MLF Experimental Report	提出日 Date of Report
課題番号 Project No. 2009A0005 実験課題名 Title of experiment Magnetic fluctuations in Sr2RuO4 実験責任者名 Name of principal investigator Seunghun Lee 所属 Affiliation University of Virginia	装置責任者 Name of responsible person 梶本亮一 装置名 Name of Instrument/（BL No.） BL-01 実施日 Date of Experiment 2009/12/24-2009/12/28

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.

Ruthenate : Sr2RuO4

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.

Five single crystals of Sr_2RuO_4 with a total mass of 29.15 g were prepared by a floating-zone method. They were coaligned for our neutron scattering measurements performed at 4SEASONS. The crystals were mounted in a way that the crystallographic c-axis was along the incident neutron beam, which allows one to probe the scattering in the (HK0) plane for this quasi-two-dimensional system. The crystals were put into an aluminum sample can that was then attached to a closed-cycle displex refrigerator, and the measurements were done at 5 and 300 K. We selected two setups that collected the following sets of incident energies: one with E_i=12.6, 21.6, 45.5, 151.2 meV and another with E_i=28.1, 48.3, 101.6, 336.6 meV.

Figures 1(a) and 1(b) show the scattering intensity with energy transfer up to hw=100 meV along the H-direction. There are strong bands of scattering centered at around 20, 40, 60, and 85 meV. They are phonons that have already been reported by the previous neutron scattering study using a thermal triple-axis spectrometer. In addition, there are strong spin fluctuations at the IC positions centered at Qc=(0.3,0.3) that exist up to hw of at least 80 meV (see the white arrows), which are consistent with a previous polarized inelastic neutron scattering experiment that reported the IC peaks up to 40 meV.

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

The magnetic fluctuations can be more clearly seen at low energies where no strong phonon modes exist. Figure 2(a) shows the data up to hw=10 meV. The strong IC peaks are centered at the characteristic wave vector transfer, Qc=(0.3,0.3). The peak position does not change with hw up to 80 meV (see Fig. 1). The full-width-of-the-half-maximum of the magnetic scattering along the H-direction does not change at low energies (see Fig. 2(a)), suggesting a very high stiffness of the magnetic fluctuations.

In order to investigate the Q-dependence of the low energy magnetic fluctuations, we integrated S(Q,hw) over hw from 2.5 to 7 meV and L from −5 to 5 at T=5 K, and the result as a function of Q=(H,K) is plotted in Fig. 2(b). There exist several IC peaks with the characteristic wave vector of Qc=(0.3,0.3). The IC magnetic fluctuations were theoretically predicted as the consequence of the Fermi surface nesting of the quasi-one-dimensional alpha and beta sheets and have been observed experimentally. On the other hand, these peaks showed no L-dependence.

Our inelastic neutron scattering measurements on Sr_2RuO_4 over a very wide range of the Q-hw phase space revealed the three components of the magnetic fluctuations; the strong IC spin fluctuations at 5 K centered at Qc=(0.3,0.3) that extend up to at least 80 meV. Our data clearly shows that the ridge scattering is strong around the (pi,pi) rather than around the Gamma points.

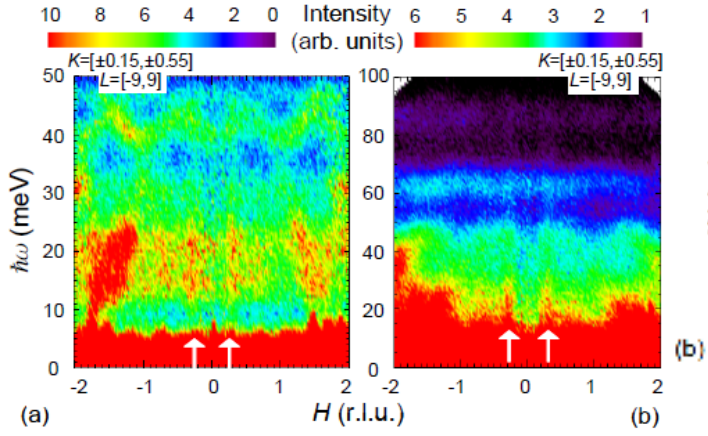

Fig. 1.

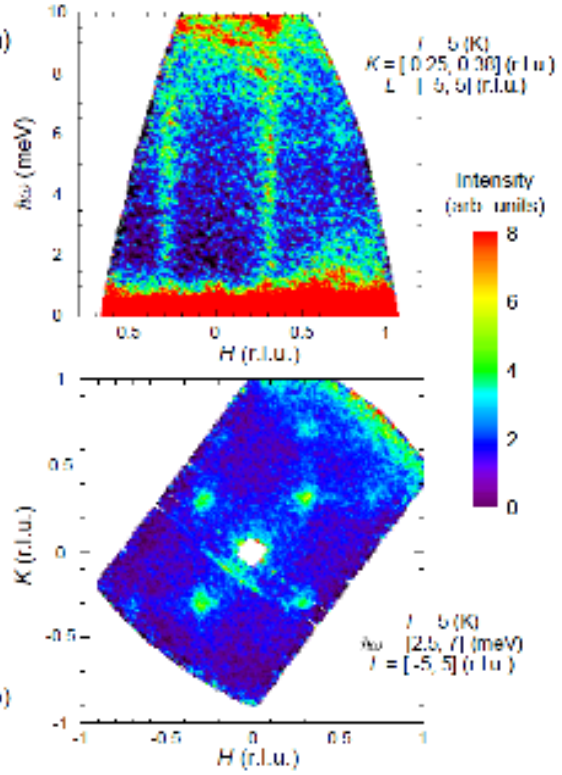

Fig. 2