Abstract Book

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The Role of Effective Mass in Dynamical Aspects of Individual Vortex Motion

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The dynamics of a single vortex line is an actual problem now [1, 2]. In this report a De Gennes and Matricon's problem of finding the spectrum of oscillations vortex line taking into account the pinning, viscosity forces and effective vortex mass is solved. Two branches of spectrum have been obtained. The first (low-frequency, ω_1) mode (Figure 1, Γ_1 - is dissipation) coincides with De Gennes-Matricon's solution [3] in certain limit. The second (high-frequency) mode is a novel mode connected with the effective mass of a vortex line [4-6]. The activation behavior is present in both modes. The activation of the first mode is proportional to the pinning force. The activation of the second mode is mostly connected with cyclotron frequency of the vortex line. Group velocity of oscillation wave has practically line dependence from wave vector and has some tenth m/s order (Figure 2). In the present report, the absorption of energy by a vortex depending on the frequency of external AC transport current has been calculated. The frequency dependence of the absorption demonstrates two typical resonance maxima, one of them being due to depinning frequency of the vortex, and the other one due to its cyclotron resonance. The position of resonance maximum for typical superconductors has been calculated. The temperature-dependent frequency of the first resonance maximum is about MHz. The frequency of the second resonance maximum is of order 10^{10} Hz and 10^{12} Hz for NbTi and YBaCuO, respectively, and is connected with different values of effective mass of vortex lines.

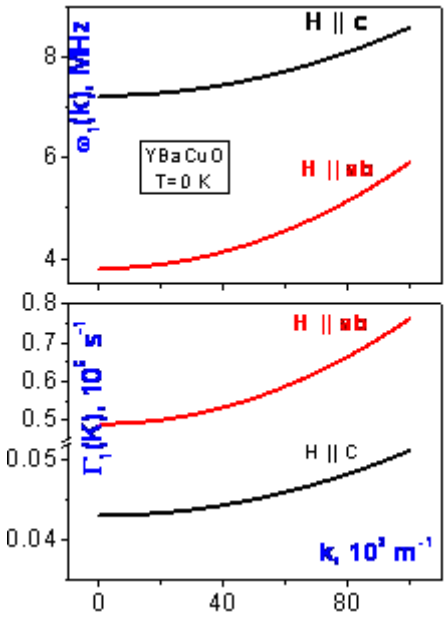

Figure 1. The spectrum and the dissipation for low-frequency mode calculated for YBaCuO; k is the wave vector; T=0 K.

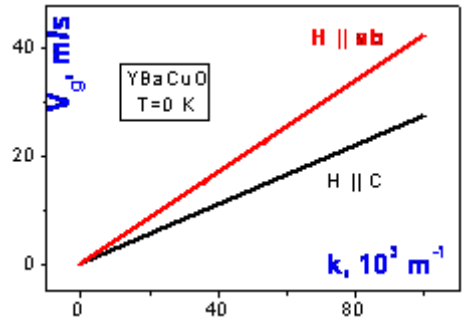

Figure 2. Group velocity dependencies at different orientation of crystal; T=0 K.

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