

The supervisor's report on the PhD study of Ahmed Youssef

A graduate study of Ahmed Youssef was focused on measurements of the response of type II superconductors to an applied magnetic field using noncommercial SQUID magnetometers and interpretation of these measurements. Particularly, temperature and field dependence of an AC magnetic susceptibility was applied.

The interpretation of the measurements become more transparent with an availability of Nb films from IPHT in Jena, Germany, (T. May) and second generation of high temperature superconductor wires from SuperPower, Inc., Schenectady, NY USA. Strong flux pinning in these materials generates Bean critical state of a vortex matter. In this case an analytical formulae to the response of the samples of special geometries to the applied AC field are known. By these models, magnetization loops are calculated as a function of the applied AC field amplitude and critical depinning current density. Next, the AC susceptibility computed on the basis of these magnetization loops is confronted with an experimental susceptibility.

Ahmed Youssef describes the above mentioned in his dissertation "Critical state response in hard type II superconductors (comparison of transverse and longitudinal geometries)". In a theoretical part Ahmed Youssef briefly reviews foundations of Ginzburg Landau phenomenological theory of superconductivity, resulting differences between type I and type II superconductors, and vortex matter behavior. A next chapter is devoted to the critical state, particularly Bean critical state. In an experimental part Ahmed Youssef briefly depicts principles of operation of non-commercial SQUID magnetometers we use for the magnetic studies of the samples and data processing. The calculations of the magnetization loops and AC susceptibility for considered sample shapes follow. Next, a novel method of mapping of the model susceptibility as a function of the critical depinning current density to the experimentally observed temperature dependence is described. In the chapter "Results and discussion" the measurements on Nb and "YBCO" films as well as on bulk "YBCO" samples are shown and confronted with model susceptibilities. The determined critical depinning current densities and its temperature dependencies are discussed.

Short description of the scientific accomplishments:

Ahmed Youssef measured magnetic properties of the samples and deal with processing and interpretation of these measurements. Also, he actively participated in operation and maintenance of our SQUID magnetometers.

Ahmed Youssef significantly contributed to an experimental verification and application of Clem Sanchez model to a response of the hard type II superconductor thin films in an AC magnetic field. The novel method allows us contact-less determination of the critical depinning current density and its temperature dependence.

The results of his work were published in four papers listed in Web of Science database, in book "Superconductivity - Theory and Applications" ISBN 978-953-307-151-0, and another papers.

Ahmed Youssef has shown to have the ability to do an independent scientific work.

Considering the above mentioned items, I recommend to recognize his dissertation for PhD award.

In Prague, October 7, 2011

RNDr. Zdeněk Janů, CSc.