(※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 2014/6/30 承認者 Approver Ryoichi Kajimoto 提出日 Date of Report 2014/6/30
課題番号 Project No. 2014A0100 実験課題名 Title of experiment Dual nature of spin excitation in doped cuprate 実験責任者名 Name of principal investigator Masaki Fujita 所属 Affiliation Tohoku University	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 2014/5/22 – 2014/5/28

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.

As-grown $Pr_{1.22}La_{0.6}Ce_{0.18}CuO_4$ (PLCCO(x=0.18))

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

We used assembled single crystals with the total mass of 52 grams. The crystals were sealed in an aluminum cell with He gas. The sample was set so that the incident neutron beam was perpendicular to the CuO_2 plane. To avoid Bragg scattering from aluminum cell, we covered it by thin Cd film (~1 mm). To observed the spin excitations in a wide energy and momentum range, we selected the incident energy sequence of 21, 37, 81, and 303 meV with the chopper frequency of 250 Hz. Furthermore, the #1 disk chopper was not operated to gain the higher beam flux,. The measurements were done at T = 10, 300, 450 K, and the counting time for each measurement was about 35 hours. At low temperature, we used other series of incident energies to check the existence of higher-energy spin excitations above 300 meV, but no well-defined excitation was detected. Therefore, we focused the low-energy part of excitation below ~200 meV to study the temperature dependence of spin excitation.

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

Experimental Results

We succeeded in observing the spin excitations around the antiferromagnetic Brillouin zone center up to ~250meV. In Fig. 1, constant-E slice of S(Q, ω) at 130 ± 20 meV is shown. In orthogonal notation (a = b = 5.62 Å, and c = 12.20 Å), the magnetic zone center corresponds to (±1, 0) and (±1, 0). The observed magnetic intensity is consistent with previous work performed at 4SEASONS, but the background was higher in the present experiment. We speculate that the background from the aluminum cell caused the worse Signal-to-Noise ratio. (Aluminum cell was not used in the previous experiment.)

In Fig. 2, constant-E slice along *h*-direction through zone center (0, 1) is shown for the energy of 5 ± 2, 130 ± 20, and 200 ± 20 meV. The solid lines indicate the fitting results by using single Gaussian and constant background. At 5 meV, the spectrum drastically changes upon warming, and the intensity weakens at 450 K. In the high-energy region, although the statistic is not enough, the peak-width increases upon warming, while the integrated intensity is the same. We ware analyzing the signal carefully and will discuss the temperature dependence of spin excitation.

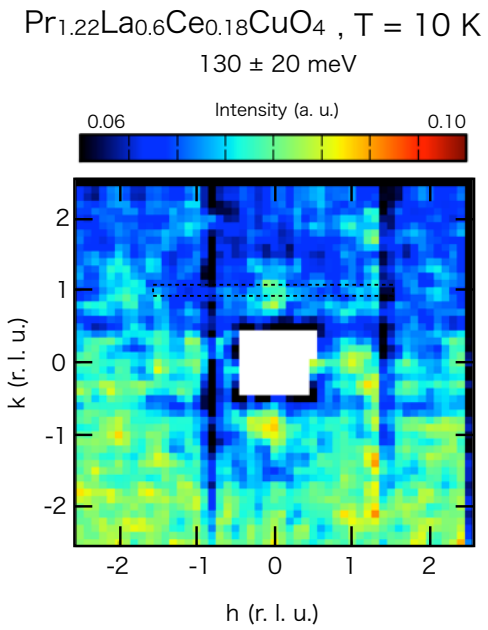

Fig. 1. Constant-E slice of S(Q, E) at 130 ± 20 meV with incident energy of 303 meV shown In the orthogonal notation. (±1, 0) and (0, ±1) correspond to magnetic zone center.

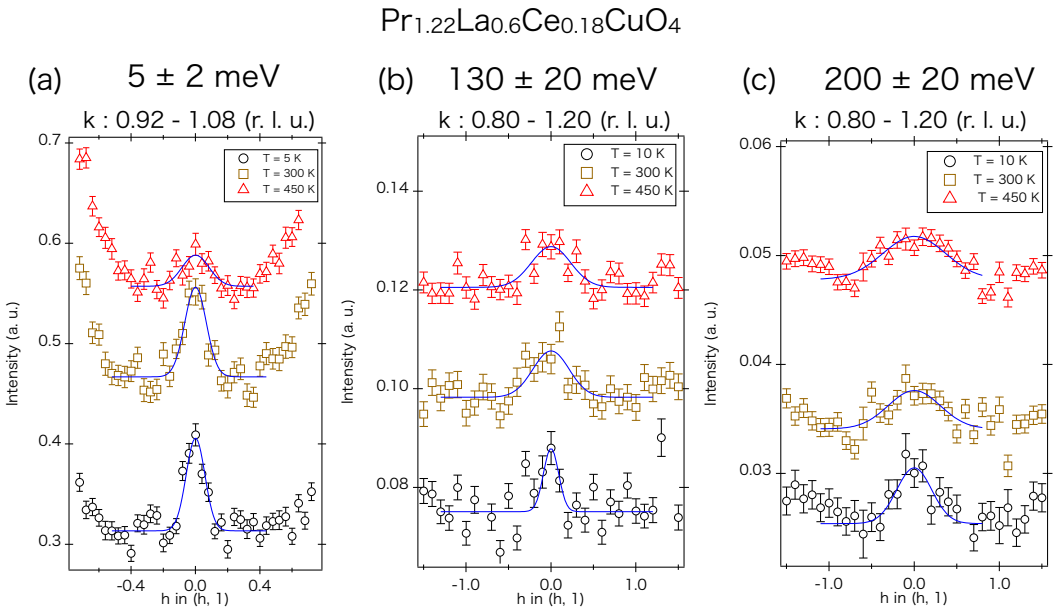

Fig. 2. Constant-E cuts of S(Q, E) at 5 ± 2, 130 ± 20, and 200 ± 20 meV. Symbols indicate the result taken at each temperature, 10 K (circle), 300 K (square), and 450 K (triangle). The spectra are sifted for the clearly visualization. Solid lines are the fitting results obtained by using single Gaussian and constant background.