Pair spectrometer mapping

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Goals and specifications

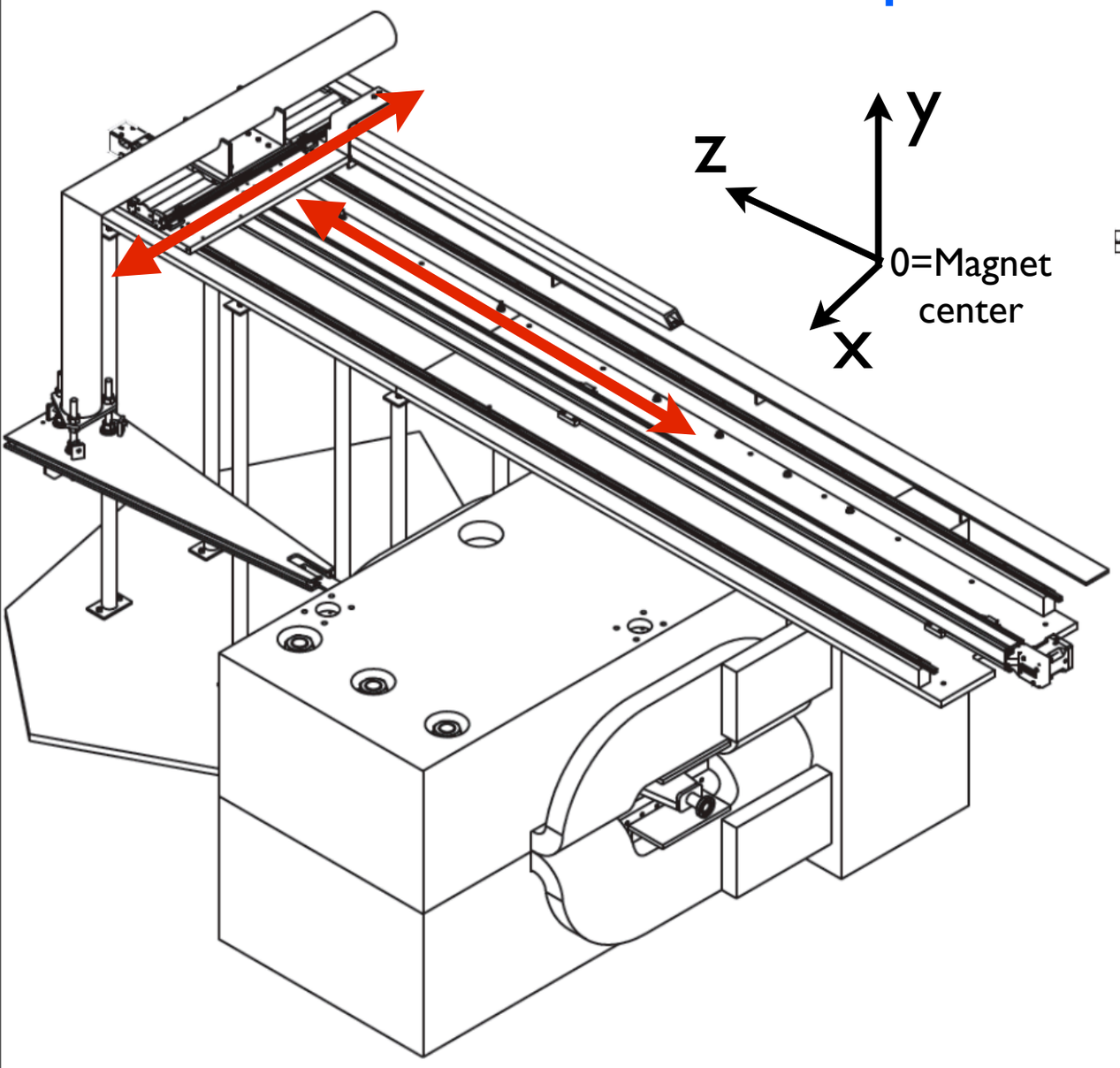
- Provide 3D maps of the Pair Spectrometer magnetic field for several central field values. (Nominal central field during ops: 1.8T).

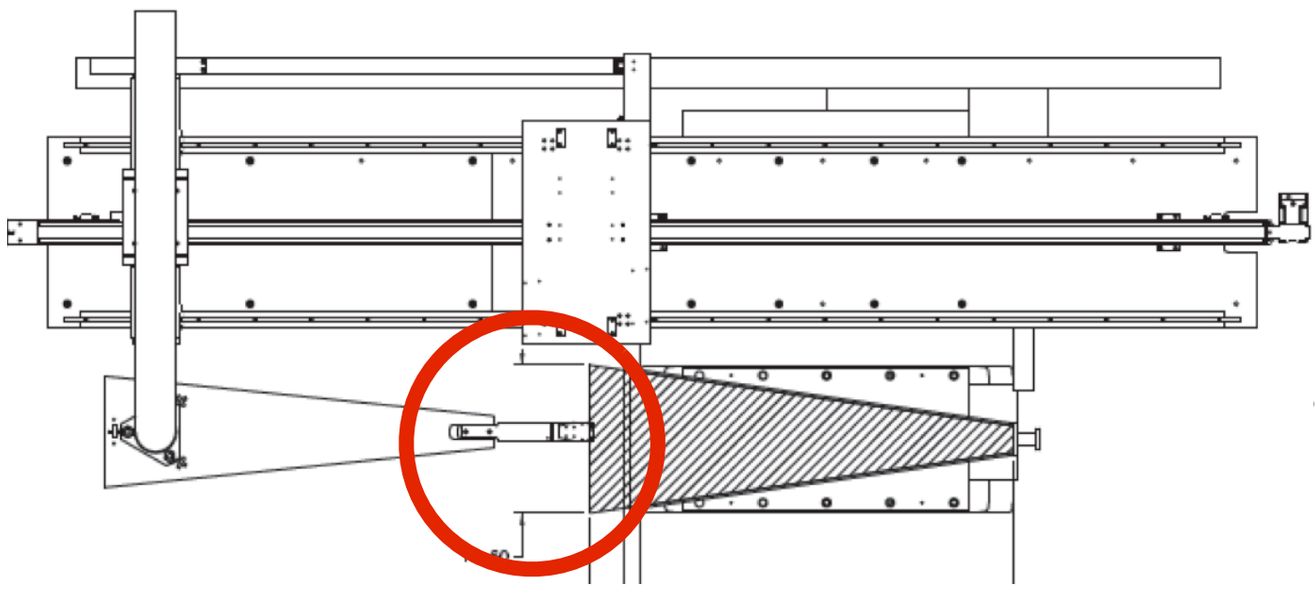
- Relative precision on B better than 10^-3. Distance precision: mm.

- Verify/Constrain TOSCA simulation. Validate it.

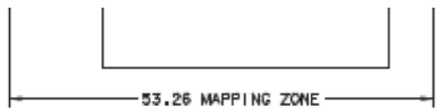
- BdL for e-/e+ pairs.

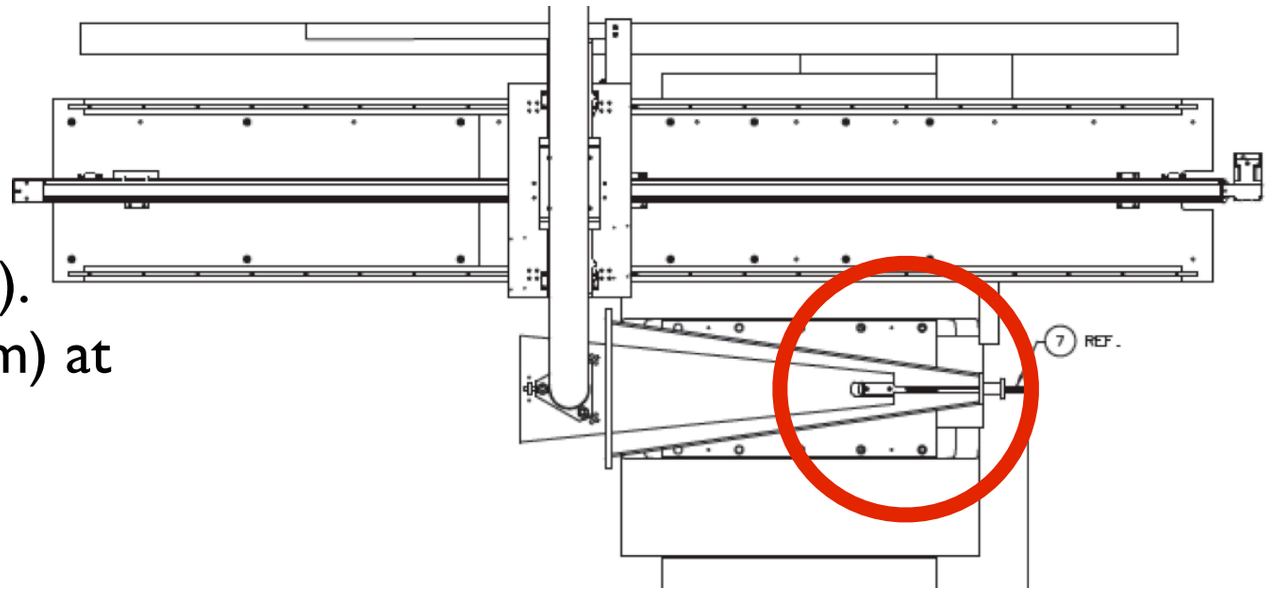
Experimental setup



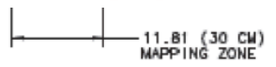


Arm for "downstream" mapping





Arm for "upstream" mapping

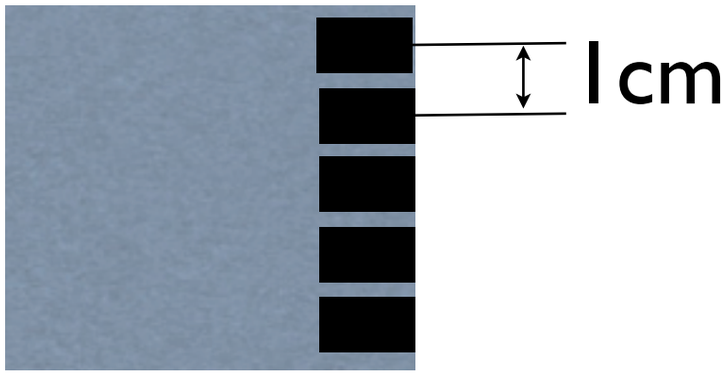


Similar system as for tagger mapping (different arms).
"2D+1" maps (downstream) and 1D maps (upstream) at B=2.0, 1.8, 1.5 and 1 T.
Similar procedure as for tagger mapping:

- Initial and final surveys.
- Hall probe calibration with NMR.
- Reduction of hysteresis & temperature effects.

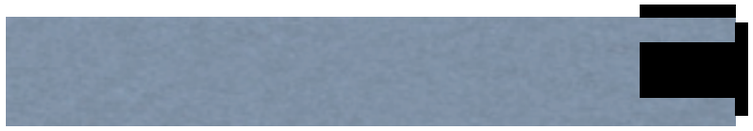
Experimental setup

Probe configurations:



Downstream: nominally: 5 Hall probes spaced by 1 cm and measuring By.

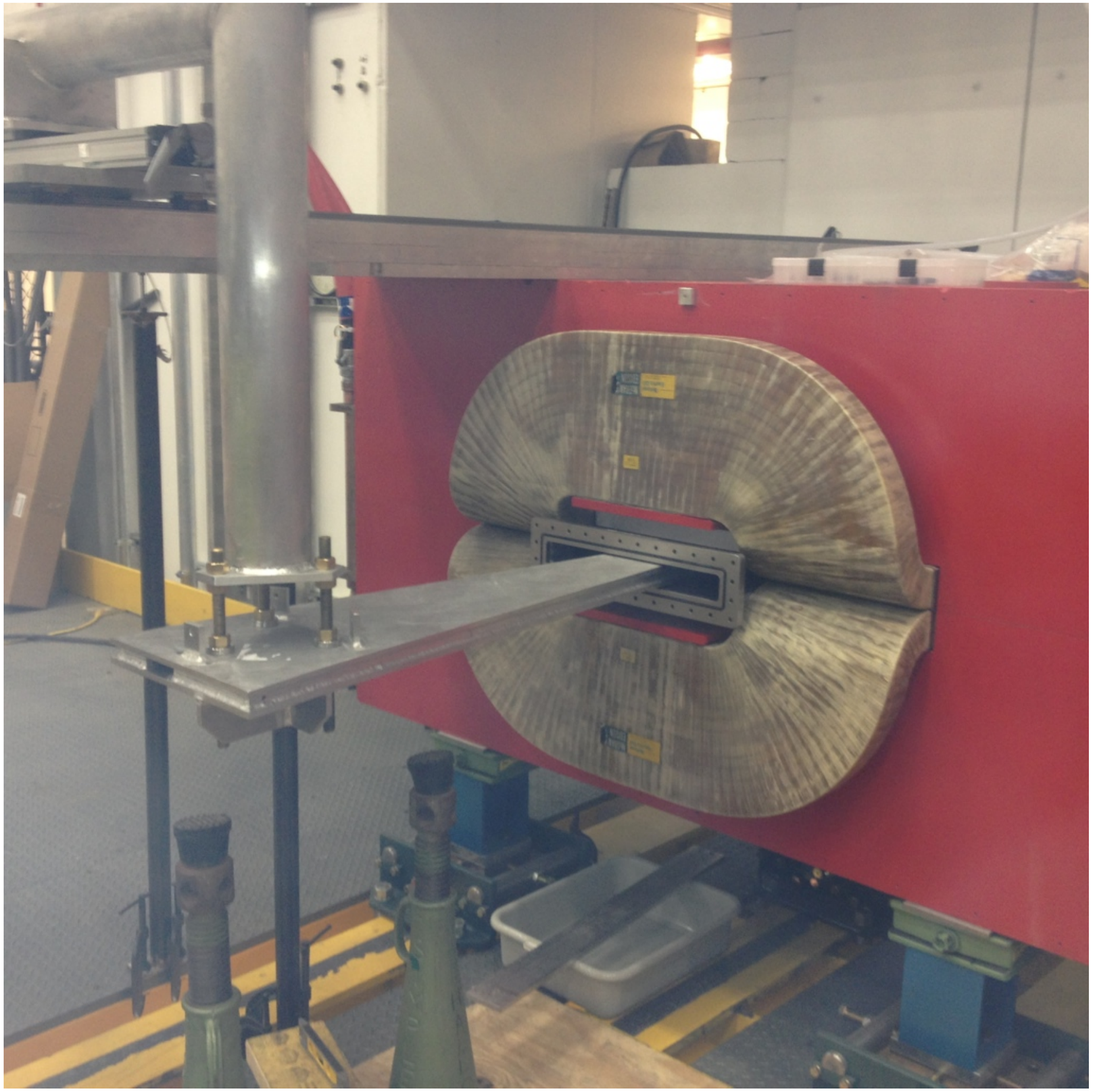
Also ran with two probes measuring Bx and Bz:



Upstream: 3 Hall probes measuring By, Bx and Bz.

Bx and Bz: Constraints on possible angle variations during mapping or tilt of the rails.

Experimental setup



Data taking (completed)

Downstream 1D data (Z direction only):

- 2.0T x=0,y=0
- 2.0T x=10cm,y=0
- 2.0T x=-10, y=0
- 1.8T x=0,y=0
- 1.5T x=0, y=0
- 1.5T x=5cm, y=0
- 1.8T x=-10cm,y=0
- 1.0T x=0,y=0
- 1.0T x=5cm,y=0
- 1.0T x=-10cm y=0

By measurements only.

Upstream 1D data (Z direction only):

- 2.0T x=0,y=0
- 1.8T x=0,y=0
- 1.5T x=0, y=0
- 1.0T x=0,y=0

Bx,By,Bz measurements.

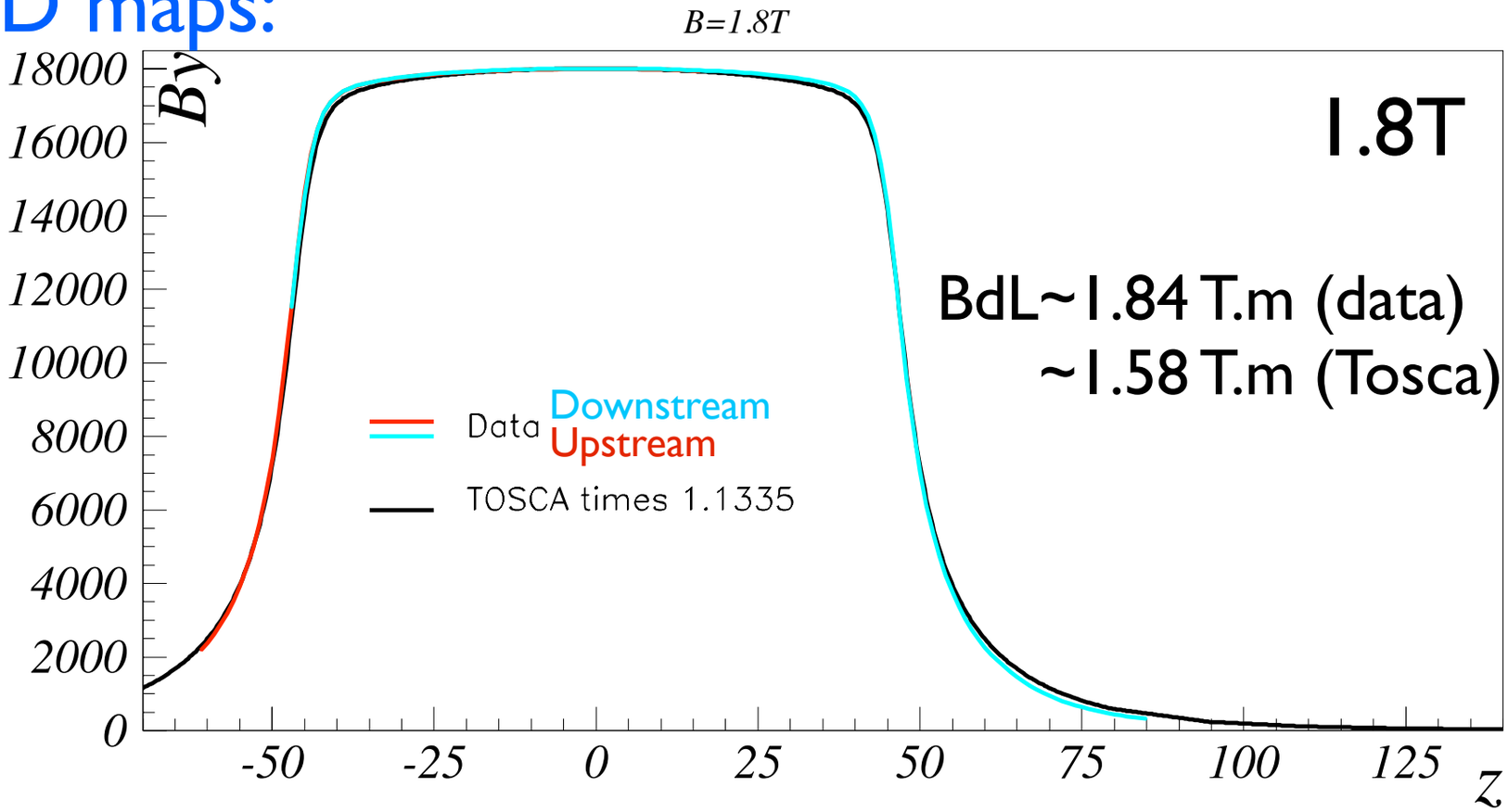
Downstream (2+1)D data:

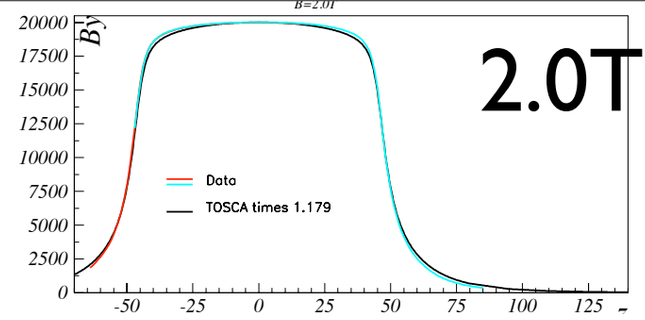
- 2.0T y=0
- 1.8T y=0
- 1.8T y=+1cm
- 1.8T y=-1cm

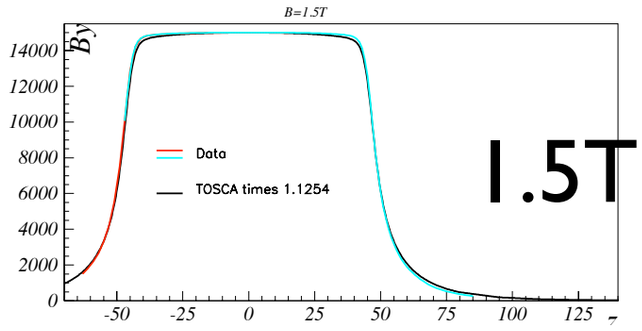
Bx,By,Bz measurements.

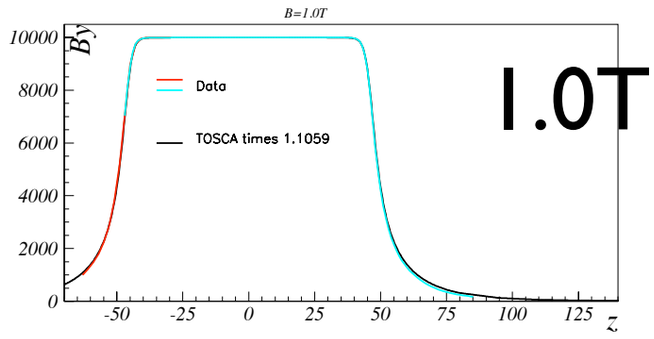
Analysis (in progress)

1D maps:









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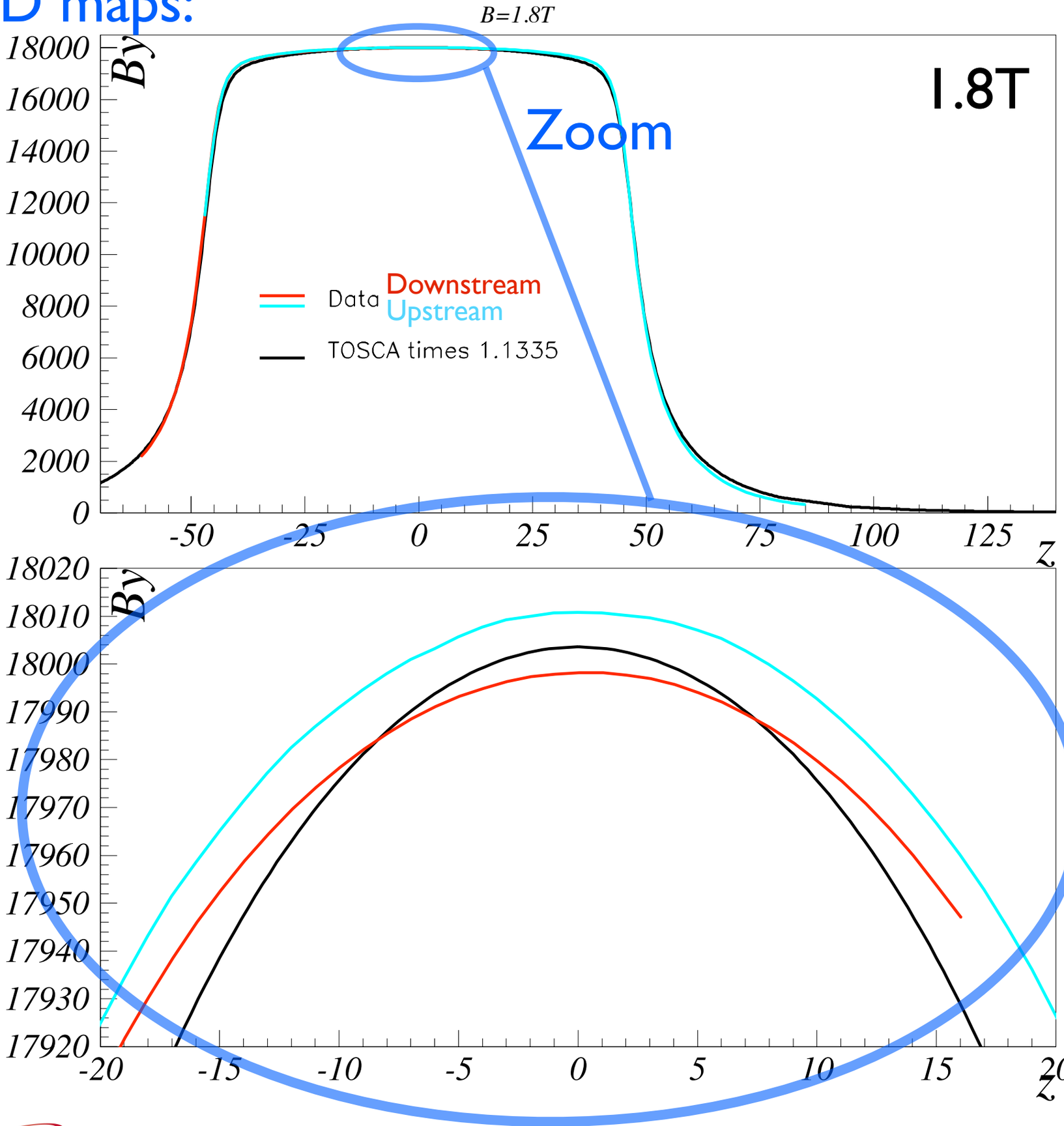

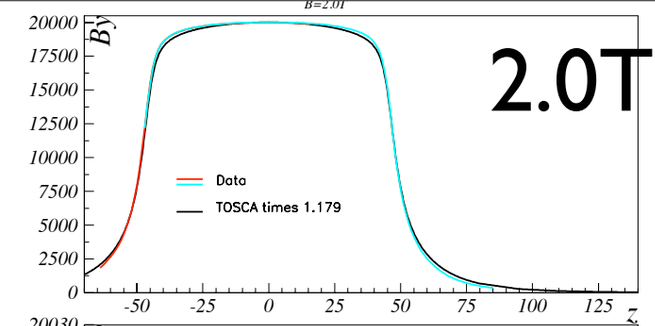

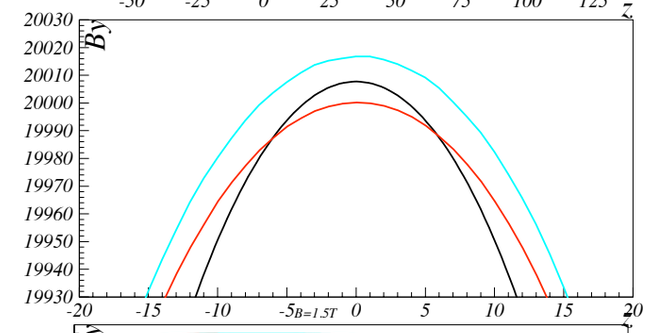

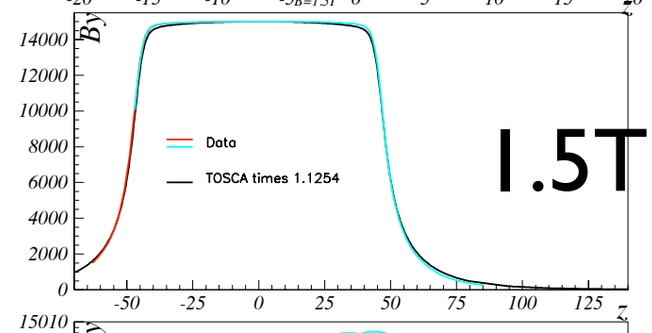

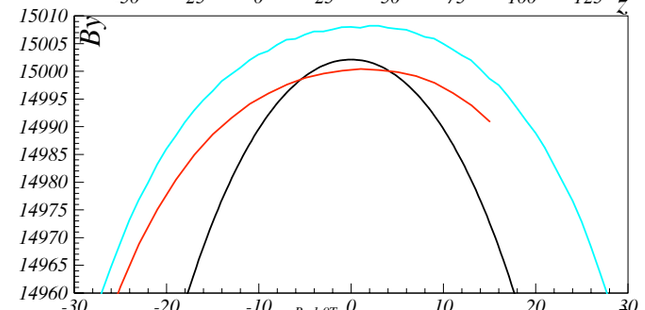

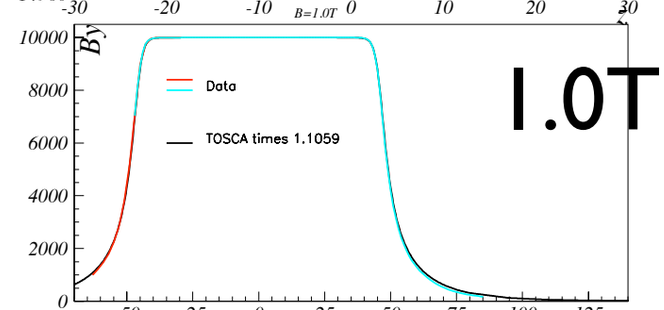

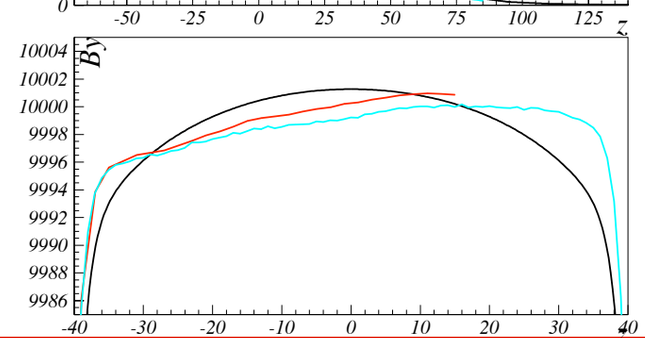

Analysis (in progress)

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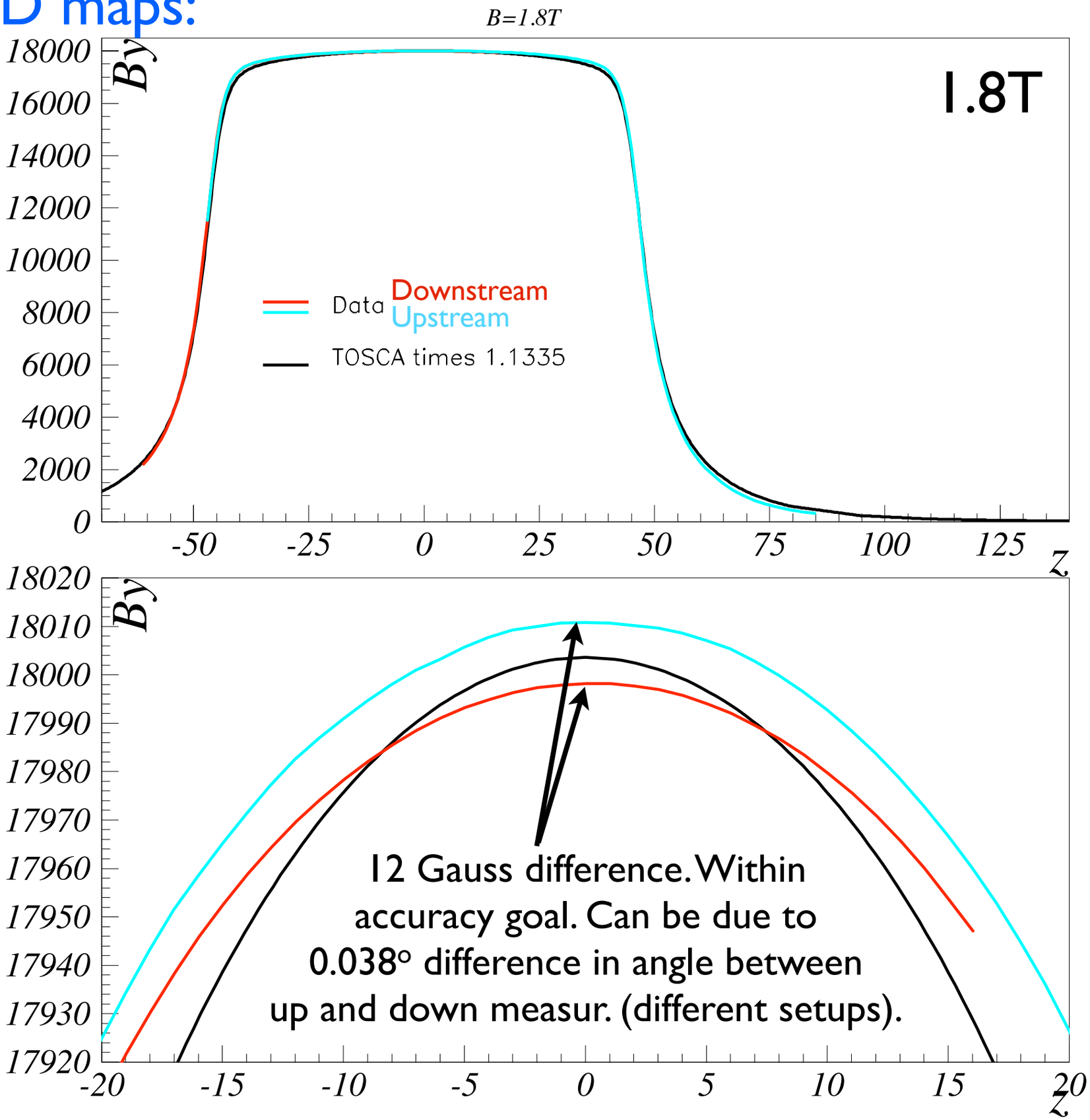

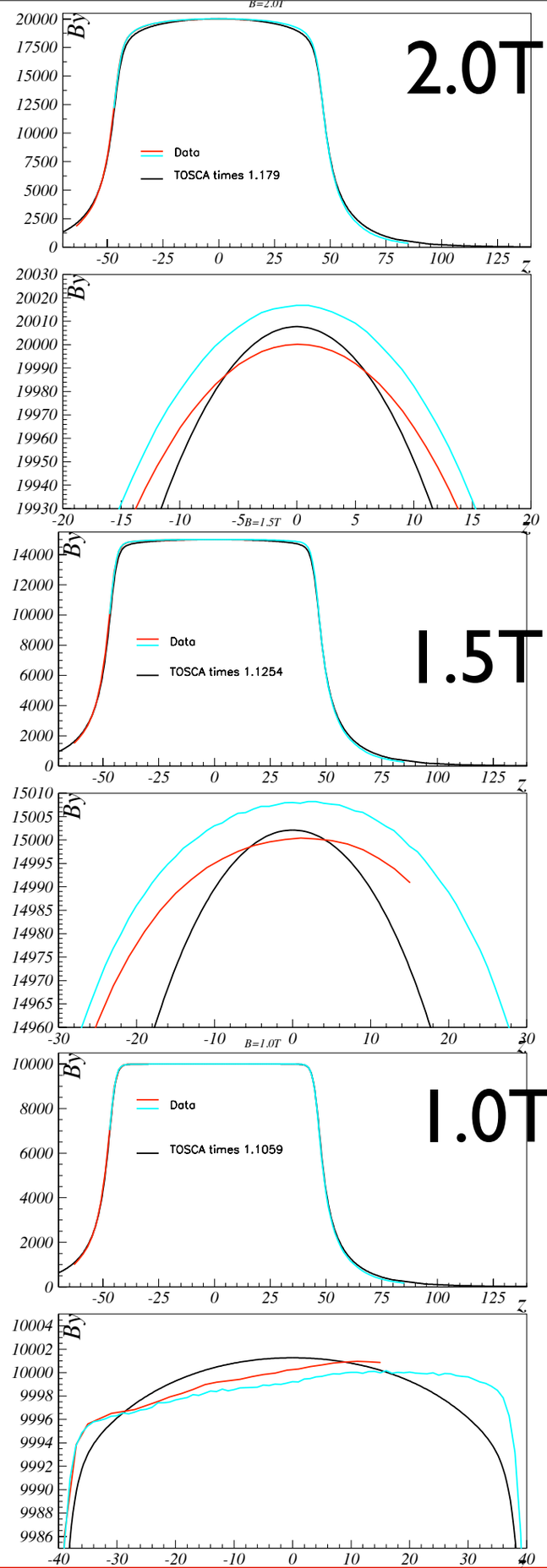

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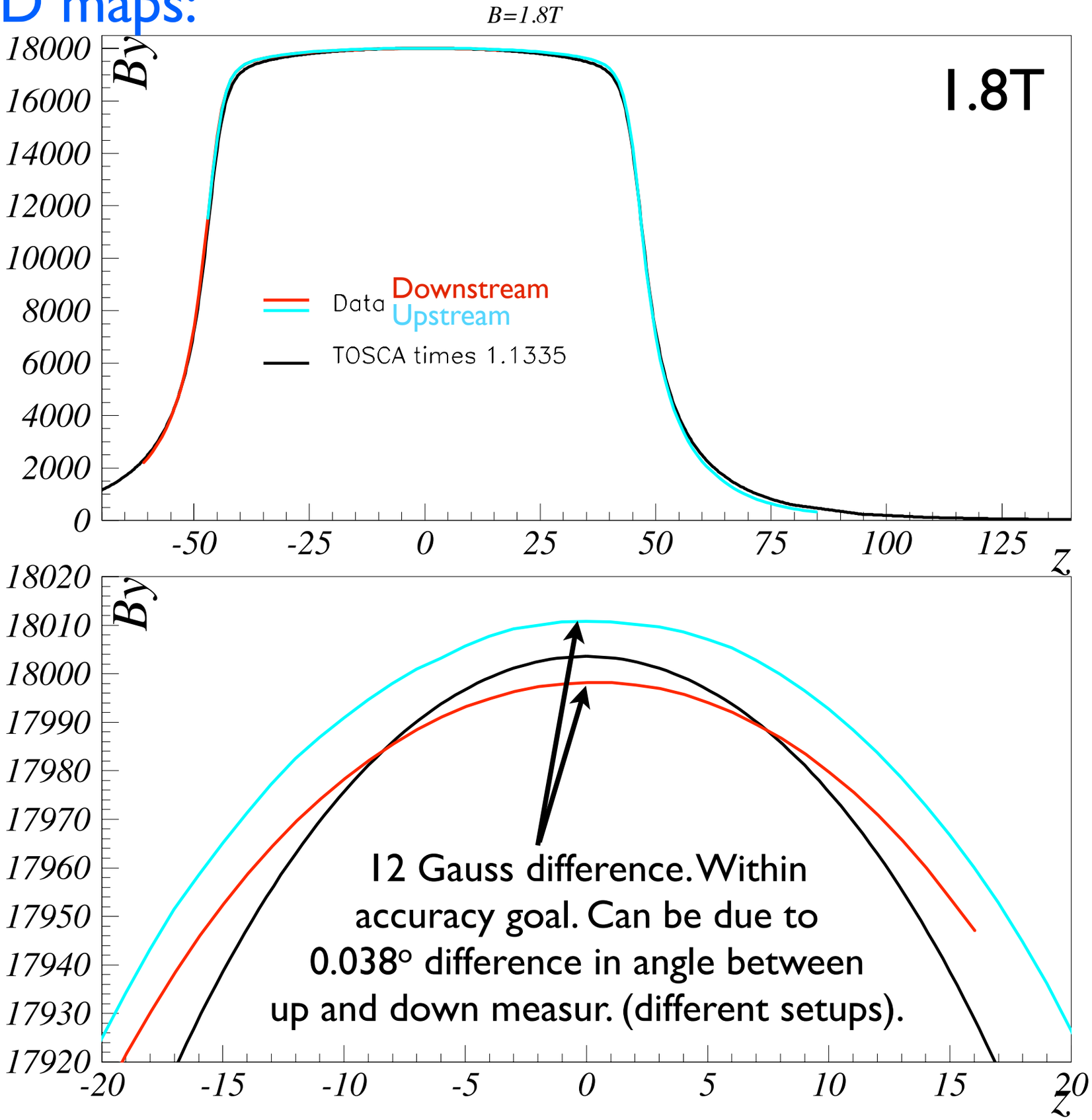

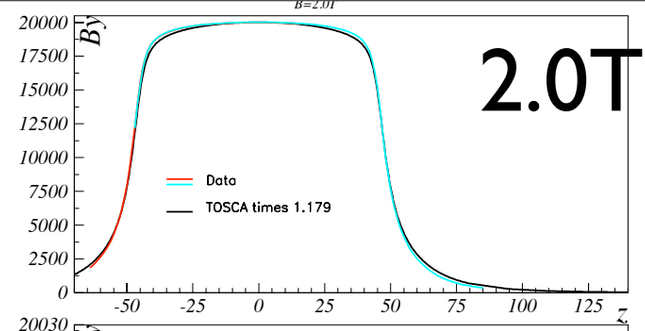

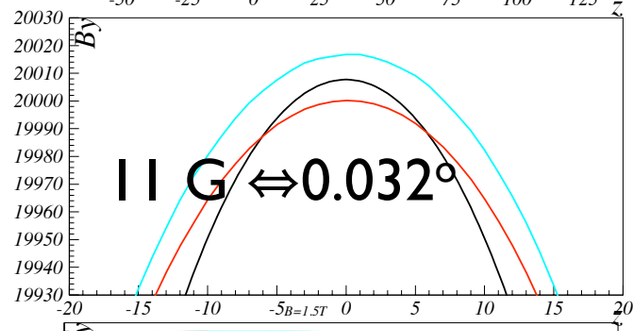

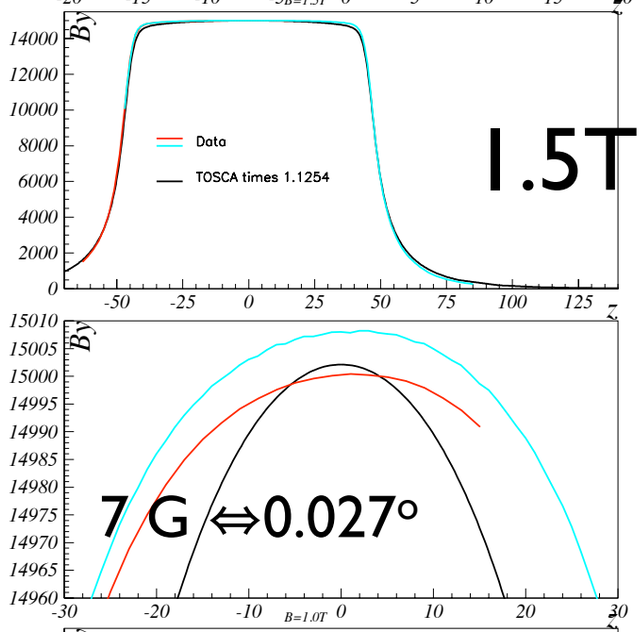

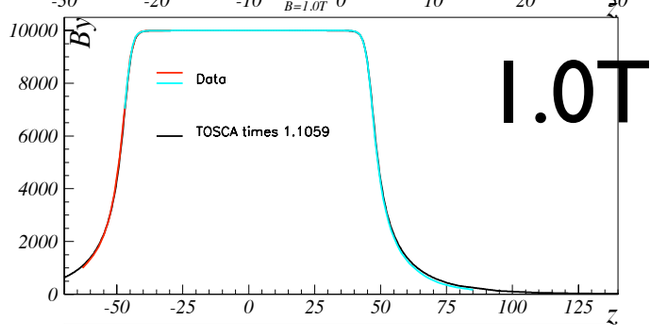

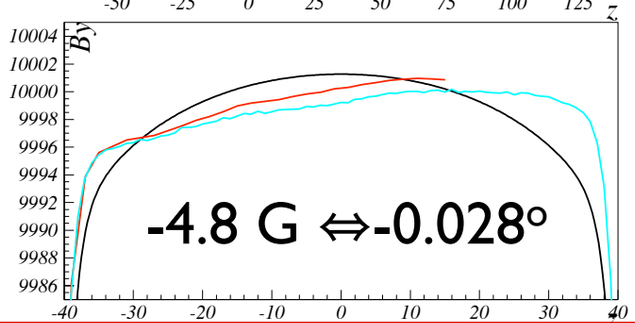

Analysis (in progress)

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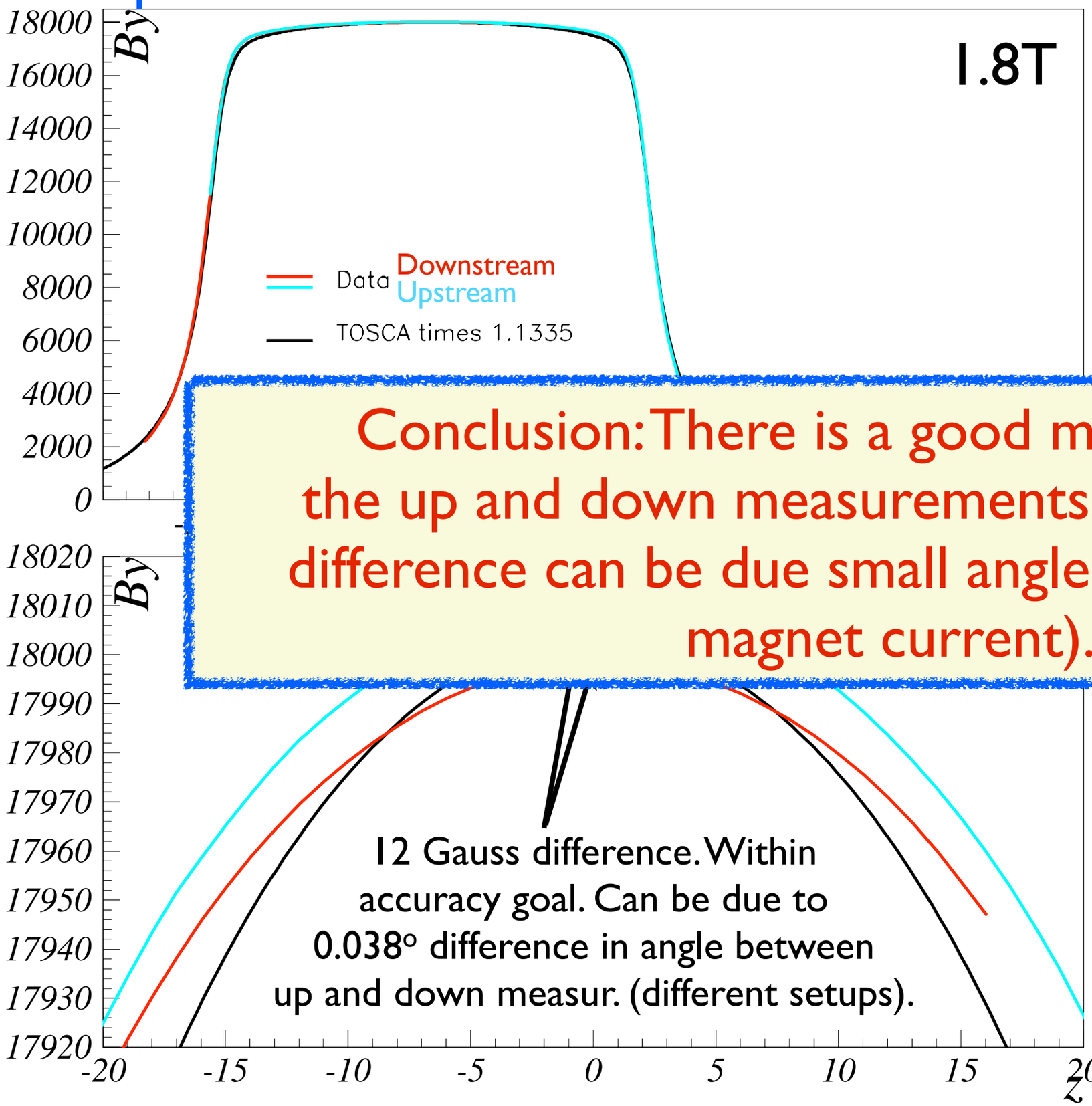
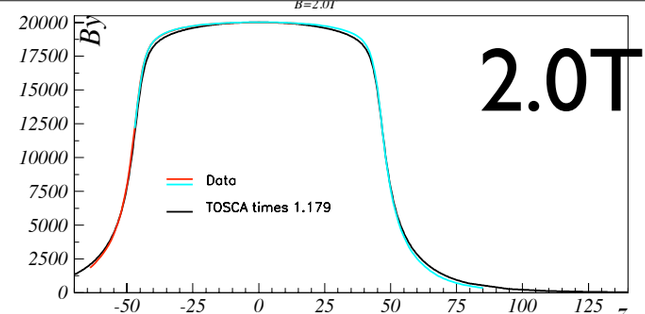
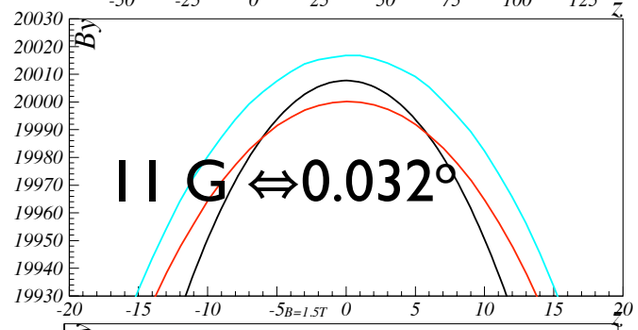
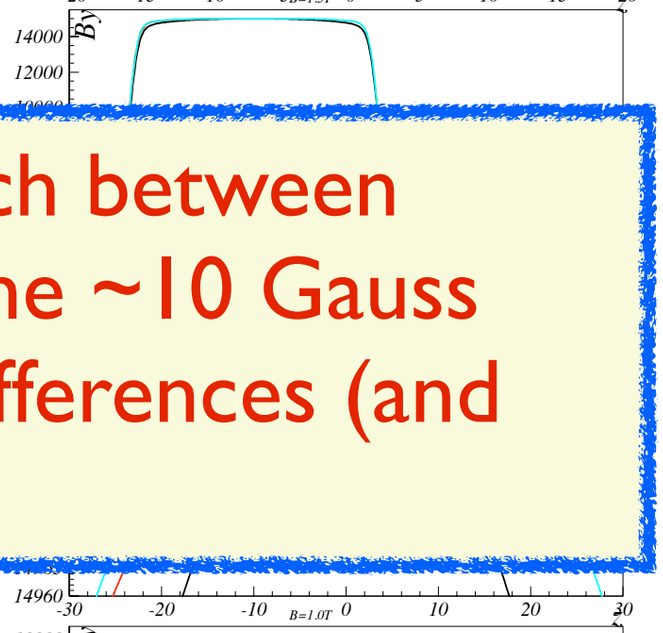
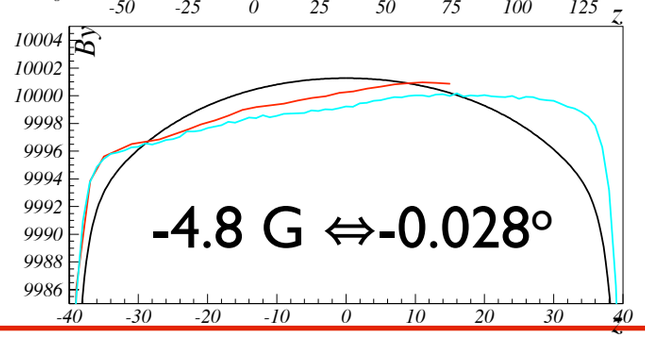






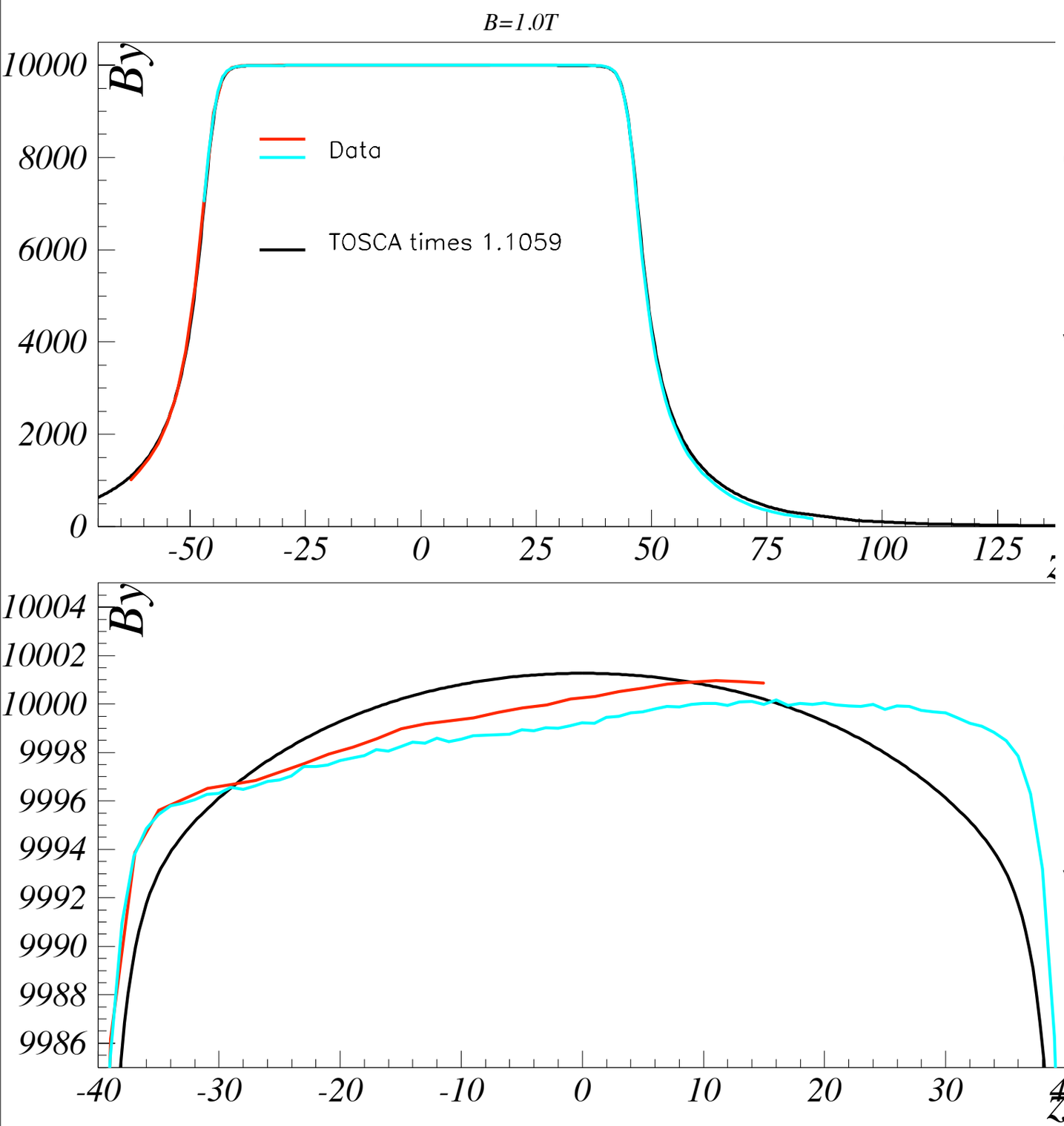




Conclusion: There is a good match between the up and down measurements. The ~10 Gauss difference can be due small angle differences (and magnet current).

Analysis (in progress)

1D maps:



~1.5 Gauss drift (both for up and down, although slightly different).

Best seen at 1 T, but there too for other fields:

When no plateau (1.5, 1.8 and 2 T), effect mixed with possible z offset.

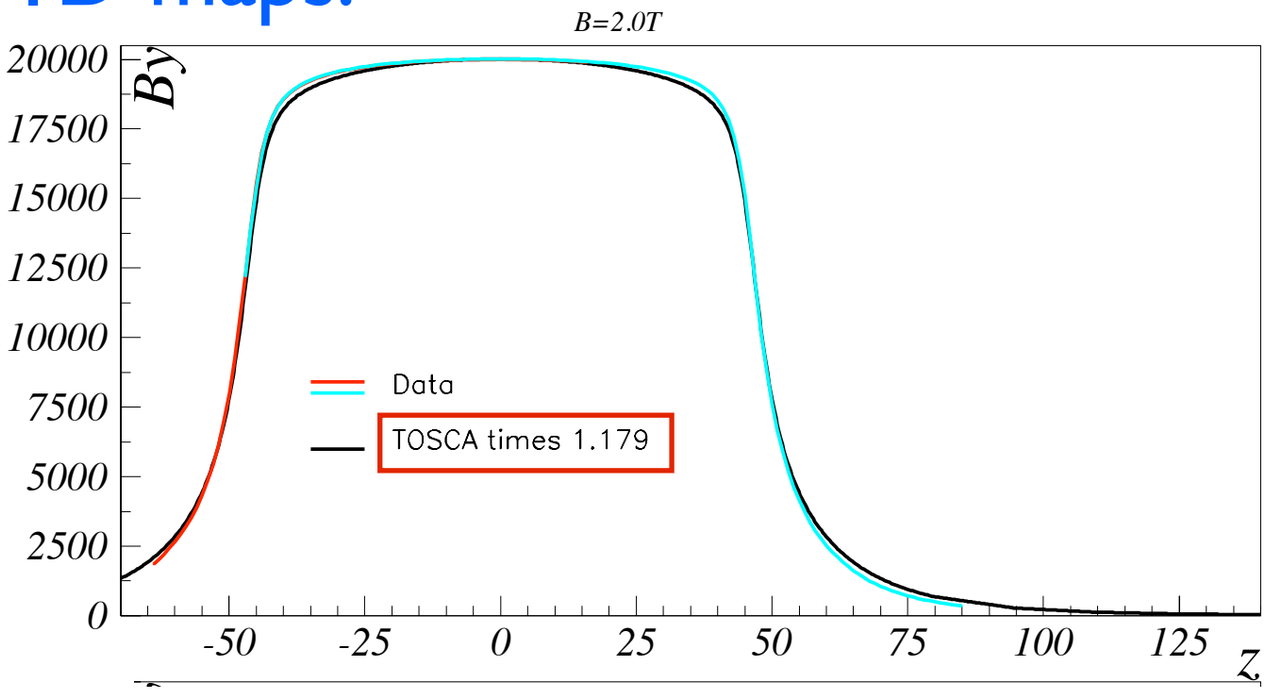
Could be due to:

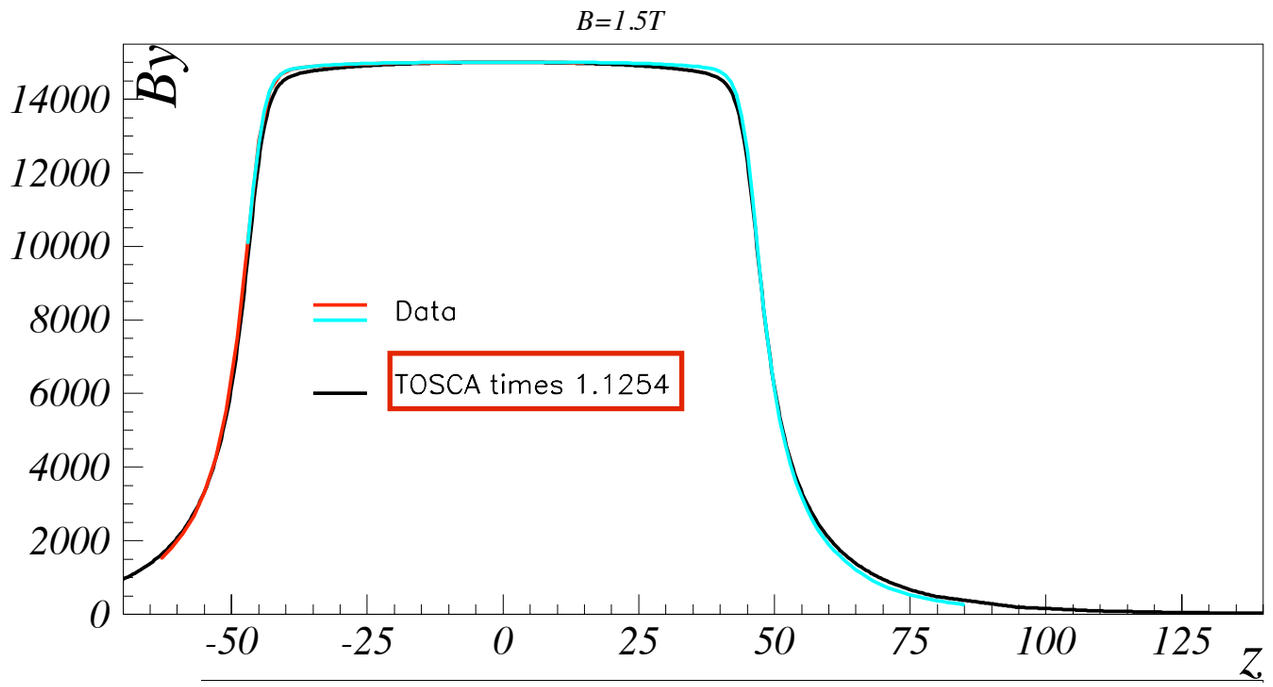
- Slight non-parallelism of coils.
- Non horizontal rails.
- Constant shift of probe as we move along z.

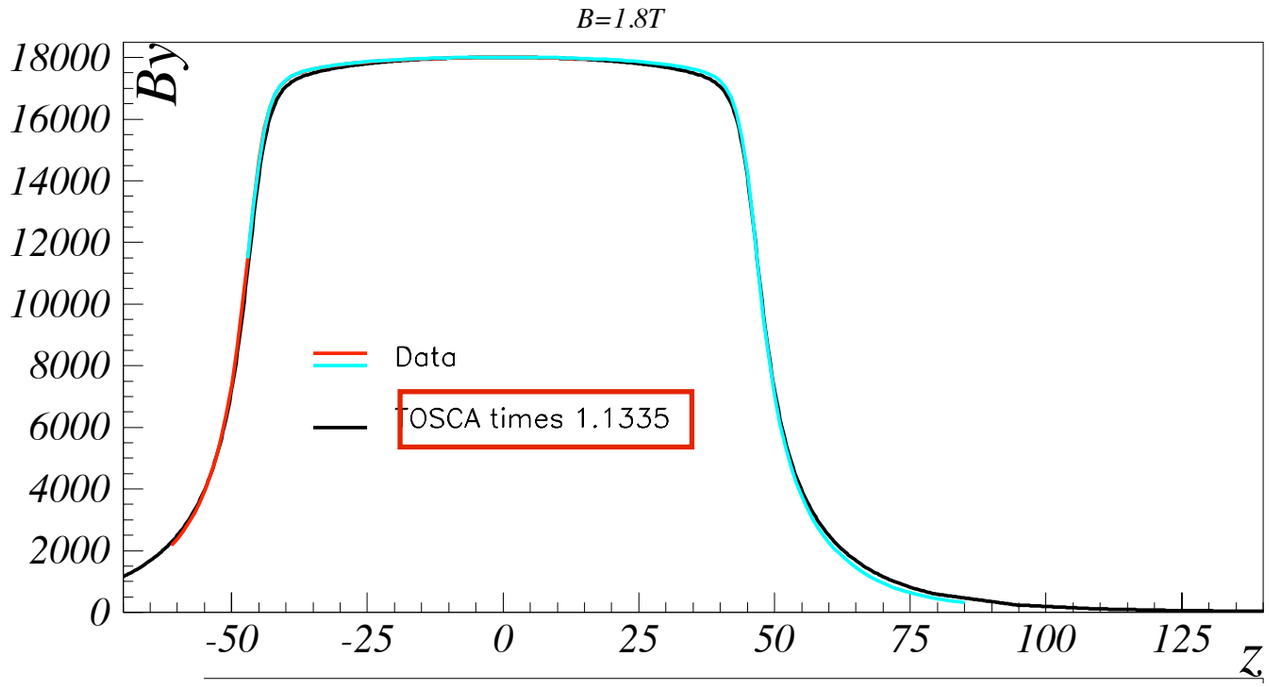
Very small effect: Unimportant.

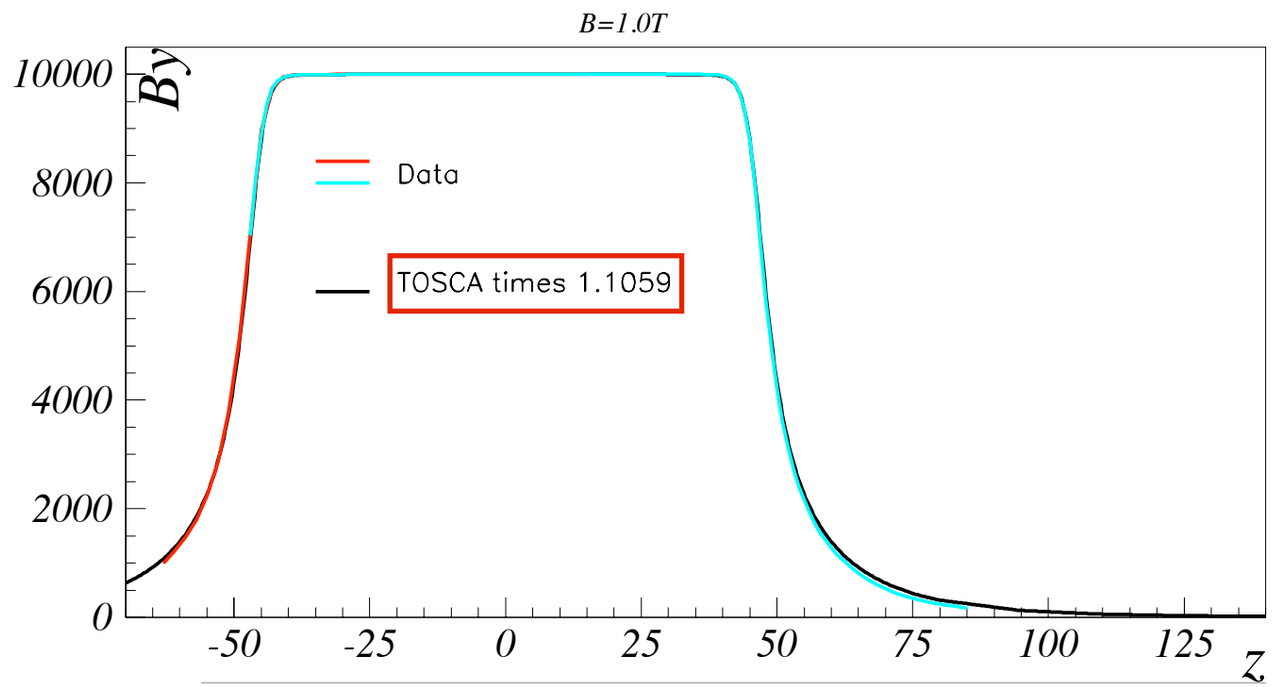
Analysis (in progress)

1D maps:



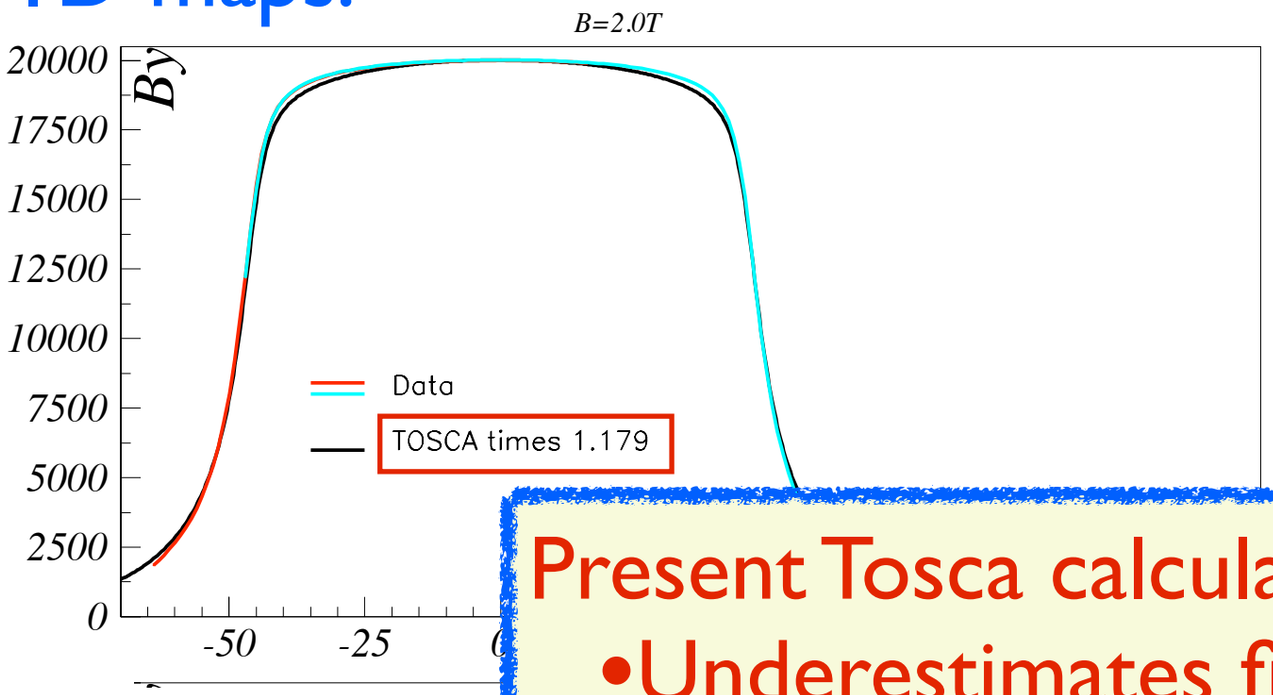


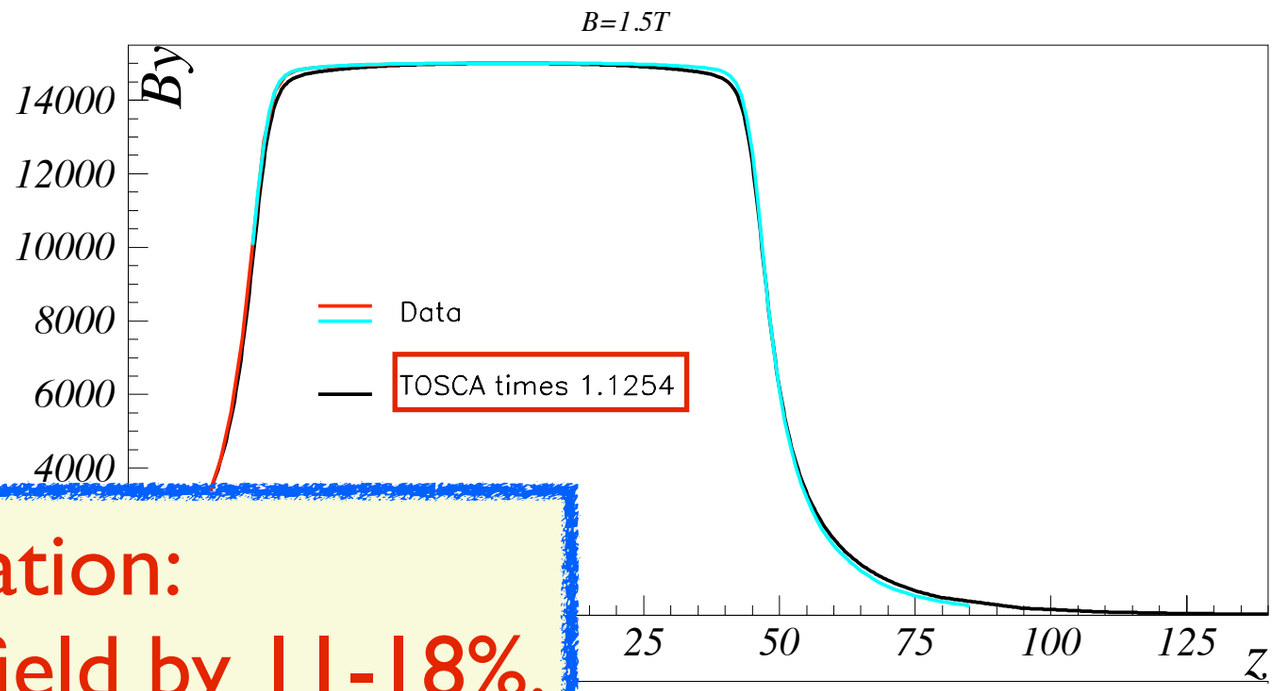




Analysis (in progress)

1D maps:



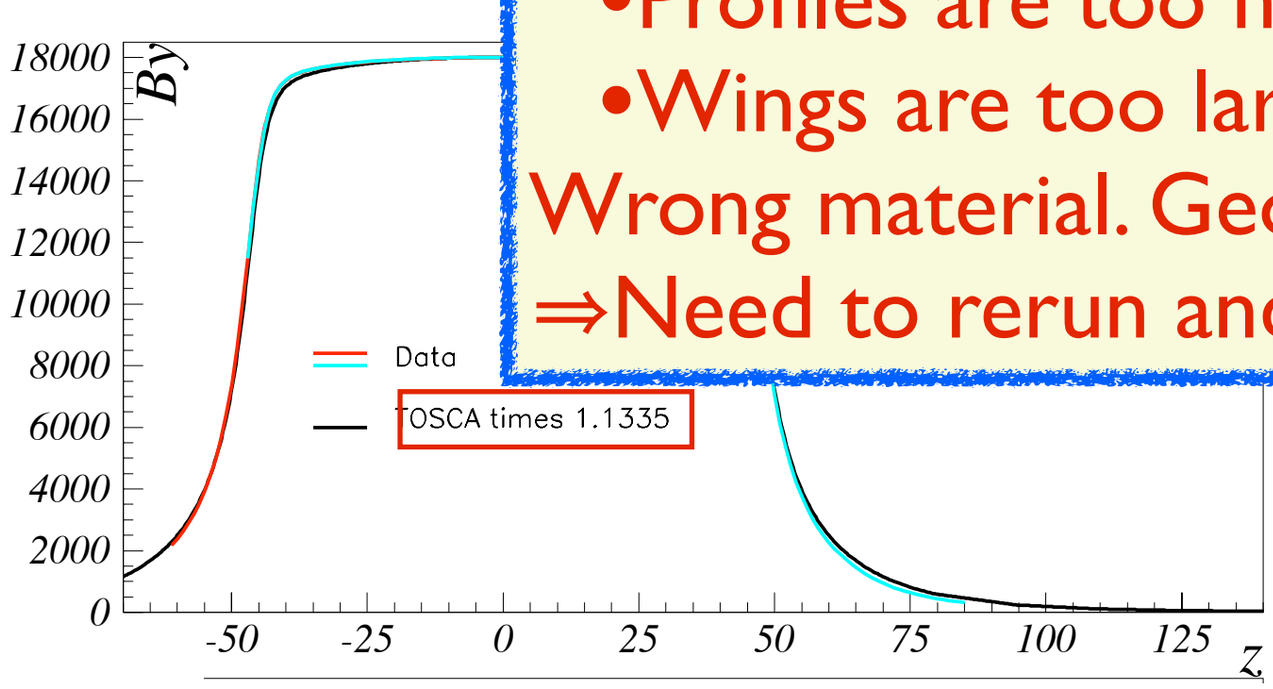


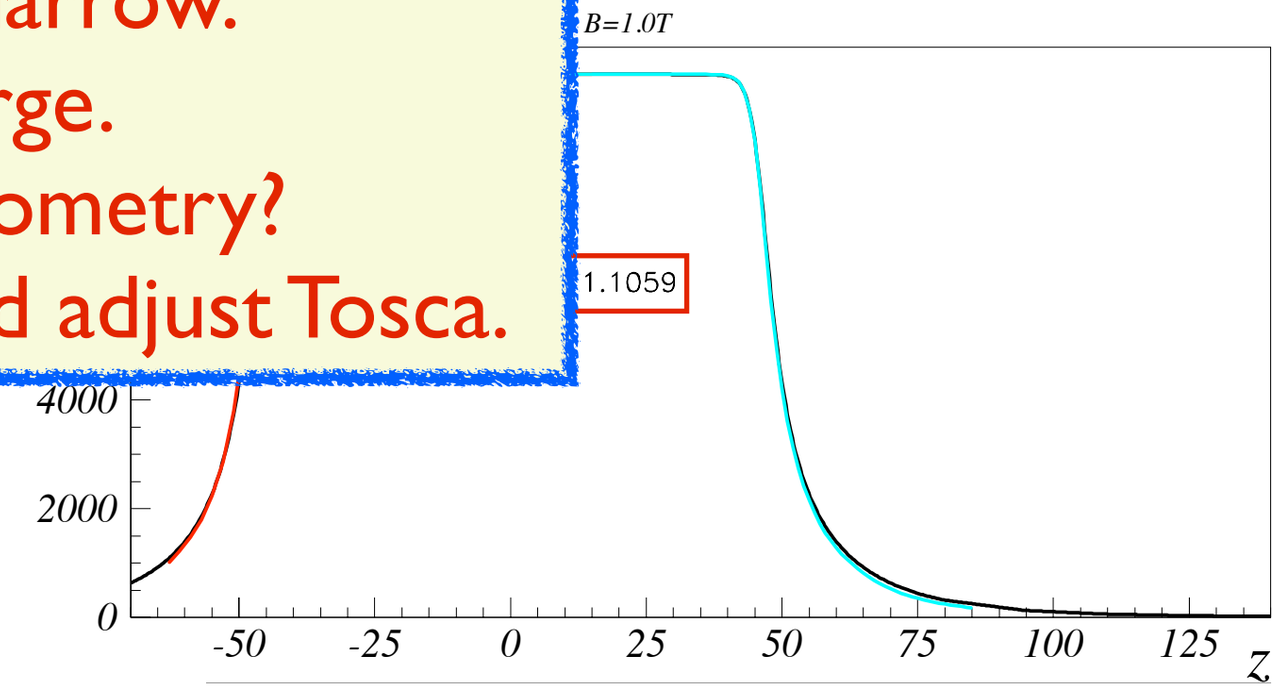
Present Tosca calculation:

- Underestimates field by 11-18%.
- Profiles are too narrow.
- Wings are too large.

Wrong material. Geometry?

⇒Need to rerun and adjust Tosca.





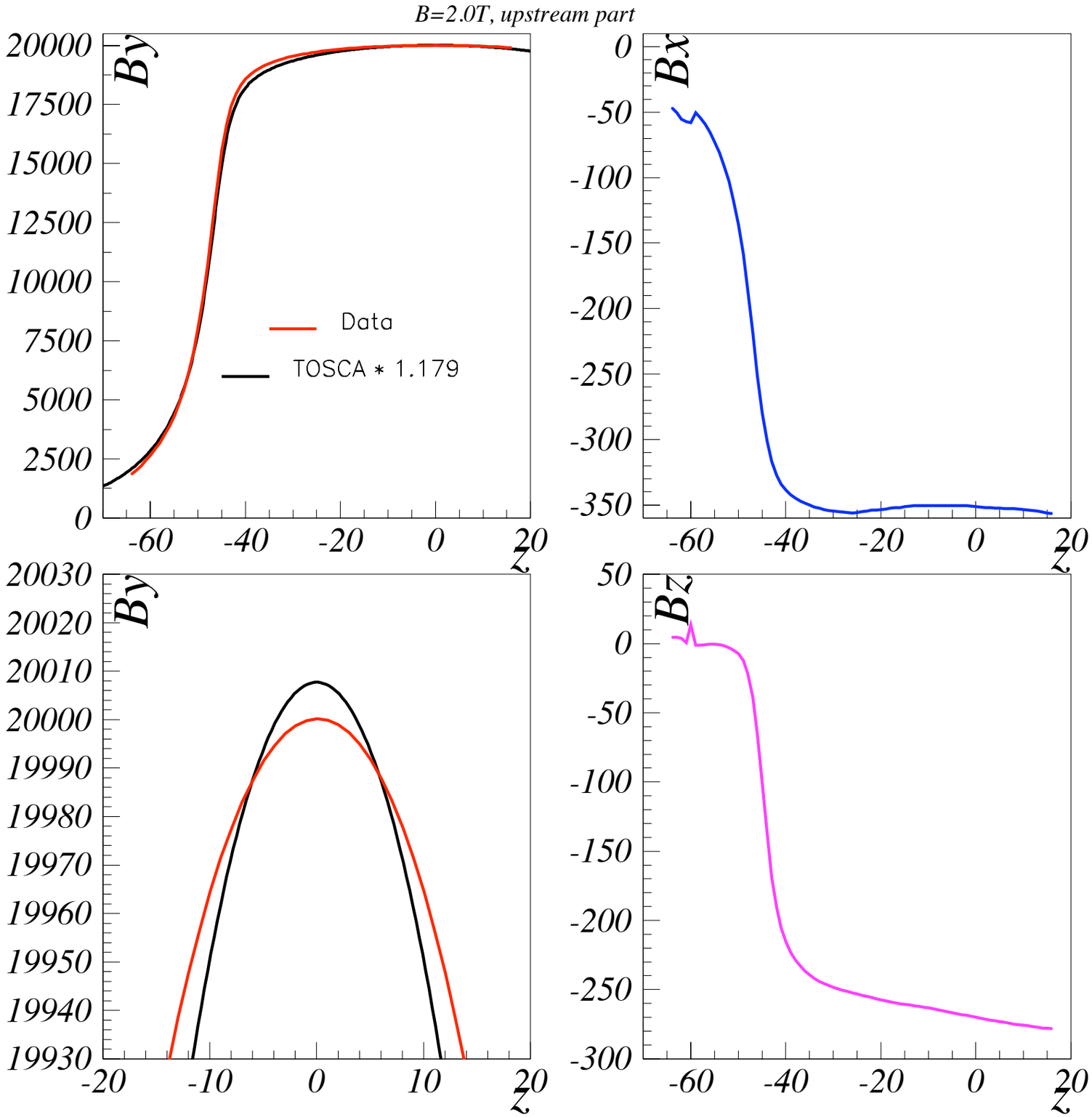
Analysis (in progress)

1D maps:

For up maps. Measured Bx, By and Bz components:

Main purpose: verify that probe angle does no change during mapping, or that rails are not tilted.

May help constrain TOSCA
(although so far only By from TOSCA).



Analysis (in progress)

1D maps:

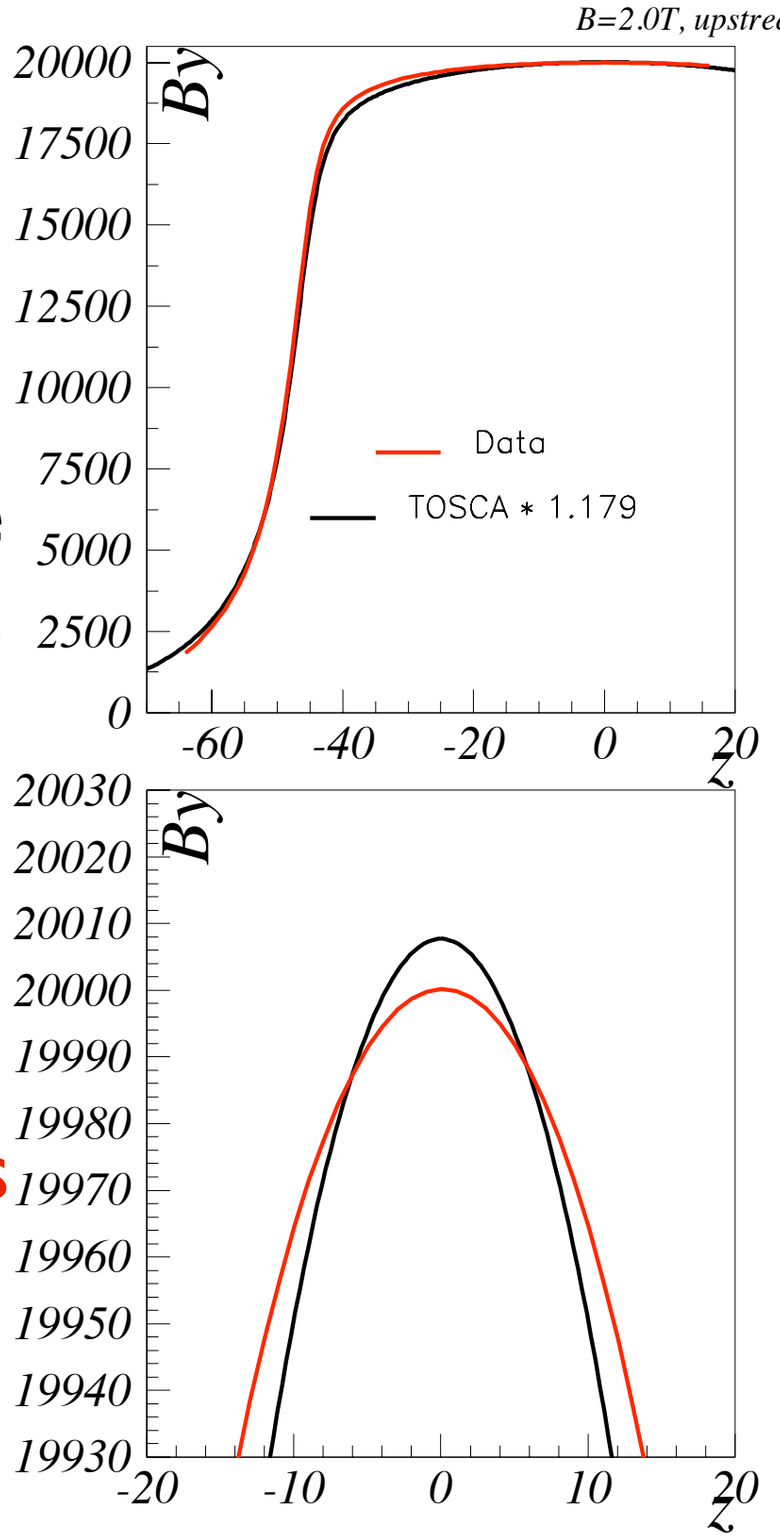
For up maps. Measured Bx, By and Bz components:

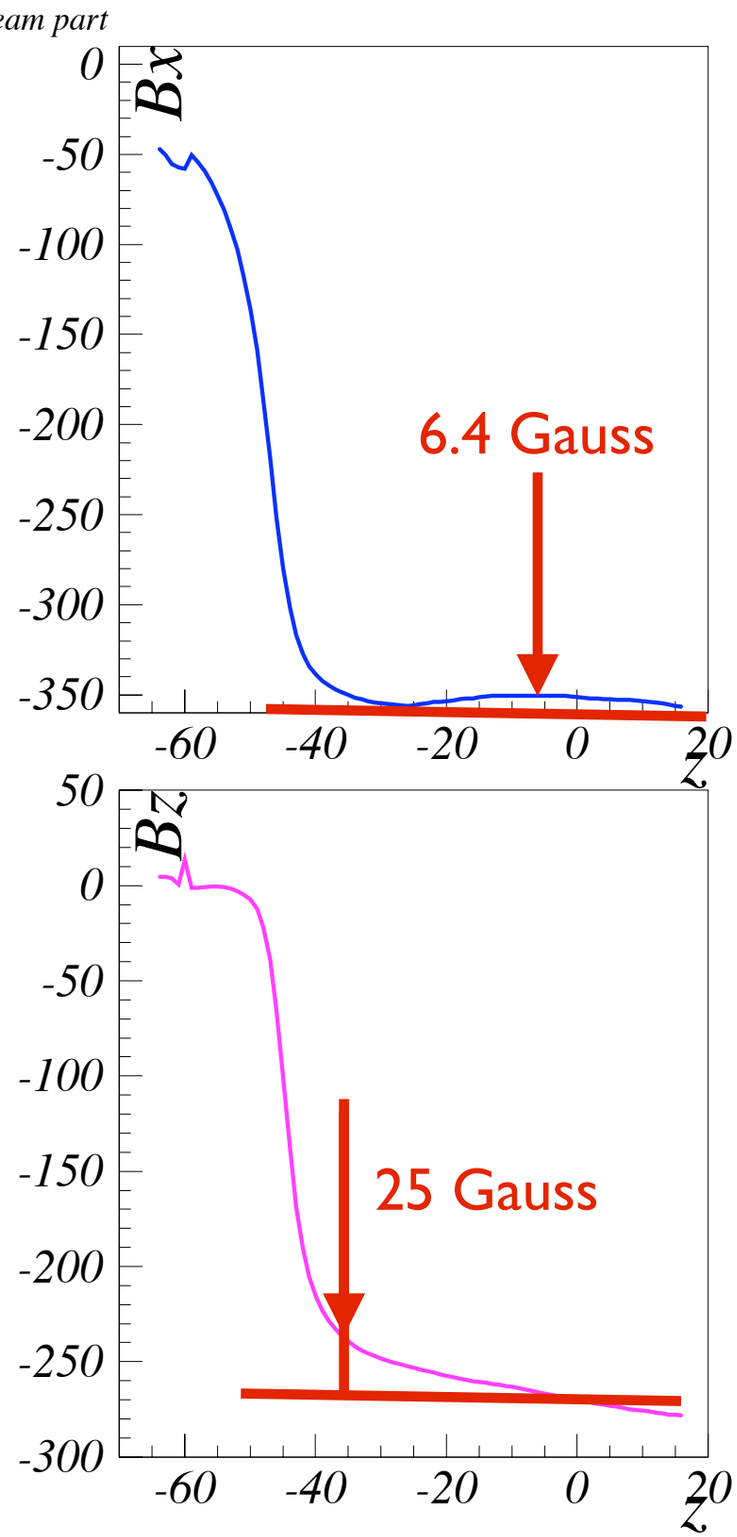
Main purpose: verify that probe angle does no change during mapping, or that rails are not tilted.

May help constrain TOSCA
(although so far only By from TOSCA).

The 6.4 Gauss and 25 Gauss are equivalent to 0.02° and 0.14°.

⇒ Negligible effect on By.





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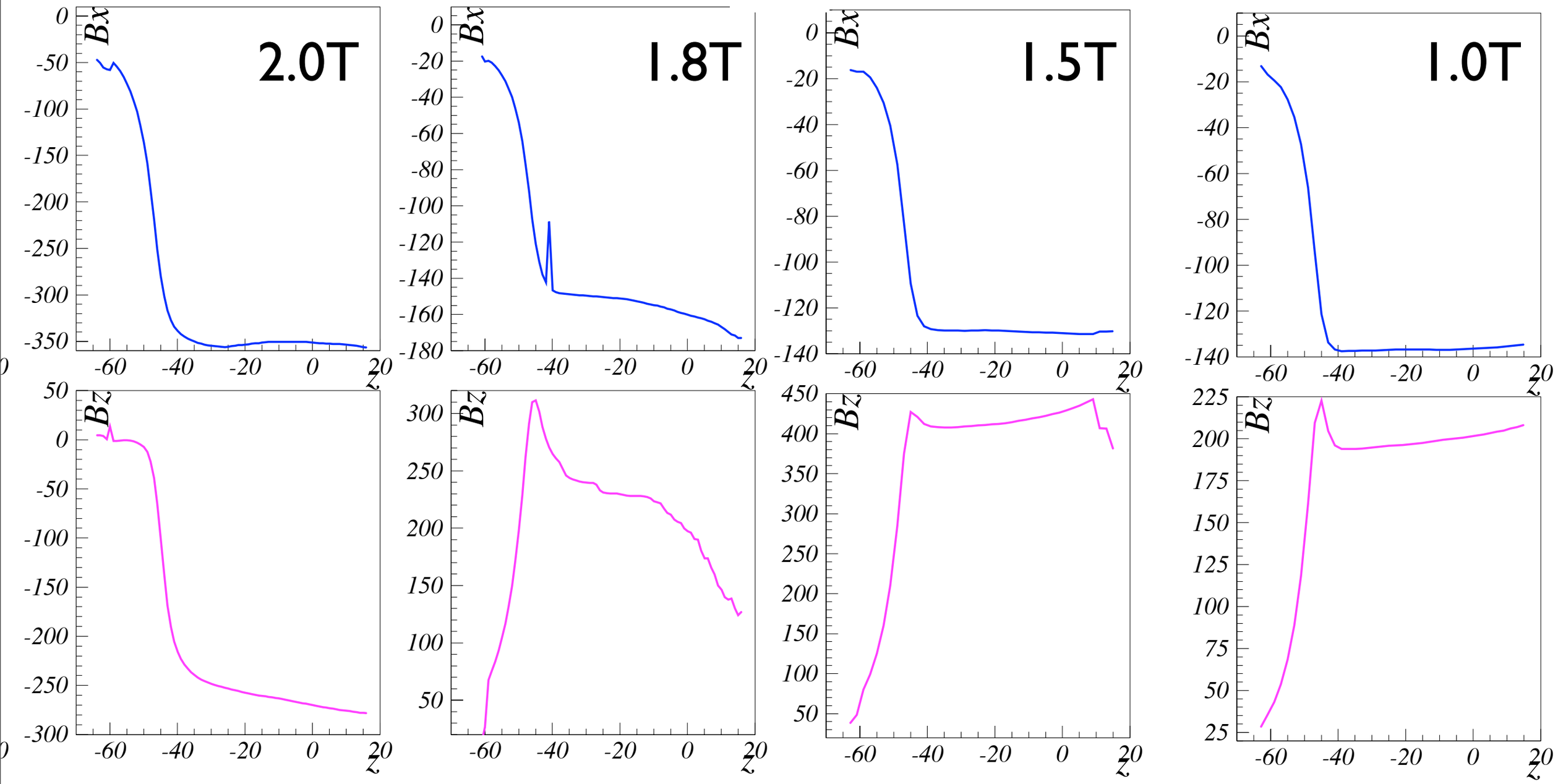
1D maps:



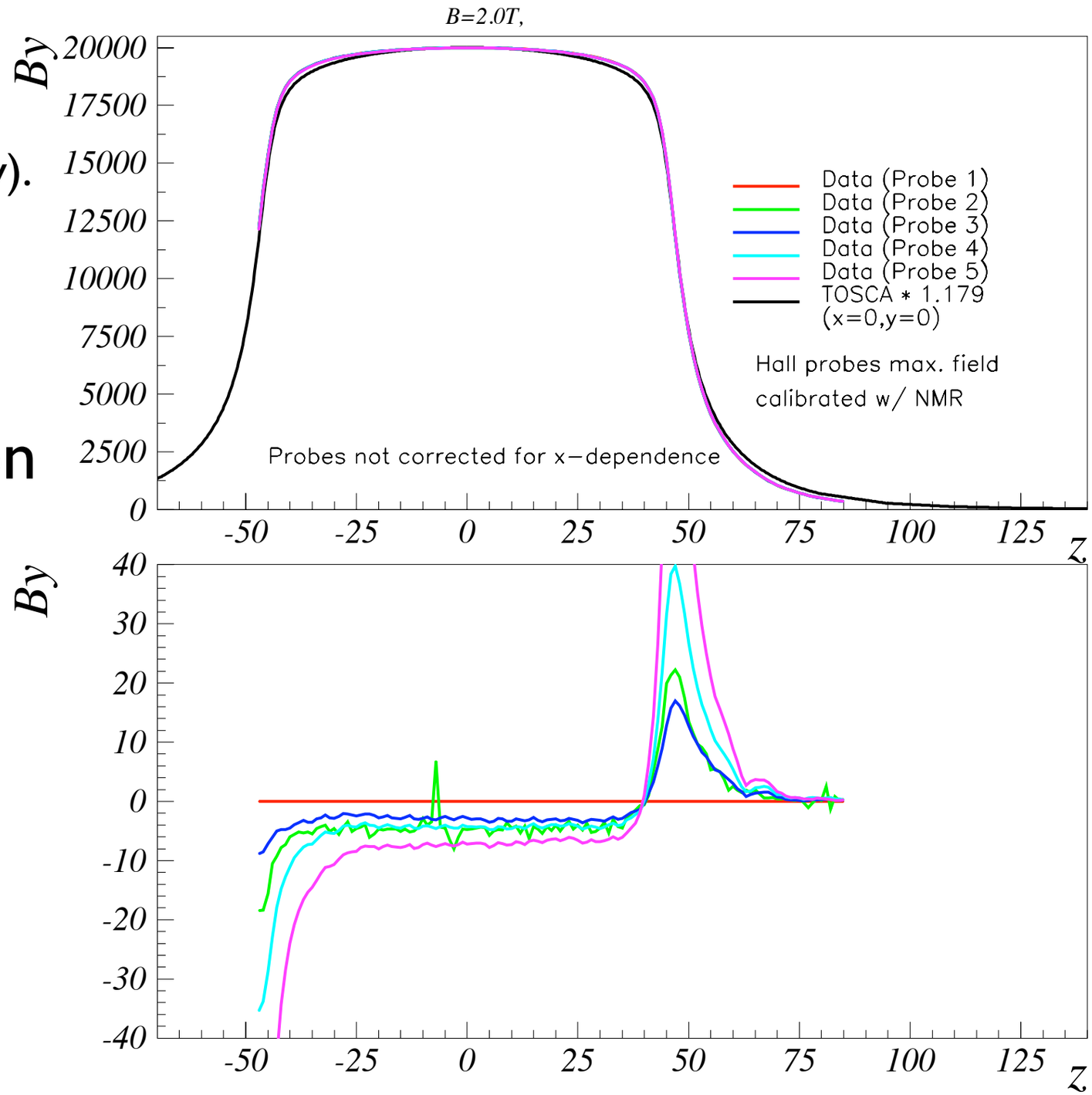
Other maps: Bz and Bx drifts imply negligible corrections to By. Profiles do not scale with current. Bz profile very different for 2.0T. Saturation effects?

Analysis (in progress)

1D maps:

Consistency of Hall probes for down mapping (all measured By).

Initial cross-calibration with NMR probe.
Zero probes before turning on magnet.



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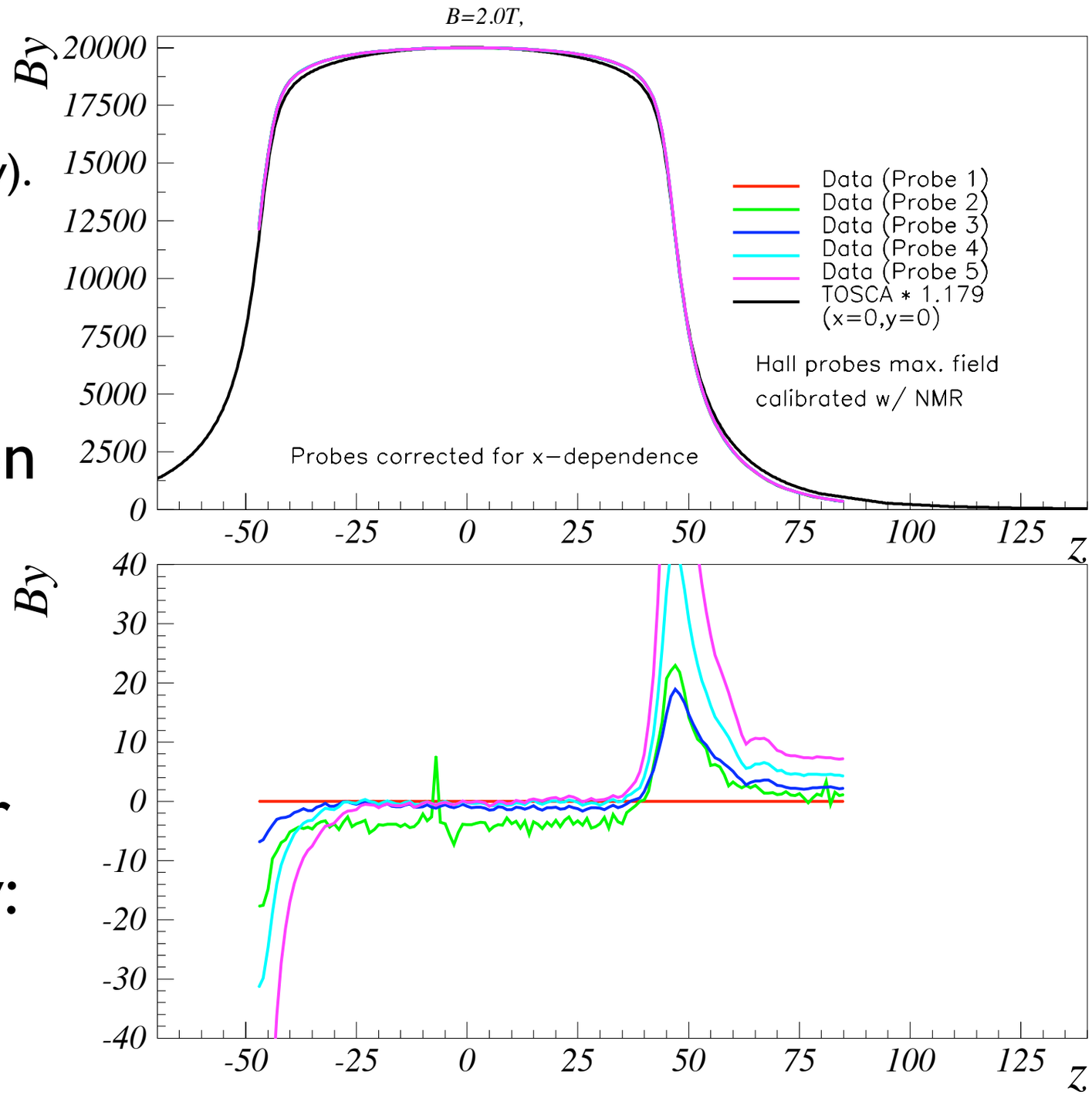
With correction for x-dependence of By:



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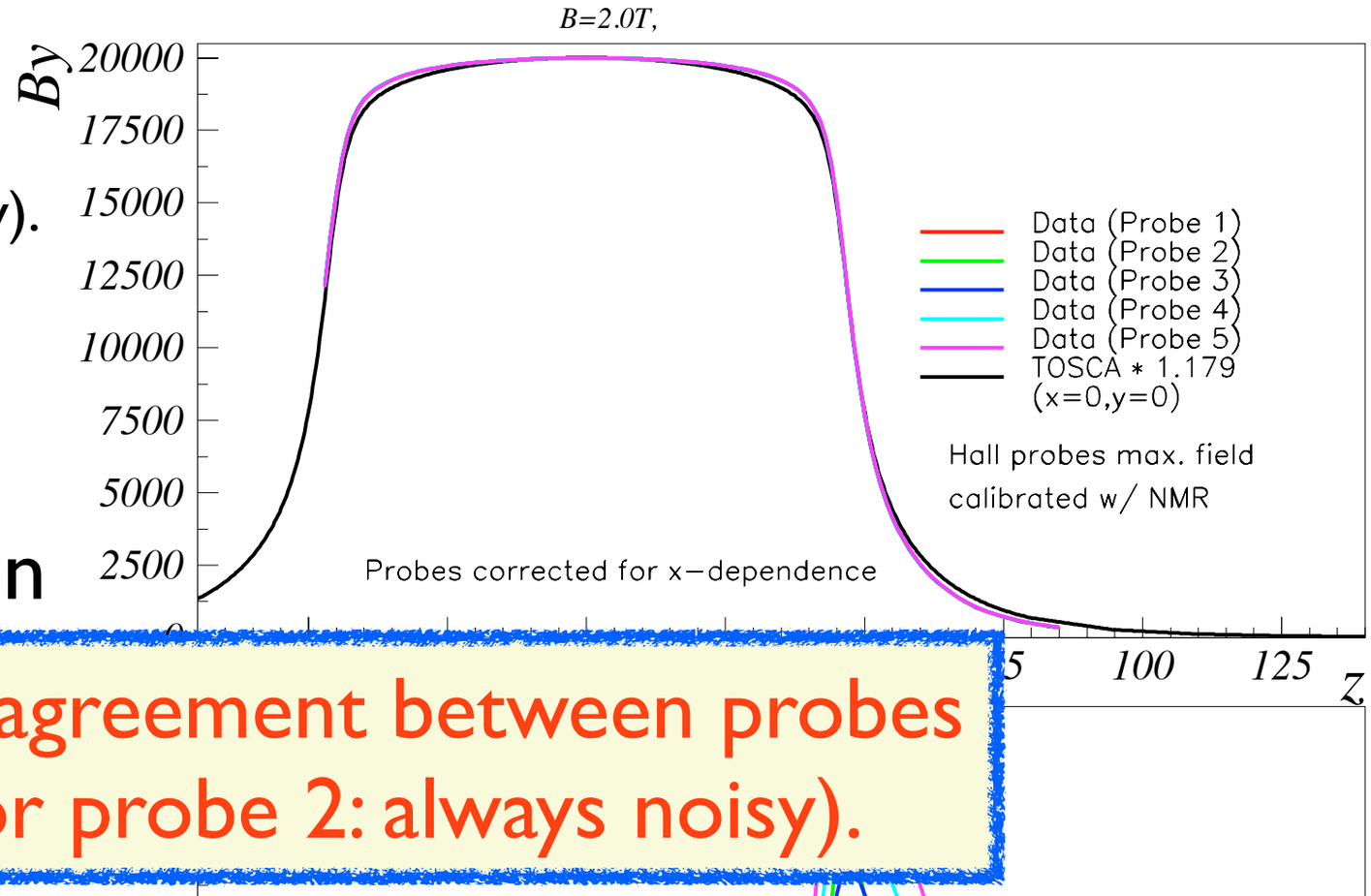
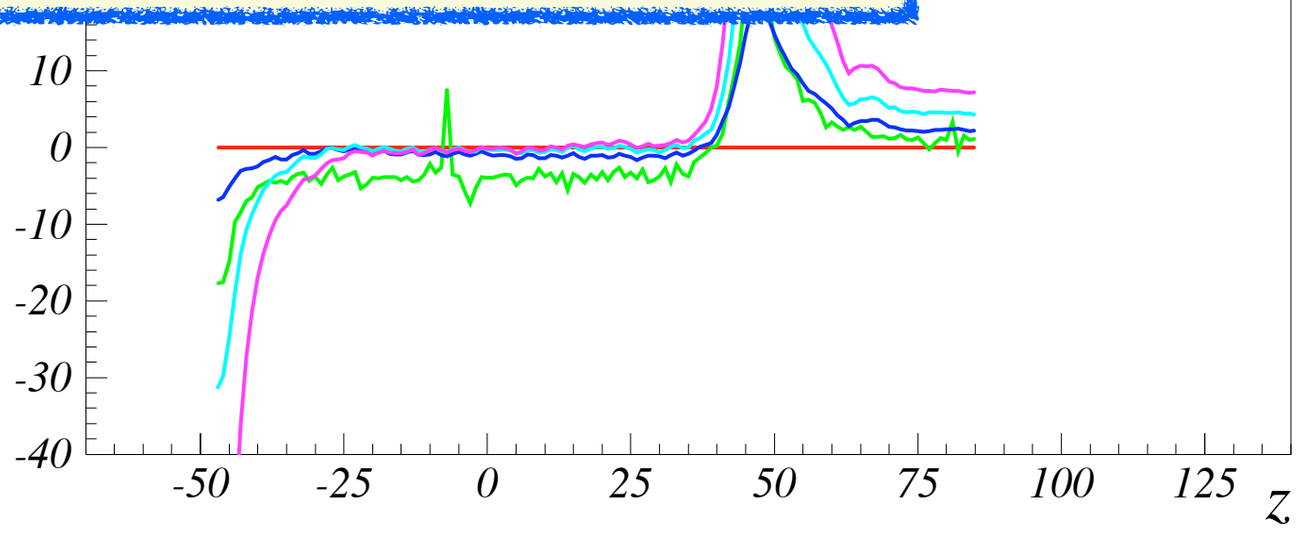


Very good agreement between probes (apart for probe 2: always noisy).

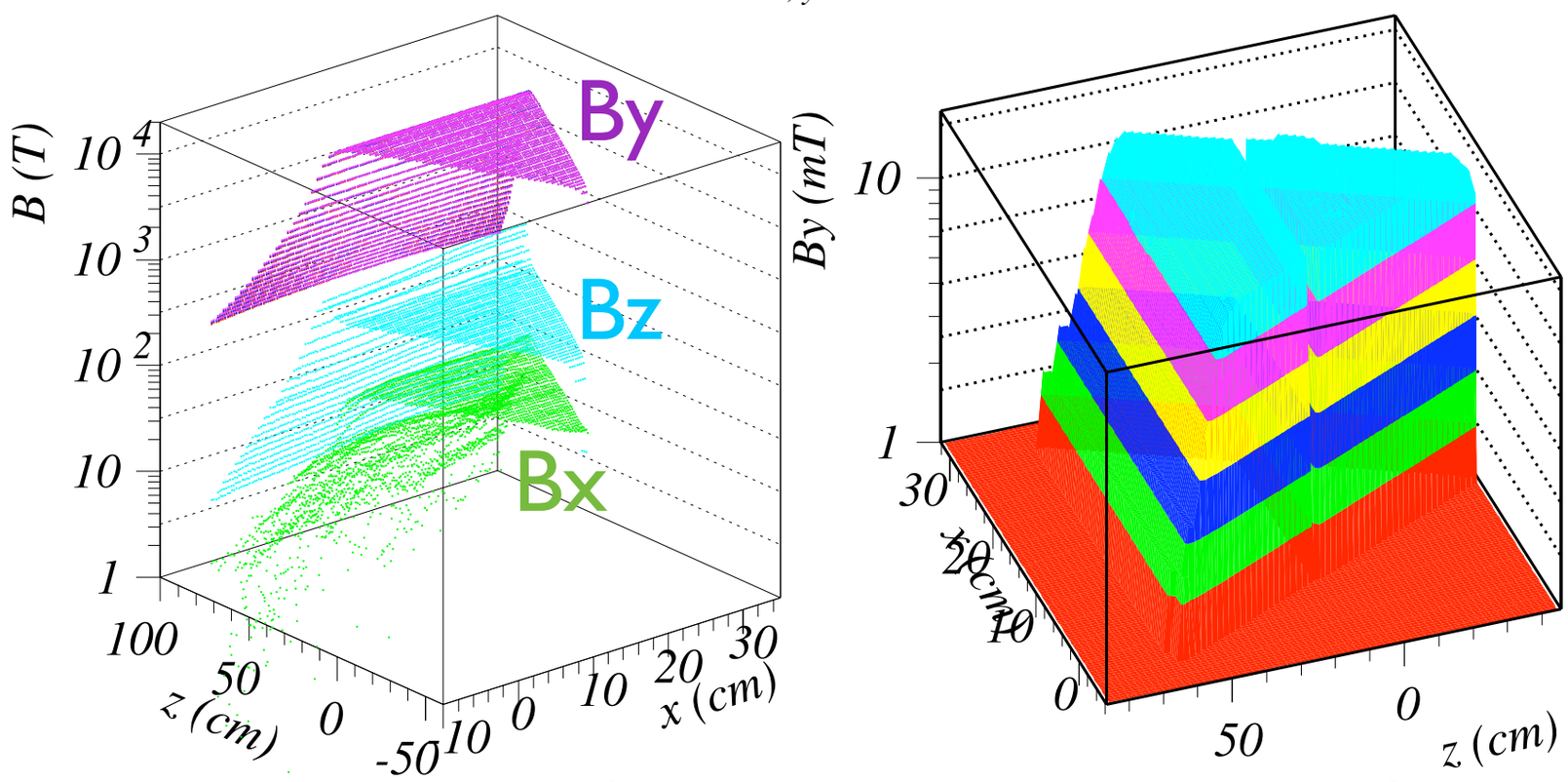
With correction for x-dependence of By:



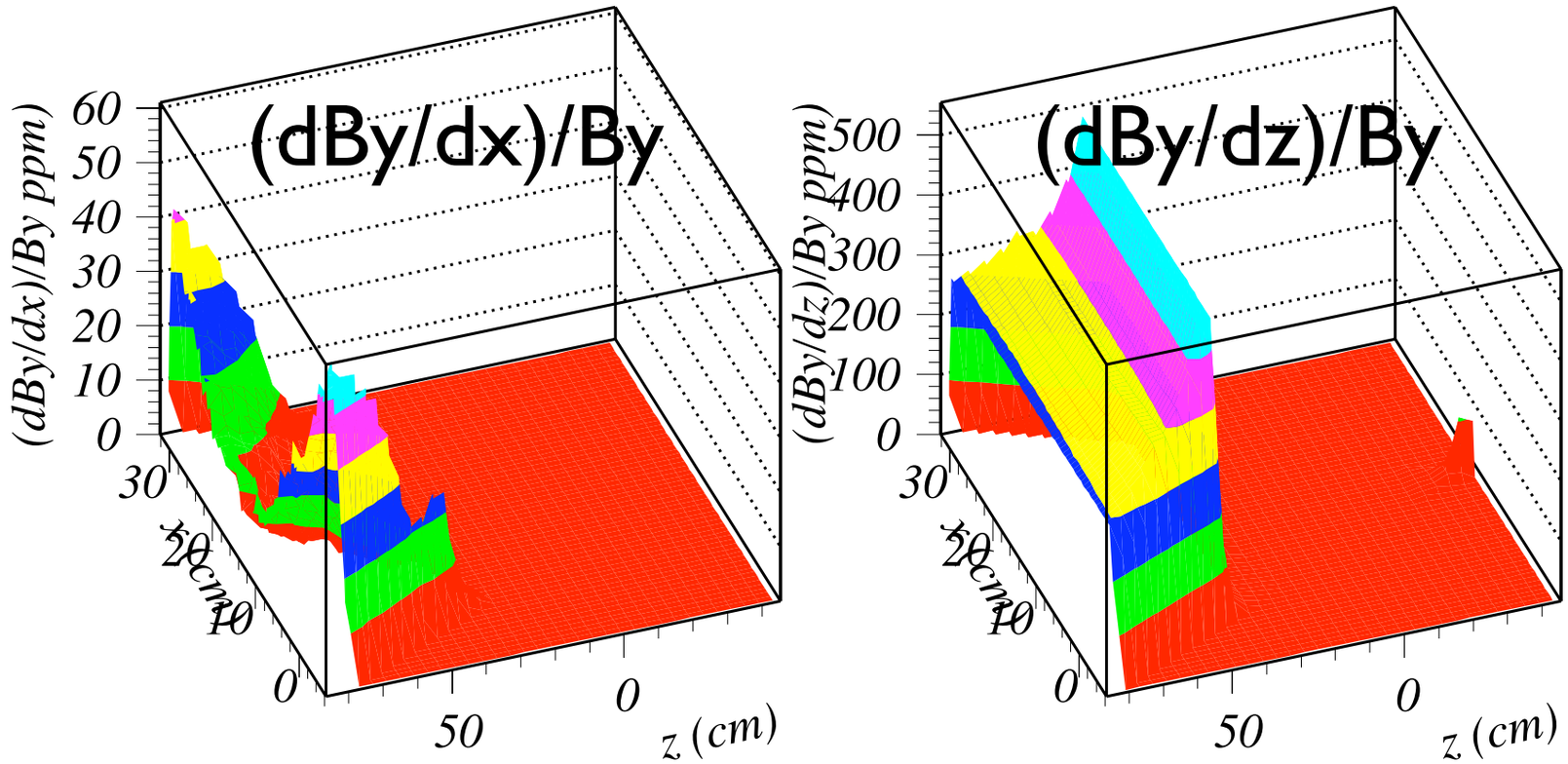
Analysis (in progress)

2D maps:

1.8T



Norm. fields gradients:

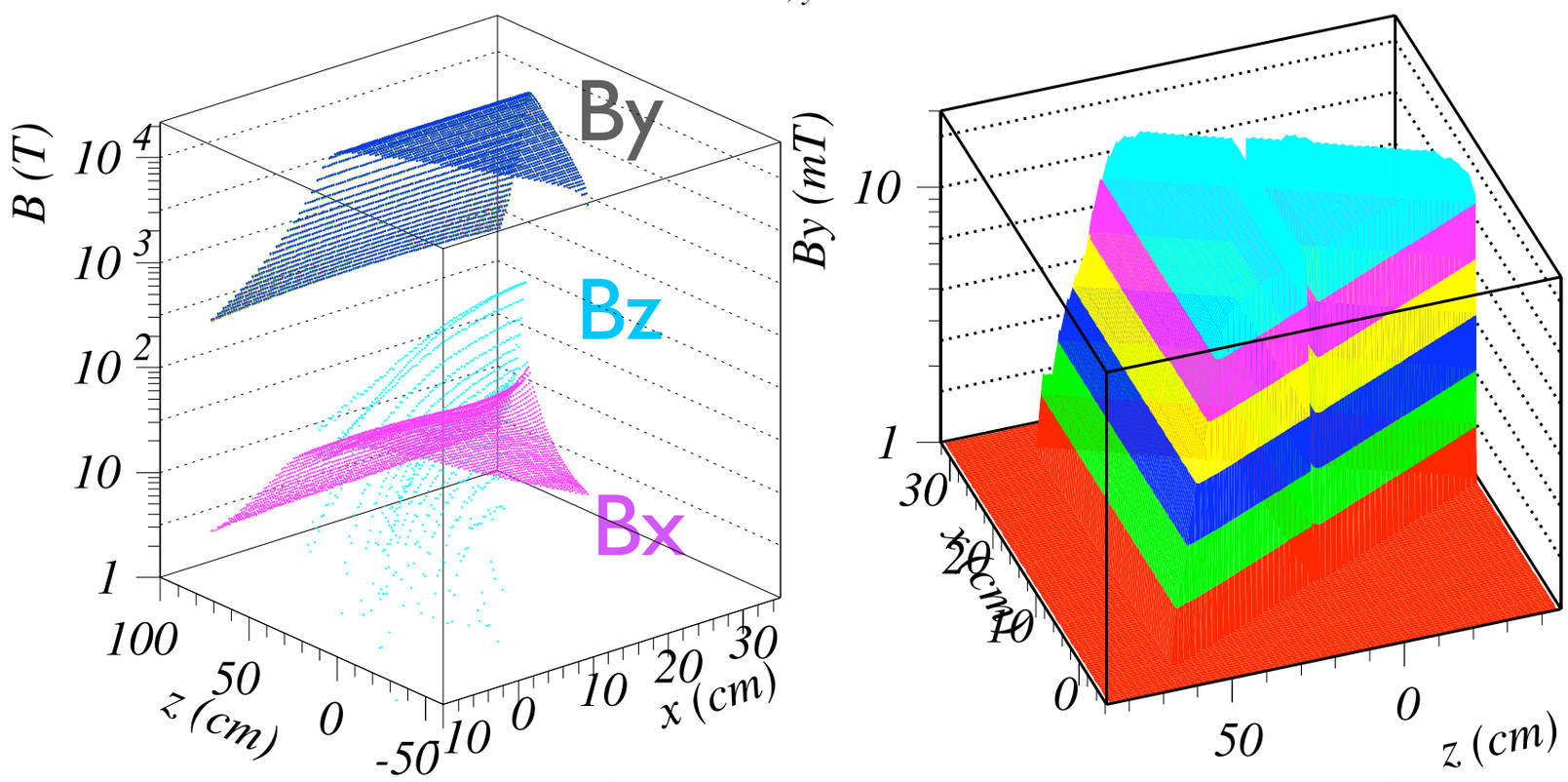


Gradient values rule out simple NMR probe installation for Pair Spec. field monitoring.

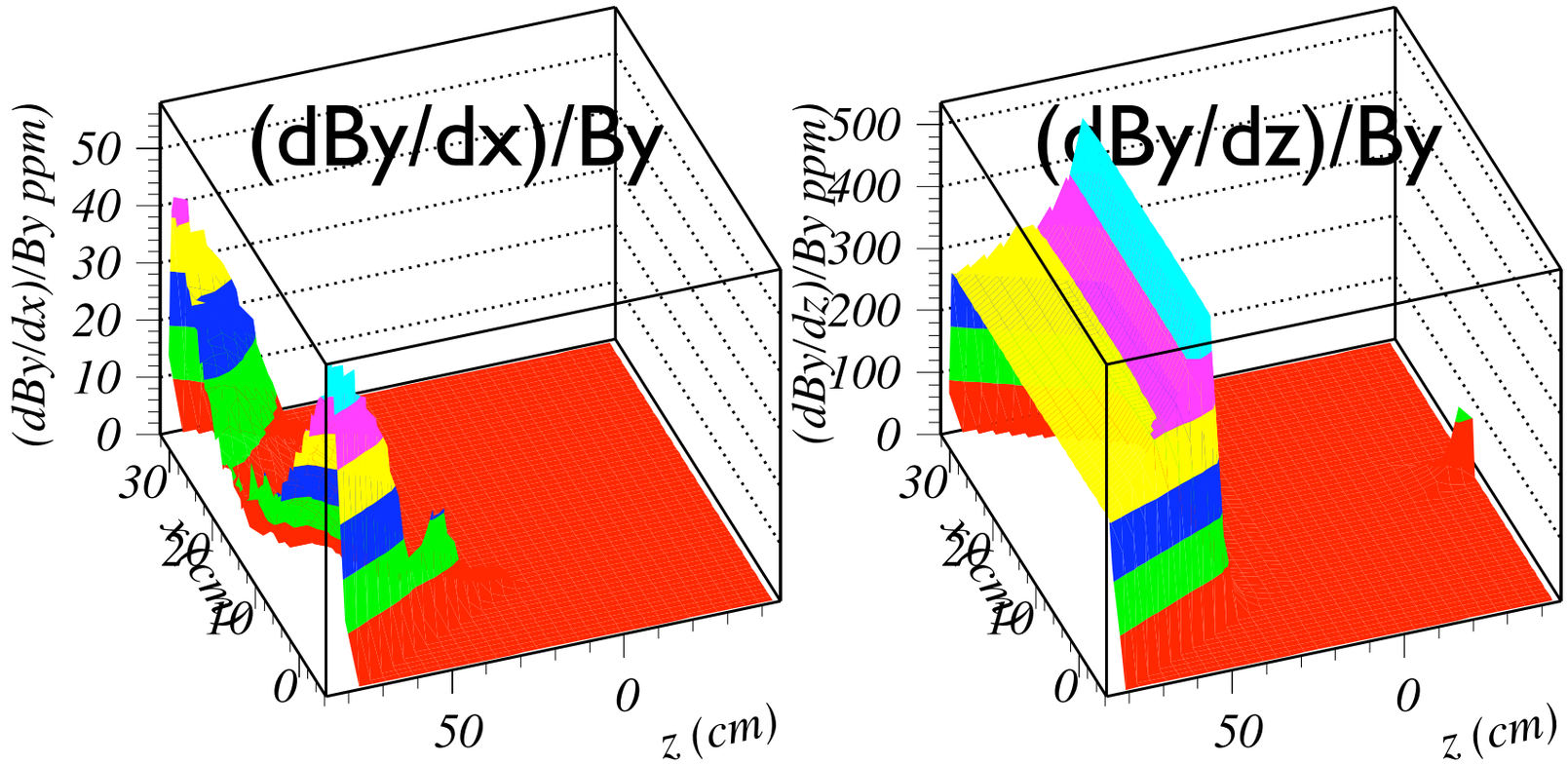
Analysis (in progress)

2D maps:

2.0T



Norm. fields gradients:



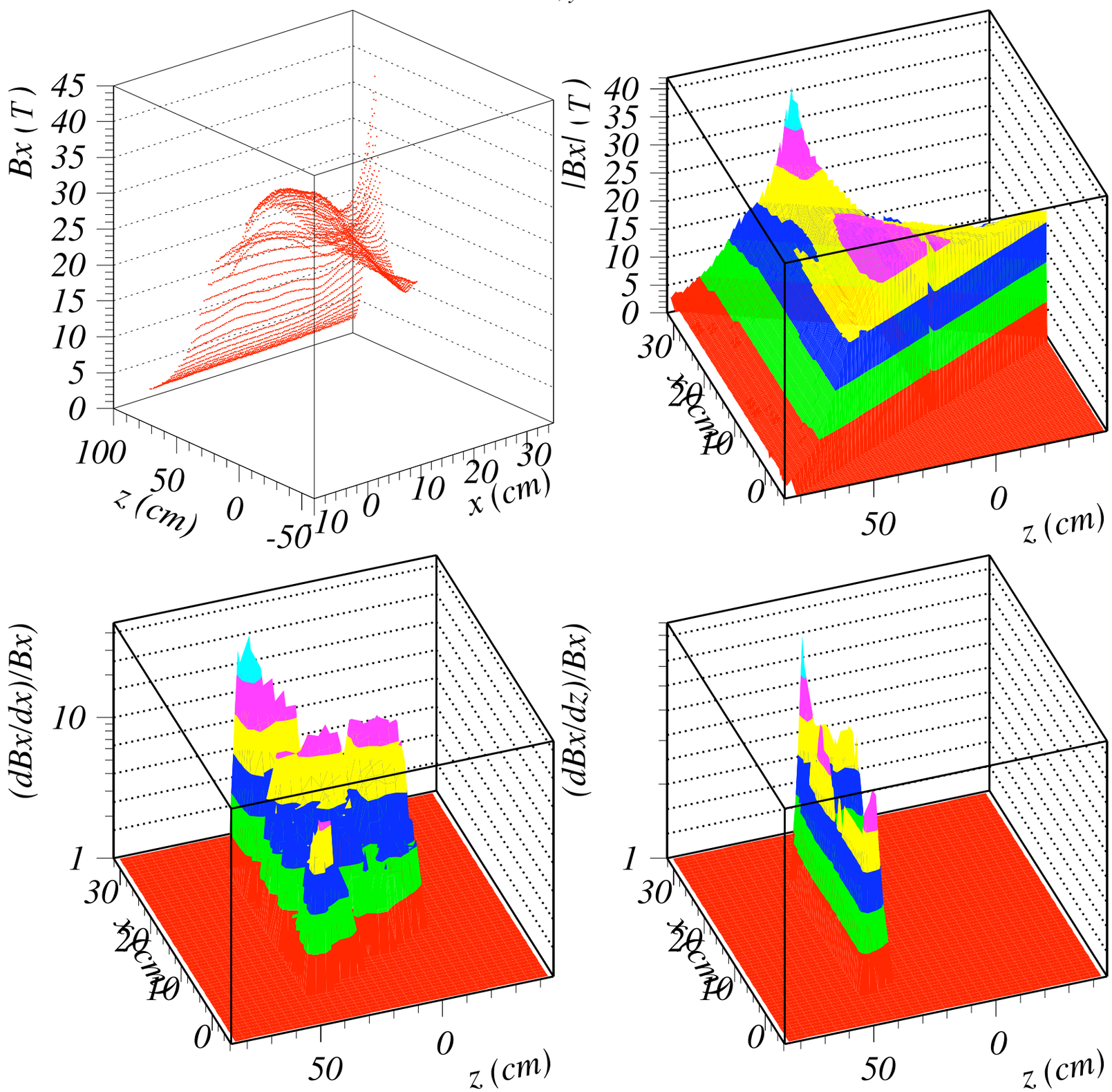
Gradient values rule out simple NMR probe installation for Pair Spec. field monitoring.

Analysis (in progress)

2D maps:

Small component: Bx

2.0T

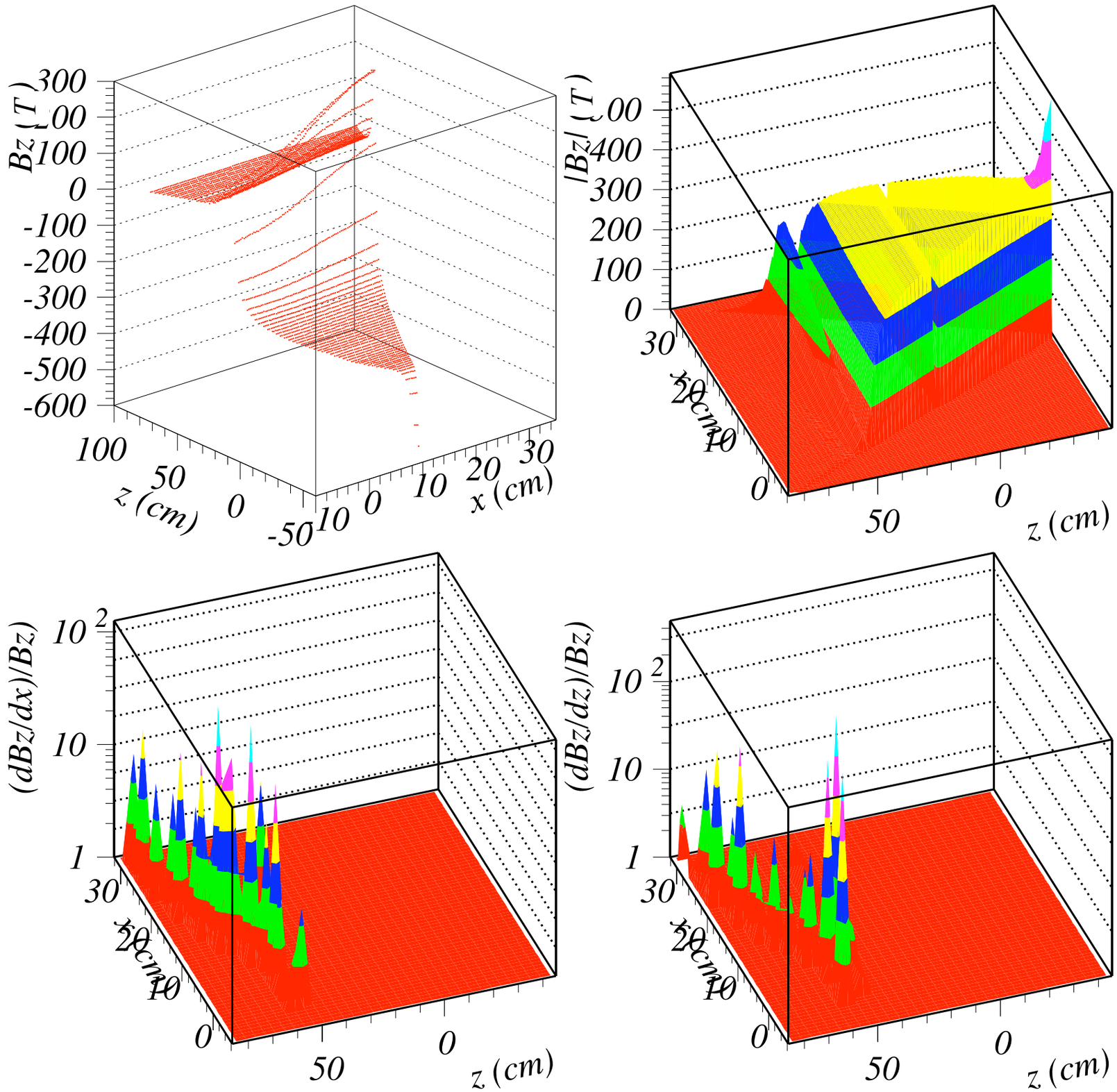


Analysis (in progress)

2D maps:

Small component: Bz

2.0T



Conclusions

Data taking done.

Preliminary analysis shows that data quality is good.

2D maps under analysis.

Comparison with TOSCA reveals large differences. Wrong material used in TOSCA.

Not available yet:

- **New Tosca calculations.** (Then need to compare and adjust input geometry)
- **Survey report.** (Survey did find that rails were inclined).