Anomalous Hall Resistance jump at Lebed's magic angles

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Quasi-one-dimensional conductors have attracted much attention following the discovery of superconductivity and rich magnetic angular effects in materials such as $(TMTSF)_2X$ compound. After years of intensive studies many questions still remain, such as the nature of electron pairing in the superconducting state. One of the biggest puzzles is the giant Nernst effect N observed in $(TMTSF)_2PF_6$ and $(TMTSF)_2ClO_4$ in the vicinity of Lebed's magic angles[1,2]. The sign change in N at the magic angles and its enhancement at a few degrees off from the magic angles are beyond the semi-classical description which is successful in explaining many of the phenomena related to Lebed resonances. Due to the similarity of the enhancement of N in the cuprates, it has been suggested that the Lebed resonance could be related to vortex motion [3].

To cast light on to this problem, we performed a series of electrical transport measurements focusing on the transverse response (the Hall effect) far from the Field-Induced Spin Density Wave (FISDW) region, and found anomalous enhancement at certain angles. The similar behavior of signal was observed in the Hall effect measurements at Lebed magic angles to that observed in Nernst effect measurements, though the magnetic field strength and angular region are different. This similarity suggests that the two effects may originate from the locking of conduction in the plane of the magnetic field at magic angles, while the enhancement mechanism may not be the same. We report detailed transport measurement results and discuss the conduction mechanism in the vicinity of Lebed's magic angles.

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