# Effects of a superconducting lead endcap on the magnetic field profile for the nEDM search

Aritra Biswas
Kellogg Radiation Laboratory
Mentors: Brad Filippone, Simon Slutsky

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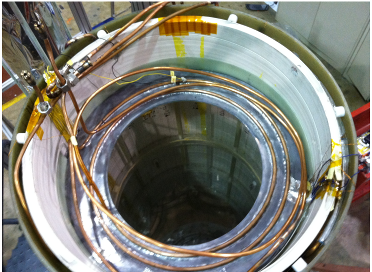
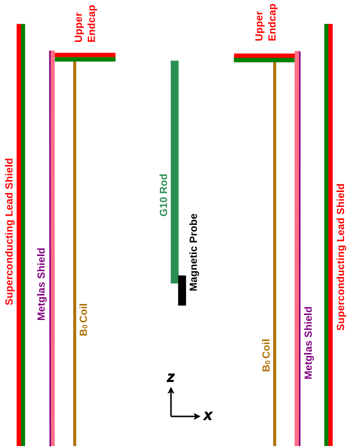
- installed a lead endcap on the top end

# the half-scale model

# inside the half-scale model



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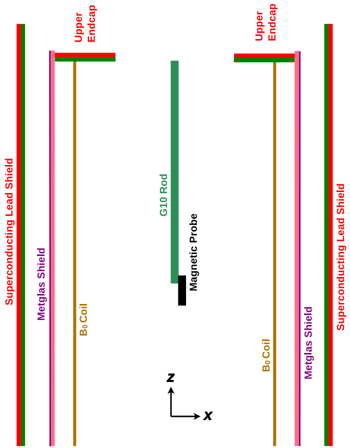
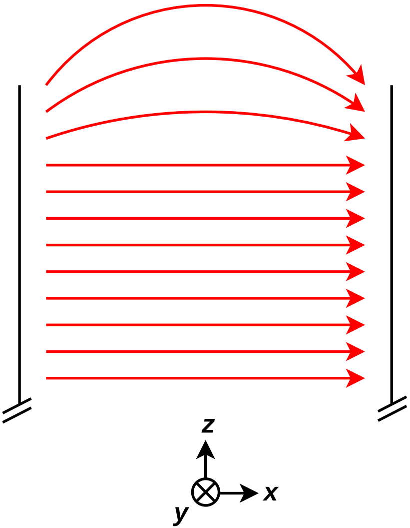



- $B_0$ coil: $\cos\theta$ coil geometry
  - **B** field in $x$ direction
- ferromagnetic Metglas shield
- superconducting axial shield
- superconducting top endcap

# edge effects and the superconducting endcap



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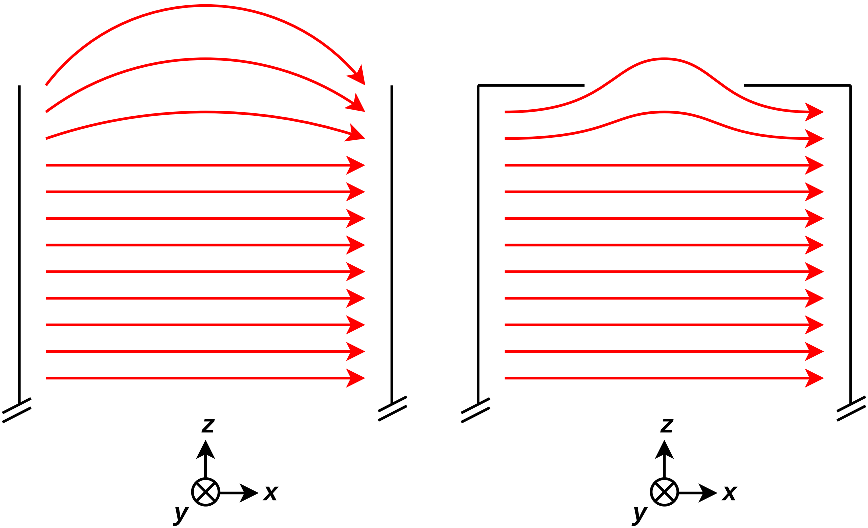

# overview of the data analysis

- $B_z$ vs. $z$ is an indicator of field uniformity near the endcap

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Mendenhall, M. P. Source code: `RotationShield`. ⟨https://github.com/mpmendenhall/rotationshield⟩ (2014)
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  2. axial SC, endcap normal
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- identified systematic errors and applied relevant corrections (`plotter`)
- compared with expected field profiles (`plotter`)

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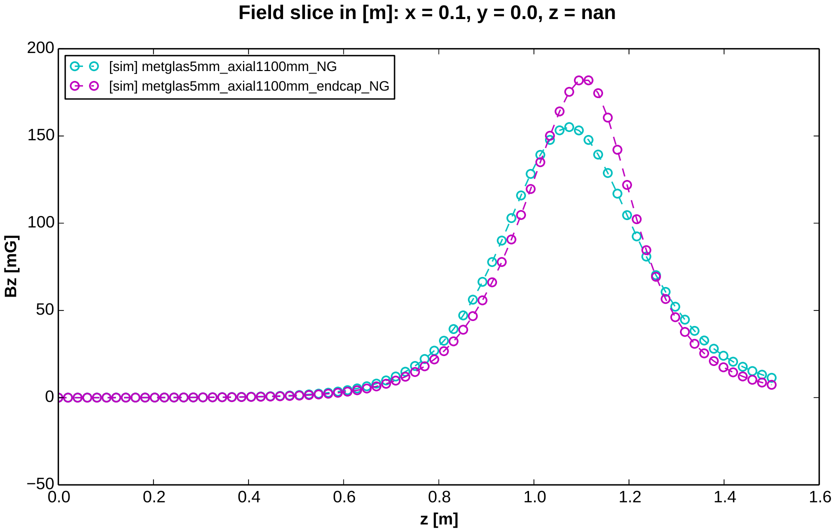
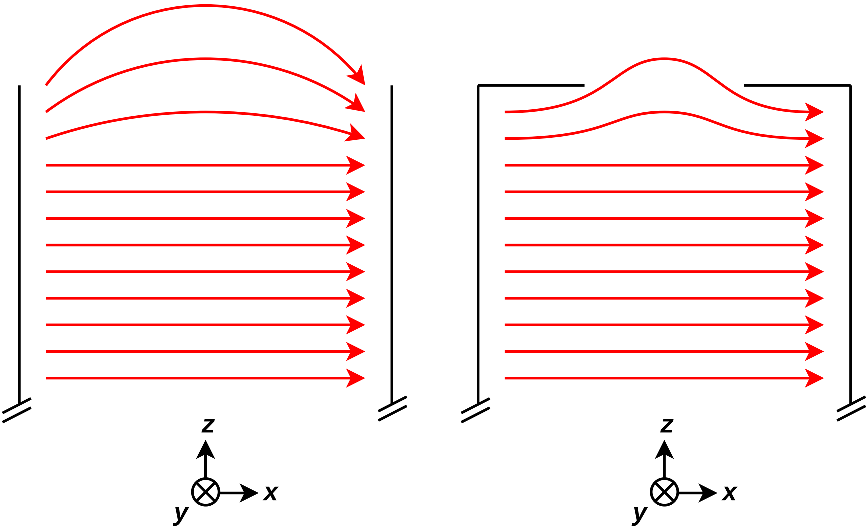
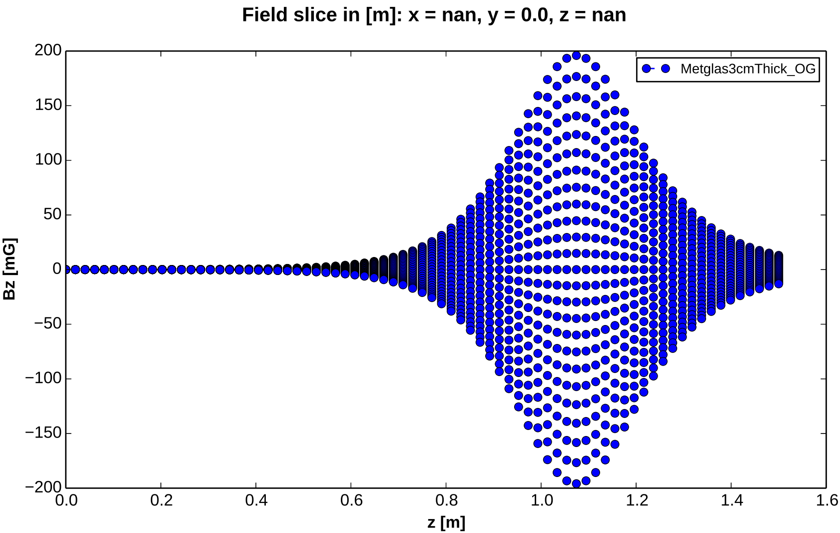
# simulations of endcap effect



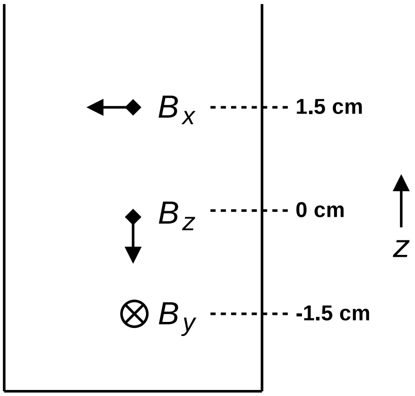
# correction: probe $x$ centering



# correction: simulation of $x$ sensitivity



# correction: probe axis offset

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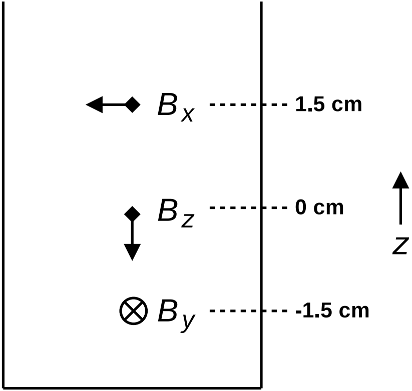


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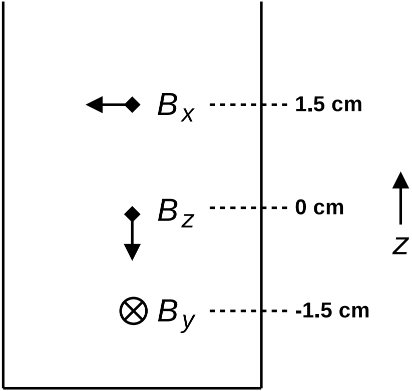
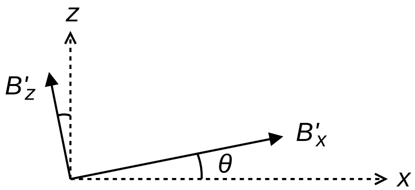



- 3 separate 1-axis probes
- incomplete vector map
- need to store $z$-axis offset vector along with $z$ array

# correction: probe tilt



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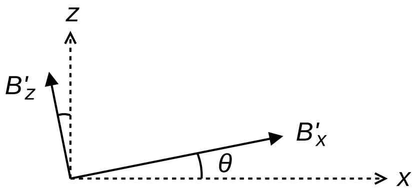


$$B_x = B'_x \cos\theta - B'_z \sin\theta, \quad B_z = B'_z \cos\theta + B'_x \sin\theta \qquad (1)$$

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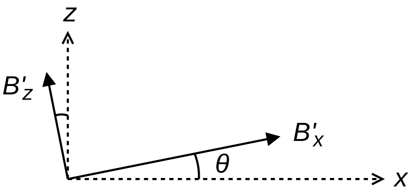


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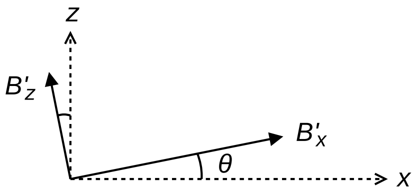


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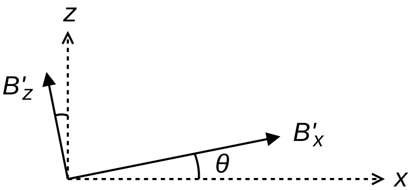


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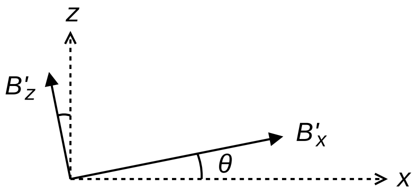


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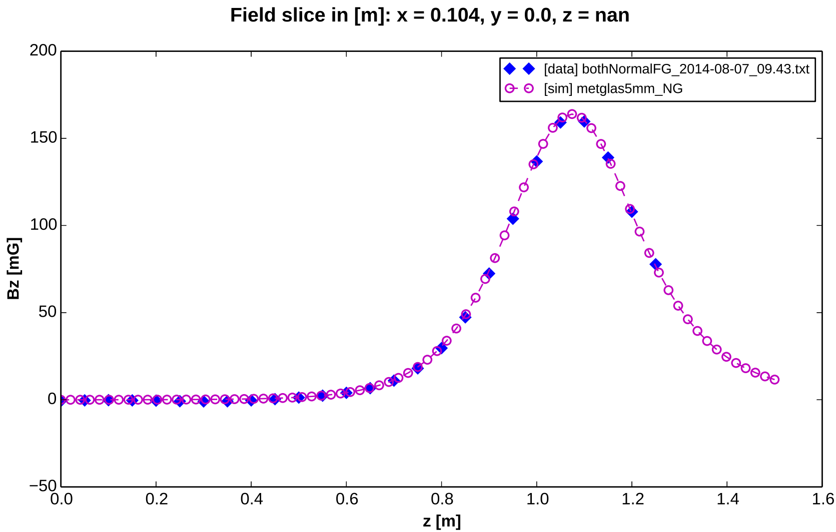
# comparison: axial shield normal, endcap normal



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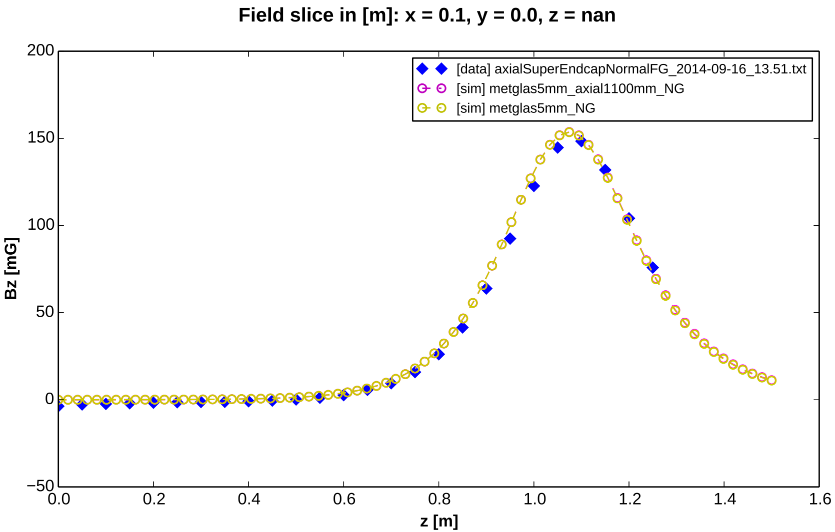

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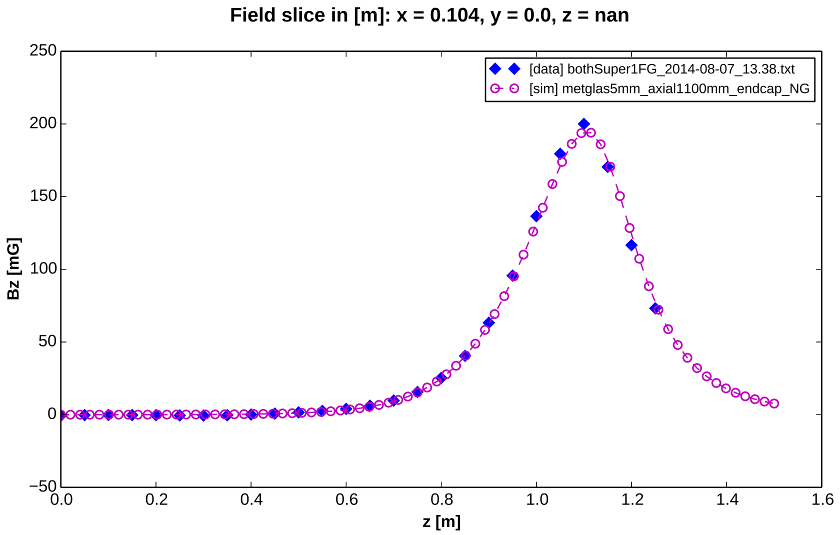
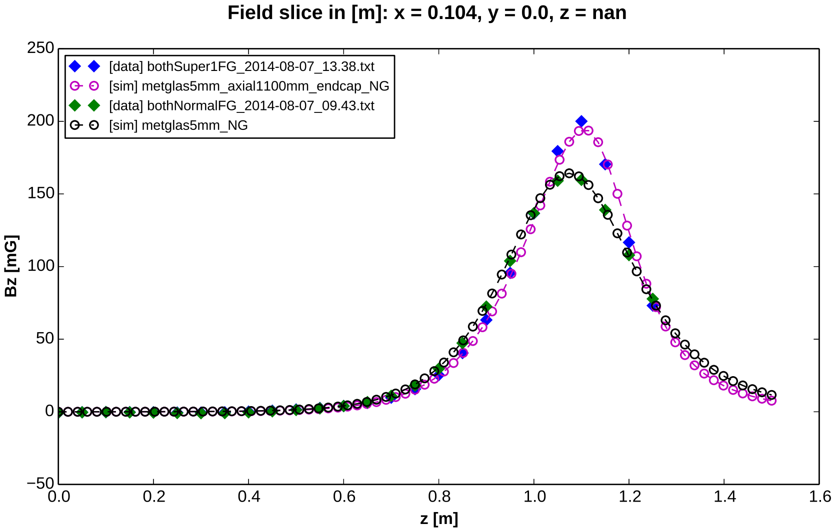


# comparison: SC/SC with normal/normal



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- our endcap seems to shift the $B_z$ peak away from magnet center
- axial shield effect is stronger when more of it is “uncovered” by the Metglas
- SC endcap hides axial shield influence, even over small variation in height

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# acknowledgments

- Arthur R. Adams SFP Fellowship
- Caltech SURF Program
- National Science Foundation