μSR Investigation of Doped $IrTe_2$

Murray Wilson

Jiaqiang Yan, David Mandrus, Timothy Munsie, Teresa Medina, Graeme Luke

McMaster University

TRIUMF

Outline

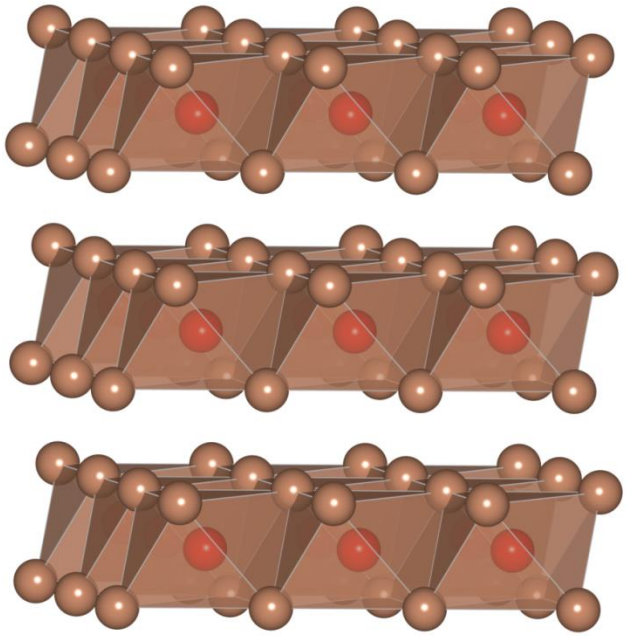
- Motivation
- μSR Introduction
- $Ir_{0.95}Pt_{0.05}Te_2$ TF μSR
- $Fe_{0.33}Ir_{0.83}Te_2$ ZF μSR
- Conclusion

Motivation – $IrTe_2$

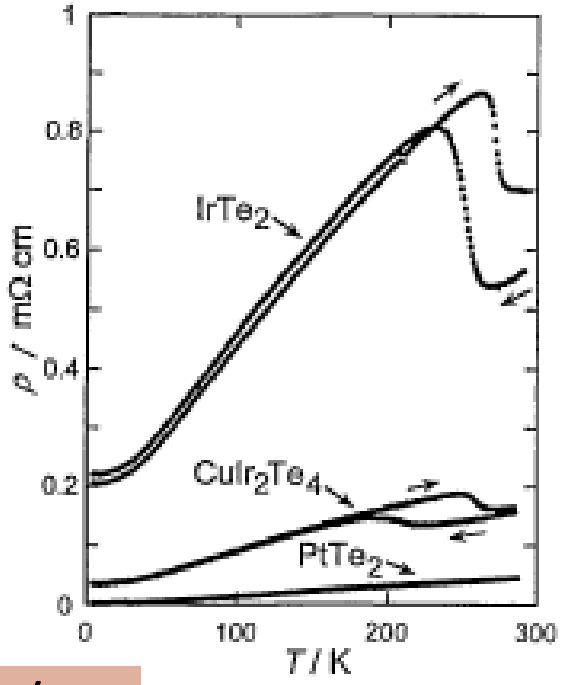
Layered structure

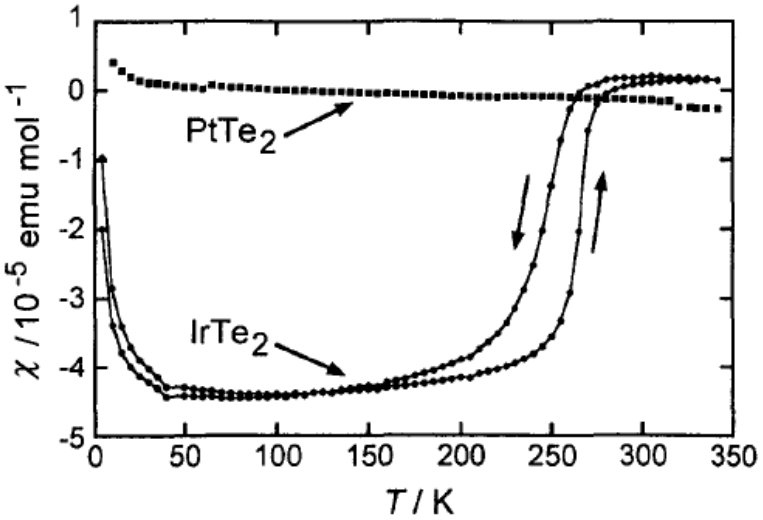
High spin-orbit coupling

Structural transition



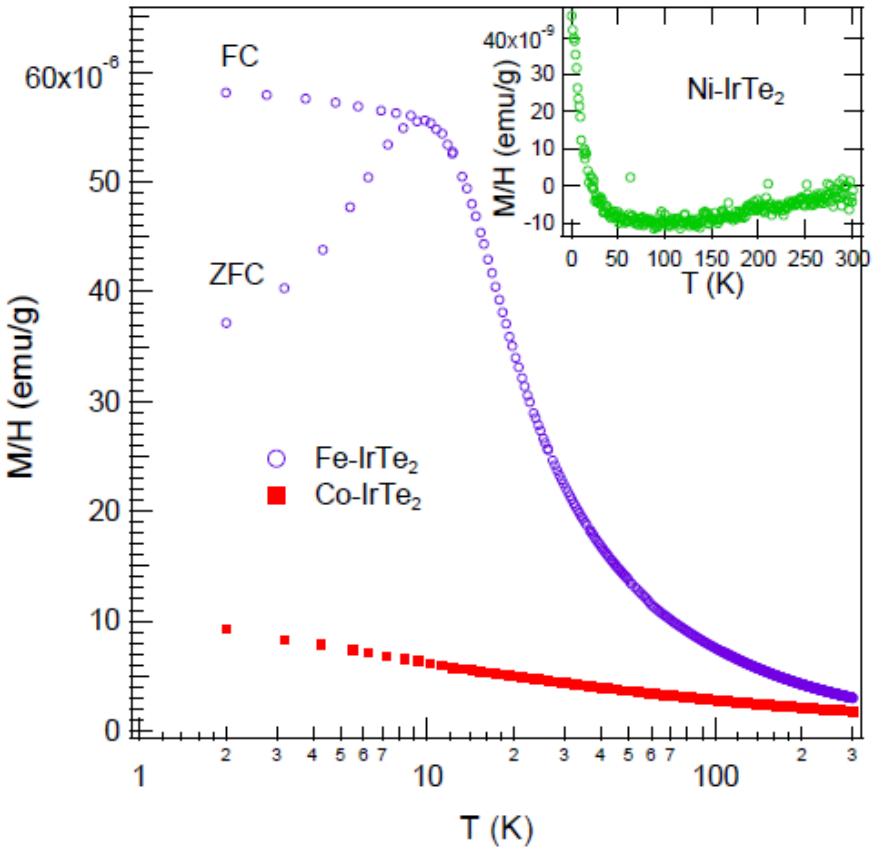
$P\bar{3}m1$



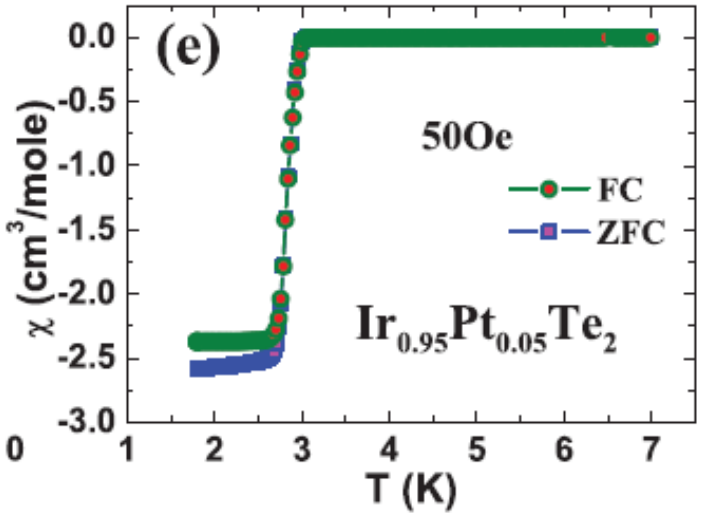


Matsumoto JLTP 1999

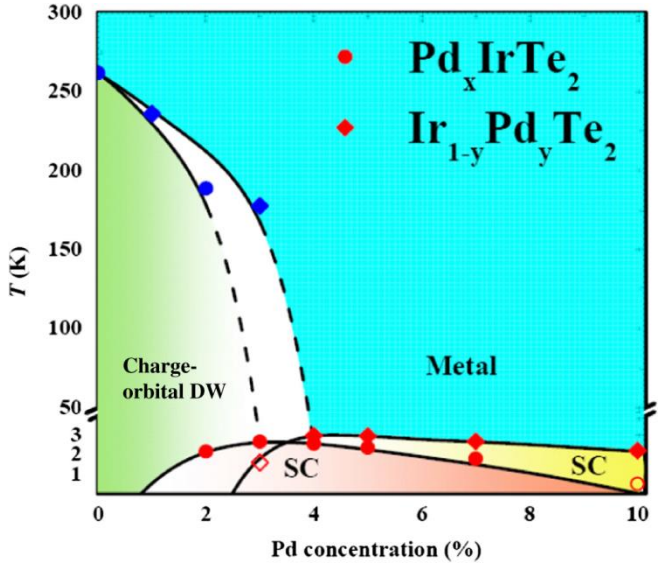
Motivation



Yan arXiv:1309.4829v1

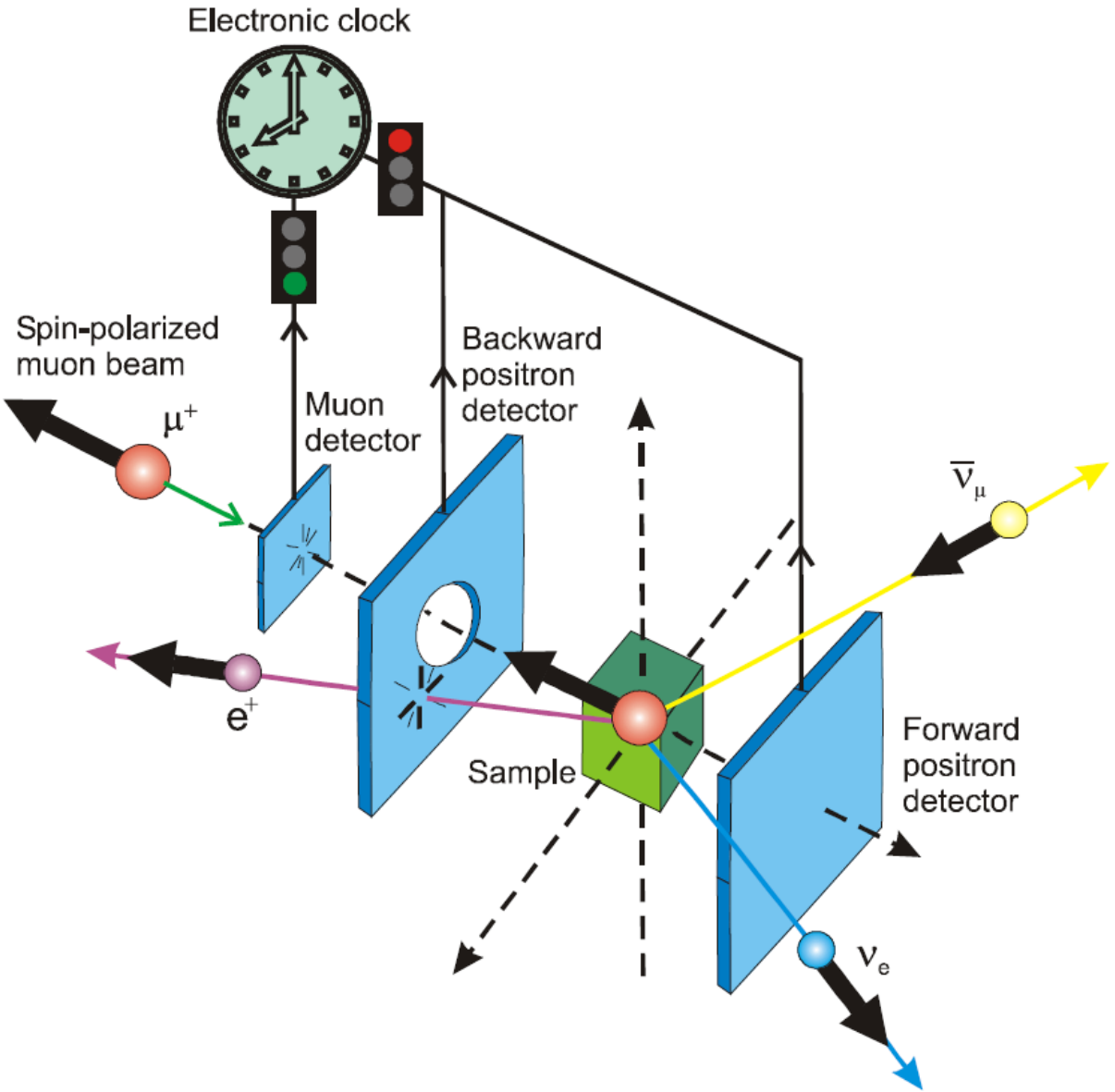


Feng Sci. Rep. **3** 1153 2013



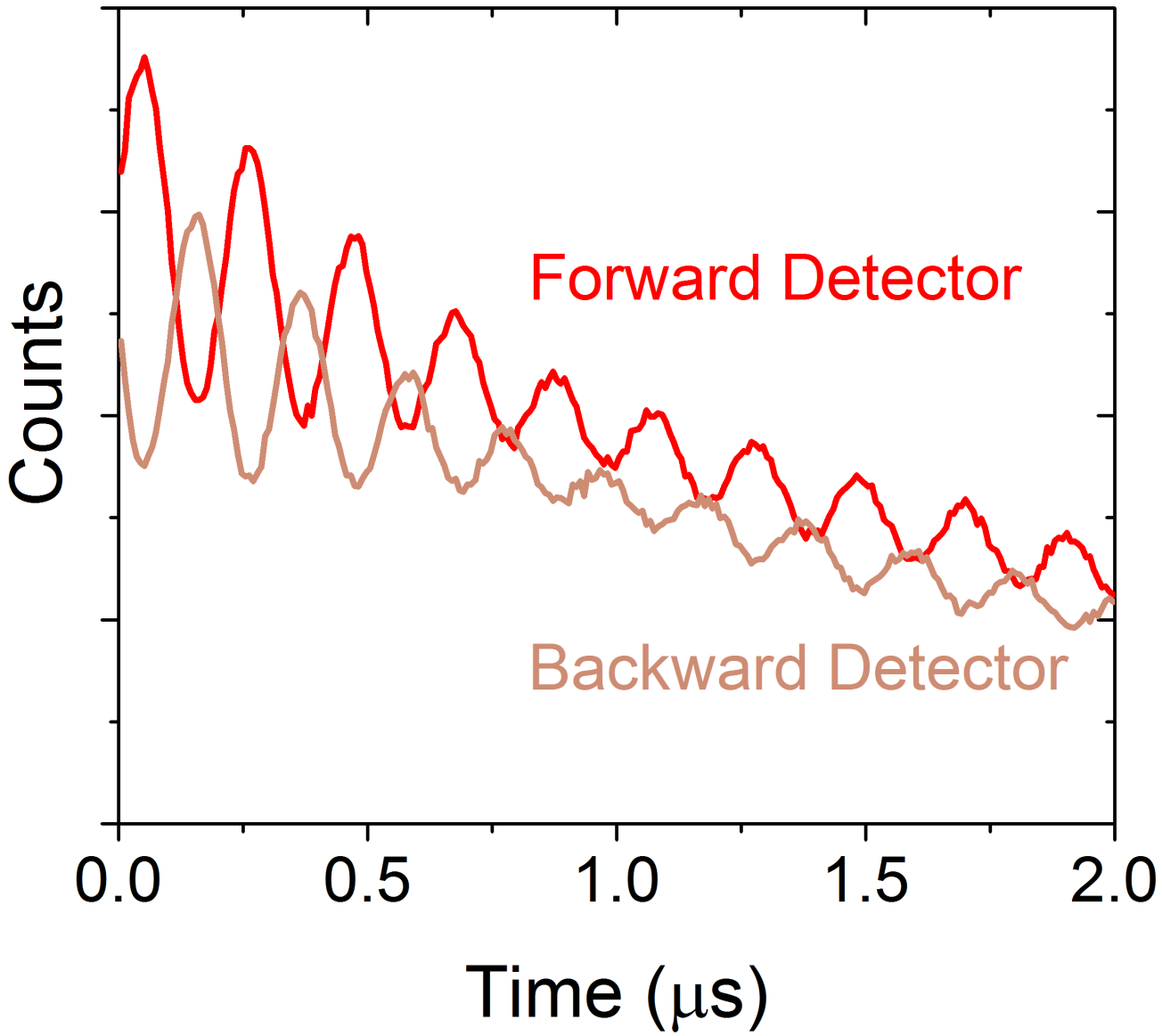
Yang PRL **108** 116402 (2012)

μSR Technique

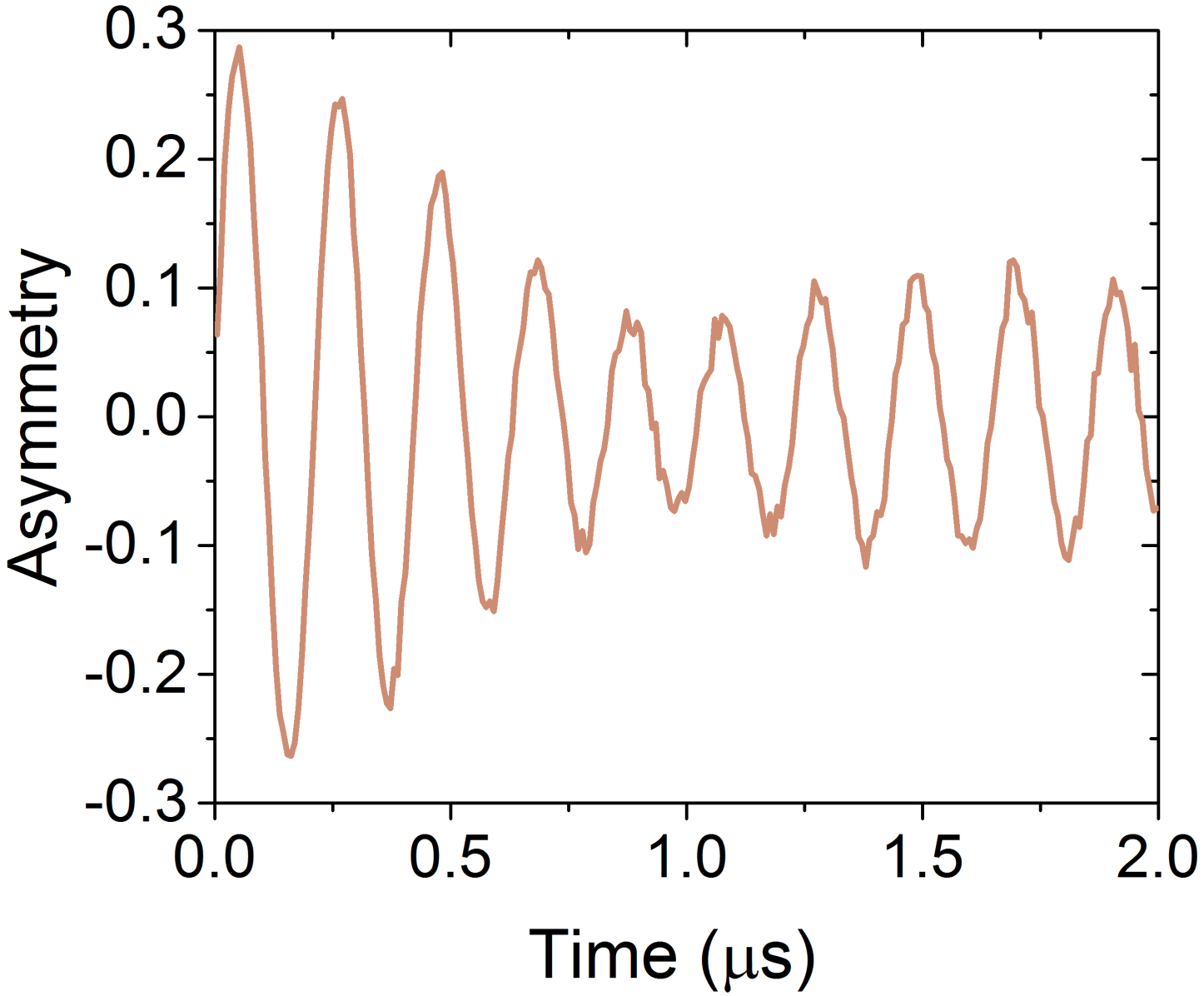


J.E. Sonier *Muon Spin Rotation/Relaxation/Resonance (μSR)*

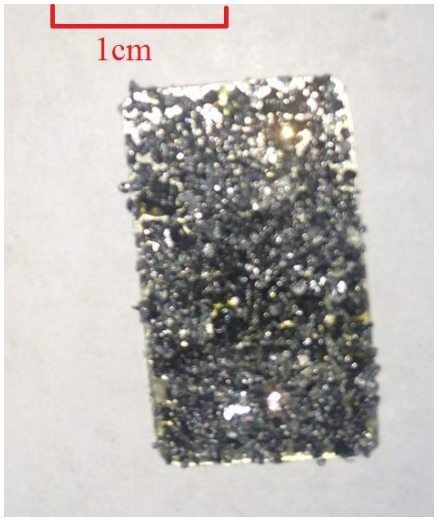
μSR Technique



μSR Technique



$Ir_{0.95}Pt_{0.05}Te_2$

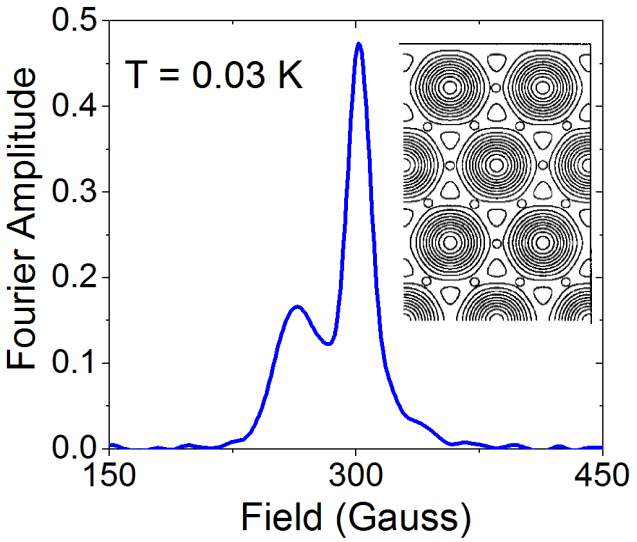


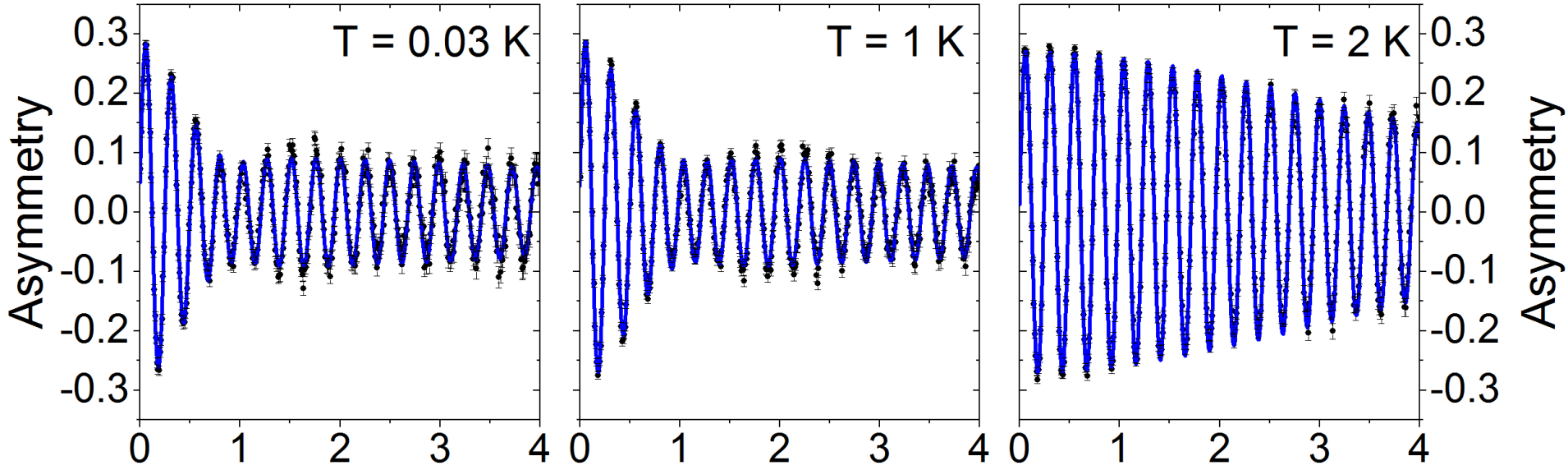
TF μSR

Pt-$IrTe_2$

$$A(t) = \sum_{i=1}^{2} A_i \cos(\omega_i t + \varphi_i) e^{-\frac{1}{2}(\sigma_i t)^2}$$

B = 300 G



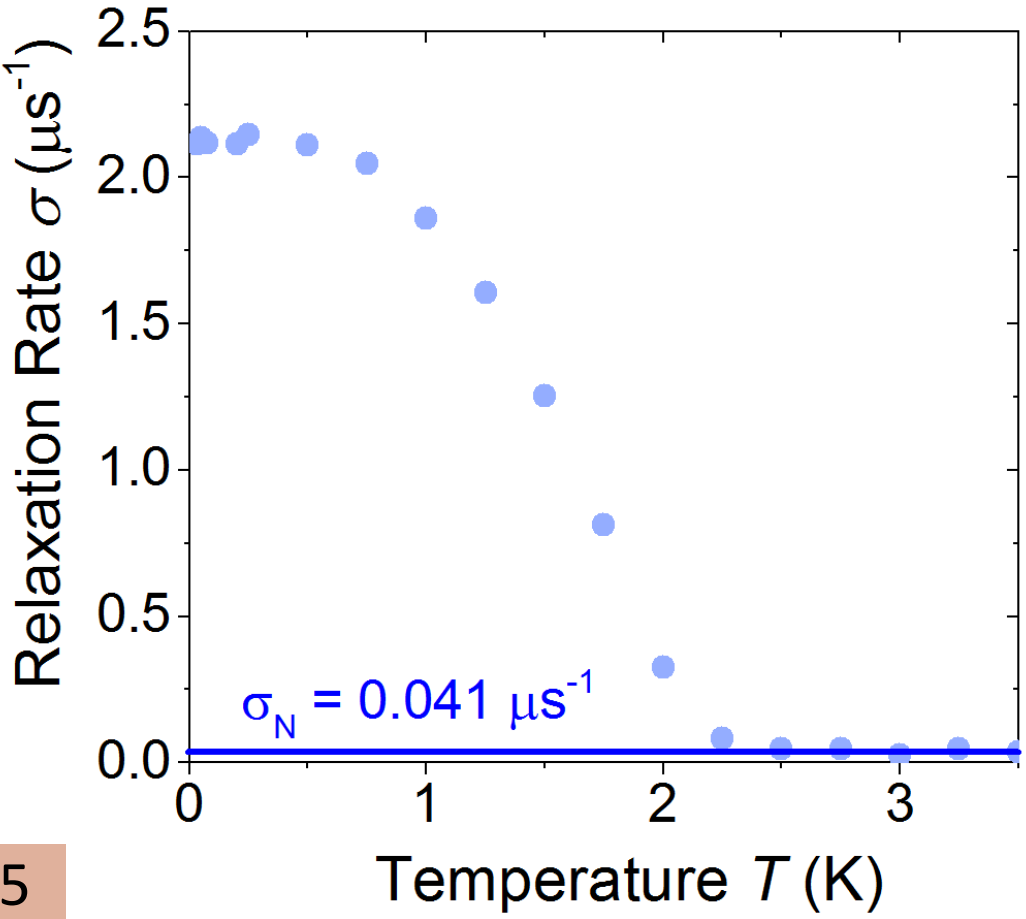


Superfluid Density

Pt-$IrTe_2$

$$n_s = \frac{m\sigma_{SC}}{0.043\mu_0 e^2 \gamma_\mu \Phi_0 \sqrt{2}}$$

$$\sigma_{SC} = \sqrt{\sigma^2 - {\sigma_N}^2}$$

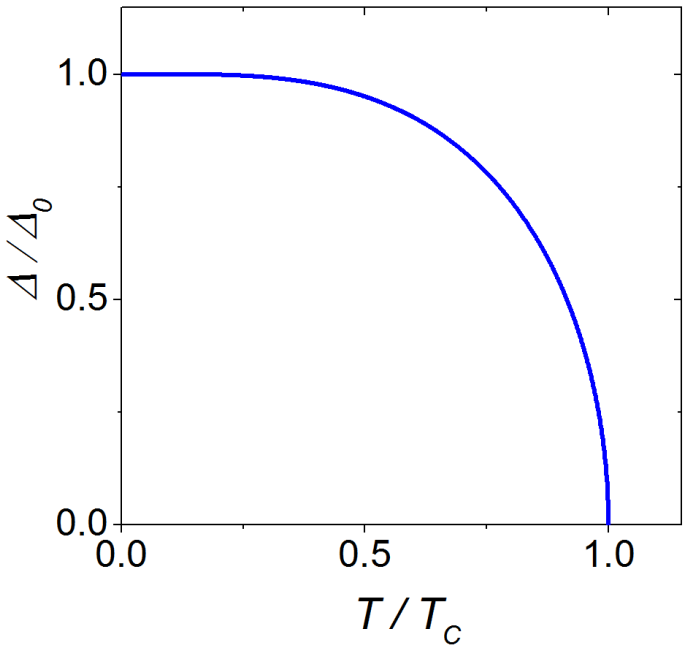


Superfluid Density

Pt-$IrTe_2$

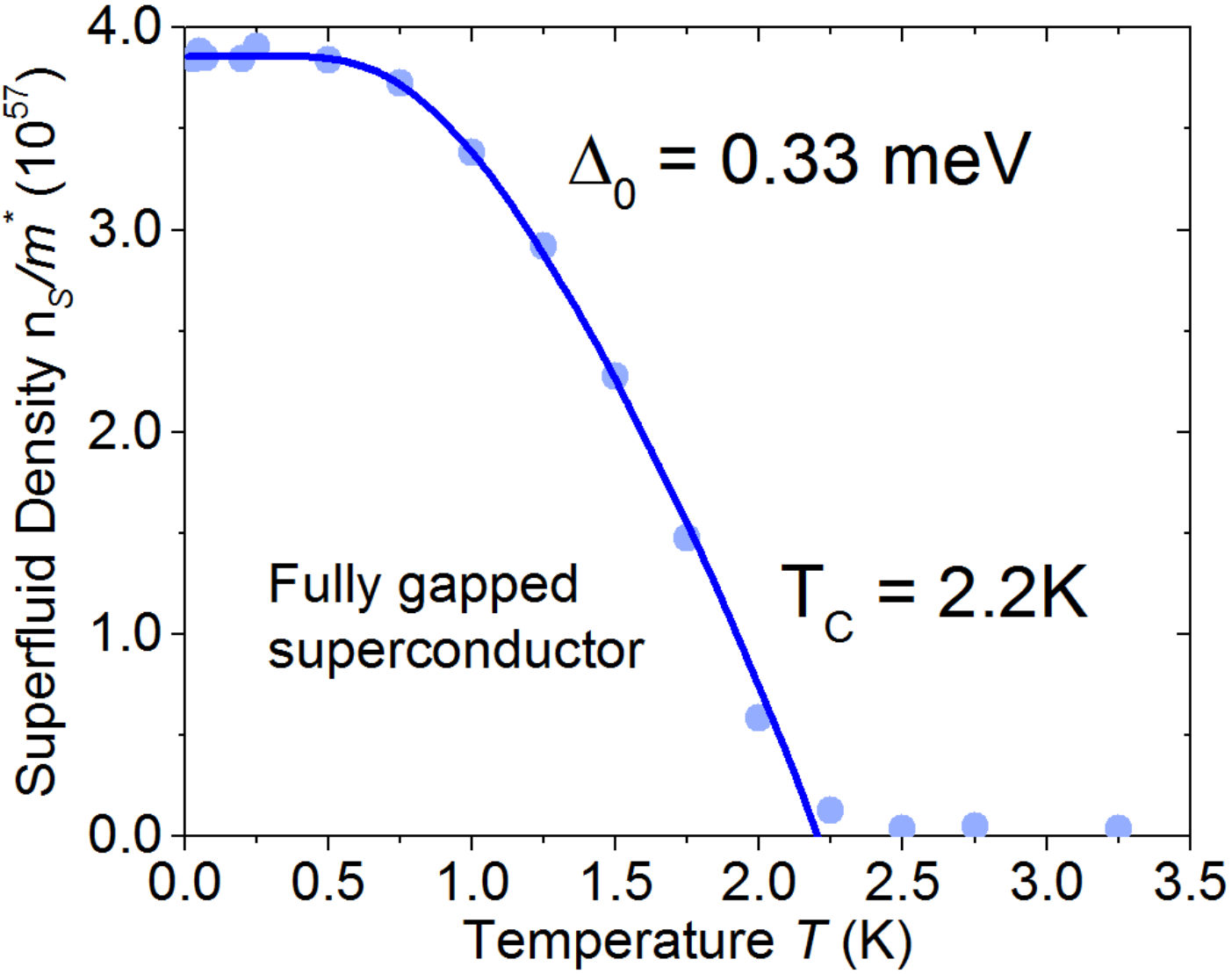
$$n_s = \frac{m}{\mu_0 {\lambda_0}^2 e^2}\left[1 + 2\int_{\Delta(T)}^{\infty} dE \frac{e^{E/(k_B T)}}{(e^{E/(k_B T)}+1)^2}\frac{E}{\sqrt{E^2 - \Delta(T)}}\right]$$

$$\Delta(T) = \Delta_0 \tanh\left(1.837\left(\frac{T_C}{T} - 1\right)^{0.51}\right)$$



Superfluid Density

Pt-$IrTe_2$



BCS Comparison

$Ir_{0.95}Pt_{0.05}Te_2$ Present Work	$Ir_{0.95}Pd_{0.05}Te_2$ Ref. [1] (STS)	BCS weak coupling
$\Delta_0 = 0.33$ meV	$\Delta_0 = 0.39$ meV	$\frac{2\Delta_0}{k_B T_C} = 3.5$
$T_C = 2.2$ K	$T_C = 2.5$ K	
$\frac{2\Delta_0}{k_B T_C} = 3.5$	$\frac{2\Delta_0}{k_B T_C} = 3.6$	

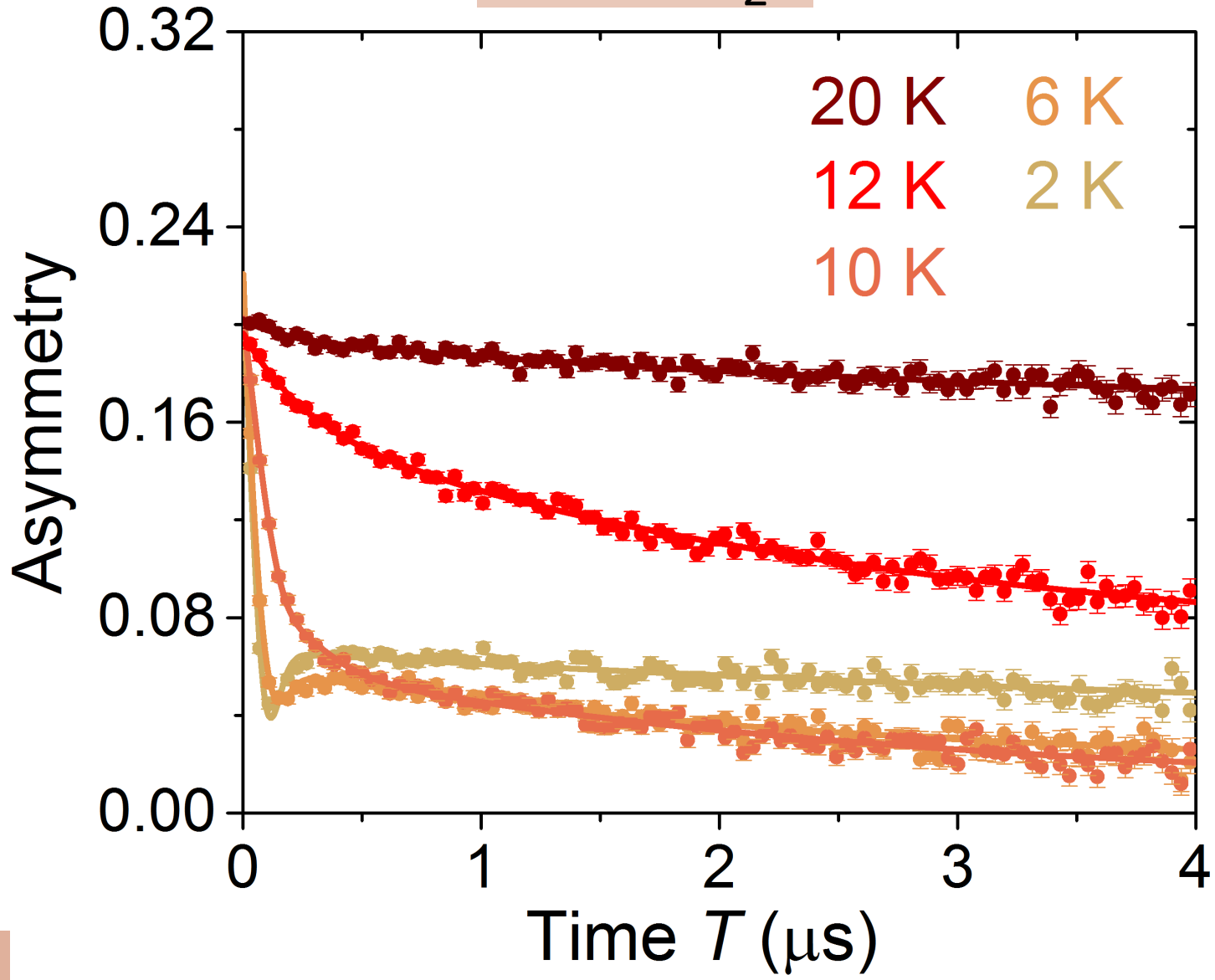
[1] D.J. Yu et. al PRB 89, 100501(R) March 4 2014

$Fe_{0.33}Ir_{0.83}Te_2$

Single Crystal

ZF μSR

Fe-$IrTe_2$

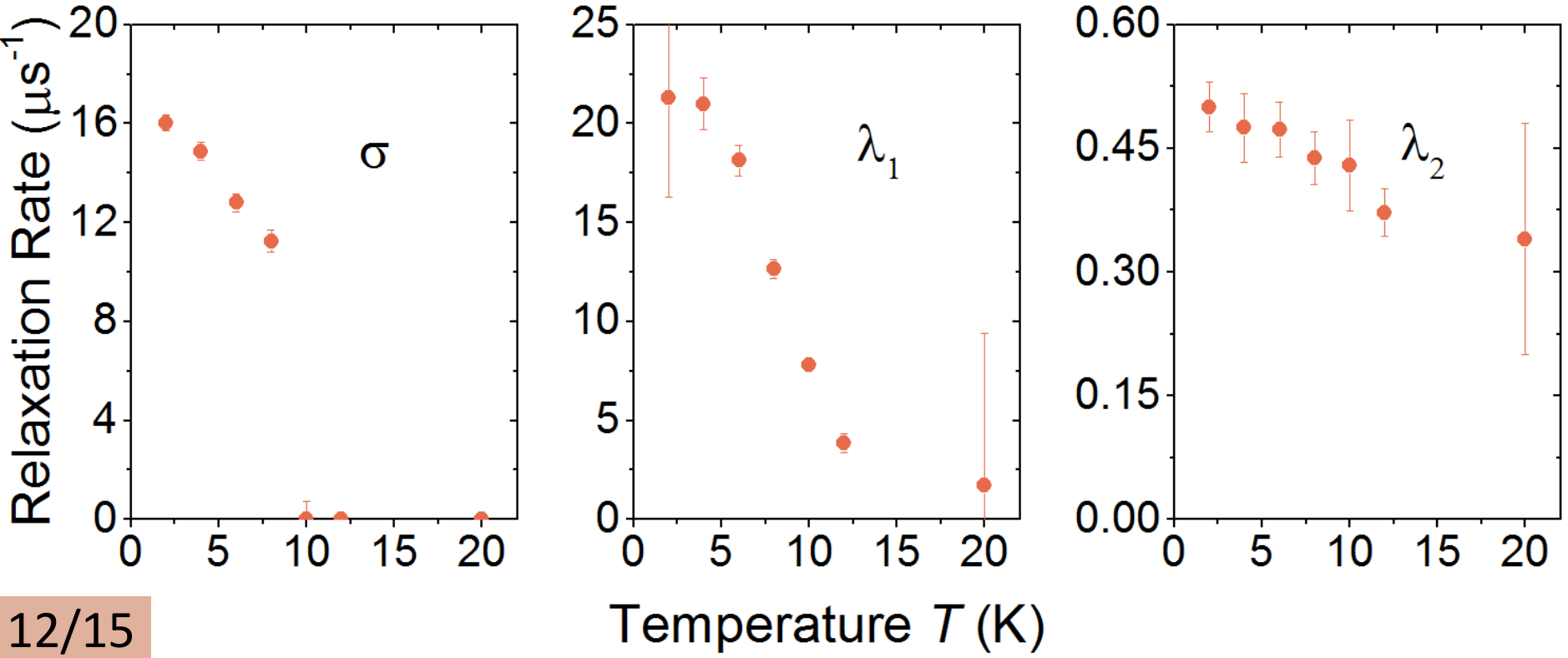


ZF μSR

Fe-$IrTe_2$

$$A = A_1\, KT(\sigma, t) + A_2\, e^{-\lambda_1 t} + A_3\, e^{-\lambda_2 t}$$

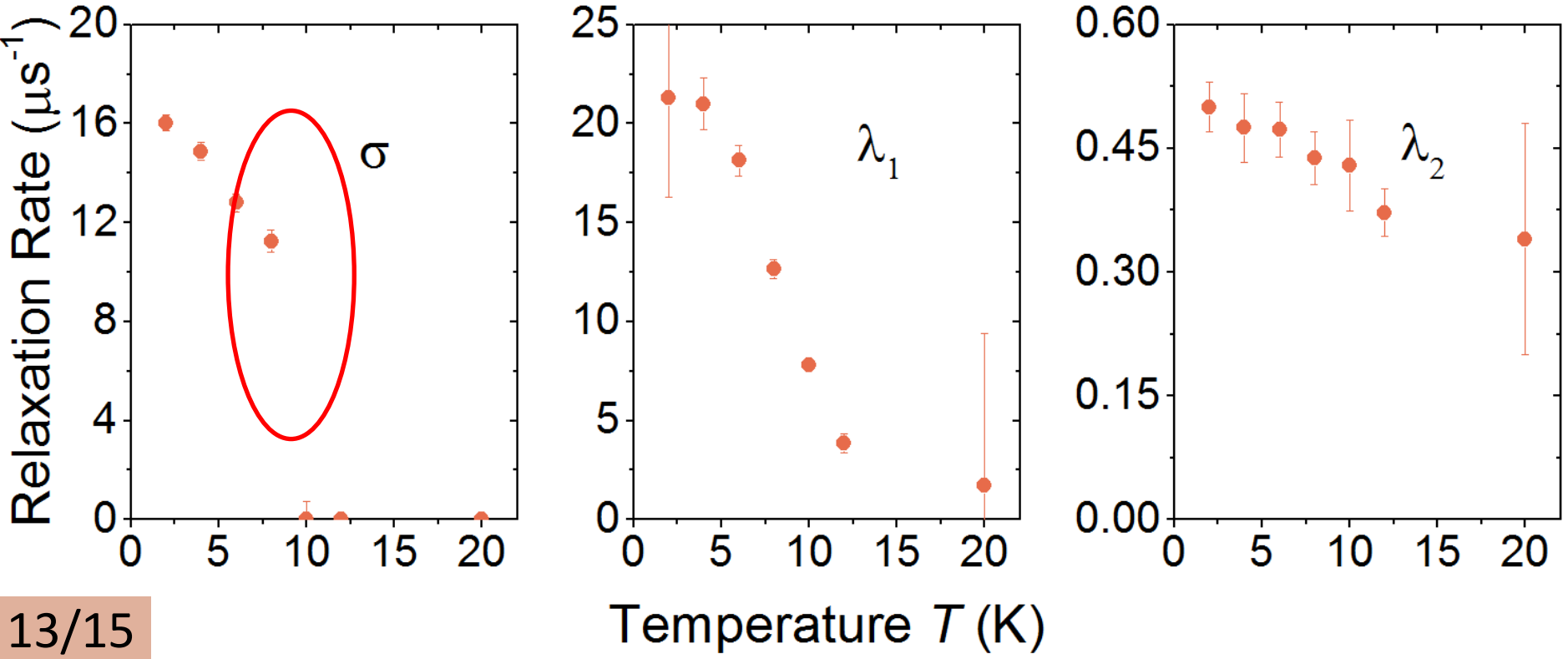
$$KT(\sigma, T) = \frac{1}{3} + \frac{2}{3}[1 - (\sigma t)^2]e^{-(\sigma t)^2/2}$$



ZF μSR

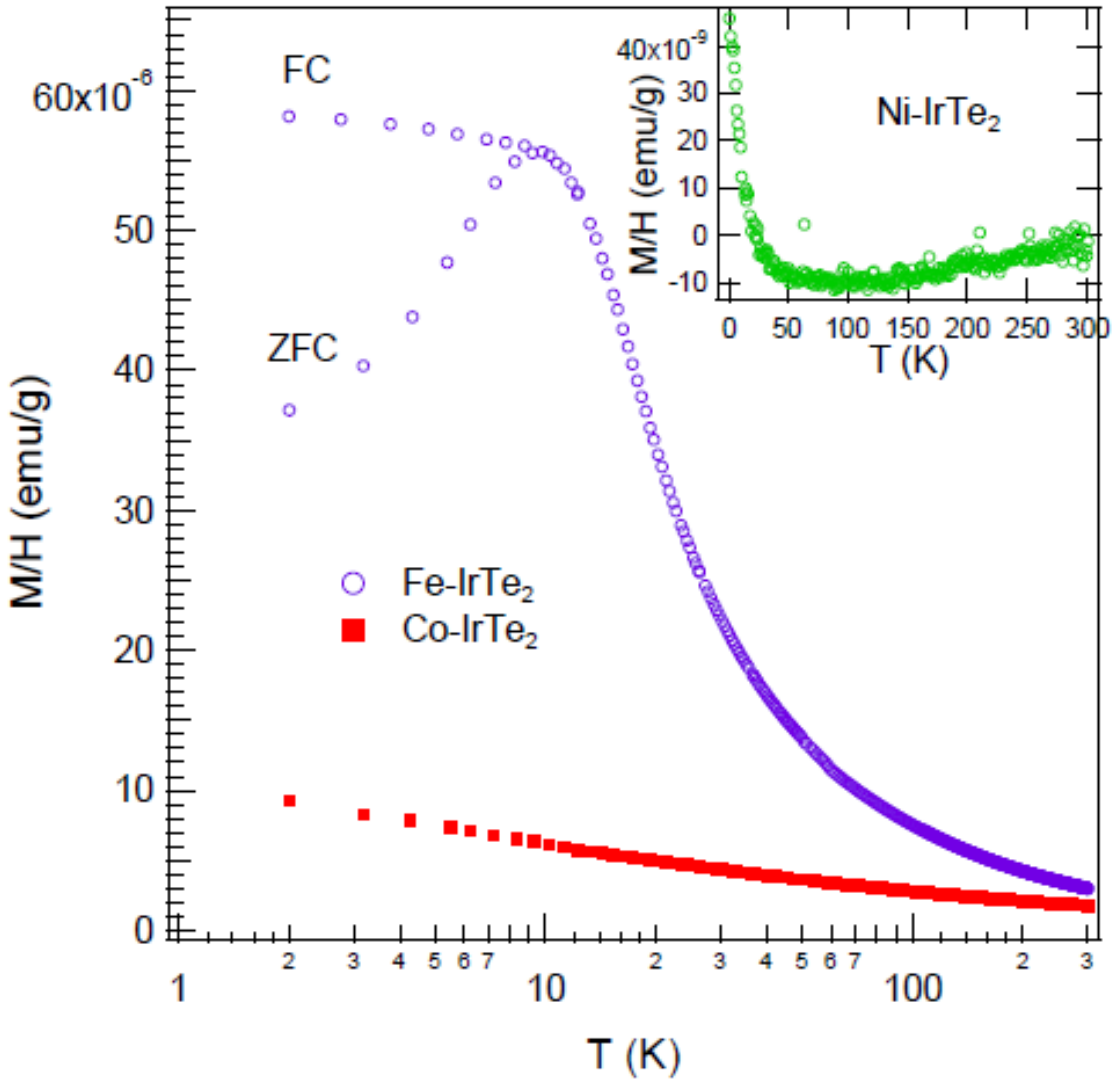
Fe-$IrTe_2$

Spin Glass $T_C \approx 10K$



ZF μSR

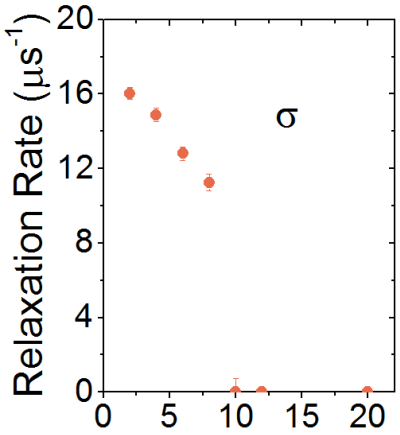
Fe-$IrTe_2$



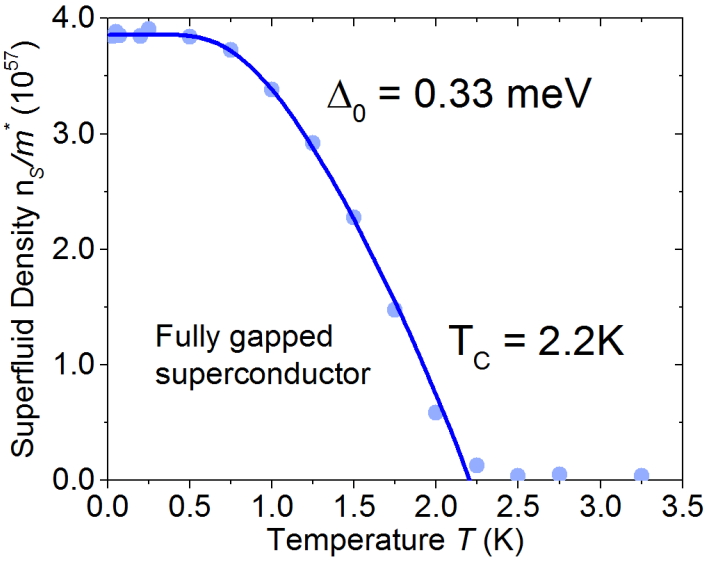
J.-Q. Yan et al. arXiv:1309.4829v1 [cond-mat.supr-con] 19-09-2013

Conclusions

Fe-$IrTe_2$ spin glass, $T_C \approx 10K$



Pt-$IrTe_2$ weak coupling fully gapped BCS superconductor, $T_C = 2.24K$



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