Two dimensional magnetism and magnon decay in $RMnO_3$

Joosung Oh[1,2], Manh Duc Le[1,2], Jaehong Jeong[1,2], Jung-hyun Lee[3], HyungjeWoo[4,5], Wan-Young Song[3], T. G. Perring[4], W. J. L. Buyers[6], S.-W. Cheong[7], and Je-Geun Park[1,2#]

[1]*Center for Correlated Electron Systems, Institute for Basic Science (IBS), Seoul 151-747, Korea*
[2]*Department of Physics & Astronomy, Seoul National University, Seoul 151-747, Korea*
[3]*Department of Physics, Sungkyunkwan University, Suwon 440-746, Korea*
[4]*ISIS Facility, STFC Rutherford Appleton Laboratory, Oxfordshire OX11 0QX, UK*
[5]*Department of Physics, Brookhaven National Laboratory, Upton, New York 11973, USA*
[6]*Chalk River Laboratories, National Research Council, Ontario K0J 1J0, Canada*
[7]*Department of Physics and Astronomy, Rutgers University, New Jersey 08854, USA*

 # a corresponding author: E-mail jgpark10@snu.ac.kr

Two-dimensional triangular lattice has been the source of rich physics with its generic frustration effects. We have investigated the magnetism of the two-dimensional triangular lattice in multiferroic hexagonal $RMnO_3$. The hexagonal $RMnO_3$ belongs to the class of multiferroic materials with both ferroelectric and antiferromagnetic transitions in a single compound. We have demonstrated that a strong spin-lattice coupling lies at the heart of the magnetoelectric coupling in these compounds [1].

In this talk, we will present our latest inelastic neutron scattering data, where we further extend our previous work by measuring the spin dynamics [2]. By accurately measuring a wide Q-E space of the spin dynamics, we could confirm that there is indeed a large splitting in the nearest Mn-Mn exchange interactions, supporting our previous high-resolution neutron diffraction studies [1]. By examining the experimental results in detail and comparing it with the theoretical predictions based on linear spin wave theory, we could demonstrate that the spin dynamics of the two-dimensional triangular magnetism of $RMnO_3$ exhibits significant deviations from the theoretical calculations, namely a roton-like minimum, a flat mode and a magnon decay. All these three key features are consistent with the theoretical studies of non-linear spin wave making our studies a rare example of such. We have since measured several other $RMnO_3$ materials to find very similar features.

[1] Seongsu Lee, A. Pirogov, Misun Kang, Kwang-Hyun Jang, M. Yonemura, T. Kamiyama, S-W. Cheong, F. Gozzo, Namsu Shin, H. Kimura, Y. Noda, and J.-G. Park, Nature **451**, 805 (2008).

[2] Joosung Oh, Manh Duc Le, Jaehong Jeong, Jung-hyun Lee, Hyungje Woo, Wan-Young Song, T. G. Perring, W. J. L. Buyers, S-W. Cheong, and Je-Geun Park, Phys. Rev. Lett. **111**, 257202 (2013).