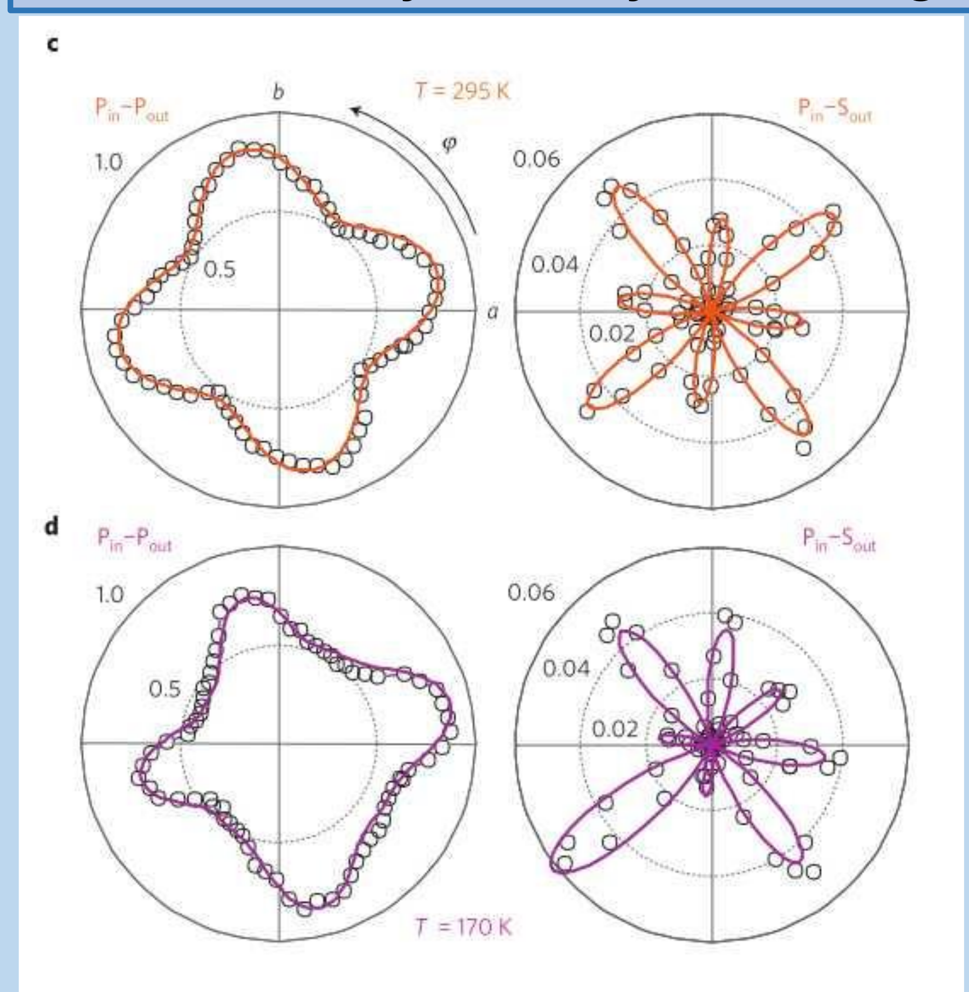
Unusual slow magnetic fluctuations in $Sr_2Ir_{1-x}Rh_xO_4$ studied by muon spin relaxation (μSR)

C. Tan[1], Z. F. Ding[1], J. Zhang[1], Z. H. Zhu[1] D. E. Maclaughlin[2], O. O. Bernal[3], P. C. Ho[4], and 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

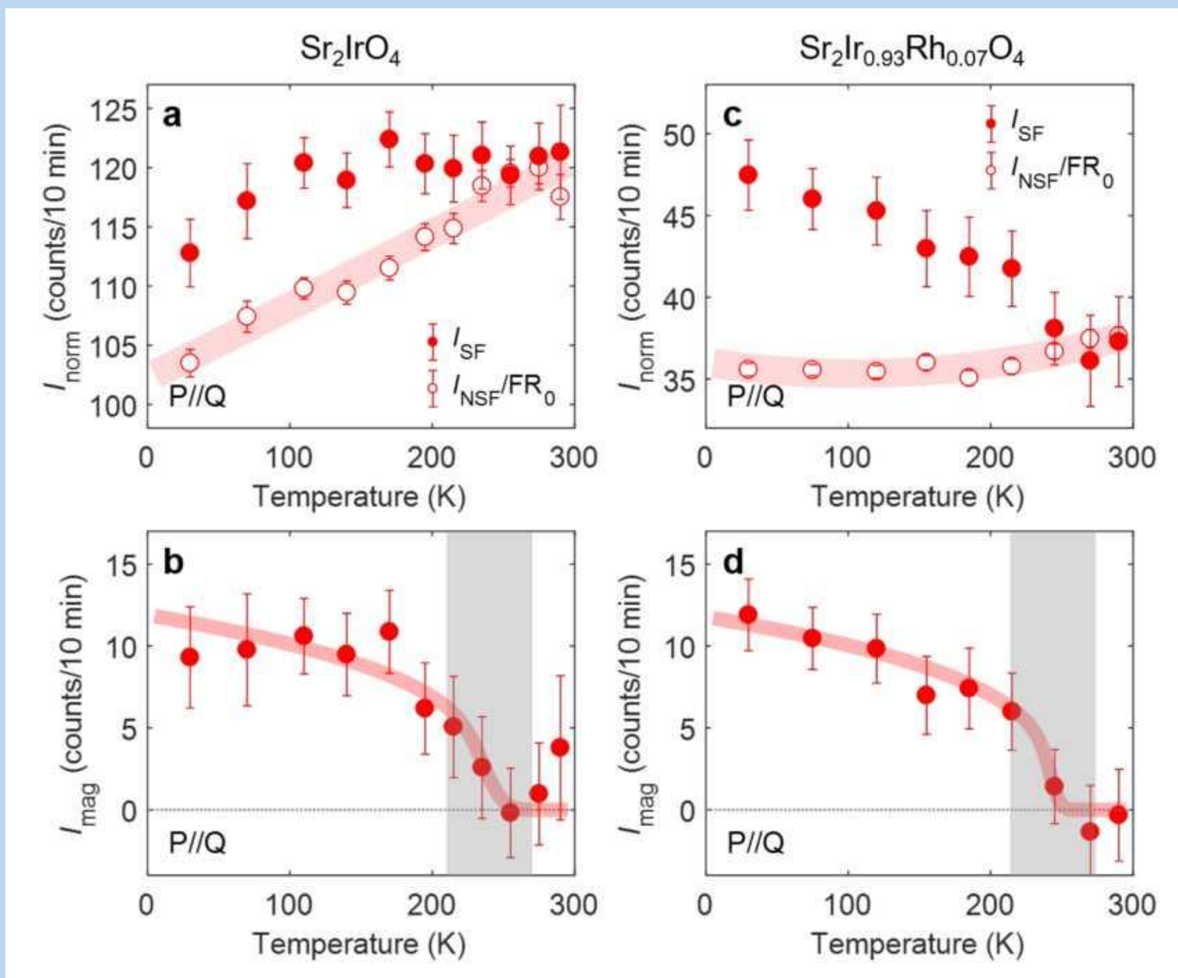
Motivations： The hidden order phase is similar to pseudo-gap state in cuprates

Rotational symmetry breaking



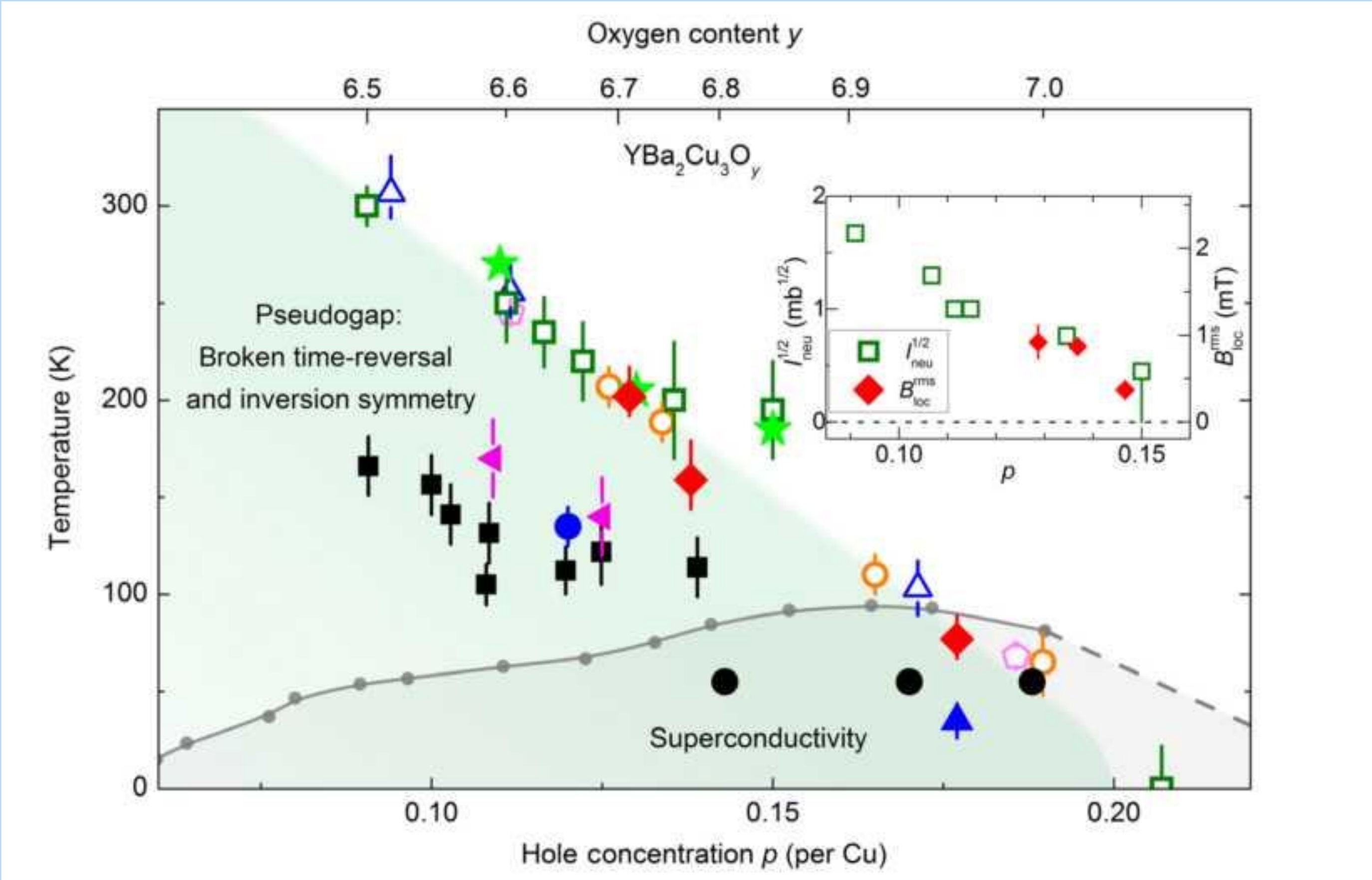
Zhao, L. *et.al* Nature_Physics (2015)

Time reversal symmetry breaking



Jeong, J. *et al.* NATURE COMMUNICATIONS (2017)

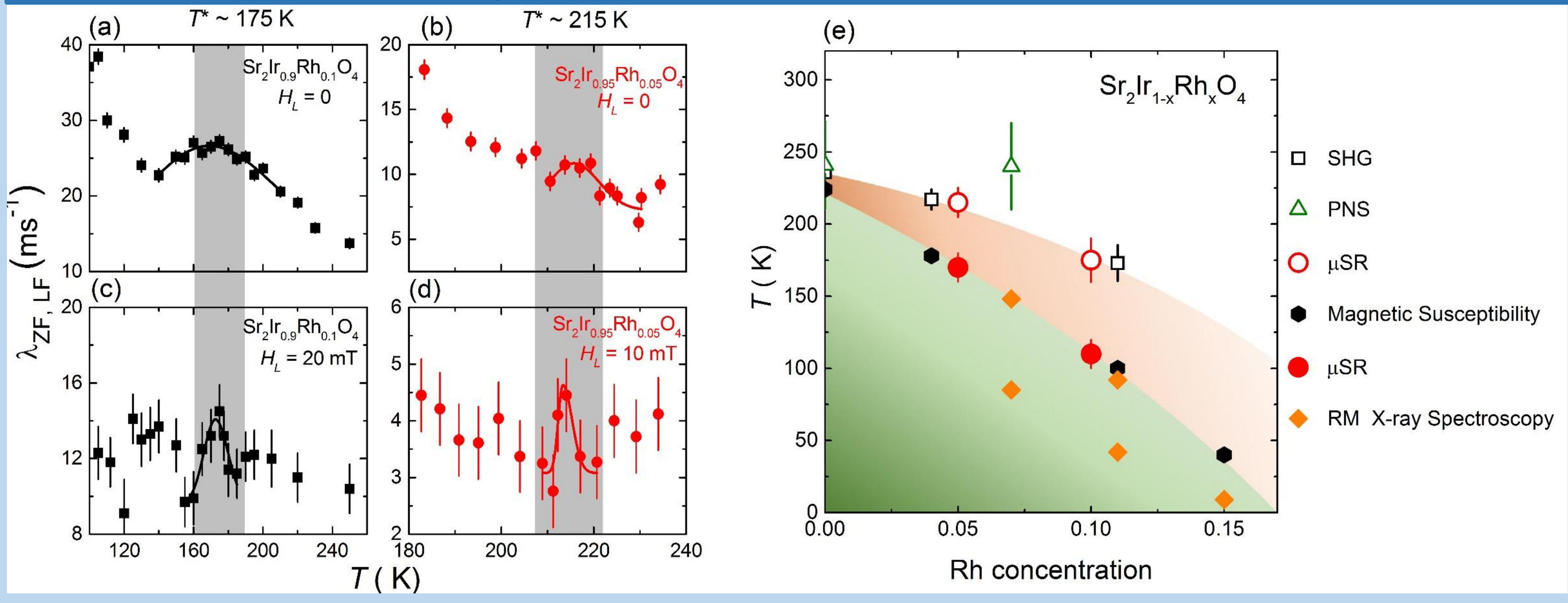
Pseudo-gap state in cuprates



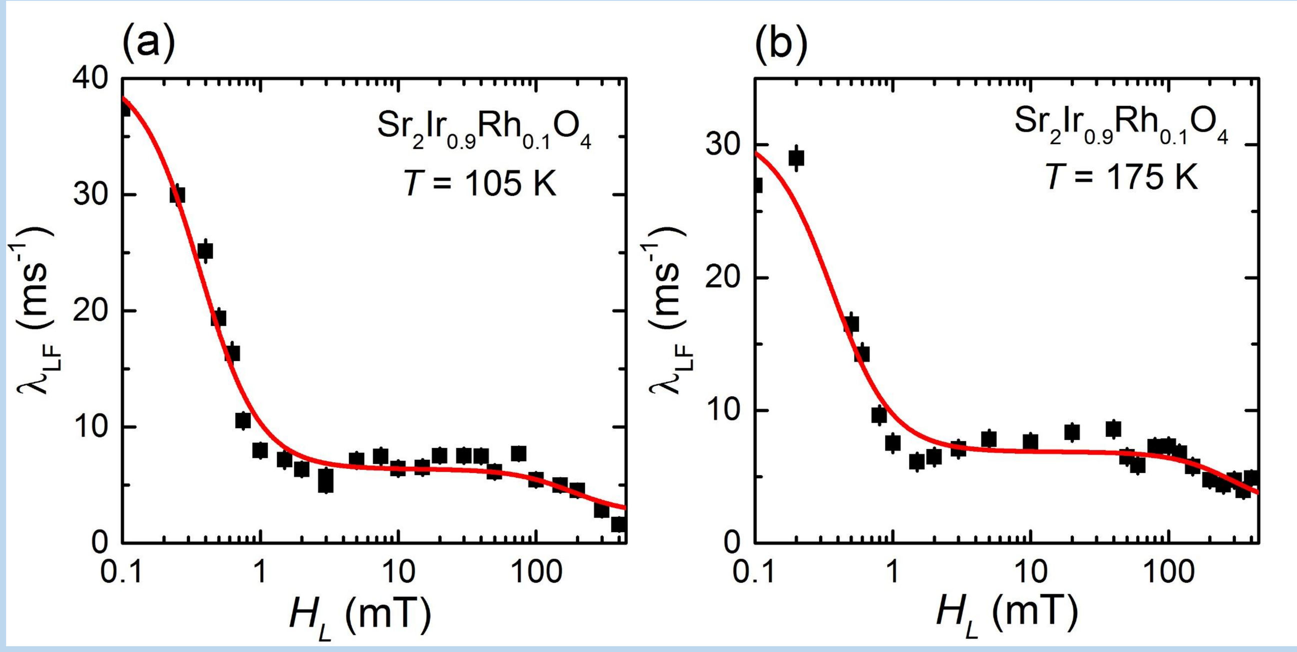
Zhang, Ding *et al.* Science Advances (2018)

ZF & LF-μSR Results

$\lambda_{ZF/LF}(T)$: The maxima at T^*



$\lambda_{LF}(H_L)$: Two slow magnetic fluctuations

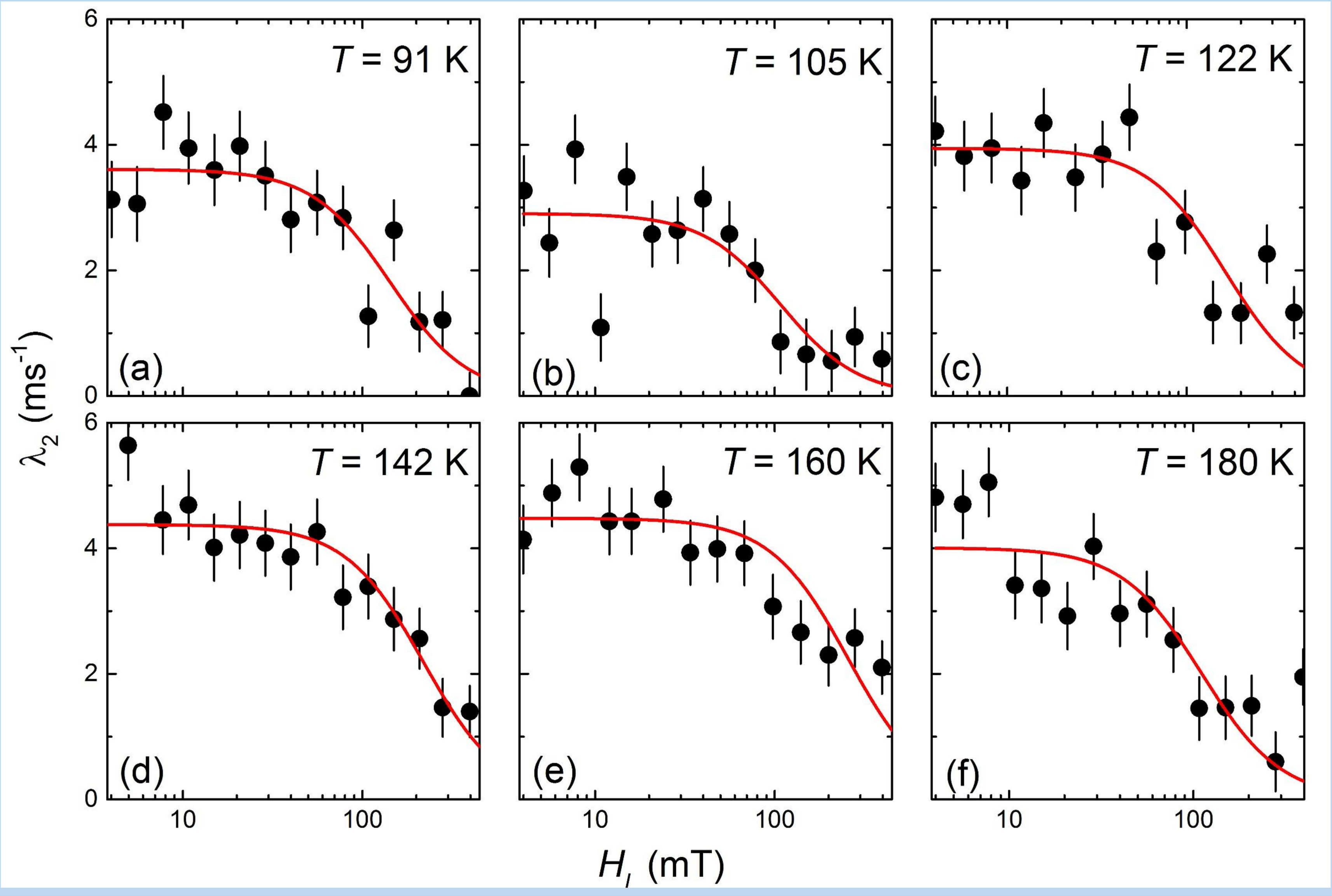


Redfield Relation: The function to describe field dependence of relaxation rate

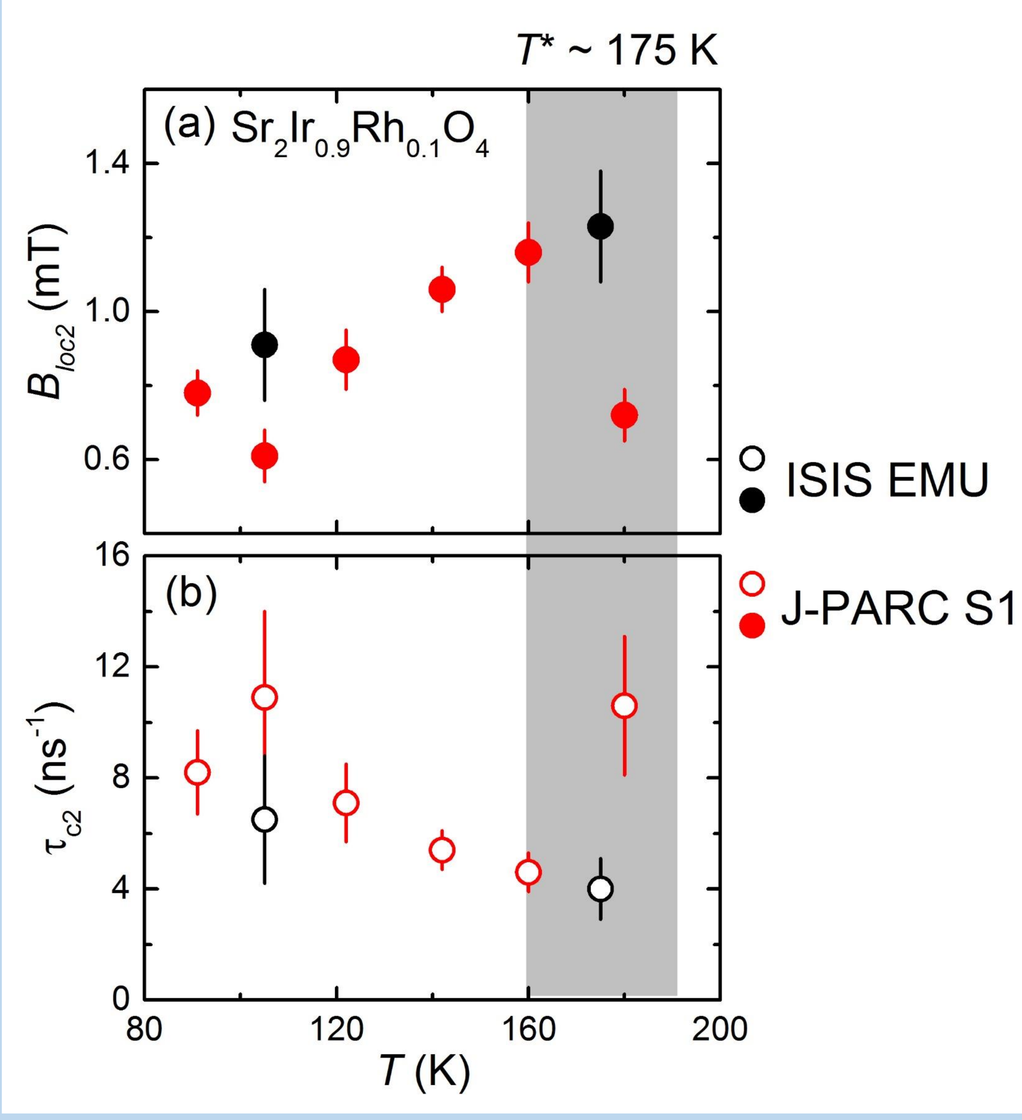
$$\lambda_{LF}^{(1)} = \frac{2(\gamma_\mu B_{loc}^{(1)})^2\tau_c^{(1)})}{1+(\tau_c^{(1)}\gamma_\mu H_L)^2},\ \lambda_{LF}^{(2)} = \frac{2(\gamma_\mu B_{loc}^{(2)})^2\tau_c^{(2)})}{1+(\tau_c^{(2)}\gamma_\mu H_L)^2}$$

$\lambda_{ZF/LF} = \lambda_{LF}^{(1)} + \lambda_{LF}^{(2)}$, $\lambda_{LF}^{(1)}$ represents the field dependence of λ_{LF} at low fields, corresponding to **nuclear dipolar field**; $\lambda_{LF}^{(2)}$ represents the high field part, corresponding to the **hidden magnetic order**.

$\lambda_{LF}(H_L)$ at different temperatures



B_{loc} and τ_c versus T



- Positive slope of $B_{loc}^{(2)}(T)$
- Negative slope of $\tau_c^{(2)}$
- Critical slowing down at T^*

Preliminary conclusions

- The temperature of maxima in $\lambda_{ZF}(T)$ are consistent with its measured by symmetry breaking probe.
- Our LF results indicate that there are two different magnetic fluctuations with different fluctuating rate in $Sr_2Ir_{0.9}Rh_{0.1}O_4$.
- The maxima we observed in ZF is caused by faster magnetic fluctuation.
- The maxima in $\lambda_{ZF}(T)$ indicates a critical slowing down