


(※本報告書は英語で記述してください。ただし、産業利用課題として採択されている方は日本語で記述していただいても結構です。)

 MLF Experimental Report	提出日 Date of Report
課題番号 Project No. 2014A0198 実験課題名 Title of experiment μ SR study of the possible ferromagnetic state in the heavily overdoped Bi-2201 high- T_c superconductor 実験責任者名 Name of principal investigator Tadashi Adachi 所属 Affiliation Department of Engineering and Applied Sciences, Faculty of Science and Technology, Sophia University	装置責任者 Name of responsible person Yasuhiro Miyake 装置名 Name of Instrument/(BL No.) D1 実施日 Date of Experiment 2015. 11. 19 – 22

試料、実験方法、利用の結果得られた主なデータ、考察、結論等を、記述して下さい。(適宜、図表添付のこと)
 Please report your samples, experimental method and results, discussion and conclusions. Please add figures and tables for better explanation.

1. 試料 Name of sample(s) and chemical formula, or compositions including physical form. Bi-based high- T_c superconducting cuprates $\text{Bi}_{1.71}\text{Pb}_{0.32}\text{Sr}_{1.97}\text{CuO}_{6+\delta}$ Single crystals

2. 実験方法及び結果 (実験がうまくいかなかった場合、その理由を記述してください。) Experimental method and results. If you failed to conduct experiment as planned, please describe reasons. Zero-field and longitudinal-field μ SR measurements have been performed using the dilution refrigerator at temperatures between 72 mK and 2 K and in magnetic fields up to 200 G for non-superconducting heavily overdoped $\text{Bi}_{1.71}\text{Pb}_{0.32}\text{Sr}_{1.97}\text{CuO}_{6+\delta}$ (Bi-2201) single crystal. Measurements have been performed in the double-pulsed mode. On the first and second days, the dilution refrigerator was in trouble and the temperature did not reach below 2 K. On the third trial, the temperature reached at 72 mK. The reason of the trouble is probably tiny leak of the vacuum around the window of the dilution refrigerator where muons come into. Therefore, we had only one day for the measurements.
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2. 実験方法及び結果(つづき) Experimental method and results (continued)

From the zero-field μ SR measurements, it has been found that the spectra are Gaussian-like more or less for all temperatures. At the lowest temperature of 72 mK, it has been found that the spectrum tends to deviate slightly from the Gaussian-like behavior at 2 K, suggesting that the spin correlation is slightly developed at 72 mK.

We have analyzed the spectra using the function: $A(t) = A_0 \exp[-\lambda t] G_Z(\Delta, t) + A_{BG}$, where λ is the depolarization rate of muon spins and $G_Z(\Delta, t)$ is the static Kubo-Toyabe function. The A_{BG} is the time-independent background term. As shown in the figure, it has been found that λ increases with decreasing temperature below ~ 0.7 K, suggesting the development of the spin correlation.

Combined with the electrical-resistivity and magnetization results [1], the present μ SR results suggest that the ferromagnetic correlation is developed at low temperatures in the non-superconducting heavily overdoped Bi-2201. Therefore, the ferromagnetic fluctuation might be related to the disappearance of the superconductivity in the heavily overdoped high- T_c cuprates.

[1] K. Kurashima, T. Adachi, K. M. Suzuki, Y. Fukunaga, T. Kawamata, T. Noji and Y. Koike, J. Phys.: Conf. Series **568**, 022003 (2014).

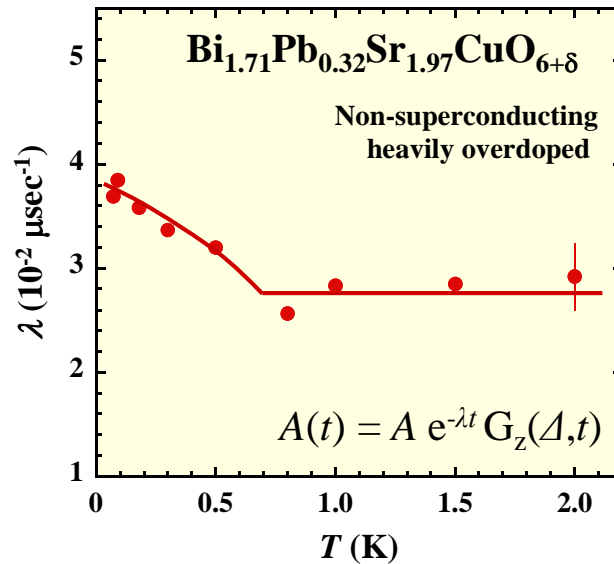


Figure: Temperature dependence of the depolarization rate of muon spins, λ , in non-superconducting heavily overdoped $\text{Bi}_{1.71}\text{Pb}_{0.32}\text{Sr}_{1.97}\text{CuO}_{6+\delta}$ single crystal.