 MLF Experimental Report	提出日 Date of Report 2013. 7. 8
課題番号 Project No. 2012B0061 実験課題名 Title of experiment μ SR study of the magnetic ground state in 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 2013. 2. 8 – 9, 2013. 3. 17 – 18

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 $\text{Bi}_{1.74}\text{Pb}_{0.38}\text{Sr}_{1.88}\text{Cu}_{1-y}\text{Zn}_y\text{O}_{6+\delta}$ with $y = 0.03$ Polycrystals
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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. <p>The beam time on March 17 – 18 could not be used for this proposed measurement because the dilution refrigerator could not be used. Therefore, here I report the μSR results taken on February 8 – 9.</p> <p>Zero-field (ZF) and longitudinal-field μSR measurements have been performed at temperatures between 36 mK and 1.5 K for 3% Zn-substituted samples in the non-superconducting heavily underdoped regime by using the dilution refrigerator. Measurements have been performed in the double-pulse mode.</p> <p>During the measurements, the new positron counter ‘KALLIOPE’ installed at D1 beam line did not work well, so the statistics of the spectra is not enough high and we needed to perform measurements for a longer time than planned.</p>
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2. 実験方法及び結果(つづき) Experimental method and results (continued)

Figure 1 shows ZF- μ SR spectra of $\text{Bi}_{1.74}\text{Pb}_{0.38}\text{Sr}_{1.88}\text{Cu}_{1-y}\text{Zn}_y\text{O}_{6+\delta}$ with $y = 0.03$ and the hole concentration per Cu, $p, < 0.062$. The p value is estimated from an empirical law in high- T_c cuprates. At 1.5 K, the spectrum shows depolarization close to Gaussian, indicating the development of the Cu-spin correlation is weak. With decreasing temperature, the spectra changes to exponential-like behaviors due to the development of the Cu-spin correlation. However, around the base temperature of 36 mK, the change of the spectra is saturated and the depolarization is not so fast compared with that observed in the La-214 cuprates. These results suggest that the magnetic ground state of the heavily underdoped $\text{Bi}_{1.74}\text{Pb}_{0.38}\text{Sr}_{1.88}\text{Cu}_{1-y}\text{Zn}_y\text{O}_{6+\delta}$ is not a ordered but a fluctuating state of Cu-spins, probably originating from the strong two dimensionality of the crystal structure of Bi-2201 cuprates due to the long distance between neighboring CuO_2 planes.

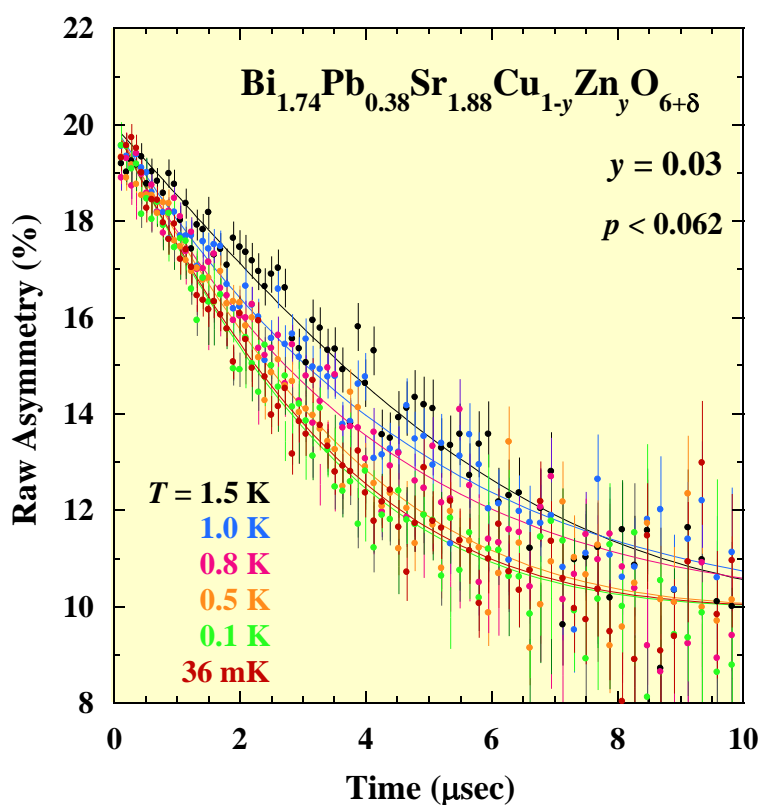


Fig. 1. Zero-field μ SR spectra of $\text{Bi}_{1.74}\text{Pb}_{0.38}\text{Sr}_{1.88}\text{Cu}_{1-y}\text{Zn}_y\text{O}_{6+\delta}$ with $y = 0.03$ and the hole concentration per Cu, $p, < 0.062$.