Interlayer Hall effect of Zero gap conductor

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α-$(ET)_2I_3$ exhibits mysterious transport behavior under high pressure [1]. A few years ago, this material was found to be a zero gap conductor with Dirac cone type energy dispersion [2]. Now, we are in a stage where we can analyze the behavior of α-$(ET)_2I_3$ based on the knowledge of zero gap conductors.

This material is the first 1) bulk, 2) two dimensional 3) intrinsic zero gap conductor with layered crystal structure. Since a conductive layer is separated by insulating layers, the electrical transport occurs in each layer, almost independently. Weak but finite electron transfer between layers ,however ,exists which is important because it opens a way to examine the intra-layer electronic states through the interlayer transport phenomena. The purpose of this work is to clarify the properties of zero-mode Landau electrons that appears at the contact points when a magnetic field normal to the 2D-layer is applied. To investigate how zero-mode carriers are created, the Hall effect was measured. Recently, we succeeded in observing the Hall effect for the current normal to the layers. In the experiment, magnetic field with a fixed strength was rotated in a plane normal to the current and the Hall resistance was measured as a function of the field direction. The interlayer Hall resistance has a peak when the field is parallel to the layers (Fig.1). We found the envelope of curves in Fig.1 can be fitted to a function $\rho = a\cot(\theta)$ in a wide region of θ. This characteristic behavior can be explained in terms of zero mode carriers. In the vicinity of θ=0, on the other hand, Landau levels disappear and carriers created by the Zeeman effect gives a dominant contribution on transport .

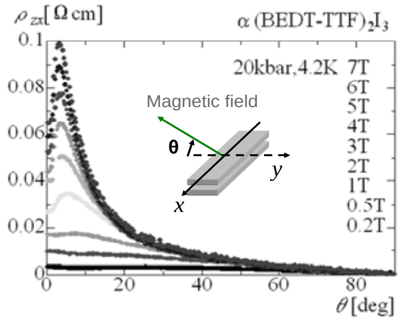

Fig.1 Magnetic angle dependence of Interlayer Hall resistance at high hydrostatic pressure

[1] N. Tajima *et al.*, J. Phys. Soc. Jpn. 5 (2009) 051010.
[2] S. Katayama *et al.*, cond-mat (2009) 0601068.