

Field Mapping DarkLight Dipoles

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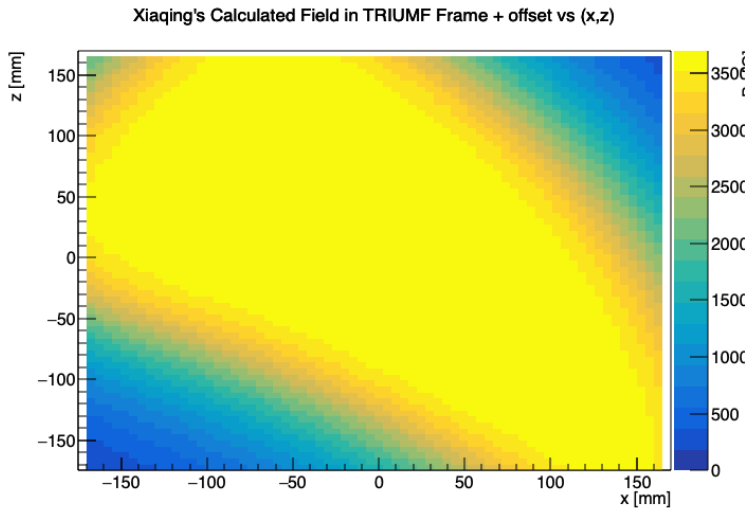
March 20, 2025



Comparing Field Measurement and Field Calculation

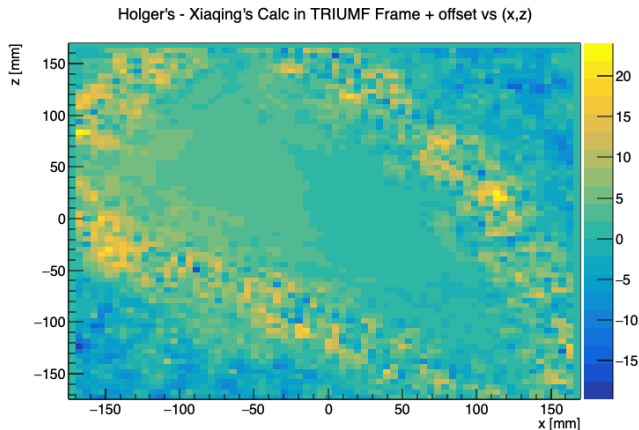
- Shaquille at TRIUMF has performed another **new** field map of the dipoles
 - Jump in measured field has disappeared.
 - Came from the power supply needing 24 hours to stabilize
 - Stable field enables a simple fit of calculation to data to determine offsets
- Holger and Xiaqing have provided calculations of the field in COMSOL and ANSYS-Maxwell respectively

Reminder of Field Shape



Calculated field in Gauss.

Calculations Agree



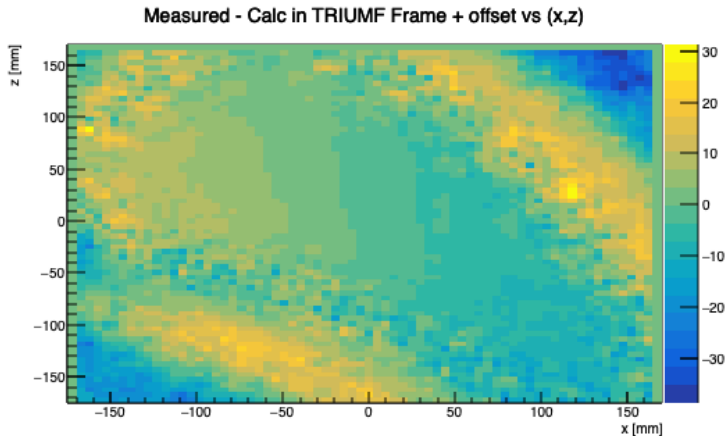
Difference between calculated fields in Gauss. Calculations agree quite well. Bigger discrepancy in fringe field areas where field rapidly changes, likely dependent on mesh calculation points.

Strange point: Xiaqing's calculation done at 192 A. Holger's done at either 192, 200, or 225(?). Expect scale of 1, 1.04, or 1.17. Instead see scale of 1.11. Why? Different number of turns?

Fit Calculation to Measurement

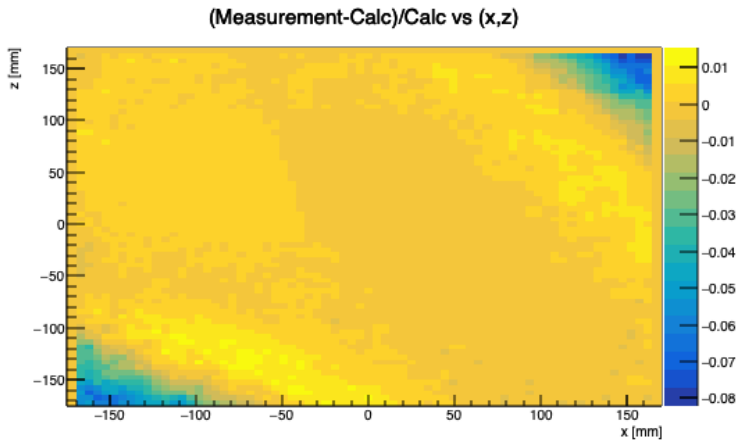
- Now that the field is stable we can do a simple fit to better align calculation and measurement
- Fit an x , y , and z offset, plus a rotation about y , and an overall scale using all three measurement planes provided by Shaquielle
- Same offsets as were previously being determined by eye and from Shaquielle's survey
- Minor, mm sized, differences in z and x . Rotation changed by 0.12° .
- Bigger effect is a 3.5 mm offset in y . Possible indication of a slope in y as a function of x and z . Could be magnet is not mounted perfectly level.
- Also, overall scale is off. Calculation performed at 192 A. Measurement at 200 A. One would expect a $200/192 \approx 1.04$ difference in scale. Instead see ≈ 1.06 difference. Not large, but unexplained. Could be due to power supply and ramp procedure.

Calculations and Measurement in Better Agreement



Difference between calculated and measured fields in Gauss. Note potential “steps” in field difference across pole tip. This is extremely small but point towards a slope.

Calculations and Measurement in Better Agreement



Generally agreeing within 1 % in pole tip region and near-fringe field. Drops quickly to 8 % in far-fringe.

Next Steps

- Agreement between measurement and calculation looks significantly better with stable power supply and fit of calculation to data!
- As Doug is at TRIUMF, have asked him to look at magnets and probe and see if the y offset can be verified
- Maybe also connect MIT power supply, ramp magnet, and make single measurement of field between pole tips to verify scale
- Generally optimistic, should map next dipole
- If Shaquille or others at TRIUMF are willing, next map should be three, maybe five planes in y , but separated by a larger distance. Say 7 mm.
- Lingering question about scale of two calculations