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Possible dominance of the Maki–Thompson process in the fluctuation conductivity of Bi-2212 superconducting whiskers

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Abstract

We report the measurement of the a-axis fluctuation conductivity in zero field for $Bi_2Sr_2CaCu_2O_{8+x}$ microcrystals. A complete geometrical characterization allows us to determine the absolute value of the excess conductivity and its temperature behaviour with high accuracy. A careful application of the complete fluctuation theory (Varlamov *et al* 1999 *Adv. Phys.* **48** 655), which implements a minor correction for the $\tilde{k}$ factor and a suitable procedure for disentangling the influence of the different fit parameters, shows that data interpretations excluding the Maki–Thompson (MT) process are either not consistent with the crystal structure or not self-consistent. On the other hand, a data interpretation including the MT process appears to be both self-consistent and consistent with experimental measurements of the electron dephasing time τ_ϕ performed in other metallic or semiconducting systems. According to the latter scheme, the anomalous MT term could be a very important contribution to the excess conductivity throughout the temperature range of interest and thus the s-wave symmetry becomes an important component of the order parameter above T_c.

1. Introduction

The additional contribution to the normal state conductivity due to Cooper pairs formed above T_c ($\Delta\sigma$, also called paraconductivity or excess conductivity) was theoretically investigated for the first time by Aslamazov and Larkin (AL) [1], who obtained for 2D systems $\Delta\sigma_{AL}^{2D} = e^2/(16\hbar d\varepsilon)$, where $\varepsilon = (T - T_c)/T_c$ and d is the thickness of the 2D layer. Soon after,

