Spin Liquid Behavior and Anomalous Hall Effect of the Frustrated Kondo Lattice $Pr_2Ir_2O_7$

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The pyrochlore magnet $Pr_2Ir_2O_7$ is a geometrically frustrated Kondo lattice. It exhibits no magnetic long-range order down to 80 mK despite of an antiferromagnetic RKKY interaction of $T^* = 20$ K between the <111> Ising-like Pr 4*f*-moments. Instead, Kondo effect emerges and leads to partial screening of the localized 4*f*-moments below T^*. In the susceptibility and specific heat, the underscreened 4*f*-moments show spin-liquid behavior below a renormalized energy scale of $\theta_W \sim 1.7$ K and $B_c \sim 1.0$ T [1].

Here, we report novel Hall transport phenomena observed in the spin liquid regime. Interestingly, the anomalous Hall coefficient R_s at the low field limit is found to increase *logarithmically* on cooling as shown in Fig. 1. In the same temperature region, the longitudinal resistivity ρ_{xx} has nearly no T dependence, and thus, the diverging behavior in R_s cannot be ascribed to the conventional mechanisms such as skew scattering and side jump processes. Furthermore, the field induced crossover of the Pr spin state around B_c dramatically changes the field dependence of the Hall resistivity ρ_{xy}. This suggests that the short-range non-collinear spin texture of the Pr-moments including spin-chirality plays an important role for the low temperature divergence of ρ_{xy}.

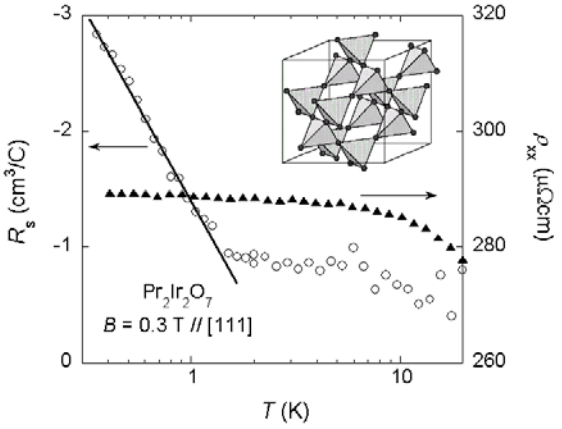

FIG. 1: Temperature dependence of the anomalous Hall coefficient R_s and the longitudinal resistivity ρ_{xx} under a magnetic field of 0.3 T along the [111] direction of $Pr_2Ir_2O_7$.

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