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Study of μSR in Iron-Based Superconductor $LaFeAs_{1-x}P_xO_{0.9}F_{0.1}$

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In the iron-based superconductors $LaFeAs_{1-x}P_xO_{1-y}F_y$, the electron doping level and the local crystal structure can be controlled by the F substitution for O and P substitution for As. With these chemical substitutions, Fermi surface (FS) topology changes giving three different superconducting (SC) phases [1]. For example, at y=0.1, the As-rich compounds are in the first superconducting phase (SC1), while the P-rich compounds are in the second superconducting phase (SC2) [2]. The theoretical study by Kuroki and coworkers has indicated that the different nesting in LaFeAsO-type and LaFePO-type FSs induces the different SC gap symmetries, i.e., full and nodal gaps [3].

In the present work, we have investigated the difference between SC gap symmetry in SC1 and SC2 using μSR measurement in $LaFeAs_{1-x}P_xO_{0.9}F_{0.1}$ (x=0.0~0.8). The μSR measurement were performed at TRIUMF in Canada and Research Center for Nuclear Physics (RCNP), Osaka University in Japan using a He gas-flow cryostat in a magnetic field of 250G. At x=0, the temperature (T) dependence of the muon spin relaxation rate σ shows a rapid increase with decreasing T below T_c and a saturation at low temperatures, indicating the s-wave behavior. In contrast, $LaFeAs_{1-y}P_yO_{0.9}F_{0.1}$ (y=0.2~0.8) show the slightly different T dependence of the relaxation rate σ. In these P doping compounds, the T dependence of the relaxation rate σ does not show a clear saturation at low temperatures and cannot be fitted by the simple s-wave model. These results suggest that the P-doped compounds have several SC gaps with different gap sizes or a nodal SC gap, and the SC gap symmetries in the SC1 and SC2 phases may be different.

[1] S. Miyasaka *et al.*, Phys. Rev. B **95**, 214515 (2017).
[2] K. T. Lai *et al.*, Phys. Rev. B **90**, 064504 (2014).
[3] K. Kuroki *et al.*, Phys. Rev. B **79**, 224511 (2009).

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