Superconductivity and Giant Magneto Resistance in Layered Rare Earth Halides

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Halides of the rare earth metals represent an amazingly large group of compounds, particularly when containing additional elements like boron, carbon etc. [1]. The talk covers experimental and theoretical investigations on this new class of materials, which are frequently metallic. The origin of metallicity is two-fold. A low oxidation state of the rare earth metal may result in a $f^x d^y$ configuration (case A) with f electrons in a localized and d electrons in an itinerant state. Covalent mixing of nonmetal p states with metal d states provides a second source for metallicity (case B).

Layered GdI_2 [2] is an example for case A. The metal atom configuration f^7d^1 reminds of the d^1 configuration of the isotypic superconductor $NbSe_2$, however, with additional magnetic moment due to the $4f^7$ core. The compound exhibits ferromagnetism below room temperature and shows a large negative magneto resistance, 70% in 7 T at 300 K.

The layered carbide halides $RE_2X_2C_2$ (X = Cl, Br, I) of non-magnetic RE = Y, La are superconductors with T_c up to 11K [3]. They provide model systems for the chemical reasons of a pair-wise attraction of conduction electrons in terms of a flat band-steep band scenario. Superconductivity in other systems, e.g. MgB_2, is briefly discussed along these lines [4].

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