

Magnetic Measurement Test Stand for Insertion Devices (Undulator, Wiggler)

Hall probe and coil measurement systems

The magnetic measurement room, MM1, has two granite measurement benches installed, one 3-m long and the other 7-m long. Both benches are equipped with Hall probe, traveling short coil, and stretched coil measurement systems. There is remote three-axis positioning capability for the Hall probes (Fig. 1); in addition, the Hall probes are mounted on a goniometer that allows the plane of the Hall probe to be rotated about one axis and tilted about a perpendicular axis. A recent (2010) upgrade in the mechanical systems resulted in 0.5- μm linear resolution and 0.005° angular resolution in the Hall probe positioning. The Hall probe is read with 23 bits of resolution and the coil with 16 bits. Coordination in time between the linear positioning and readout is 25 nsec.

Point-by-point field measurements are made using a two-axis Hall probe (from SENIS) that has high accuracy, high spatial resolution, and is temperature compensated. It has a sensitivity of 5 V/T ($\pm 0.1\%$ at 1 T field) at room temperature. The ambient temperature in MM1 is held at 74° F during magnetic measurements.

A 150- μm -diameter Cu-Be wire is stretched between end holders to make the coil utilized for field integral measurements. Cu-Be is strong, so the tension on the wire can be high to minimize sag. The width of the coil can be adjusted using the end holders (Fig. 2). If the ends are adjusted differently, the coil can be triangular or figure-8 shaped.

The measurements that can be made with the coil and Hall probe measurement systems are:

- Point-by-point field map of an undulator or electromagnet, with an accuracy of ± 0.01 G
- First and second field integrals, with a reproducibility of ± 1 G-cm or ± 0.1 kG-cm²
- Integrated multipole moments

Helmholtz coil measurement system:

The Helmholtz coil measurement system (Fig. 3) is utilized for measurement of the magnetic moment of a permanent magnet block for an undulator. The pair of identical 26-in.-diameter coils is separated by 13 in. Each coil has 392 turns. The magnet block is inserted in a holder at the center of the coil pair; the motor that rotates the magnet block is at the end of a long shaft to minimize noise in the measurement.

Hall probe calibration system:

A nuclear magnetic resonance spectrometer (Fig. 4) is used to calibrate the Hall probes, both at room temperature and, for the probes that will be used at cryogenic temperatures for measurements of the superconducting undulator, over the range from 4.2 K to 320 K. A miniature cryostat is used for calibration at cryogenic temperatures. The field range for calibrations is ± 2 T. The Hall probe is mounted on a goniometer so it can be aligned during calibration.

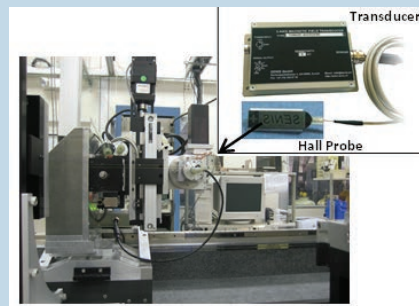


Fig. 1

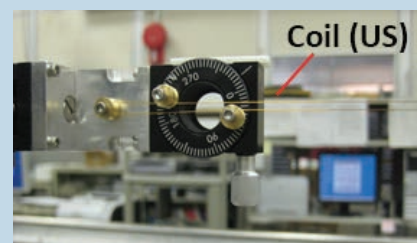


Fig. 2

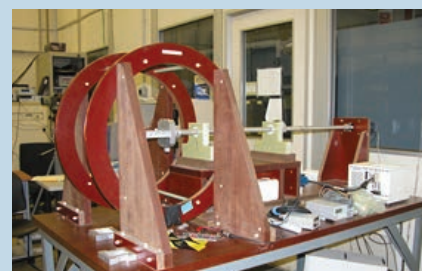


Fig. 3

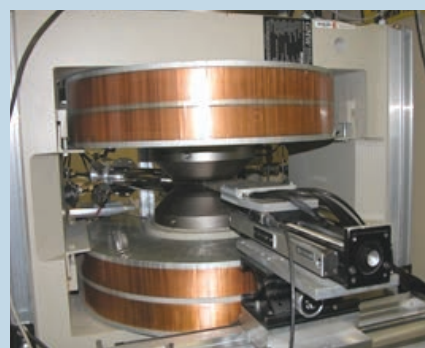


Fig. 4