実験報告書様式（一般利用課題・成果公開利用）

（ ※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。）

J-PARC MLF Experimental Report	提出日 Date of Report 30 March 2015
課題番号 Project No. 2014A0187 実験課題名 Title of experiment µSR study of the magnetism and superconductivity in H-substituted Fe-based superconductor $CeFeAsO_{1-x}H_x$ 実験責任者名 Name of principal investigator Masatoshi Hiraishi 所属 Affiliation Institute of Materials Structure Science, KEK	装置責任者 Name of responsible person Yasuhiro Miyake 装置名 Name of Instrument/（BL No.） MUSE D1 実施日 Date of Experiment 22-26 June 2014

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.

Chemical formulas	Physical form.	Mass / g
$CeFeAsO_{0.62}H_{0.54}$	Pelletized polycrystal	1.0
$CeFeAsO_{0.36}H_{0.62}$	Pelletized polycrystal	1.0
$CeFeAsO_{0.34}H_{0.66}$	Pelletized polycrystal	1.0

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.

We perfomed muon spin relaxation (µSR) measurements at MUSE D1 area of MLF J-PARC on $CeFeAsO_{1-x}H_x$ (Ce1111-H) with x = 0.54, 0.62, and 0.66 to investigate the magnetic ground state of the highly doped region. A standard zero field (ZF) µSR method using intense surface muon beam under the 300kW MLF beam power was conducted. Pellet shaped polycrystalline samples were mounted on the 15 x 15 or 20 x 20 mm^2 Ag sample holder, which is cooled by thermal conduction from the cryostat.

It is revealed that ZF-µSR time spectra of Ce1111-H with x = 0.54, 0.62, 0.66 below 100 K exhibit apparent reduction of the initial asymmetry A_0 compared to the spectrum above 100 K, as shown in Fig. 1 (**a**, **b**, **c**), indicating that spatial segregation of non-magnetic and magnetic phases occurs with decreasing temperature. Due to the limitation of the instrumental time resolution, fast relaxation/rotation signal from the magnetic phase results in disappearance of the A_0. Moreover, spectra above magnetic transition temperature (T_N) exhibit x-independent exponential depolarization, which is currently attributed to Lorentzian field distribution due to a residual iron impurity, which is known to exist in the present samples. Considering these, we used the following

2. 実験方法及び結果（つづき） Experimental method and results (continued)

form for the curve-fit analysis of the ZF-μSR time spectra: $A(t) = A_0\exp(-\lambda t) + A_{BG}$, where λ is the relaxation rate of the non-magnetic phase, A_0 is a initial asymmetry for sample volume, and A_{BG} is a temperature independent background coming from muons stopped at Ag sample holder. Figure 2 shows the temperature dependence of the magnetically ordered volume fraction (MVF) in x = 0.54 deduced from the A_0, where the magnetic phase emerges below ~100 K, and gradually develops with decreasing temperature. MVF becomes mostly independent of temperature below ~50 K to reach 0.84(2) at the lowest temperature. We determined the onset of T_N = 98(5) K by linear extrapolation, in the same manner, 100(8) K, 95(2) K, with x = 0.62, 0.66, respectively. Thus, it is revealed that T_N in x > 0.5 is slightly lower than that in $LaFeAsO_{1-x}H_x$ (La1111-H) with x > 0.5, as revealed by our previous experiment (proposal No. 2014AUD101).

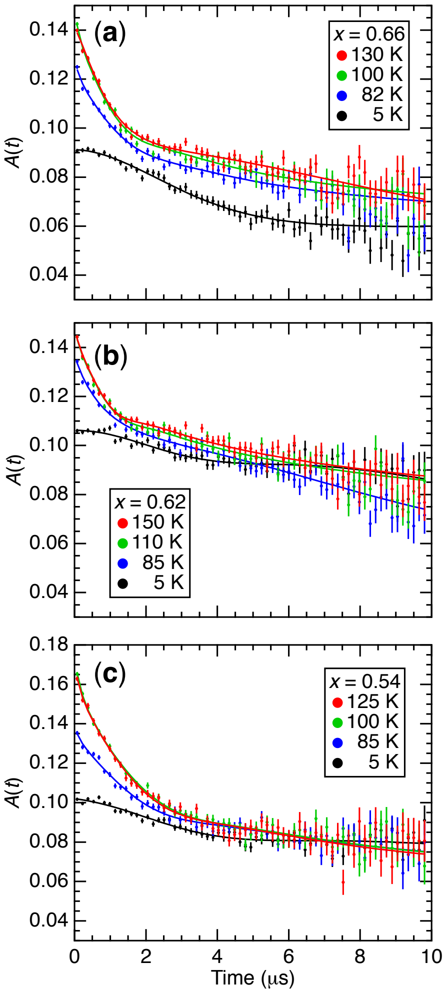

Figure 1: ZF-μSR time spectra for x = 0.66 (**a**), 0.62 (**b**), and 0,54 (**c**).

To investigate the more detailed property of the magnetism, we performed additional μSR experiment using high-time resolution setup at PSI, Swiss with x = 0.44 (non-superconducting sample). We observed the fast relaxation and oscillation of the signal below 80 K. It is revealed that rotating frequency at the lowest temperature [58(1) MHz] has much increased compared to that of x = 0.45 in La1111-H [5.13(7) MHz], indicating that the magnetic structure of Fe atoms maybe different from one another. Magnetic volume fraction (MVF) at the lowest temperature with x > 0.44 are almost unity, which is almost identical to that in La1111-H with $x \geq 0.45$. Additionally, we found that x dependence of the T_N seems to have a maximum around x = 0.62. Although this behavior is also analogous to La1111-H, maximum of the T_N ~100 K is slightly lower than that of La1111-H (~120 K).

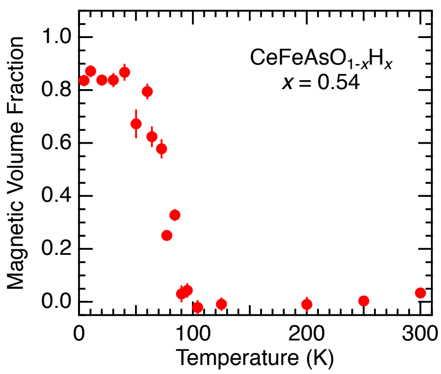

Figure 2: Fractional yield of magnetic phase in x = 0.54.

It is known that substitution of Ce for La brings in a chemical pressure to the system, resulting the decrease of the As-Fe-As bond angle α and the increase of pnictogen height (h_{As}). Since both are key parameters for the Fermi surface as pointed out by theoretical works, information on crystal structure in low-temperature phase is important for better understanding of the magnetism in this system. To achieve this, further investigation is currently in progress.

In summery, μSR experiment on Ce1111-H with $x \geq 0.44$ reveals the existence of magnetic phase. There are difference of the magnetic properties between Ce1111-H and La1111-H, which may originate from the magnitude of the chemical pressure.