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Size distribution of flux avalanches in MgB2 films visualized by magneto-optical imaging

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We report on the quantitative and spatially resolved observation of flux avalanches in superconducting films. Magneto-optical imaging was used to visualize the flux penetration in MgB2 films subjected to a slowly varying perpendicular field. Below 10 K, flux avalanches with typical size around 20 microns and regular shape are found to occur at random locations along the flux front. The total number of vortices that participates in one avalanche is varying between 50 and 10000 [1]. An adiabatic model is proposed to calculate the flux jump size for a thin-strip superconductor. The flux density and temperature distributions in the final state after flux jump are calculated. The jump size is found to grow monotonously with applied field and this dependence is in a good agreement with experimental data. At larger applied fields we observe another kind of jumps: a much bigger dendritic and branching avalanches [2,3]. Their dimensions are limited only by the sample size, while their morphology can be described within a linear model based on Maxwell and thermal diffusion equations [4]. References: [1] A. V. Bobyl et al., Physica C 408-410, 508 (2004) [2] T. H. Johansen et al., Europhys. Lett. 59, No. 4, 599-605 (2002) [3] F. L. Barkov et al., Phys. Rev. B 67, 064513 (2003) [4] A. L. Rakhmanov et al., Phys. Rev. B 70, 224502 (2004)