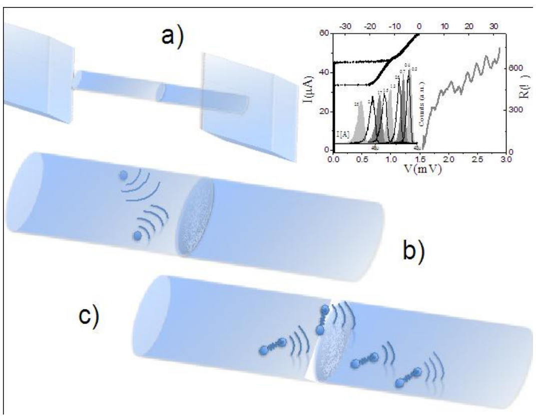
Future information technology and new generation of fast computing rely on tailoring and designing of quantum devices. Nanolitography provides scale reduction of devices at an unprecedented pace, but it will soon come to its physical limit. Superconductivity of dissipationless electron pairs realizes macroscopic quantum states (MQS). Josephson junctions represent a unique system to measure and manipolate MQS. High Tc cuprates are recent materials with novel properties common to strongly correlated systems, waiting to be exploited. In the last years hybrid systems are being syntetized at an intermediate, mesoscopic scale, in which sample dependent quantum behavior at low temperatures turns into robust emerging universal responses (independent of the disorder) under electronic control which allows for applications in metrology and quantum computing. One of the goals of our CNR-SPIN group is to investigate the interplay between superconducting coherence and mesoscopic disorder. The nature of HTS promotes an intriguing length scale hierarchy where the mesoscopic normal state coherence prevails over the superconducting order induced in the barrier of grain boundary nanocontacts. It is found that conduction channels are secured, in which high energy anti-nodal quasi-particles coherently interfere with surprisingly long decay times. This provides further understanding for the appearance of Macroscopic Quantum Tunnelingin YBCO Josephson Junctions, as measured in our devices at low temperatures. In our paper, the experimental observation of another mesoscopic property is reported, i.e. a minigap in the excitation spectrum of a Grain Boundary HTS Josephson Junction, which has been quite elusive to observation in transport measurements, up to now. More is to expect from the confluence of HTS and nanophysics




Top right inset: Current-Voltage characteristics. Switching current probability distributions versus bias current for different temperatures down to 300 mK. Resistance versus voltage (voltage scale at the top).
a) Scheme of the YBaCuO nano-channel; b) and c) enlargement of grain boundary (GB) region belonging to the naochannel. Interfering quasiparticles and Cooper pairs transport processes across the GB are sketched in b) and c) respectively.