

Uniaxial anisotropy in the superconducting state of $\text{PrOs}_4\text{Sb}_{12}$

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We performed local magnetization measurements in the superconducting state of $\text{PrOs}_4\text{Sb}_{12}$ using micro-Hall probe with an active area of $30 \times 30 \mu\text{m}^2$. Figure 1 shows local magnetization hysteresis curves in $\text{PrOs}_4\text{Sb}_{12}$ for a magnetic field applied along one of the principal axes, which we tentatively call [001] direction. A remarkable dip structure is observed in each hysteresis loop near the central magnetization peak field H_{cp} . The inset shows the local magnetization re-plotted as a function of local magnetic induction B_z , indicating the anomalies appear close to $B_z = 0$ G. In Fig. 2, we show the local magnetization curves measured along another axis, which we call [010]. There is no anomaly as we observed for the local magnetization along the [001] axis. The anomaly is pronounced only when the magnetic field is applied along the [001] direction, and is not observed along other two axes. These facts indicate that the superconducting nature of $\text{PrOs}_4\text{Sb}_{12}$ is uniaxial in spite of its cubic crystalline symmetry. Just like a uniaxial ferromagnet, these results strongly suggest that the superconductivity in $\text{PrOs}_4\text{Sb}_{12}$ accompanies chirality, with chiral vector pointing along a certain axis of the crystal. We believe that anomalies in the local magnetization are universal to the spin-triplet superconductors with broken time-reversal symmetry. We also measured temperature dependence of the local magnetic induction in $\text{PrOs}_4\text{Sb}_{12}$ to examine the presence of spontaneous magnetic field generated at the edge of the chiral domains. M - T curves for positive and negative applied fields are symmetric and do not give supporting evidence for the chiral domains. These two apparently contradictory results can be reconciled by assuming that the size of the chiral domains are smaller than the Hall probe.

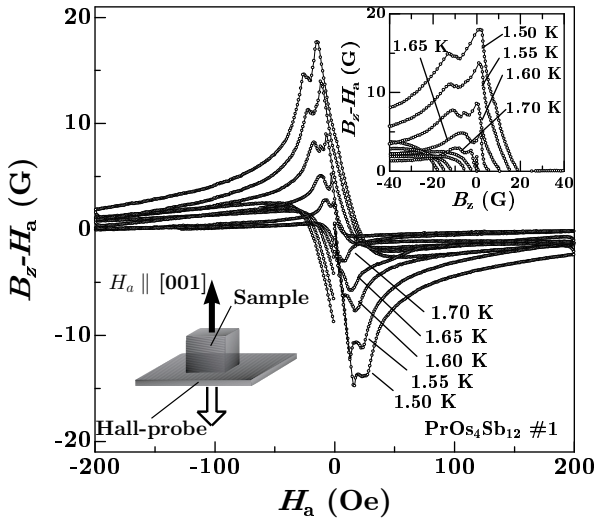


Figure 1: Local magnetization hysteresis curves in $\text{PrOs}_4\text{Sb}_{12}$ measured for the [001] axis. The lower inset shows the schematic setting of the sample and the Hall-probe. The open arrow indicates the possible direction of the chiral vector.

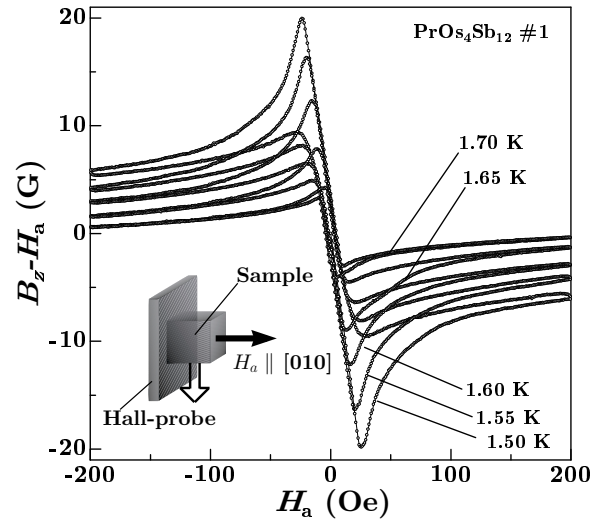


Figure 2: Local magnetization hysteresis curves in $\text{PrOs}_4\text{Sb}_{12}$ measured for the [010] axis. The inset shows the schematic setting of the sample and the Hall-probe. The open arrow indicates the possible direction of the chiral vector.