Mapping of the Mag-H magnetic field

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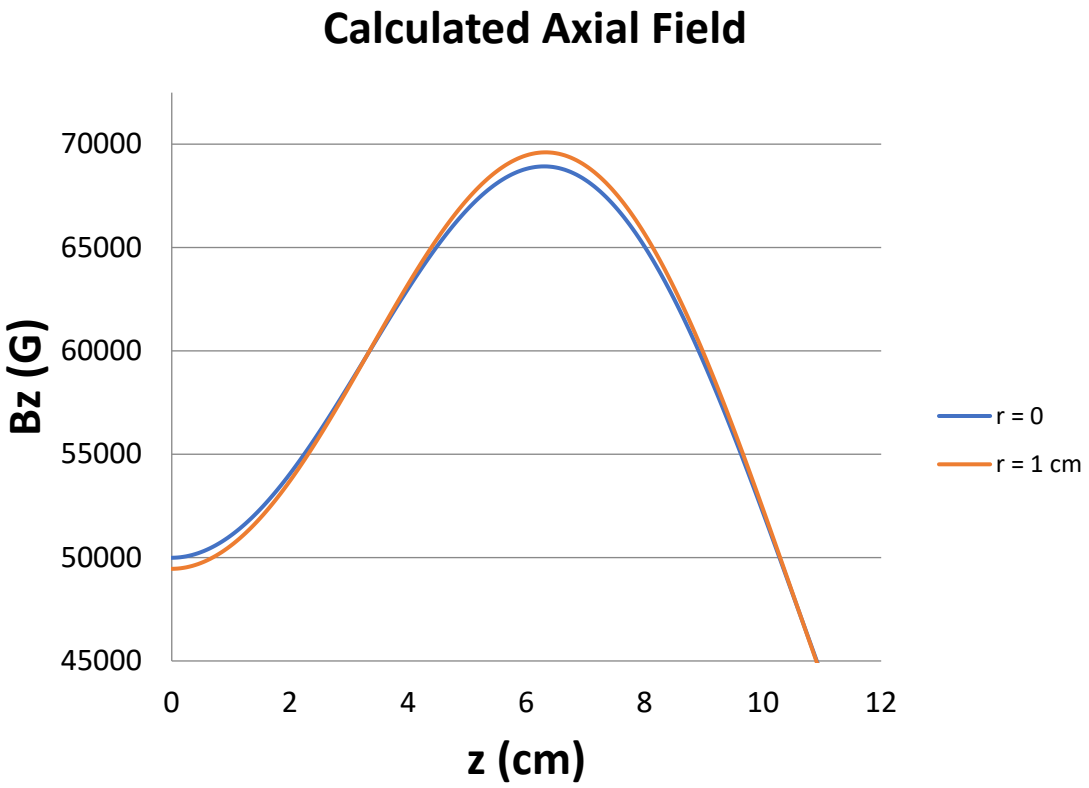
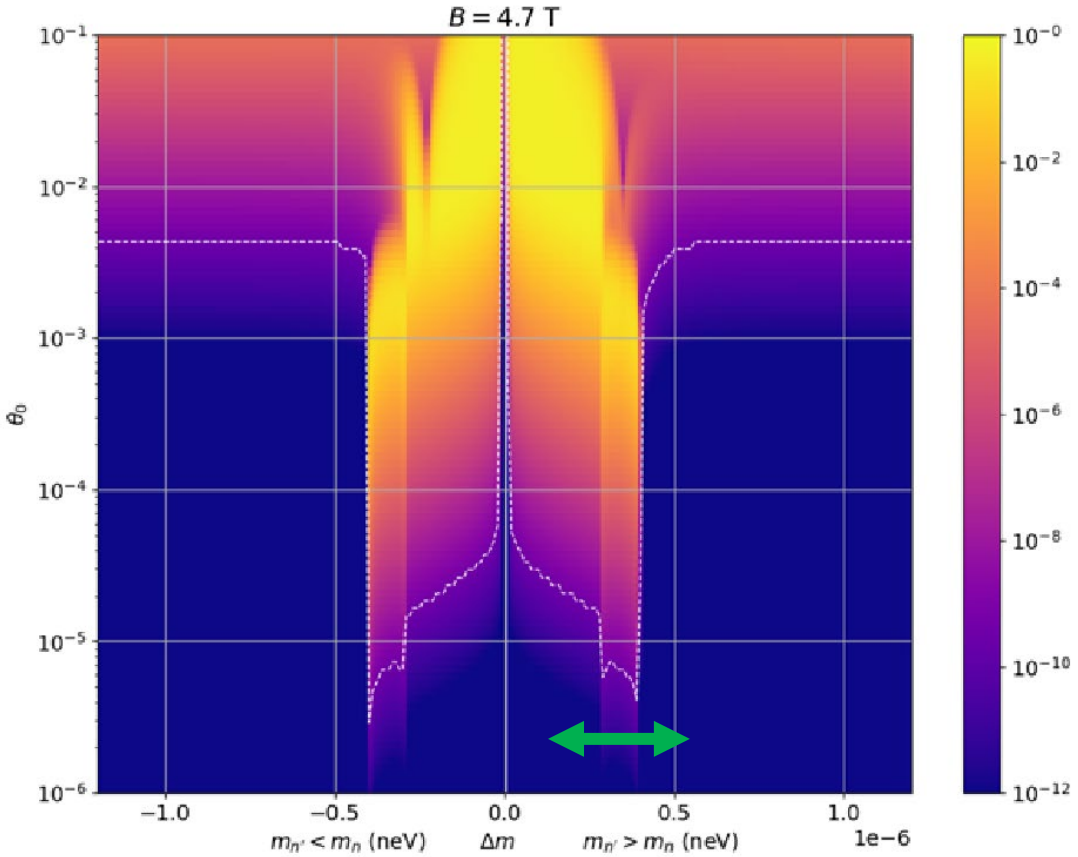
Mapping of Mag-H magnet

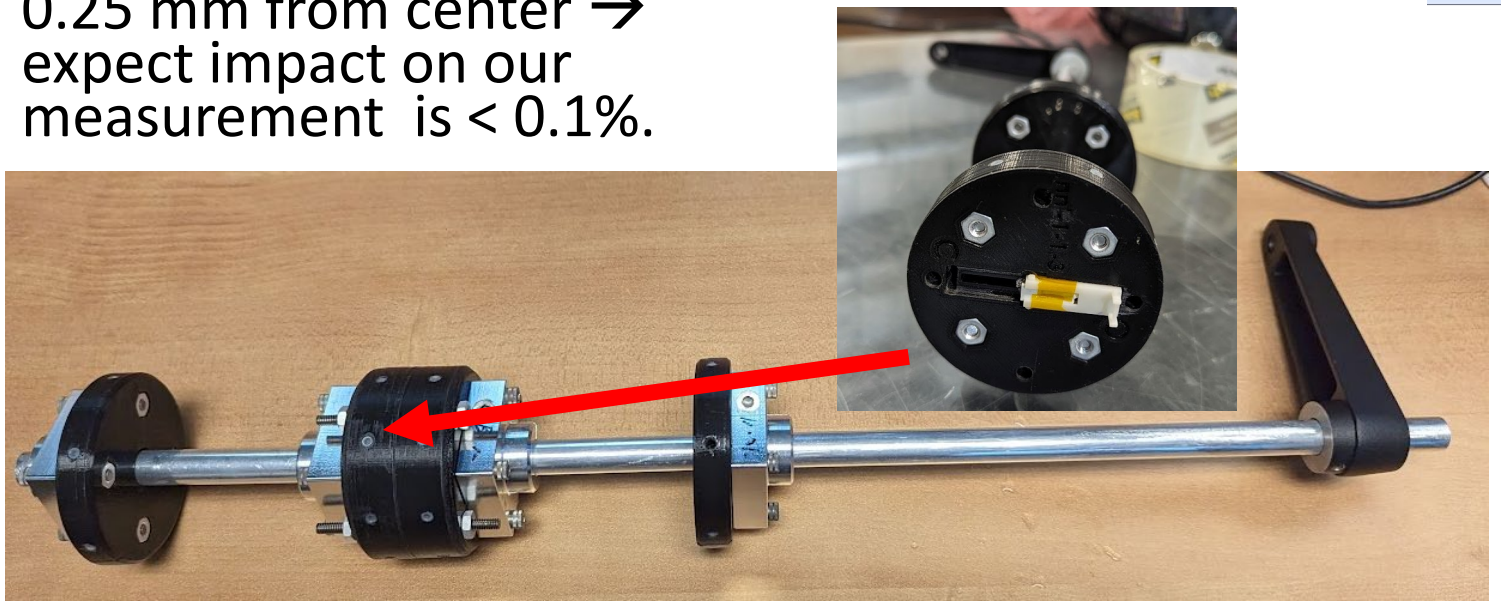
- Reviewer asked us to measure the Mag-H field to confirm the vendor's calculated profile
- Primary impact of any discrepancy would be to shift values along Δm axis in butterfly plot (I believe)

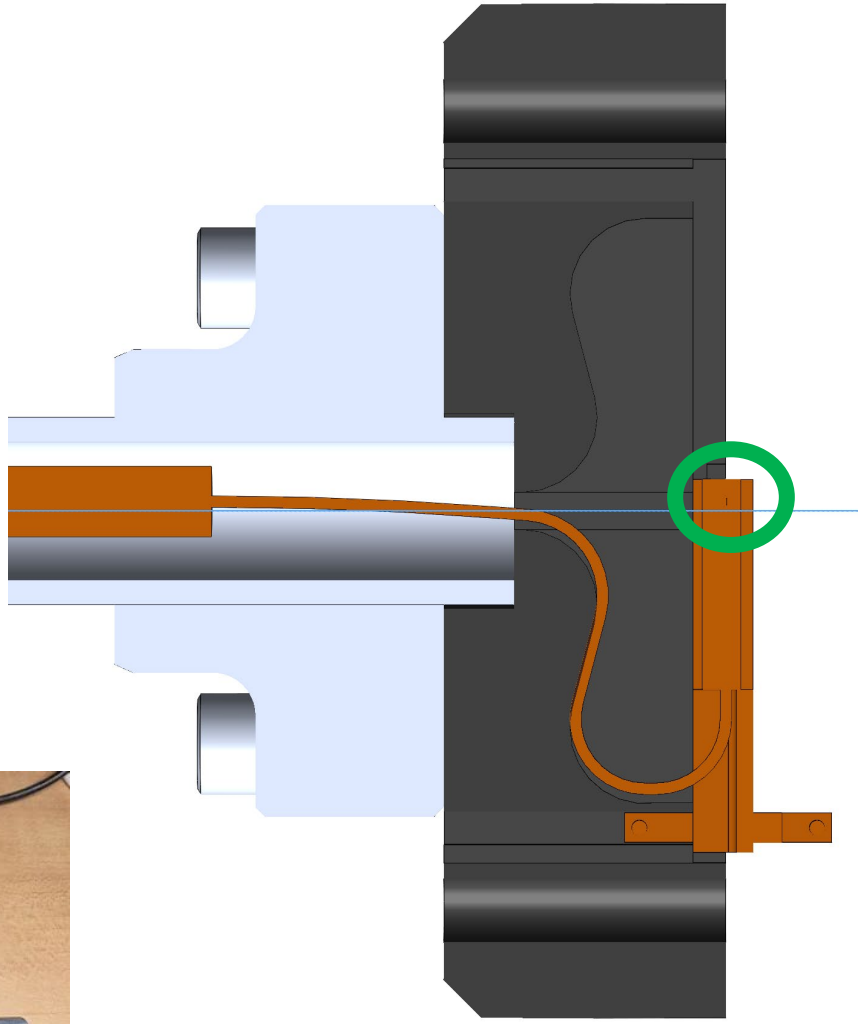




Mag-H mapper

- Hall probe calibrated up to 6.3 T with 0.1% accuracy (a few years ago)
- Confirmed all assembly components were non-magnetic using Ferromaster permeability meter
- Note that bore is not perfectly round: translation device either slight too tight or slightly too loose at various points in magnet. Positioning precision difficult to directly quantify. Probe estimated to be 0.25 mm from center → expect impact on our measurement is < 0.1%.



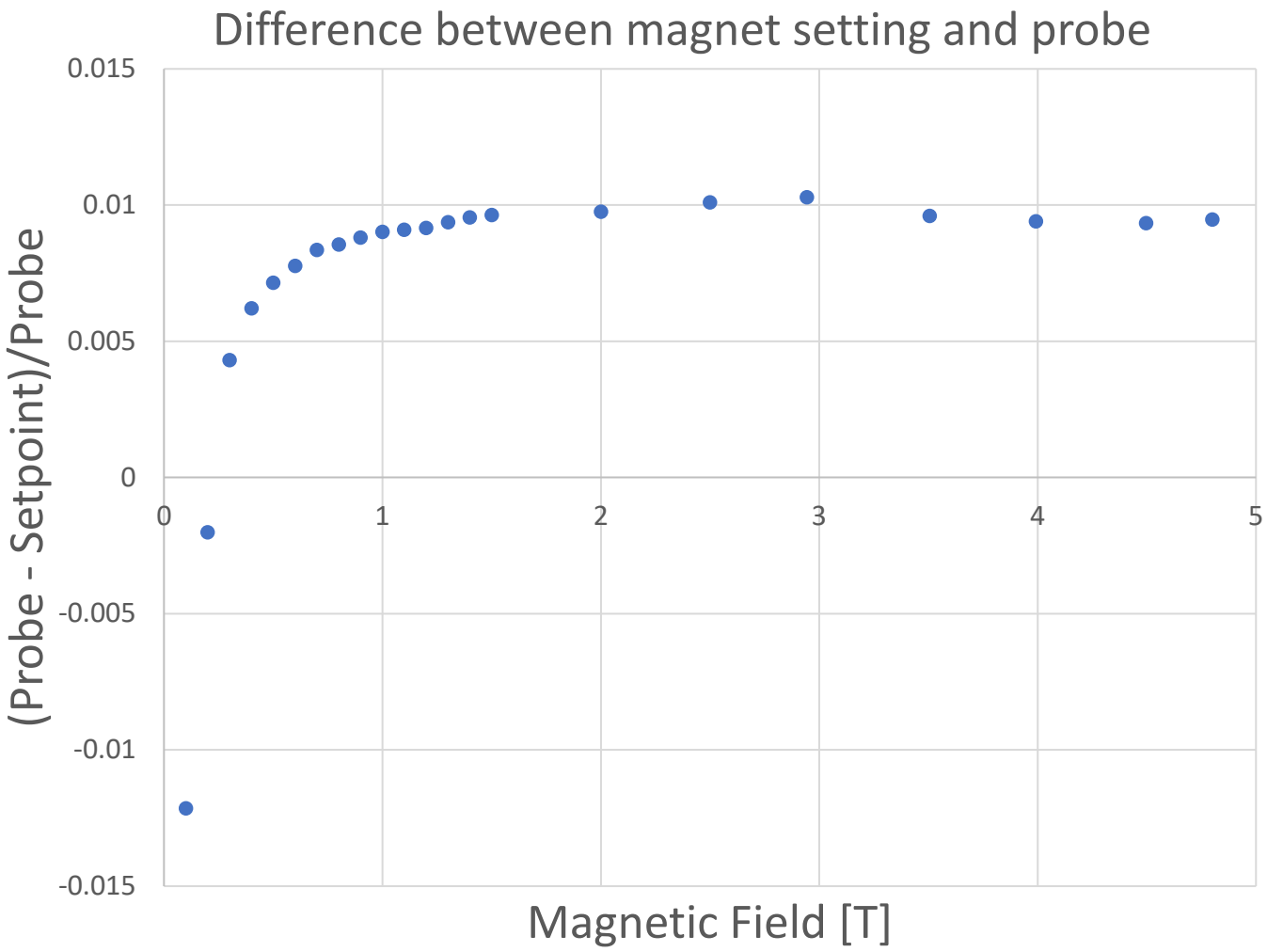


Studies performed

- 3-hour block allocated for field map study at HFIR (limited by maintenance activities)
- Measurements
  - Measured field at center while ramping up
  - Measured field at center and maxima at 4.7 T and 2.35 T
  - Measured field in 1 cm steps, in 1 direction
- Checks
  - Probe temperature was 25.4 C. (Calibration performed at 25 C)
  - Checked zero-offset of probe before/after measurements: 0.0003 T before, 0.0029 T after (0.1% effect at 2.35 T)
  - Compared field at +/- 0.1 T (0.007 T offset, larger than probe offset) and +/- 0.2 T (0.0009 T offset)
  - Checked positioning error by rotating probe (to check centering) and repeating measurements (see next slides)

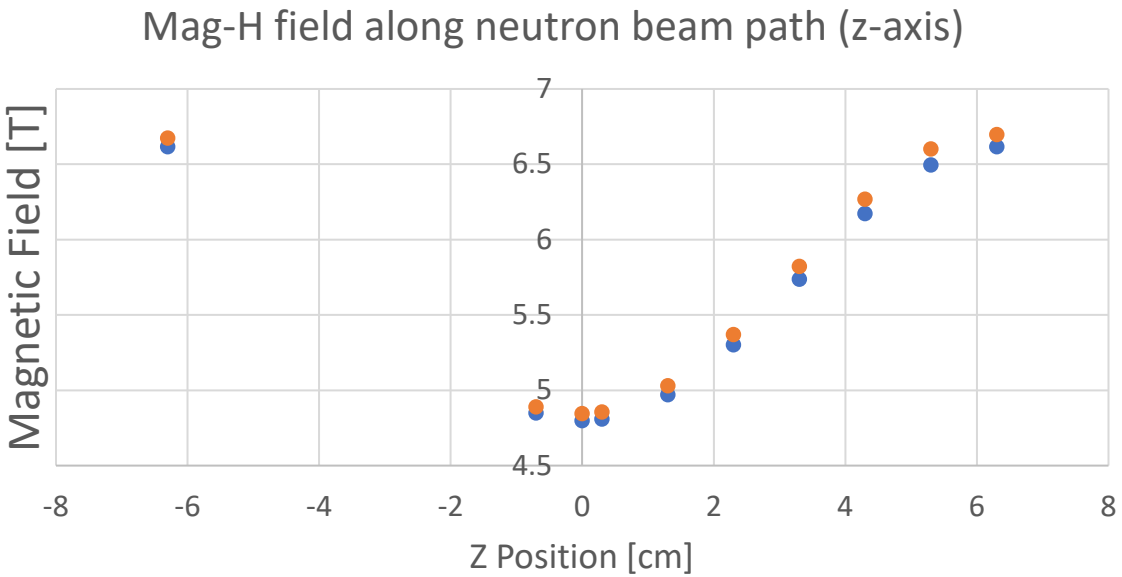
Field Ramp at Magnet Center

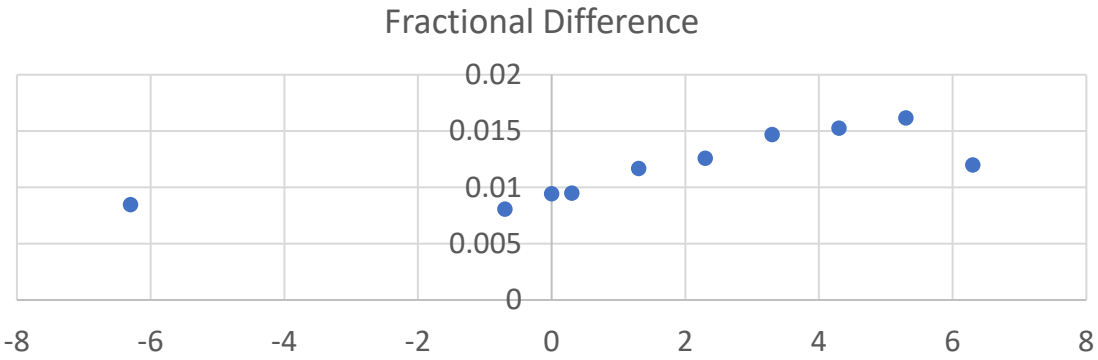
- Probe centered in z-axis by adjusting to find local minimum
- Probe appears to be very well radially centered with <0.01% change in field observed when rotating translation device
- Hall probe is 1% higher than magnet setting at center



Field Scan in +z (along neutron beam direction)

- z-position scan with center at 4.8 T
- Measured 1 cm steps with ~ 1 mm accuracy (expect <0.1% impact on field)
- Radial position uncertainty estimated from rotating translation device ~ 0.5%
- Measurement is 1.0 – 1.5% higher than magnet setting





Compare to measurements from SNS run

- SNS datasets at 4.7 T and 2.35 T
- Measurements at center and both peaks are 1–2% higher than magnet setting
- Location of center / maxima found by translating to find local extremum in field

	4.7 T			
	Magnet	Probe 1		% Diff
center	4.7	4.7443		0.009338
peak DS	6.479891	6.5904		0.016768
peak US	6.479891	6.5635		0.012738
	2.35 T			
	Magnet	Probe 1		% Diff
center	2.35	2.3744		0.010276
peak DS	3.239946	3.3079		0.020543
peak US	3.239946	3.2923		0.015902

Impact

- Based on previous simulations we are not strongly sensitive to shape of field map, but mainly to field maximum
- Field actually larger by 1-2 %, which (I believe) mainly shifts plot to slightly larger Δm
- Should we redo simulation? Impact is likely very small, but technically perceptible
- For HFIR dataset: Should we attempt a full 3D map? We likely can slightly increase our sensitivity