Evolution of the magnetic order of $Sr_3Ir_2O_7$ under pressure by REXS

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We investigated the evolution of the magnetic behavior of $Sr_3Ir_2O_7$ under pressure using Resonant Elastic X-Ray Scattering (REXS) on I16, the beamline for materials and magnetism at Diamond Light Source [1]. This compound is the n=2 case of the Ruddlesden-Popper (RP) series of layered perovskites $Sr_{n+1}Ir_nO_{3n+1}$ that presents tetragonal structure at ambient conditions (I4/mmm, a = 3.9026 Å, c = 20.9300 Å).

In this series of layered perovskites, the interplay between the crystal field, the on-site Coulomb repulsion (U) and the increasing bandwidth (W) from n=1 to n=∞, give rise to a rich landscape of fascinating behaviors from the Mott-insulating Sr_2Ir0_4 (n=1) [3], to the fully metallic $SrIrO_3$ (n=∞) [4]. $Sr_3Ir_2O_7$ (n=2), presents a weak insulating behavior and antiferromagnetic order, with k = (0.5,0.5,0) and moments along the c-axis, below 285 K at ambient pressure. Pressure is an ideal tool to explore the natural tendency of the transition metal oxygen octaedra in this kind of structures to rotate and distort, giving rise to potential alterations in the strength and sign of the mangetic interactions. In fact, the effect of chemical pressure by dopping the Sr sites with La in the $(Sr_{1-x}La_x)Ir_2O_7$ has shown to be the lead to a very rich phase diagram of electronic behaviours (see fig. 1).

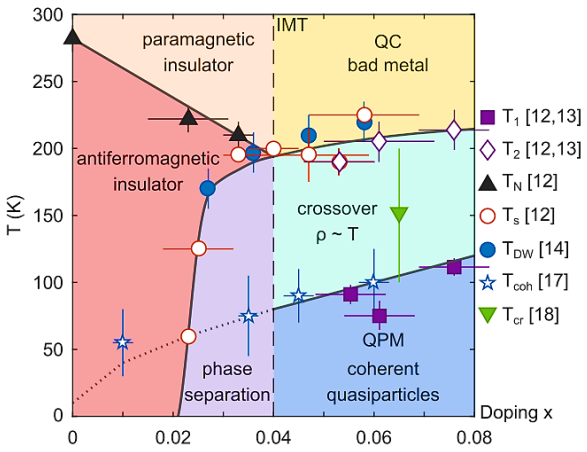

Figure 1. Electronic phase-diagram of $(Sr_{1-x}La_x)Ir_2O_7$ from [5].

Thanks to the recently developed high-pressure capability on I16 [6] we measured magnetic reflections (see fig. 2) up to 12 GPa tuning the photon energy through the Ir-L_3 absorption edge. A preliminary analysis of the collected data suggest a linear decrease of T_N mirroring what observed under chemical substitution. The models qualitatively consistent with this trend will be discussed.

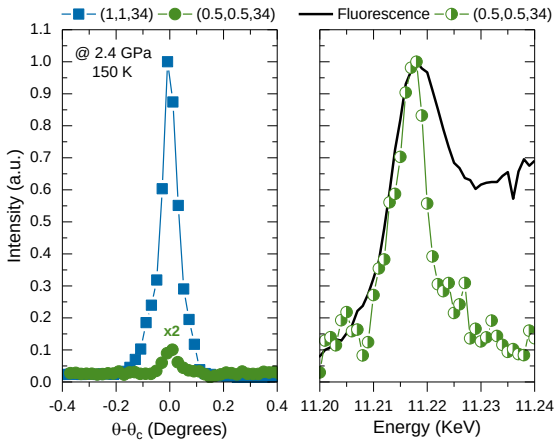

Figure 2. Right. Magnetic and Bragg reflections (0.5,0.5,34) and (1,1,34), green dots and blue squares respectively, of $Sr_3Ir_2O_7$ collected at 2.4 GPa and 150 K. Left. Energy scan on the magnetic peak (0.5,0.5,34) (green half-filled dots) collected in the same conditions. Solid black line shows the fluorescence from the sample collected at 2.2 GPa of pressure and 200 K.

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