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► To cite this version:

Cécile Daversin, Francois Debray, Jean Dumas, Romain Hild, Philippe Sala, et al.. Comparative study between in-situ measurements and a 3D efficient model for the computation of magnetic fields in High Field Polyhelix magnets. 25th International Conference on Magnet Technology, Aug 2017, Amsterdam, Netherlands. , 169, 2017. hal-01588678v1

HAL Id: hal-01588678

<https://hal.science/hal-01588678v1>

Submitted on 16 Sep 2017 (v1), last revised 21 Sep 2017 (v2)

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Comparative study between in-situ measurements and a 3D efficient model for the computation of magnetic fields in High Field Polyhelix magnets

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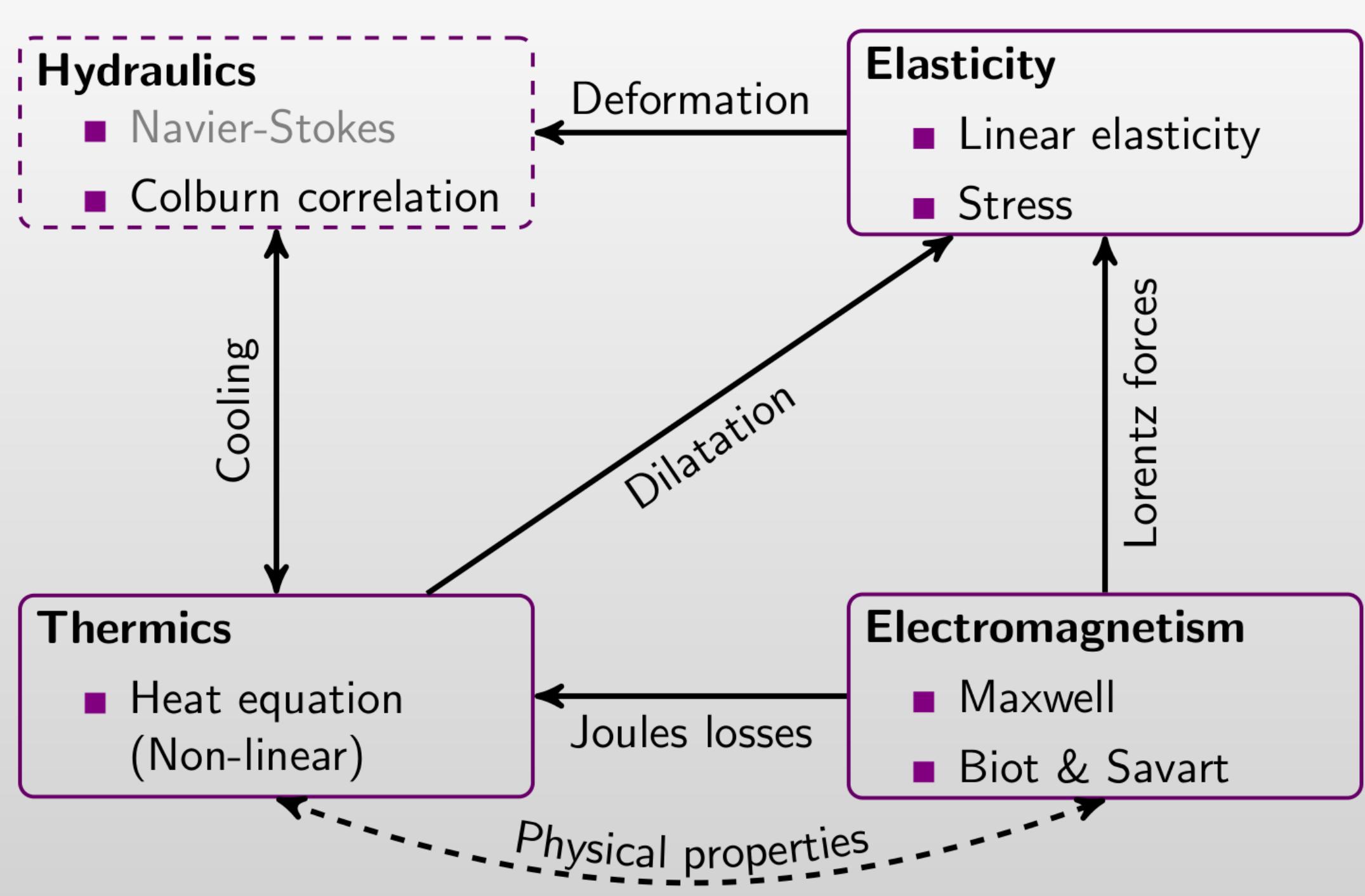
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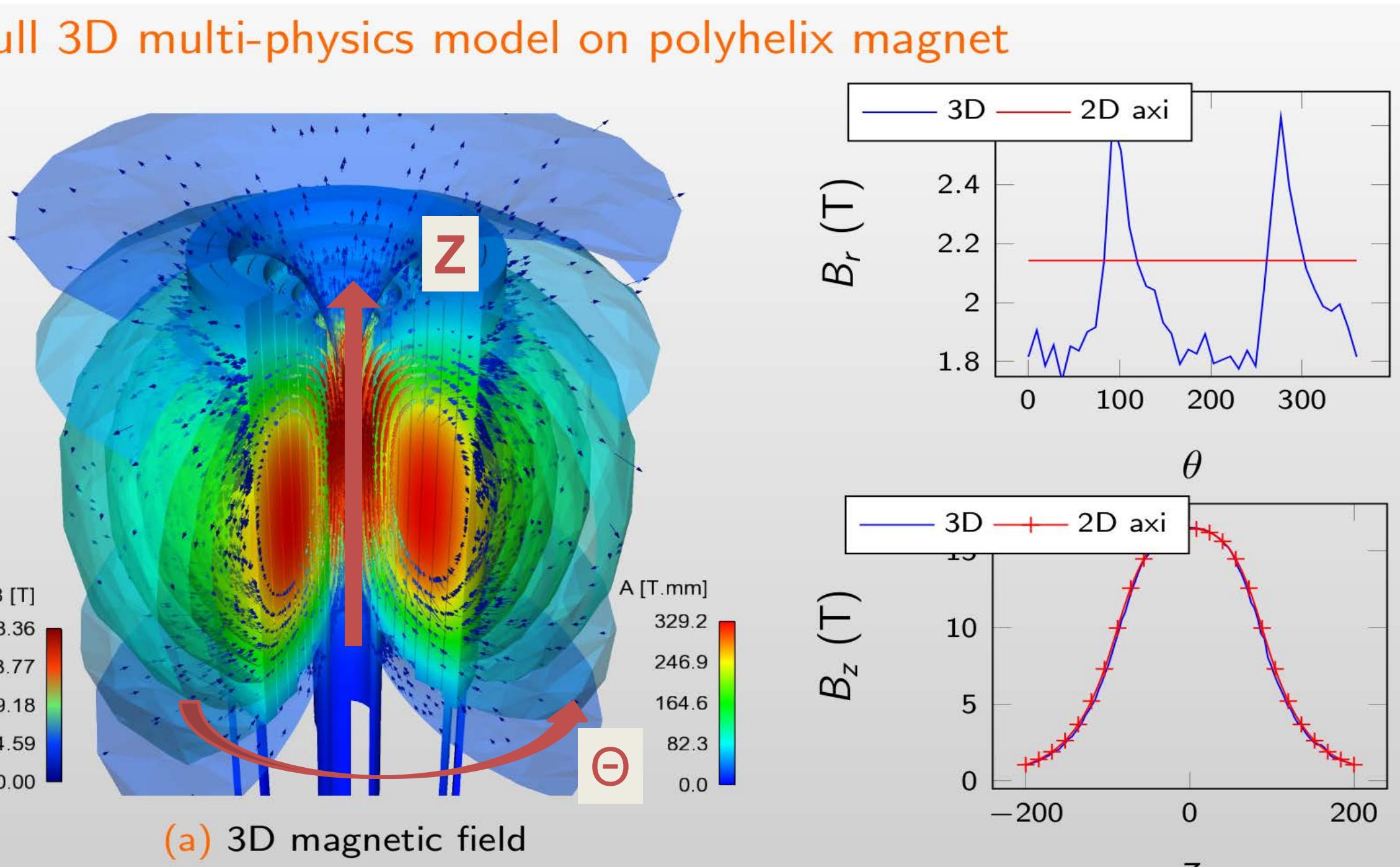
IRMA

Tue-Af-Po2 [169]

PolyHelix Magnet Modeling



- Full 3D NL Multi-Physics model**
- Use **FeeL++ C++-14** FEM library
 - ThermoHydraulics: 0D
 - **Parallel Biot-Savart** Magnetic Field
 - Automatic CAD and Meshing (**Salome**)
 - Up to 1024 procs
 - Up to $70 \cdot 10^6$ elts



Unexpected 3D B Field profile observed in calculation

Elements: 27 10⁶
Cpus: 48 procs
Time: 1640s
Mem: 785 Gb

Objectives

Confirm the 3D effects predicted

- Validate Numerical Model(s)

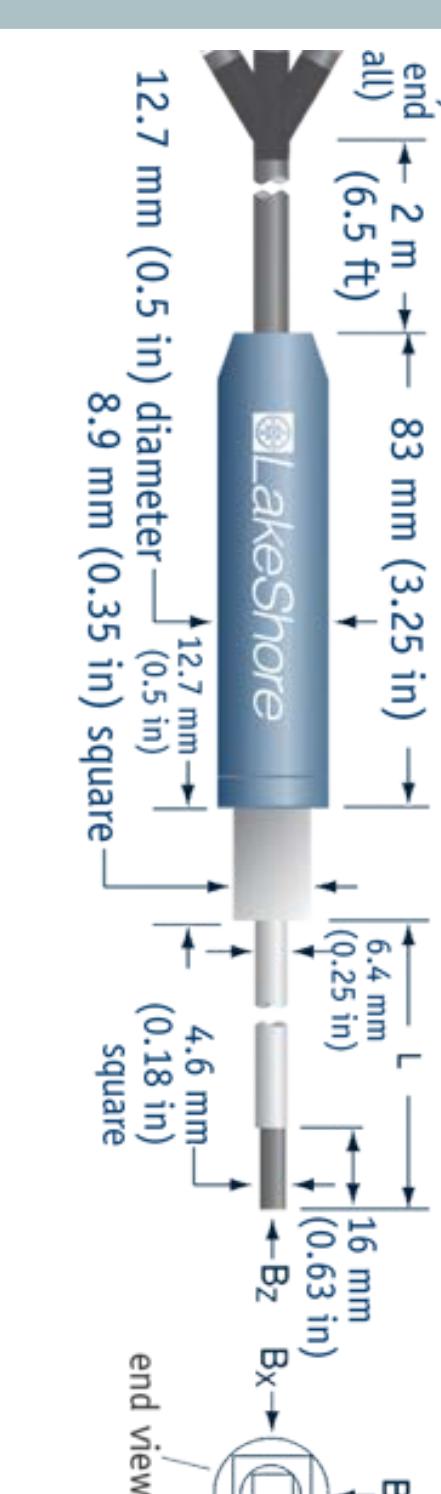
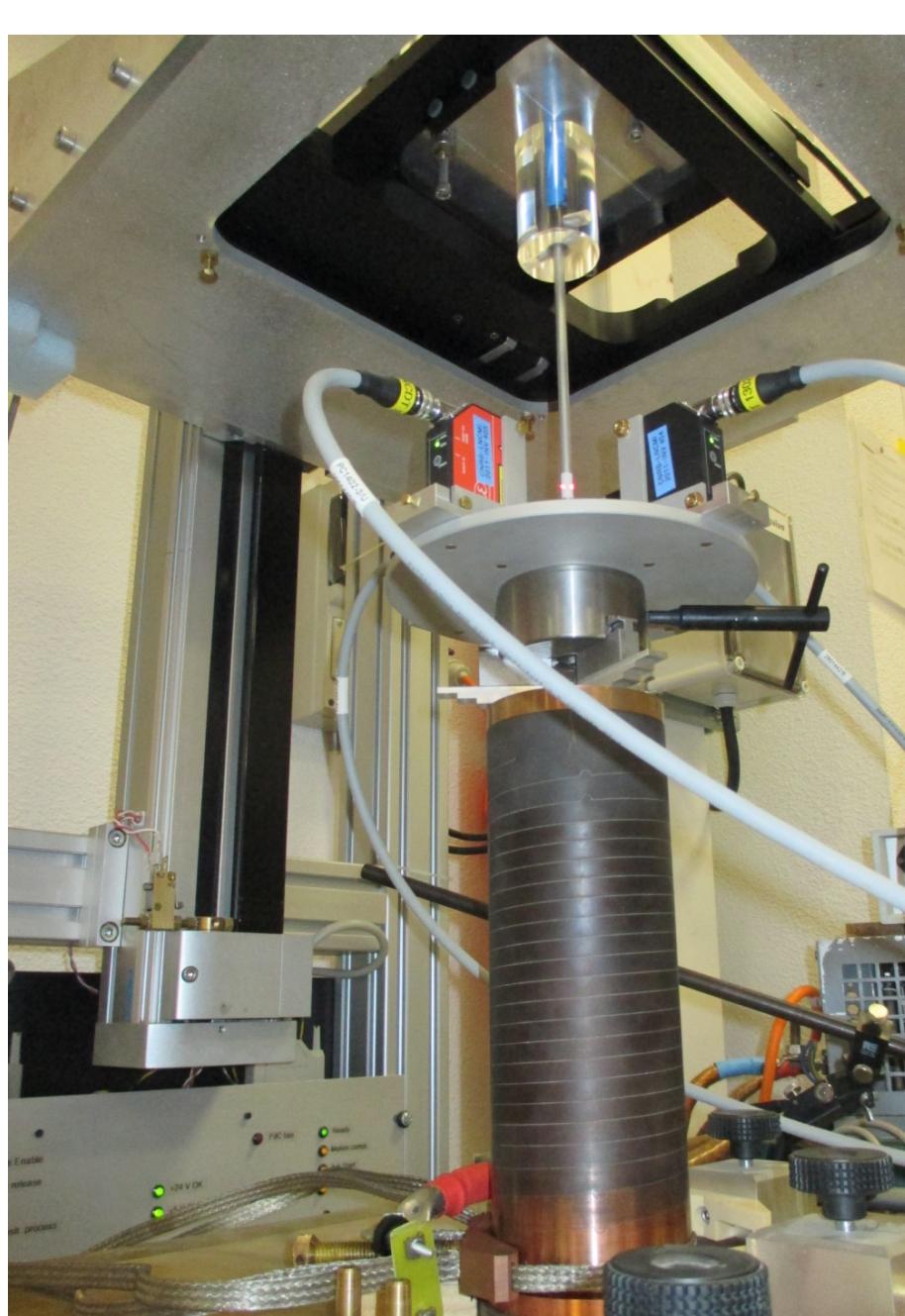
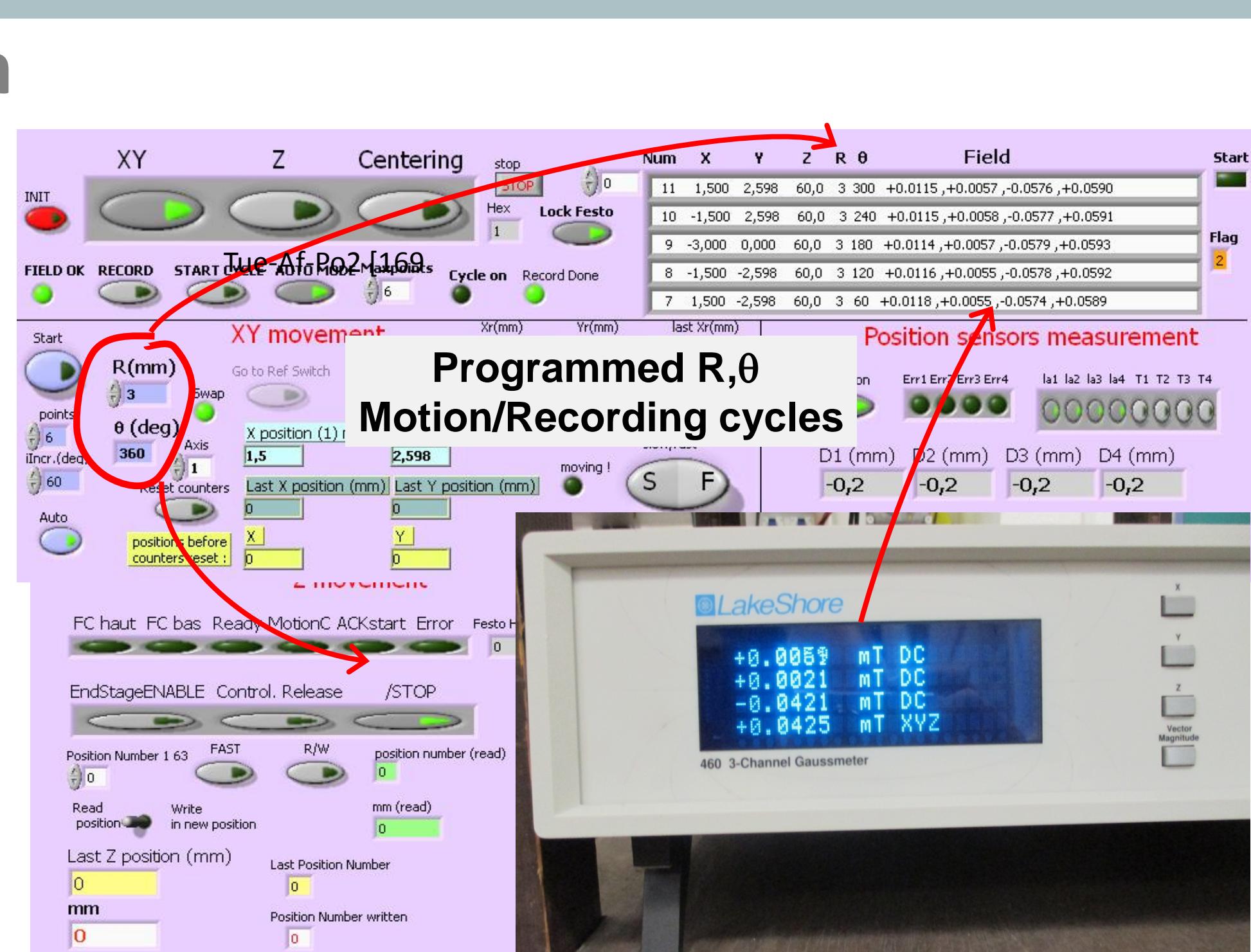
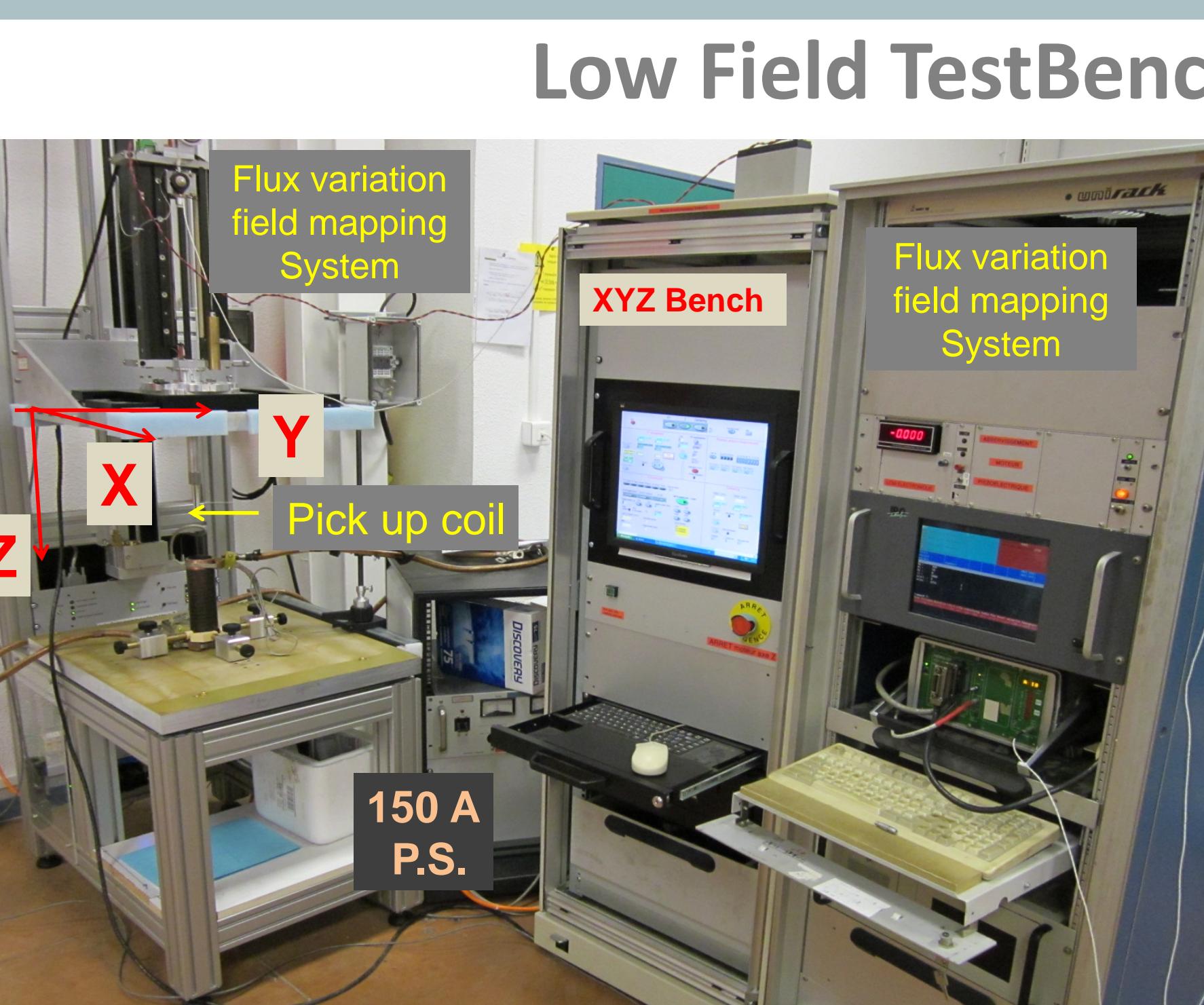
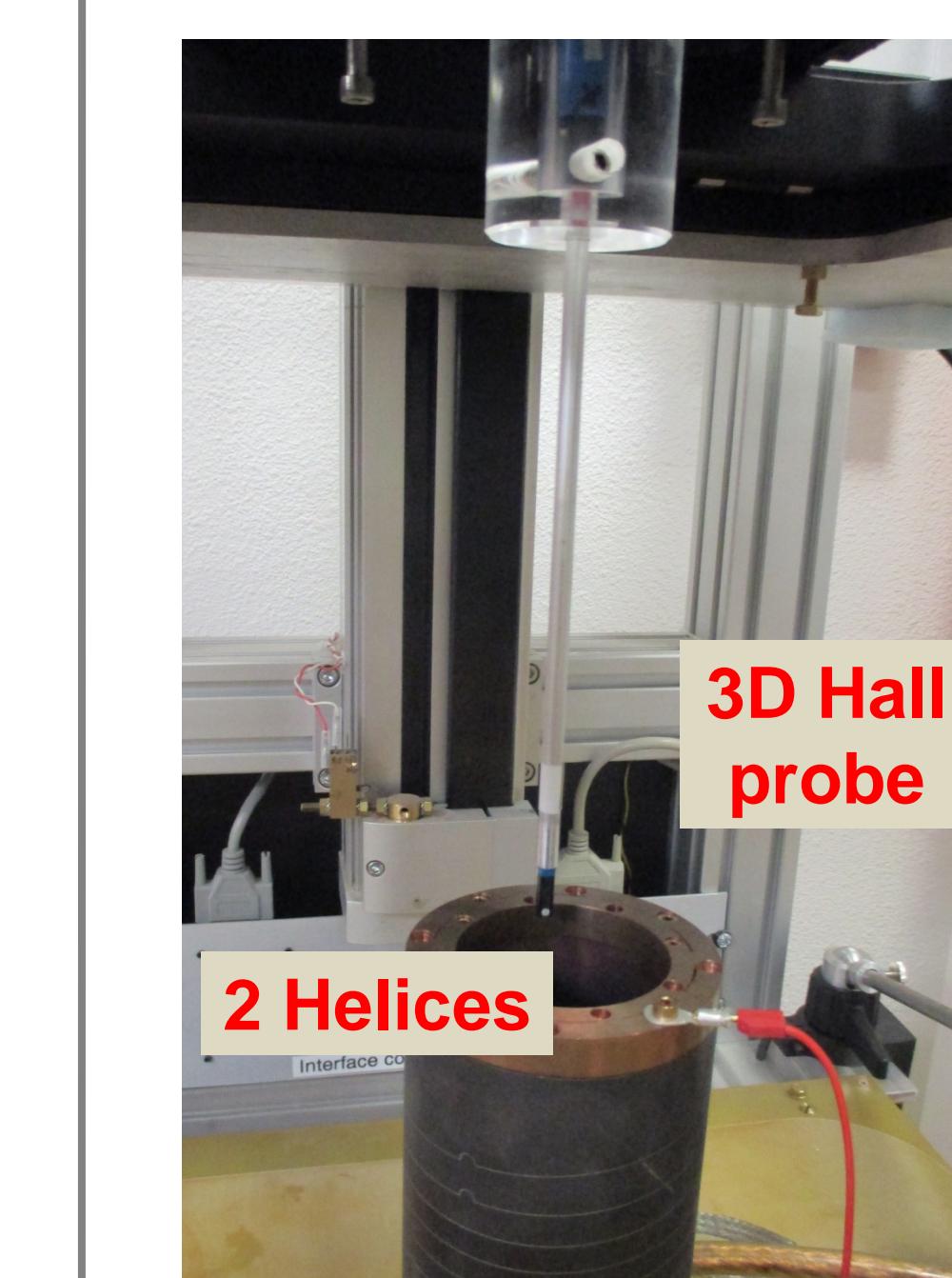
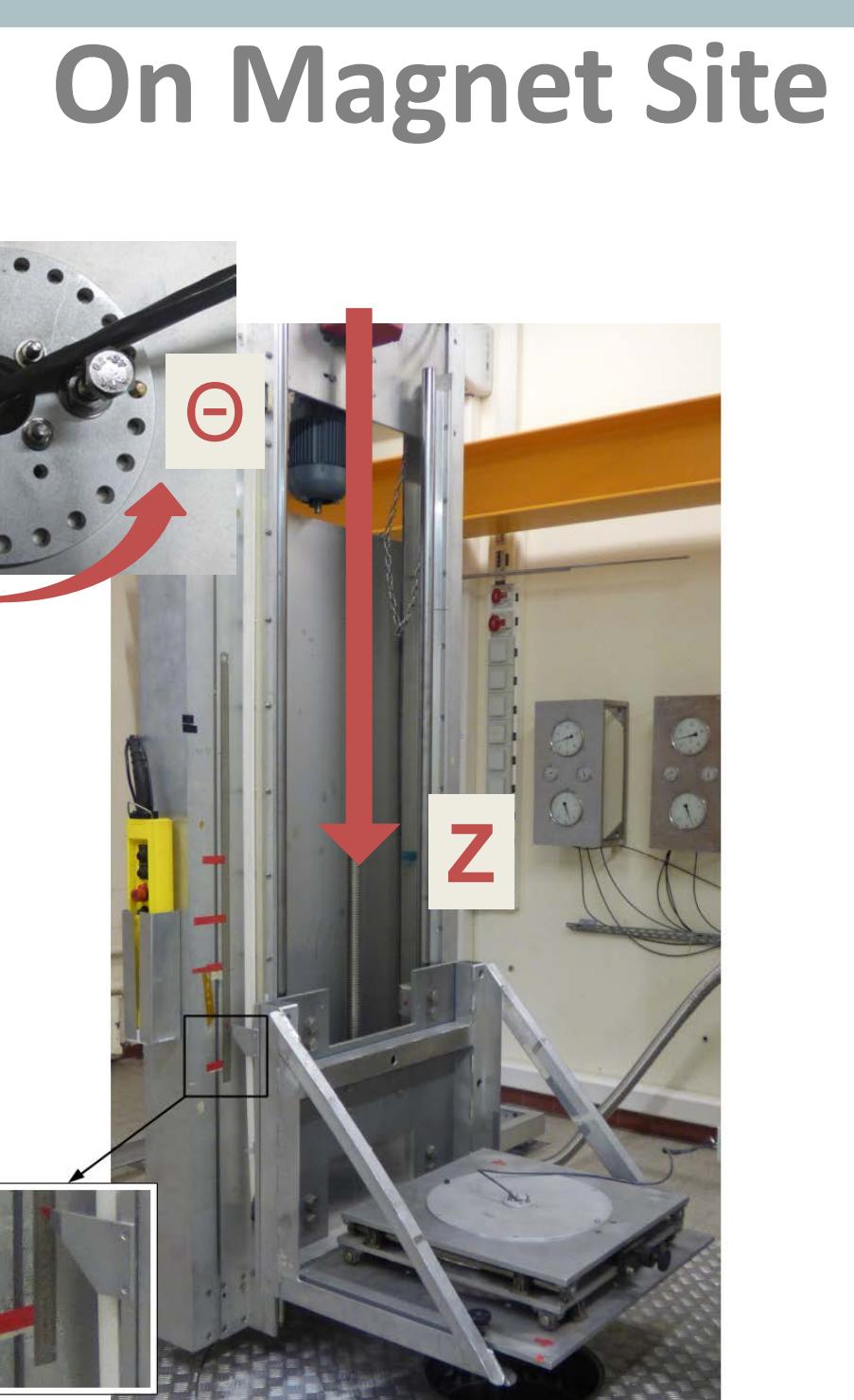
Existing Mag. Field profile : only available

- on Oz axis
- in a small sphere of 1 cm³

Need for Dedicated experimental setup

- On Magnet Site setup
- Low Field TestBench

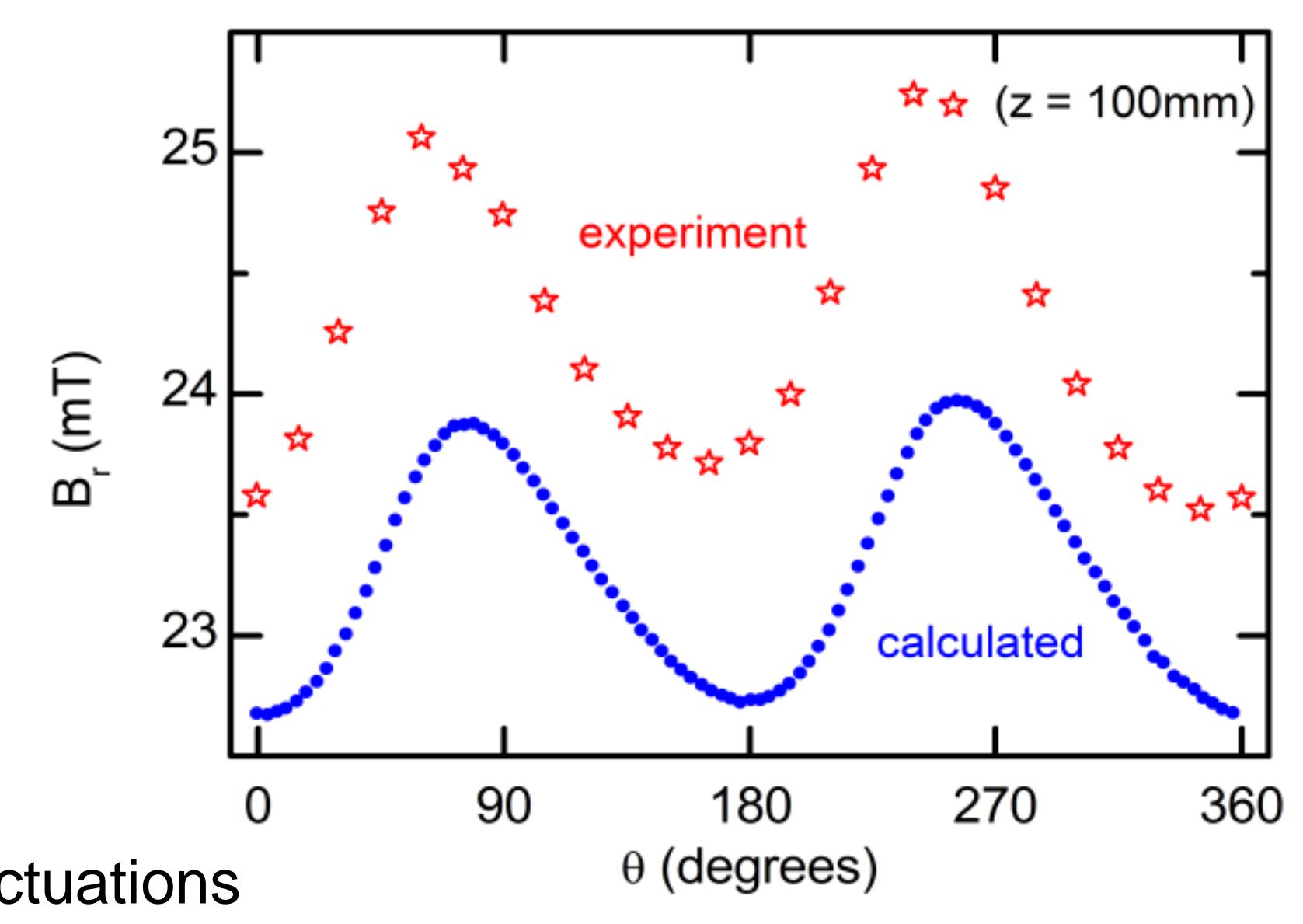
Experimental Setups



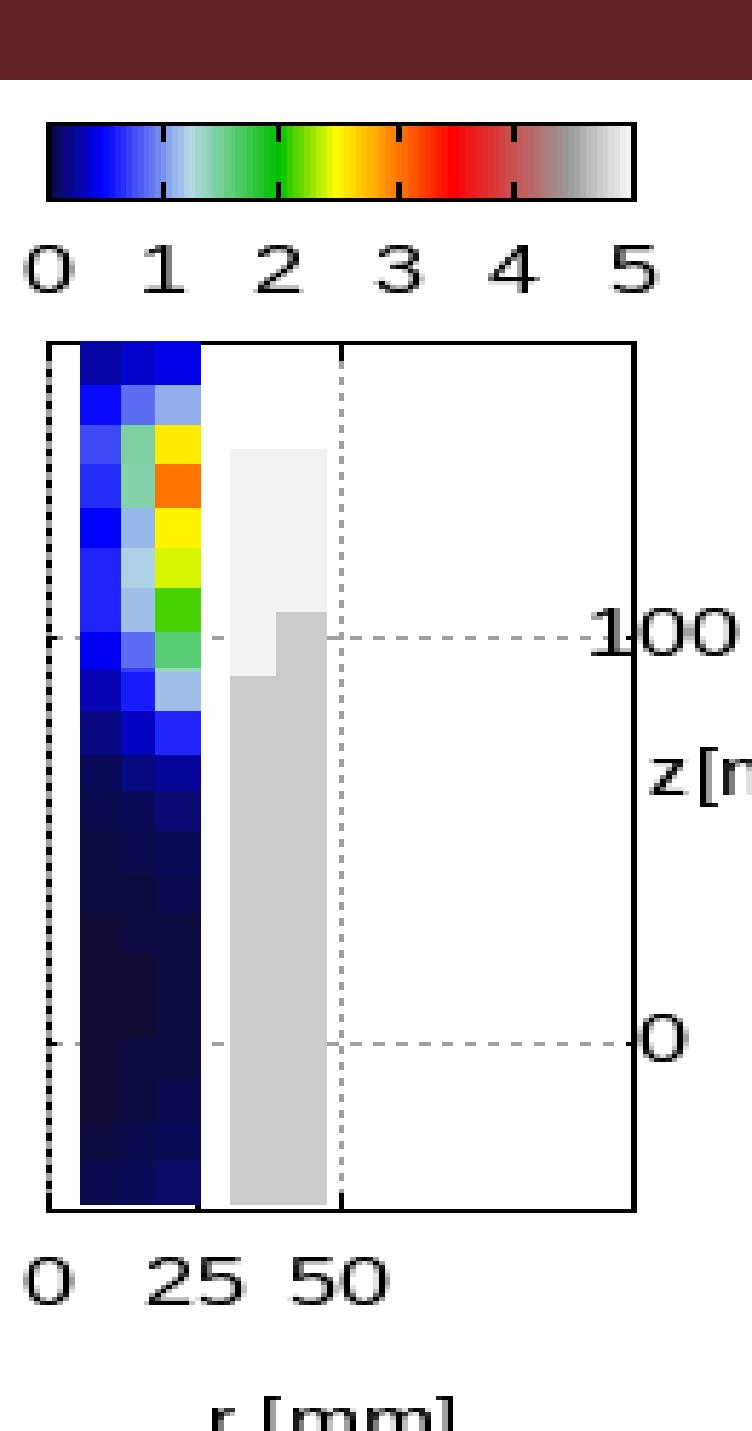
	On Site	Test Bench
Displ.	Translation Z + Rotation t	Translation X,Y,Z
Automated	No	Partly
Precision	-	++
Alimentation	500 A	150 A (stabilized)

Results

Best fit for $r = 20$ mm and $z = 100$ mm



3D Exp Indicator:
 $100 \cdot \text{std}(B_r) / \text{mean}(B_r)$

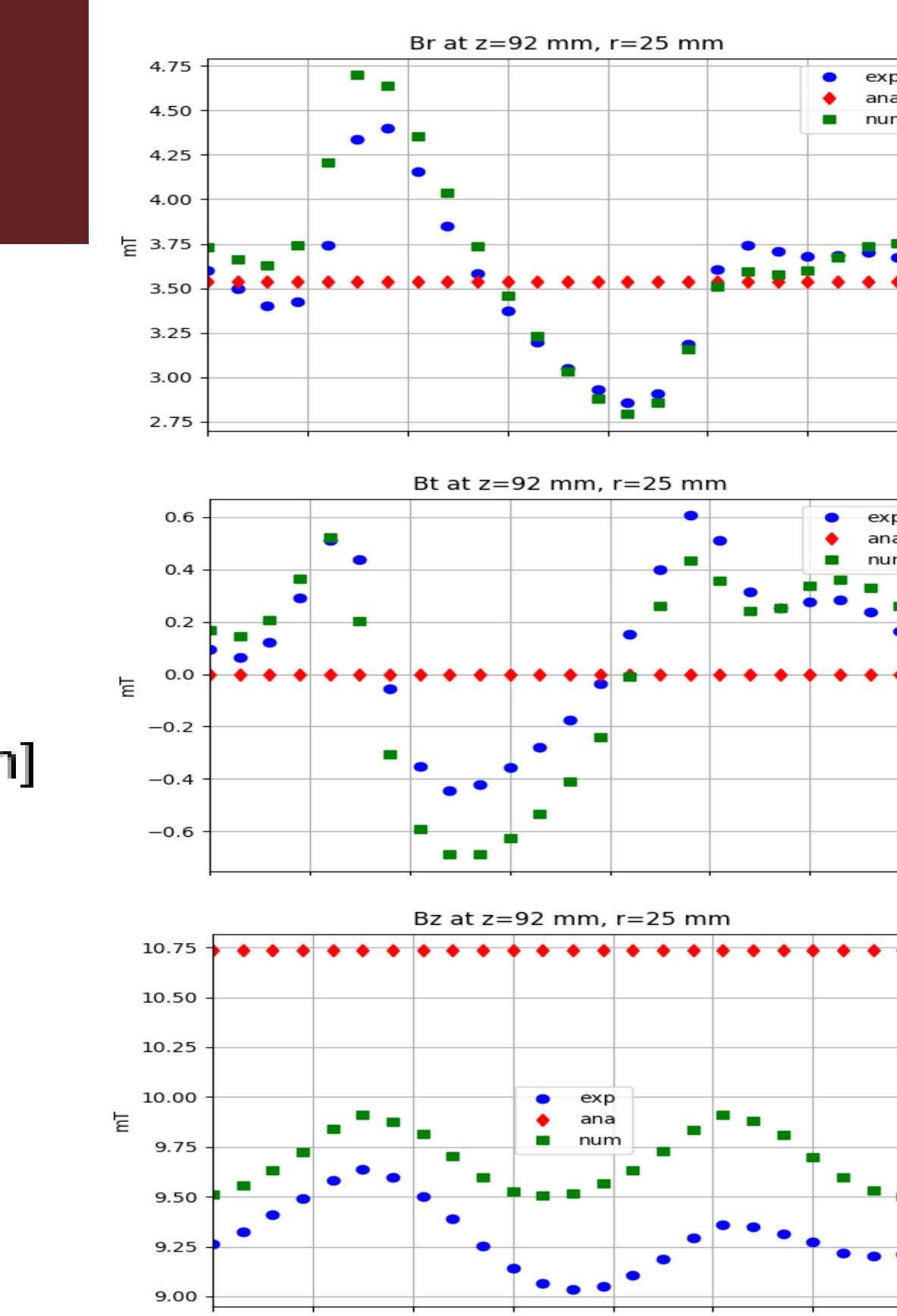
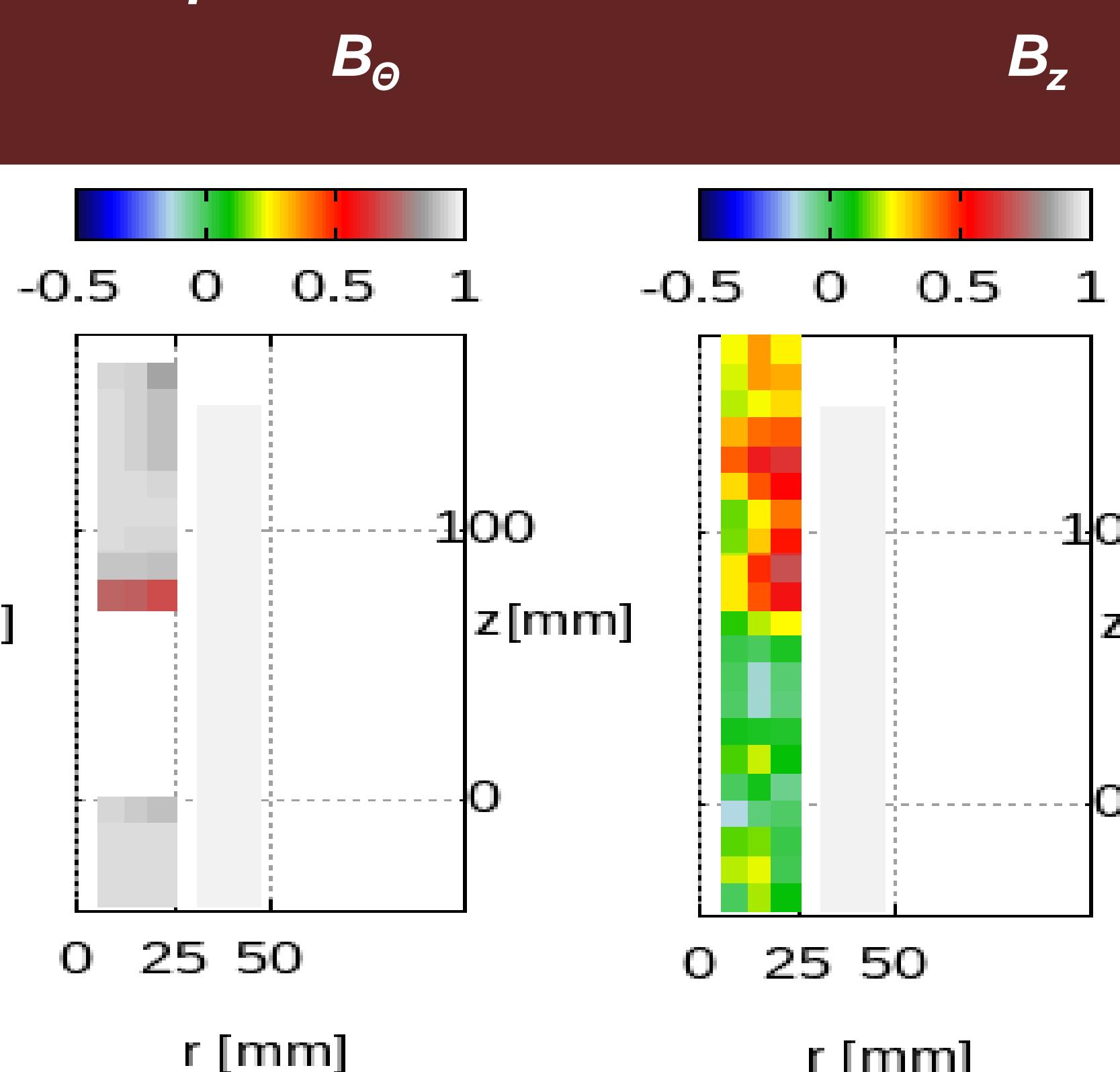


B_r

B_θ

B_z

Num/Exp Correlation Index



Conclusions

Experiments

- 3D Magnetic Field B profile
- Work needed to improve setups
- Improve Precision of On Magnet Site setup

Full 3D multi-physics model

- Validation
- Add RB feature to investigate UQ on B
- In progress Consequence on Mechanical Efforts

Perspectives

- 3D effects in Bitter? (expected to be less import.)
- PolyHelix Magnet design
- Address Users demand for specific B profile: eg, NMR, Levitation, Ions sources