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Angular Magnetoresistance Oscillations at Very High Magnetic Field: Beyond the Semiclassical Limit

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Introduction

Angular magnetoresistance oscillations in quasi-one or quasi-two-dimensional electron systems have been well documented in various organic and inorganic low dimensional materials. Semiclassical theory based on the Boltzmann transport equation successfully explained most of the oscillations to a good degree of precision. Organic conductors are good candidate to apply this physics because subtle change can be easily introduced to the otherwise simple Fermi surface structure by substituting anions or by applying pressure.

Detailed study of angular oscillations reveals that there are a few findings, which are completely beyond the semicalssical explanation. Recently found separation of Lebed resonance oscillations are one of such examples. In this study, we measured the field dependence of splitting behavior up to 31.46 T. The splitting behavior varies from one system to another.

Experimental

One of the most serious restrictions to work with organic conductors is that samples must be pressurized to be metallic. And then, the pressure cell should be able to rotate at low temperature and under magnetic field. We have developed a cylindrical clamp type pressure cell which is small enough to rotate full 360 degree in the System B / 31.46 T resistive magnet in the Cell 9. Interlayer resistance was measured in the R_{zz} geometry with lock-in amplifiers from Stanford Research Systems.

Results and Discussion

Fig. 1 shows representative result obtained in $(TMTSF)_2PF_6$ when the magnetic field rotates from the *z*-axis in the ϕ =55 degree plane. The second derivative, showed in Fig. 2, shows clearly that each Lebed resonance dip consists of four sub-resonances. Fig. 3 is the similar result, but obtained in the sister compound $(TMTSF)_2ReO_4$. ϕ was 45 degree in this case. The number of sub-resonances depends on the system. The separation between sub-resonances looks independent of the magnetic field strength.

Conclusions

We confirmed that the Lebed resonances split into more than one sub-resonances under strong magnetic field when the magnetic field rotates in a plane between *xz*- and *yz*-planes. Their origin is not clearly understood for the moment and we need more systematic investigation to see how the splitting evolves with azimuthal angle.

Acknowledgements

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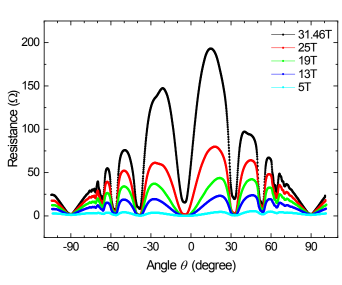

Fig.1 AMRO of $(TMTSF)_2PF_6$ at 0.5 K. ϕ=55 degree.

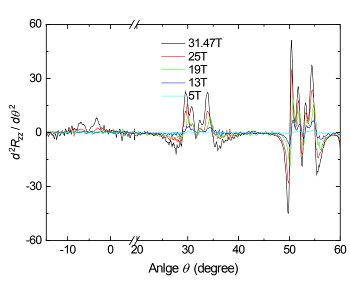

Fig.2 Second derivative of data presented in Fig. 1.

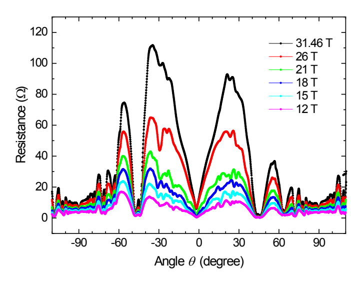

Fig.3 AMRO of $(TMTSF)_2ReO_4$ at 0.5 K. ϕ=45 degree.