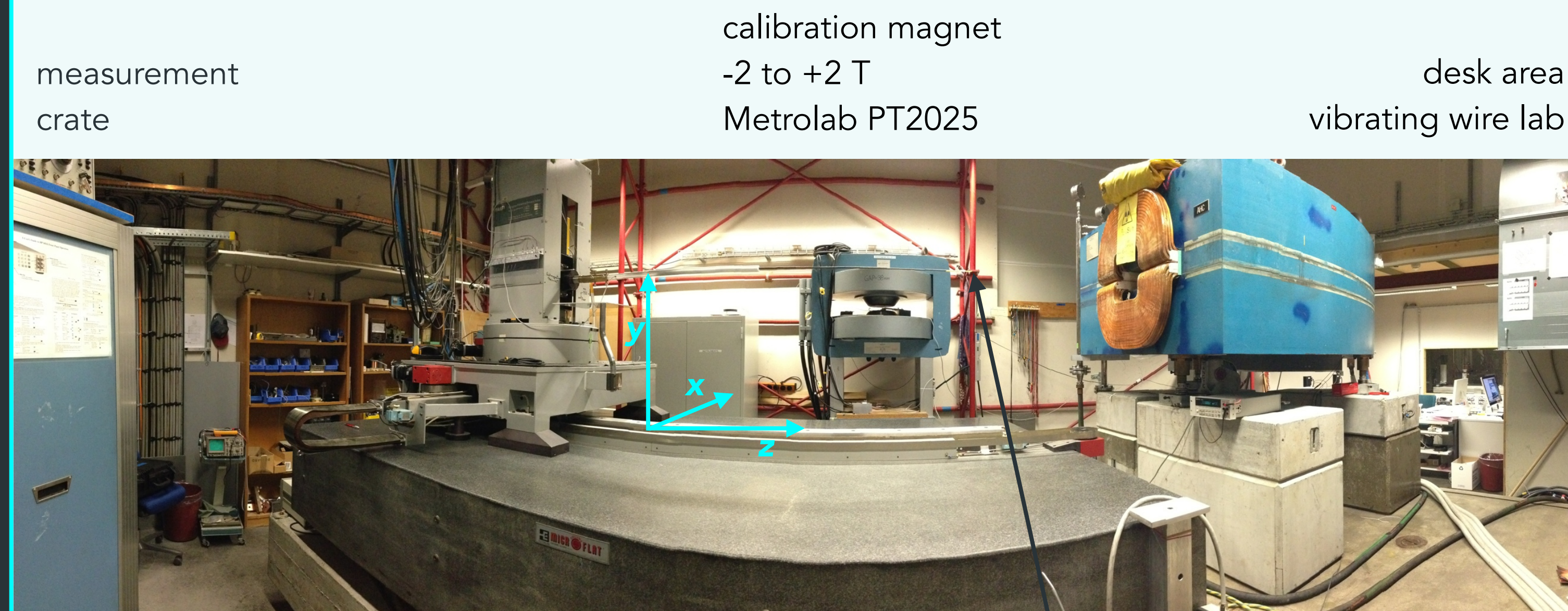


Accurate 3D Field Mapping of an Iron Shielded Split Coil Spectrometer Magnet

V. Vranković, C. Wouters, P. Chevtsov, and Z. Salman

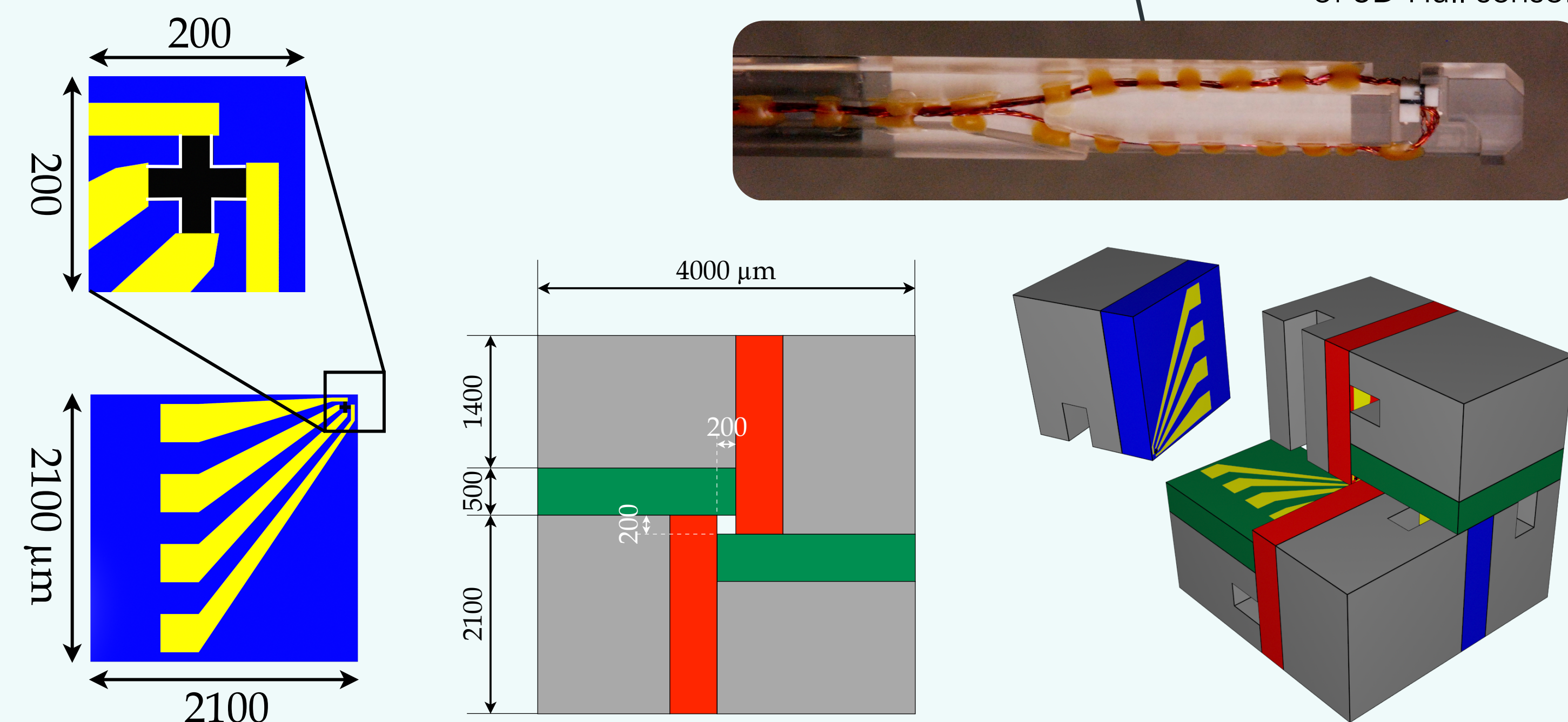
Upgrade of PSI's Hall probe measurement bench: 1D to 3D



HP magnet measurement machine

5-axis
position detection 0.5 μm
z-axis 2100 mm
"on-the-fly"

prototype of PSI
developed new type
of 3D Hall sensor



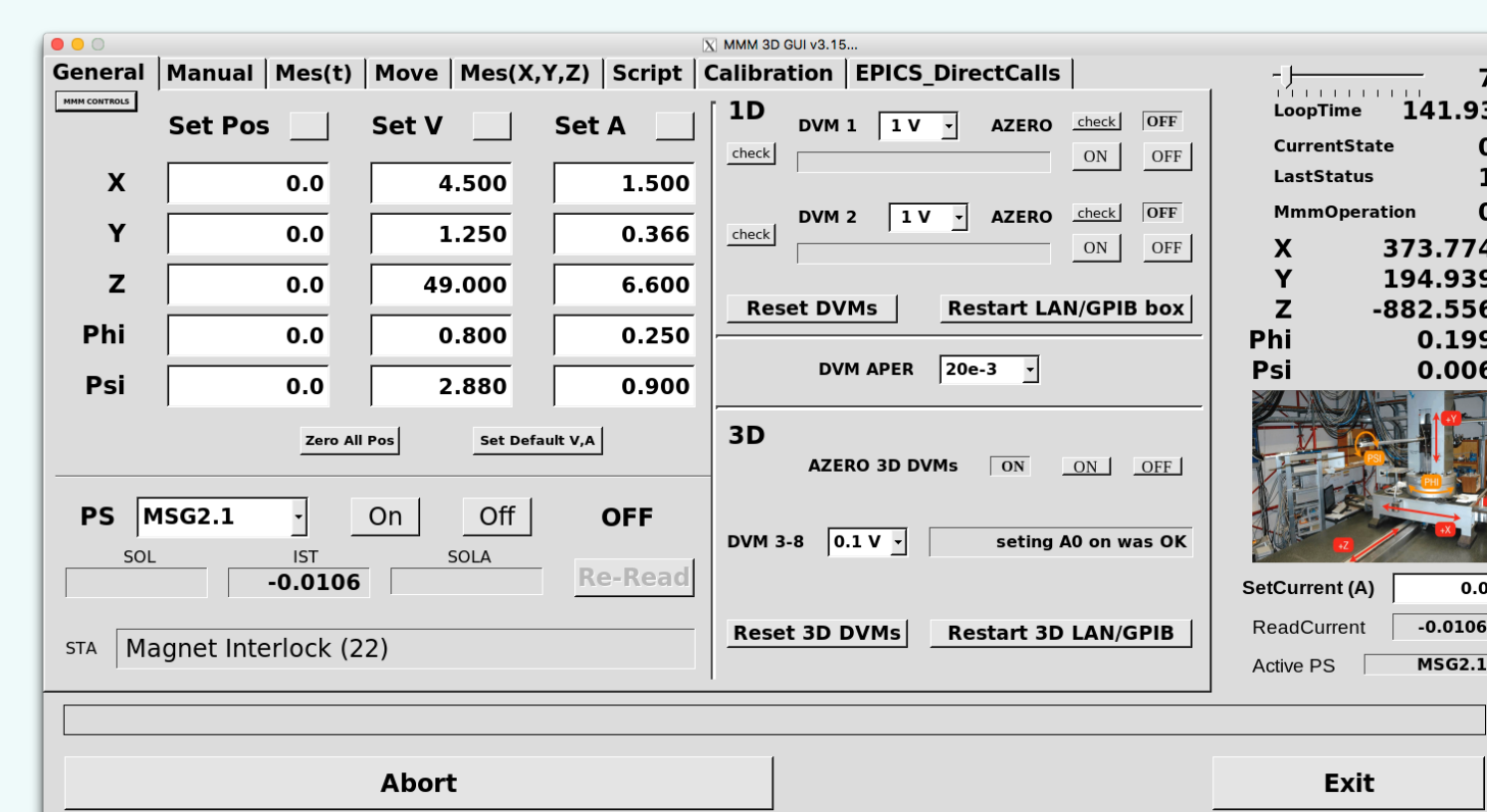
Sketched 3D Hall sensor images reproduced from [1]

Upgrade with in-house developed 3D Hall sensor ("Hallcube")

- 6 Hall plates encapsulated in a cube with a volume of a mere (200 μm)³
- Plate pairs enhance accuracy (double readings), compensate the planar Hall effect as well as induction loops
- Magnetic field vector is found at cube center, i.e. in a single point in space and time

Soft- and hardware upgrade

V_H : HP/Agilent/Keysight 3458A
 I_H : Keithley 6221 (0.1 mA, prototype)
Sensirion temperature sensor
Metrolab PT2025 + NMR probes
SmarAct SR2013-S-NM piezo-rotators
EPICS control system and Qt user interface [2]



[1] C. Wouters, V. Vranković, C. Rössler, S. Sidorov, K. Ensslin, W. Wegscheider, C. Hierold, Design and fabrication of an innovative three-axis Hall sensor, Sens. Actuators A A237 (2016) 62–71.

[2] P. Chevtsov et al. Advanced process control tool for magnet measurement at PSI, ICALEPS 2017 in preparation.

Measurement setup WEW

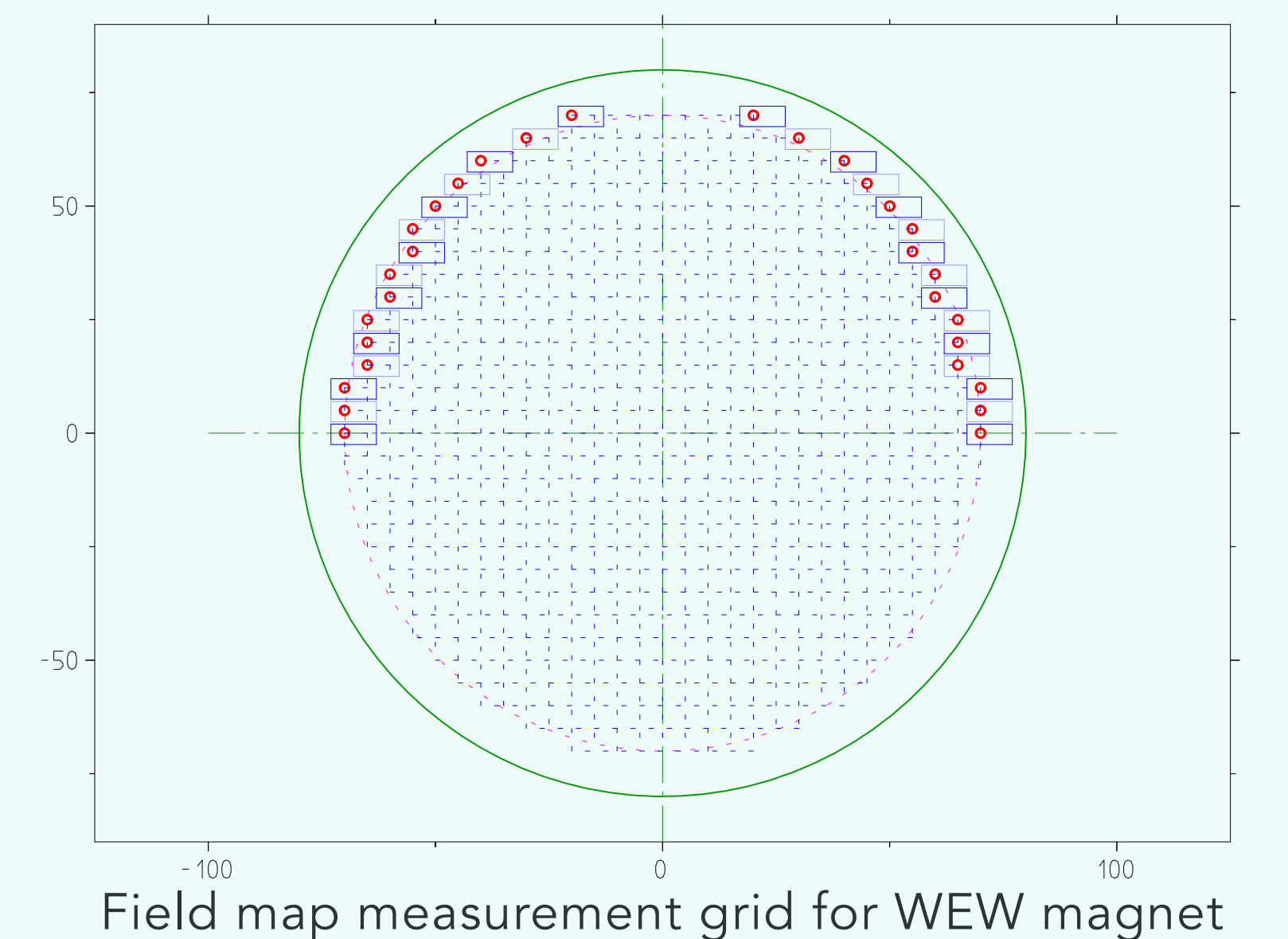
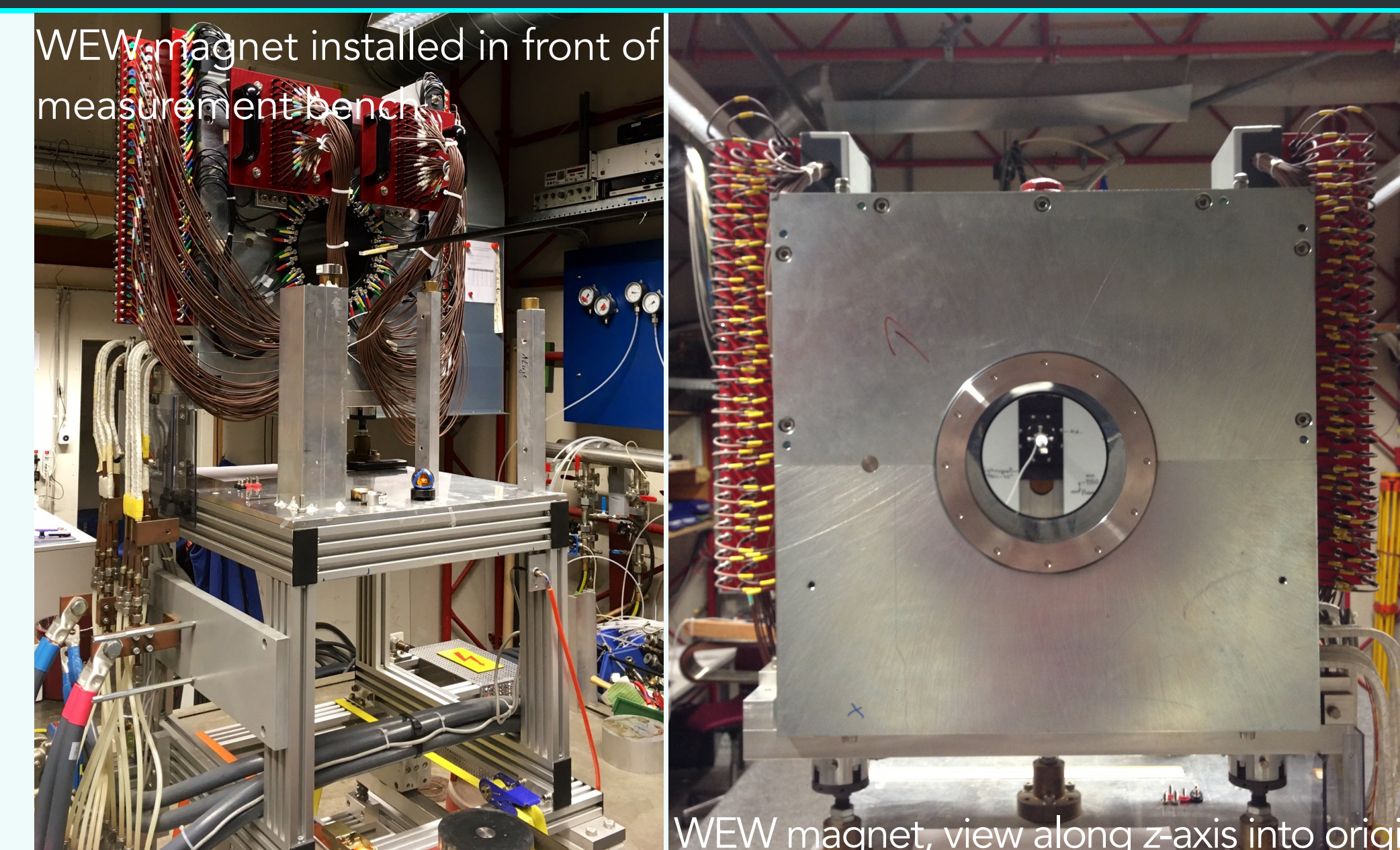
WEW split coil spectrometer magnet

Coil radius: 114 mm (inner), 211 mm (outer)
72 turns per coil, $I_{\text{max}} = 600 \text{ A}$
Magnet alignment: FARO arm

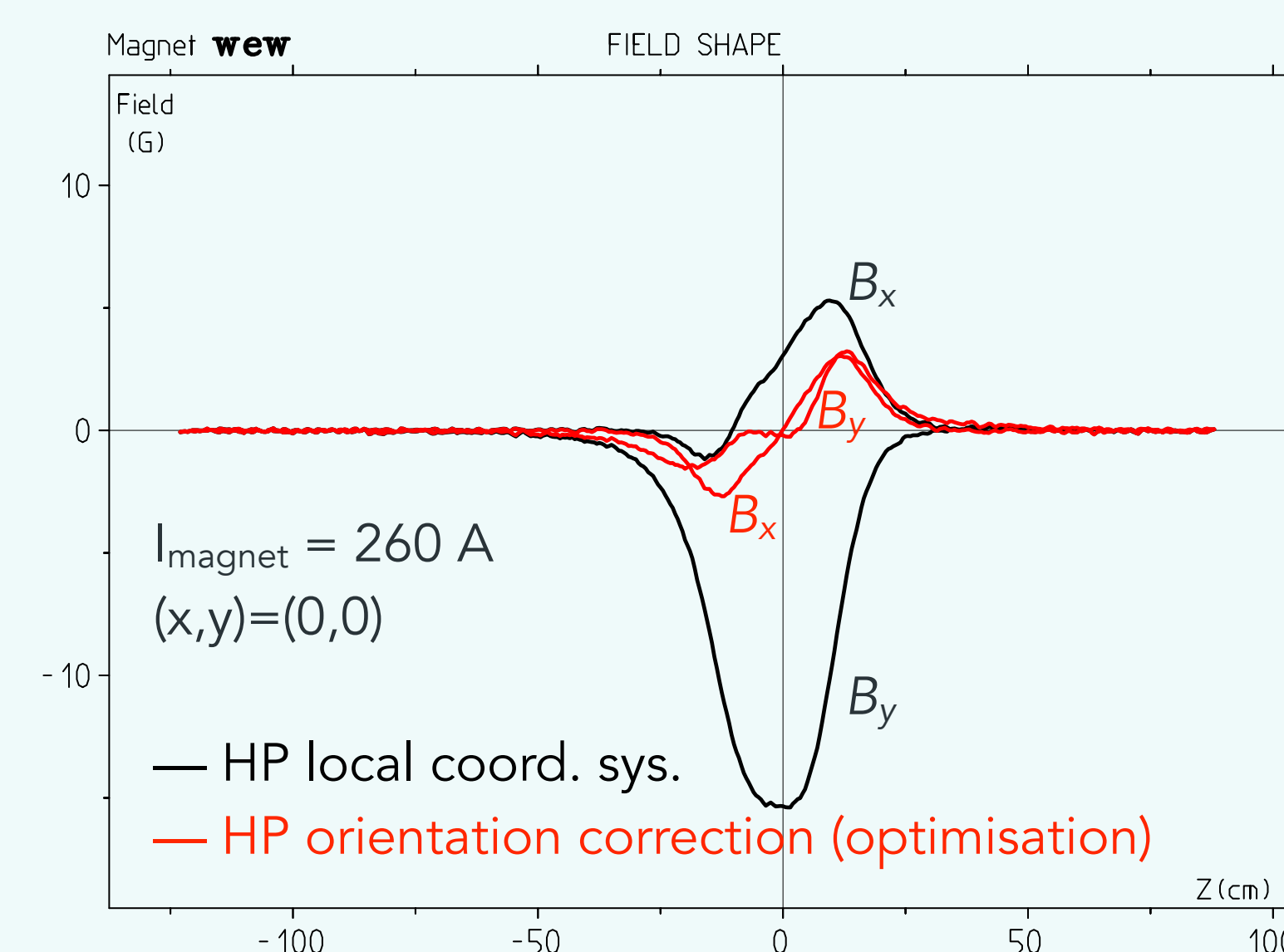
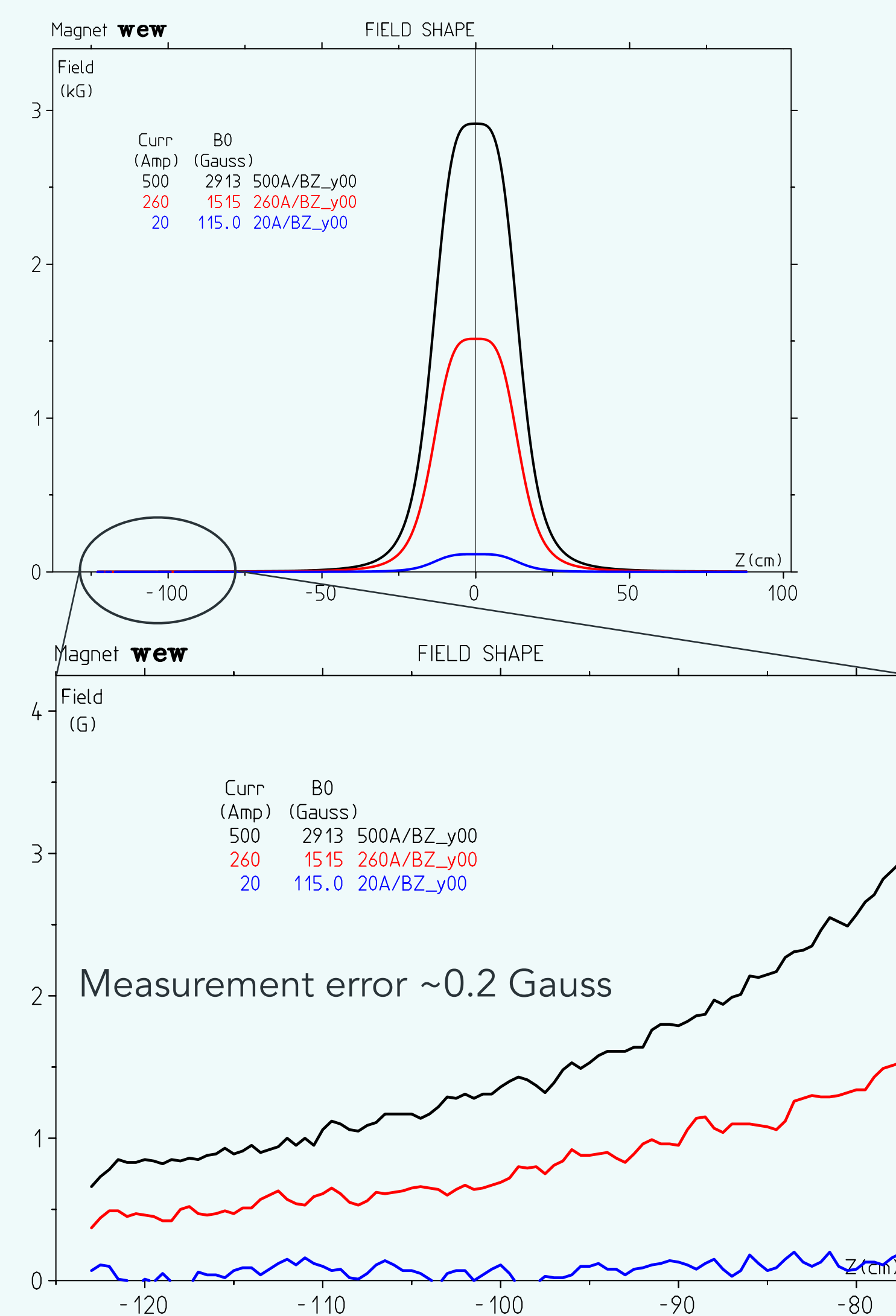
Measurement of full volume

HP positioning with permanent magnet reference tool, HP orientation by eye
For 3 magnet currents: 20, 260, and 500 A
On-the-fly: 50 mm/s along z
Each line measured in forward and backward direction: average
Each line measured at +I and -I: subtract

WEW magnet installed in front of measurement bench



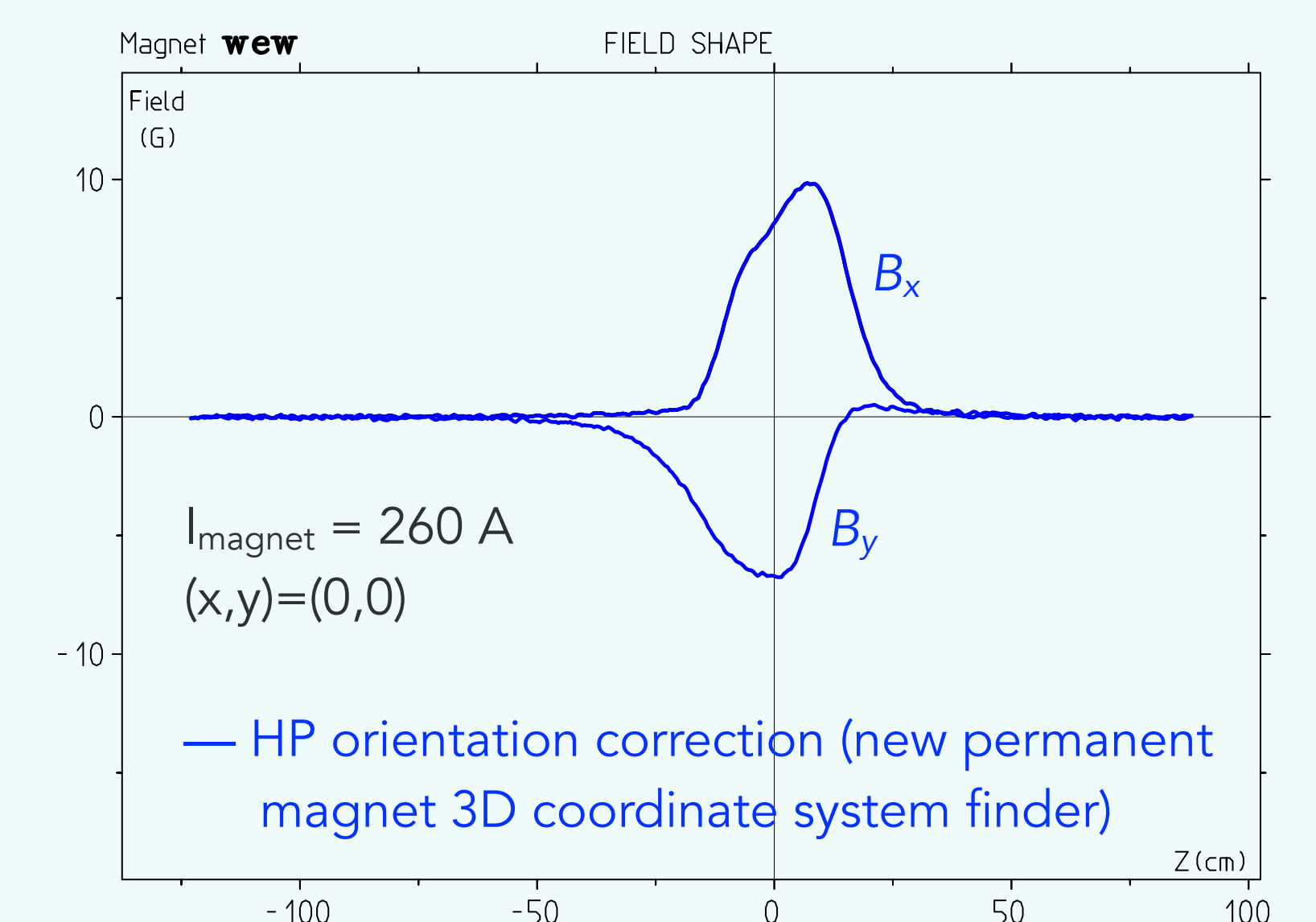
Measurement results



Mathematical correction for Hall plates' orientation

Optimised by minimising $B_x(z)$ and $B_y(z)$ at $(x,y) = (0,0)$

yaw = -0.114
pitch = -0.573
roll = -0.660



Correcting for Hall plates' orientation through measurement

New reference tool based on permanent magnets for finding Hallcube sensor orientation
3 months after WEW measurement completion

yaw = 0.196
pitch = -0.330
roll = -0.631

Field model

