X-RAY MAGNETIC CIRCULAR DICHROISM UNDER HIGH MAGNETIC FIELD

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Keywords: X-ray spectroscopy, circular polarization, magnetism

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X-ray Magnetic Circular Dichroism (XMCD) spectroscopy is a well-established experimental tool to study the microscopic origin of magnetism allowing one to determine separately spin and orbital magnetic moments of each element in both amplitude and direction. So far, XMCD has been extensively used to investigate mainly ferro- or ferrimagnetic materials, and only very few studies have been performed on paramagnetic compounds. This is partly because a sufficiently high magnetic field for magnetizing paramagnetic or antiferromagnetic materials was not available at synchrotron facilities. Fields of 1 – 2 T are generally used for conventional XMCD experiments, and even the highest field using a large superconducting magnet has been limited to 10 T.

In this presentation we describe first a new experimental set-up dedicated to high field XMCD measurements that has been recently installed at the ESRF beamline ID12. Static magnetic field of up to 17 Tesla is generated by a superconducting solenoid. The sample is mounted on a cold finger of a He constant flow cryostat allowing to vary the temperature from 2.2 K to 300 K. Spectra are measured using total fluorescence yield detection mode with a Si photodiode mounted on a liquid nitrogen shield of the magnet.

Performances of this set-up are illustrated with results of thorough XMCD studies of a variety of magnetic systems:

- Metamagnetic phase transitions under high magnetic field have been studied in antiferromagnets with large magnetic anisotropy like $PrCo_2Ge_2$ and $CeRu_2Si_2$;
- The existence of an intrinsic magnetic moment in gold nanoparticles grown onto naturally thiol-containing proteinatious archaeal surface layer has been evidenced by XMCD at the Au $L_{2,3}$-edges;
- Curie and van Vleck magnetic susceptibilities have been measured on paramagnetic insulators ($Gd_3Ga_5O_{12}$ and $Eu_3Ga_5O_{12}$) using an intense XMCD signal at the L-edges of the rare-earth.