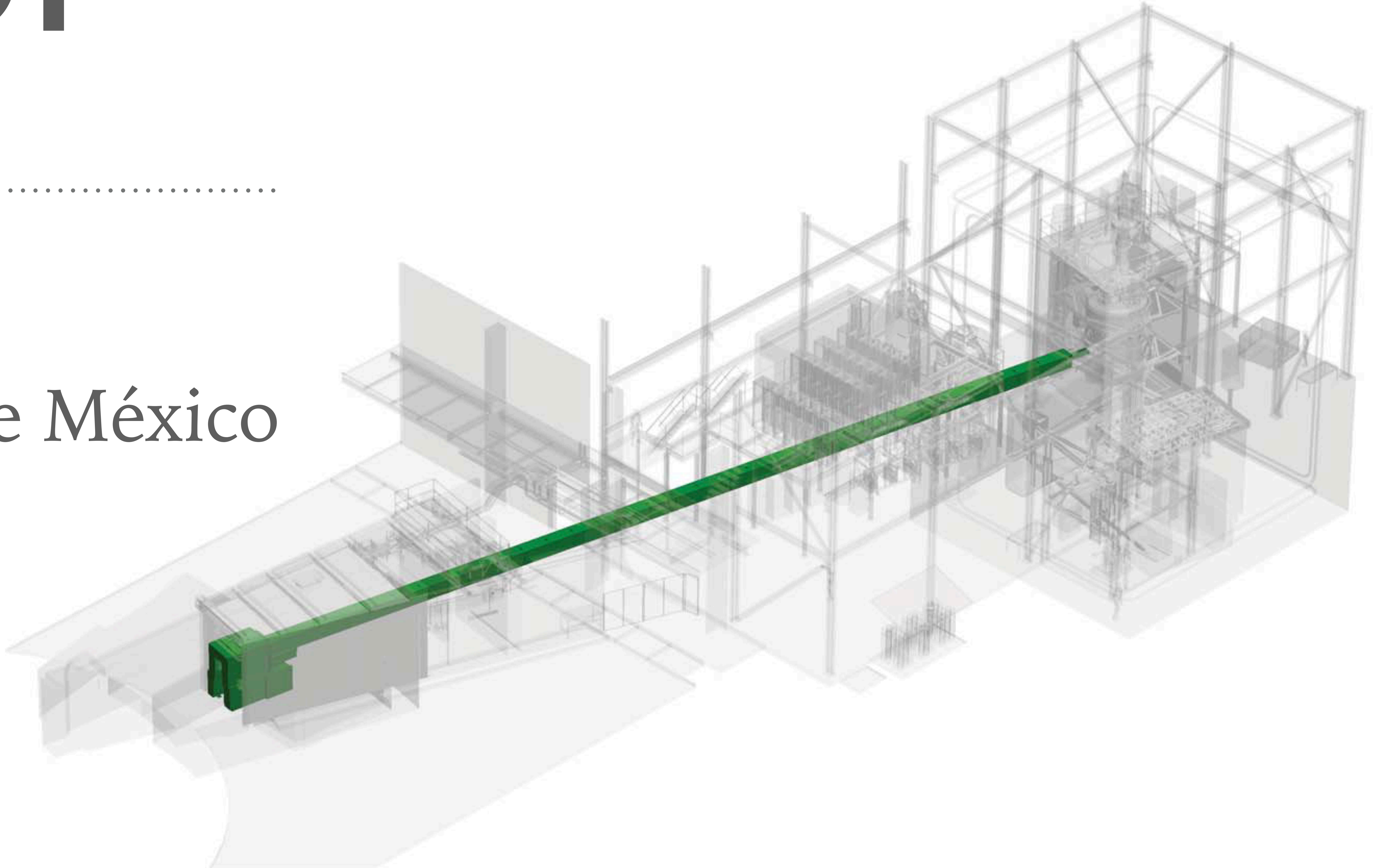
Neutron spin transport for

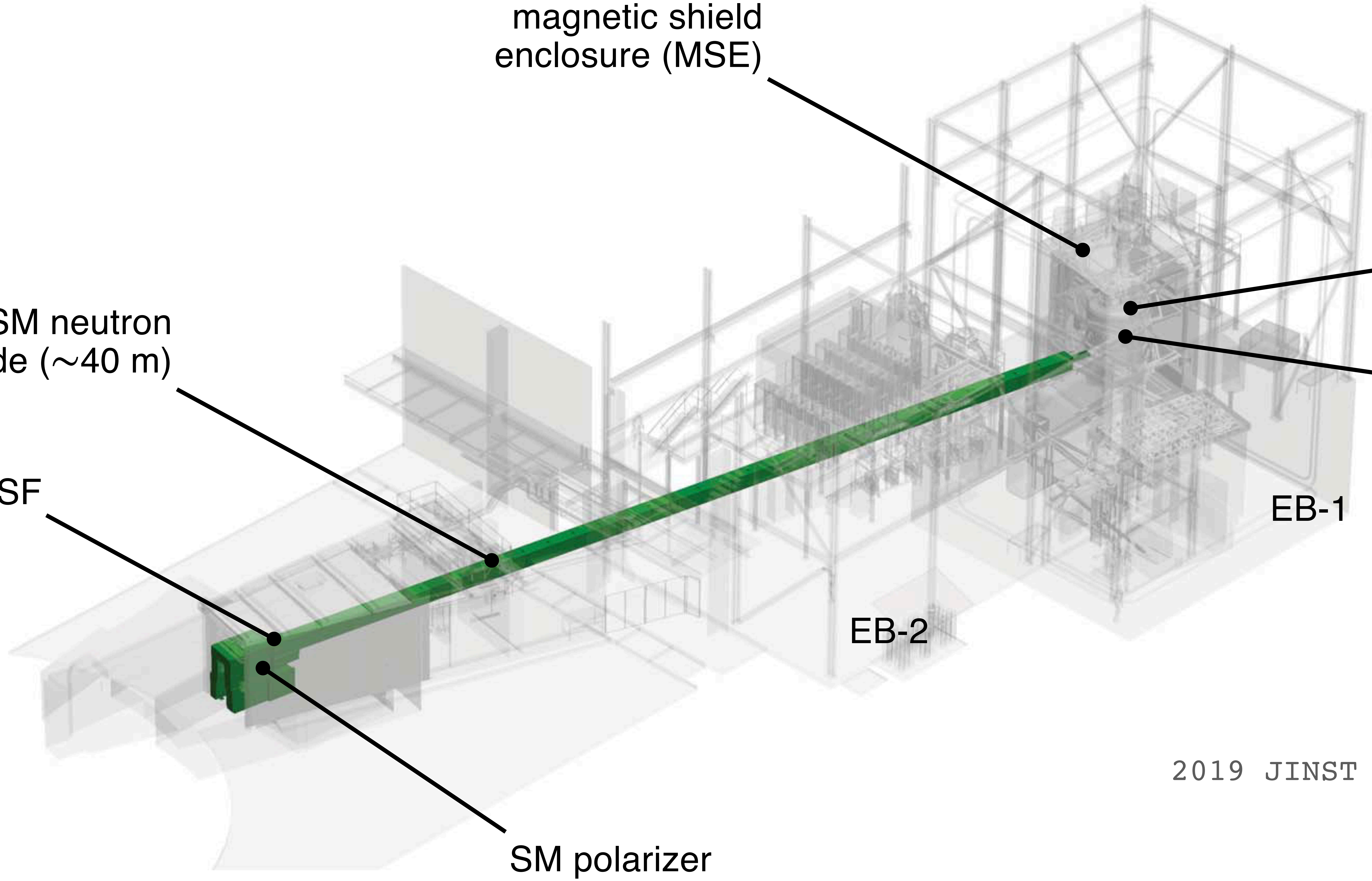
Libertad Barrón-Palos

Universidad Nacional Autónoma de México

INSTITUTO DE FÍSICA



NEUTRON BEAM TRANSPORT



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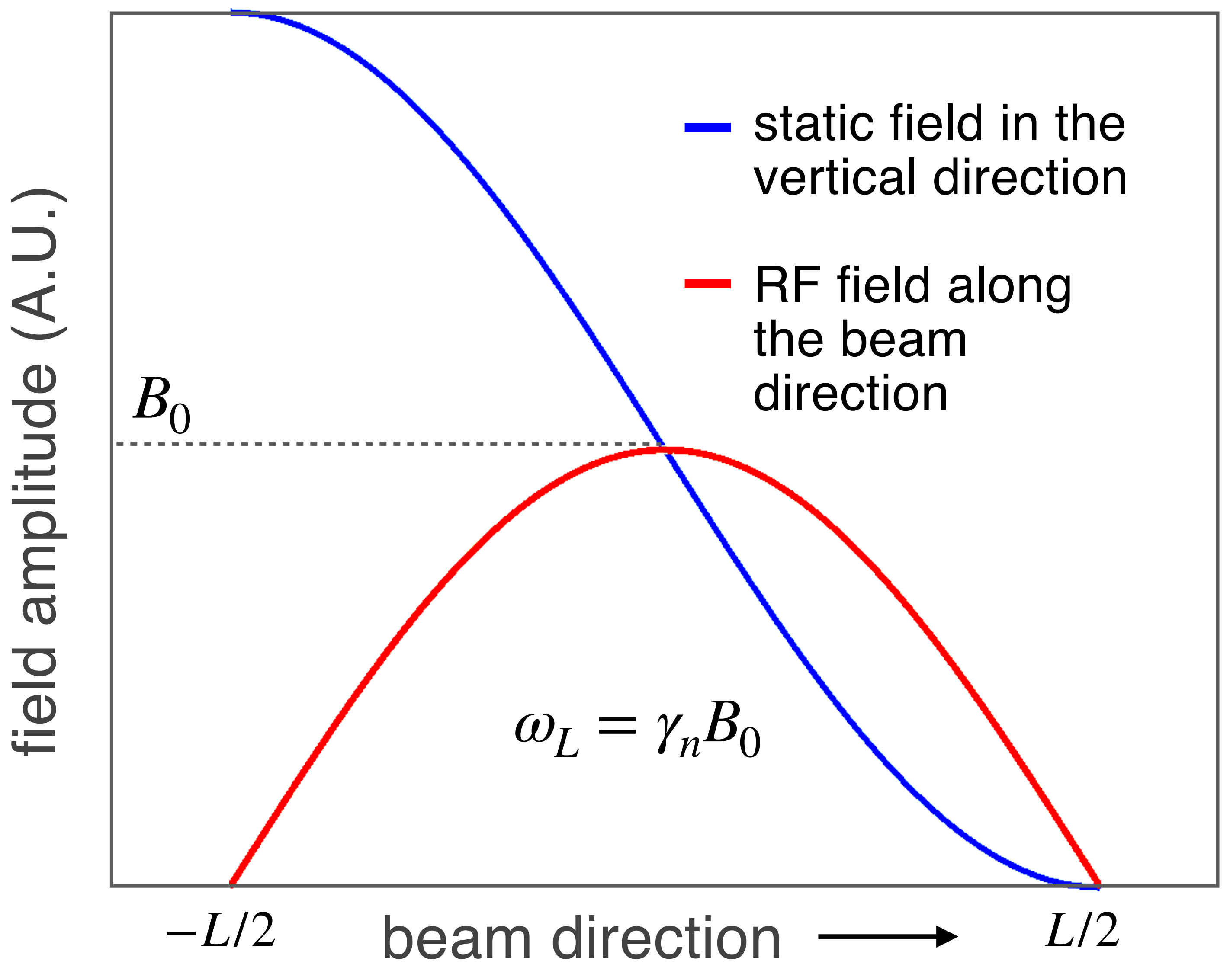
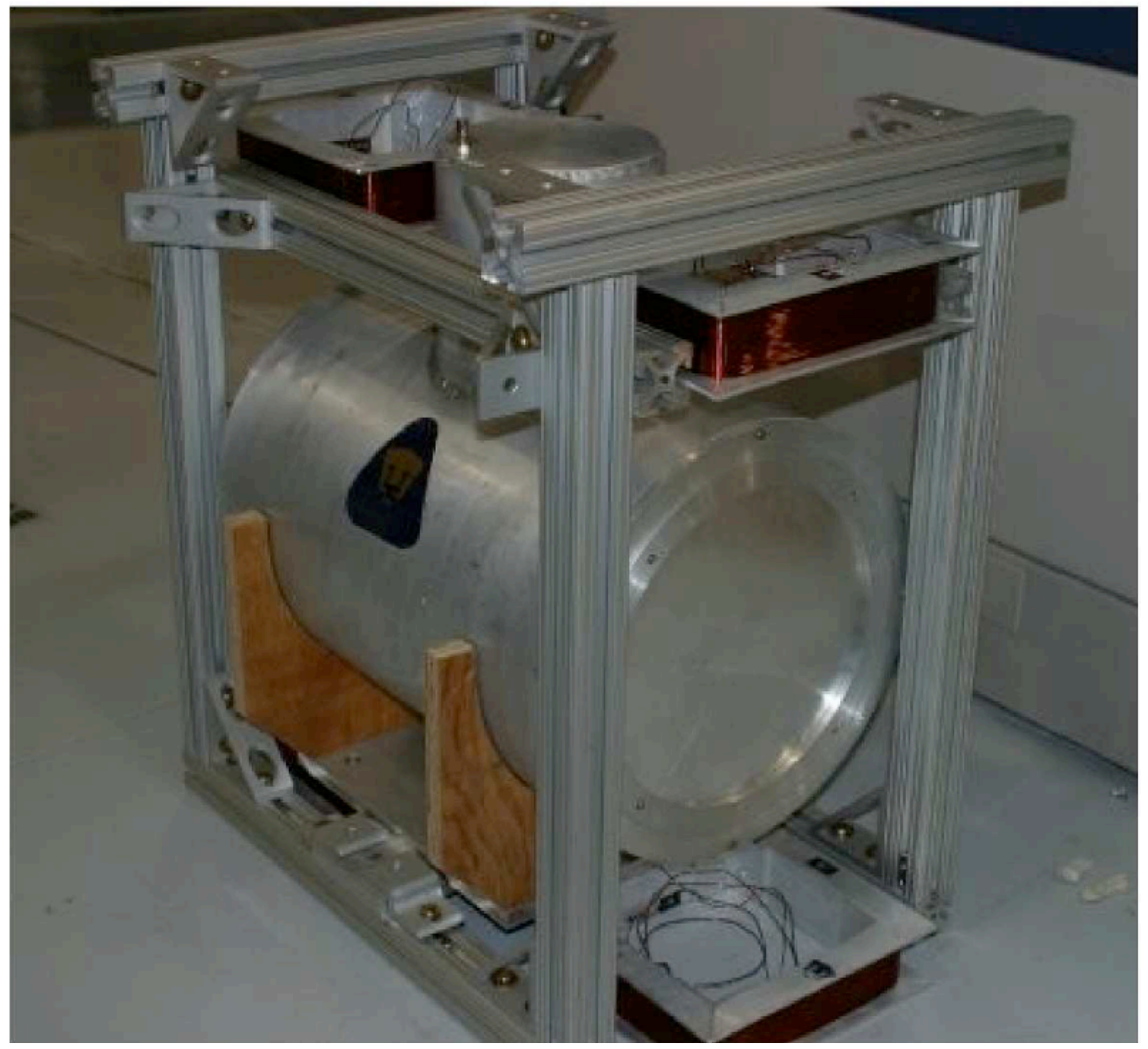
RF ADIABATIC SPIN FLIPPER





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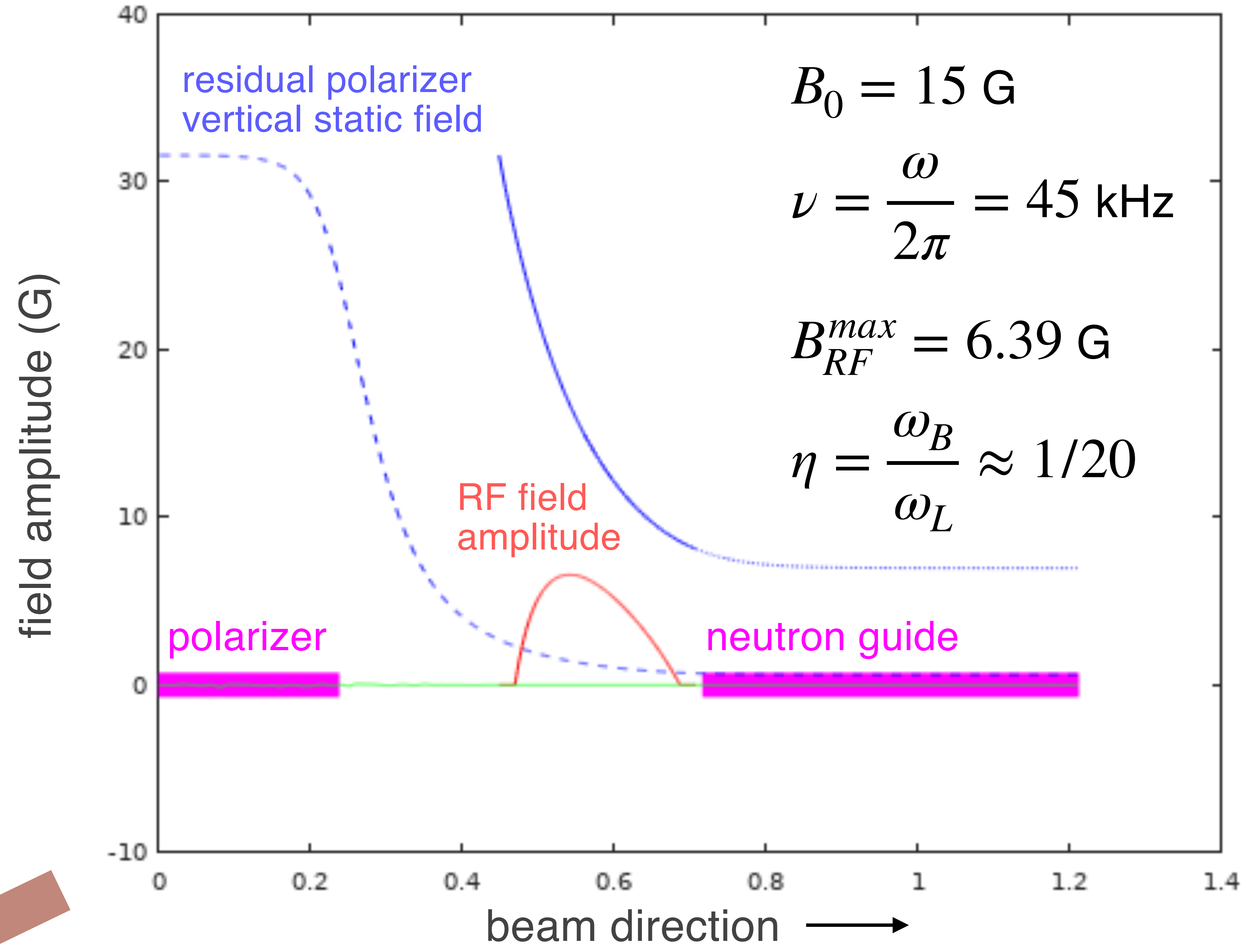
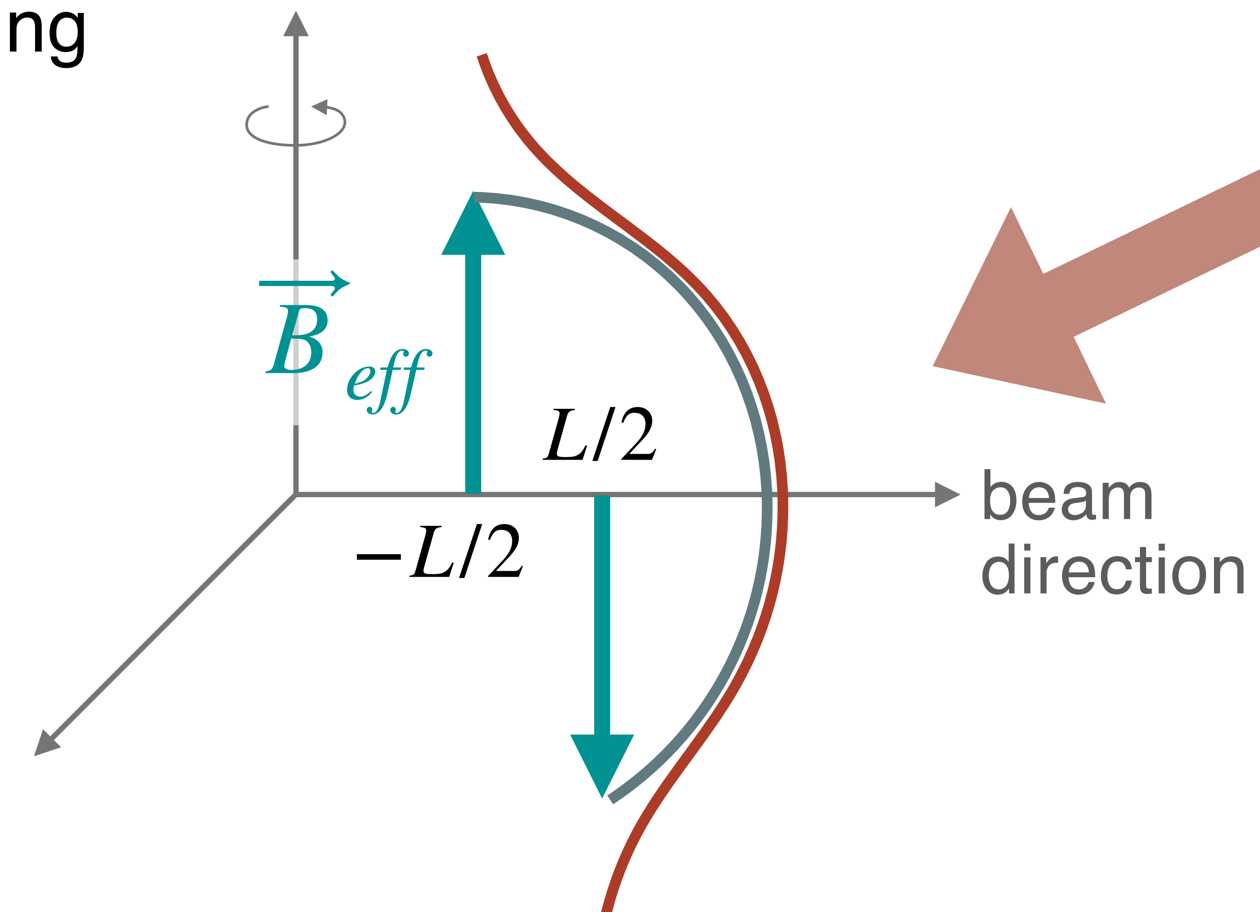
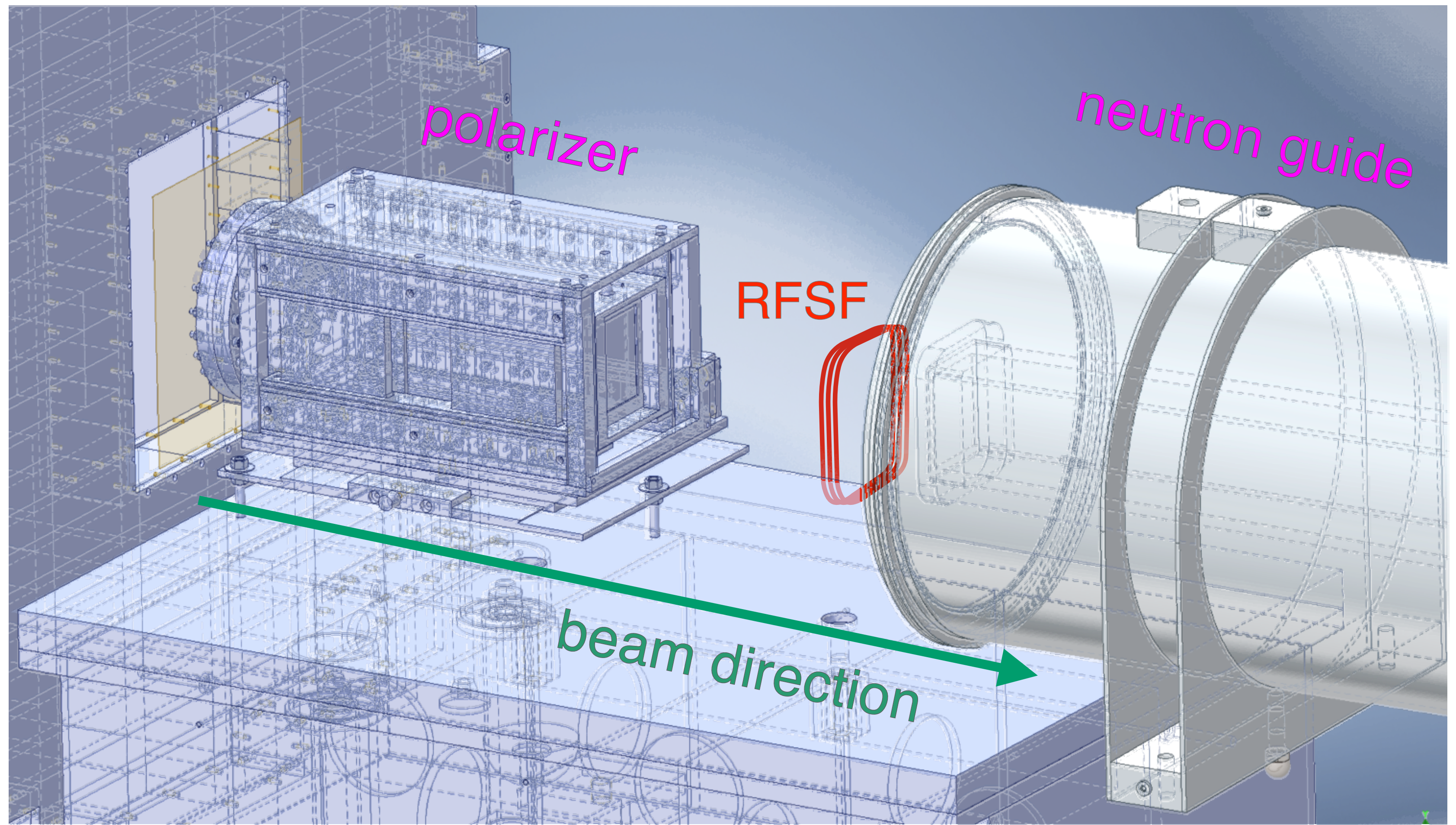


C. CRAWFORD

if $\omega_{RF} = \omega_L$

in the rotating frame of reference





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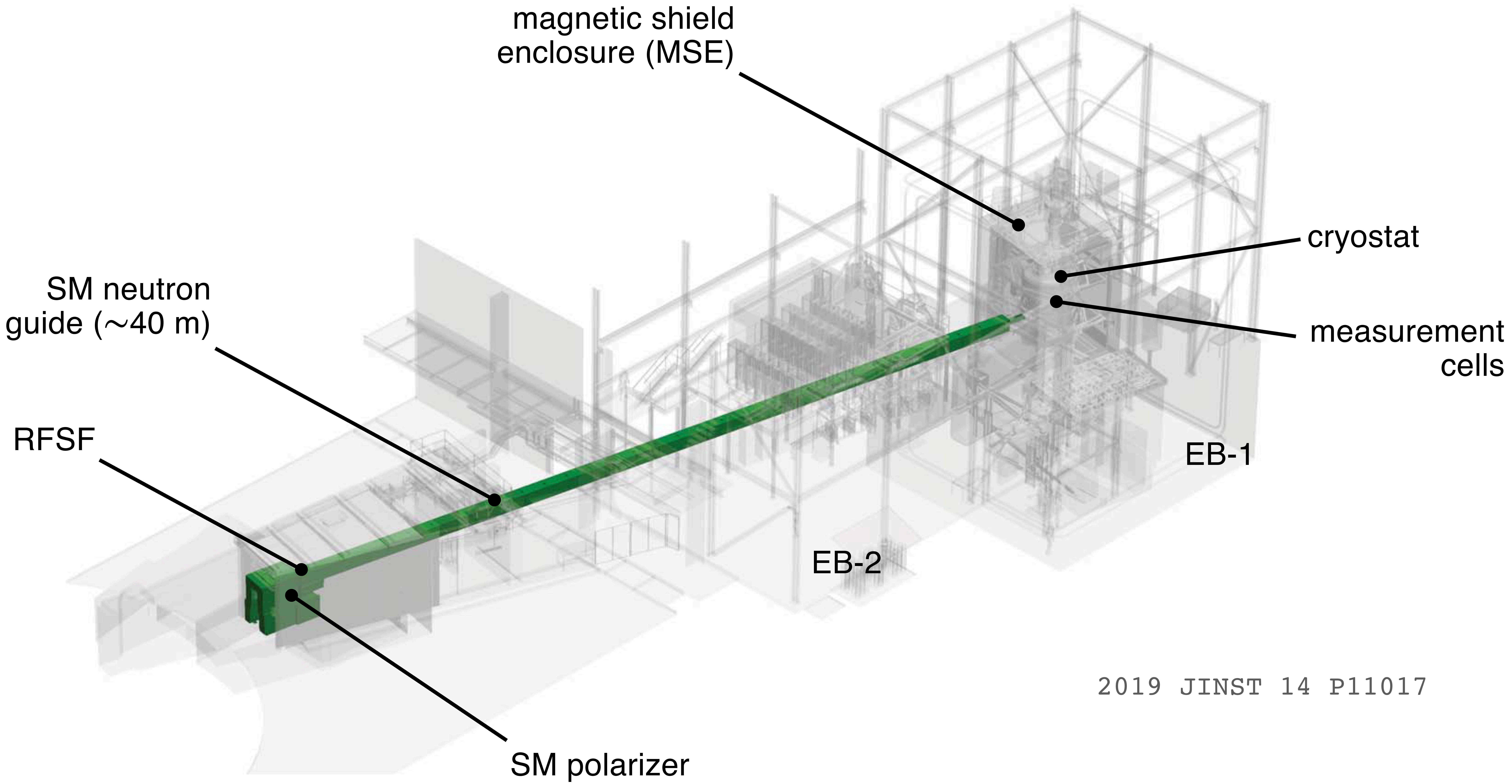

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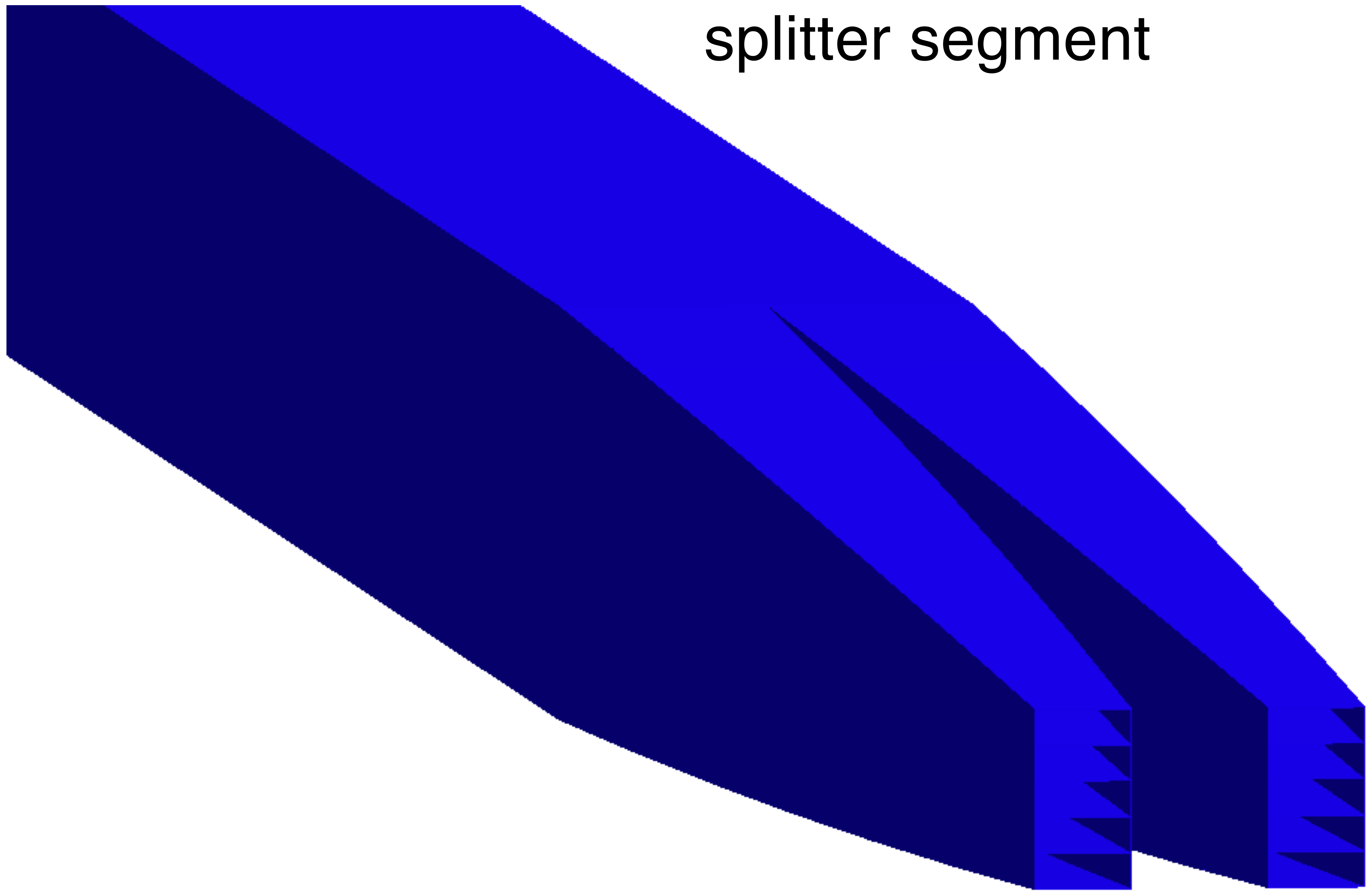
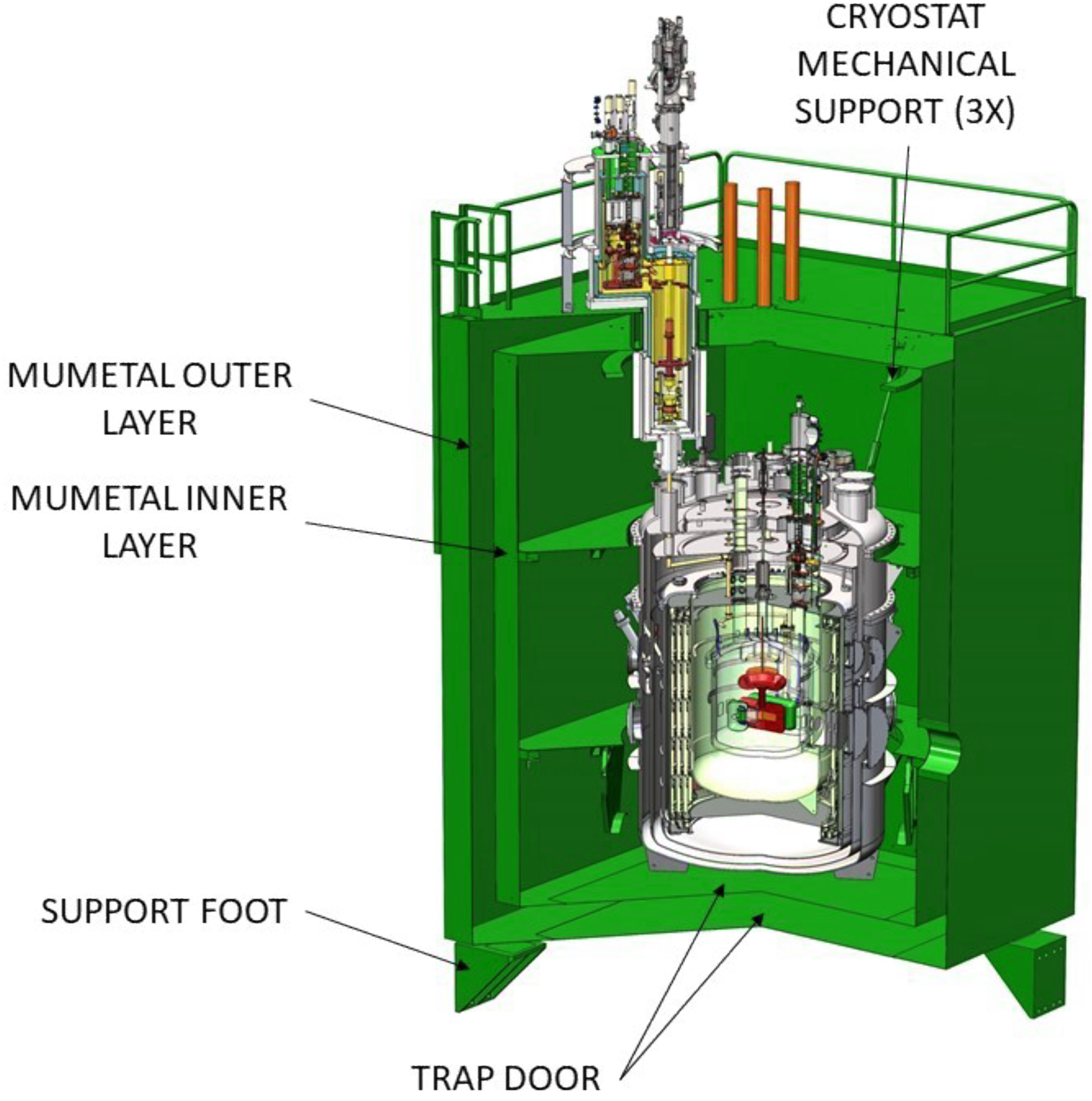
TRANSITION INTO THE MAGNETICALLY CONTROLLED ENVIRONMENT





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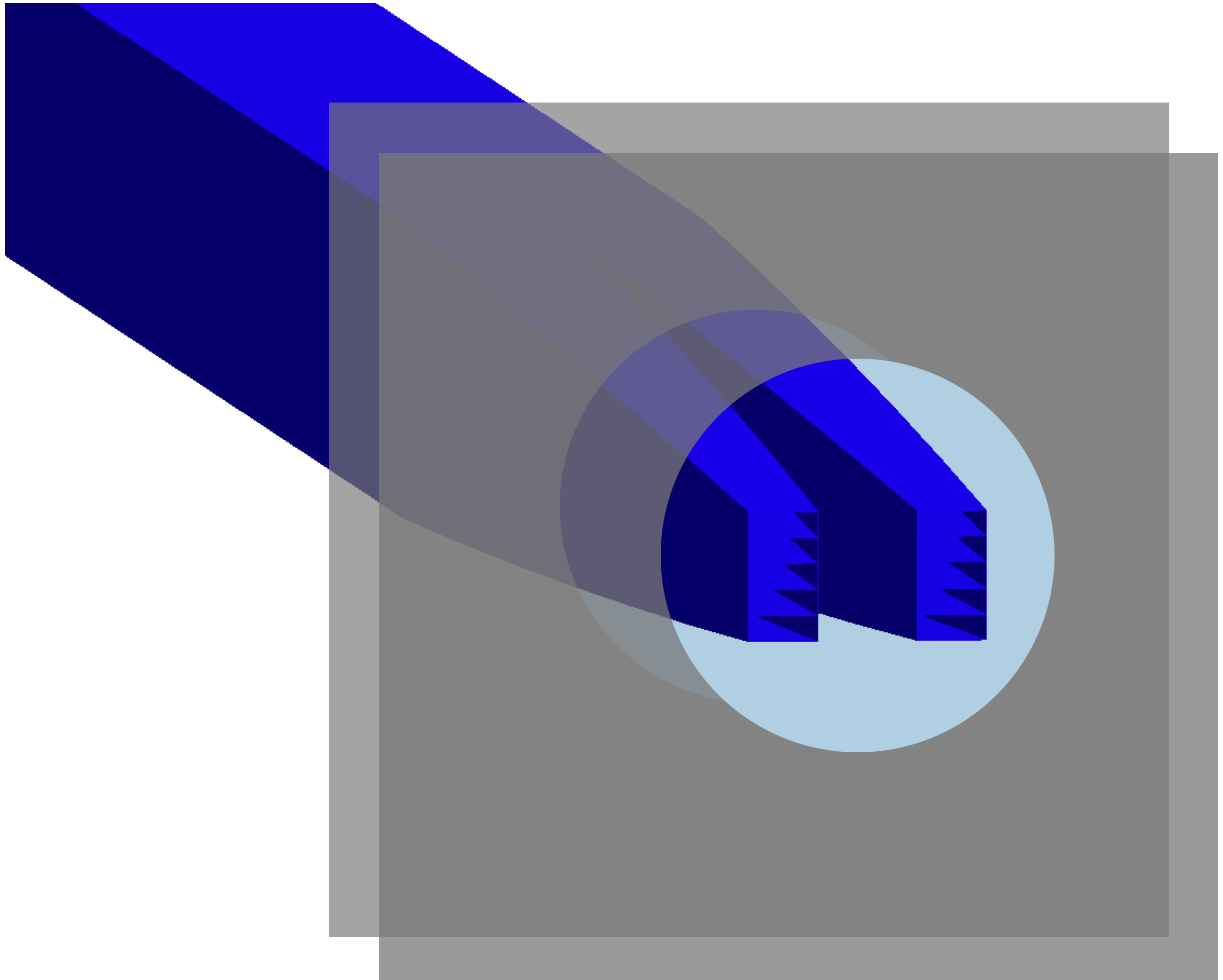

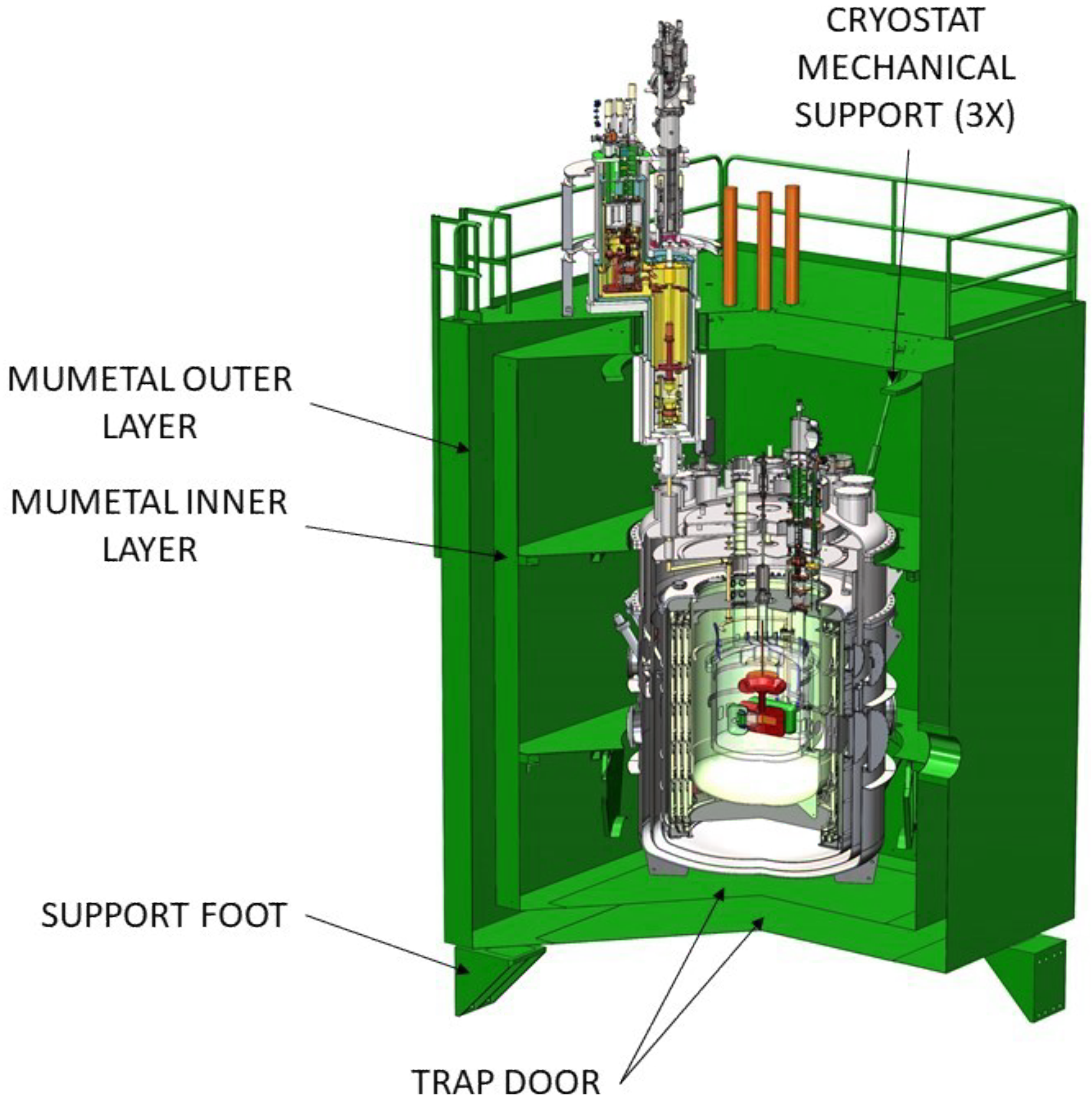

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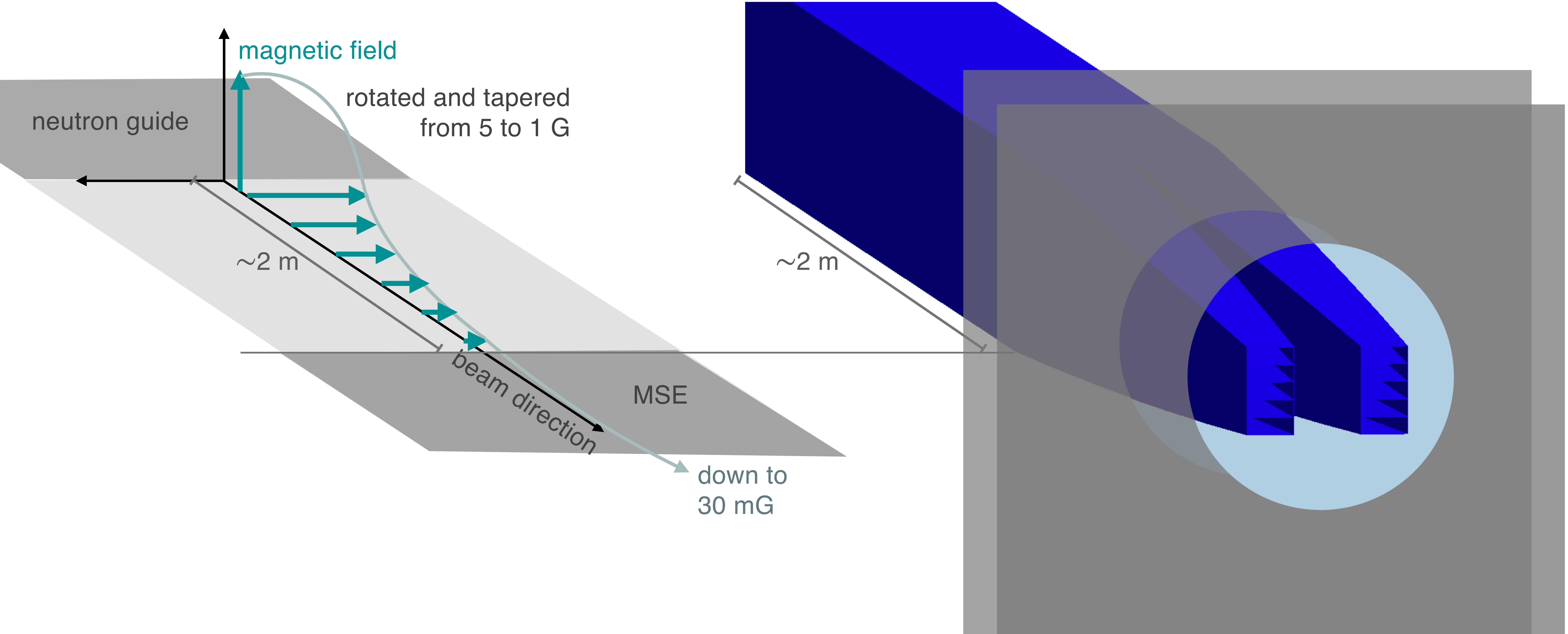
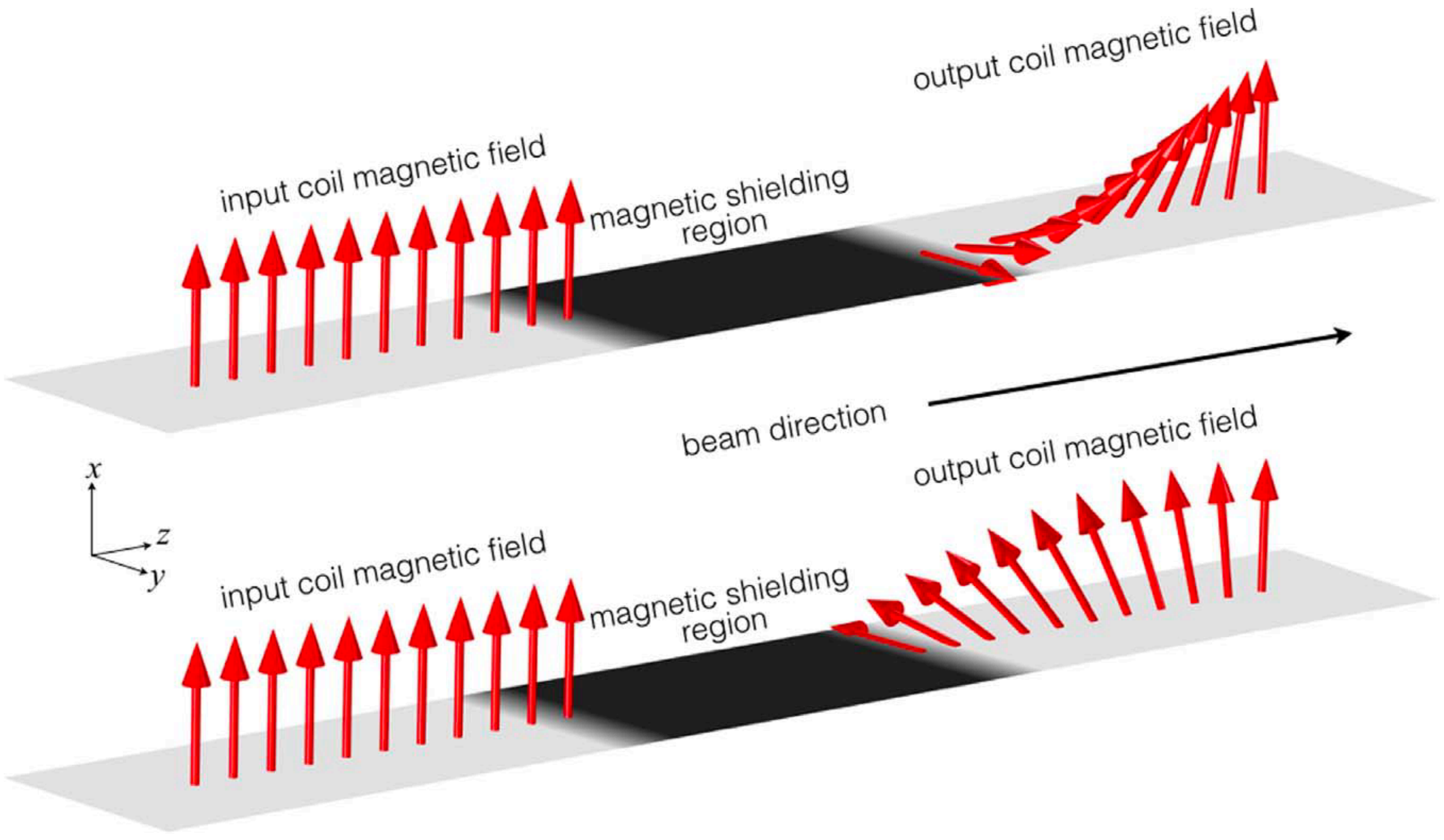
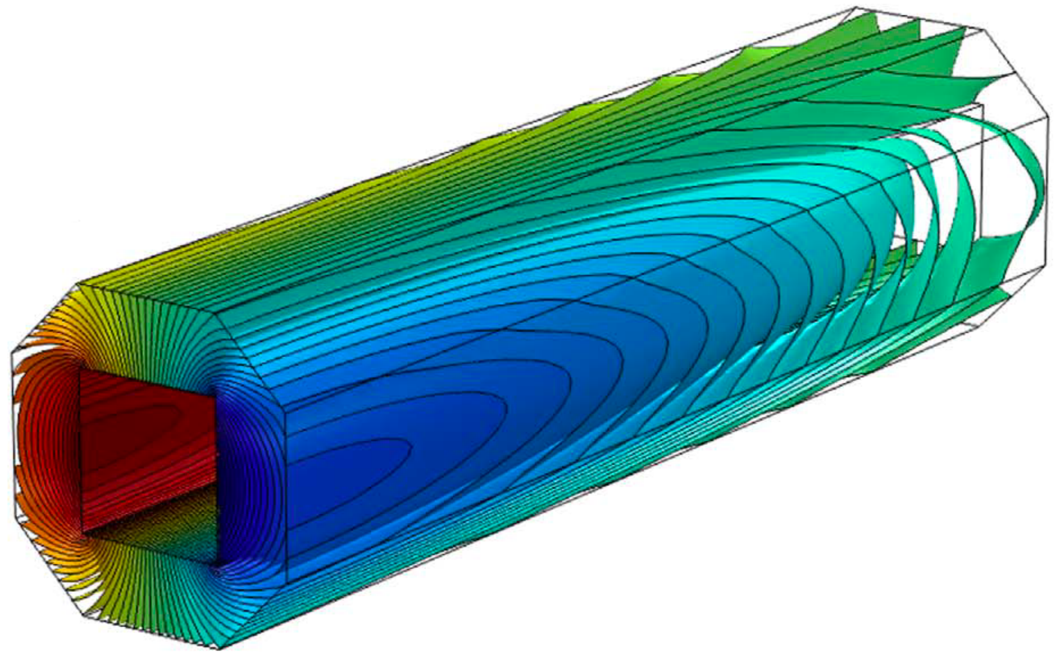
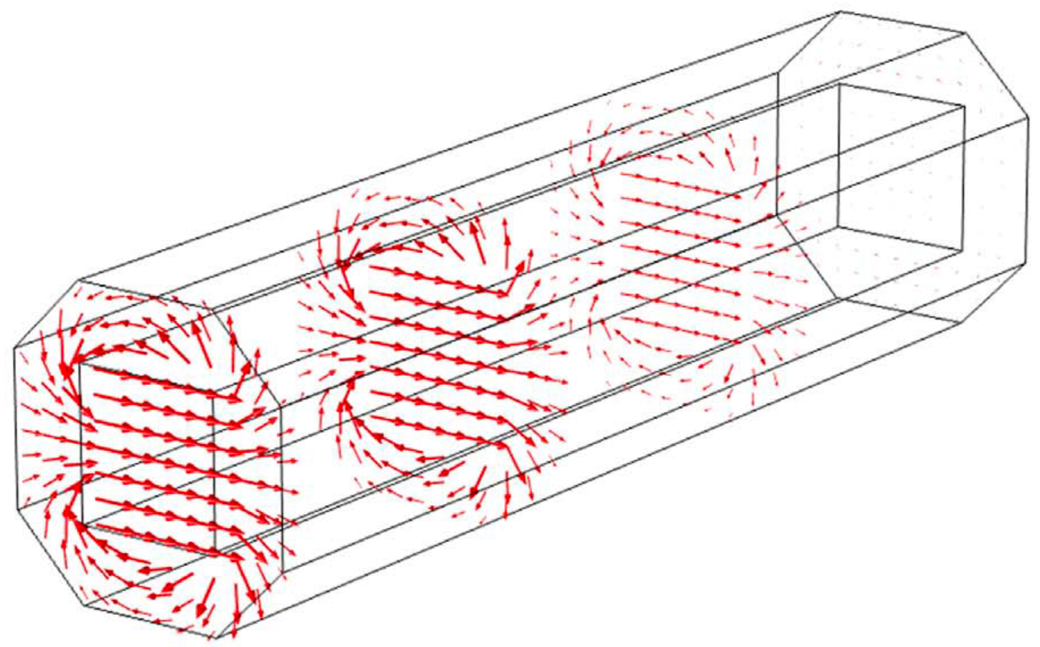
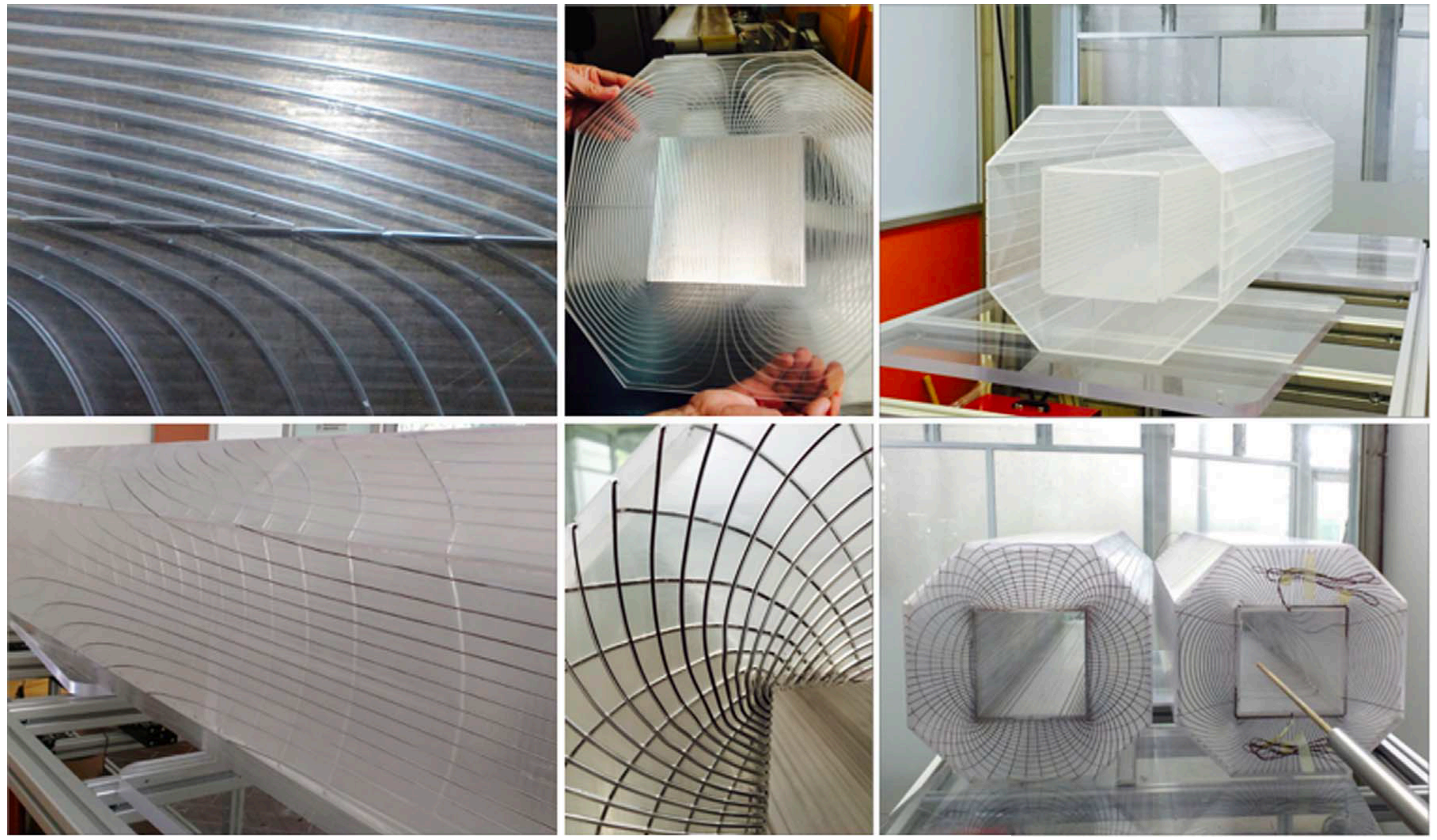


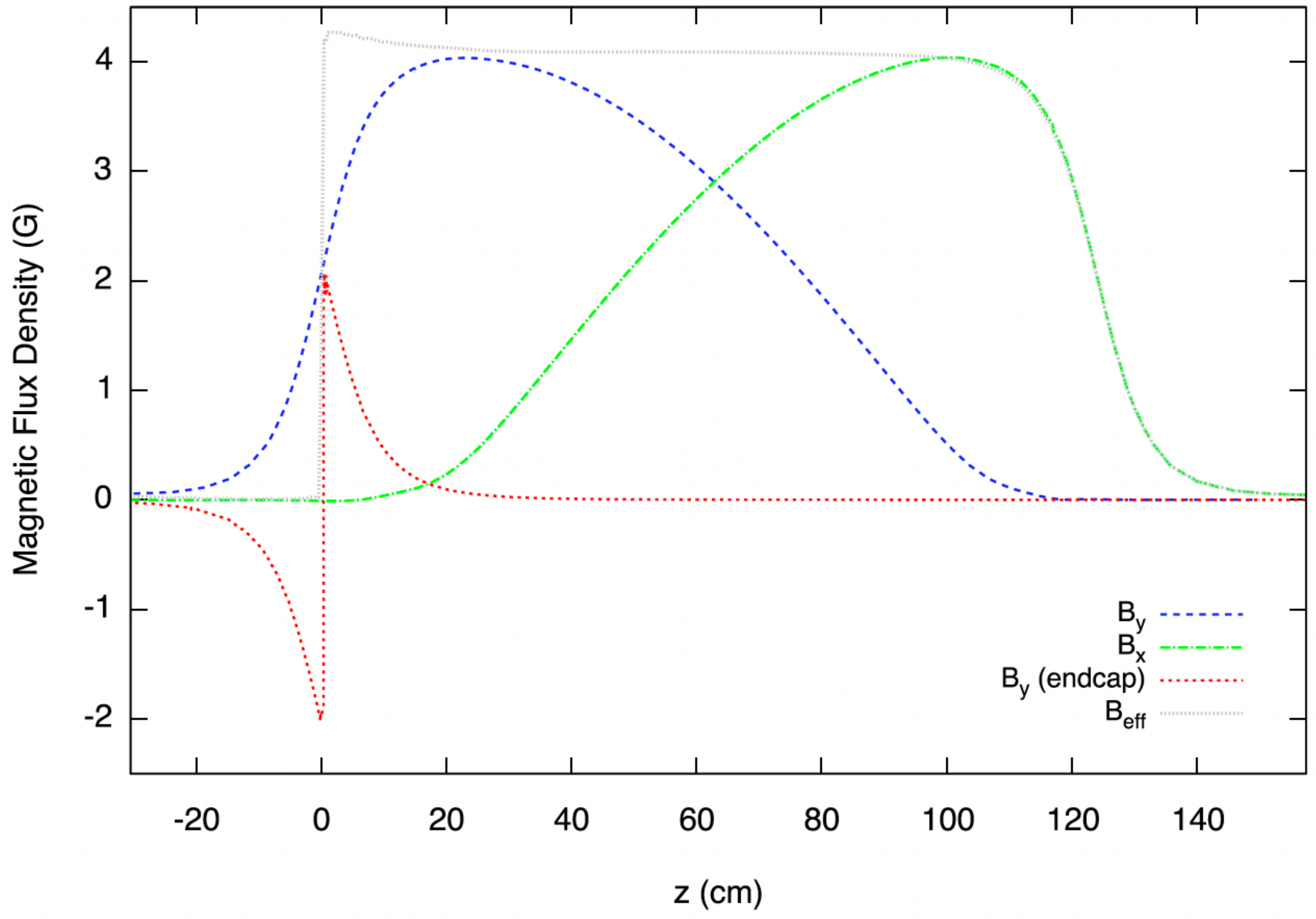
SPIN ROTATION











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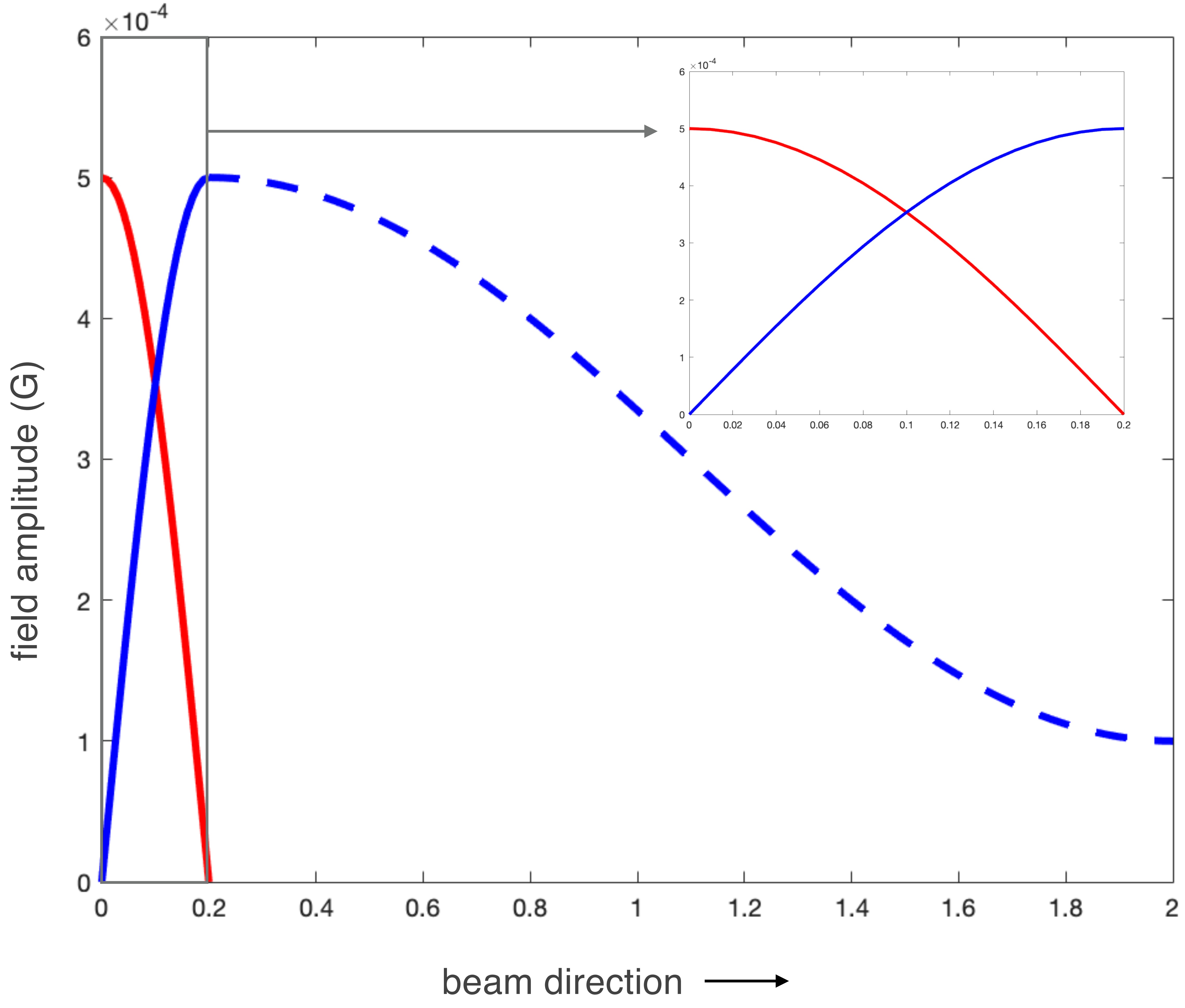
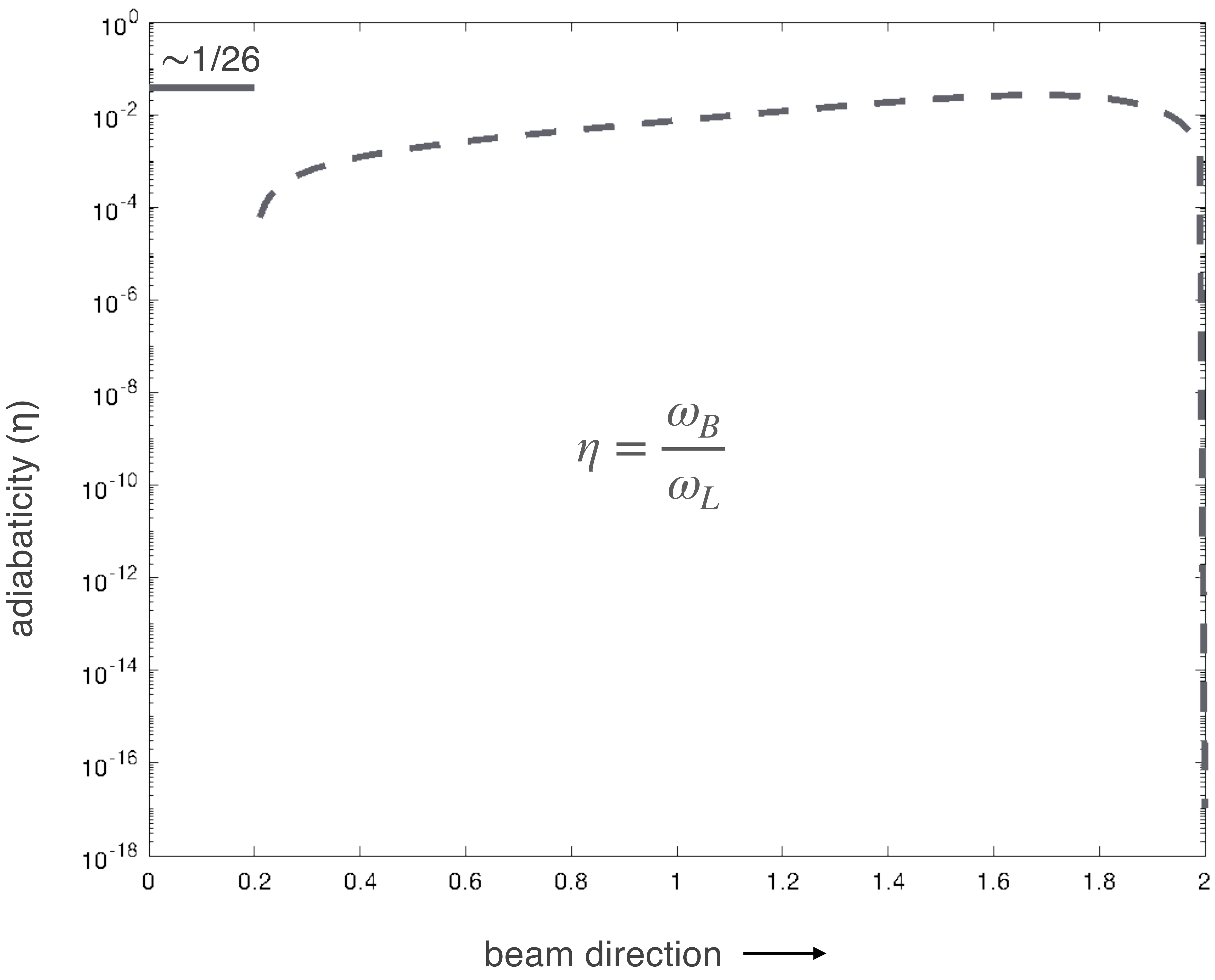
SPIN ROTATION & TAPPER





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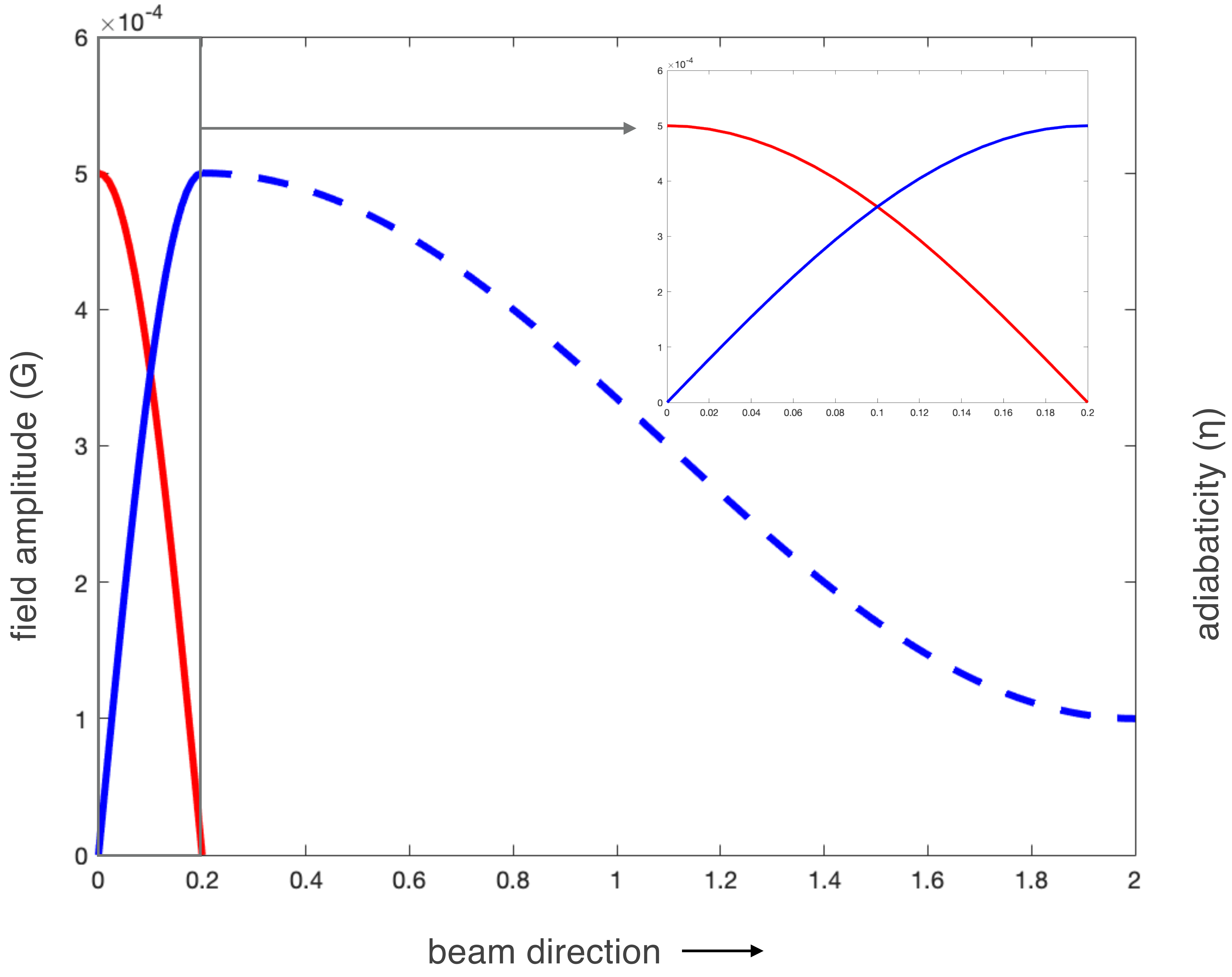
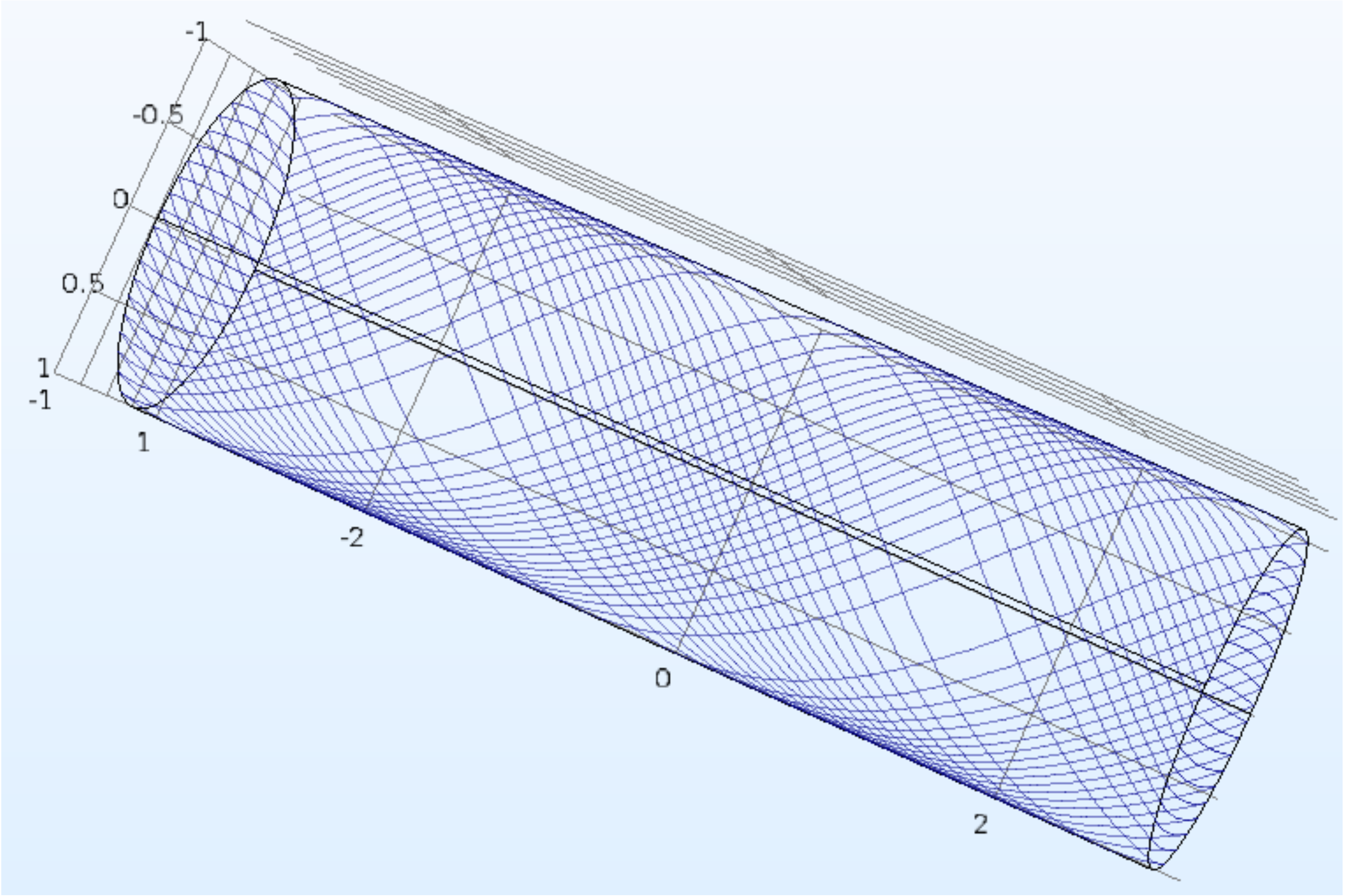
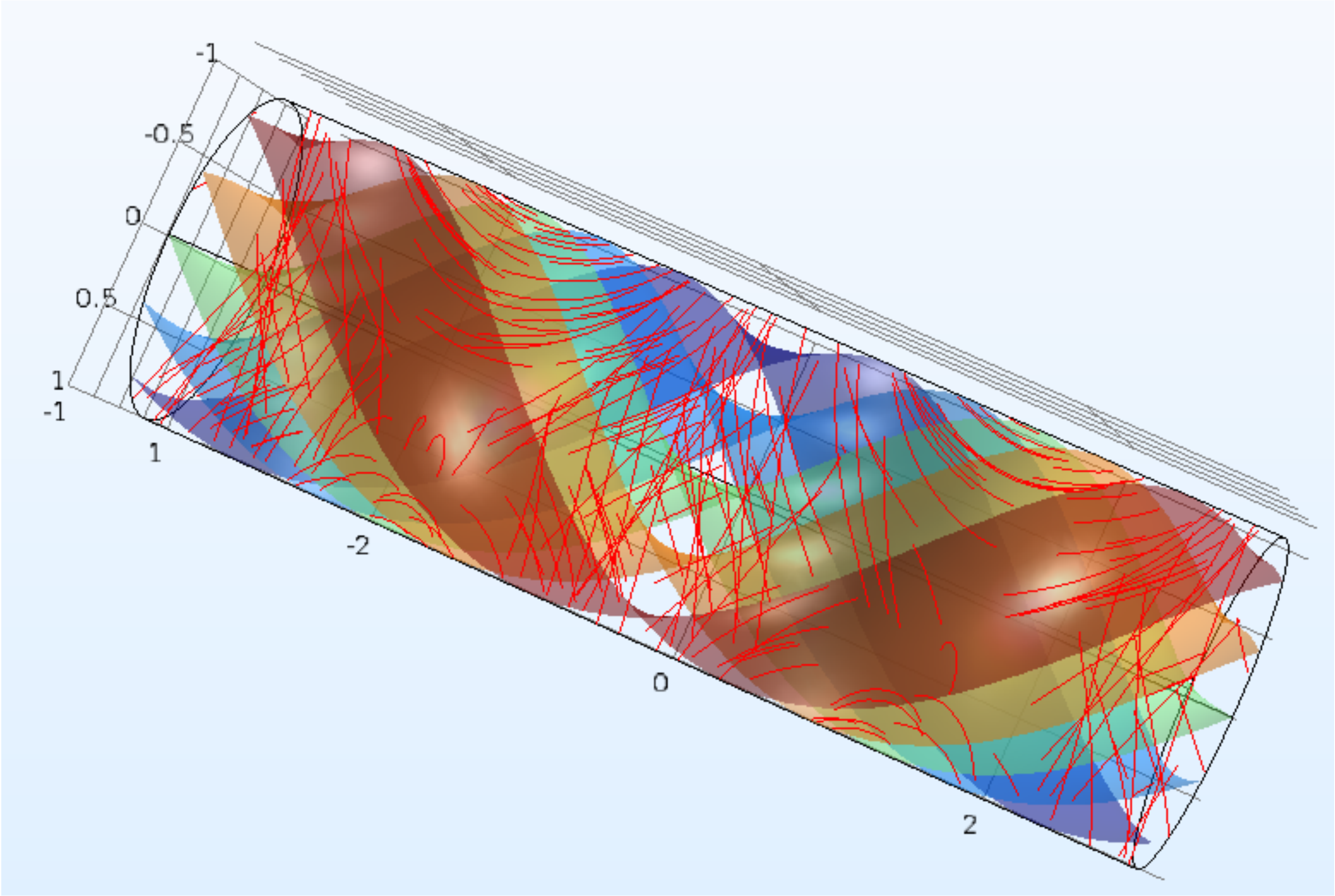
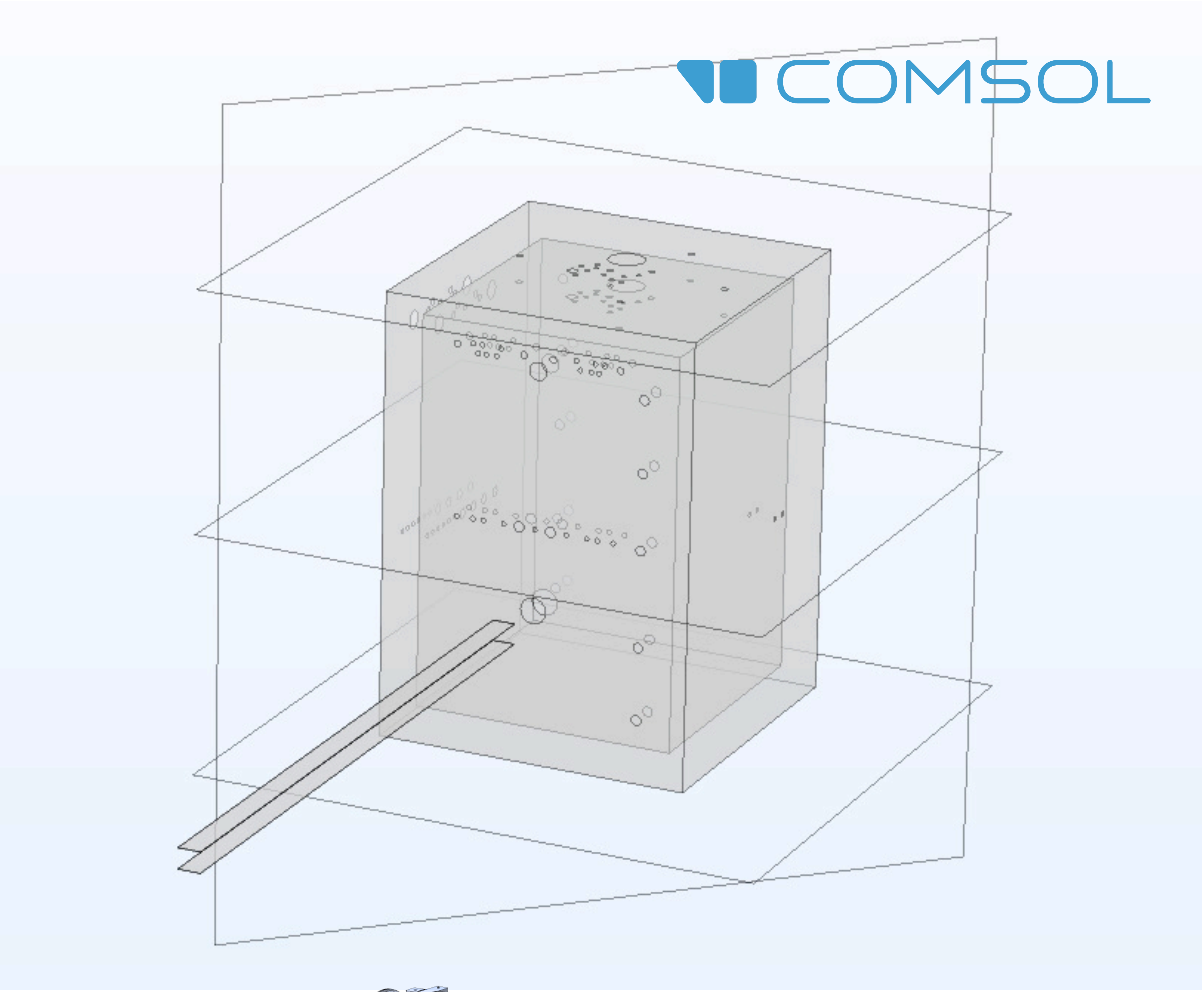


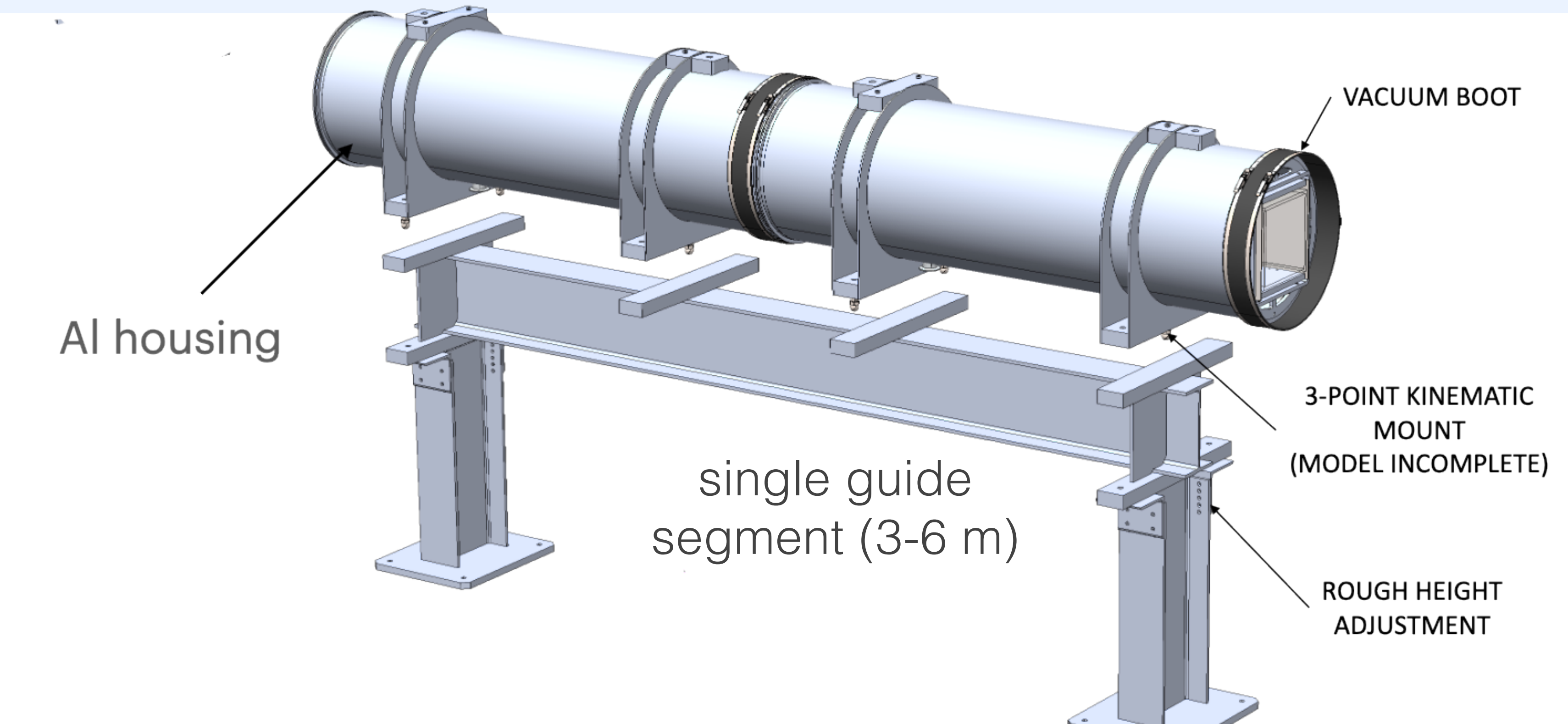




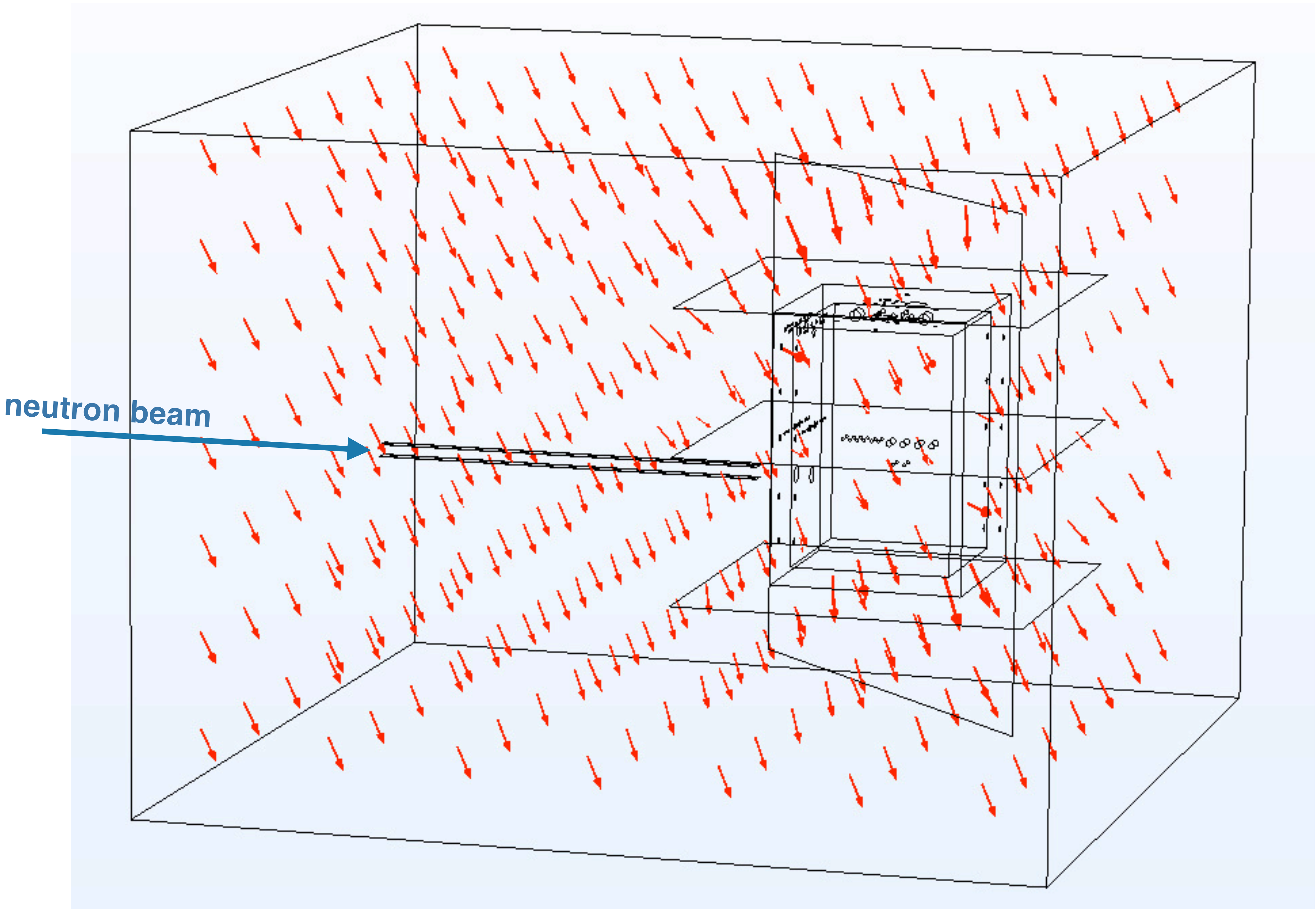
SIMULATION OF AMBIENT FIELDS

- Only steel pole tips (for the permanent magnets) are modeled
- 5 G guiding vertical magnetic field between pole tips (produced by permanent magnets)
- Only a segment about 1/4 of the total length of the guide
- Separation between the end of the guide and the entrance of the MSE is about 2 m
- Two MSE walls with all the penetrations

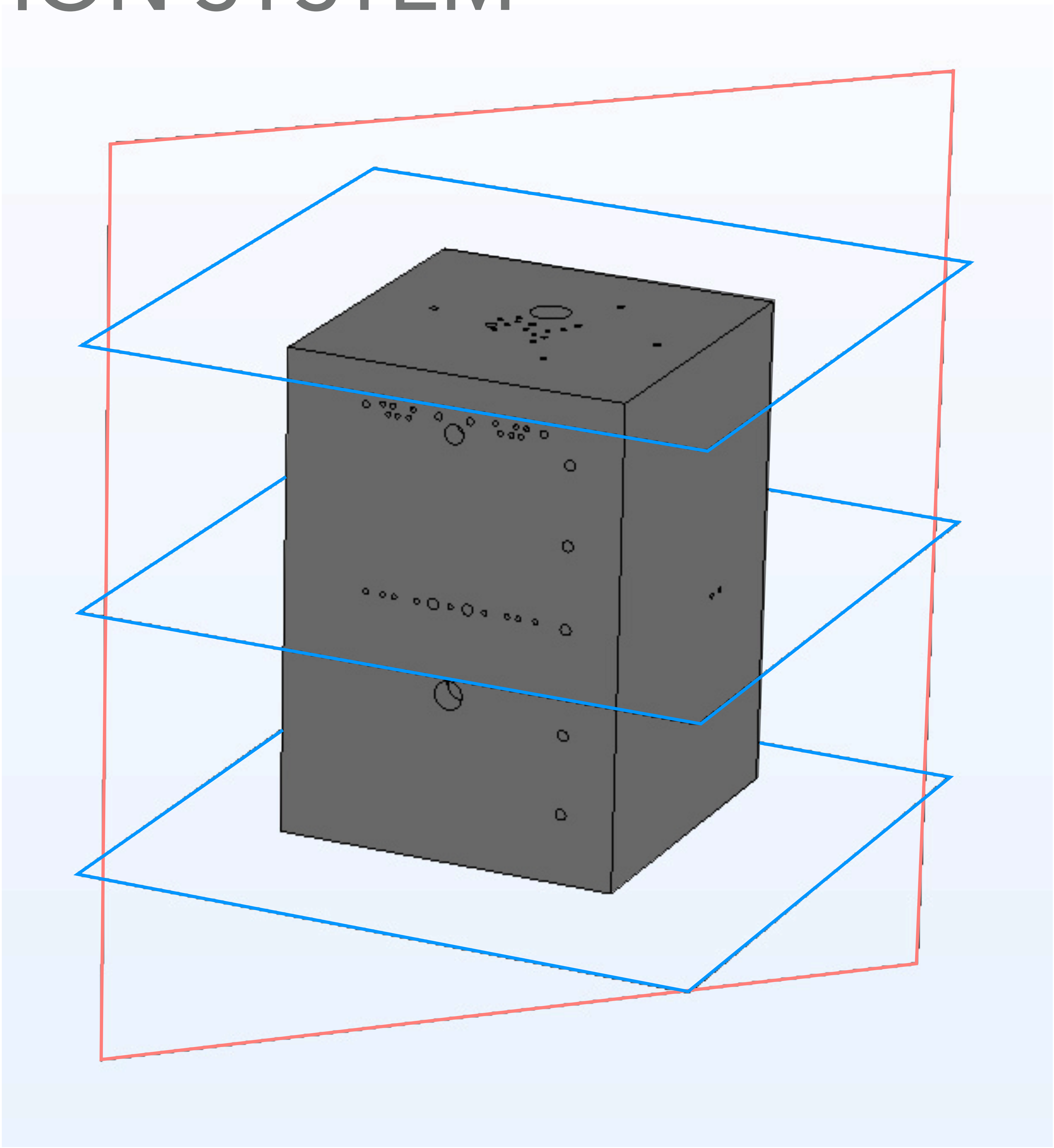




EARTH'S MAGNETIC FIELD & COMPENSATION SYSTEM

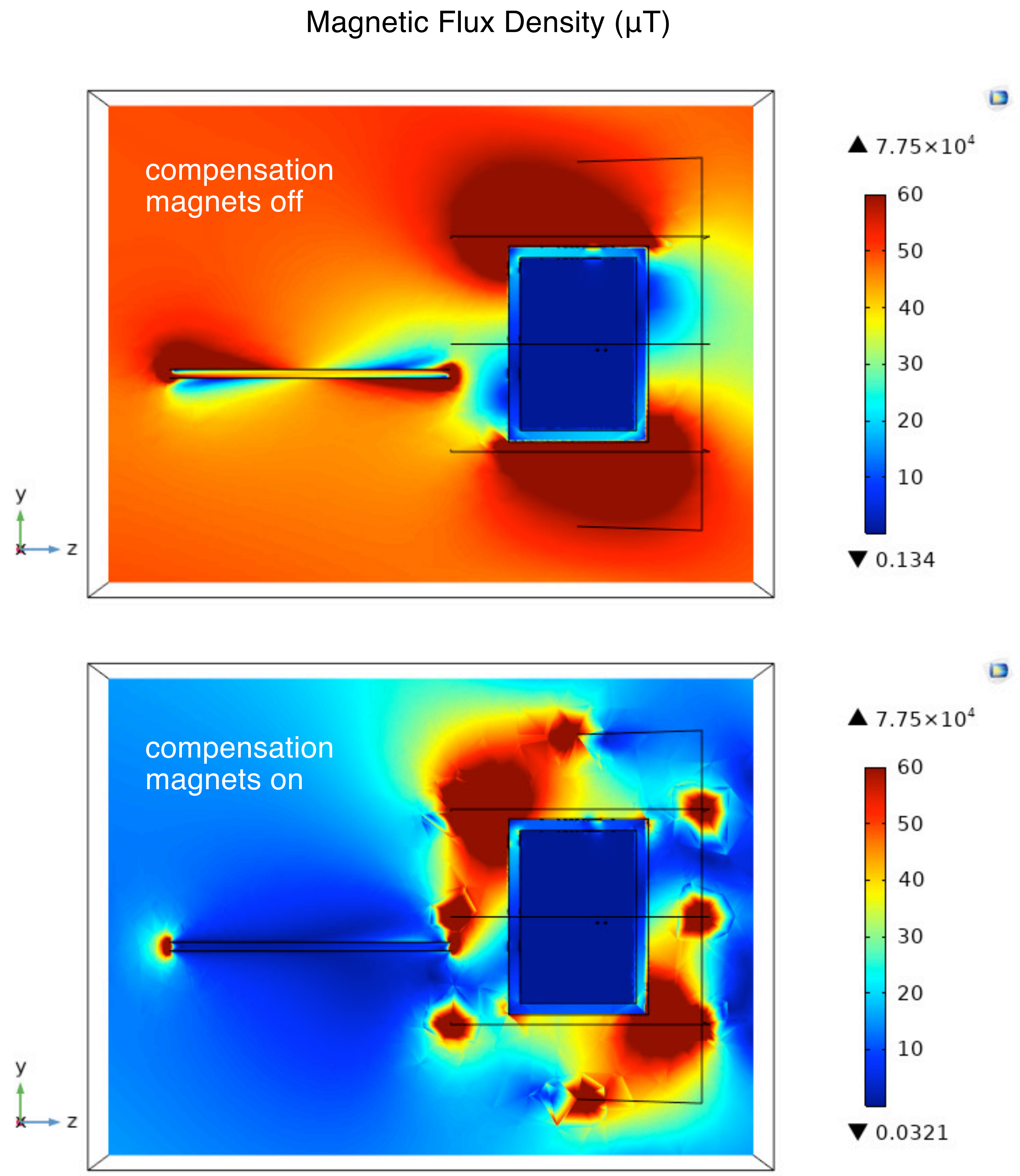


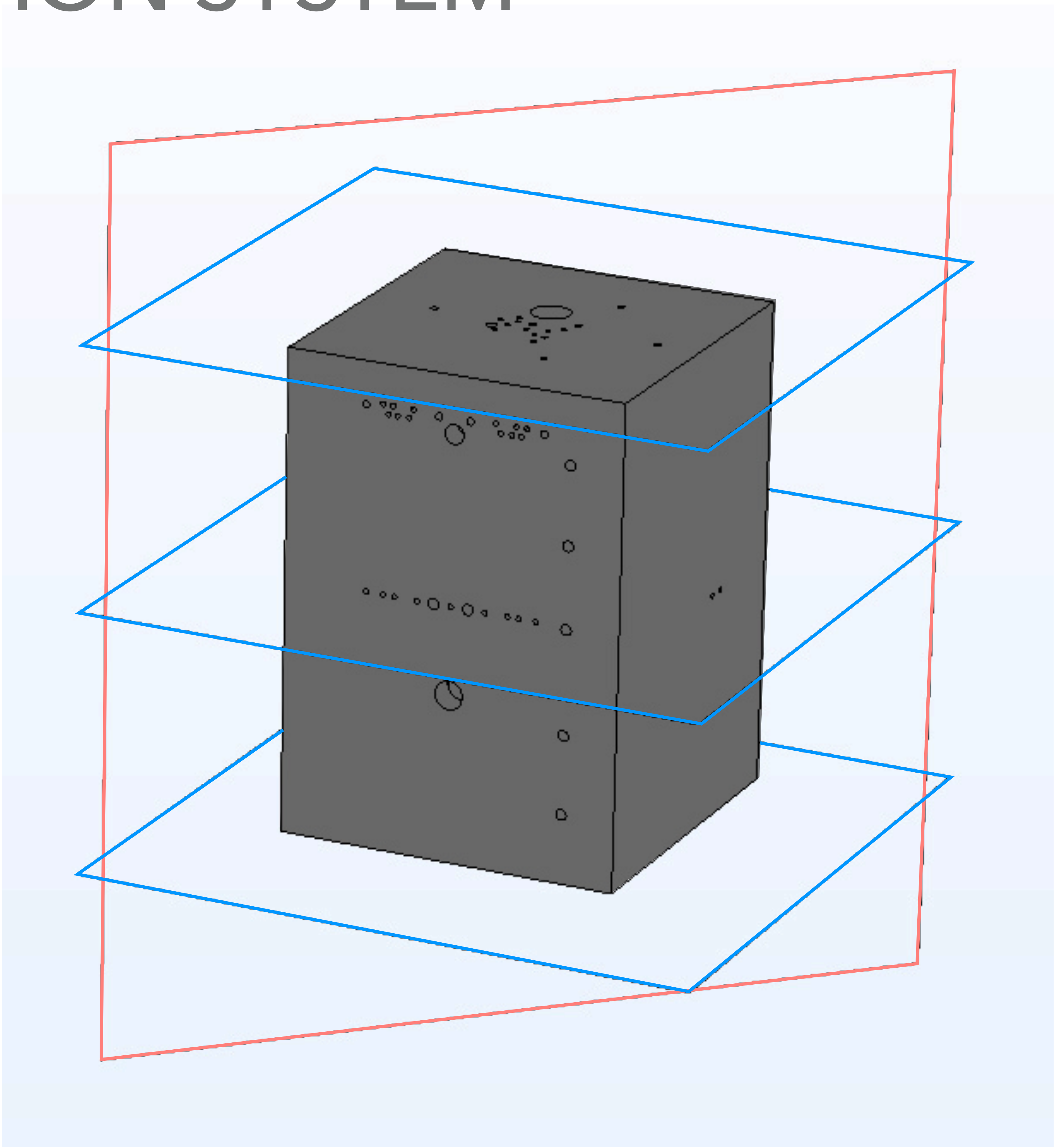
- Angle of the neutron beam to the magnetic north of 39.79°, with beam directed to the northeast.



- 3 coils to produce a vertical field and one to produce a diagonal field.
- Maintains magnetic fields < 30 μT on the outer surface of the MSE.

EARTH'S MAGNETIC FIELD & COMPENSATION SYSTEM





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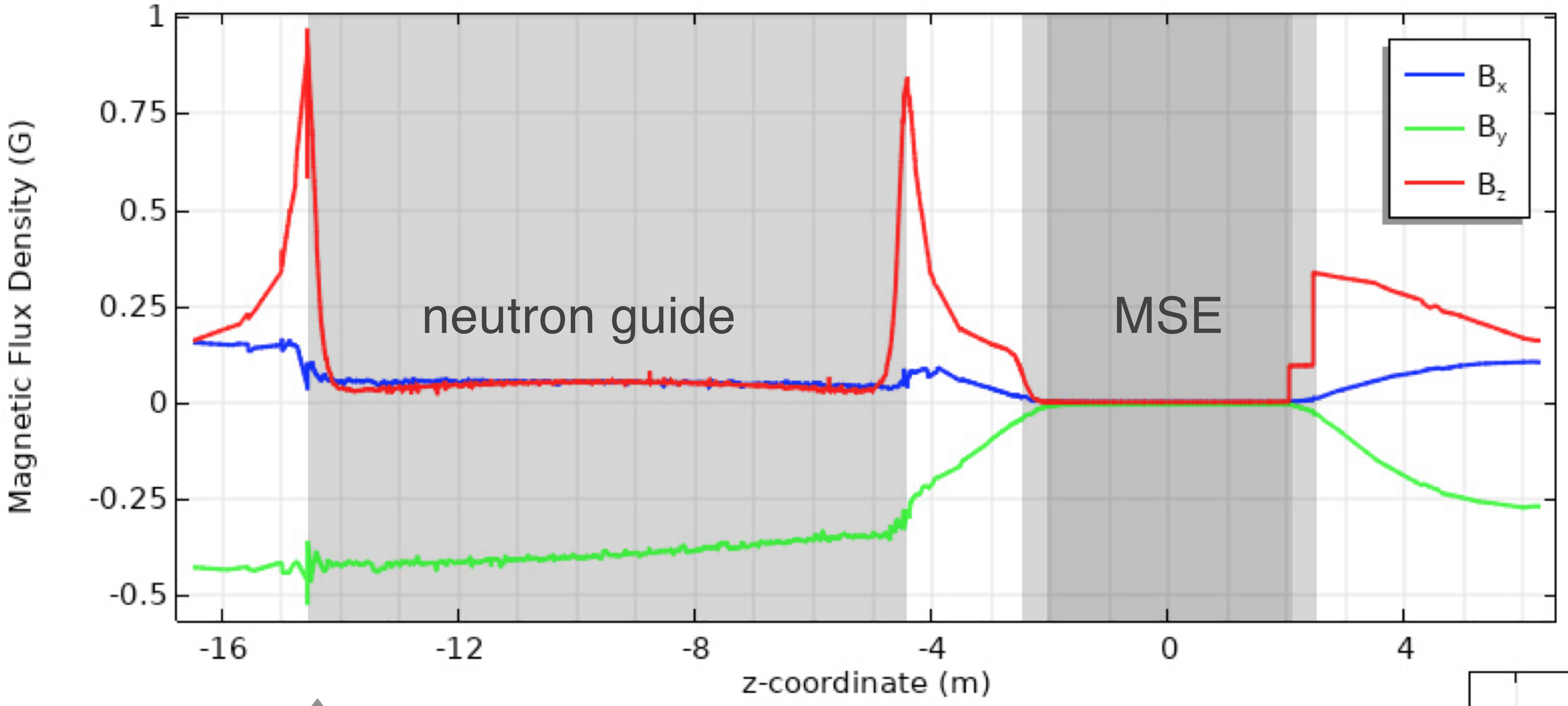
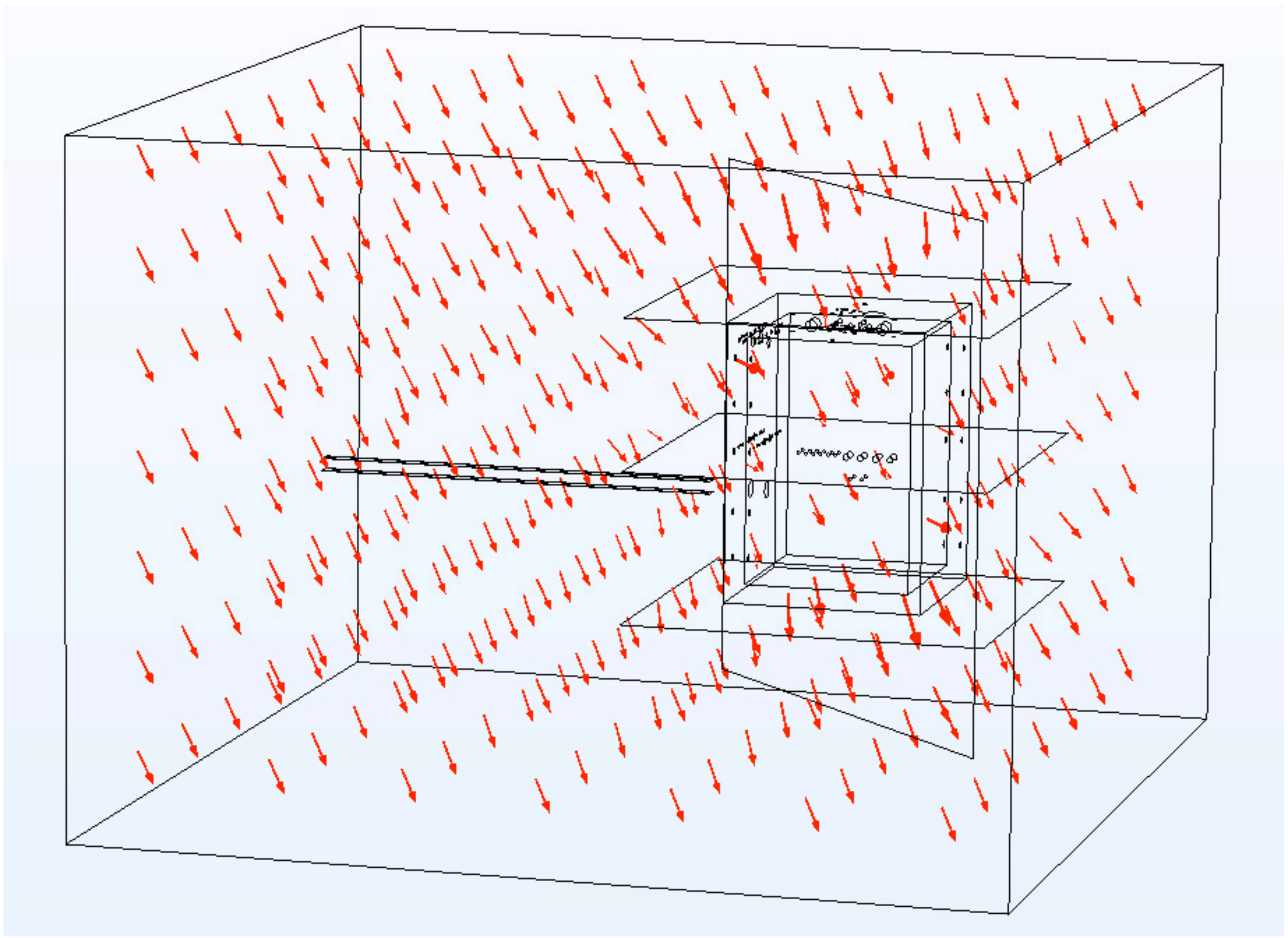
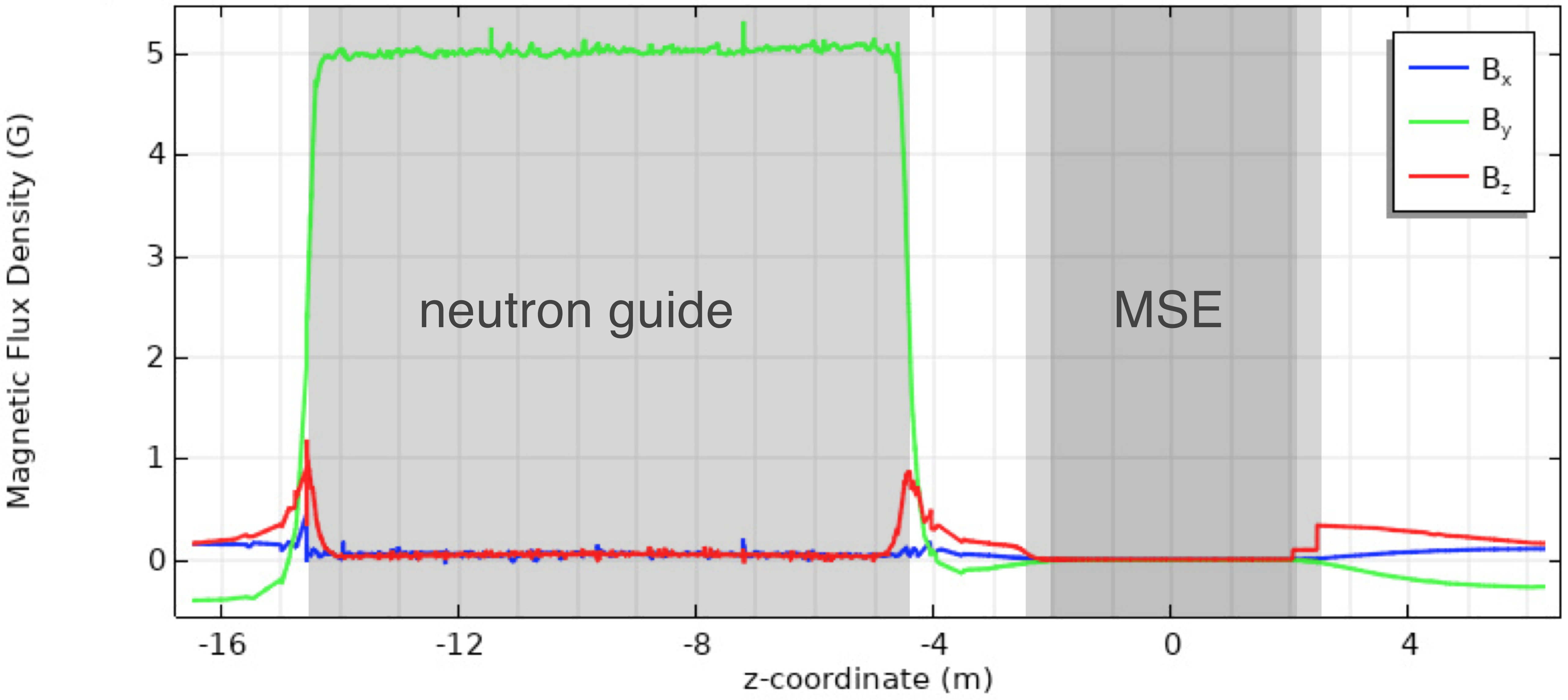
STEEL POLE TIPS EFFECT





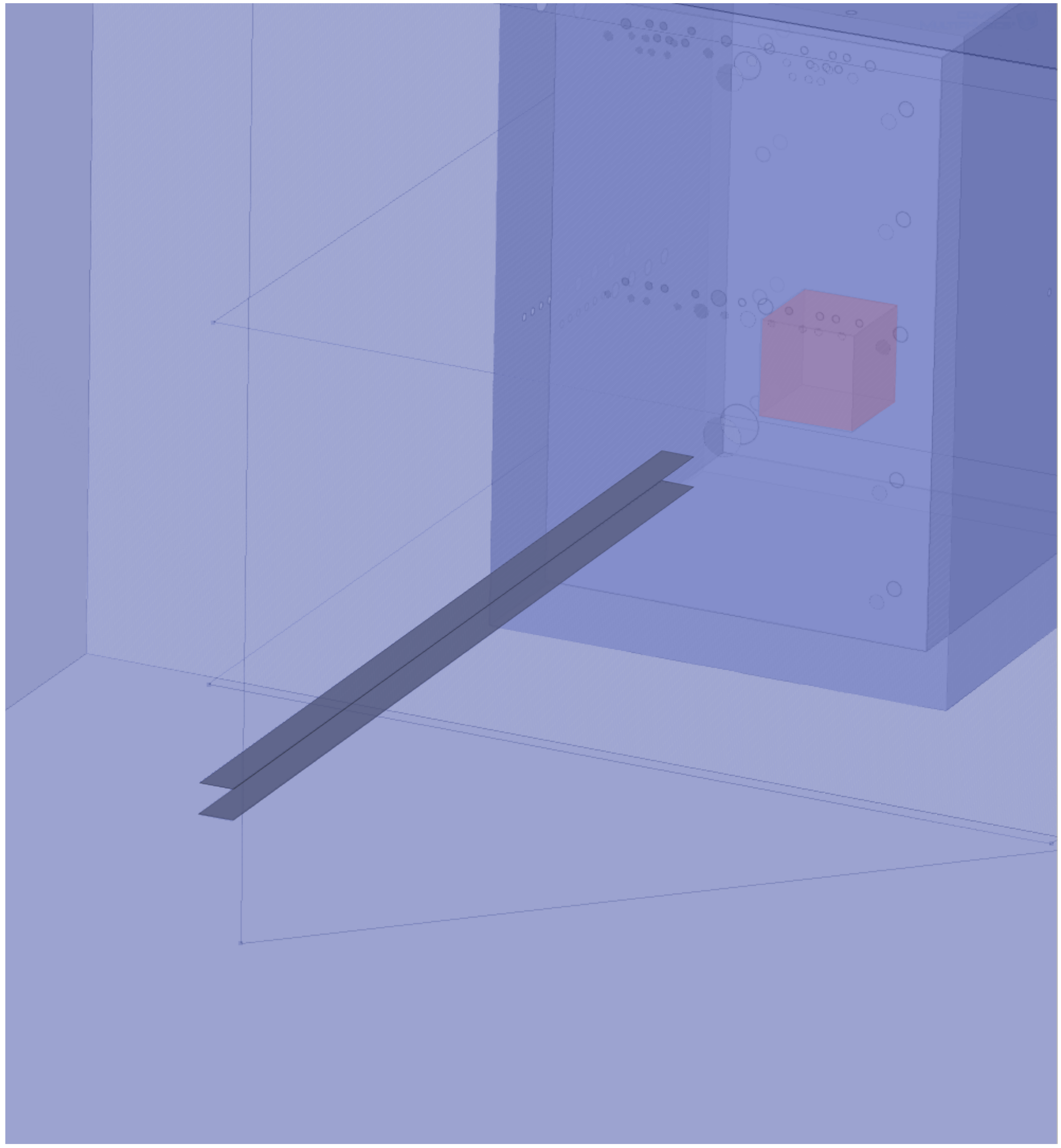
Earth's field

Earth's field + guide permanent magnets



LONGITUDINAL AND TRANSVERSE MAGNETIC FIELD GRADIENTS IN THE MEASUREMENT REGION

- $1\ m^3$ volume in the measurement region
- magnetic field gradients required to be below 1 nT/m

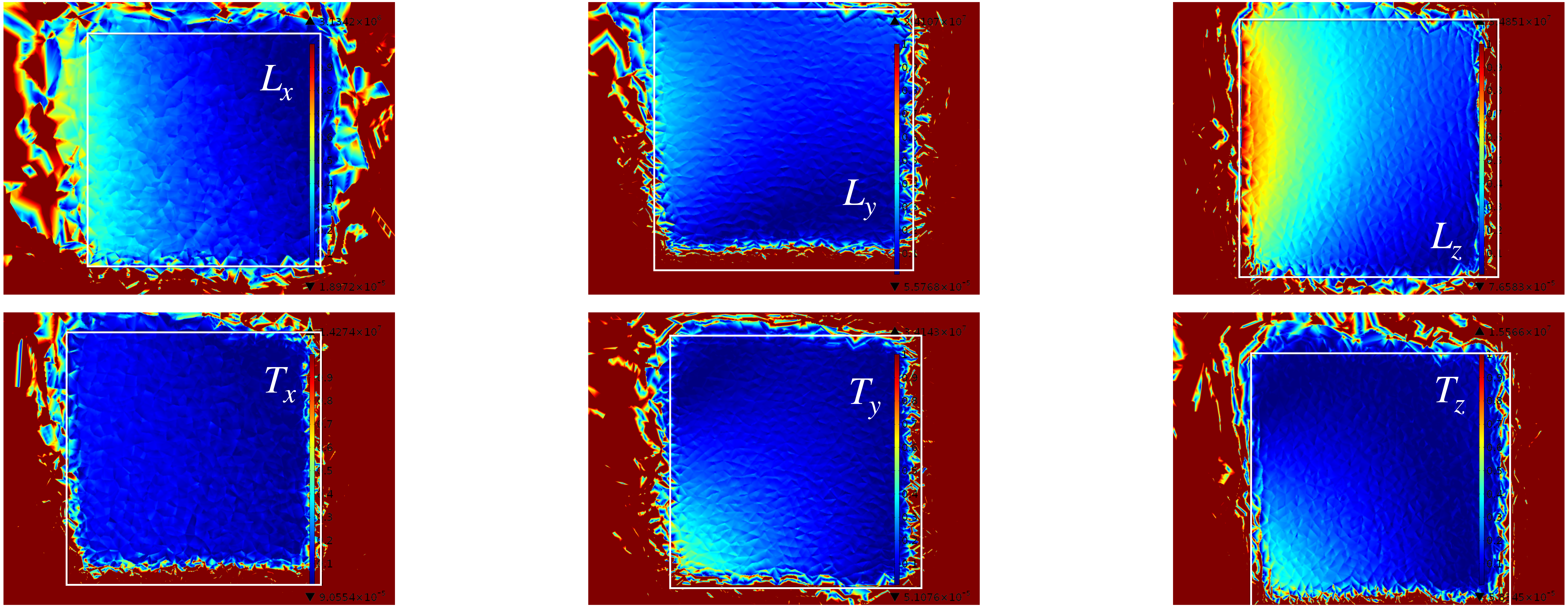


LONGITUDINAL AND TRANSVERSE MAGNETIC FIELD GRADIENTS IN MEASUREMENT REGION

$$L_i = \frac{\partial}{\partial q_i}\left(B_{Earth_i} + B_{CSV,i} + B_{CSD,i}\right)$$

Maximum in color range is 1 nT/m

$$T_i = \frac{\partial}{\partial q_i}\left(B_{Earth_j} + B_{Earth_k} + B_{CSV,j} + B_{CSV,k} + B_{CSD,j} + B_{CSD,k}\right)$$



SUMMARY

- Adiabatic RFSF design ✓
- Rotation and tapper of magnetic field to transition from beam guide into the measurement region - in progress
- Simulation of ambient fields and gradients in the measurement region ✓
- Proper compensation of ambient field (steel pole tips) - in progress

neutron spin transport and ambient fields for

nEDM
@SNS

Thanks!