

NMR Studies on Iron-Based Superconductors

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In my presentation, we review NMR results obtained in various Fe-based superconductors, mainly focus on the relationship between antiferromagnetic (AFM) fluctuations with the stripe correlations and superconductivity.

First, we introduce our NMR results on $\text{BaFe}_2(\text{As}_{1-x}\text{P}_x)_2$ with the “122” structure. $\text{BaFe}_2(\text{As}_{1-x}\text{P}_x)_2$ is one of the best systems in the Fe-based superconductors, since high-quality single crystals are available and isovalent P-substitution does not change carrier content essentially. $1/T_1T$ in $\text{BaFe}_2(\text{As}_{0.67}\text{P}_{0.33})_2$ with a maximum $T_c \sim 31$ K in $\text{BaFe}_2(\text{As}_{1-x}\text{P}_x)_2$ continues to increase down to T_c , indicating the development of the AFM fluctuations, and sharply decreases below T_c due to opening of the SC gap. The AFM fluctuations are suppressed and T_c also decreases systematically with increasing P content. From the analyses of $1/T_1T$ in the normal state, it is shown that the maximum T_c sample is located in the vicinity of the quantum critical point of the AFM instability, and that the AFM fluctuations are intimately related to the superconductivity[1]. The similar results have also reported in $\text{Ba}(\text{Fe}_{1-x}\text{Co}_x)_2\text{As}_2$ with the same “122” structure[2]. These NMR results are compared with those obtained in other Fe-based systems such as “1111”, “111” and “11” compounds.

I also discuss relationship between magnetic ordering and superconductivity observed in compounds located near the boundary between magnetic and superconducting phases.

Our NMR studies have been done in collaboration with Y. Nakai, S. Kitagawa, T. Iye for NMR measurements, S. Kasahara, T. Shibauchi, Y. Matsuda, and T. Terashima for $\text{BaFe}_2(\text{As}_{1-x}\text{P}_x)_2$ samples, and Y. Kamihara, M. Hirano, and H. Hosono for $\text{LaFeAs}(\text{O}_{1-x}\text{F}_x)$ samples.

[1] Y. Nakai, T. Iye, S. Kitagawa, K. Ishida, S. Kasahara, T. Shibauchi, Y. Matsuda, and T. Terashima, *Phys. Rev. Lett.* 105, 107003 (2010).

[2] F. L. Ning, K. Ahilan, T. Imai, A. S. Sefat, M. A. McGuire, B. C. Sales, D. Mandrus, P. Cheng, B. Shen and H.-H Wen, *Phys. Rev. Lett.* 104, 037001 (2010).