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 MLF Experimental Report	提出日 Date of Report 2011/8/31
課題番号 Project No. 2009A0093 実験課題名 Title of experiment Commissioning of the 4SEASONS spectrometer 実験責任者名 Name of principal investigator Ryoichi Kajimoto 所属 Affiliation Comprehensive Research Organization for Science and Society	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 2009A: 35 days; 2009B: 10 days 2010A: 4 days, 2010B: 13 days

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.
Vanadium, CuGeO ₃ , BaFe ₂ As ₂ , Cu, etc.

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.
<p>1. Characterization of the instrument performance We measured the absolute neutron flux at sample using the foil activation method and gold foils. We also estimate the energy resolution using a vanadium sample.</p> <p>2. Success of multiple-incident-energy measurement The first inelastic measurement on 4SEASONS is to measure magnetic excitations in single crystals of the spin-Peierls compound CuGeO₃. In this measurement we could obtain multiple data with different incident energies (E_i's) simultaneously (multi-E_i measurement) (Fig. 1) by the repetition rate multiplication (RRM) with the monochromating chopper. This might be the first demonstration of the RRM technique by a Fermi chopper spectrometer.</p> <p>3. Reduction of the background scattering As the most powerful measure to reduce the background scattering, we installed a so-called T0 chopper in the spectrometer and performed evaluation measurements. Left panel of Fig 1 shows time spectra measuring a vanadium sample with and without the T0 chopper rotating in 25 Hz. It shows that the background is</p>

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

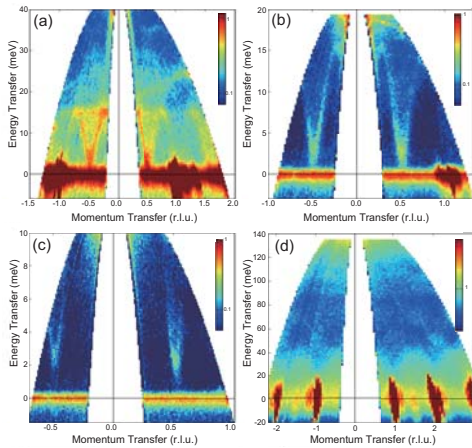


Fig. 1. Result of the first inelastic scattering measurement on 4SEASONS: Magnetic scattering spectra of CuGeO_3 below the spin-Peierls transition temperature, where data with (a) $E_i = 45.4$ meV, (b) 21.5 meV, (c) 12.6 meV, and (d) 150.7 meV are obtained simultaneously.

dramatically decreased by the T0 chopper e.g. by a factor of 10^{-2} – 10^{-3} at $E_i \sim 300$ meV. Right panel shows test inelastic scattering measurements with and without the T0 chopper. It shows the T0 chopper is very effective to reduce the background especially at a high energy region.

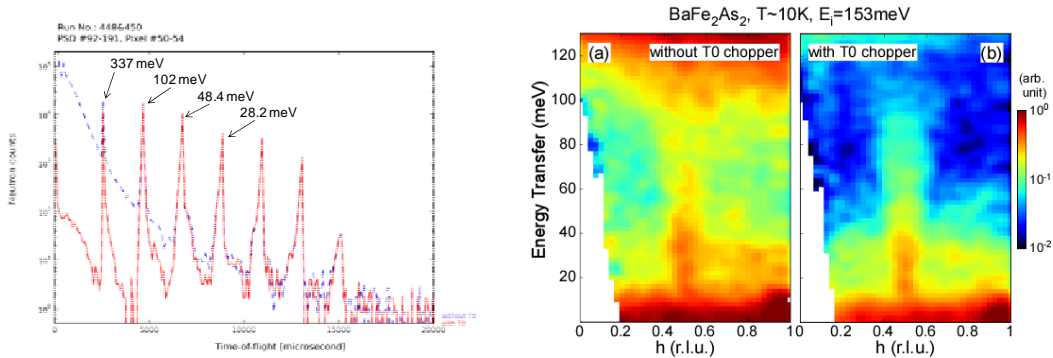


Fig. 2. (Left) Time spectra measuring a vanadium sample with (solid line) and without (dashed line) the T0 chopper. (Right) Excitation spectra of a single crystal of BaFe_2As_2 at ~ 10 K without (a) and with (b) the T0 chopper.

4. Measurements of single crystal samples of three-dimensional (3D) systems

We can obtain data at arbitrary \mathbf{Q} and E positions in a 3D system by rotating the crystal, so that the scan trajectory covers the entire four-dimensional space of \mathbf{Q} and E . Recently, we have developed a prototype of a software to handle data from such a measurement. Figure 3 shows the result of a test measurement of a single crystal of copper. We could obtain dispersion relations of phonons along arbitrary directions

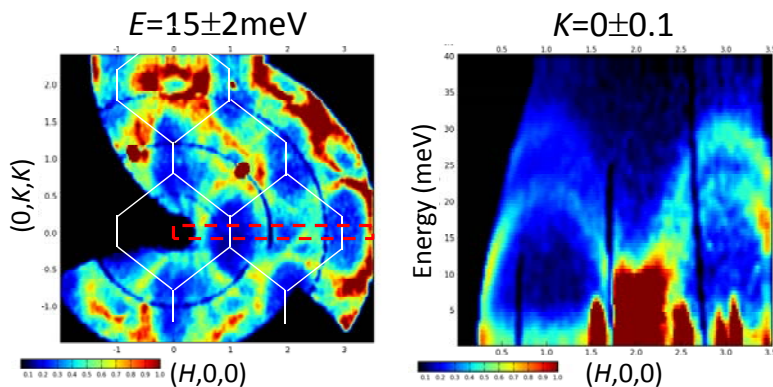


Fig. 3. (Left) Map of phonon excitations in Cu on the (H,K,K) plane with $E = 15$ meV. (Right) Slice of the phonon excitations along $(H,0,0)$.