（ ※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 Sep. 6, 2011
課題番号 Project No. 2009A0087 実験課題名 Title of experiment Neutron Scattering Study of High-T_c Superconductors 実験責任者名 Name of principal investigator Masatoshi Arai 所属 Affiliation J-PARC Center, Japan Atomic Energy Agency	装置責任者 Name of responsible person Ryoichi Kajimoto 装置名 Name of Instrument/（BL No.） 4SEASONS/BL01 実施日 Date of Experiment Nov. 2009 ~ Feb. 2011

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.

$LaFeAsO_{1-x}F_x$, $PrFeAsO_{0.9}F_{0.1}$, $LaFePO_{0.9}$, $BaFe_2(As_{0.65}P_{0.35})_2$, Ca-Fe-Pt-As, $YBa_2Cu_3O_{6.7}$, $La_{1.82}Sr_{0.18}CuO_4$, $Pr_{1.24}La_{0.6}Ce_{0.16}CuO_4$, $La_2CoO_{4.24}$, $La_{1.5}Ca_{0.5}CoO_4$, $CuGeO_3$, Mn_3Pt, $ZnFe_2O_4$, NiS_2, $BiFeO_3$, $La_2O_2Fe_2OSe_2$, $Mn_{2.8}Fe_{0.2}Si$, PMN-34%PT

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 first concentrated on measurements of low-energy excitations, because unfortunately, the T0 chopper was not available before late 2010, which made high-energy measurements quite difficult. We measured low-energy magnetic excitations in iron-based superconductors, charge-ordered magnetic oxides, itinerant magnets, frustrated magnets, and phonon excitations in a relaxor ferroelectris. We could obtain many important results, which have already been reported in several workshops and conferences or been published in scientific journals. After the T0 chopper became operational, the S/N ratio in a high-energy region was much improved. Then, we measured high-energy magnetic excitations in hole-doped and electron doped cuprate superconductors. We could obtain preliminary but important results to characterize the unique magnetic excitations in the cuprates.

Below we show two examples on magnetic excitations in iron-based superconductors in more detail:

1. Magnetic excitations in the iron-based nodal superconductor $BaFe_2(As_{0.65}P_{0.35})_2$

Although $BaFe_2(As_{0.65}P_{0.35})_2$ is expected to have line nodes in its superconducting order parameter, which should decrease the superconducting transition temperature (T_c), the compound has quite a high T_c of 30 K. we measured magnetic excitations in a powder sample of this compound and observed spin resonance at the same scattering vector as that appearing in the other iron-based superconductors without line nodes. Moreover, the resonance enhancement is comparable to those without line nodes (Fig. 1). These facts indicate the line nodes should create only a limited area of sign reversal on a single Fermi surface. Hence the system can hold higher Tc than the other iron-based superconductors with nodal symmetry, such as $LaFePO_{1-y}$ and KFe_2As_2 (T_c < 10 K). This work will be published as M. Ishikado *et al.*, Phys. Rev. B.

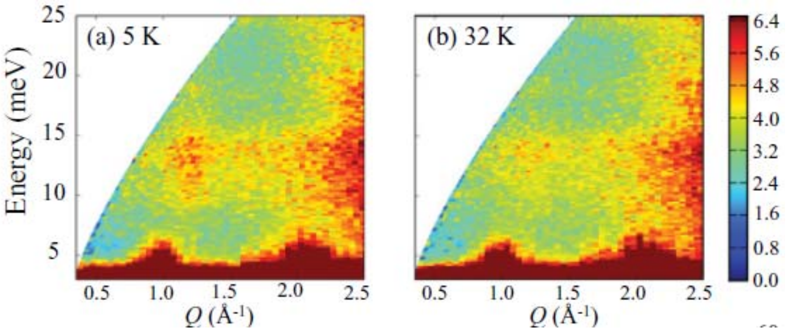

Fig. 1. Dynamical structure factor $S(Q, E)$ (Q and E are the momentum and energy transfer) of $BaFe_2(As_{0.65}P_{0.35})_2$ measured with an incident energy E_i = 45.5 meV at (a) 5 K (below T_c) and (b) 32 K (above T_c).

2. Magnetic excitations in superconducting Ca–Fe–Pt–As system

The Ca–Fe–Pt–As system is a newly found compound and belongs to one of the series of superconducting systems with FeAs planes. The superconducting transition temperature T_c was found to be ~30 K. We measured magnetic excitations in a single crystal sample of this system, and found that the magnetic inelastic scattering exhibits characteristics commonly observed for many Fe pnictide systems: a peak of the scattering intensity exists at the reciprocal point (0.5, 0), and the spectral weight of the magnetic excitations is enhanced with decreasing temperature through T_c (Fig. 2). However, the enhancement of the spectral weight seems not to be very significant as compared with the sharp and strong enhancement in both the $\boldsymbol{Q}$ and E spaces expected for the so-called $s_\pm$ symmetry of the superconducting order parameter. The observed shape of the peak structure seems to be favorable for the s_{++} symmetry. This work was published as M. Sato *et al.*, J. Phys. Soc. Jpn. **80**, 093709 (2011).

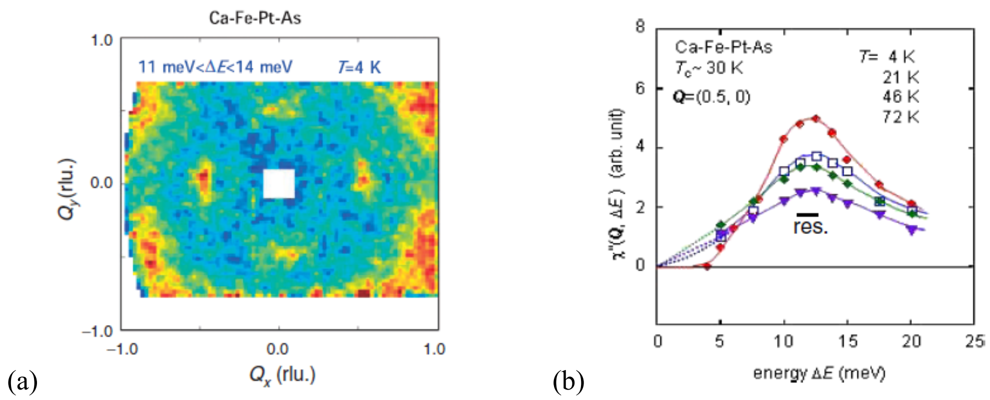

Fig. 2. (a) Map of the magnetic scattering intensity $S(\boldsymbol{Q}, E)$ collected in a region of 11 meV < E < 14 meV at T = 4 K. (b) Temperature dependence of $\chi''(\boldsymbol{Q}, E)$ values at the peak position $\boldsymbol{Q}$ = (0.5, 0) plotted against E.