T_cSUH Special Seminar

Texas Center for Superconductivity

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"Approaching a quantitative understanding of dendritic flux avalanches"

Tuesday, April 25, 2006
Room 102, University of Houston Science Center
12:00 noon – 1:00 p.m.

Abstract

Magneto-optical imaging (MOI) has revealed that metastable distributions of pinned vortices often break down by abrupt avalanches creating dendritic flux patterns in the superconductor. This intermittent dynamics, the distinct fingering character of the patterns, and that it all occurs only in thin films, has for more than a decade been a puzzle. We present here MOI results allowing for the first time a direct quantitative comparison between experiment and a model based on a thermo-magnetic feedback mechanism (flux jump) and the non-local electrodynamics typical of film superconductors. Measurements on MgB_2 and Nb films are shown to agree with the model on key features like the magnitude of the instability onset magnetic field, and how it varies with both temperature and sample size. Another observation that only 5% anisotropy in J_c can lead to a strongly anisotropic avalanche activity also finds an easy explanation within the model.

The talk reports also a recent breakthrough in using low-temperature fluorescent thermal imaging (FTI) to study dissipative processes in superconductors. The method is based on the temperature dependent fluorescence in a thin rare-earth chelate film deposited directly on the superconductor. It will be shown that FTI can detect distributions of local heating with a temperature resolution of 0.05 K and can locate hot spots down to a few microns in size, demonstrating that the method is very promising for diagnostic testing of powered superconducting devices operating at 77 K. If we succeed to improve the method at even lower temperatures it will open a new window also for studies of thermo-magnetic avalanches in vortex matter.

Bio

Professor Tom H. Johansen, Visiting Scientist at TcSAM during Fall of 2004, received the Ph.D. degree from the University of Oslo in 1988. He became Assistant Professor at the University of Oslo in 1989, where he initiated and built a laboratory for studies of magnetic levitation with superconductors. In 1993, he established a laboratory for Magneto Optical Imaging, the core activity in his present research. Johansen became full professor in 1997.

Prof. Johansen has previously been Visiting Scientist at Institute for Solid State Physics, Russian Academy of Sciences, Chernologovka, Russia (1994), The University of Mining and Metallurgy, AGH, Cracow, Poland (1998), The University of Houston, TcSUH, USA (2000), and he received in 2002 a Dozor Visiting Fellowship at Ben Gurion University of the Negev, Israel.

Prof. Johansen has since 1989 been the head of the Superconductor Laboratory at The University of Oslo. For an overview of present activities, see the website; http://www.fys.uio.no/super/, (cited by The Royal Swedish Academy as primary "further reading" reference to the work of the 2003 Nobel Laureate, A.A. Abrikosov). In 1993 he was awarded the IBM/NFS Prize in Solid State Physics.

Prof. Johansen has published 200 papers, presented 125 invited talks at conferences, and he is editor of 2 books, including Magneto-Optical Imaging (2004).

Persons with disabilities who require special accommodations in attending this lecture should call (713) 743-8210 as soon as possible.

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