PHYSICS DEPARTMENT COLLOQUIUM

" Diluted magnetic semiconductors: Disorder, transport, and correlations”

BY

DR. CARSTEN TIMM
Free University Berlin

Diluted magnetic semiconductors (DMS) are promising materials for technological applications as well as interesting from the basic-physicspoint of view. Possible applications exist in spintronics, which employs the spin degree of freedom of electrons in addition to their charge. Afte a review of key experiments we turn to the central theoretical question regarding DMS, which concern disorder, transport, and correlation effects. Examples for each of these are given in the talk. Firstly, disorder is very important due to the presence of many charged defects and the random positions of impurity spins. Based on Monte Carlo and numerical diagonalization results in comparison with experimental observation we argue that the impurity positions are partially correlated and that these correlations are crucial for the understanding of magnetic properties and the observed metal-insulator transition. Secondly, the transport properties of DMS are known to be anomalous, as exemplified by the observed resistivity maximum at the Curie temperature. As a step towards a transport theory of DMS a semiclassical approach is used to predict the Hall voltage noise in zero magnetic field. Thirdly, DMS contain transition-metal impurities with strong electron-electron interactions in their d shells. These interactions suppress charge fluctuations, leaving only the spin degrees of freedom. The effective exchange interaction between impurity spins is derived for a realistic band structure and found to be highly anisotropic. Finally, promising directions for future research in DMS are discussed.

THURSDAY, MARCH 4, 2004
4:00 PM IN 102 JFB
REFRESHMENTS AT 3:30 PM IN 219 JFB