

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

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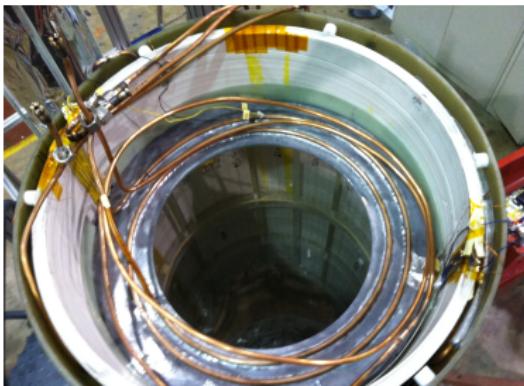
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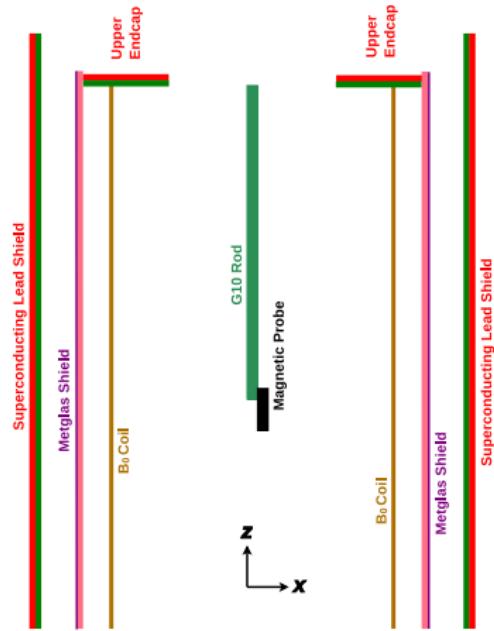
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- ▶ installed a lead endcap on the top end

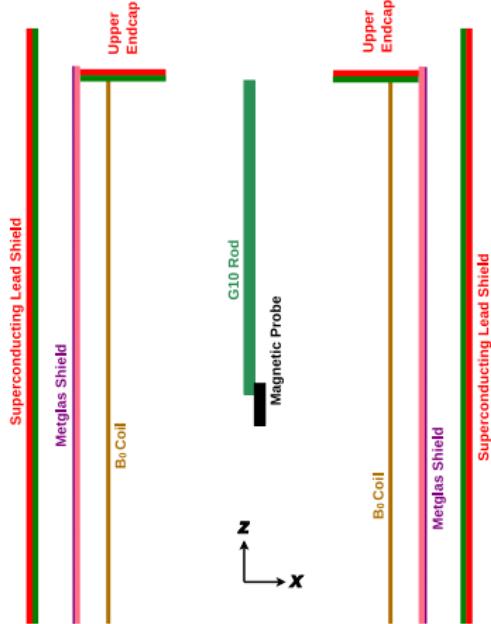
the half-scale model



inside the half-scale model

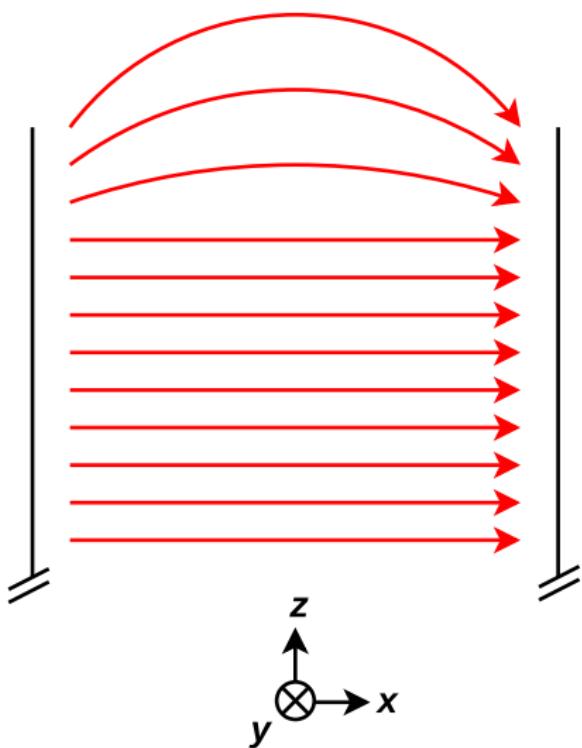


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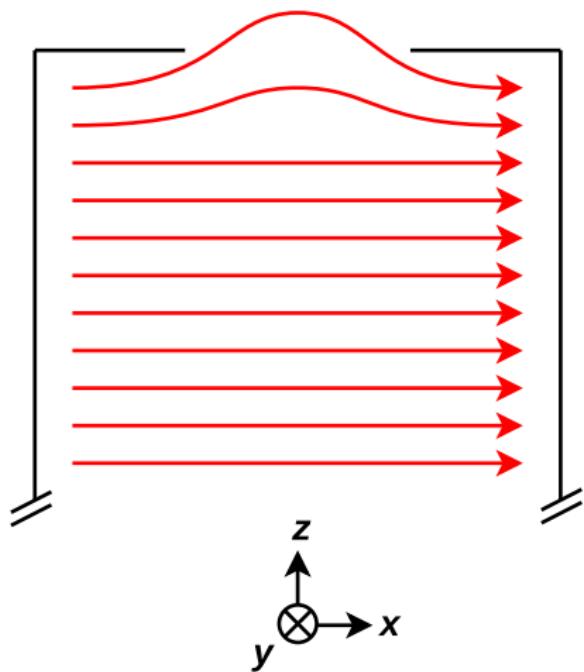
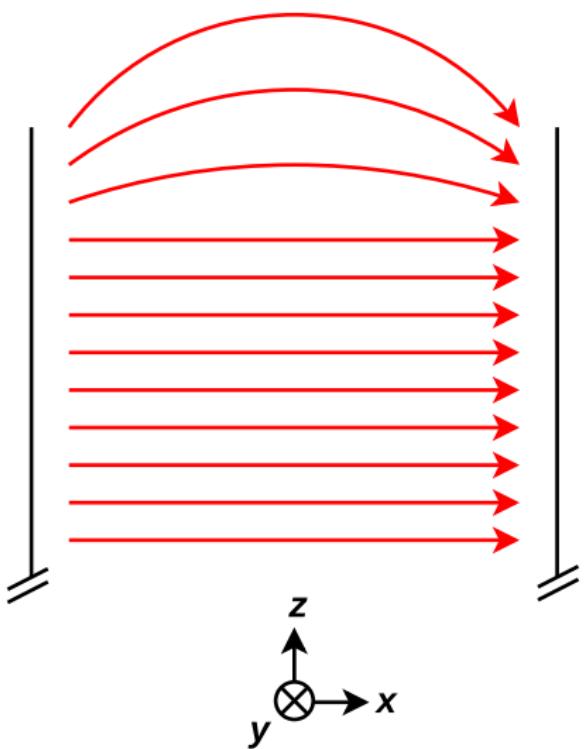


- ▶ B_0 coil: $\cos \theta$ coil geometry
 - ▶ \mathbf{B} field in x direction
- ▶ ferromagnetic Metglas shield
- ▶ superconducting axial shield
- ▶ superconducting top endcap

edge effects and the superconducting endcap



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Mendenhall, M. P. Source code: RotationShield. <https://github.com/mpmendenhall/rotationshield> (2014)

Biswas, A. Source code: plotter. <https://github.com/xerebus/nedm> (2014)

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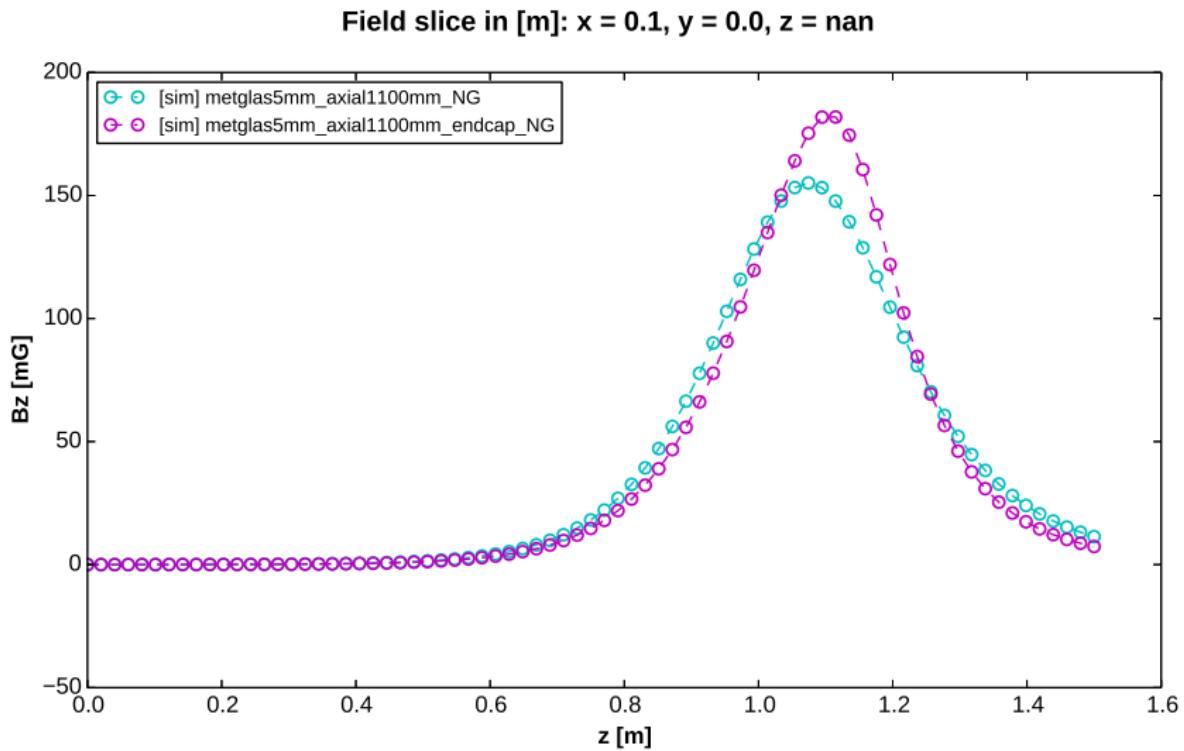
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- ▶ configurations:
 1. axial normal, endcap normal
 2. axial SC, endcap normal
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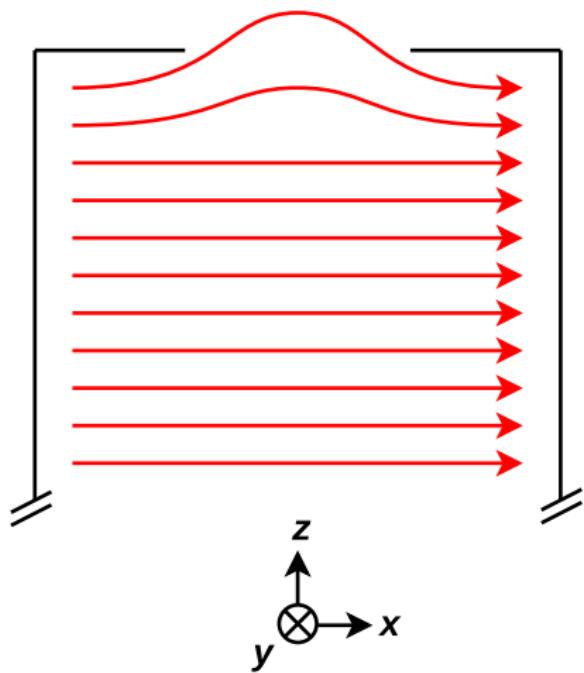
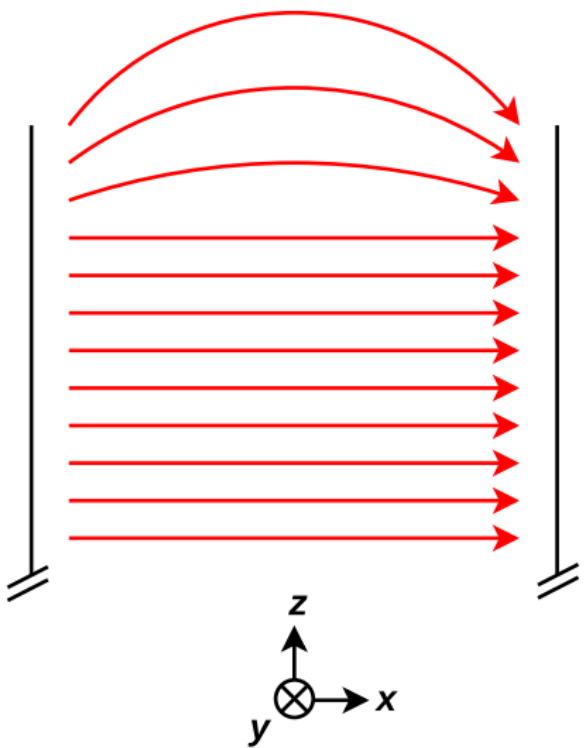
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- ▶ configurations:
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- ▶ identified systemic errors and applied relevant corrections (plotter)
- ▶ compared with expected field profiles (plotter)

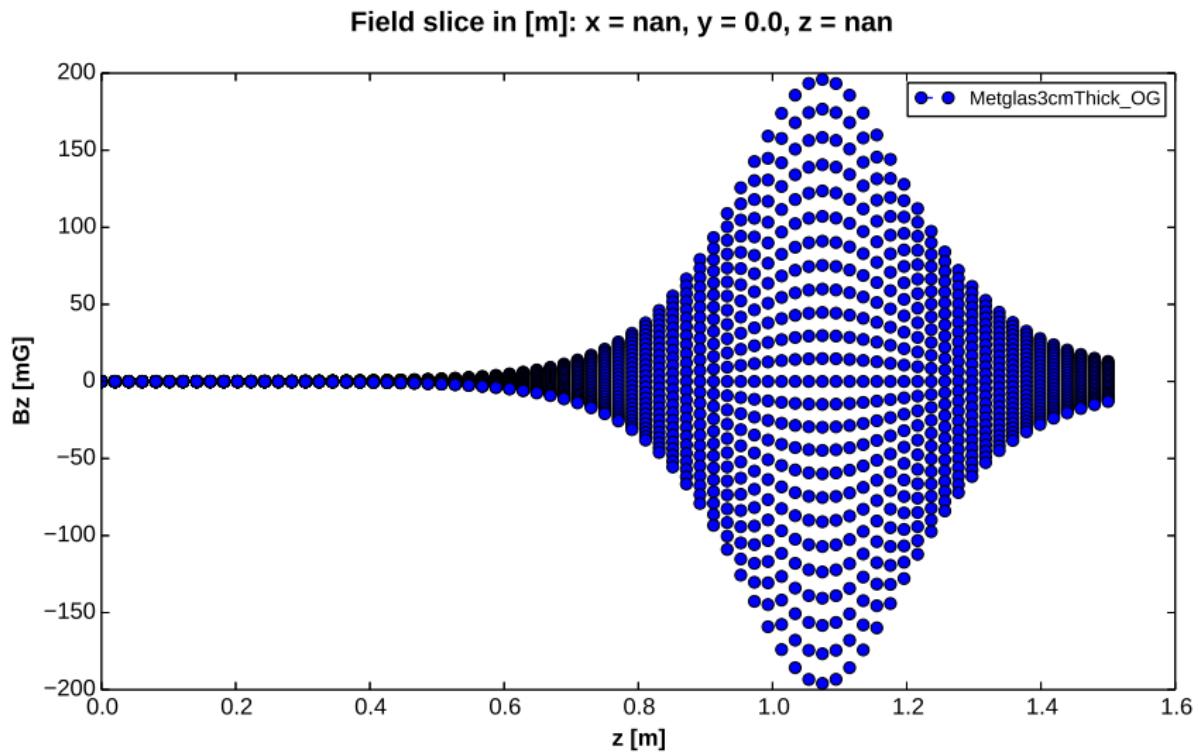
simulations of endcap effect



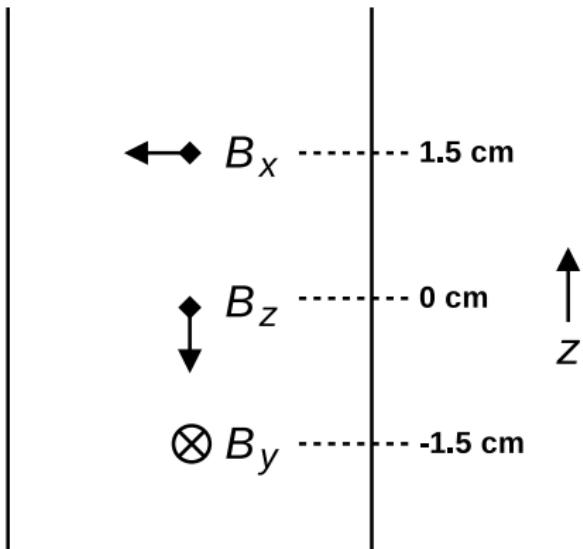
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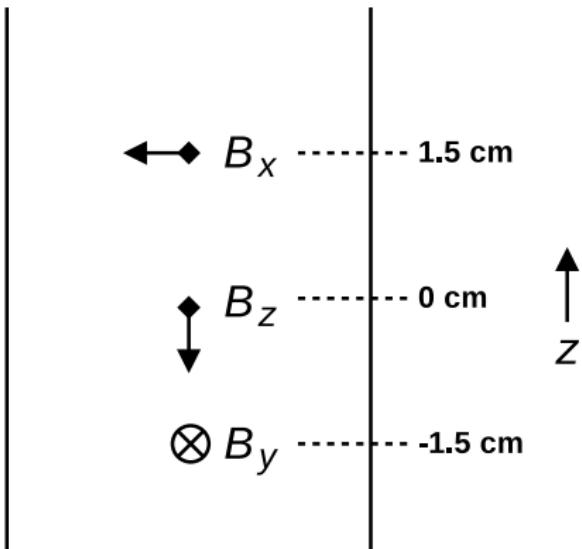


correction: probe axis offset



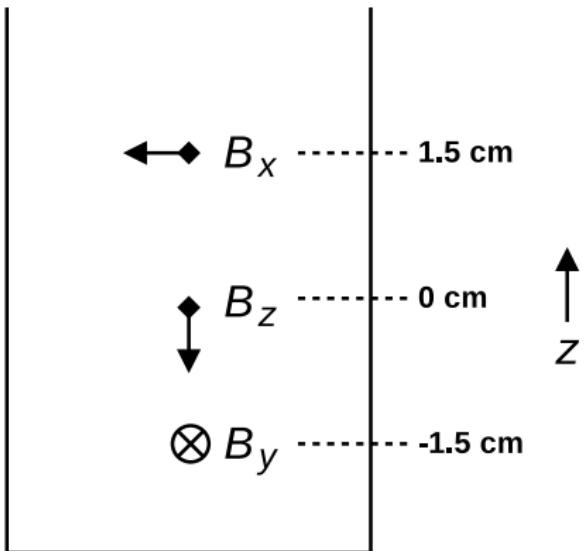
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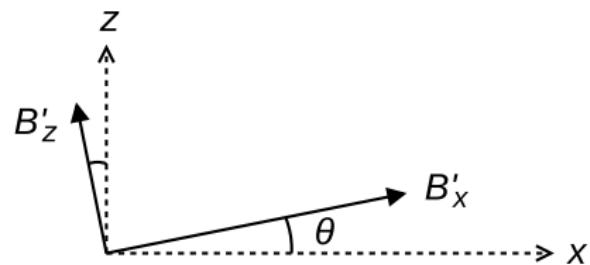
- ▶ 3 separate 1-axis probes
- ▶ incomplete vector map

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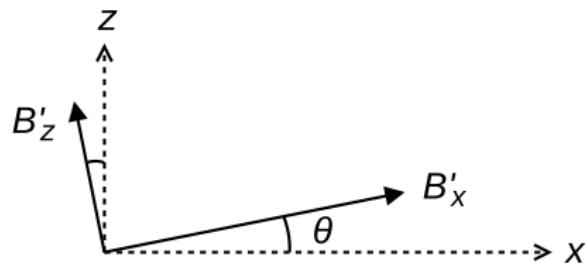


- ▶ 3 separate 1-axis probes
- ▶ incomplete vector map
- ▶ need to store z-axis offset vector along with z array

correction: probe tilt

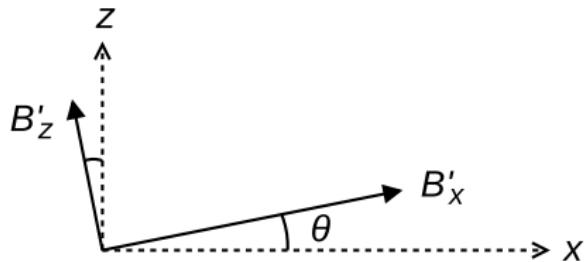


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$$B_x = B'_x \cos \theta - B'_z \sin \theta, \quad B_z = B'_z \cos \theta + B'_x \sin \theta \quad (1)$$

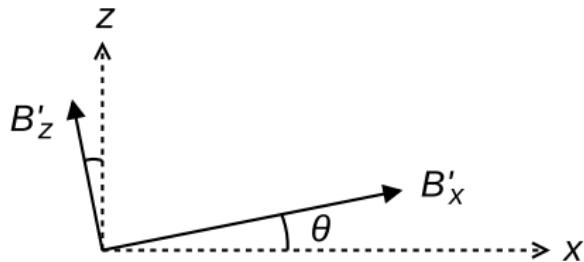
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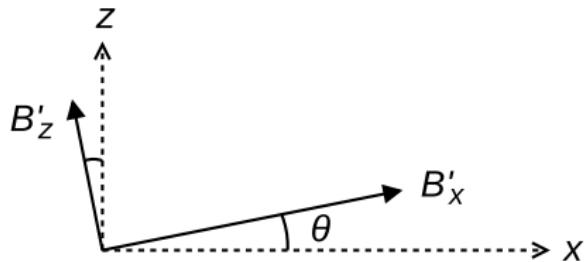


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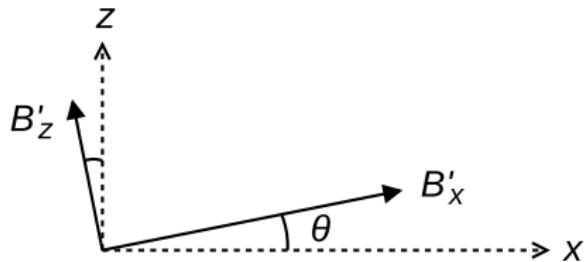
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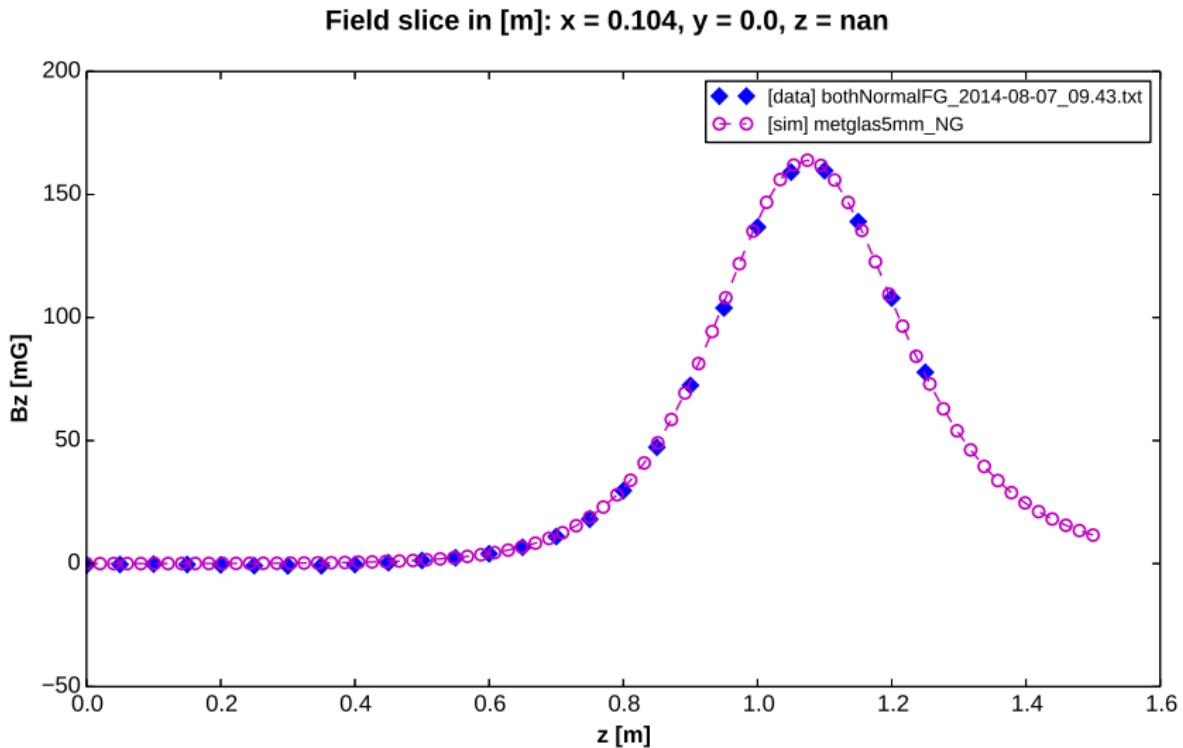
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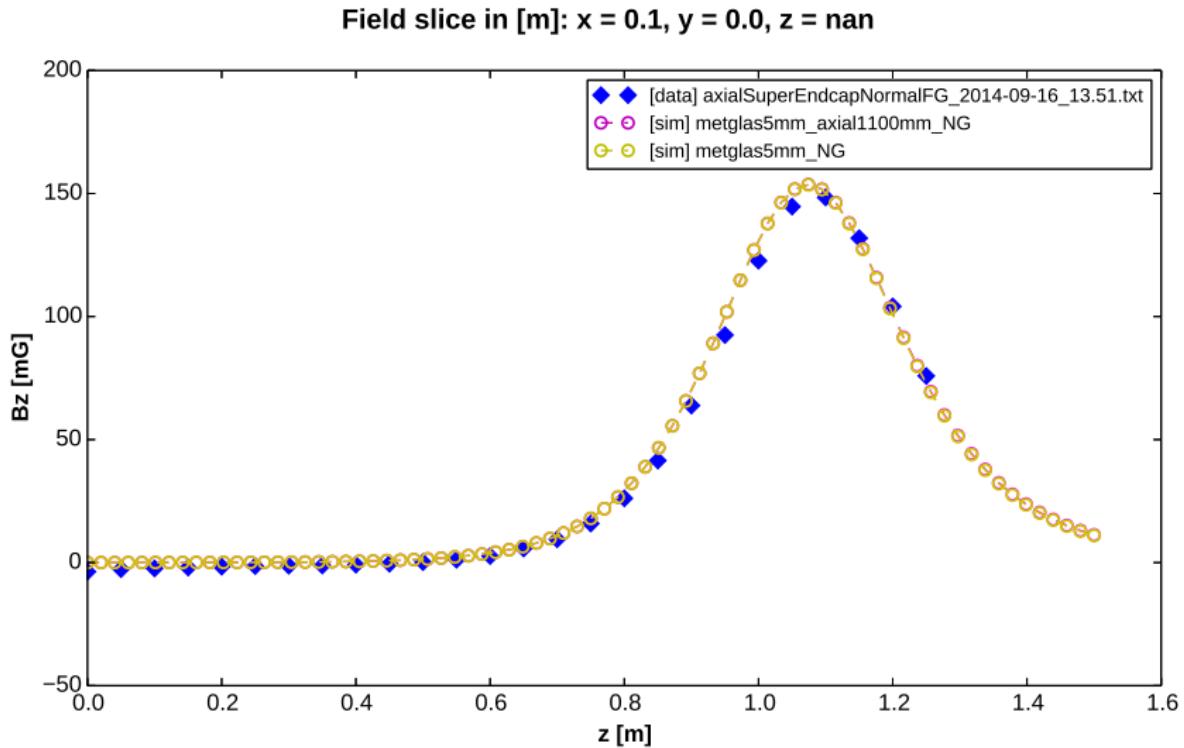
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$$\theta = -\frac{B'_z}{B'_x}$$

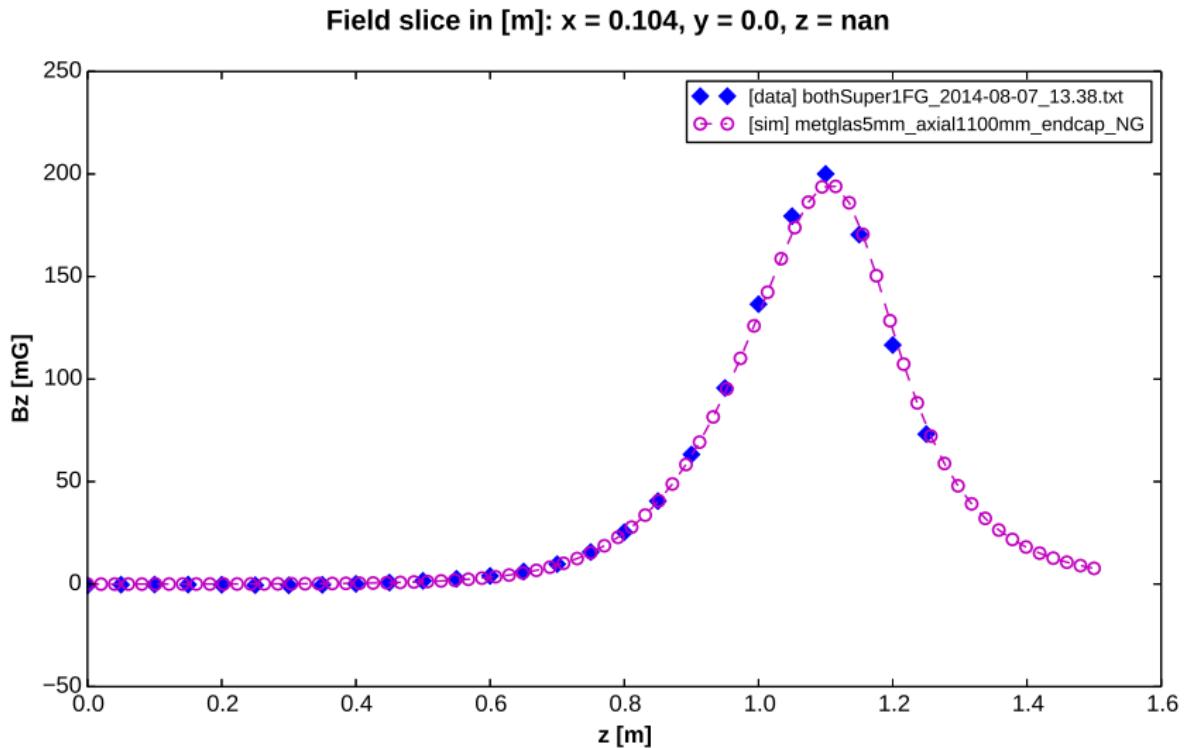
comparison: axial shield normal, endcap normal



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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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- ▶ analysis of field gradients in measurement cell volumes

acknowledgments

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