Magnetic and Orbital Excitations in Thin Film A_2IrO_4 Probed by Hard X-ray RIXS

J.P. Clancy*[1], H. Gretarsson[1], A. Lupascu[1], J.A. Sears[1], Z. Nie[1], M.H. Upton[2], J. Kim[2], D. Casa[2], T. Gog[2], A.H. Said[2], Z. Islam[2], M. Uchida[3], D.G. Schlom[3], K.M. Shen[3], J. Nichols[4], J. Terzic[4], S.S.A. Seo[4], G. Cao[4], V.M. Katukuri[5], H. Stoll[6], L. Hozoi[5], J. van den Brink[5], and Y.-J. Kim[1]

[1]University of Toronto
[2]Argonne National Laboratory
[3]Cornell University
[4]University of Kentucky
[5]IFW Dresden
[6]University of Stuttgart

The layered perovskite iridates A_2IrO_4 (A = Sr or Ba) are prototypical spin-orbital Mott insulators, displaying a novel j_{eff} = 1/2 ground state driven by strong 5d spin-orbit coupling effects. Efforts to understand, and ultimately control, this spin-orbit-induced ground state have led to a surge of interest in thin film iridates, which offer unique opportunities for tuning electronic and magnetic properties via epitaxial strain. We have performed high resolution Ir L_3-edge resonant inelastic x-ray scattering (RIXS) measurements on epitaxial thin film samples of Sr_2IrO_4 and Ba_2IrO_4. By measuring films grown on a variety of different substrates (PSO, GSO, STO, and LSAT) we are able to investigate the impact of tensile and compressive strain on the characteristic excitations of these materials. Unlike other perturbations, such as doping or applied magnetic field, we find that epitaxial strain does not affect the magnetic structure of A_2IrO_4. However, it does have a significant impact on the magnetic energy scales of the system, altering the dispersion of the low-lying magnetic and orbital excitations, and providing a means of tuning both the magnetic ordering temperature (T_N) and the strength of the magnetic exchange interactions (J). These results demonstrate that hard x-ray RIXS can be used to perform detailed magnetic dispersion measurements on thin film samples of 13 nm ($\sim$5 unit cells) or less.

*Corresponding author: pclancy@physics.utoronto.ca