実験報告書様式（元素戦略）

（ ※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。 ）

CROSS TOKAI **Experimental Report** J-PARC	承認日 Date of Approval 4/18/2014 承認者 Approver Ryoichi Kajimoto 提出日 Date of Report; April 17, 2014
課題番号 Project No. 2013S0003 実験課題名 Title of experiment Neutron-scattering research on element-strategy project for electronic materials 実験責任者名 Name of principal investigator Youichi Murakami 所属 Affiliation Institute of Materials Structure Science, KEK	装置責任者 Name of Instrument scientist Ryoichi Kajimoto 装置名 Name of Instrument/(BL No.) 4SEASONS (BL01) 実施日 Date of Experiment [1] 5/8 21:00-5/10 17:00, 2013; C12A7 [2] 3/3 11:00-3/5 9:00, 2014; Fe pnictide

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] Name of sample: Inorganic electride C12A7.

Chemical formula: $[Ca_{24}Al_{28}O_{64}]\cdot 2O$.

Form of shape: Single-crystal plates with (111)-surface cutting.

Quantity: (10 × 10 × t1) mm^3 × 4 pieces for a non-doped sample (Fig. 1), and × 2 pieces for an electron-doped sample.

[2] Name of sample: Deuterium-doped lanthanum iron pnictide.

Chemical formula: $LaFeAsO_{0.9}D_{0.1}$.

Form of shape: Powder (wrapped in an Al foil with cylindrical shape, ϕ16 × 40 mm).

Quantity: 30 g.

Physical property: Superconducting-transition temperature, T_c = 27 K.

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.

Instrumental configuration of 4SEASONS

[1] C12A7

Chopper speed; 200 Hz.

E_i; 120 meV.

MLF beam power; 300 kW.

Temperature; 290 K.

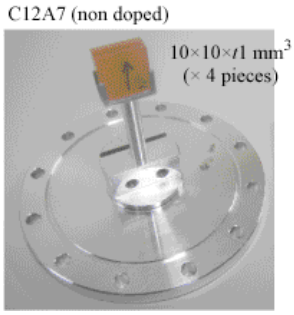

Fig. 1. Single crystals of C12A7 (non-doped) aligned for the present INS experiment.

[2] Fe pnictide

Chopper speed; 150 Hz.

Multi E_i; 271, 44.1, 17.5, and 9.27 meV.

MLF beam power; 300 kW. (beam stop 3/4 19:15– 3/5 0:20, 5 h)

Temperature; 4, 8, 10, 15, 20, 25, 30, 35, 40 and 60 K.

Results

[1] C12A7

Because of three-dimensional phononic properties, one needs to pile up several trajectories to extract intensity-contour maps in ($\boldsymbol{Q}$, ω) space. Therefore, we carried out a sequential scan by rotating the crystal angle over 40° with 1° step. At present, we have no quantitative data to analyze the low-energy phonon dispersion, because the neutron intensity scattered inelastically was too weak to extract any phonon cross sections. The small sample volume (0.4 cc) together with the relatively short measuring time (0.5 hours for each shot) could be the reason of the weak intensity.

[2] Fe pnictide

Figure 2(A) shows energy profiles at Q = 2.0 Å^{-1} measured at 4 K well below T_c and 40 K above T_c, in which each data point represents the value integrated in Q over 1.7–2.3 Å^{-1}. In addition to a peak at 11 meV (green arrow), a gap-like structure appears significantly below 5 meV at 4 K. The 11-meV peak intensity begins to increase below around T_c, as shown in the thermal evolution of Fig. 2(B). Hence, we infer that the gap-like feature below 5 meV and the intensity enhancement at 11 meV are closely coupled and possibly related to the emergence of superconductivity. Note that no such the dynamic features were reported in the past papers dealing with F-doped LaFeAsO system. The x dependence of $S(Q, \omega)$ will shed a light on the relationship between the superconductivity and the dynamics of doped deuterium.

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

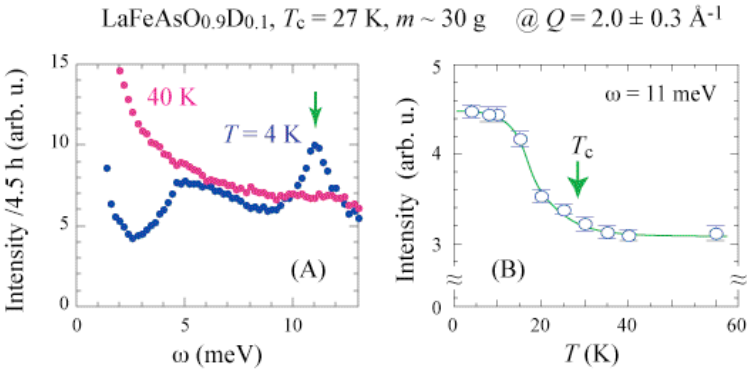

Fig. 2. (A) Energy profiles at Q = 2.0 (±0.3) Å^{-1} for T = 4 K (blue) and 40 K (ref). (B) Temperature dependence of the peak intensity at 11 meV.