

Invitation to IQST Seminar

on Thursday, April 18th, 2019, 10.30am
University of Stuttgart
NWZII, Room 3.531



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Observation of hexatic vortex fluid in a thin superconducting film

In 1969, working on a theoretical problem out of pure mathematical curiosity, David Thouless stumbled upon a new kind of phase transition, across which physical properties show abrupt change but the free energy varies smoothly. Very soon, Michael Kosterlitz and David Thouless realised that this kind of phase transition could be ubiquitous across 2-dimensional (2D) systems. For the particular case of a 2-dimensional crystalline solid, the (Berezinski)-Kosterlitz-Thouless (BKT) theory predicts that the solid melts via a novel intermediate state, called the hexatic fluid, which possesses the orientational order of a solid but the flow properties of a fluid.

Over the years there have been several attempts to test the BKT theory in diverse 2D systems such as electrons over a liquid He surface, inert-gas monolayers adsorbed on graphite, vortices in superconducting thin films and colloidal crystals, but unambiguous identification of hexatic fluid phase has been very few. Indeed, according to the various experimental conditions one can either prove the occurrence of the melting transition at the expected value, or the existence of an orientational order when the translational one is lost, but the simultaneous observation of the two features has so far been available only in the case of some magnetic colloidal crystals. Recently, using a combination of real space imaging and transport measurements we unraveled the hexatic vortex fluid state in a thin film of the amorphous superconductor, MoGe [1]. In this talk I will discuss the properties of this hexatic vortex fluid, and present results that points towards the possibility of this state being a quantum fluid. I will also contrast the hexatic vortex fluid with the hexatic glass observed in more disordered superconductors.

1. Melting of the Vortex Lattice through Intermediate Hexatic Fluid in an a-MoGe Thin Film, Indranil Roy, Surajit Dutta, Aditya N. Roy Choudhury, Somak Basistha, Ilaria Maccari, Soumyajit Mandal, John Jesudasan, Vivas Bagwe, Claudio Castellani, Lara Benfatto, and Pratap Raychaudhuri, Phys. Rev. Lett. 122, 047001 (2019)

Host: Prof. Dr. Martin Dressel, 1st Phys. Institute, University of Stuttgart