

We have investigated Ir based double perovskites of the form $\text{La}_{2-x}\text{Sr}_x\text{CoIrO}_6$ with $x = 0, 0.5, 1, 1.5$ and 2 by X-ray absorption circular dichroism (XMCD) analysis. A previous study of these compounds using neutron diffraction has indicated a canted antiferromagnetic ordering of Co and weak ferromagnetic behavior of Ir [1]. However, due to the low scattering coefficient of Ir, the magnetic ordering of Ir was not unambiguously established.

Several samples of $\text{La}_{2-x}\text{Sr}_x\text{CoIrO}_6$ with a focus on $x = 0$ and $x = 1$ were measured by X-ray absorption near-edge structure (XANES), XMCD for Co and Ir at a temperature of 2.2 K and in fields up to 17 T. Due to the unique elemental selectivity of XMCD, magnetization curves of Ir and Co ions were measured separately. For $\text{La}_2\text{CoIrO}_6$ (see Fig. 1) a clear hysteresis is observed for both elements Co and Ir. Although the hysteresis curves show different coercive fields for both elements, the hysteresis behavior is clearly coupled. The Ir magnetic moment is coupled negatively with respect to the canted moment of the Co ions. This clearly indicates a novel form of induced ferromagnetic magnetic moment in a canted antiferromagnetic matrix.

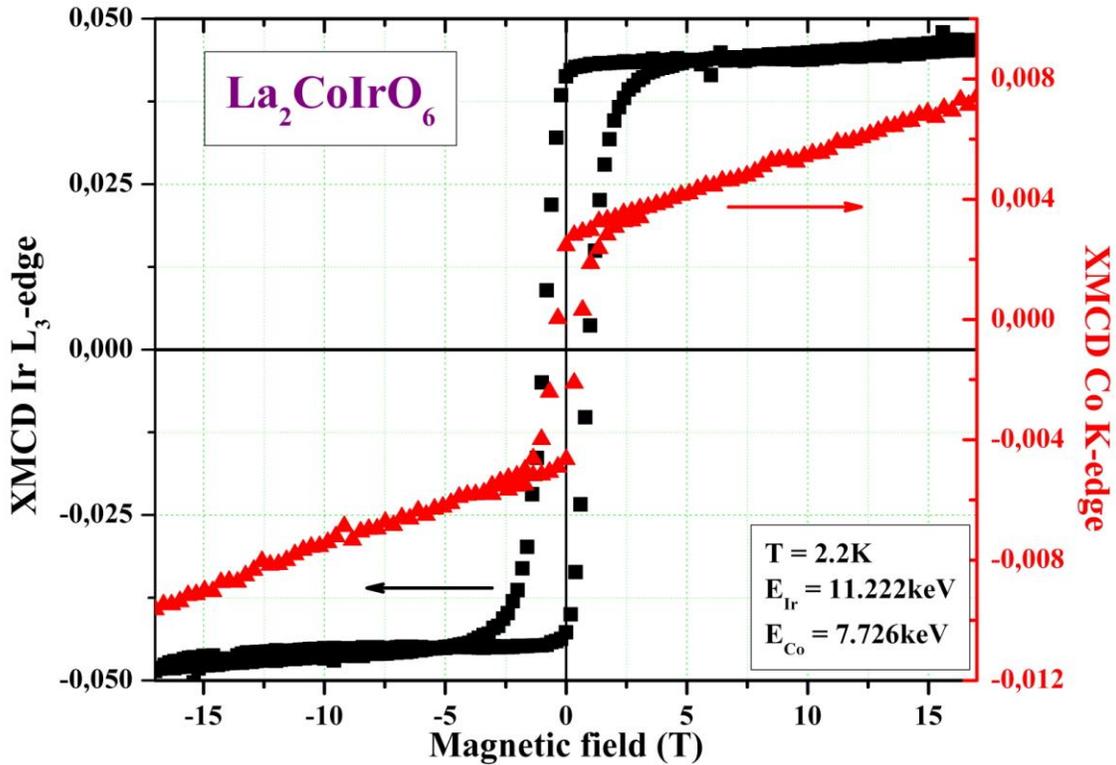


Fig. 1. Magnetization curves of Ir and Co in $\text{La}_2\text{CoIrO}_6$.

XMCD measurements of $L_{2,3}$ X-ray absorption edges of Ir and following calculations, based on sum rules showed that indeed Ir has a weak magnetic moment of $-0.2 \mu_B/\text{f.u.}$ (Fig. 2). In contrast, for $\text{Sr}_2\text{CoIrO}_6$ neutron scattering has revealed a perfect antiferromagnetic structure [1]. It is therefore not expected that there is a coupling to the Ir moments or enhancement of Ir magnetization. This is confirmed by our XMCD measurements in which orbital, spin and total magnetic moments of Ir were calculated. The total magnetic moment of Ir is $+0.02 \text{ muB/f.u.}$ and can be attributed to an intrinsic paramagnetic moment of Ir (Fig. 3).

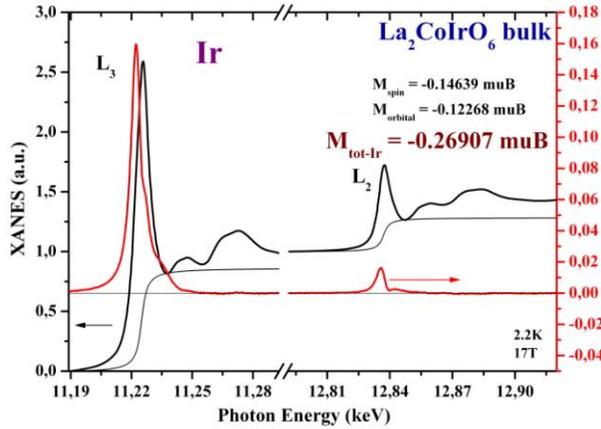


Fig. 2. L_2 and L_3 edges of Ir in $\text{La}_2\text{CoIrO}_6$.

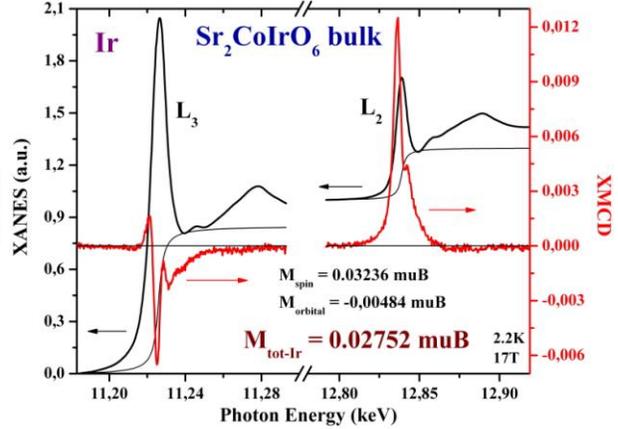


Fig. 3. L_2 and L_3 edges of Ir in $\text{Sr}_2\text{CoIrO}_6$.

Summary: A novel model of induced magnetism on Ir in a canted antiferromagnetic structure has been proposed and confirmed by XMCD studies [2].

[1] N. Narayanan, D. Mikhailova, A. Senyshyn, D. M. Trots, R. Laskowski, P. Blaha, K. Schwarz, H. Fuess, and H. Ehrenberg. Temperature and composition dependence of crystal structures and magnetic and electronic properties of the double perovskites $\text{La}_{2-x}\text{Sr}_x\text{CoIrO}_6$ ($0 \leq x \leq 2$). *Phys. Rev. B* **82**, 024403 (2010).

[2] A. Kolchynska *et al.*, Magnetic coupling in Ir-based double perovskites $\text{La}_{2-x}\text{Sr}_x\text{CoIrO}_6$. To be submitted to *Phys. Rev.*