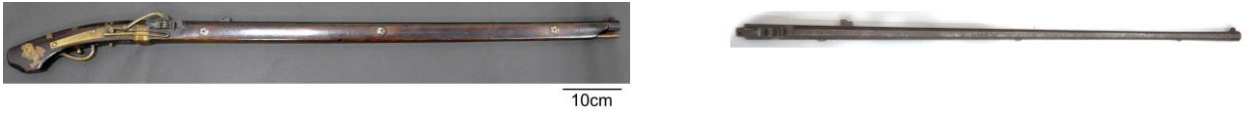

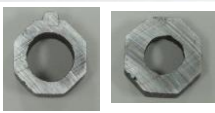


(※本報告書は英語で記述してください。ただし、産業利用課題として採択されている方は日本語で記述していただいても結構です。)

 MLF Experimental Report	提出日 Date of Report 08/15/2014
課題番号 Project No. 2014A0270 実験課題名 Title of experiment Nondestructive study of traditional Japanese matchlock guns using pulsed neutron imaging for evaluating crystallographic texture and microstructure- Complementary use with SPring-8- 実験責任者名 Name of principal investigator Manako Tanaka 所属 Affiliation Tokyo University of the Arts	装置責任者 Name of responsible person Kenichi Oikawa 装置名 Name of Instrument/(BL No.) NOBORU (BL No.10) 実施日 Date of Experiment 05/10/2014-05/13/2014 and 06/09/2014-06/13/2014

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.	
1. Japanese matchlock gun fabricated by Kunitomo manufacturer, Fe, solid, 101cm, 2kg	
2. Japanese matchlock gun (unsigned), Fe, solid, 101.7cm, 2.5kg	
3. Fragment of Japanese matchlock gun (muzzle), Fe, solid, 1cm, 30g	
4. Fragment of Japanese matchlock gun (breech), Fe, solid, 1cm, 10g	
5. Fragment of standard high purity iron sample, Fe, solid, 3cm, 100g	
6. Fragment of standard low carbon steel sample, Fe, solid, 3cm, 100g	
7. Fragment of standard medium carbon steel sample, Fe, solid, 3cm, 100g	
8. Fragment of standard high carbon steel sample, Fe, solid, 4cm, 130g	
9. Fragment of standard white cast iron sample, Fe, solid, 4cm, 130g	
10. Fragment of standard quenched steel, Fe, solid, 4cm, 130g	
11. Japanese iron nail, Fe, solid, 75mm, 18g	
12. Japanese iron nail Fe, solid, 70mm, 10g	
13. Japanese iron nail Fe, solid, 78mm, 10g	

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.
【Experimental method】 Experiment was carried out by pulsed neutron imaging using the time-of-flight (TOF) method. Before analyzing, we checked the radioactive activation of impurities in Japanese matchlock guns by using handheld

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

XRF. A 2D-PSD is used to get the spatial dependent of TOF data. Distribution of nonmetallic inclusions and inlaid piece of the barrel are observed from spectrum transmission images. Information of the crystal structure, crystallite size, and crystal strain of the barrels are obtained from the Bragg edge. The layout of the experiment is shown in Fig. 1.

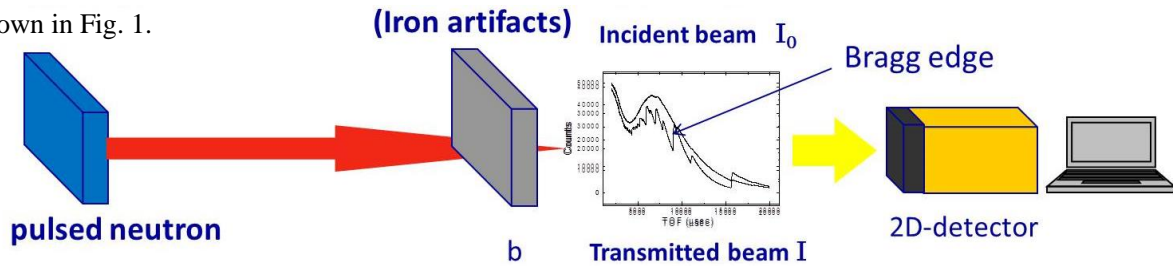


Fig.1 Experimental layout

【Results】

The experiment was conducted as planned. The parts of the results obtained are shown in Fig.2 and Fig.3. The crystal structures show differences depending on the areas (the muzzle, the center, and the breech of the barrel) of Japanese matchlock guns. According to our previous destructive study, this result shows a possibility that the muzzle is reinforced with higher carbon steel to resist a strong impact by the explosion of the gunpowder. Now we are still analyzing the obtained data, the shape and the position of the Bragg edge of the samples cautiously. We are also comparing the data of standard iron samples.

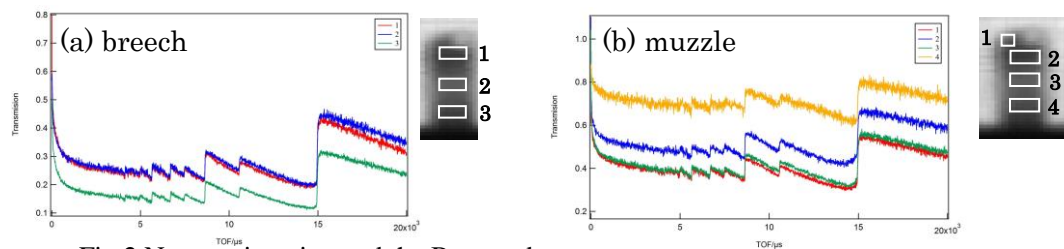


Fig.2 Neutron imaging and the Bragg edge of fragments of Japanese matchlock gun.

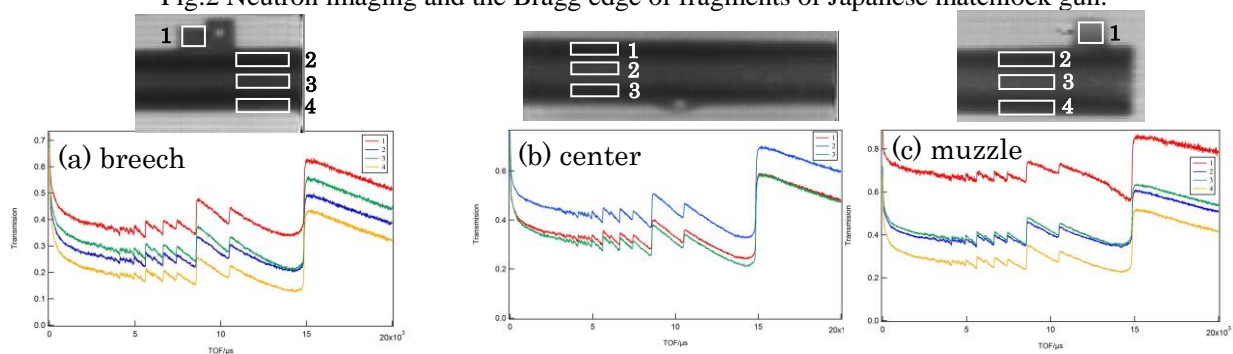


Fig.3 Neutron imaging and the Bragg edge a Japanese matchlock gun fabricated by Kunitomo manufacturer.

Through the experiment, we were conceived that the information of the preferred orientation, the crystallite size, and crystal strain obtained by pulsed neutron imaging will be very useful to clarify the metallurgical characteristics of Japanese matchlock gun and to reveal the traditional Japanese iron making and forging techniques. The method is adoptable to analyze other iron artifacts and may contribute to the development of the nondestructive study of iron artifacts.