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Magnetic Metrology of SOLEIL Synchrotron Storage Ring multipoles

SOLEIL Synchrotron is a set of 3 electron accelerators (LINAC, Booster and Storage Ring). The 354m circumference storage ring is dedicated to synchrotron radiation for fundamental and applied physics research. The most sensitive components of the Storage

Ring are quadrupoles therefore manufacturing requirements are very strict: $5 \cdot 10^{-4}$ of the gradient for magnetic field harmonics, $\pm 25 \mu\text{m}$ for magnetic axis location in the transverse plane (x,z) and $\pm 0.1 \text{ mrad}$ for magnetic roll angle orientation.

To check magnetic properties of the magnets, it was necessary to measure entities at a lower level than the specifications required by the beam dynamic: less than 10^{-4}

for harmonics, $5 \mu\text{m}$ for magnetic axis location and $2 \mu\text{rad}$ for magnetic roll angle. To

measure such low values, harmonic coils method was chosen with the use of printed circuit technology for sensitive coils. There were 160 quadrupoles to measure.

It means that measurements were to be very durable which implies an accurate manufacturing of the bench, especially of the sensor. That is why the mechanical structure of the bench sensor has been particularly elaborated.

To check the manufacturing quality, a quadrupolar permanent magnet has been manufactured. This magnet is a reference and was used to quantify all imperfections of

the bench like sag effect, positioning and orientation errors of the sensitive coils.

Such a magnet is easy to handle and can be measured in several positions (8) thanks to its mechanical octagonal interface. This type of mechanical interface permits us to

know imperfections by making only a few amount of swing measurements which do not require absolute knowledge of the magnetic field produced.

The presentation will describe the SOLEIL Multipolar Magnetic Measurements Bench (SMB) and the way taken to avoid manufacturing errors effects. Finally, some figures about performances of the bench will be given to show the low level of residual positioning and angular offsets obtained after shims adjustments.

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