STATUS OF MAGNETIC MEASUREMENT BENCHES FOR INSERTION DEVICE CHARACTERIZATION AT MAX IV LABORATORY

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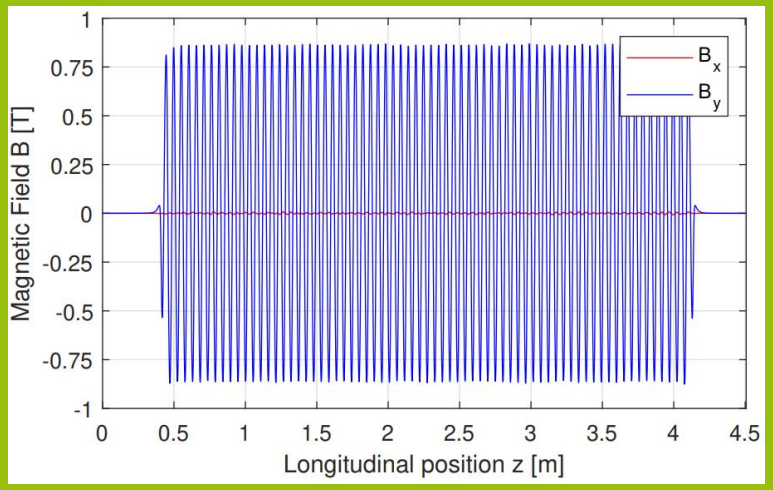
Introduction

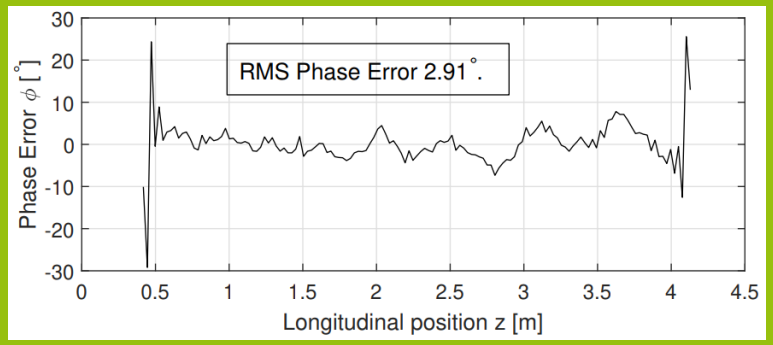
- Insertion Devices are the sole source of radiation at MAX IV.
- An ID laboratory was founded to develop the technology.
- 6 APPLE-II EPUs were constructed in-house at the ID lab.
- Magnetic measurement systems also developed in house to characterize the various types of IDs available.

Hall-Probe Mapper Bench

- The heart of the ID lab, and used to obtain local magnetic field maps.
- Relies on a low-noise Hall-sensor, moving very accurately in space.

Example field scan and ID phase error



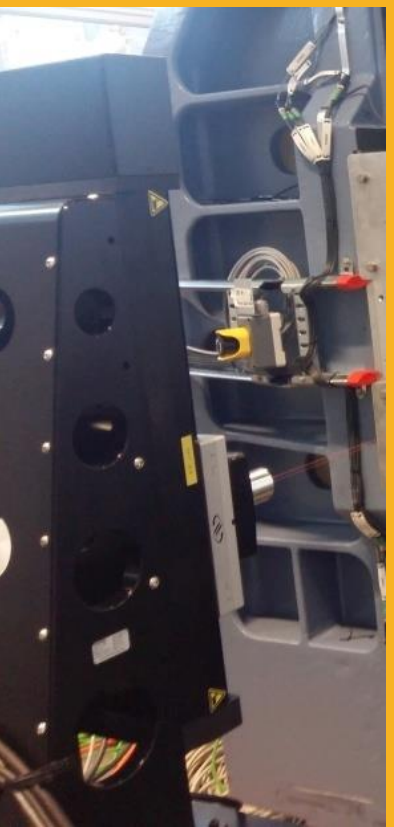


Hall-probe system precision for measuring ID parameters shows excellent repeatability

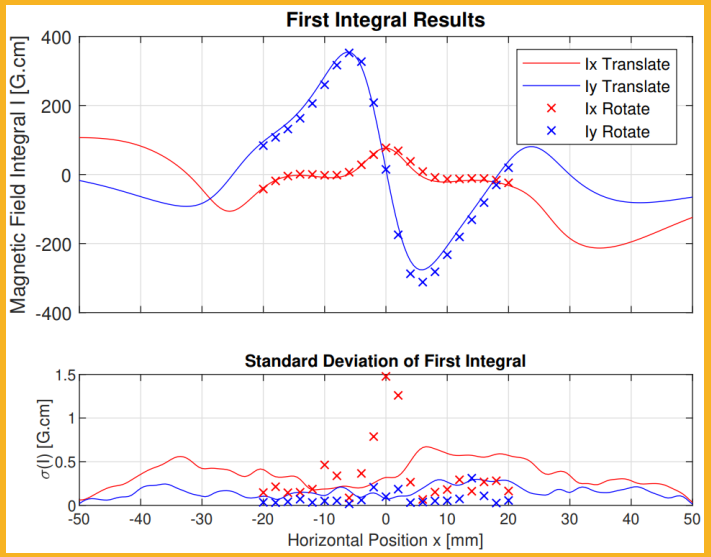
Parameter	Value	STD	STD/Value
Peak Field	0.772 T	16.1 μT	20.9 ppm
Effective Field	0.781 T	12.7 μT	16.3 ppm
Effective K	3.863	68.8 ppm	16.3 ppm
RMS Phase Error	2.682°	0.0091°	0.34 %

Flip Coil Bench

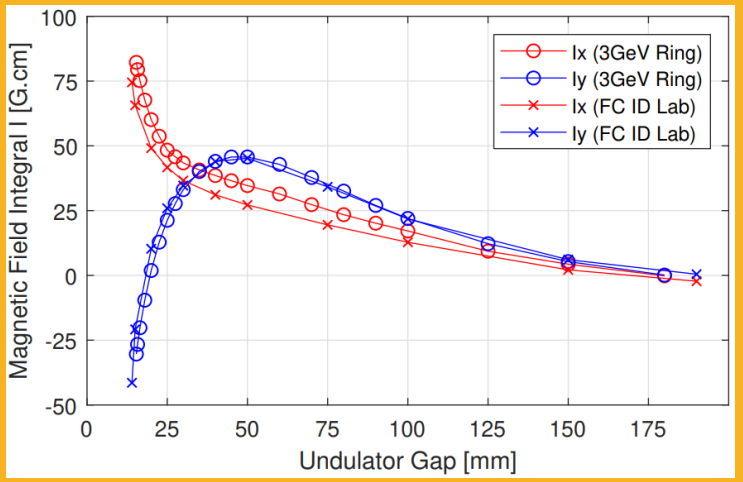
- An induction-based method to obtain magnetic field Integrals (1st & 2nd).
- Relies on a multi-turn coil of wire and a nano-voltmeter integrator.
- Can be very precise (repeatable).



Can operate in both “Translate” and “Rotate” modes, both give consistent results with low random errors

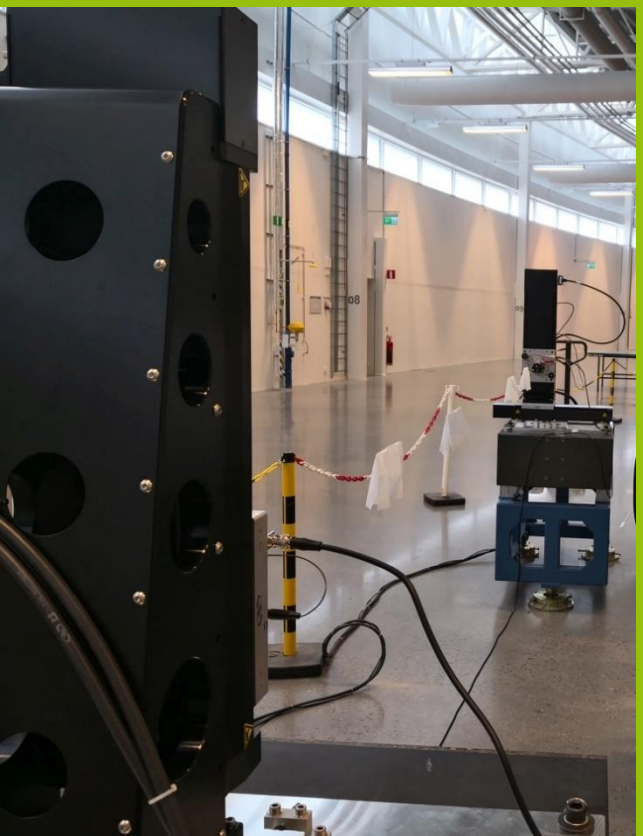


Comparing Flip Coil measurements to e-beam based ones from the 3 GeV ring show excellent agreement



Stretched Wire Bench

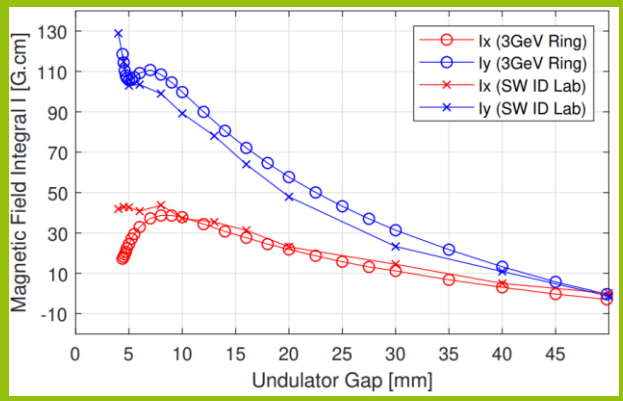
- An induction-based method to obtain magnetic field Integrals (1st & 2nd).
- Relies on a single wire and a nano-voltmeter, suitable for small gap IDs.
- Can be very accurate (absolute measurement).



Can be used to obtain precise measurement of multipole content. Example of a skew quadrupole magnet results

Component	Value	STD
Normal Dipole	−0.61 G.cm	0.28 G.cm
Skew Dipole	−5.19 G.cm	0.31 G.cm
Normal Quadrupole	1.66 mT.m/m	10.8 μT.m/m
Skew Quadrupole	125.7 mT.m/m	14.2 μT.m/m
Normal Sextupole	15.5 unit	0.24 unit
Skew Sextupole	−3.54 unit	1.26 unit
Normal Octupole	1.92 unit	0.44 unit
Skew Octupole	−2.65 unit	0.50 unit
Normal Decapole	109.4 unit	0.18 unit
Skew Decapole	−11.7 unit	0.49 unit
Normal Duodecupole	20.91 unit	0.23 unit
Skew Duodecupole	500.0 unit	0.31 unit
Hor. Magnetic Center	41.4 μm	2.2 μm
Ver. Magnetic Center	−4.3 μm	2.0 μm

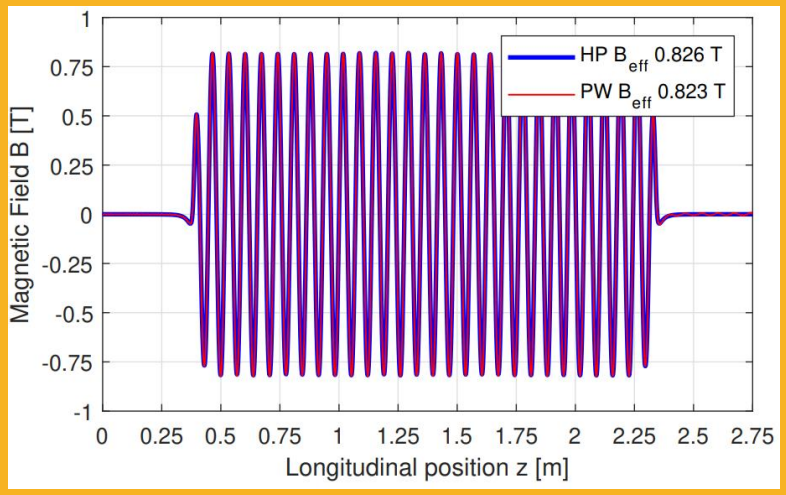
Comparing Stretched Wire measurements to e-beam based ones from the 3 GeV ring show excellent agreement

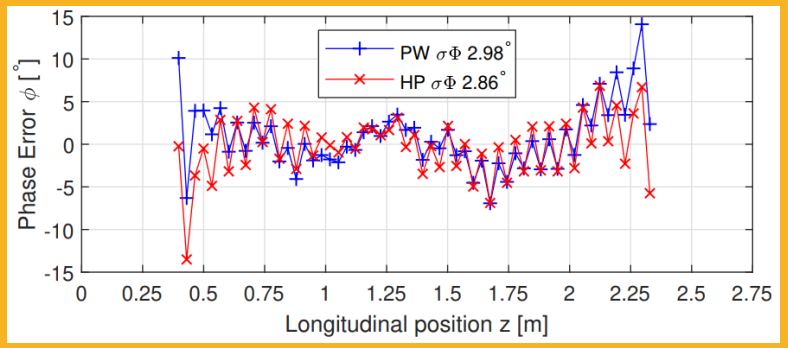


Pulsed Wire Bench

- A promising method for obtaining local magnetic field measurements.
- Creates wire oscillations by sending a current pulse, magnetic field is calculated from analysing the oscillations detected at one point.
- Still in-development, but preliminary results are very promising.

Comparing pulsed wire measurements against Hall-probe ones shows excellent agreement in magnetic field, effective field and phase error.





Thank You

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