Insertion Device Magnetic Measurement at Sincrotrone Trieste

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- **General remarks**

The ELETTRA storage ring is a 2 – 2.4 GeV third generation synchrotron radiation source designed to include up to 11 insertion devices (IDs). The insertion device magnetic measurement laboratory has the responsibility of developing and optimising the undulators and wigglers of ELETTRA.

Up to 1997, each ID consisted of up 3 separate independent sections of 1.5 m. Since then seven new elliptical IDs were designed, constructed and installed in the storage ring : one electromagnetic wiggler (EEW) with a length of 3.3 m and six undulators (EU) (based on the APPLE-II scheme) with a length of about 2.2 m.

The old Hall plate bench with a travel range of 2.5 m was substituted with a new one of 5.5 m, able to measure an ID with a length up to the maximum possible for ELETTRA straight sections (4.5 m).

For accurate field integral measurements a stretched wire/flipping coil bench is used. In order to measure the EEW, the wire length was increased to 4.2 m (the previous length was 2.5 m)

- **Hall plate bench**

To perform accurate magnetic field measurements, it is very important to position the Hall plates (HP) with high accuracy. This is particularly true for the IDs where the magnetic field gradient can be very strong. For example in EU10 undulator we have a vertical magnetic field variation of 2 T in 5 cm.
After installation of this bench, we measured the pitch, roll, and yaw. It was found to be within specification : 20 μRad. The max longitudinal positioning error was ± 10 μm (in 5 m).
The overall reproducibility of the first and second field integral were improved with respect the measurements carried out with the old bench (in some cases an order of magnitude).
The typical reproducibility (rms) that depends on the Z travel range was : I ≈ 0.1 Gm and II ≈0.04 Gm^2

- **Hall Plate Planar effect**

The Hall plate planar coefficient can be extracted from IDs magnetic measurements. For the HP_x it was found = 4.6 10^{-8} G^{-1} (EU6, phase 0, hor. polarization). For HP_y, it was not possible to extract the term (EU6, phase 30 mm, vert. pol.). The magnetic measurements of the EUs have been carried out taking into account the planar term only for the horizontal Hall plate (HP_x). A field integral variation of about 5 Gm has been evaluated if the HP planar term is included in the calibration of the Hall plate (for EU10, gap 19 mm, phase =0).

- **Stretched wire bench.**

The stretched wire bench has a typical reproducibility (rms) of 20-30 Gmm for the first integral and 0.01 Gm^2 for the second field integral. A comparison between SW and HP measurements shows differences lower than 0.5 Gm and 0.5 Gm^2 (EU4.8 and EU6).

- **Closed orbit and magnetic measurements**

A comparison between the first and second field integral measured in lab and those measured on the electron beam at 2 GeV, referred to the center of the EEW, shows an agreement of 1 Gm and 2 Gm^2.
In order to compensate the field integral variation as a function of gap (or current) and phase we use correction coils. The cor.coils calibration shows a hor. (vert.) residual closed orbit rms error of 2 (1) μm rms.
The sensitivity of the EEW correction coils is about 15 G mm/μm rms. This means that to calibrate the correction coils in the lab we should have an *overall accuracy* of ≈ 10 Gmm.