HALL PROBES

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David Beltran from IFAE reported on a measurement system which used Hall probes to give high precision measurements over a large volume. The test bench was made with a large granite block placed on a vibration isolated floor. A set of stages moved a Hall probe through a volume of 500 x 250 x 3000 mm^3 with a precision of 50 microns. The stages could be programmed to move the Hall probe along a curved path such as a beam trajectory. The Hall probe was made by Sentron. It was a 3-D probe to measure the three components of the field. The probe was placed in a temperature controlled enclosure. The probe was calibrated with an NMR. The accuracy of the measurements is around 2x10^-4 for fields around 1 Tesla.

Felix Bergsma from CERN described a 3-D calibration system for Hall probes. The probes are rotated in both phi and theta (spherical coordinates) in a uniform magnetic field. The probe response is expanded in spherical harmonics. The expansion coefficients are used to calibrate the probe. This method accounts for the planar Hall effect and other smaller effects of the probe being in different orientations in the field. Using this technique, calibrations are done to 1 part in 10^4 for any field direction. This appears to be an excellent system for calibrating 3-D probes.

Inessa Bolshakhova from the Magnet Sensor Laboratory in Lviv talked about Hall sensors capable of withstanding extreme conditions. In particular, by using appropriate materials, her group built Hall probes that can withstand high radiation environments with only a small loss in sensitivity. Her laboratory also builds Hall probes that perform self-diagnostics. A small solenoid is encapsulated with the probe and is used to monitor probe sensitivity.

Doug Evans from Triumf described Hall probe measurements in a large superconducting solenoid. The measurements were initially done at low current and seemed to indicate problems with the solenoid. The solenoid was taken apart and indeed had loose and missing parts. Future measurements on the repaired solenoid are planned.

Federico Roncarolo from CERN talked about re-mapping the LEP spectrometer dipole. The field integral of this magnet and the deflection angle of the beam are used to determine the beam energy. Very high accuracy is thus required. The magnet was initially measured in 1998. The new measurements were compared with the original measurements. The measurements agree to 7x10^-5.

Fabien Patru from CERN talked about dynamic measurements in LHC dipoles. He explained how the contact resistance between strands in the superconducting cable causes energy loss in the magnet. The energy put into the magnet on an up ramp and the energy extracted from the magnet on the down ramp are subtracted to get the energy loss. The energy loss is studied as a function of ramp rate. The twist pitch and strand contacts of the superconducting cable also make local field distortions. These were studied using different techniques, including Hall probes.

Branko Berkes of MCS, Magnet Consulting Services, gave a talk on the effect of field gradients on Hall probe measurements. In a field gradient, different parts of the Hall generator are in different magnetic field strengths. This causes magneto-resistance variations over the Hall generator, giving errors in the field measurement. This effect had been studied theoretically many years ago and had recently been studied experimentally by Mr. Kvitkovic. This work shows us that small Hall generators are more accurate in field gradients than large Hall generators. This is important to remember when measuring wigglers and the ends of dipole magnets.

Branko Berkes of MCS, Magnet Consulting Services, gave a second talk on the planar Hall effect in vertical Hall sensors. Branko did calculations of the planar Hall effect in vertical Hall sensors several years ago. Recent measurements of the effect did not agree with the calculations, however. Branko checked the calculations and found an error. The new calculations agree very well with the measurements. It was further demonstrated that if two vertical Hall sensors are used back to back, the normal Hall voltages add and the planar Hall voltages cancel. This gives a probe with very small planar Hall effect.