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NMR Studies of Iron-Oxypnictide Superconductor LaFeAs($O_{1-x}F_x$)[1]

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We present experimental results of ^{75}As and ^{139}La nuclear magnetic resonance (NMR) in the layered oxypnictide system LaFeAs($O_{1-x}F_x$) (x = 0.0, 0.04, 0.07, 0.11 and 0.14) where superconductivity occurs in x greater than 0.04 [1,2]. In the undoped LaFeAsO, $1/T_1$ of ^{139}La exhibits a distinct peak at $T_N \sim 142$ K below which the La-NMR spectra become broadened due to the internal magnetic field attributed to an antiferromagnetic (AFM) ordering[1]. In the x=0.04 sample, $1/T_1T$ of ^{75}As exhibits a Curie-Weiss temperature dependence down to 30 K, suggesting the development of AFM spin fluctuations with decreasing temperature. The AFM fluctuations are significantly suppressed with F-doping, and pseudogap behavior is observed in $1/T_1T$ in the x=0.11 sample with a gap value of $\Delta_{PG} \sim 175$ K[1]. The spin dynamics vary markedly with F-doping, which is ascribed to the change of the Fermi-surface structure by the electron doping. As for the superconducting properties for x=0.04, 0.07 and 0.11, $1/T_1$ of ^{75}As in all compounds does not exhibit a coherence peak just below T_c and follows a T^3 dependence at low temperatures. These results seemingly suggest that unconventional superconductivity with zero gap along lines, whereas the lack of the residual density of states at the low temperatures is incompatible with the presence of the line-nodes. We discuss similarity and difference between LaFeAs ($O_{1-x}F_x$) and cuprates, and also discuss the relationship between spin dynamics and superconductivity on the basis of F-doping dependence of T_c and $1/T_1$[2].

[1] Y. Nakai, K. Ishida, Y. Kamihara, M. Hirano, and H. Hosono; J. Phys. Soc. Jpn. 77, 073701 (2008).
[2] Y. Nakai, S. Kitagawa, K. Ishida, Y. Kamihara, M. Hirano, and H. Hosono; cond/mat 0810.3569.

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