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。）

TOKAI CROSS **Experimental Report** J-PARC	提出日 Date of Report Oct. 19, 2012
課題番号 Project No. 2012A0010 実験課題名 Title of experiment Giant phonon anomaly in the bond-stretching Phonon on Bi2201 Cu-O superconductor 実験責任者名 Name of principal investigator Dmitry Reznik 所属 Affiliation Department of Physics, University of Colorado-Boulder	装置責任者 Name of responsible person Ryoichi Kajimoto 装置名 Name of Instrument/(BL No.) BL 1 (4seasons) 実施日時 Date and time of Experiment 11:00 on May 13, 2012 – 11:00 on May 21, 2012

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.

Name of Sample Bi2201

Chemical formula: $Bi_2Sr_2CuO_{8-x}$

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.

In order to measure Cu-O bond stretching phonon of Bi2201, we chose 120 meV for incident neutron energy (Ei). Thanks to the special ability of 4seasnos, we could also measure different Ei data such as 60 meV, 30 meV and 15 meV. Data were taken at two temperatures, 300 K amd 5K, so that we can see temperature dependent phonon softening, if any.

Our Bi2201 sample, co-aligned by two single cystals, was aligned very well as shown in left hand side panel of figure 1. Middle and right hand side panels of figure 1 show inelasitc neutron scattering data along high symmetric direction at 5K and 300K, respectively. The inelastic neutron scattering intensity shown in figure 1 is dominatly due to phonon of our sample. Scattering cross-section by phonon becomes bigger as scattering vector is bigger. We note non-dispersive and strong peak at about 90 meV in 5 K data, but not in 300 K data. It may originate from ice frozen around sample at low temperature, although we do not know what it is exactly.

Energy scan show more detail of our scattering data (figure 2). There is a number of phonons bellow 50 meV as we see dominant neutron intensity below 50 meV. There is a boad peak feature at about 65 meV. There is a stong peak at 91 meV, which we already noticed in figure 1. This is obviously not from our sample, since there is no phonon branch above 80 meV in this material and magnetic scattering cross-section should be very weak in such big scattering vector. We believe that this may come from ice. The bond-stretching phonon, which we are interested in, disperses from 76 meV at h=0 to 60 meV to h=0.5, but we cannot see such dispersing feature from our data clearly. We could not find any other place in q-space to see such dispersion. For 300 K data, overall feature is simiar with 5 K data execpt the thing that there is no strong 91 meV peak. For direct comparison between 5 K and 300 K data, Bose factor corrected data for both tempeatures are plotted in lower panel of figure 2. We can see that overall intensity for 300 K data is bigger than that of 5 K data. We belive it is because ice, formed at 5 K, block out a portion of incident neutron.

In order to improve our experiment, we first need to be very careful not to get ice around sample at low temperature, and we need to increase more statistics, decreasing q-space range.

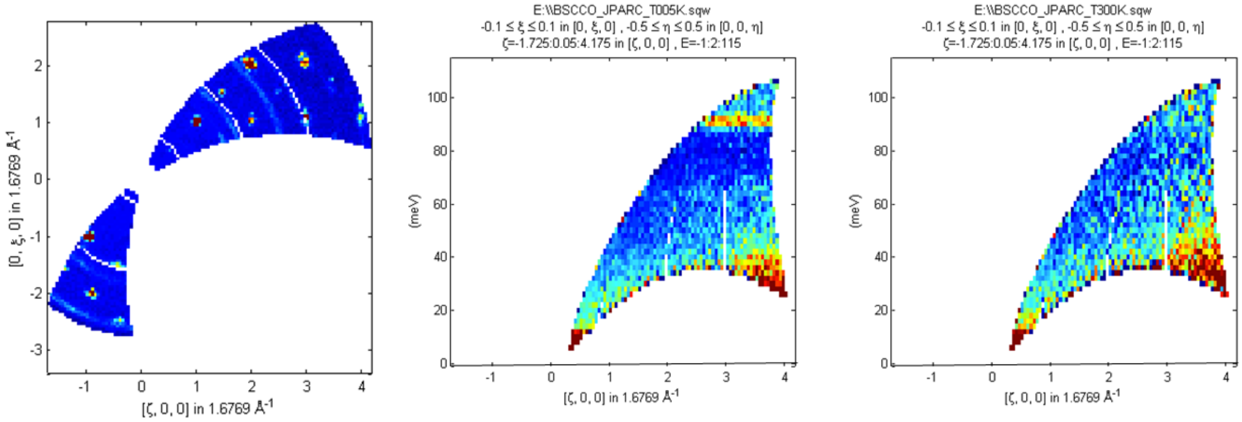

Figure 1. (left) Elastic neutron scattering data from our sample integrating l from -0.5 to 0.5. (middle) Inelastic neutron scattering data at 5 K from (0 0 0) to (4 0 0). (right) Inelastic neutron scattering data at 300 K from (0 0 0) to (4 0 0).

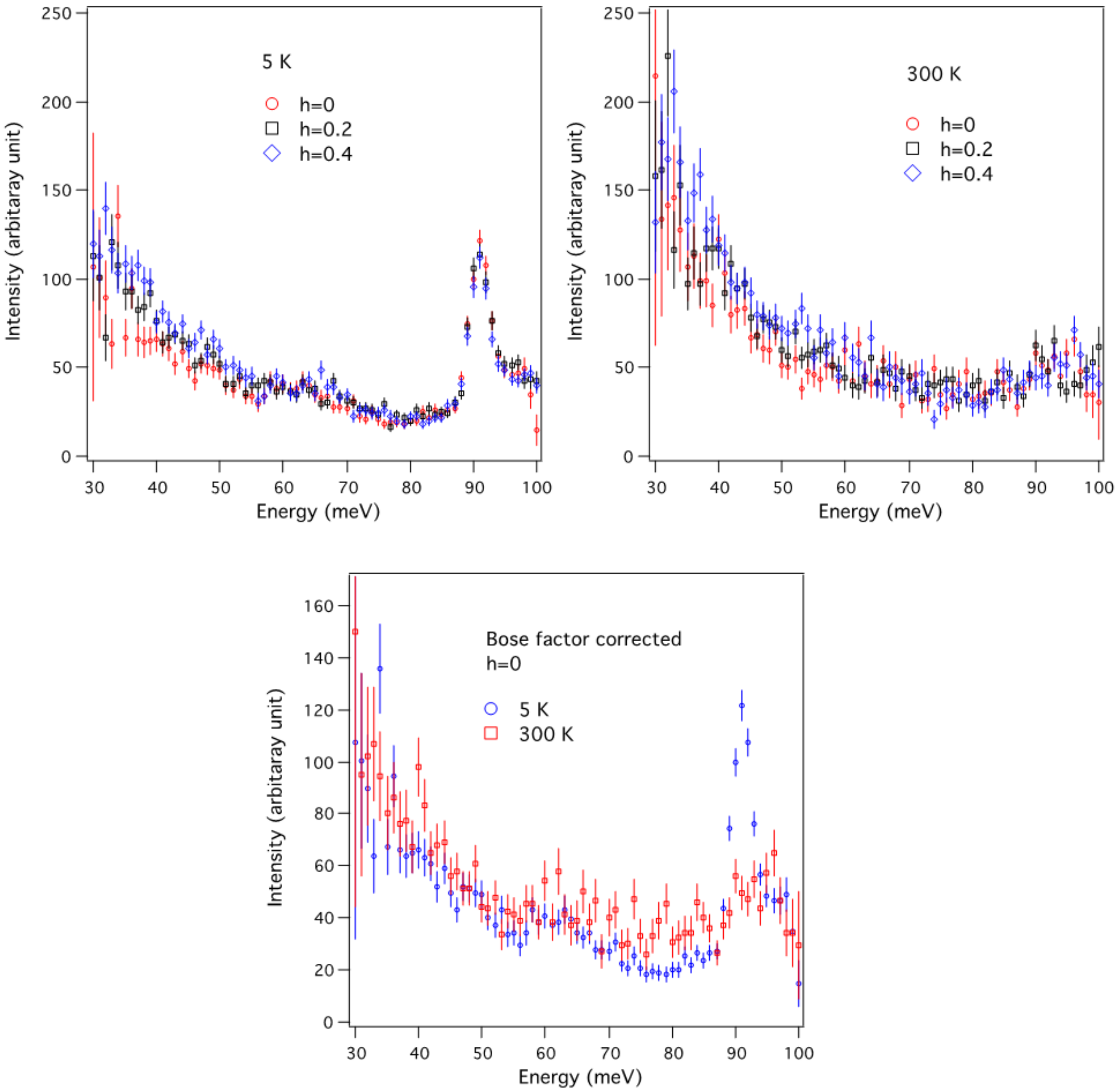

Figure 2. (upper left) Energy scan data at (3+h 0 0) taken at 5 K. (upper right) Energy scan data at (3+h 0 0) taken at 300 K. (lower) Bose corrected energy scan data at (3 0 0).