Successful Operation of Noble Equipment for Magnetic Compton-Profile Measurements at the BL08W

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Critical tests on the installed equipment for magnetic Compton-profile (MCP) measurements have been made at the beamline BL08W. It was verified that the instruments mentioned below have reliable capability as was expected.

(1) A 3-tesra Superconducting Magnet

A maximum magnetic field ±3 T could be generated with a current of ±79 A, and the sign of the magnetic field could be altered within 5 s from +3 to −3, or vice versa. It took about 3 days to precool the cryostat by using a cryocooler, which is directly combined with the cryostat for the purpose of the steady recondensation of evaporated He gas. Due to a recondense system of liquid He, the magnet was found to be completely free from maintenance of liquid He over one month. It was found that sufficient cooling water should be supplied to a power generator to produce AC-like 3T magnetic fields.

The magnet was placed on a xyz stage, which was regulated by a pulsed-motor drive controller.

(2) A 10-Kelvin refrigerator for sample cooling

It is highly required to cool a sample down to low temperatures to detect the temperature dependence of its magnetic properties. A two-stage GM type refrigerator operated with He-gas circulation was inserted in a room-temperature bore of the 3T superconducting magnet. A cold finger between a cold spot and a sample holder is 330 mm in length, and is composed of a metal tube so that the x-rays penetrating the sample should not be scattered in the refrigerator. It was found that the lowest temperature at the sample holder was 8 K, even a 3T magnetic field was repeatedly switched to −3T in 5 s. A temperature of a sample could be regulated at a desired temperature between 8K and room temperature.

(3) Magnetic Compton-profile measurement using SSD

In order to test the overall reliability of the equipment, directional MCPs of hcp-Co have been measured with a combination of 274-keV x-rays having Pc=0.6, the 3T superconducting magnet, the 10K refrigerator and a pure Ge SSD (EURISYS MESURES; EGPC 30-185-R) having an energy resolution of 0.85 keV at 276 keV. The sample was a disk with 10 mm in diameter and 2mm in thickness. The incident x-rays impinged on the side of the disk. Two MCPs along ΓM and ΓK were measured, and compared with theoretical ones calculated by means of the APW method. The agreement between the experiment and theory is fairly well. The overall momentum resolution was 0.64, which was entirely restricted by the energy resolution of the SSD.

In order to improve the momentum resolution and counting efficiency, it is highly necessary to prepare a 10-segmented SSD system having a better energy resolution and reasonable counting efficiency in an energy region above 100 keV.