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。）

# MLF Experimental Report	提出日 Date of Report
課題番号 Project No. 2014B0064 実験課題名 Title of experiment Spin dynamics in a Zn-Ln-Zn single-molecule magnet 実験責任者名 Name of principal investigator Maiko Kofu 所属 Affiliation Institute for Solid State Physics, University of Tokyo	装置責任者 Name of responsible person Kenji Nakajima 装置名 Name of Instrument/（BL No.） AMATERAS (BL14) 実施日 Date of Experiment 2015/4/8 – 2015/4/14

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.

Ce complex ($C_{40}D_{39}CeN_8O_{11}S_2Zn_2$)

Pr complex ($C_{40}D_{39}N_8O_{11}PrS_2Zn_2$)

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.

A single-molecule magnet (SMM) is a metal complex that behaves as an individual nanomagnet. Each molecule, containing several metal centers with unpaired electrons, possesses a giant resultant spin. Given that the giant spin exhibits easy-axis anisotropy ($D < 0$), the magnetization reversal between the ground states with $S_z = \pm S$ is hindered by the potential barrier of DS_z^2. The barrier yields a slow relaxation of the magnetization reversal that is characteristic of SMMs. Early SMM researches have focused on the complexes containing multiple transition metal atoms. During the past decade, lanthanide SMMs have received much attention as promising materials with high blocking temperature (stable SMM). Owing to a large contribution of angular momentum, lanthanide complexes can become SMMs containing only one or two magnetic ions. One of the central issues in lanthanide SMMs is the quantum tunneling mechanism for the magnetization reversal. In fact, lanthanide SMMs exhibit rather complicated relaxation behaviors; the tunneling occurs between ground states (pure tunneling process) and/or excited states (thermally assisted tunneling process). The energy scheme is not simply described by DS_z^2 and other terms such as higher order magnetic anisotropy and hyperfine interaction can be included in the Hamiltonian. As such, the mechanism of magnetization reversal for lanthanide SMMs has not been fully understood yet.

In this work, we have investigated a new lanthanide system, trinuclear Zn-Ln-Zn compexes (Ln=Ce, Pr). The

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

system has only one magnetic center in a molecule. Interestingly, the complexes with Kramers ion (Ce : J = 5/2) exhibit the SMM behavior while that with non-Kramers ion (Pr : J = 4) does not. In order to search for magnetic excitations in the two complexes, inelastic neutron scattering (INS) measurements were performed using AMATERAS spectrometer. Figure 1 shows the observed $S(Q,\omega)$ maps and energy spectra for the two samples.

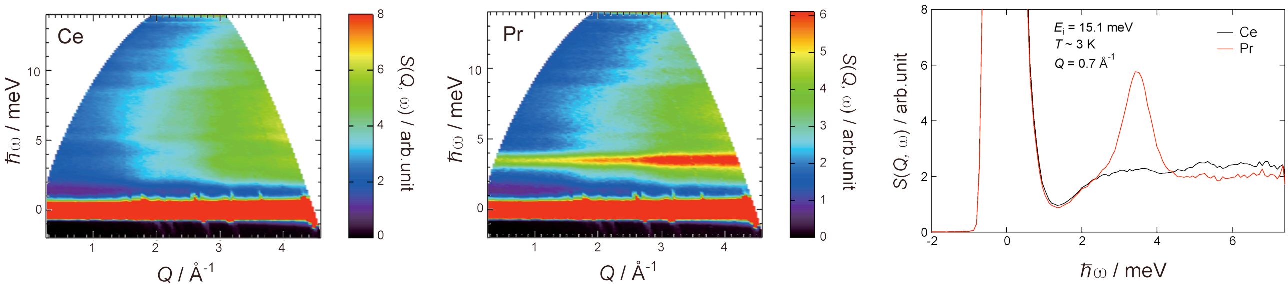

Figure 1: $S(Q,\omega)$ maps of (a) Ce and (b) Pr complexes taken on AMATERAS with E_i of 15 meV at 3 K. (c) Comparison of energy spectra for the two samples.

A magnetic excitation appeared around 3.5 meV in the Pr complex. On the other hand, a magnetic excitation was hardly detected in the Ce one. This indicates that magnetic states clearly differ between Ce and Pr complexes. To trace the reason for the absence of low-energy excitations in the Ce complex, we are going to carry out the INS measurements for a Nd (J = 9/2) SMM on AMATERAS in the 2017A proposal round. The polarized diffraction measurements on TAIKAN are also planned to identify the magnetic ground state of the system.