Interaction of phonons and Josephson vortices in layered superconductors

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The c-axis transport in the highly anisotropic cuprate superconductors like $Tl_2Ba_2Ca_2Cu_3O_{10+\delta}$ (TBCCO) and $Bi_2Sr_2CaCu_2O_{8+\delta}$ (BSCCO) can be described well by a stack of Josephson junctions between the superconducting CuO_2-multilayers. Due to the fact that this intrinsic Josephson junctions are embedded in the crystal structure of the high temperature superconductors the Josephson oscillations can interact with phonons via electric fields. This has been shown recently both experimentally and theoretically. Here we want to investigate the influence of a strong parallel magnetic field on the interaction of Josephson oscillations and phonons.

In order to describe the dynamics of the system we derive a system of coupled sine-Gordon equations for the gauge invariant phasedifference γ where we take into account the phononic degrees of freedom explicitly. With these equations we can calculate the current-voltage characteristics of a stack of coupled intrinsic Josephson junctions in strong parallel magnetic fields. We show that there is a coupling between Josephson vortices and phonons. This coupling leads to a frequency dependent Swihart velocity that shows up in an anomalous field dependence of the Flux-Flow-voltage. Also the voltage position of Fiske-steps is influenced by the phonons.