

INTERNSHIP PROPOSAL

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Thesis possibility after internship: YES
Funding: NO (candidature École doctorale PIF) If YES, which type of funding:

Title: Onset of dissipation in three-dimensional superconductors

Summary:

According to the Josephson relations, dissipation in superconductors is related to the time-variation of the phase of the wavefunction. This physics is usually studied in the case of superconducting weak links, when a voltage develops across a thin barrier having a length (L) shorter than the coherence length (ξ). It results in the flow of normal carriers simultaneously with the tunneling of Cooper pairs, which produces a charge current having both dissipative and non-dissipative components. This is theoretically modelled by a resistively-shunted Josephson junction. Although this kind of effect is typically observed in low-dimensional devices (for which at least one dimension is comparable to or smaller than ξ), there are some specific situations where it may arise in large systems ($L \gg \xi$) as well. One particular case is that of phase slip lines in wide superconducting films, for which all the dimensions exceed the superconducting coherence length. Current-voltage characteristics display step-like structures, resulting from oscillations of both the amplitude and phase of the wavefunction. Its experimental signature is a finite voltage concomitant with a finite supercurrent.

In this project, our aim is to experimentally study current-voltage relations and the fluctuations of these quantities in the phase slip regime of three-dimensional superconducting systems. We are specifically interested in the following questions:

- determining the properties of dissipative carriers in the non-equilibrium state,
- investigating possible correlations of these properties with the supercurrent component,
- statistical study of conductance fluctuations in these dissipative states.

These experiments will allow us to obtain insights about the different effects leading to the onset of dissipation, when electric fields are allowed to penetrate into the system without completely destroying its superconducting properties.

Please, indicate which speciality(ies) seem(s) to be more adapted to the subject:

Condensed Matter Physics:	YES	Soft Matter and Biological Physics:	NO
Quantum Physics:	YES	Theoretical Physics:	NO