PDO measurements of UTe_2 in high magnetic fields

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Introduction

We discovered a novel nonunitary spin-triplet superconductivity in UTe_2 [1], which closely resembles the ferromagnetic superconductors with dramatically enhanced transition temperature and upper critical field, and a paramagnetic normal state. UTe_2 exhibits the crucial ingredients of a nonunitary triplet superconducting state, namely: an extremely large, anisotropic upper critical field H_{c2}, temperature independent nuclear magnetic resonance (NMR) Knight shift in the superconducting state, and a large residual normal electronic density of states indicating that half of the electrons remain ungapped. In order to measure H_{c2}, which is clearly higher than 20T, we performed PDO measured in pulsed field in NHMFL.

Experiments

We performed PDO measurements in pulsed fields up to 65T at various temperatures at NHMFL, Los Alamos.

Results and Discussion

The results are very interesting: 1. The H_{c2} obtained from PDO along b-axis is smaller than that from resistivity measurement. Given that PDO is more a bulk measurement than resistivity, there might be surface state existing. 2. There might be reentrance of the superconducting state in high magnetic field indicated by increase of the PDO frequency after the superconducting state is completed suppressed. 3. There is a sharp change in frequency at 35 T indicating a phase transition, which very likely corresponds to spin flip from easy axis to hard axis. See Fig. 1. for the detailed data.

Even more interesting and surprising results came up when we tilted the sample towards *c*-axis. For the angle between 25 and 40 degrees, we observed a huge hysteresis loop, the nature of which needs to be confirmed with further measurement. See Fig. 2. for the detailed data.

Conclusions

UTe_2 shows very exciting phenomena in the high magnetic fields. With just PDO measurements, we cannot make conclusions about the nature of all the phase transitions we observed. Resistivity and magnetization measurements in pulsed field range is proposed to explore the underlying physics.

Acknowledgements

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References

[1] Sheng Ran, *et al*., arXiv:1811.11808 (2018).

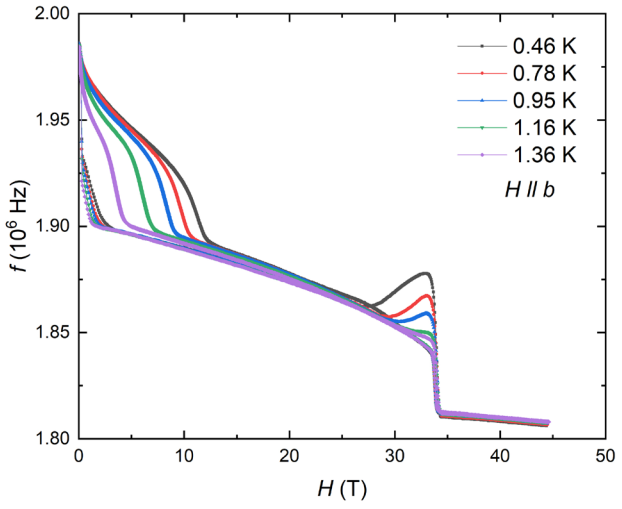

Fig.1 PDO signal as a function of field for UTe2 with *H // b*, for different temperatures.

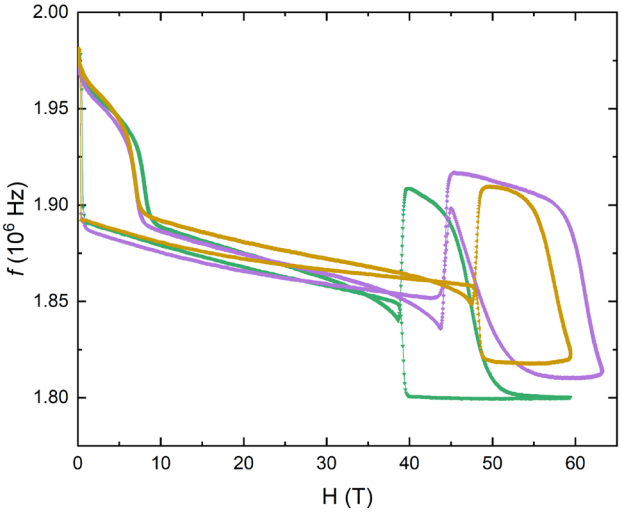

Fig.2 PDO signal as a function of field for UTe2 at 0.5 K, with H 25 degree off the b-axis.