Eigenmode Calculations for a 1.5 Cell SRF Gun Derived from a TESLA Cavity

TECHNISCHE UNIVERSITÄT DARMSTADT

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DESY-TEMF Meeting
June 13, 2019
TEMF, Darmstadt

Outline

- Motivation
- Computational model
  - Fundamental input power coupler
  - Pickup antenna as a field probe
- Numerical results
  - Electromagnetic fields along the cavity axis
  - Electromagnetic fields in the backplane of the half cell
- Summary / Outlook

Motivation

- Transition From Pulsed Operation to CW

Normal Conductive Gun

http://pitz.desy.de/news/2004/new_gun_for_pitz/

SRF Gun (Example)

https://www.hzdr.de/db/Cms?pOid=41402&pNid=2154

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Computational Model

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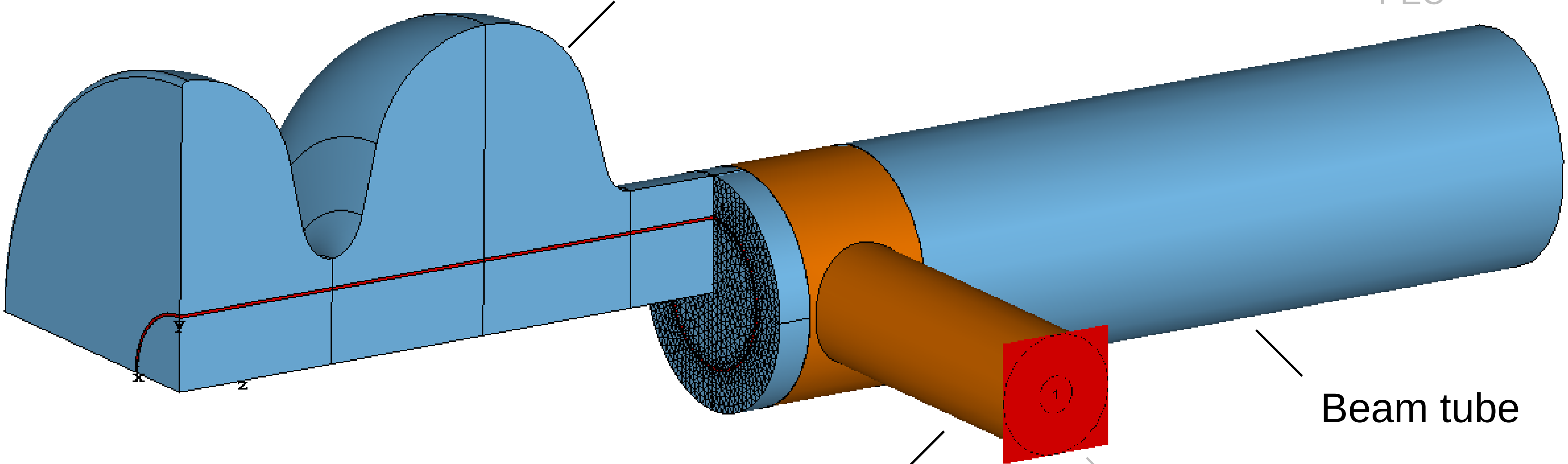
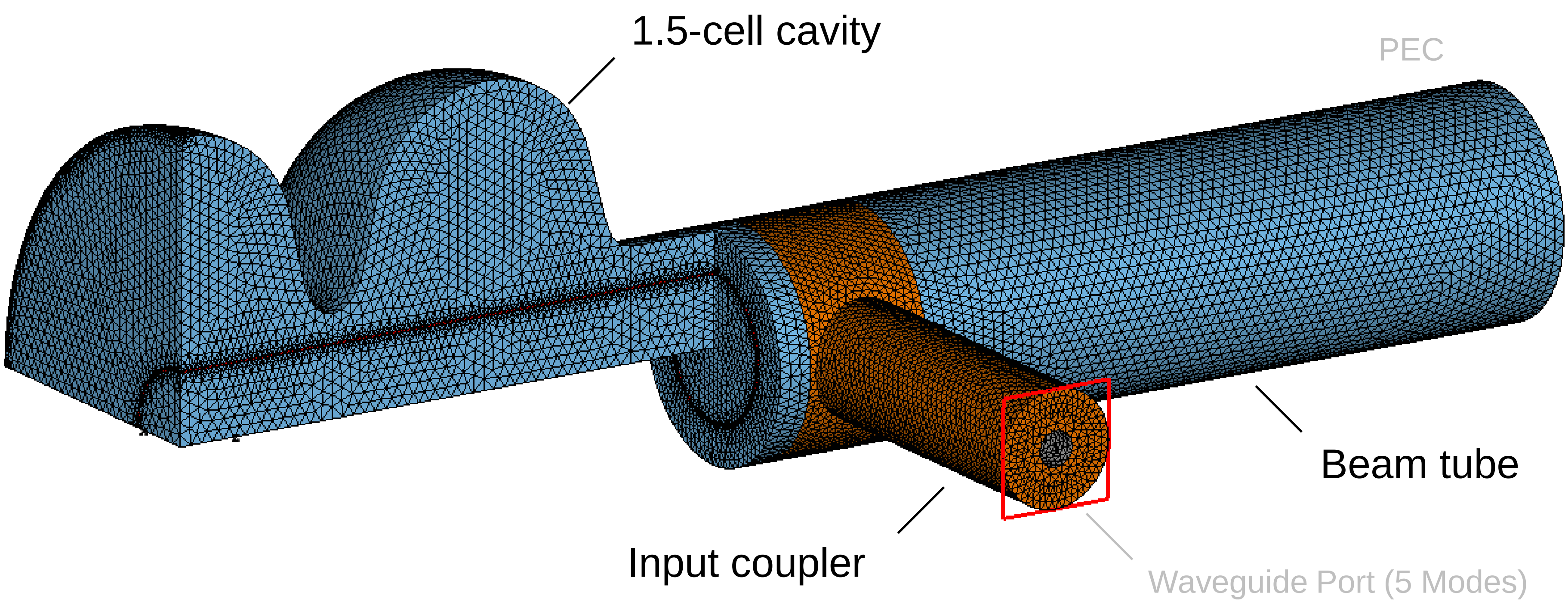
- Model of a 1.5 Cell SRF Gun (from TESLA Cavity)



Info:
A symmetric mesh is generated by meshing only a quarter of the model and assembling the full mesh in an additional processing step.

Computational Model

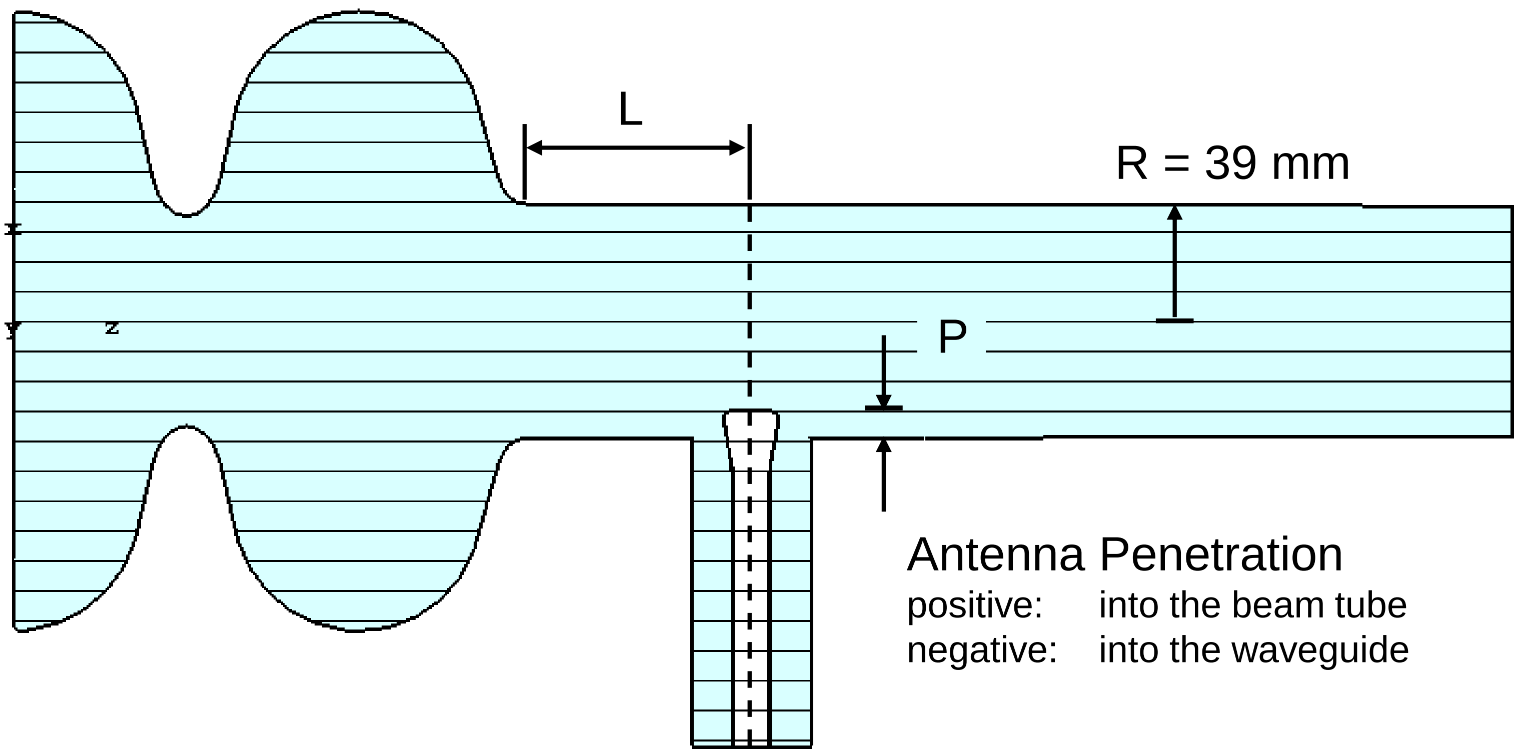
- Model of a 1.5 Cell SRF Gun (from TESLA Cavity)



Example:
2.134.554 curved tetrahedral elements for the full mesh

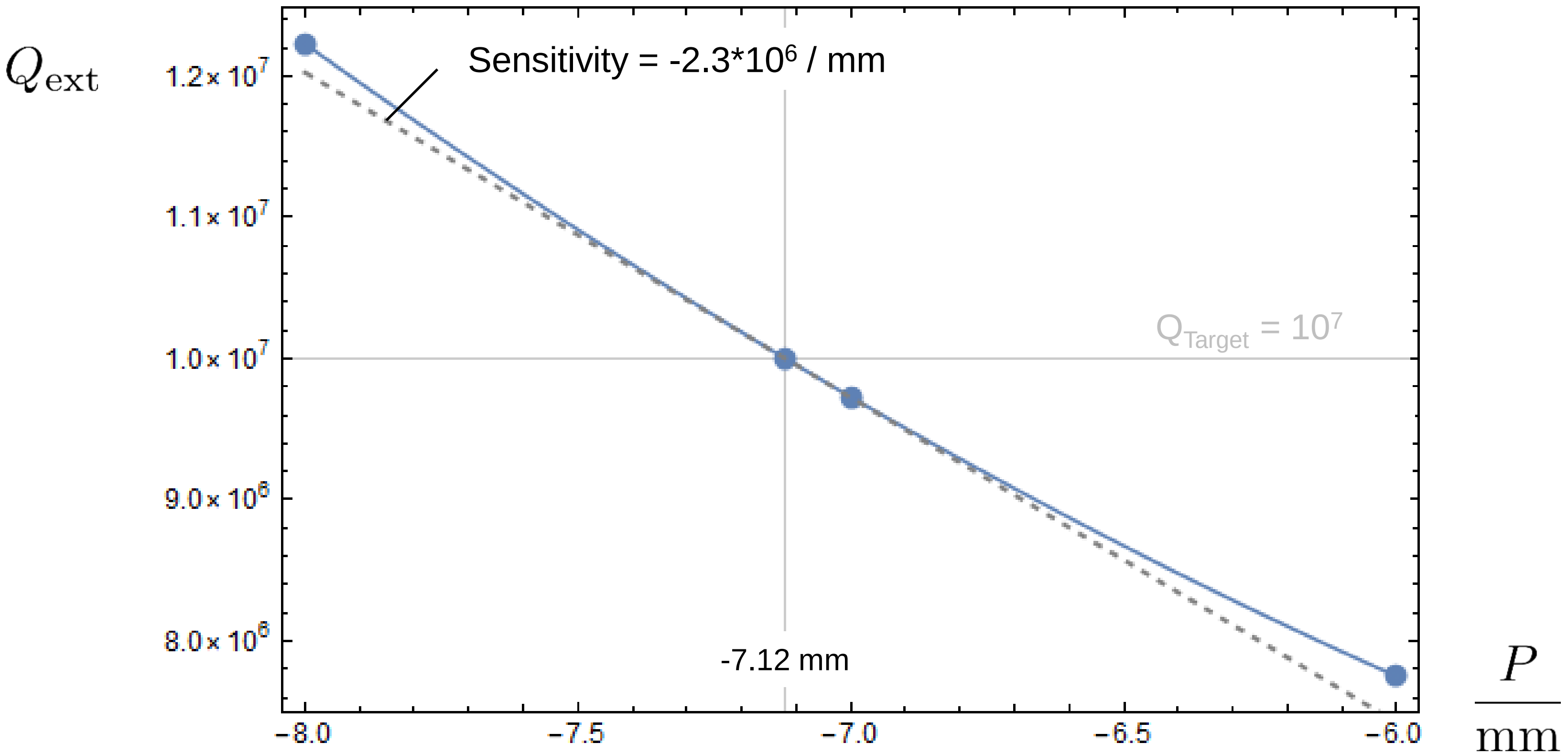
Computational Model

- Model of a 1.5 Cell SRF Gun (from TESLA Cavity)
  - Cut view



Numerical Results

- Model of a 1.5 Cell SRF Gun (from TESLA Cavity)
  - Tune Antenna Penetration (Example: L = 45 mm)



Numerical Results

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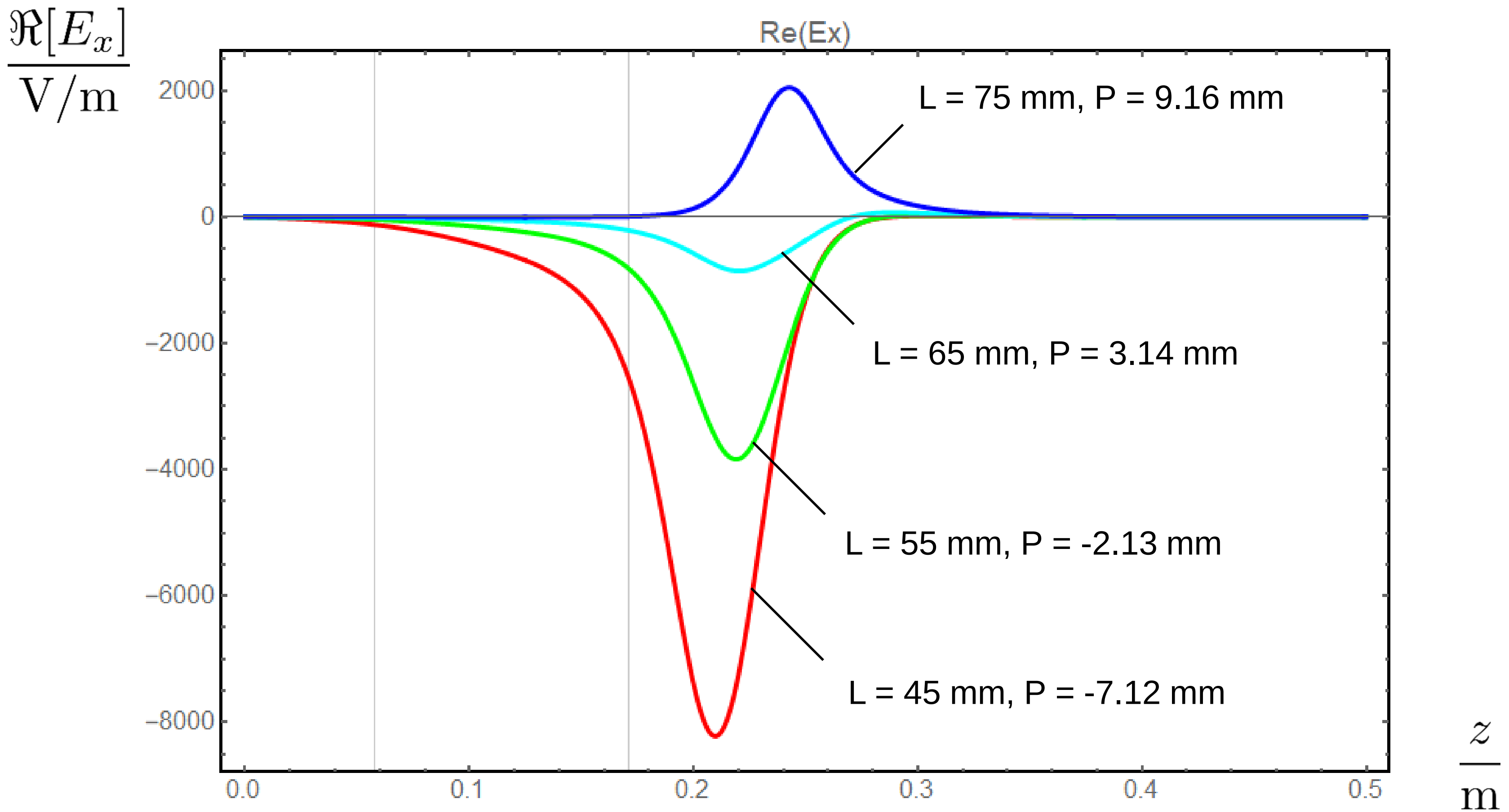
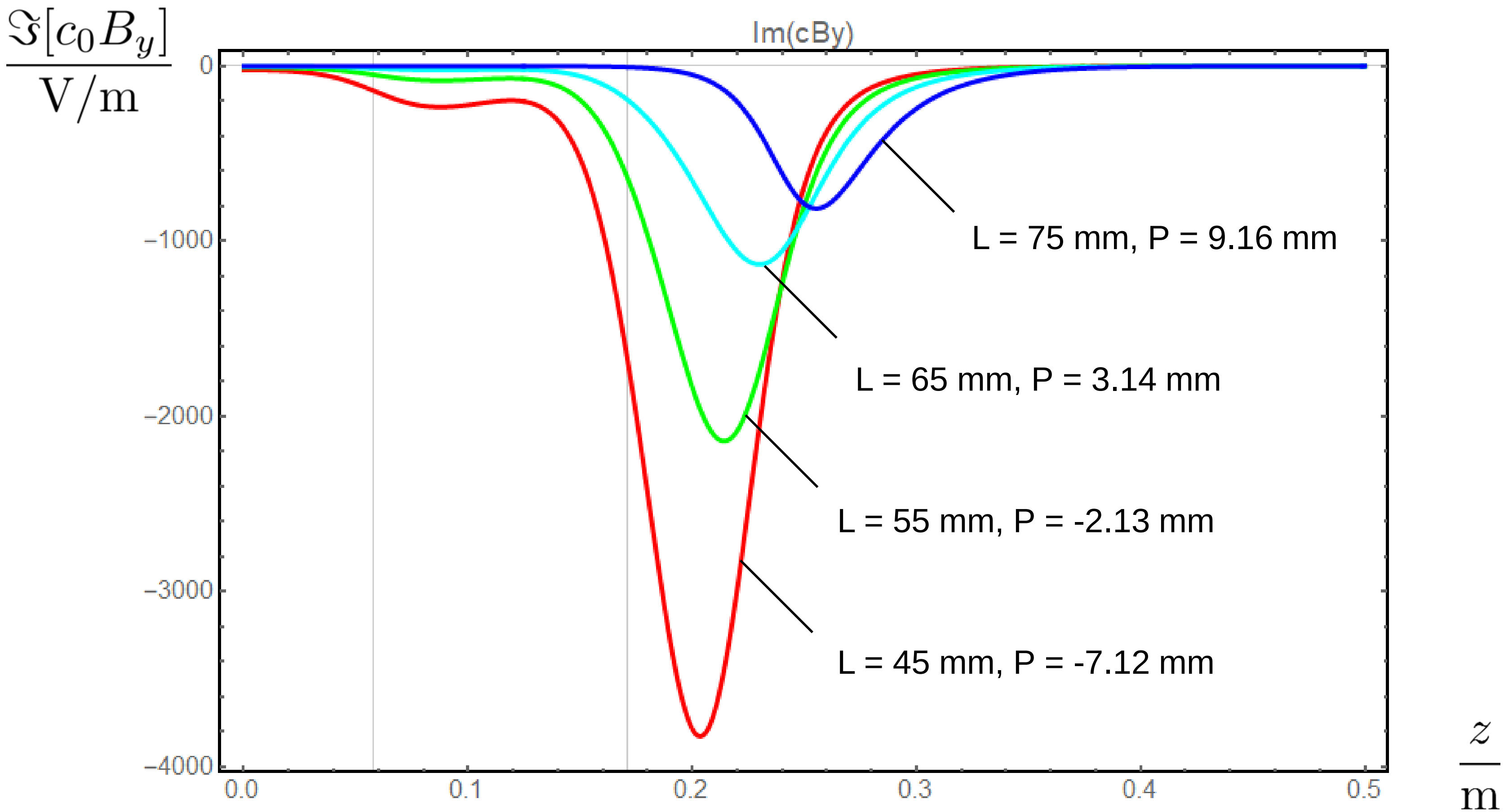
- Fields along the cavity axis



Numerical Results

- Fields along the cavity axis



Numerical Results

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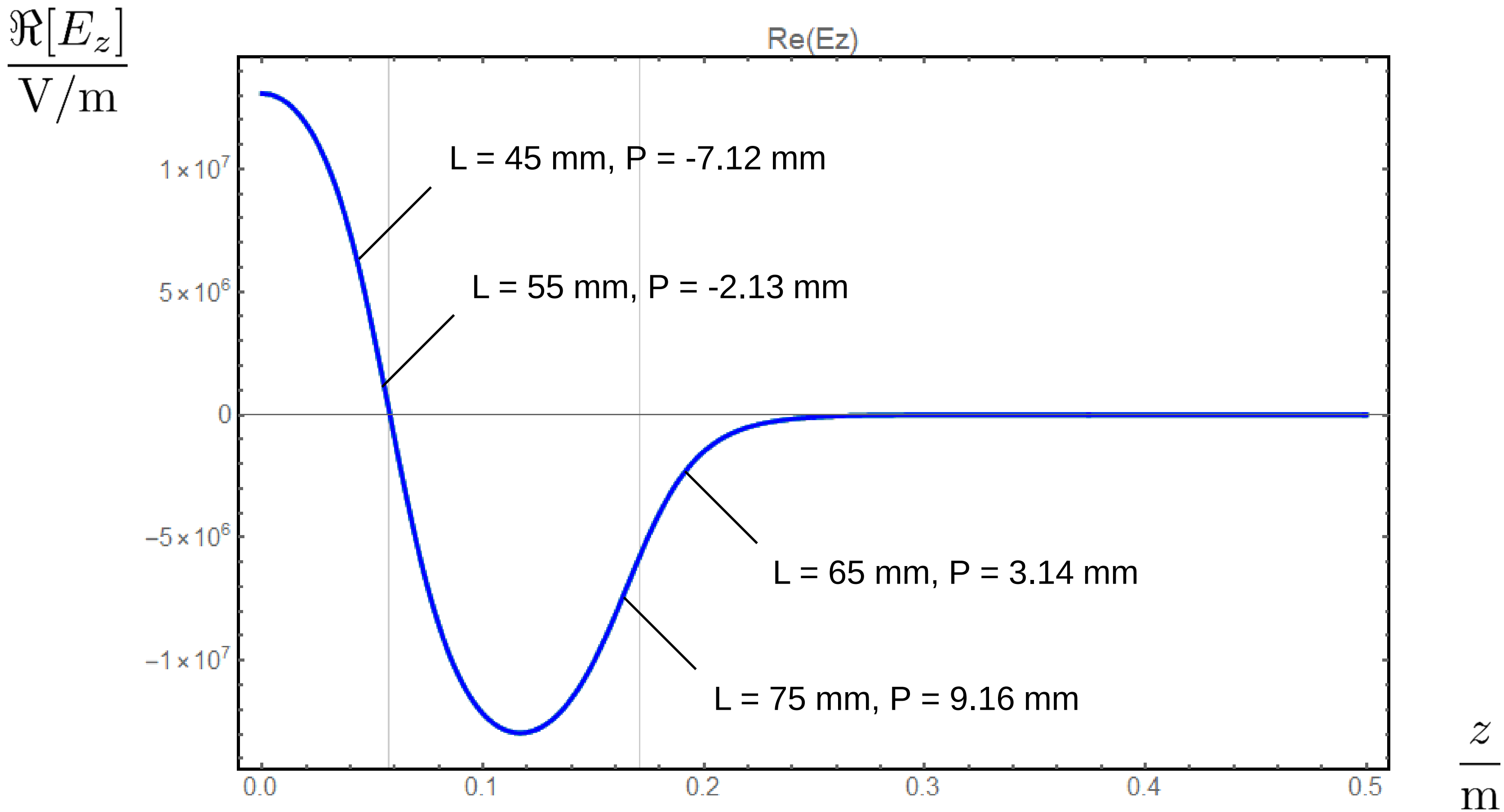
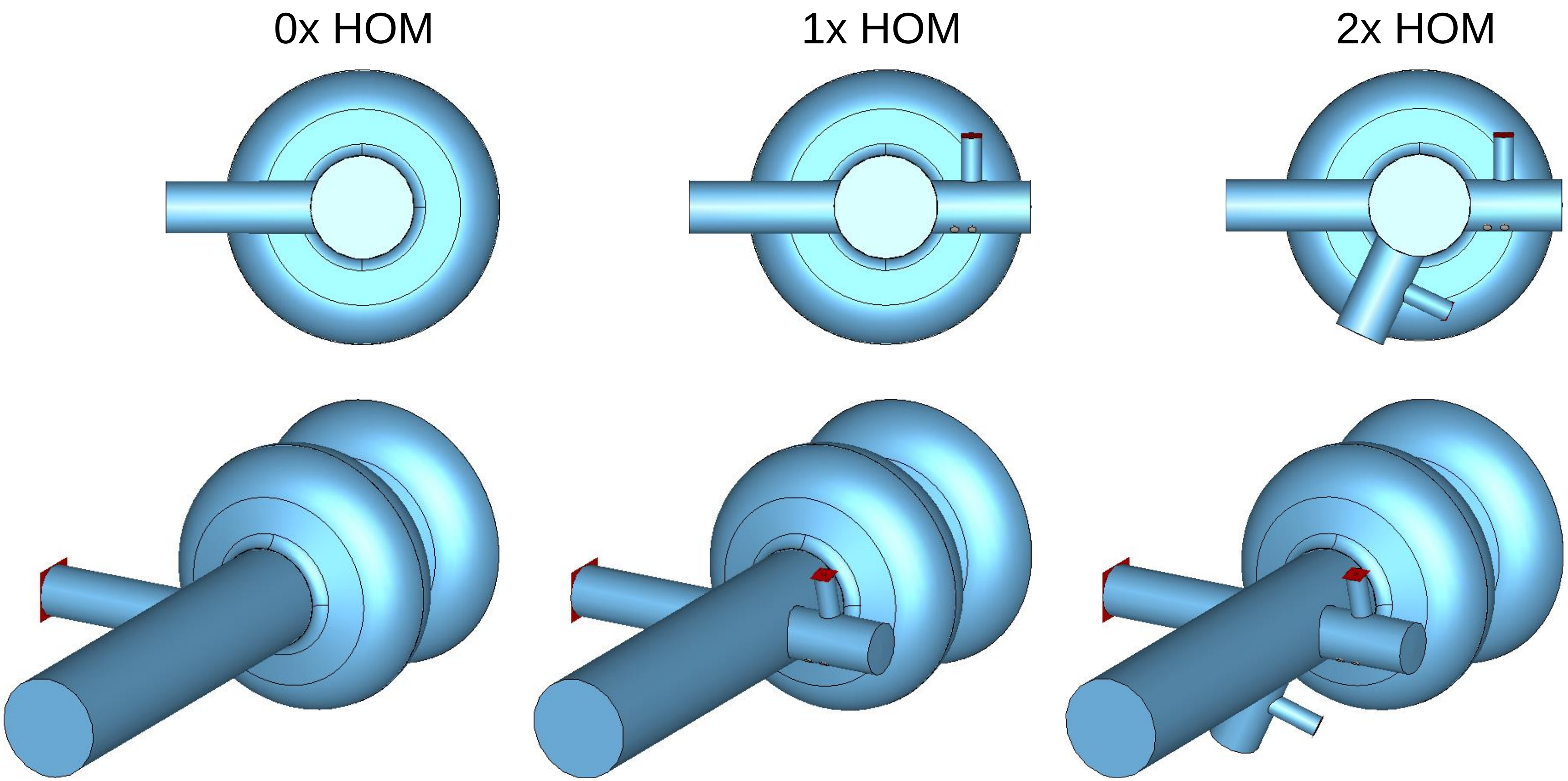
- Fields along the cavity axis



Numerical Results

- HOM Coupler Variations



Numerical Results

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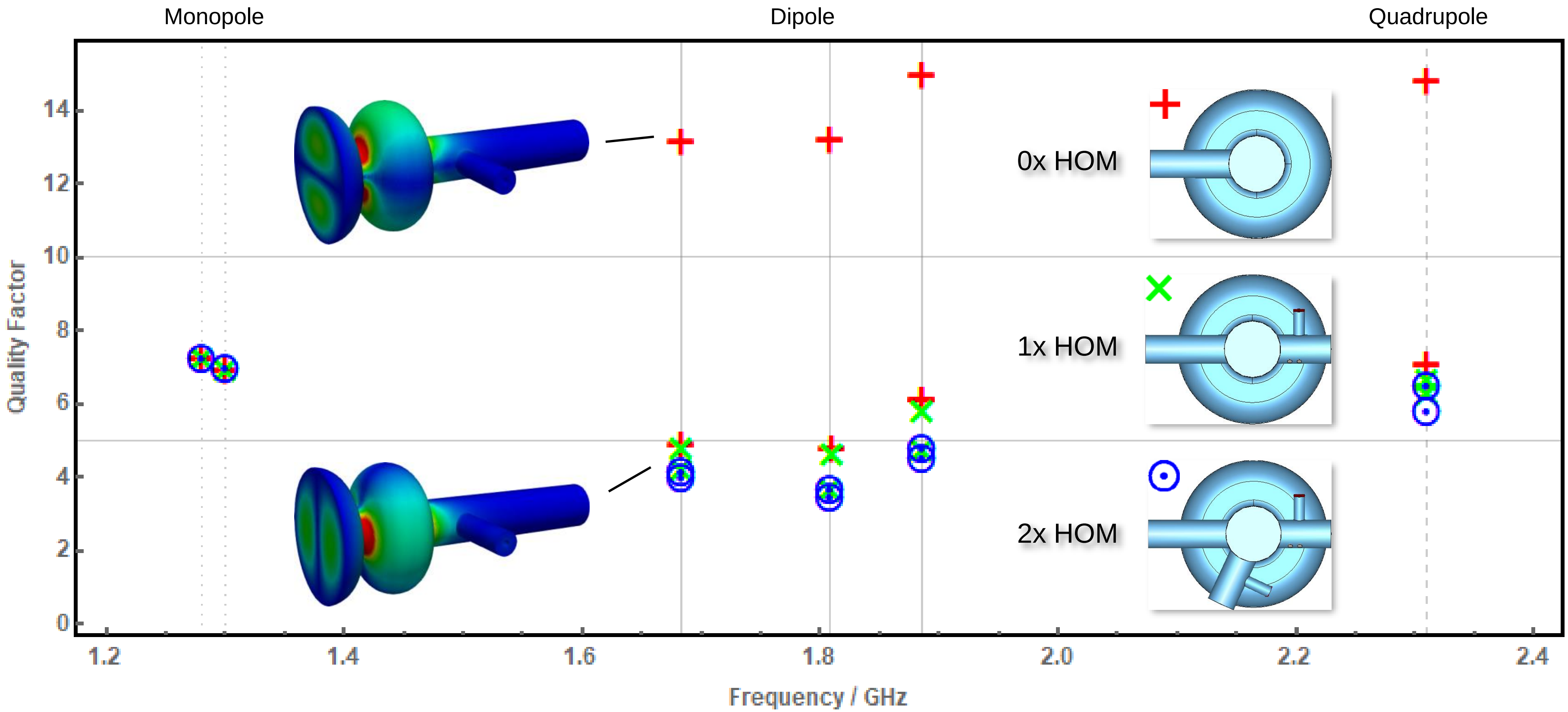
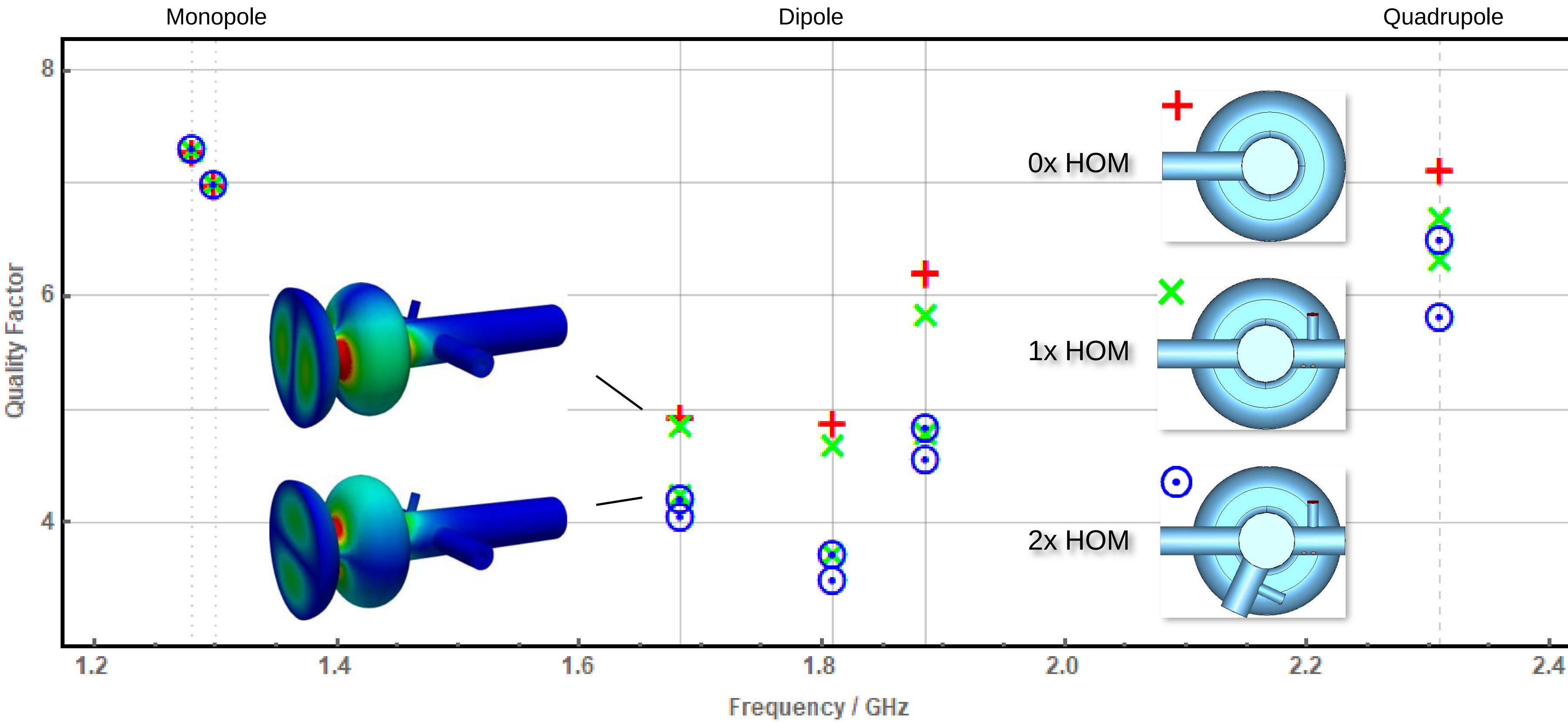
- HOM Coupler Variations



Numerical Results

- HOM Coupler Variations (zoom)



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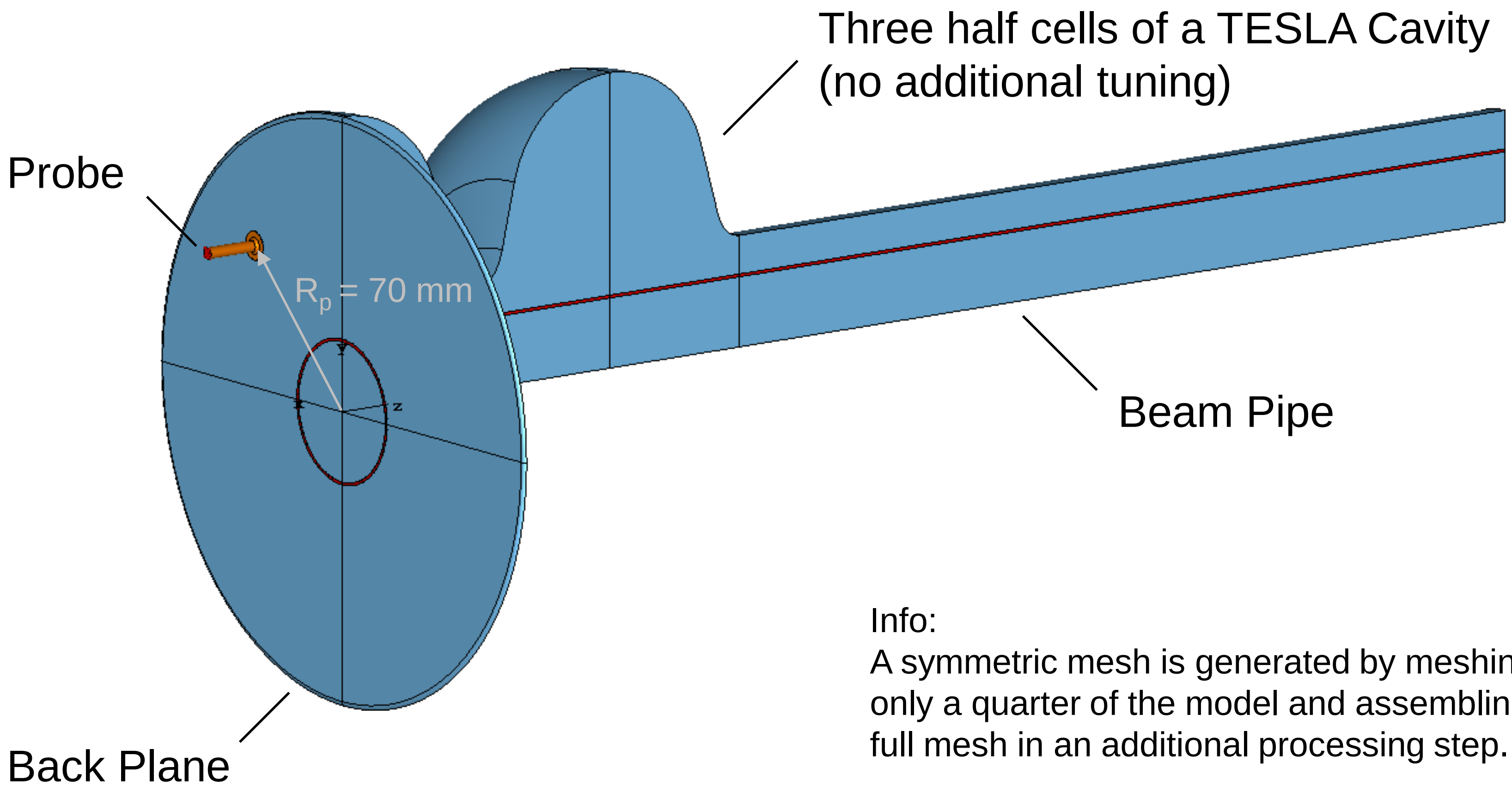
Numerical Modeling

- 1.5 Cell Gun Cavity with Field Probe



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Numerical Modeling

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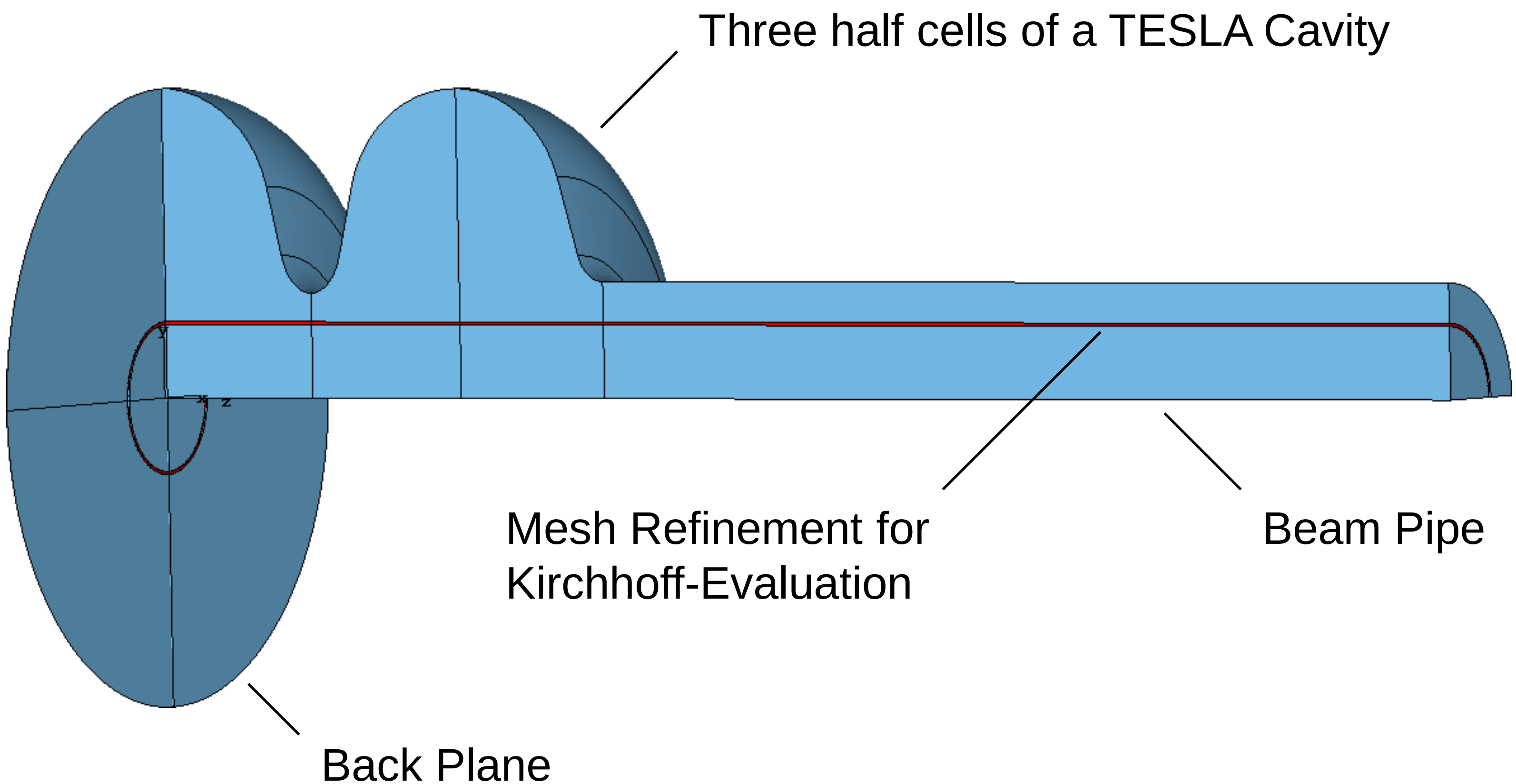
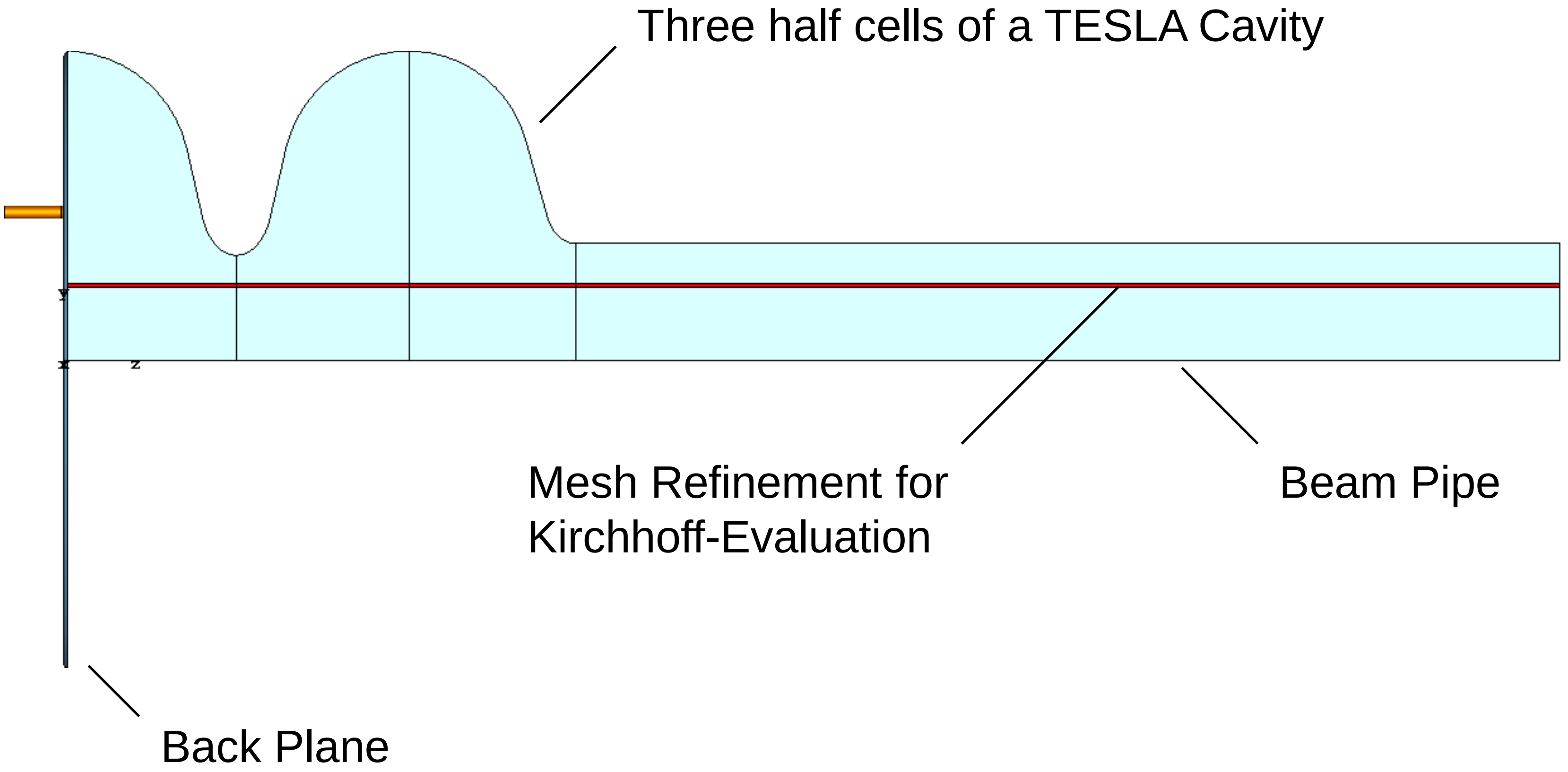


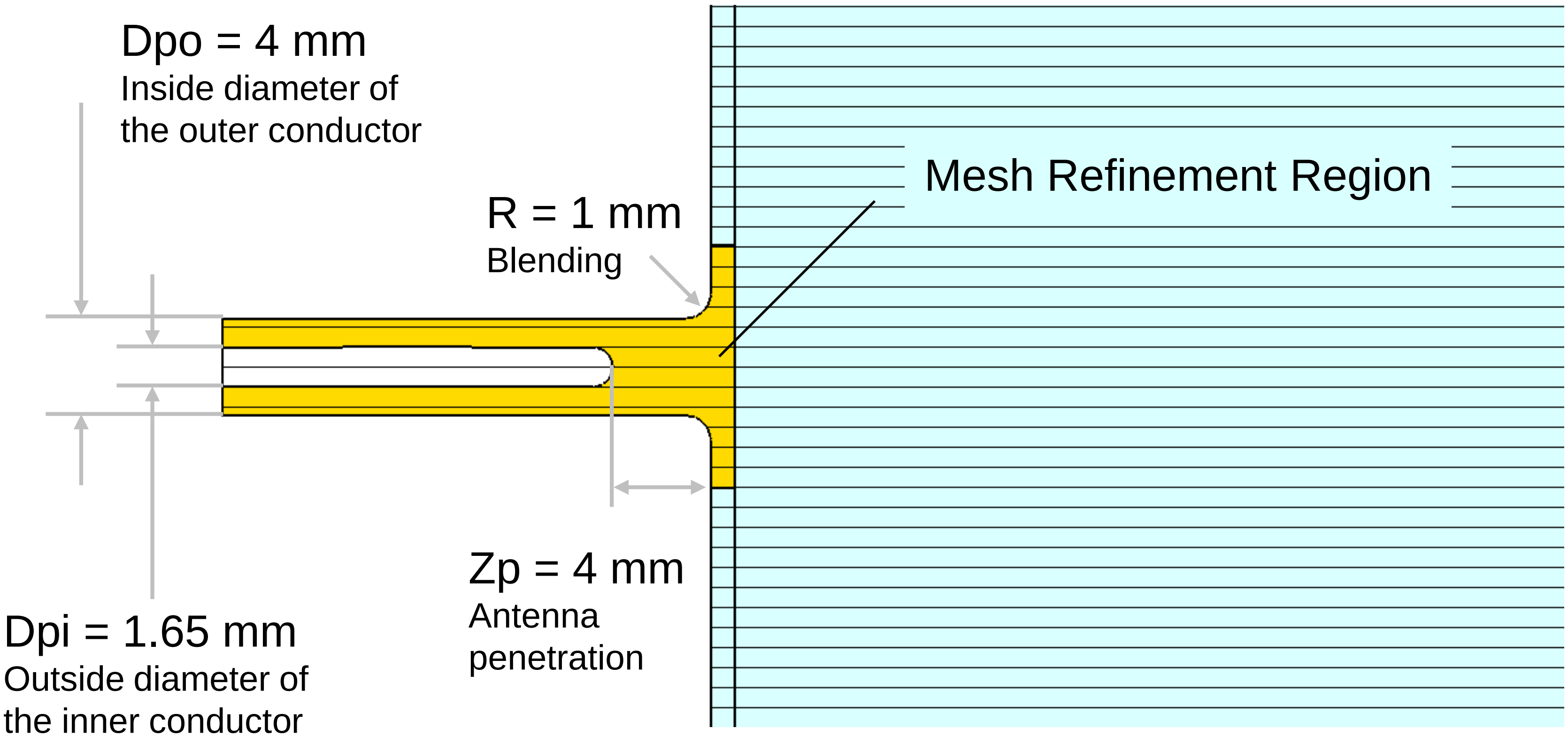
Numerical Modeling

- 1.5 Cell Gun Cavity with Field Probe



Numerical Modeling

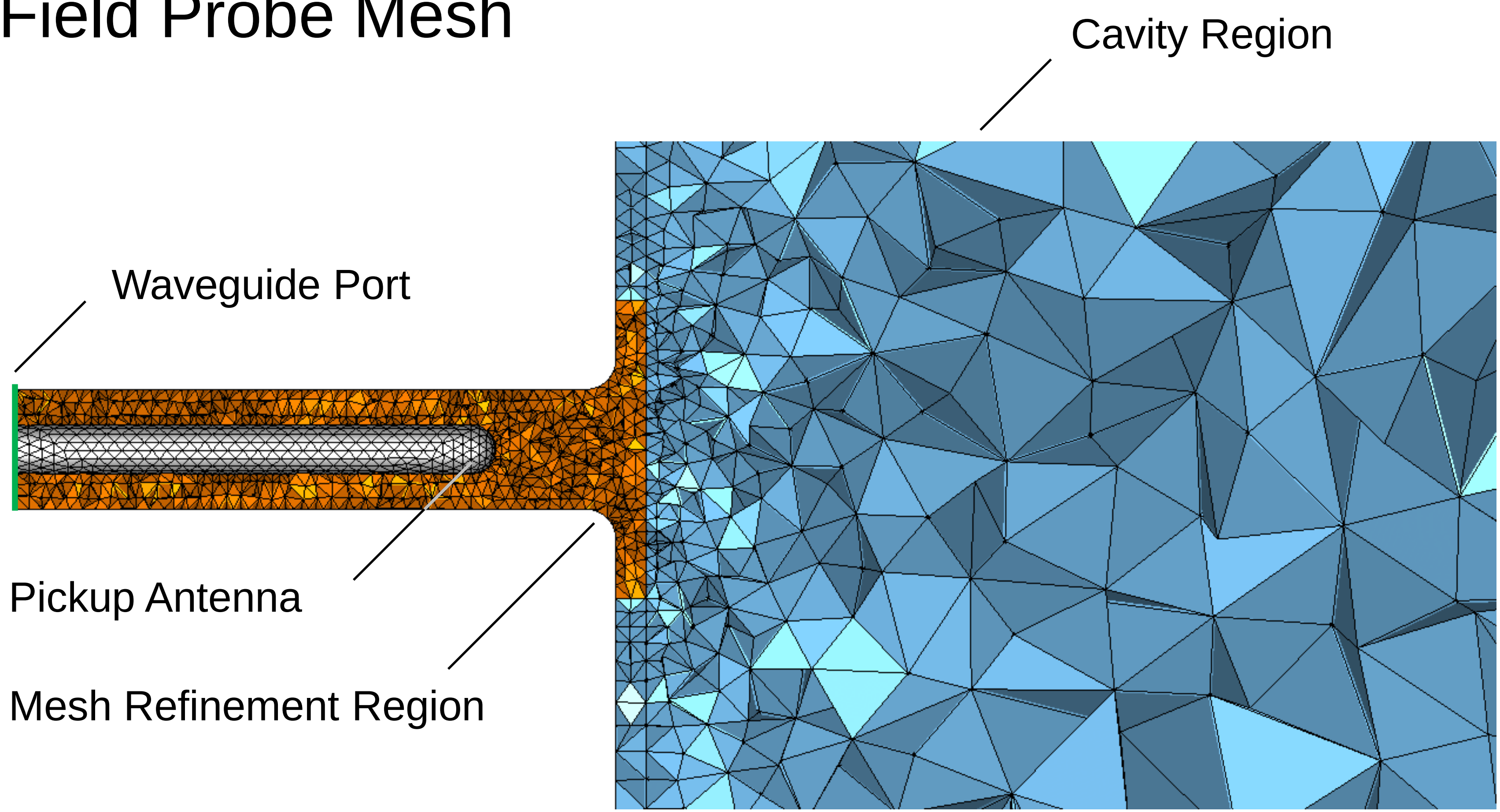
- Field Probe Parameter



Naming convention adopted from Alexey Sulimov, “SRF Gun Simulations of Probe”, October 12, 2018

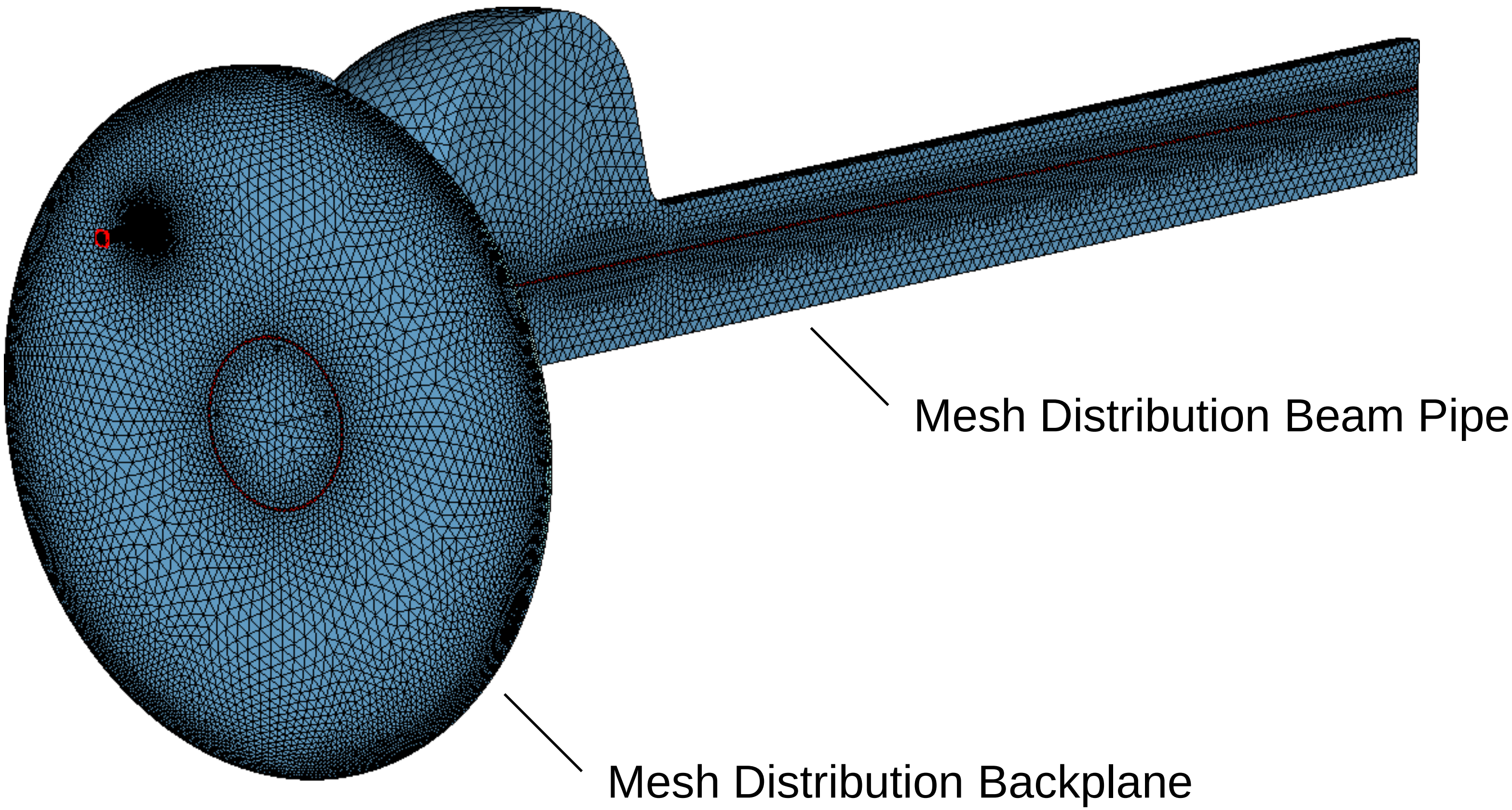
Numerical Modeling

- Field Probe Mesh



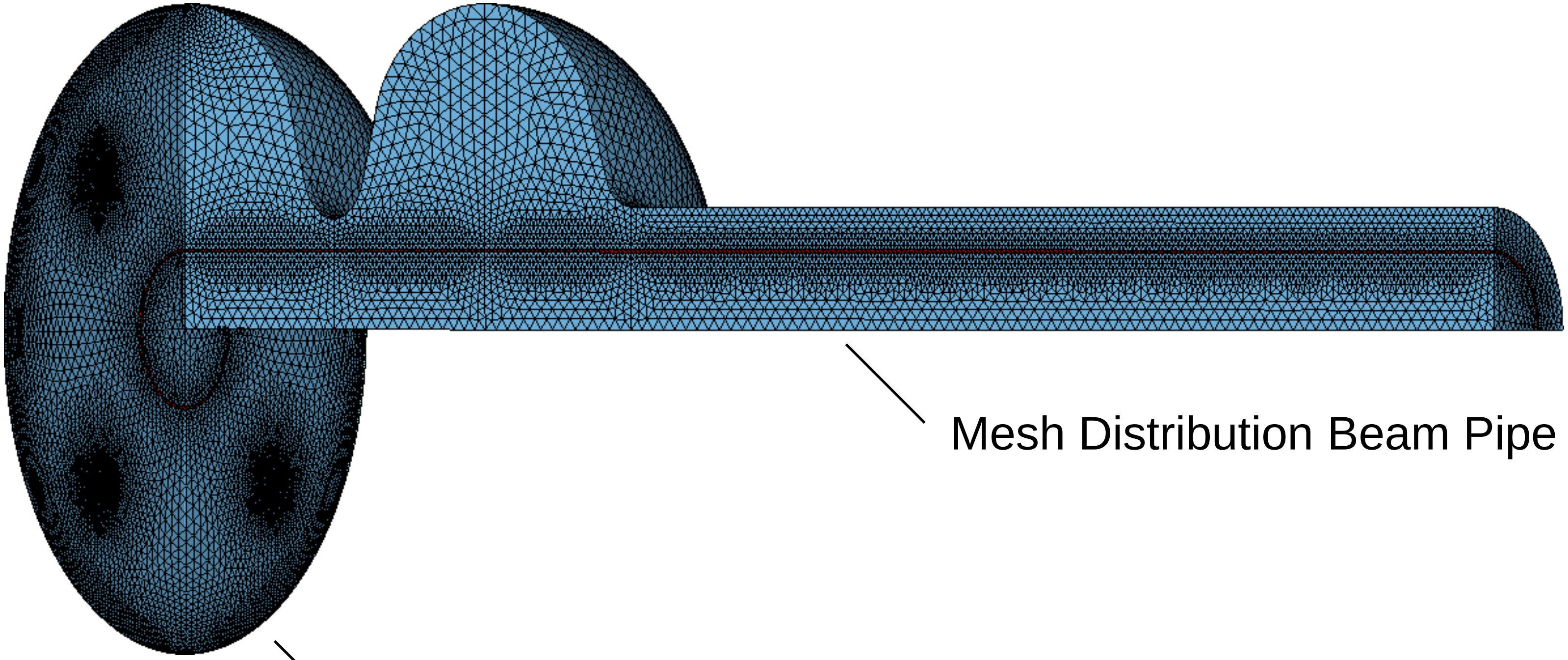
Numerical Modeling

- 1.5 Cell Gun Cavity with Field Probe



Numerical Modeling

- 1.5 Cell Gun Cavity with Field Probe



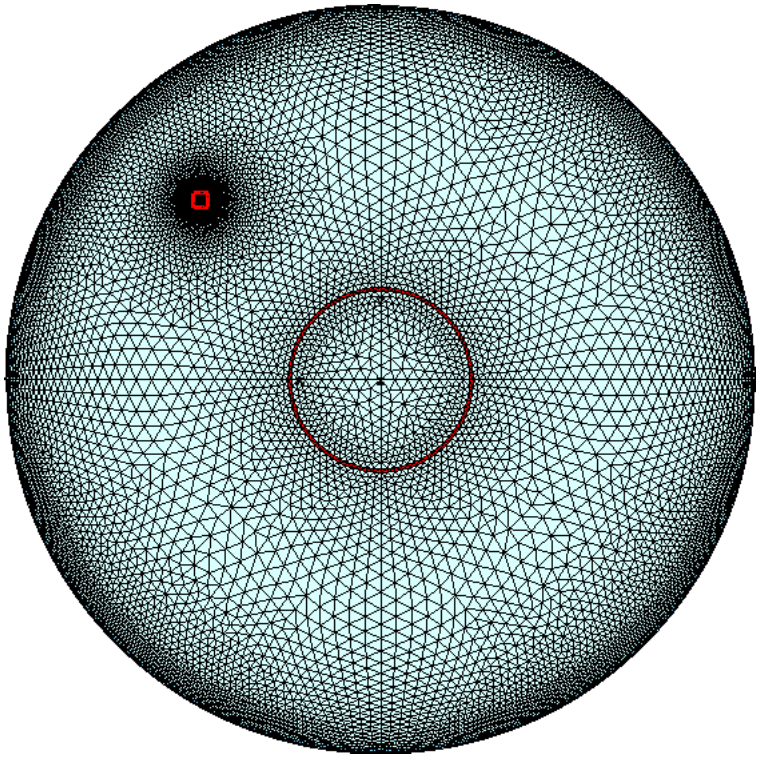
Mesh Distribution Beam Pipe

Mesh Distribution Backplane

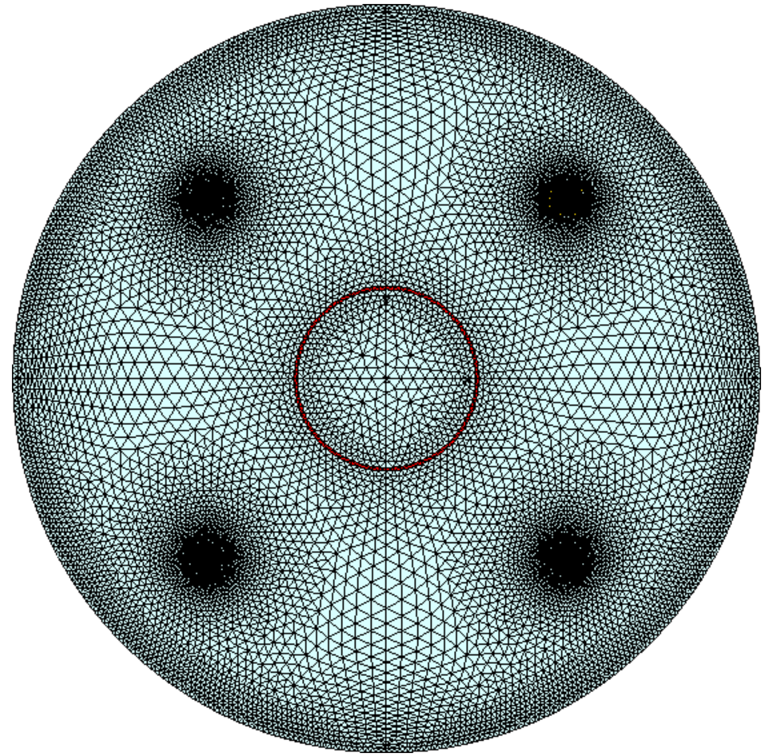
Numerical Modeling

- Mesh Distribution Backplane

R_p = 70 mm



Outside View

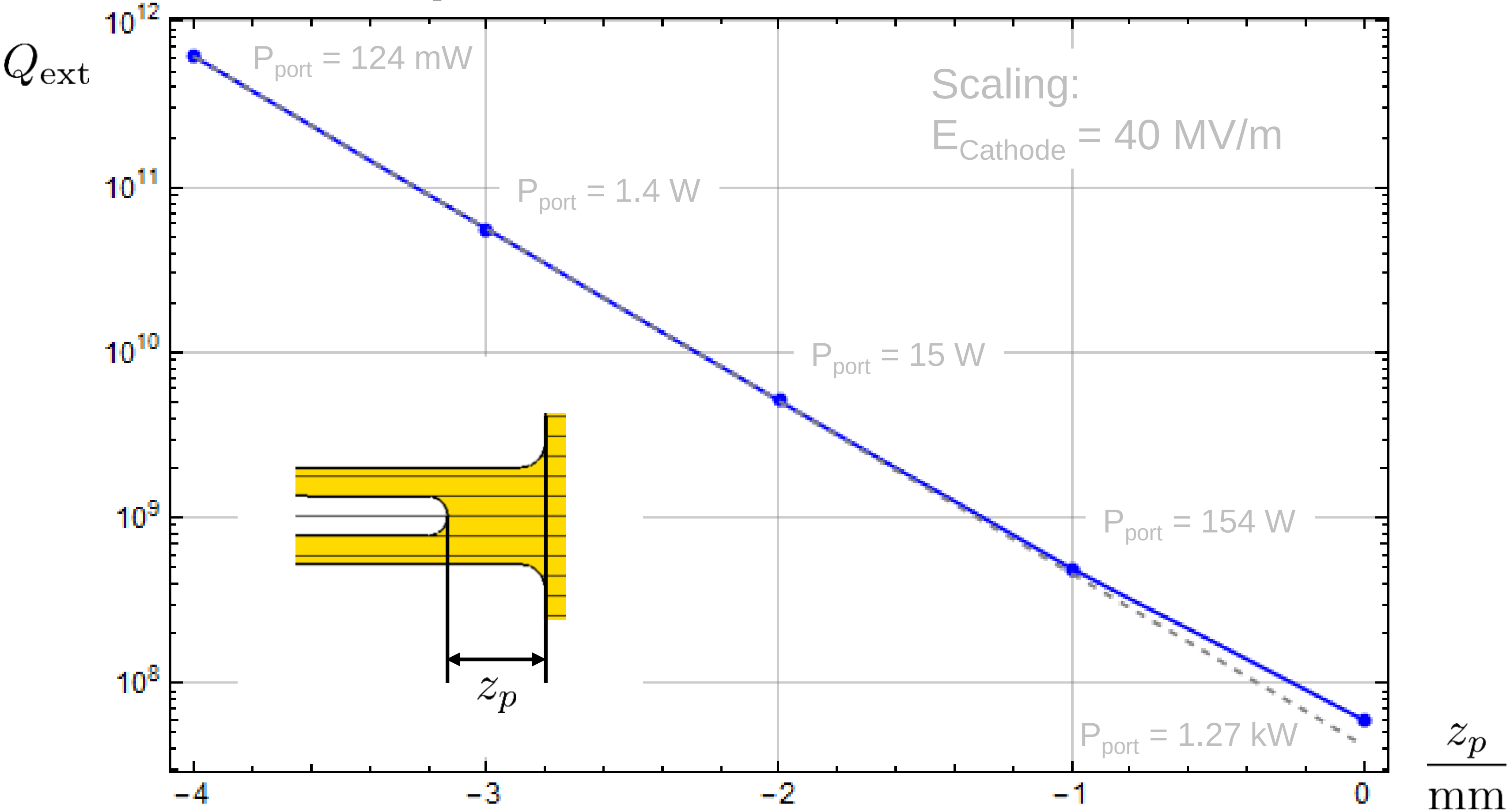


Inside View

Numerical Results

- External Quality Factor

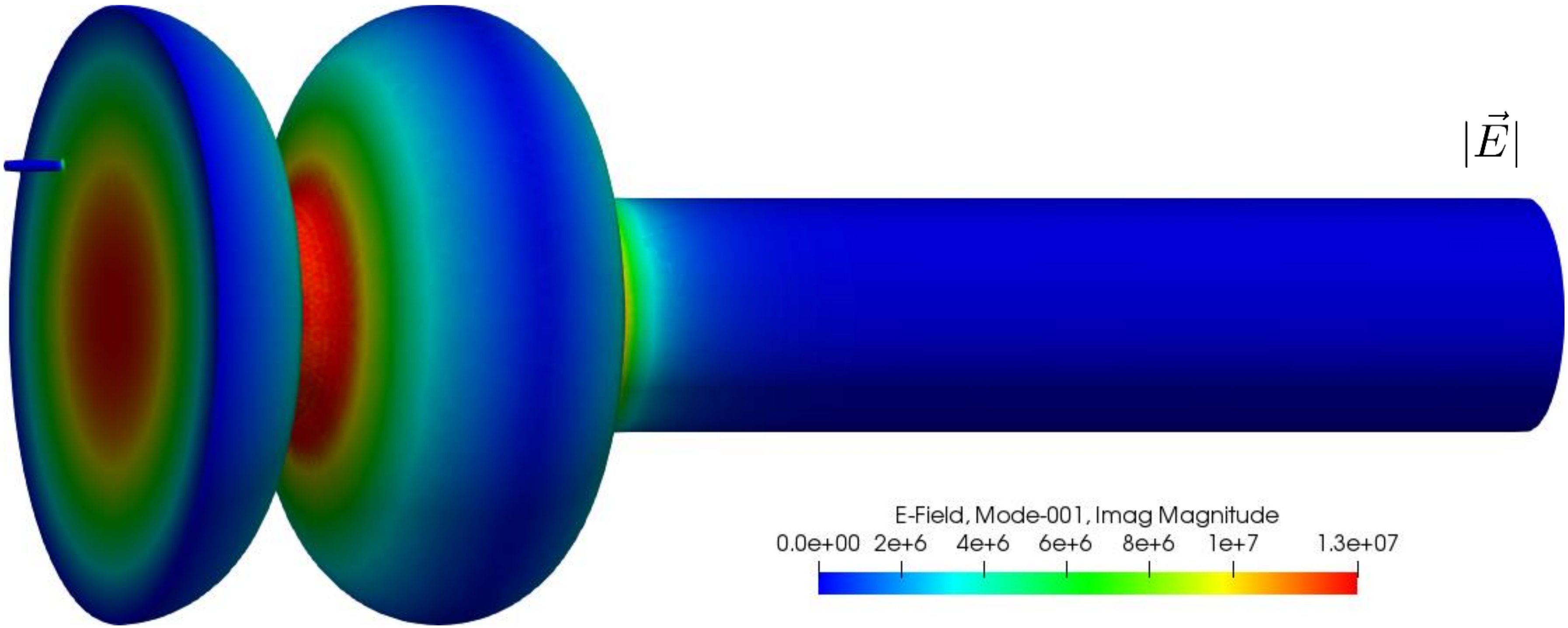
R_p = 70 mm



Numerical Results

- Electric Field Strength

R_p = 70 mm



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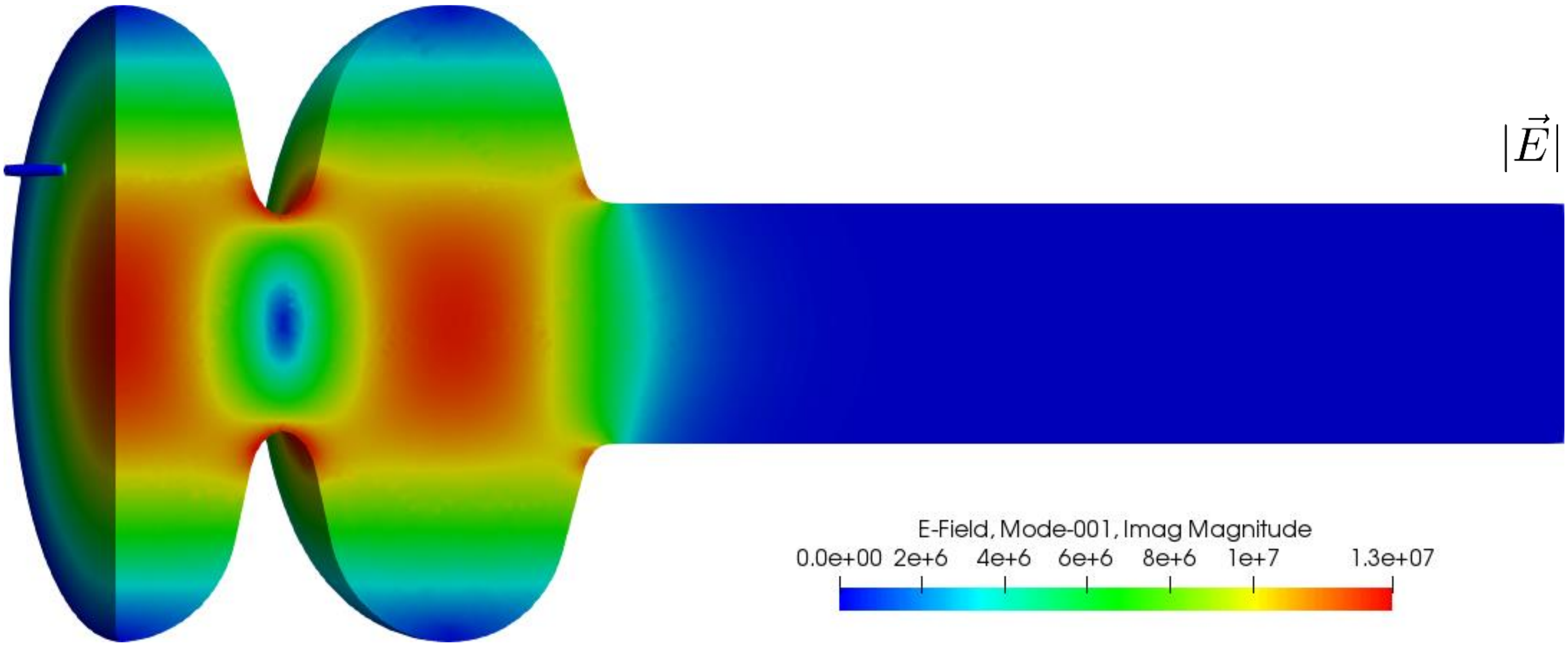

Numerical Results

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R_p = 70 mm

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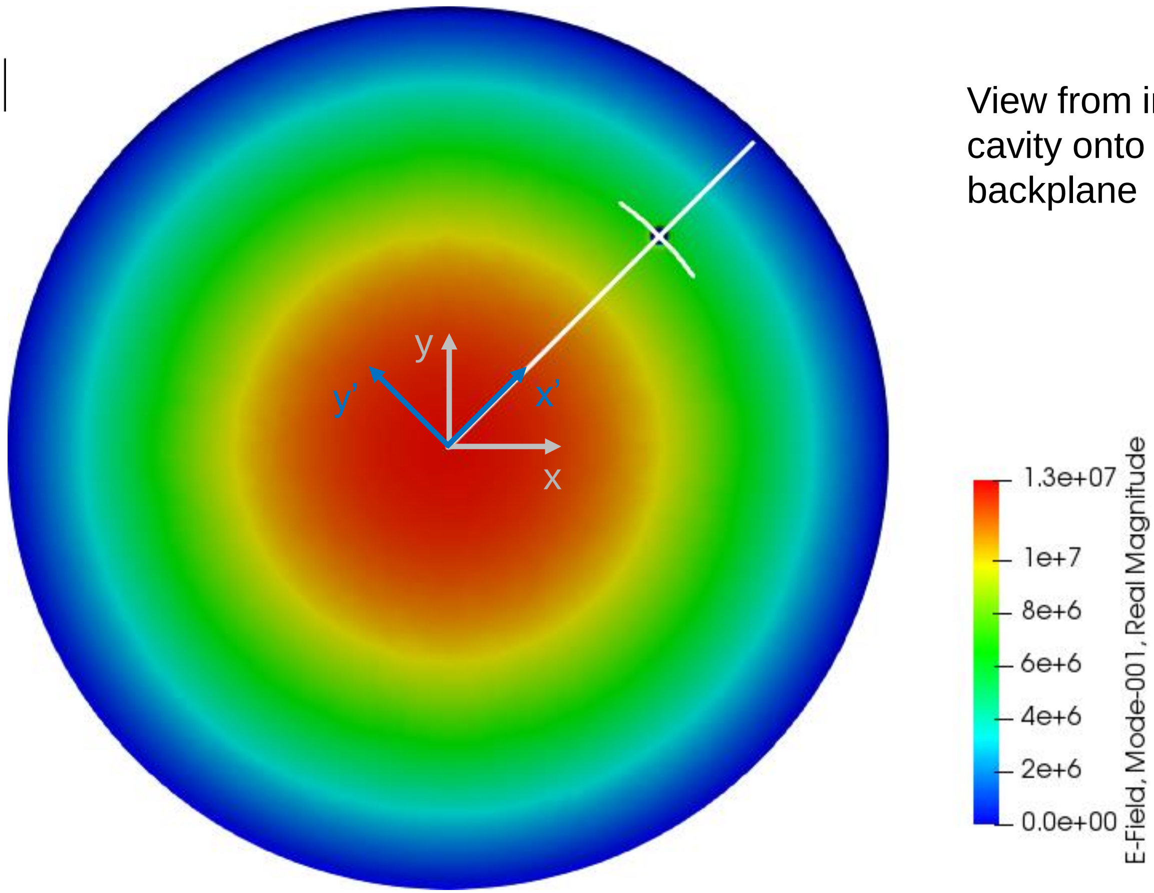

View from inside the cavity onto the backplane

Numerical Results

- Electric Field Strength

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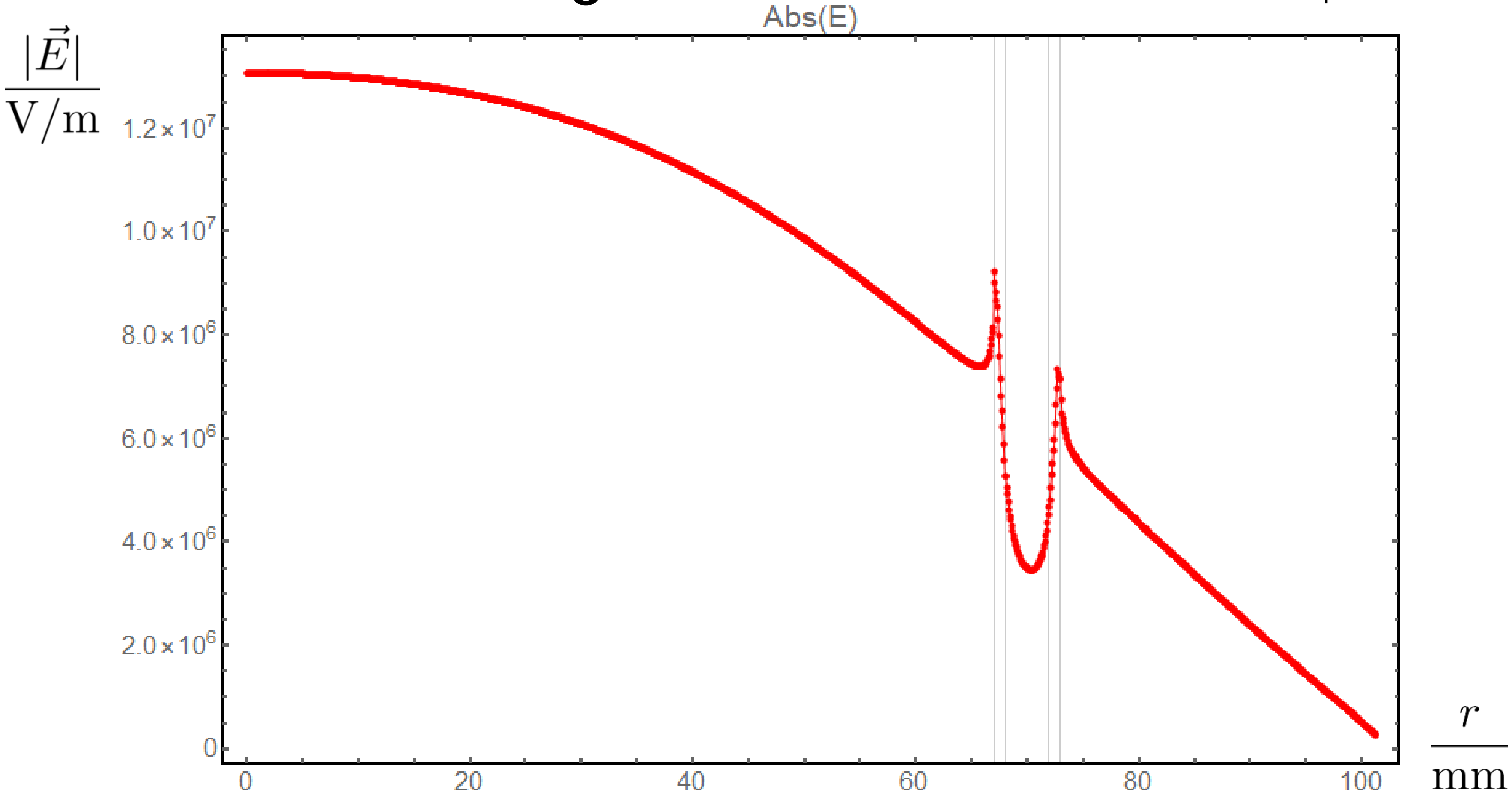

Numerical Results

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- Electric Field Strength

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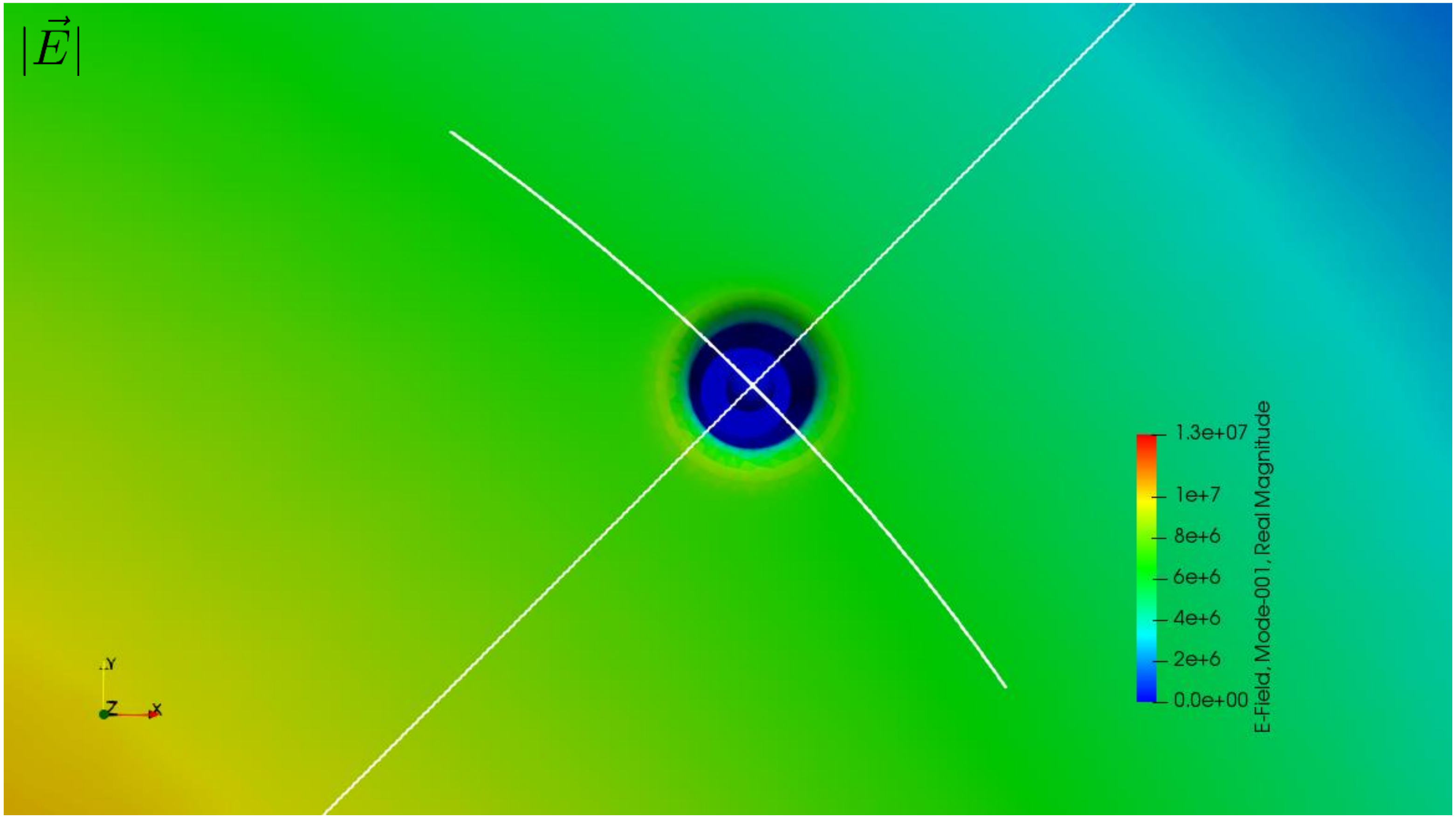

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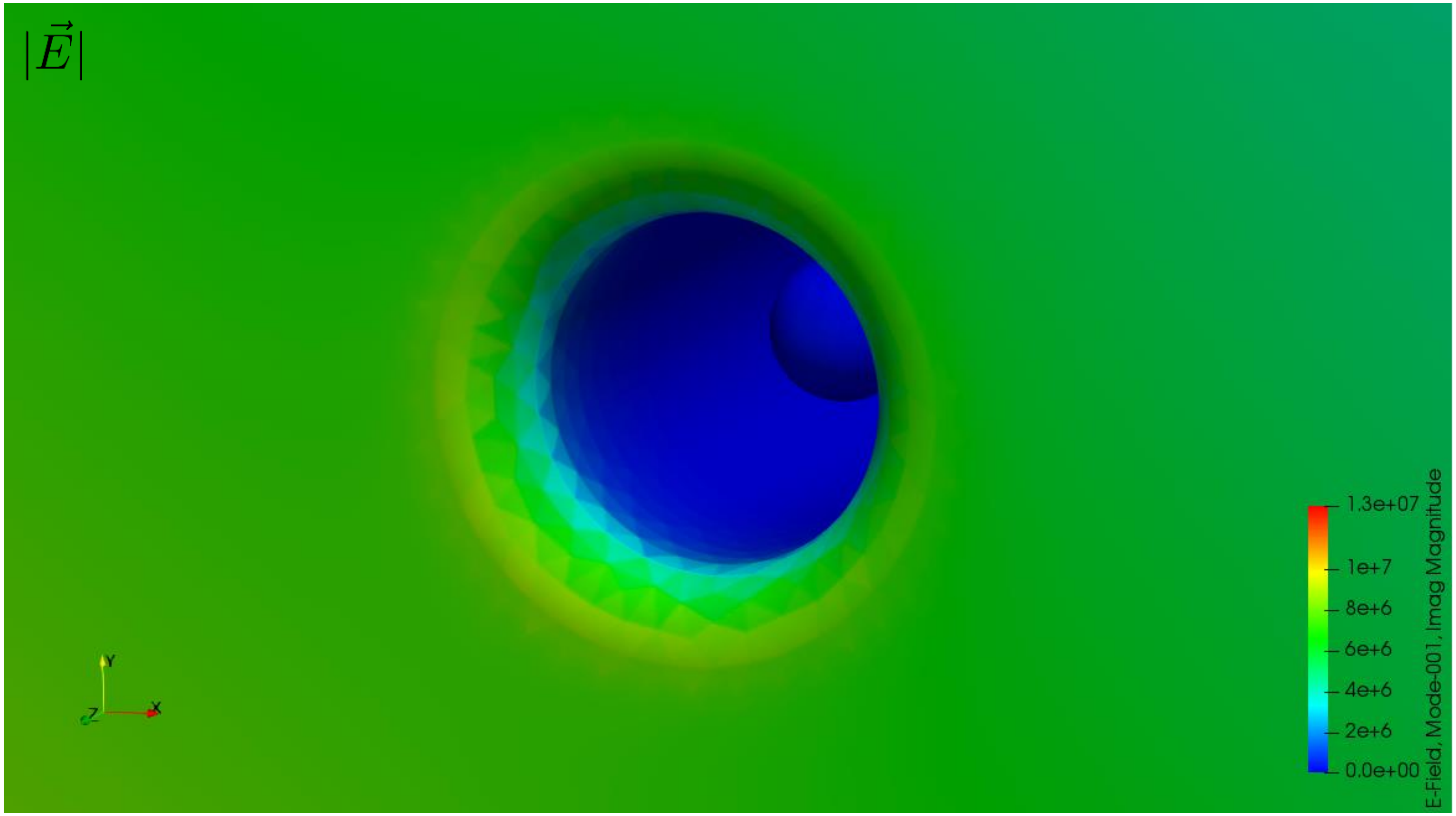

Numerical Results

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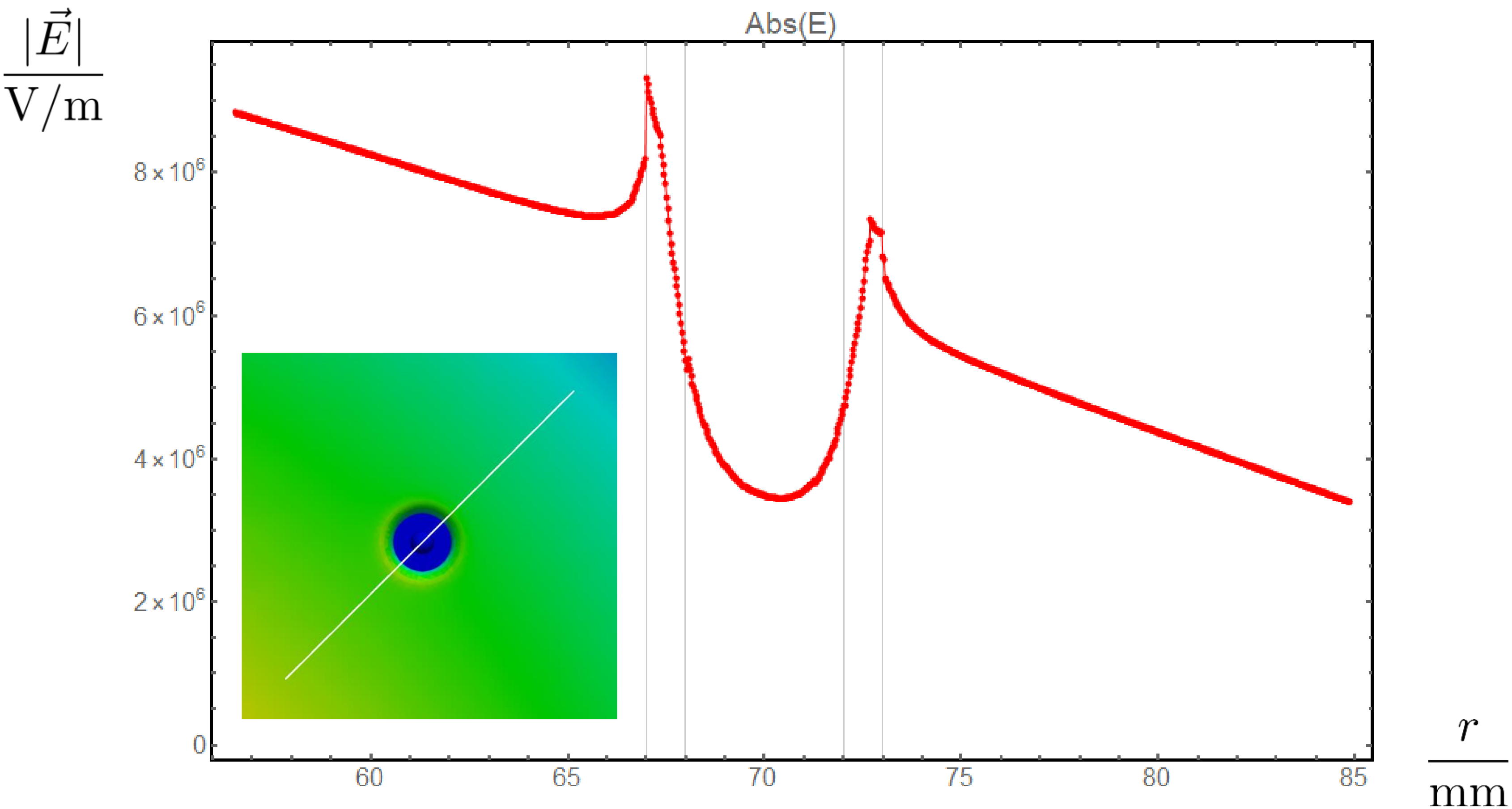

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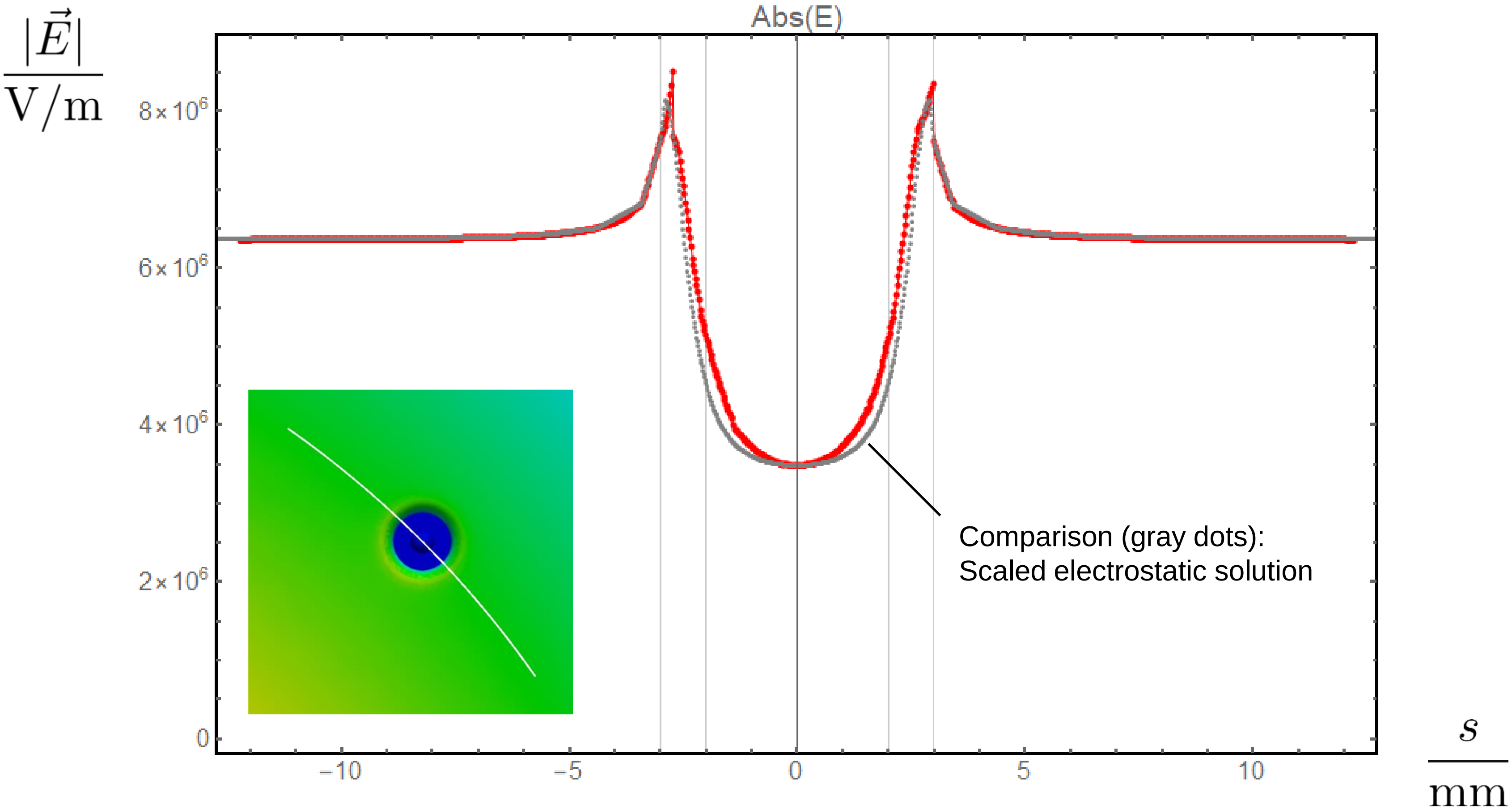
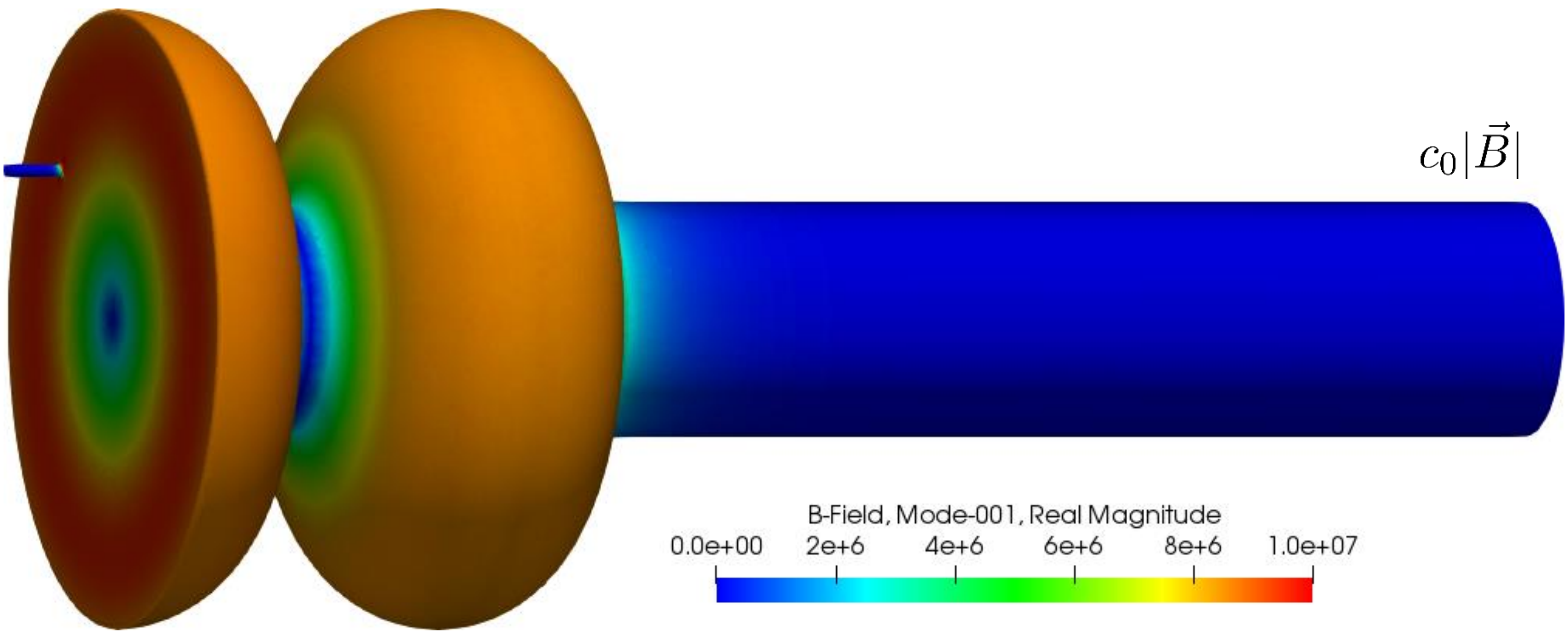


Numerical Results

- Magnetic Flux Density

R_p = 70 mm



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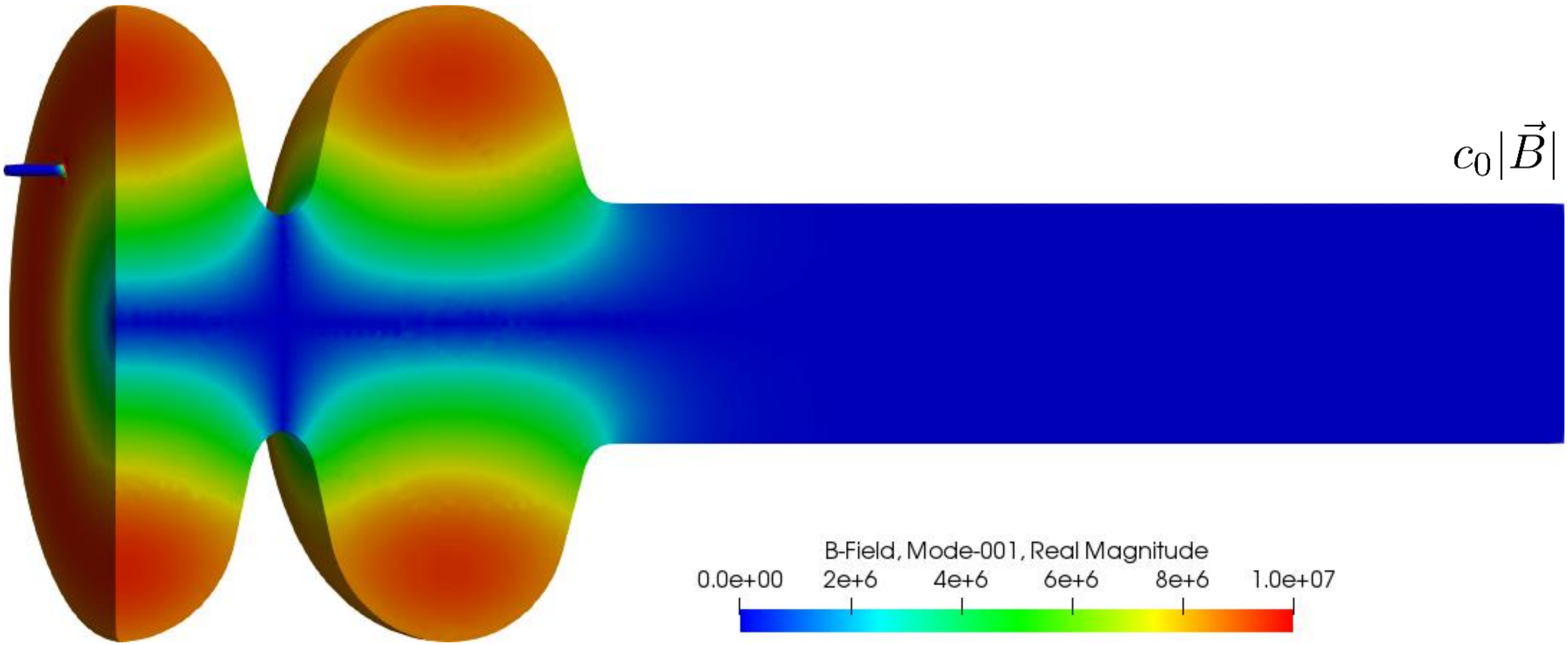

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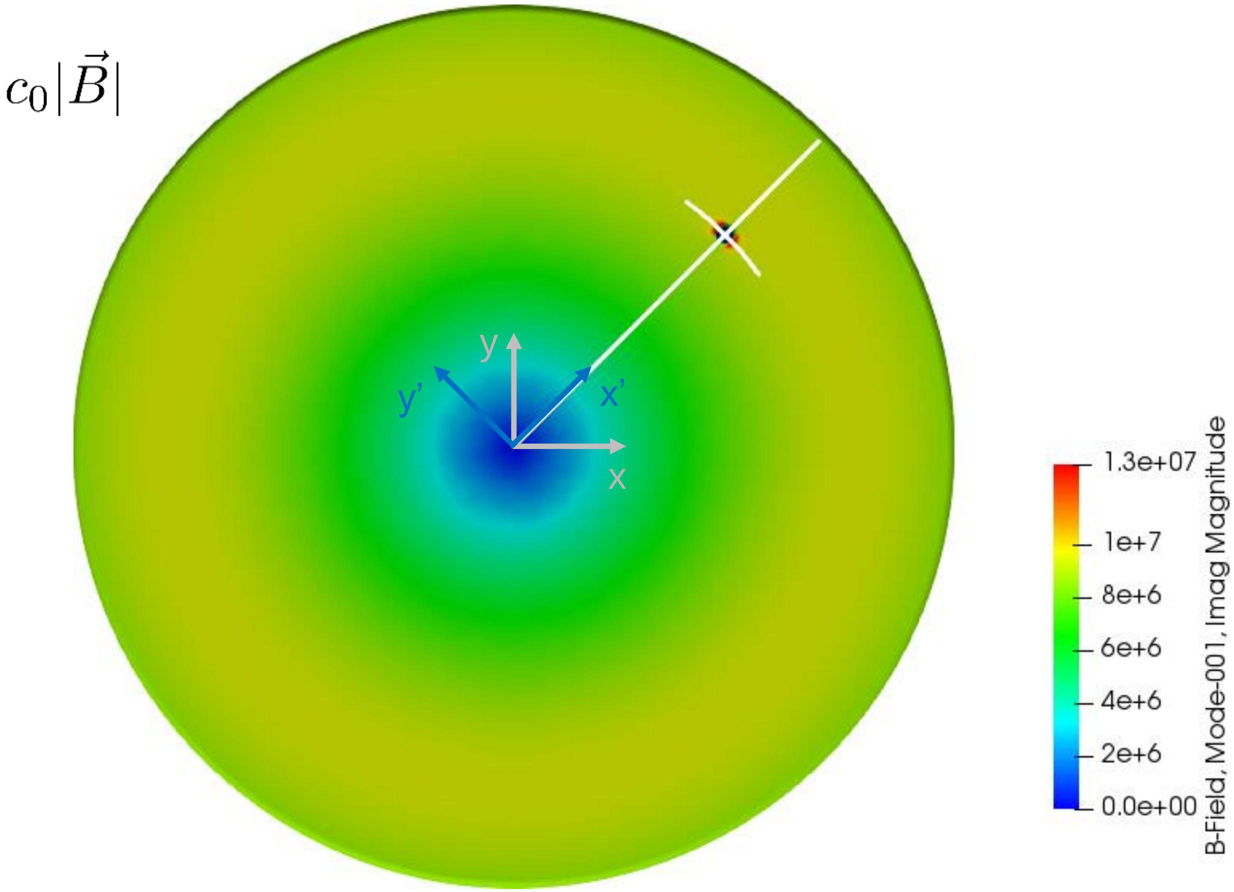

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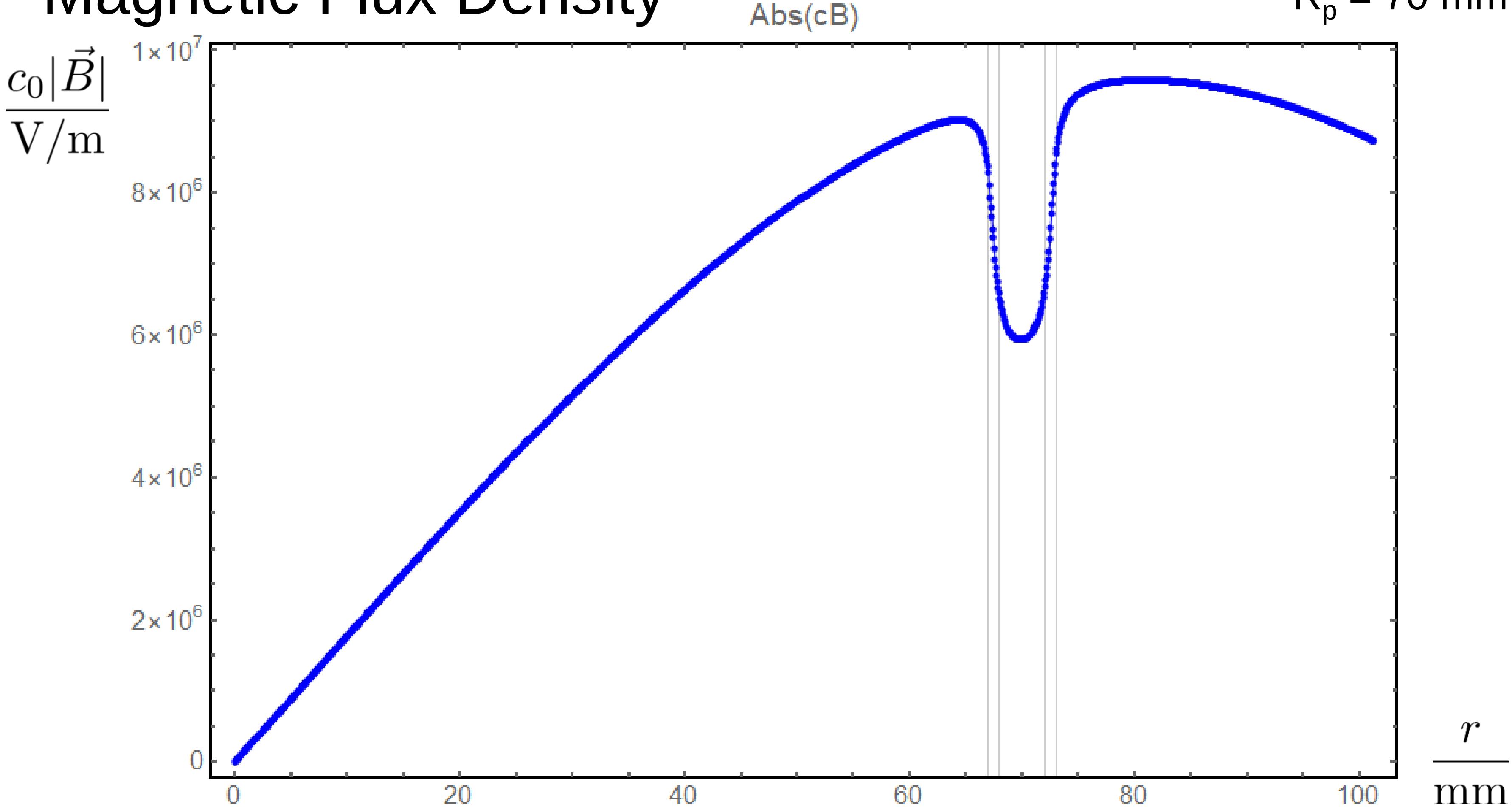

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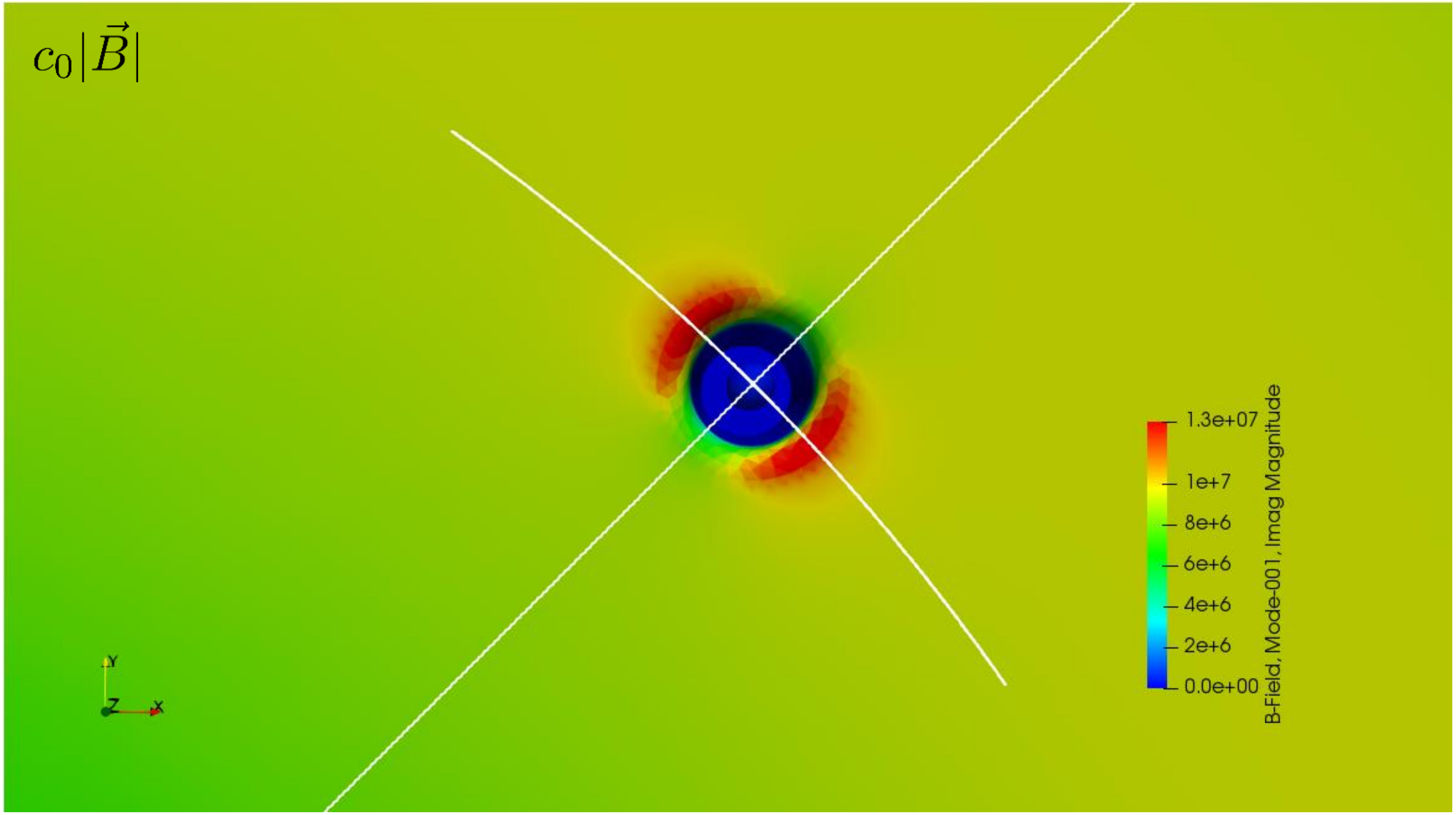

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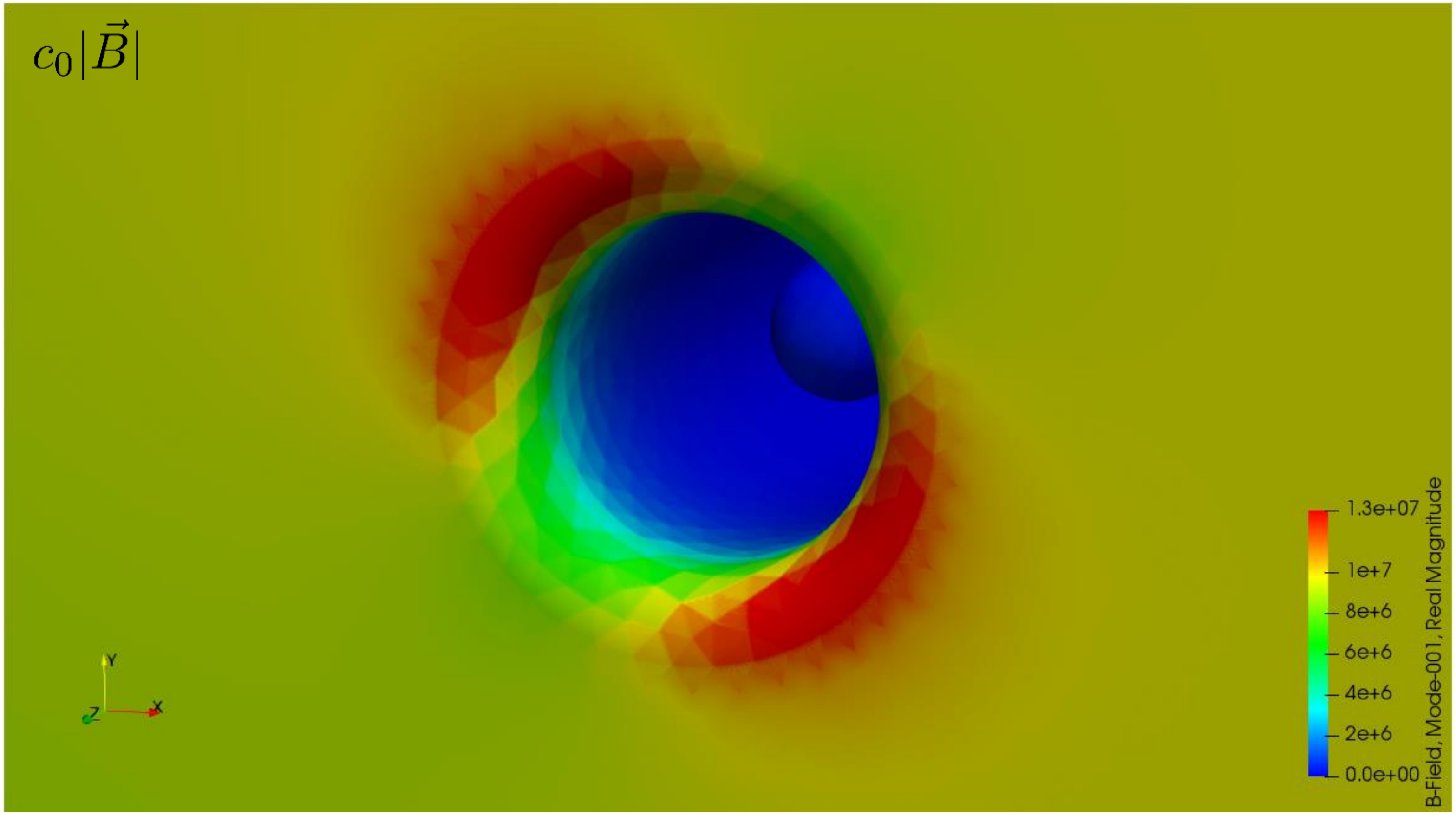

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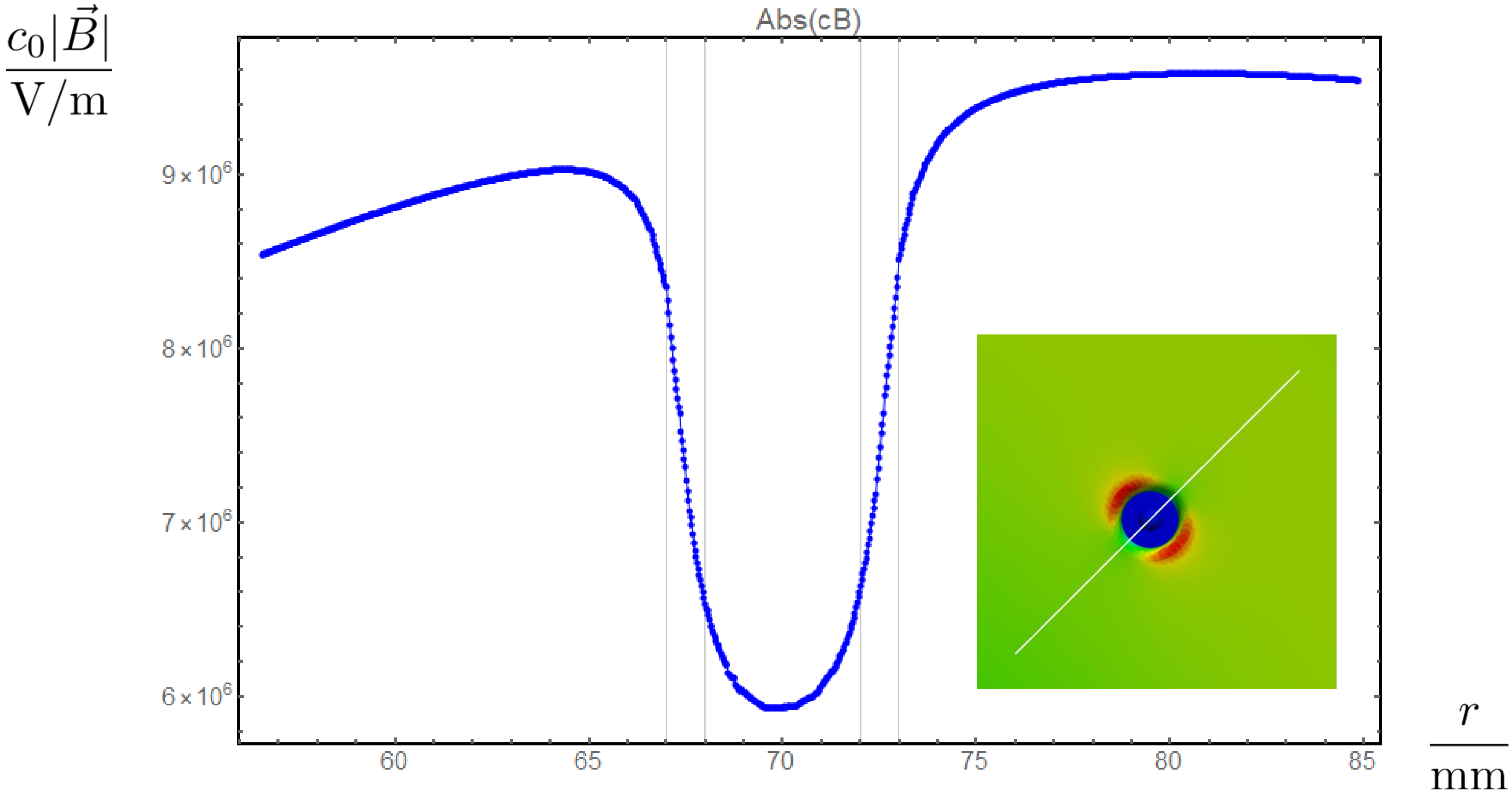

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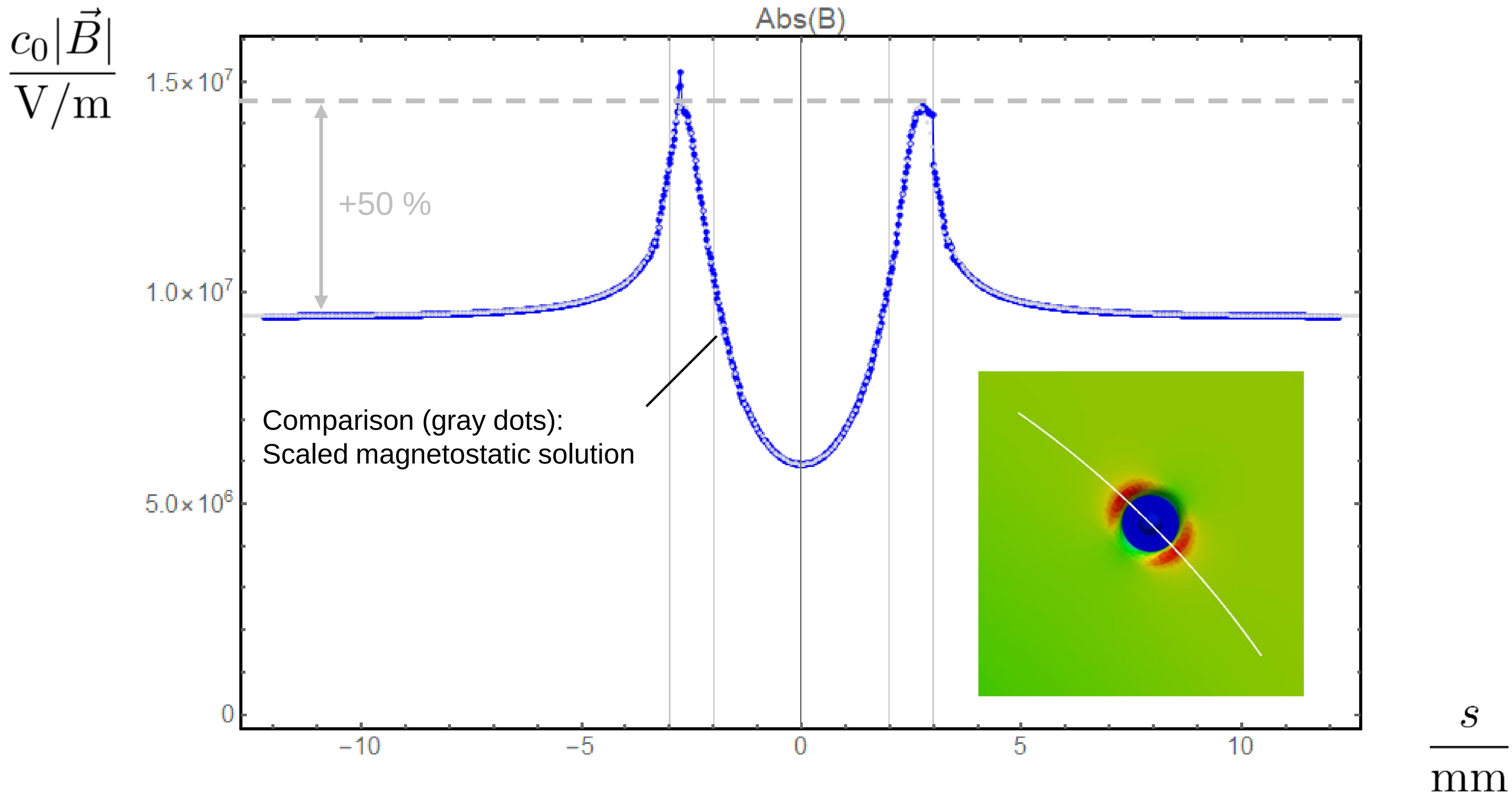
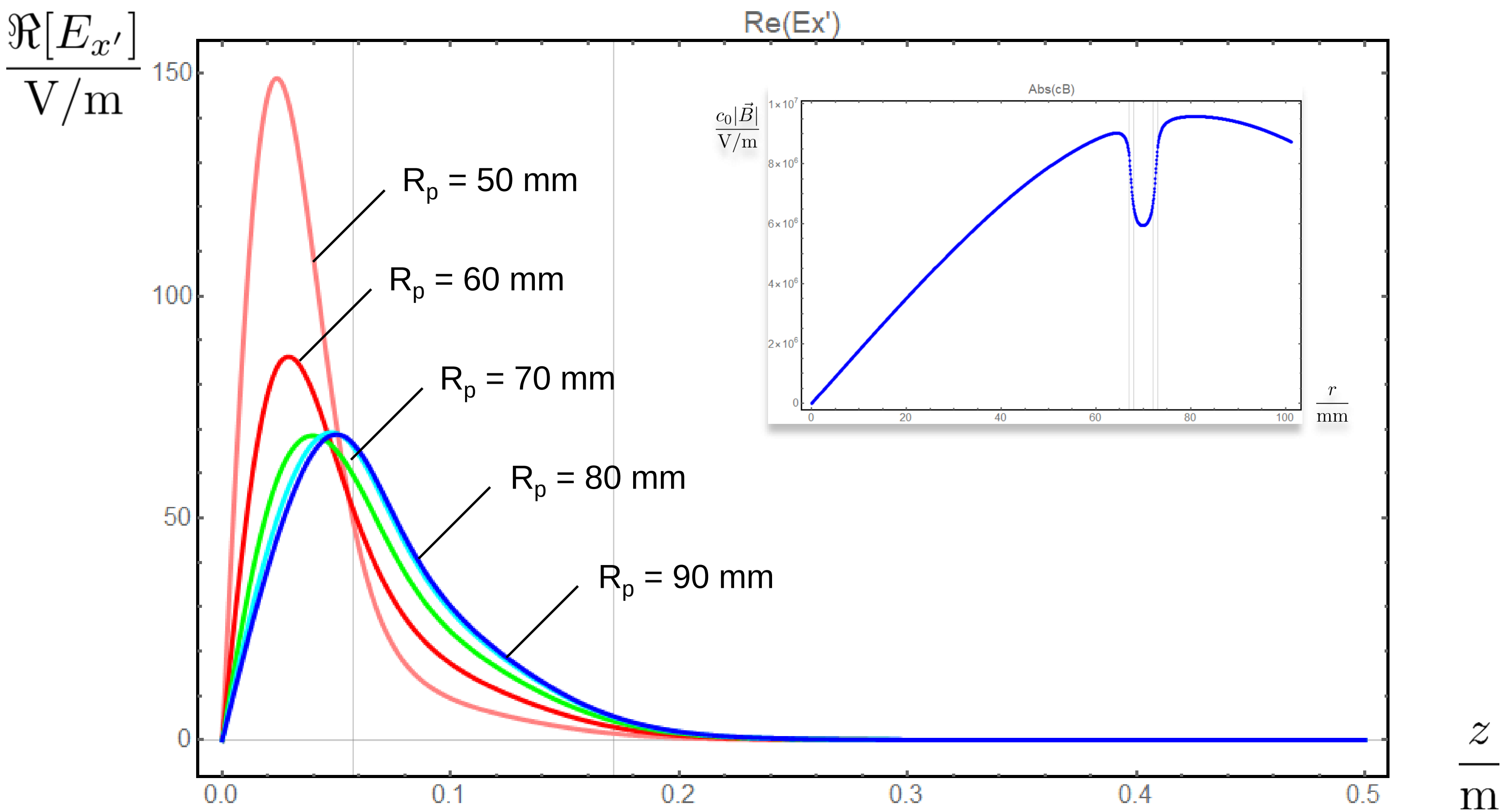


Numerical Results

- Fields along the cavity axis



Numerical Results

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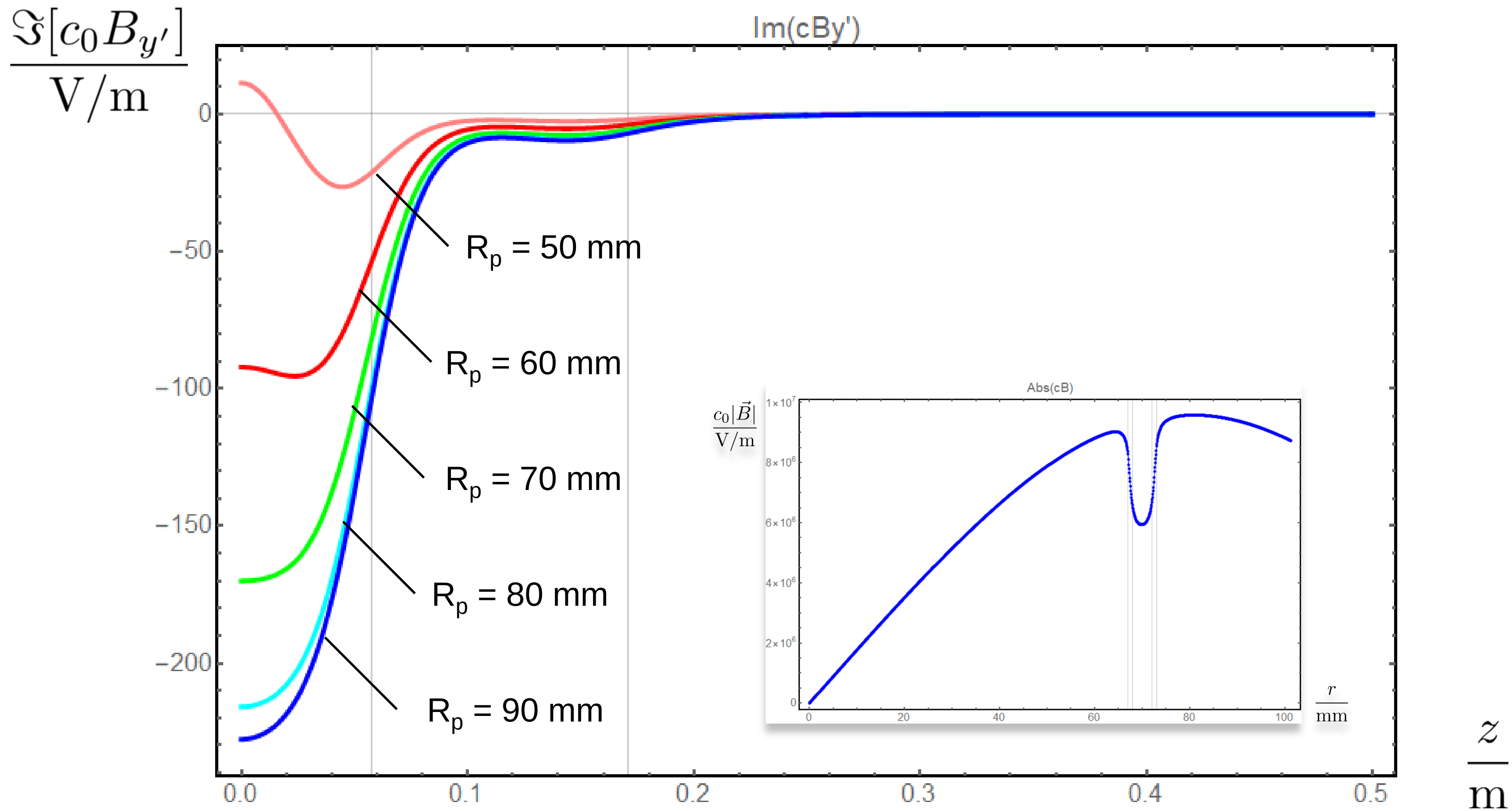

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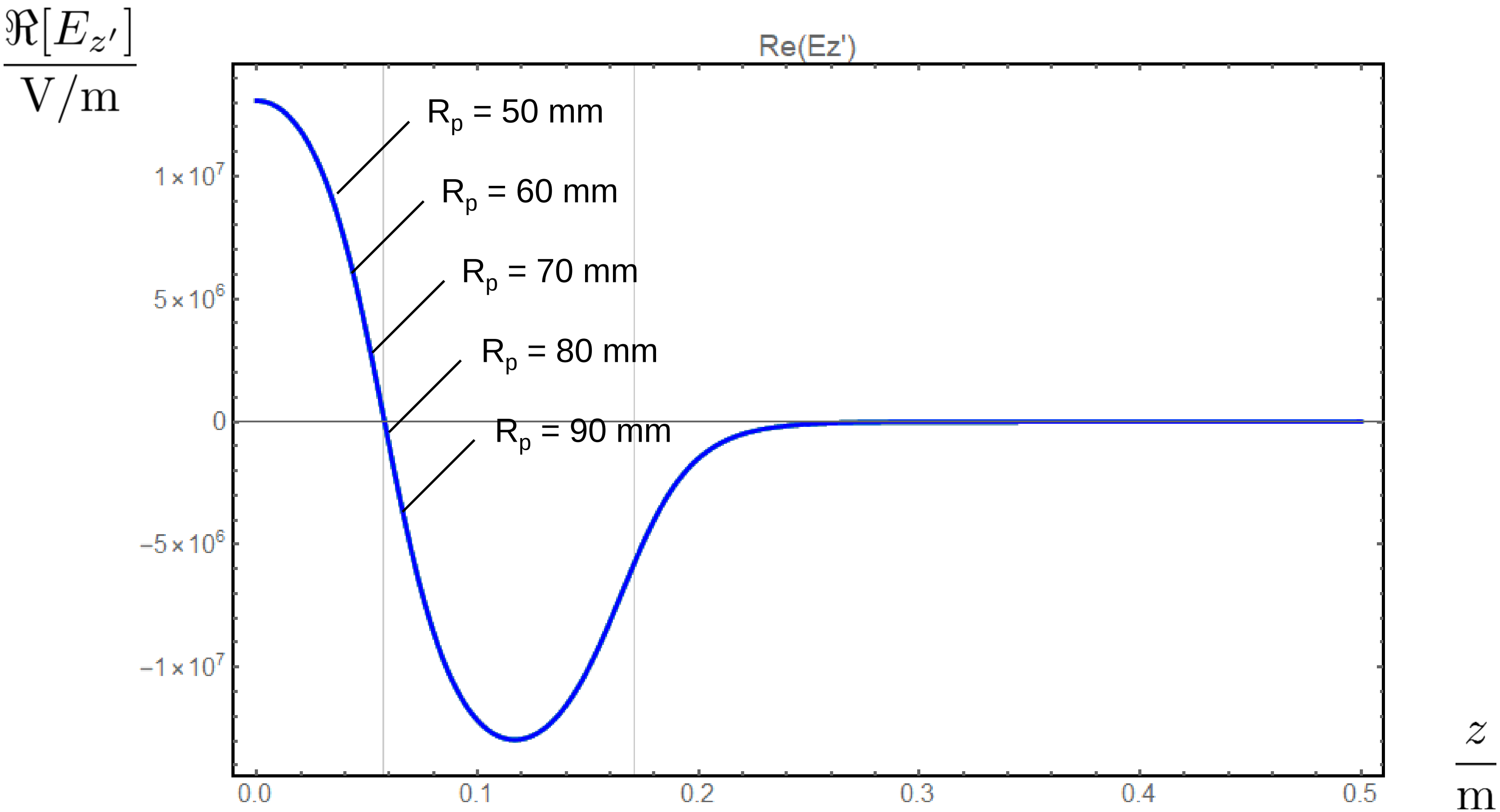

Summary / Outlook

- Summary
  - Fundamental input power coupler

    The desired quality factor can be obtained with less serious coupler fields on the axis using a larger distance from the coupler to the cavity.
  - Pickup antenna as a field probe

    A drilled hole in the backplane disturbs the induced current distribution such that locally higher magnetic fields can be observed.
- Outlook
  - Further parameter studies to examine?
  - Export a field map around the axis.