PHYSIKALISCHES KOLLOQUIUM

des Fachbereichs Physik
der Johann Wolfgang Goethe-Universität Frankfurt

Mittwoch, den 07.12.2016, 16 Uhr c.t.
Großer Hörsaal, Raum _0.111,
Max-von-Laue-Str. 1

Prof. Dr. Jens Müller

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"Learning from Noise – Studying the Dynamics of Electrons by Fluctuation Spectroscopy"

Any physical quantity is subject to (quantum or thermal) fluctuations. Particularly fascinating are low-frequency, so-called 1/f-type fluctuations, which apparently are universal in nature, since they are found in light curves of quasars, the human heartbeat, earthquakes, Autobahn traffic, the distribution of prime numbers, DNA sequences, etc. In this colloquium, we aim to give a general overview of fluctuation phenomena and what can be learned from fluctuations (or noise) in the motion of electrons in solids. Electronic noise may be viewed from different perspectives. First, it often is considered an unwanted nuisance and is sought to be reduced or even eliminated, since it ultimately limits the accuracy of physical measurements. In this spirit, understanding the microscopic origin of the different noise sources in condensed matter systems may help to improve the signal-to-noise ratio and hence the performance of semiconductor devices and sensors. A different point of view is to consider "noise as the signal", since the frequency-dependent fluctuations are related to the autocorrelation function of the measured quantity. Therefore, fluctuation spectroscopy – revealing 'hidden' pieces of information, not present in the mean quantity (e.g. the electrical resistance) itself – is a powerful tool for studying the microscopic kinetics of charge carriers in condensed matter systems. We will give an overview of recent noise studies on different systems and describe phenomena ranging from switching dynamics of electrons in micro- and nano-scale semiconductor devices (thereby enabling high-resolution nanoscale magnetic measurements) to glassy structural dynamics in molecular metals. For these materials, we will discuss examples of the low-frequency dynamics of strongly correlated electrons, namely recent findings of nano-scale electronic phase separation and percolation as well as the critical slowing down of the fluctuations at the Mott metal-insulator transition, a key phenomenon in modern condensed-matter physics.

Die Dozenten der Physik

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