実験報告書様式（一般利用課題・成果公開利用）

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CROSS TOKAI **Experimental Report** J-PARC	承認日 Date of Approval 2013/02/15 承認者 Approver Ryoichi Kajimoto 提出日 Date of Report 2013/02/15
課題番号 Project No. 2012B0075 実験課題名 Title of experiment High-energy spin excitations in hole-doped superconductor KFe_2As_2 実験責任者名 Name of principal investigator Kazumasa Horigane 所属 Affiliation Aoyama-Gakuin University	装置責任者 Name of Instrument scientist Ryoichi Kajimoto 装置名 Name of Instrument/(BL No.) 4seasons/BL-01 実施日 Date of Experiment 2012/12/13 11:00-2012/12/18 11:00

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.

Iron arsenide (KFe_2As_2) single crystals

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.

Because superconducting phase of iron pnictides lies beside static antiferromagnetic (AFM) ordering phase, much effort has been focused on examining their spin dynamics. In order to clarify the role of magnetism for superconductivity in Fe-based superconductors, understanding the overall spin dynamics by using inelastic neutron scattering (INS) is indispensable.

Our experiment aims at exploring a dispersion of spin fluctuation which appears at $[\pi(1\pm2\delta),0]$ with δ=0.16 from our preliminary experiments. In our experiment, we performed inelastic neutron experiments on single crystalline KFe_2As_2 at 6K and 50K. We used incident energies E_i of 148.8meV (45.1, 21.4 and 12.5 meV) and 75.0meV (30.1, 16.1 and 10.0meV). The incident beam direction was parallel to the *c*-axis because of 2D spin fluctuation.

Figure 1(a)-(e) shows two-dimensional constant-energy images of spin excitations of KFe_2As_2 in the

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

$Q_a(H,H)$-$Q_b(H,-H)$ scattering plane. Previous inelastic neutron scattering experiment with TAS revealed that a well-defined low-energy incommensurate spin fluctuation at $[\pi(1\pm2\delta),0]$ with δ=0.16 exist up to 14meV. For energy transfers of *dE*=15meV (Fig.1-b) and 30meV (Fig.1-c), clear peaks due to spin waves are observed at $[\pi(1\pm2\delta),0]$ with δ=0.16. As the energy increase, these peaks become broad and the scattering changes to ring-like at 50meV (Fig.1-d). The spin wave of KFe_2As_2 extends up to about 80meV. Figure 1(f) shows spin-wave dispersion for KFe_2As_2. A practically vertical dispersion, so-called “chimney structure”, was discovered below 40meV, indicating a commonality of magnetic excitations for itinerant antiferromagnets.

In this proposal, we have succeeded in observing overall spin dynamics of heavily hole doped superconductor KFe_2As_2 as a typical itinerant-electron system. In order to clarify the role of magnetism for superconductivity in Fe-based superconductors, the understanding of overall spin dynamics over the wide hole doping region is a key to progress in the study of iron based superconductors. Next step, we’re planning to perform on inelastic neutron scattering to clarify the spin dynamics of the “intermediate” region between parent compound $BaFe_2As_2$ and heavily over doped KFe_2As_2. From the comparison with them, we can clarify whether the superconductivity of these materials is originated from a weak-coupling (itinerant) or rather from an interaction with more component of strong-coupling (localized).

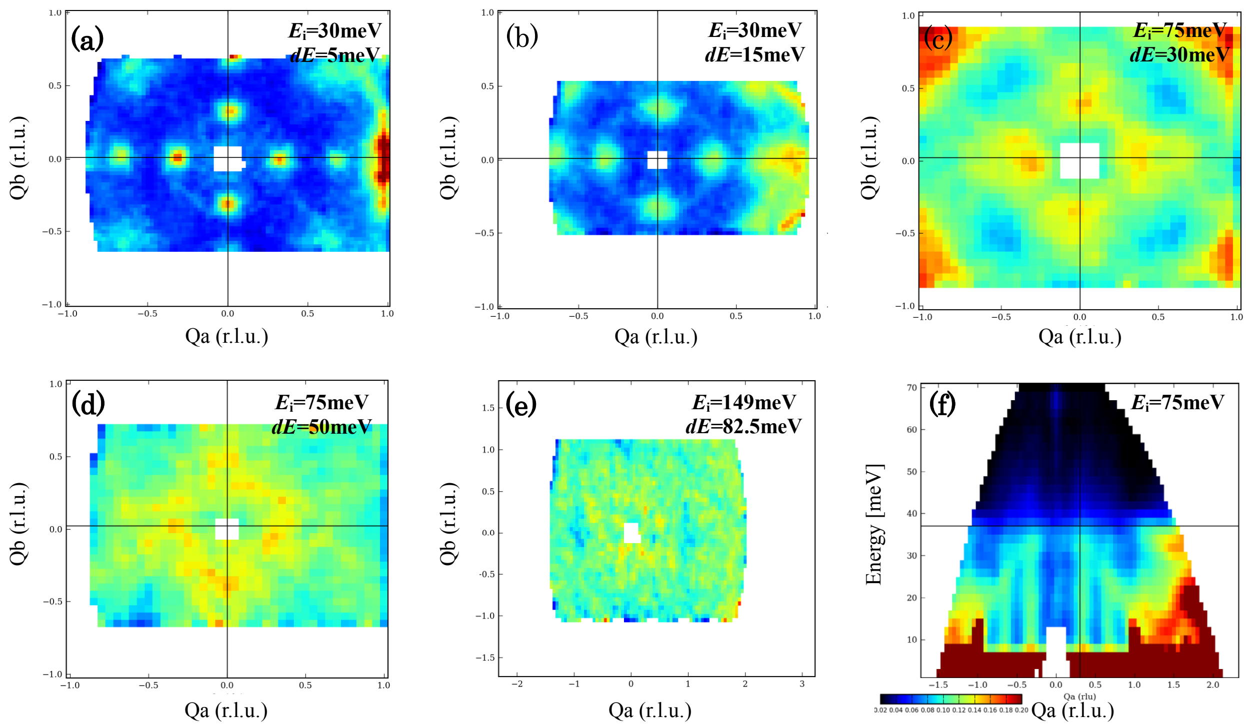

Fig.1 Spin wave excitations for energy transfers of (a) *dE*=5meV (E_i=30meV), (b) *dE*=15meV (E_i=30meV) , (c) *dE*=30meV (E_i=75meV) , (d) *dE*=50meV (E_i=75meV) and (e) *dE*=82.5meV (E_i=149meV) in KFe_2As_2. (f) Spin-wave dispersion for KFe_2As_2.