Vortex-like excitation above T_c in 2D superconductor $PrO_{0.5}F_{0.5}BiS_2$

J. C. Jiao[1], J. Zhang[1], C.-S. Chen[1], Xin Li[1], K. Huang[1], Z.-F. Ding[1], D. E. MacLaughlin[2], O.O. Bernal[3], P. -C. Ho[4], T. Shiroka[5], D. Yazici[6], M. B. Maple[6], L. Shu[1]

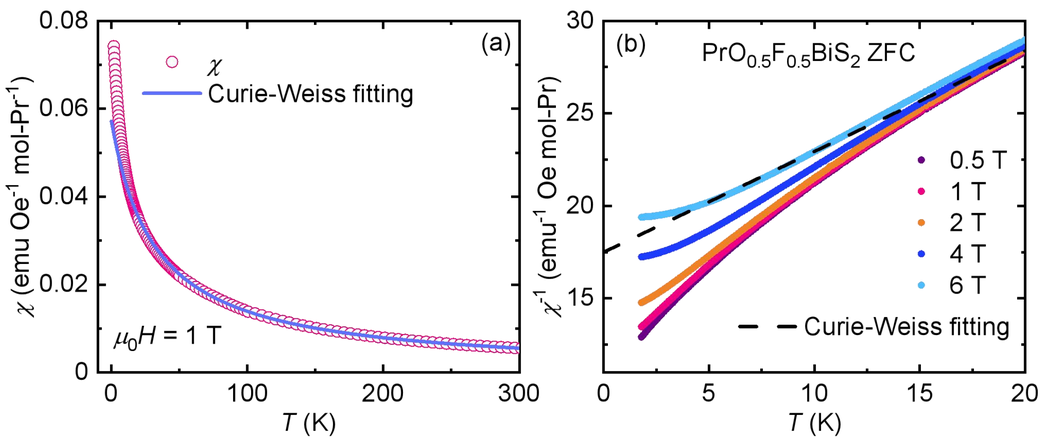
[1]*State Key Laboratory of Surface Physics, Department of Physics, Fudan University, Shanghai 200433, China*
[2]Department of Physics and Astronomy, University of California, Riverside, California 92521, USA
[3]*Department of Physics and Astronomy, California State University, Los Angeles, California 90032, USA*
[4]*Department of Physics, California State University, Fresno, California 93740,USA*
[5]*Laboratory for Muon-Spin Spectroscopy, Paul Scherrer Institute, CH-5232 Villigen PSI, Switzerland*
[6]*Department of Physics and Center for Advanced Nanoscience, University of California, San Diego, La Jolla,California 92093,USA*

Motivations

- $PrO_{0.5}F_{0.5}BiS_2$: 2D, layered structure, with $T_c = 3.5$ K[1].
- Superconductivity arised from BiS_2 layers, analogous to CuO_2 layers in cuprates and FeAs/FeSe layers in iron-based SC.
- No study on the potential phase fluctuation and pseudogap regime due to the two-dimensionality of the system[2][3].
- Explore the coexistence of superconductivity and magnetism.

Magnetic Susceptibility

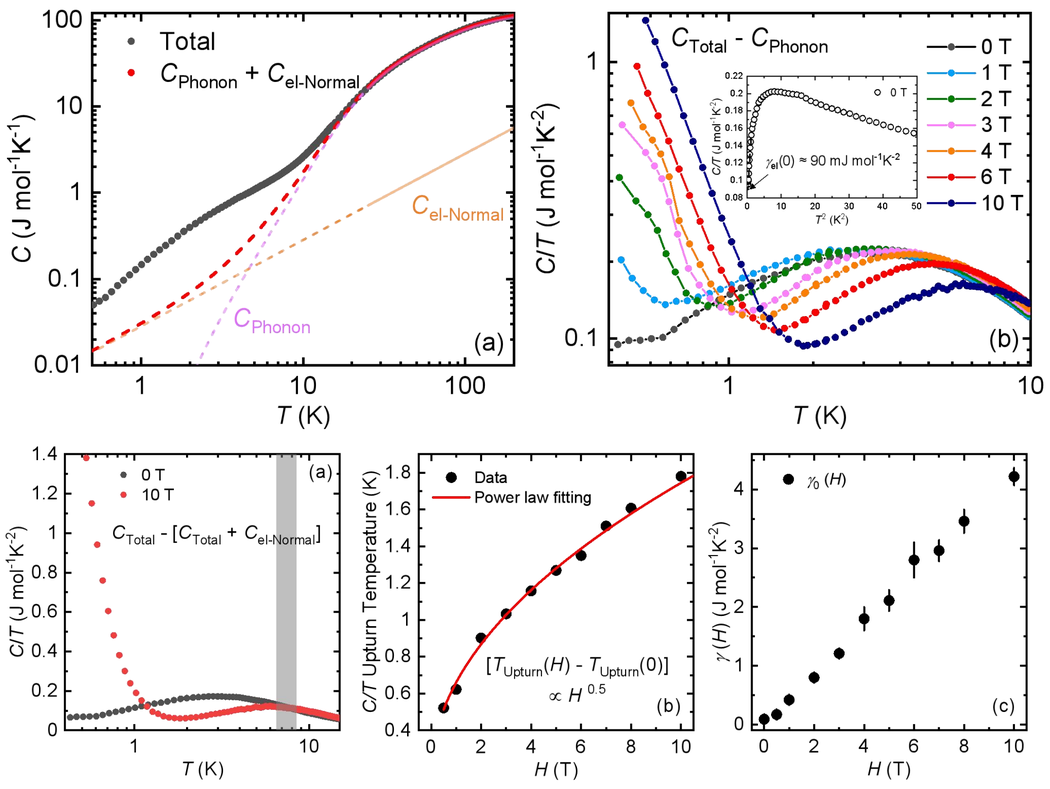
- The system becomes ltinerant below 20 K.
- External field suppresses the itineration and makes the 4f electrons in Pr more localized.



Specific Heat

$C_{total} = C_{Phonon} + C_{el\text{-}Normal}$ above 20 K

- Non-Fermi liquid behaviour: nonlinear electron specific heat.
- Kondo scattering at low temperature: a low-T rise in C/T.
- External fields enhance such Kondo scattering.
- Potential superconducting fluctuation above T_c at zero field.



Conclusions

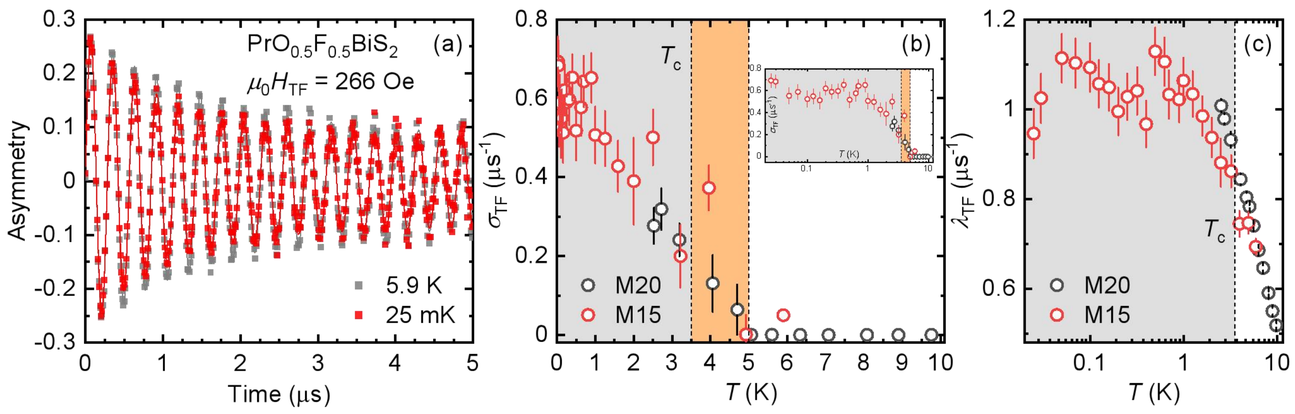
- 4f electrons of Pr ions change from itinerant to localized with the increase of external magnetic field.
- Kondo effect at low temperature.
- Vortex-like excitation and phase fluctuation above T_c.
- Slow magnetic fluctuation above T_c in the pseudogap-like regime.

Transverse field μSR

Fitting function:

$$A_s(t) = A_s exp(-\frac{1}{2}\sigma_{TF}^2 t^2 - \lambda_{TF} t) cos(\omega_s t + \phi)$$

- Gaussian relaxation rate σ_{TF} is enhanced by FLL field inhomogeneity.
- σ_{TF} appears above T_c indicating vortex-like excitation in the normal state.

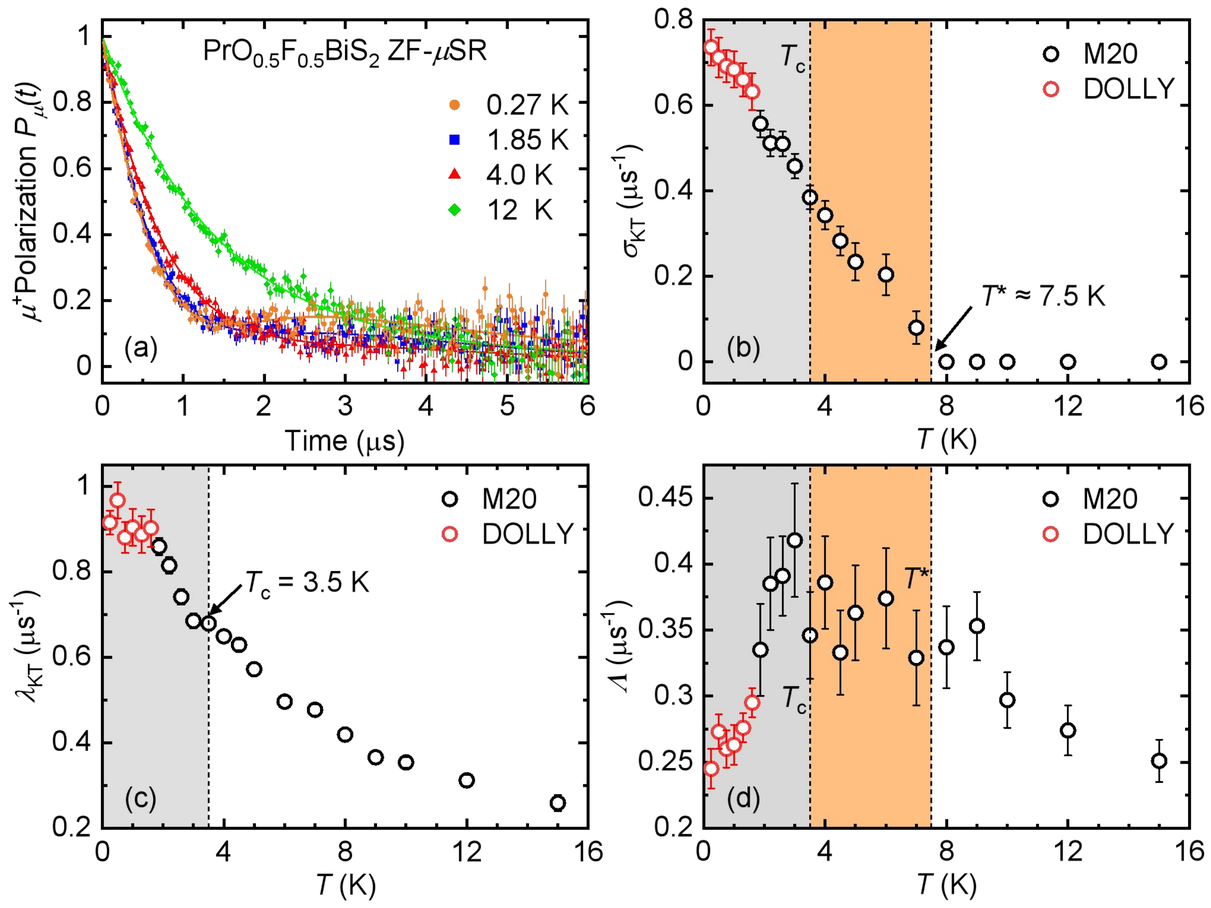


Zero field μSR

Fitting function:

$$P_\mu(t) = A_s G_{ZF}^{LGKT}(\sigma_{KT}, \lambda_{KT}, t) exp(-\Lambda t)$$

- Static fields with both Gaussian and Lorentzian distribution are obtained.
- σ_{KT} appears below T^* indicating the spontaneous vortex-like excitation in the pseudogap-like regime above T_c.



References

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