Anomalous Hall Effect in High-mobility ZnO Two-dimensional Electron System

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Two-dimensional electron system confined at the oxide interface between ZnO and MgZnO emerged in recent years as a fertile platform for studies of many-body effects in low-dimensional electron systems. It is evident, for instance, from the observation of spin-dependent transport in a nominally non-magnetic ZnO structure and from the observation of even-denominator fractional quantum Hall states at Landau level filling factors ν=3/2 and 7/2 – the first time observation of the exotic states outside the realm of GaAs [1,2].

In this talk, I will show the clear evidences for the interaction between the mobile electrons and localized magnetic moments, manifested in the observation of the anomalous Hall effect (AHE) [3]. At low temperatures, MgZnO/ZnO heterostructure yields an AHE response similar to that of a clean ferromagnetic metal, while keeping a large anomalous Hall angle. The observation of AHE is consistent with the Giovannini-Kondo model, in which the localized magnetic moments, which are here unpaired electrons localized at the epitaxial point defects, couple with the orbital motion of mobile electrons leading to the skew scattering [4,5].

The presented study reveals a new aspect of many-body interactions in two-dimensional electron system and shows how it can lead to the emergence of AHE in a non-magnetic system. The observation of both even-denominator fractional quantum Hall states and the anomalous Hall effect brings ZnO to the forefront of high-mobility two-dimensional charge carrier systems.

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