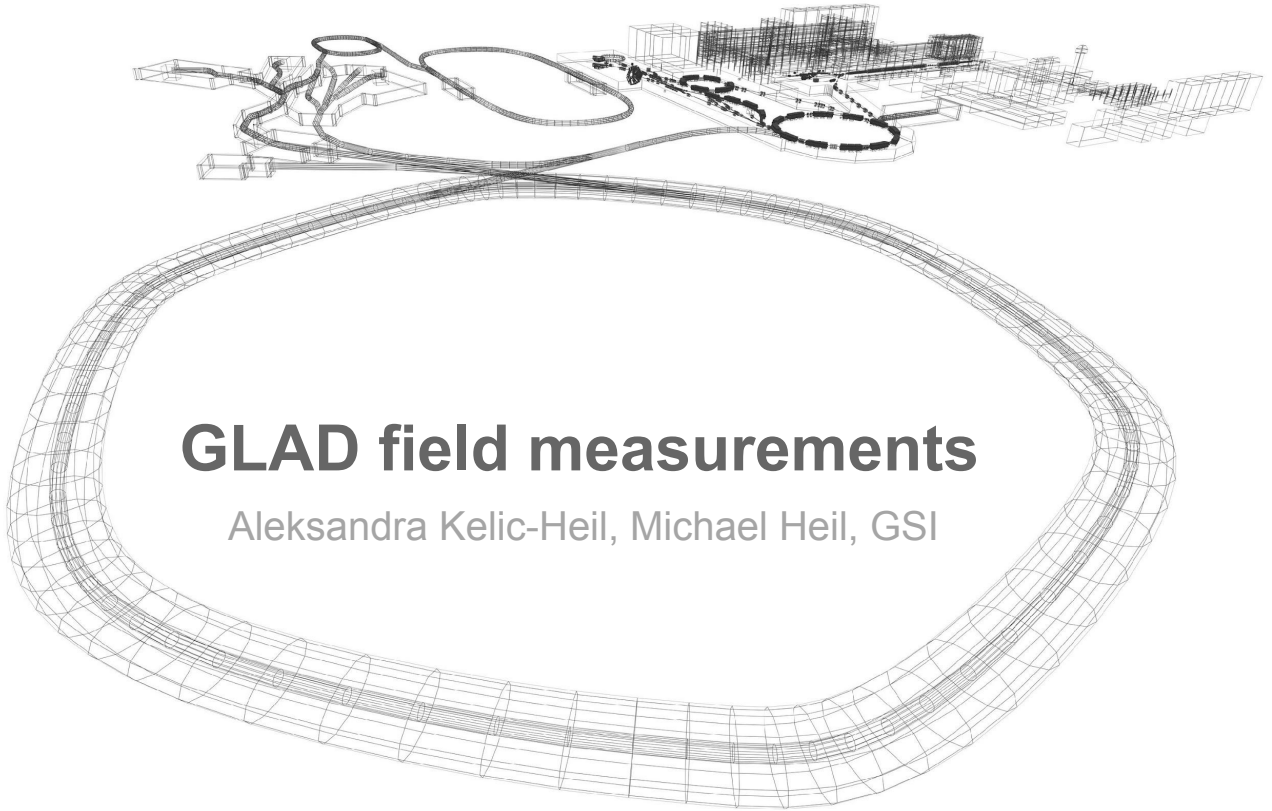


GLAD field measurements

Aleksandra Kelic-Heil, Michael Heil, GSI

Momentum tracking with GLAD

Our goal is a momentum resolution of 10^{-3} which implies also:

$$\Delta(B\varrho)/(B\varrho) < 1e^{-3}$$

Tab. 1: *GLAD parameters*

integrated field	4.8[T·m]
fringe filed at the target position	<20[mT]
vertical acceptance	±80[mrad]
horizontal acceptance	40[degree]
operational temperature	4.6[K]
momentum resolution ΔP/P	10^{-3}

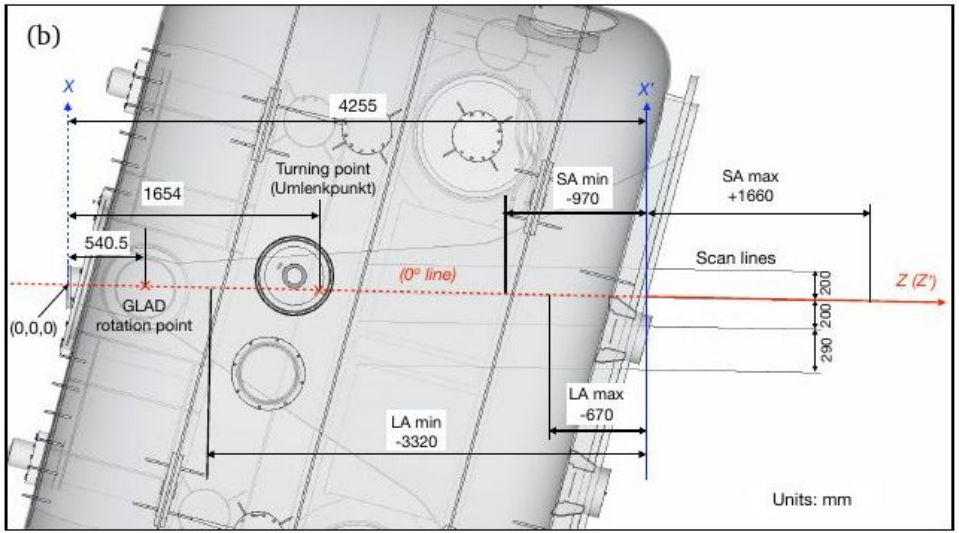
So far, we have only a calculated field map, is it good enough?

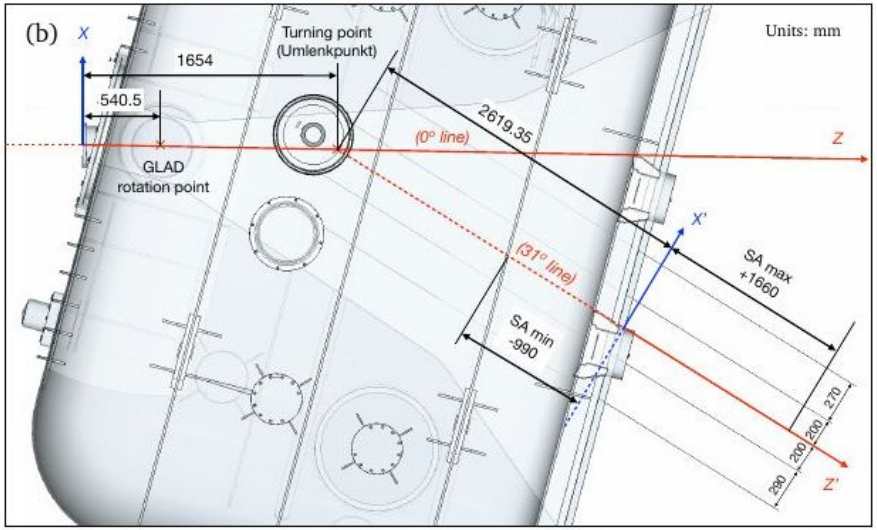
Review - field measurements in 2022

GSI Magnet Laboratory
Franz Klos, Thomas Knapp, Mischa Weipert

Review - field measurements in 2022

The field of GLAD was measured by the GSI Magnet Laboratory with a hall probe.

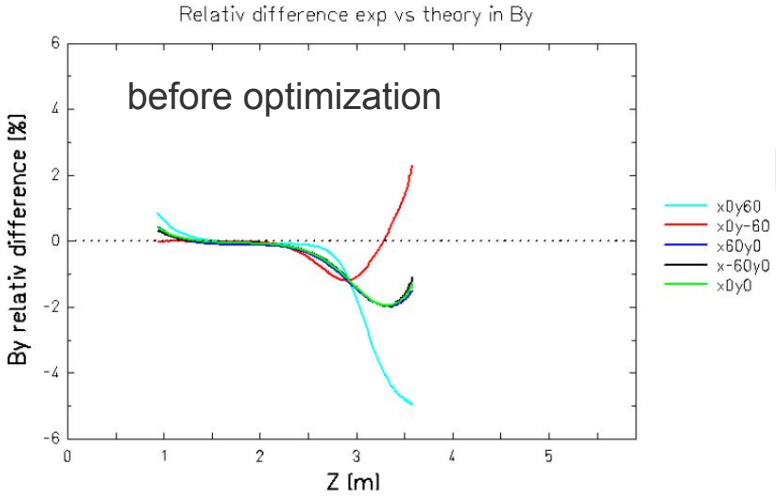


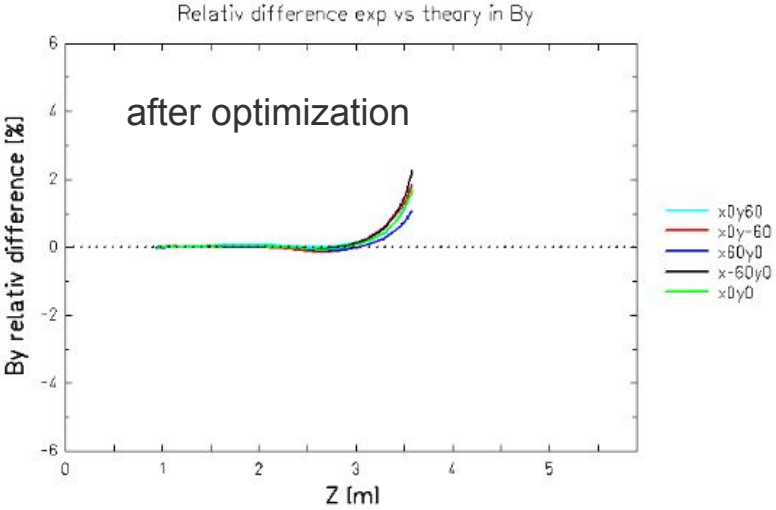


Review - field measurements in 2022

Measurements of the field showed deviations. A fit of the GLAD position parameters brought a better agreement.

	Default values	2022 data
xpos / cm	0	0.8319076
ypos / cm	0	-1.459939
zpos / cm	174.95	174.5731
angleX / deg	0	-0.09277743
angleY / deg	14	-14.18537
angleZ / deg	0	-0.5197361
scale	1	1.000470
chi2	-	0.029719

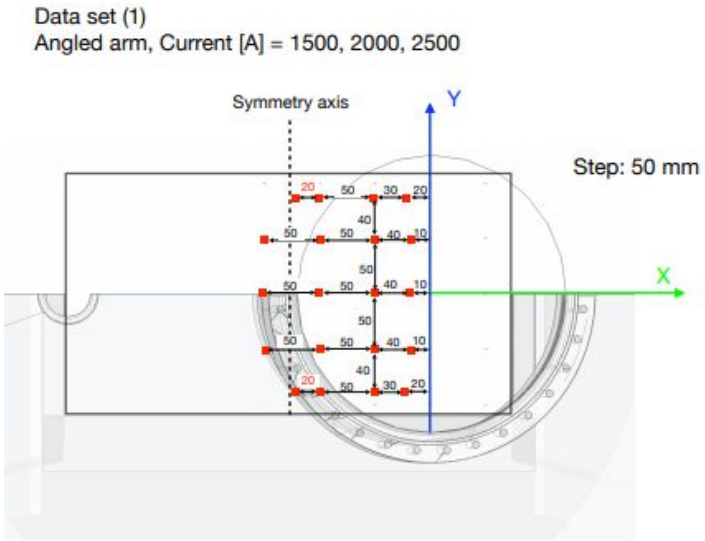


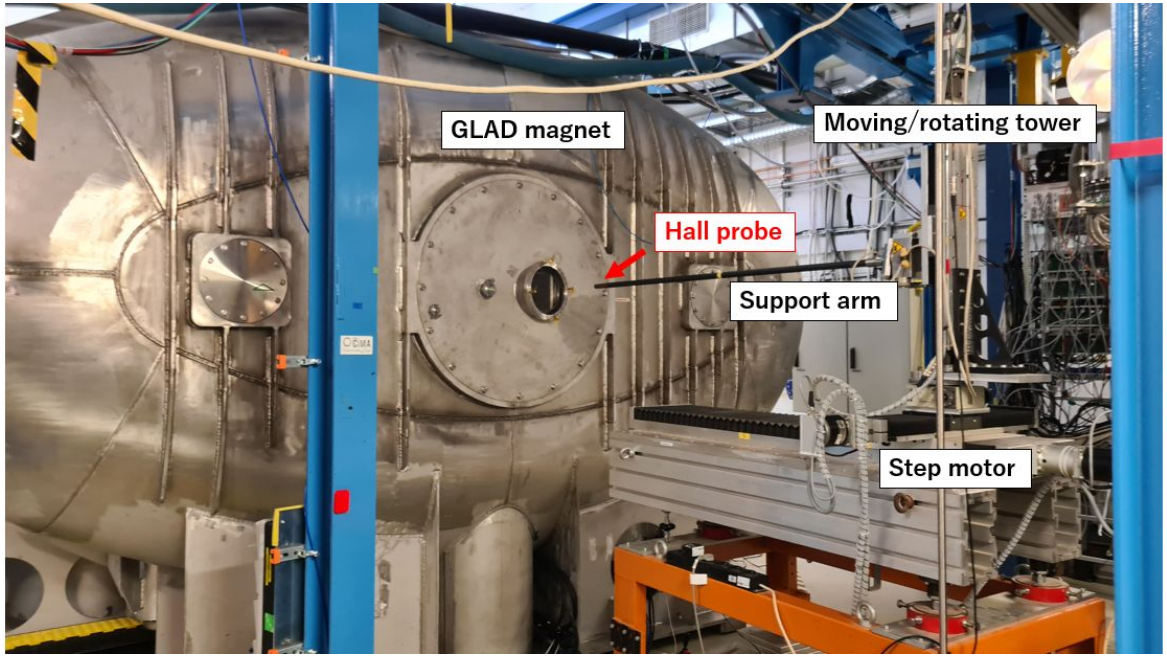


Conclusion: We need to measure at the position where the field is highest and we need to measure in the system of GLAD.

Field measurements in 2023

The field of GLAD was measured by the GSI Magnet Laboratory with a hall probe.

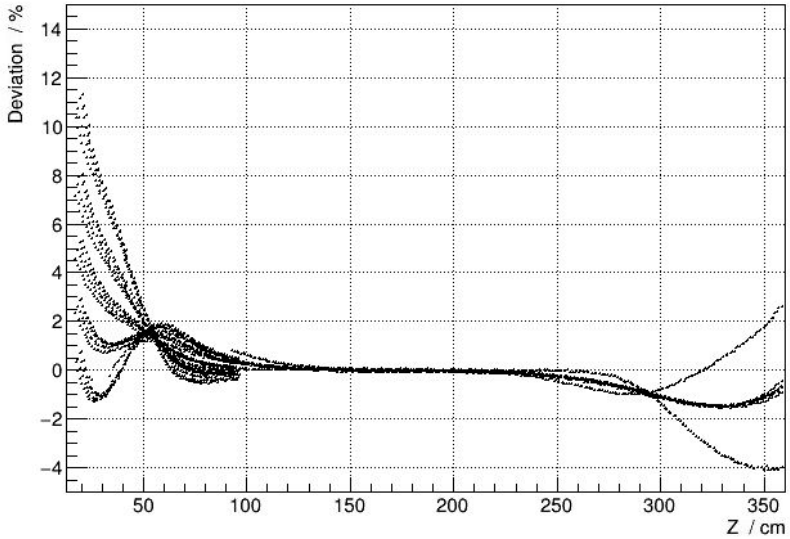


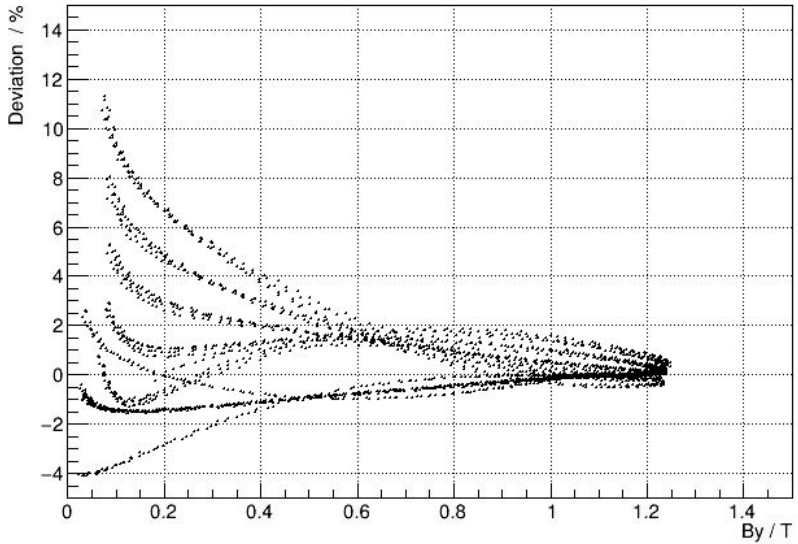


Franz Klos, Thomas Knapp, Mischa Weipert

Deviations from theory before optimization

Deviations between measurements (2022 and 2023) and theory before optimization - left as a function of z, right as a function of By.



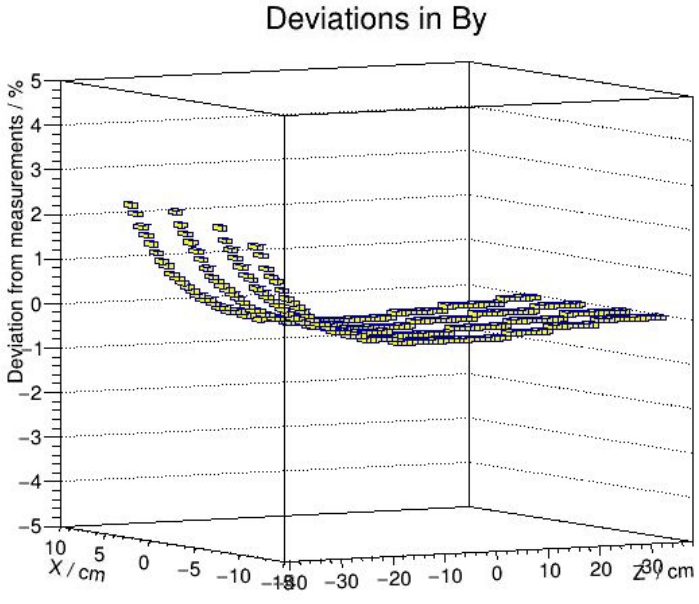


Field measurements in 2023

Measurements of the field showed deviations. Again, a fit of the GLAD position parameters brought a better agreement.

But the parameters are not in good agreement!

	Default values	2022 data	2023 data
xpos / cm	0	0.8319076	0.3625670
ypos / cm	0	-1.459939	-0.9888483
zpos / cm	174.95	174.5731	174.6339
angleX / deg	0	-0.09277743	0.1553476
angleY / deg	14	-14.18537	-14.41576
angleZ / deg	0	-0.5197361	-0.02033860
scale	1	1.000470	0.9987449
chi2	-	0.029719	0.2318



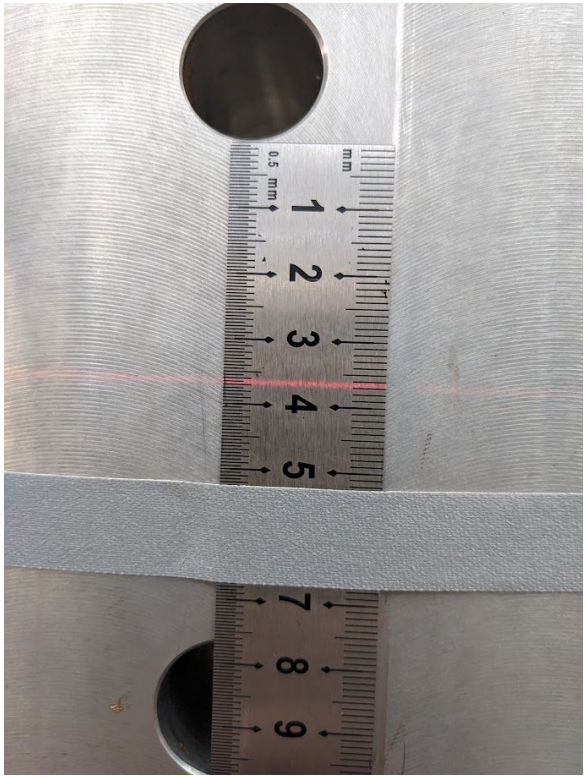
GLAD position in Cave C

Comparison between the position of GLAD we obtained from the optimization of the magnetic field and direct measurements in Cave C.

	Measured	2022 optim	2023 optim
angleX / deg	0.0419	-0.09277743	0.1553476
angleZ / deg	-0.1464	-0.5197361	-0.02033860

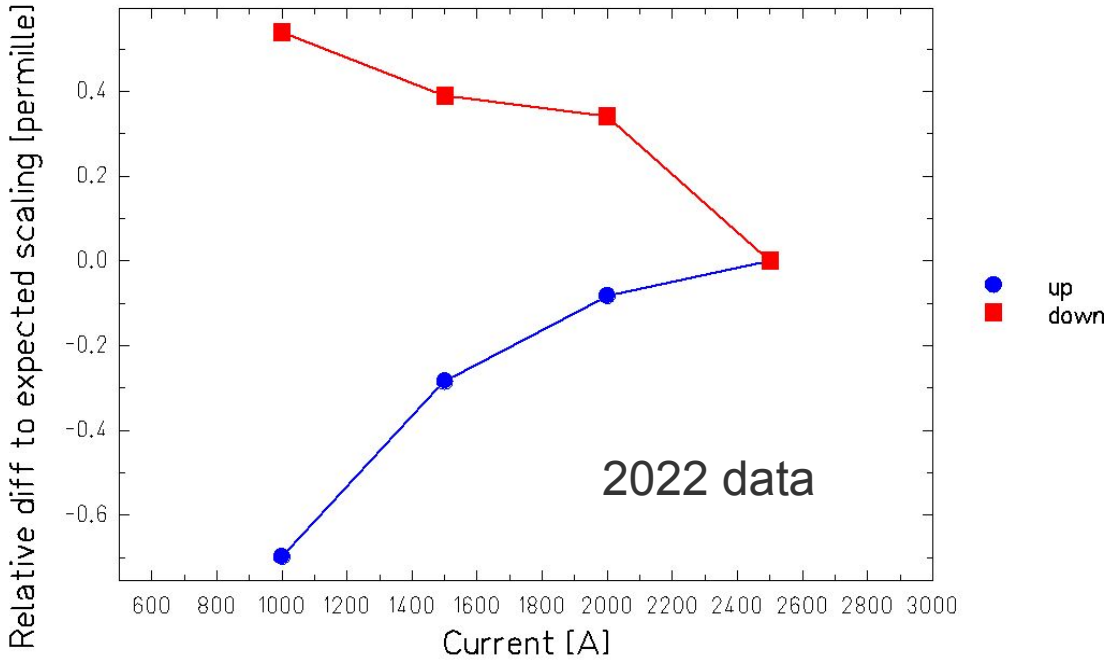
A z-angle of 0.52° would correspond to 40.8 mm difference for the exit flange on left and right.

A x-angle of 0.155 corresponds to 11.1 mm difference for the height of entrance and exit flange.



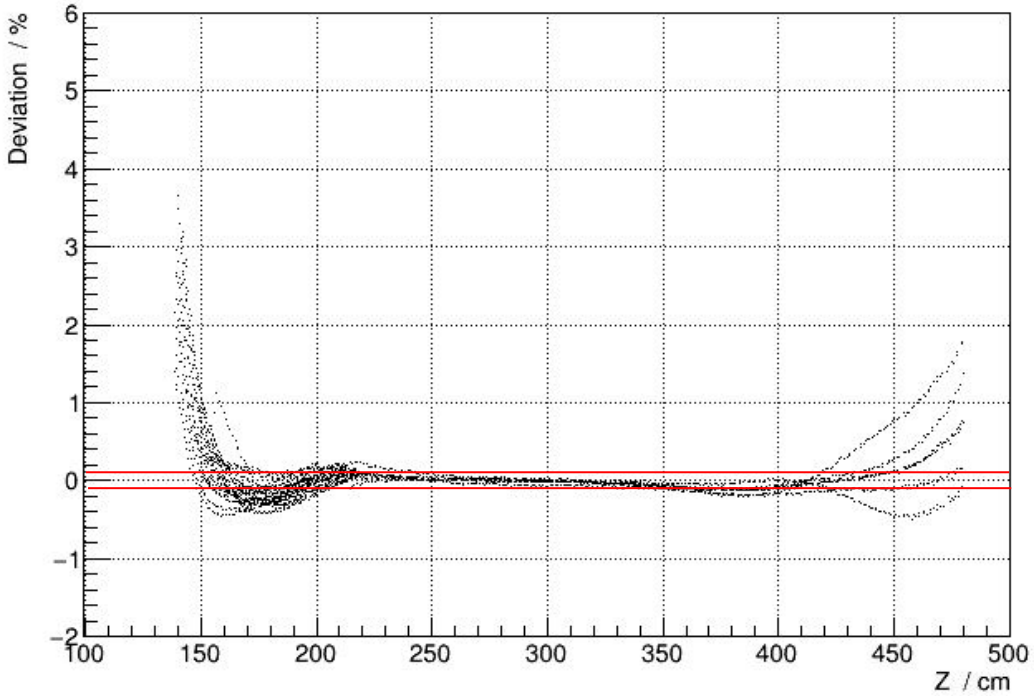
In summary

We do see hysteresis (see also report by summer student Rika Danjo for 2023 data)
:



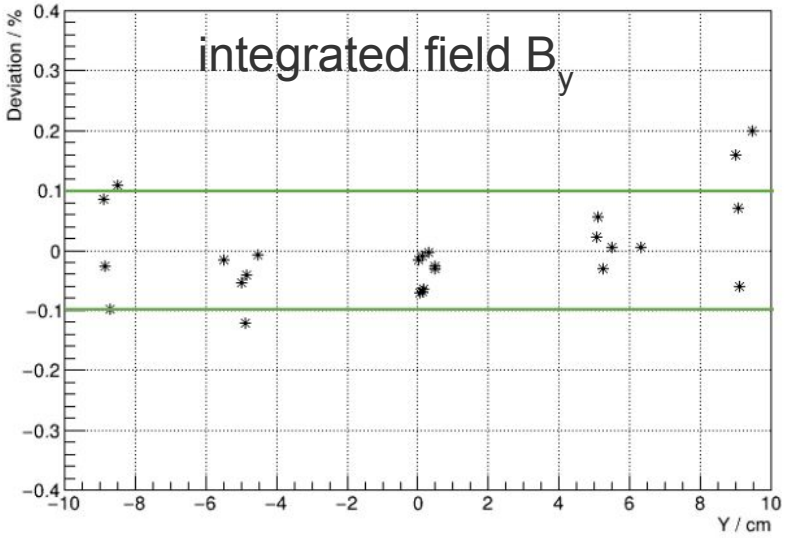
In summary

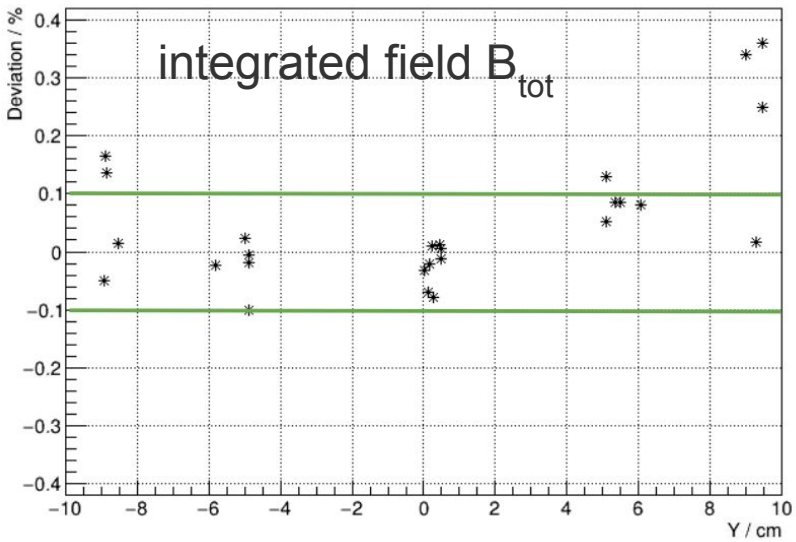
Deviations get larger when one approaches the borders of the magnet:



In summary

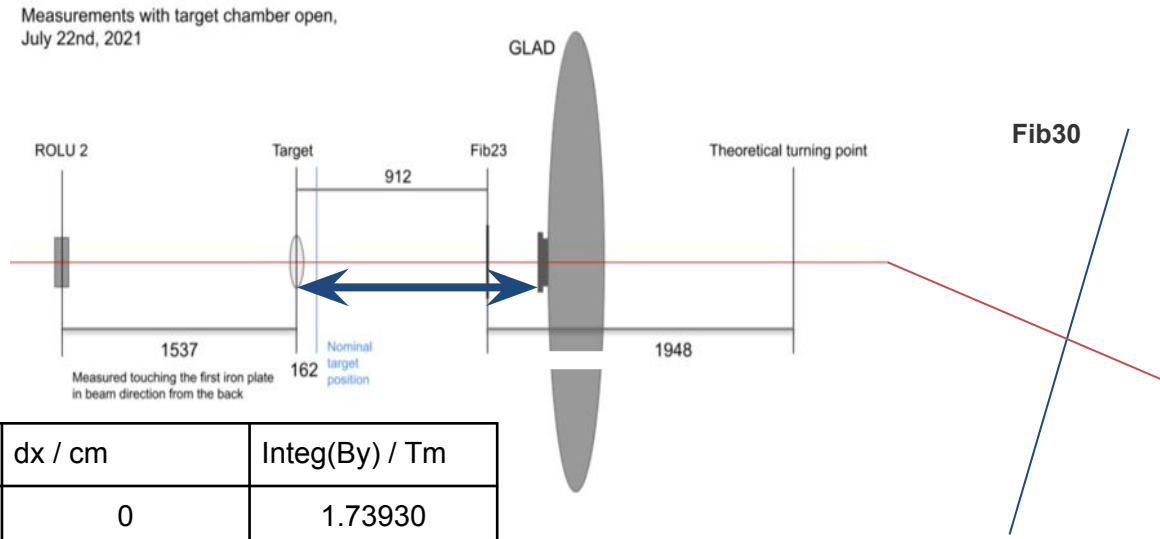
Only at the center the integrated field values have the necessary accuracy.





Simulations and tracking

We do a simulation with the theoretical field, and then track the particle with modified field.

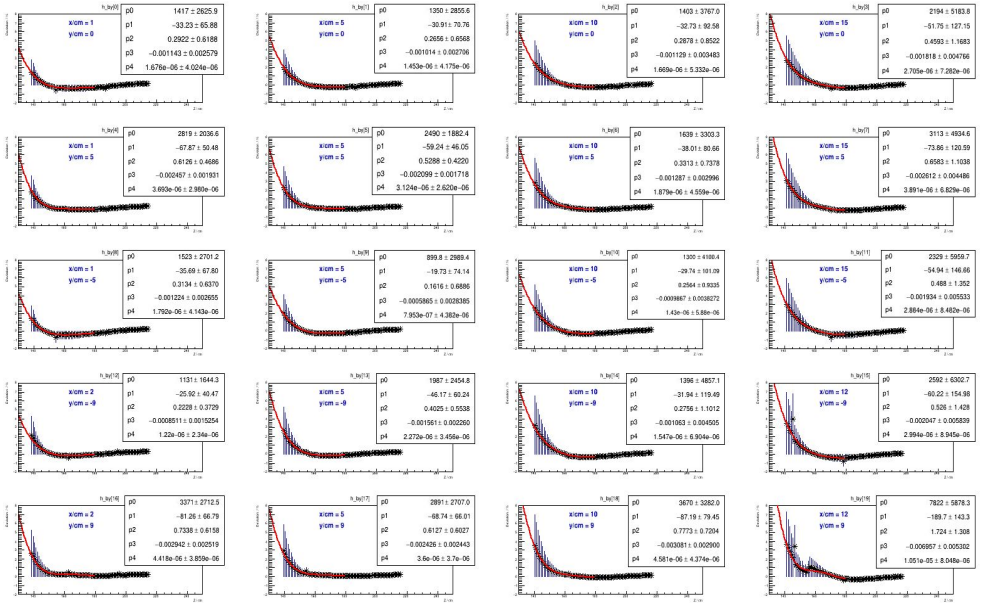


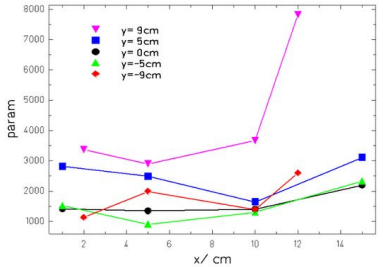
Fringe field	Tracker dp / %	xFi30 / cm	dx / cm	Integ(By) / Tm
By_true	0.02	-66.96	0	1.73930
By * 2	0.38	-67.21	0.25	1.73887
By * 1.3	0.12	-67.04	0.08	1.73915
By * 1.2	0.09	-67.01	0.05	1.73920
By * 0.7	0.08	-66.92	-0.04	1.73943

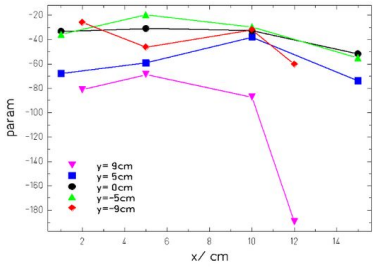
Difference in integrated By < 0.03%

Attempts to correct the theoretical field

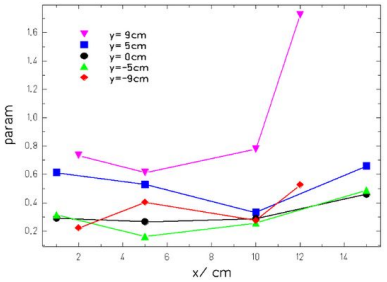
We tried to fit the deviations with polynomials of 4th degree but the tracking results outside the measured range were worse. We would need more data points for that.



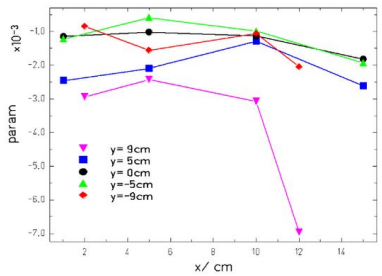




Parameter2



Parameter3

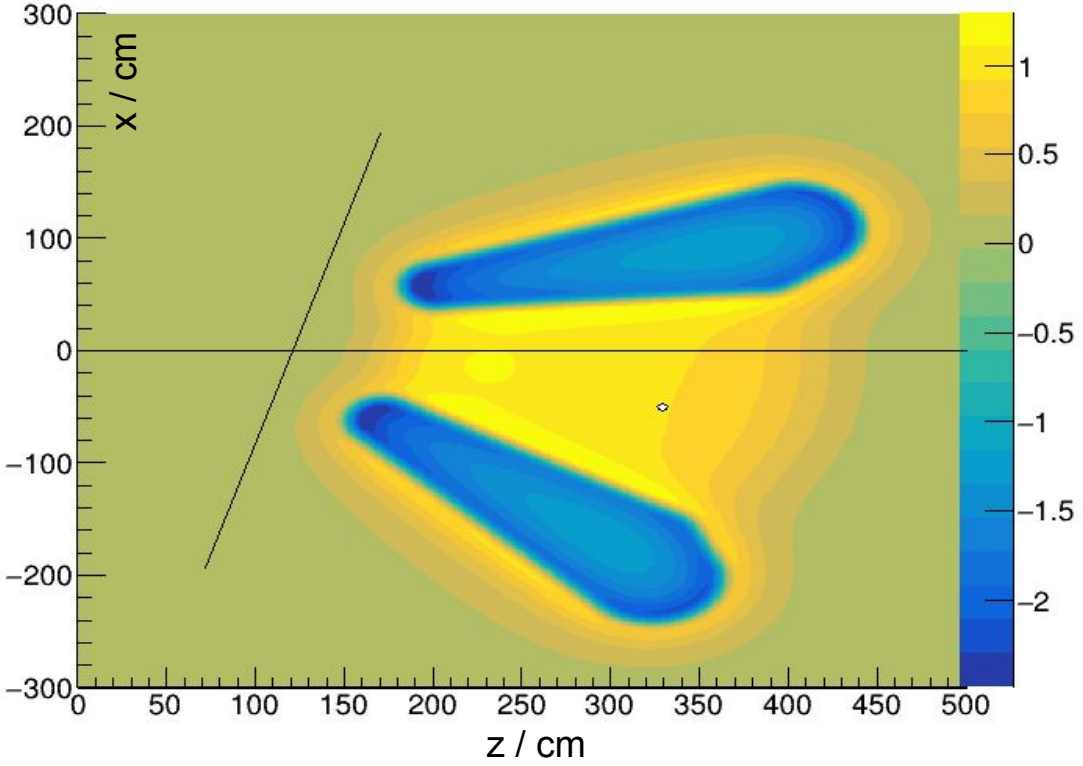


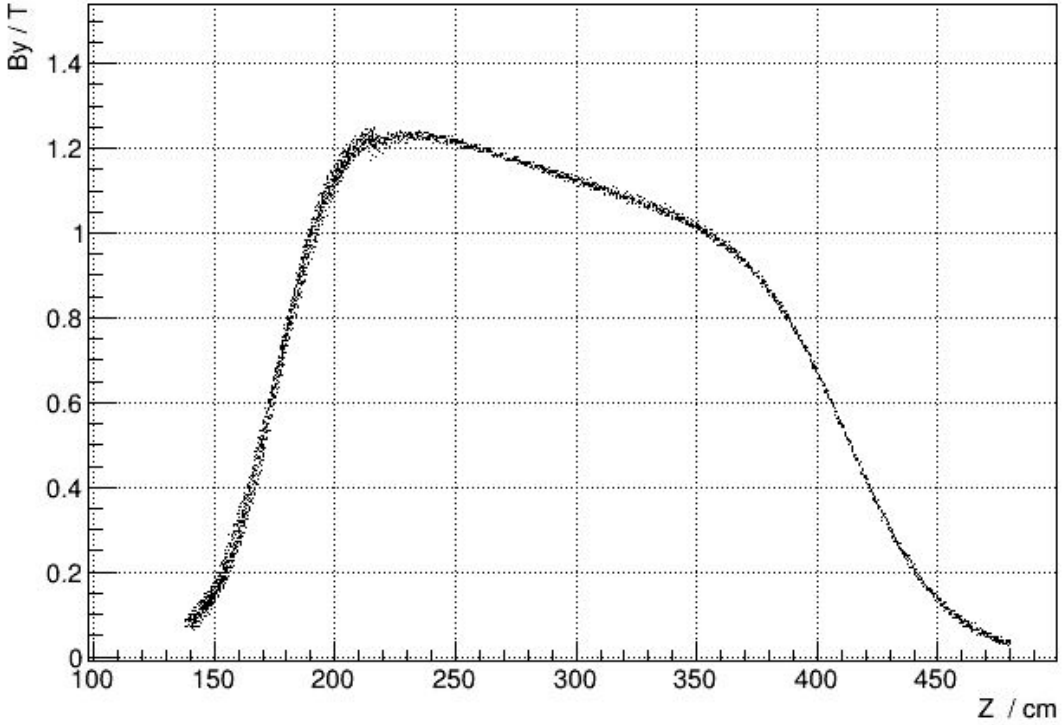
Conclusion

- The exact position of GLAD in Cave C should be measured.
- The exact position of the coils against the GLAD housing is uncertain.
- We see hysteresis and we should consider that for the experiments.
- The measured field deviates by several percent close to the GLAD housing, the integral field values have only in the center the necessary accuracy.
- Experiments which use only the inner part of GLAD are properly fine but experiments which use a large volume of GLAD should see the effect.
- The fringe field of GLAD is also important.

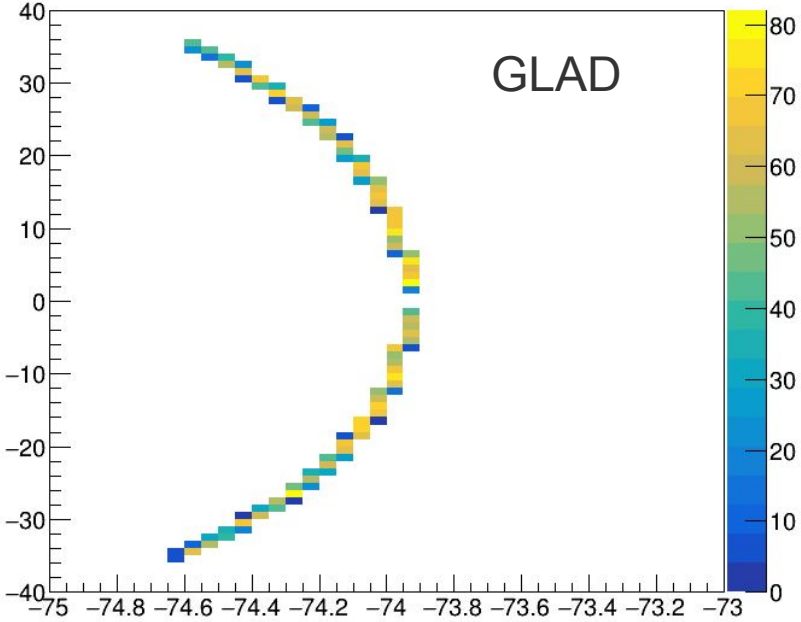
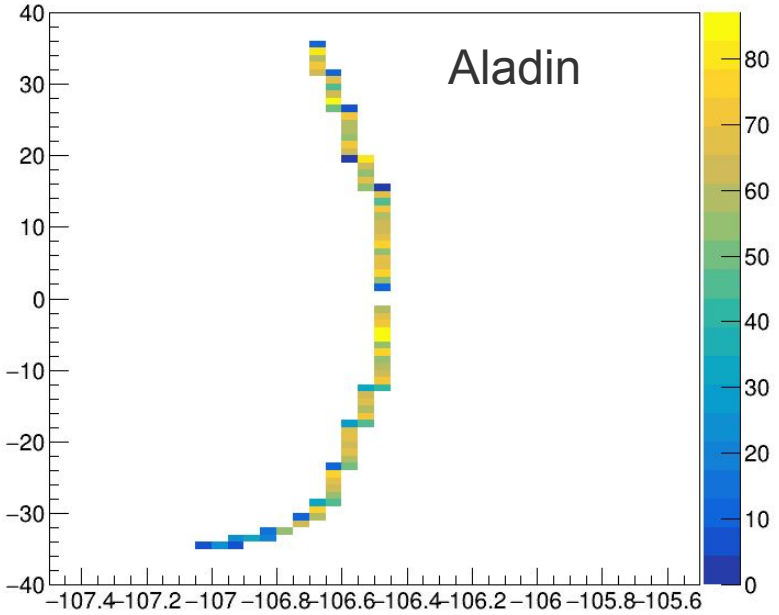
Either we need a more realistic theoretical field map which includes the magnetic parts of the housing or we have to do a mapping of the GLAD field in the new HEC.

Field map


x / cm
z / cm
300
200
100
0
−100
−200
−300
0
50
100
150
200
250
300
350
400
450
500
1
0.5
0
−0.5
−1
−1.5
−2



Measured (2022 and 2023) By as a function of z. Just to see which By values are involved.

Comparison GLAD and Aladin

Simulation of 132Sn at 500 AMeV.