Experiment title: Orbital moment anisotropy in Pt/Co and Fe/Ir multilayers		Experiment number: *HE-024*
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Names and affiliations of applicants (* indicates experimentalists):

A. Fontaine*, J. Vogel* - Laboratoire Louis Néel, Grenoble

F. Petroff*, V. Cros* - Unité mixte CNRS-Thomson, Orsay

J.P. Kappler*, W. Grange* - IPCMS-GEMME, Strasbourg

Report:

In this report, we present the results obtained from XMCD measurements using fluorescence yield detection (FY) at the Pt $L_{2,3}$ edges in both thin film and bulk Co_xPt_{1-x} alloys.

The $CoPt_3$ monocrystalline bulk sample crystallises in the cubic $L1_2$ structure and the $Co_{80}Pt_{20}$ thin film was deposited by molecular beam epitaxy onto a 10 nm Ru (0001) buffer grown at 700°C on a mica (001) substrate. An ex-situ diffraction study performed on this latter sample (O/20 symmetric reflection scan, rocking curves in symetrical and asymetrical geometries) confirmed the presence of a hcp phase.

XMCD experiments were carried out at the ESRF beamline lD12A. The source was the third harmonic of the helical ondulator Helios-II, which allowed us to cover the energy range corresponding to the Pt $L_{2,3}$ absorption edges (from 11 Kev up to 13.5 Kev). The energy was selected by a double Bragg-reflection onto Si (1 11) crystals; the rate of circular polarisation after the monochromator was constant and evaluated to be 90%.

The XMCD signal was obtained either by reversing the helicity of the incoming beam or by flipping the direction of the magnetic field. Experiments were performed at 300K (thin film) and 30K (bulk sample); *the* magnetic field (H=3.5T) was strong enough to saturate the magnetic moment.

For the thicker sample ($CoPt_3$ bulk) the FY signal was corrected for saturation effects (i.e. an atenuation of intensity of the white line) in comparison with the absorption cross section obtained in total electron yield. Note that such effects are not present in the case of a thin layer and a dilute sample ($Co_{80}Pt_{20}$ thin film), and the FY is directly proportional to the absorption cross section.

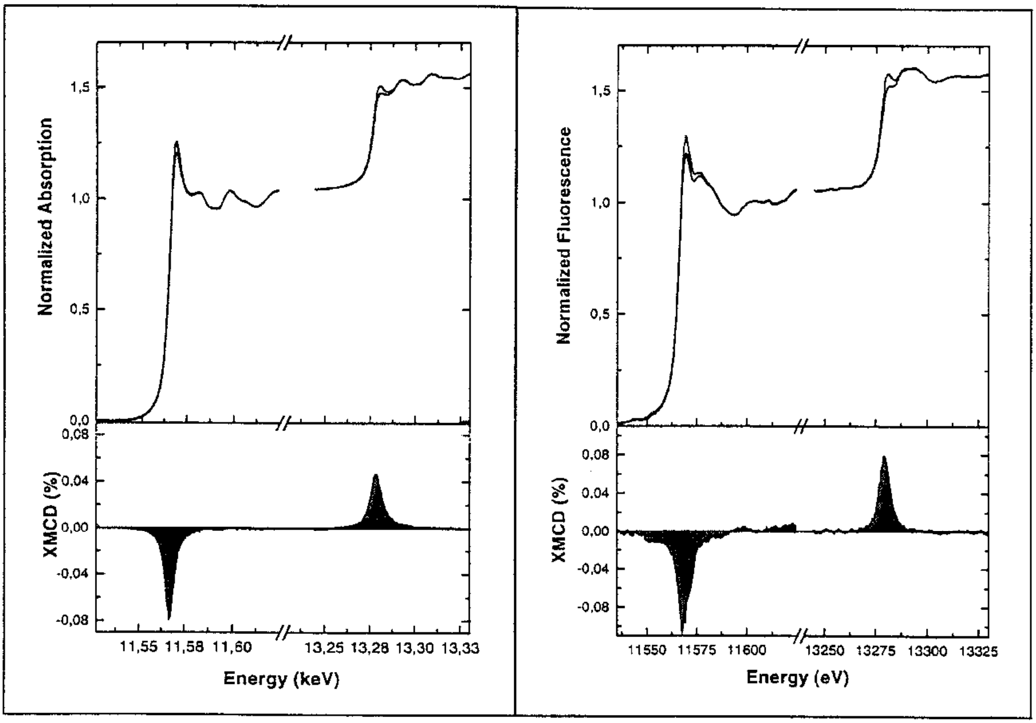
Table 1 reports the values of the orbital and spin effective moments, determined by using the sum rules. The band structure and the expectation value of S_Z in the 5d band have been calculated in a bulk sample using the Augmented Sperical Wave method; the expectation value of L_Z has been theoretically evaluated in a perturbation theory.

Our results show that the expectation value of $\langle L_Z \rangle$ is in good agreement with the calculated one; however, the value of the effective spin moment (which includes the unknown contribution of the magnetic dipole operator Tz) is as expected sligtly larger than the spin moment obtained from band structure calculations and neutron expriments.

In the case of thin film, which crystallise in a hcp phase, this result might be due to an enhancement of the dipole anisotropy moment. However, $\langle T_z \rangle$ is significantly smaller, when the local symmetry is cubic (or higher) and for an itinerant ferromagnet, as in the case for the 3d series. For the 5d, this latter argument has to be reevaluated taking into account the strong spin orbit coupling of the 5d shell, which is evidenced by the difference between the white line intensity at the L_3 and L_2 edges. Further analysis will be carried out to evaluate T_Z in order to allow a more accurate evaluation.

Table I

	$\langle L_z \rangle$	$2\langle S_z \rangle$
Theory	0.054	0.260
$CoPt_3$	0.03 ± 0.01	0.37 ± 0.04 ($\langle T_z \rangle = 0$)
$Co_{80}Pt_{20}$	0.08 ± 0.02	0.52 ± 0.04 ($\langle T_z \rangle = 0$)



$L_{2,3}$ absorption edges of Pt (normalised to a ratio of 2:1 in the step after the edge) in $CoPt_3$ simple crystal (left panel) and $Co_{80}Pt_{20}$ thin film (right panel). The XMCD signal (i.e. the difference in absorption for right and left circularly polarised X-Rays) has been corrected for the rate of circular polarisation (90%). Note the sign of the XMCD signal shows a ferromagnetic coupling between the 3d and 5d spin moments. Raw experimental data are shown.