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HUAZHONG UNIVERSITY OF SCIENCE AND TECHNOLOGY

Design of the Fast Scanning Magnets for HUST Proton Therapy Facility

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1 Scanning Magnets

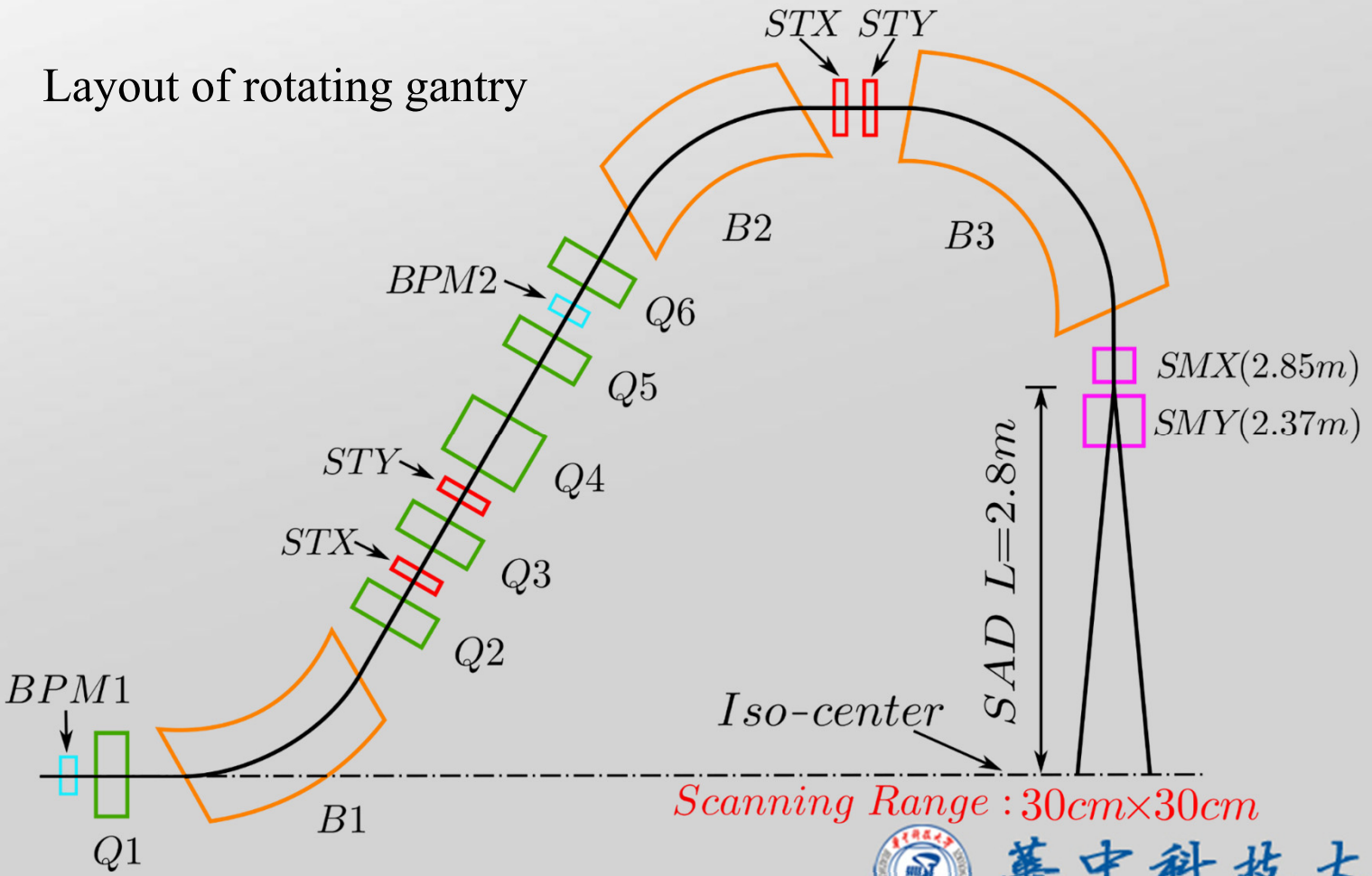
2 Eddy Current Effect

3 Conclusion

Scanning Magnets

Two rotating gantries + One fixed beam treatment room

Layout of rotating gantry



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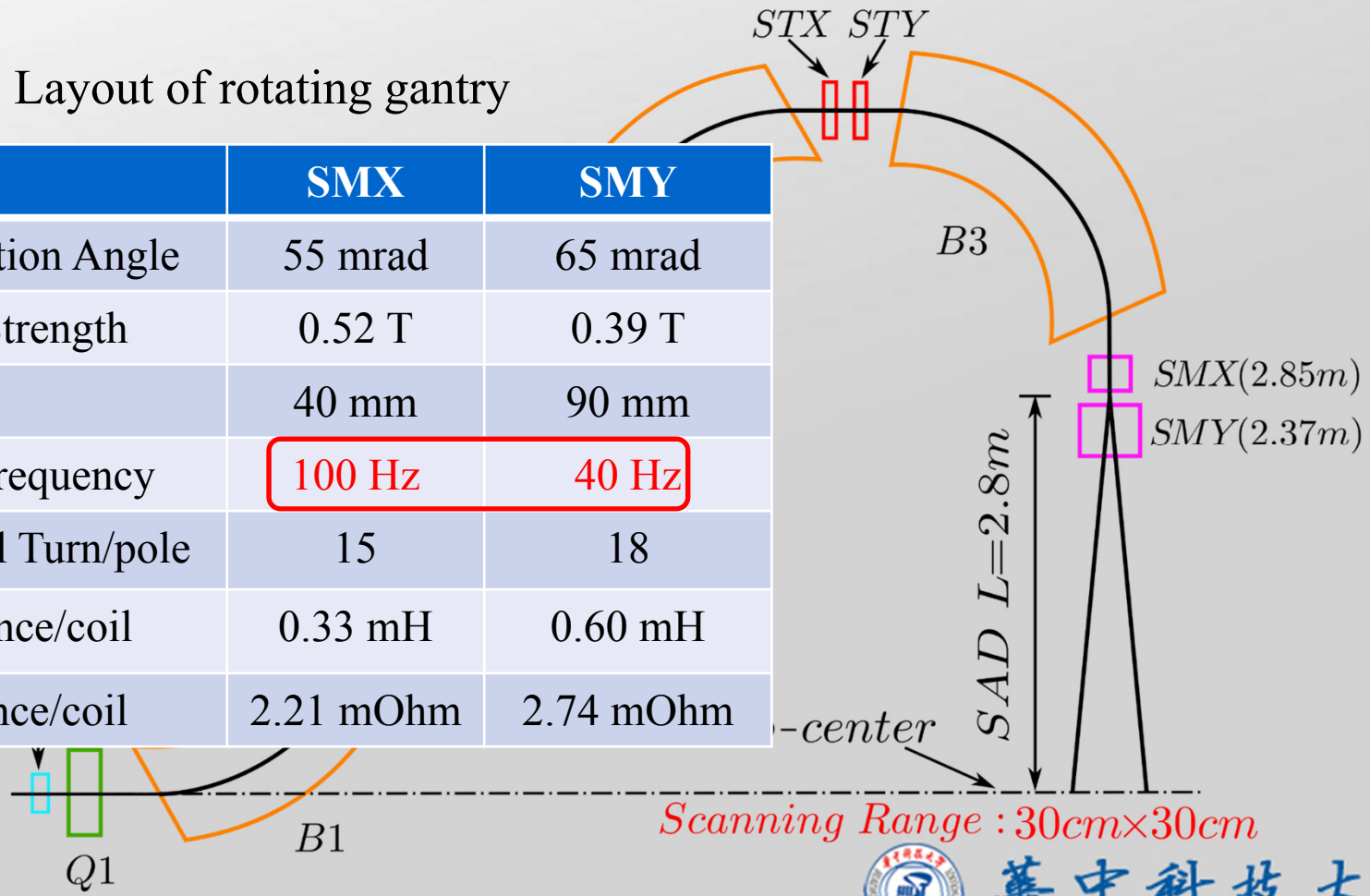
Scanning Magnets

Two rotating gantries + One fixed beam treatment room

Layout of rotating gantry

Parameter	SMX	SMY
Max. Deflection Angle	55 mrad	65 mrad
Max. Field Strength	0.52 T	0.39 T
Magnet Gap	40 mm	90 mm
Repetition Frequency	100 Hz	40 Hz
Num. of Coil Turn/pole	15	18
Coil Inductance/coil	0.33 mH	0.60 mH
Coil Resistance/coil	2.21 mOhm	2.74 mOhm



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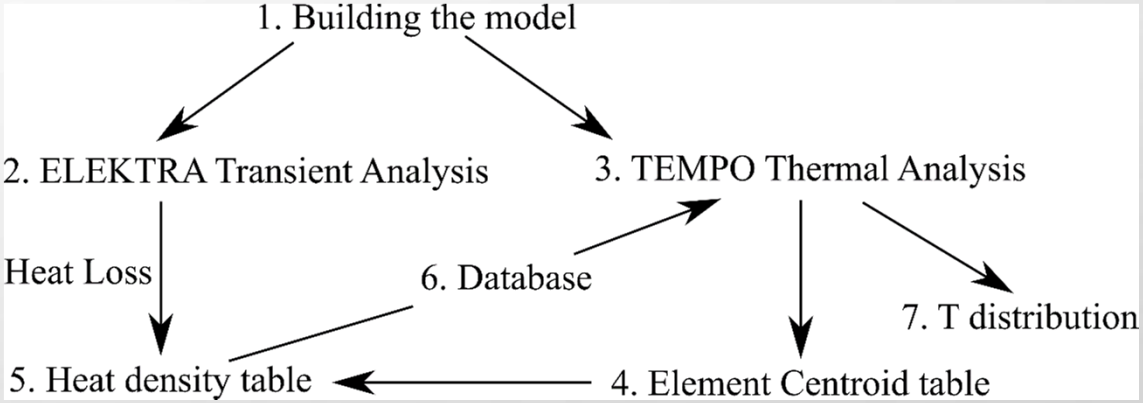
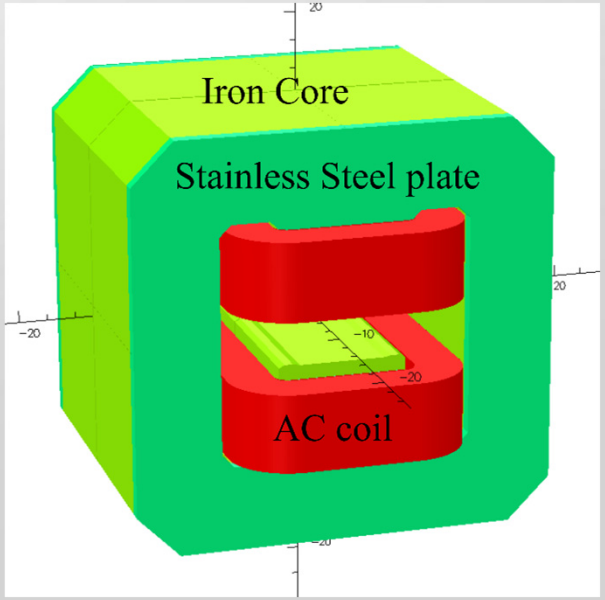
Eddy Current Effect

- Simulation method (SMX)

  ELEKTRA/TR + TEMPO/SS





Eddy Current Effect

- Simulation method (SMX)

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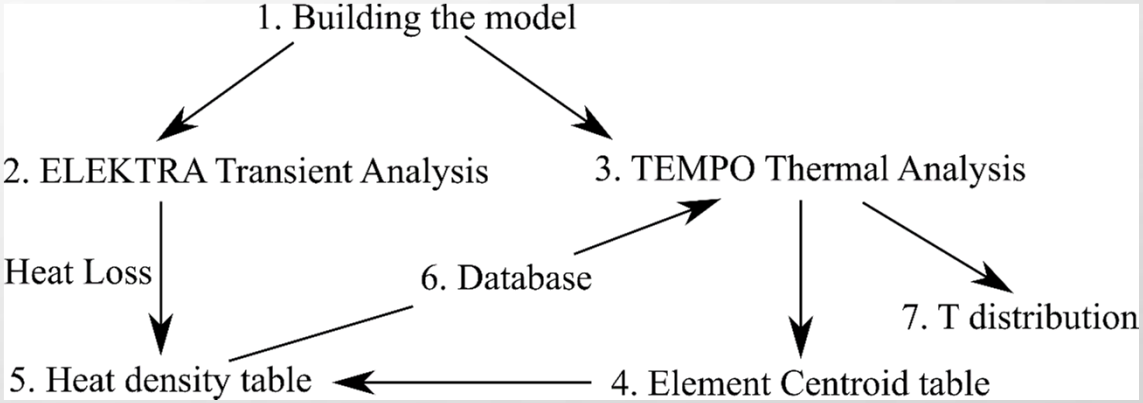
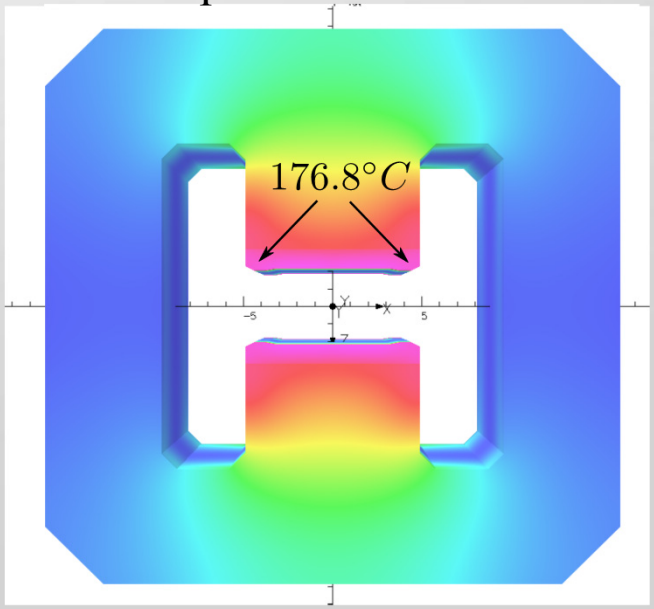
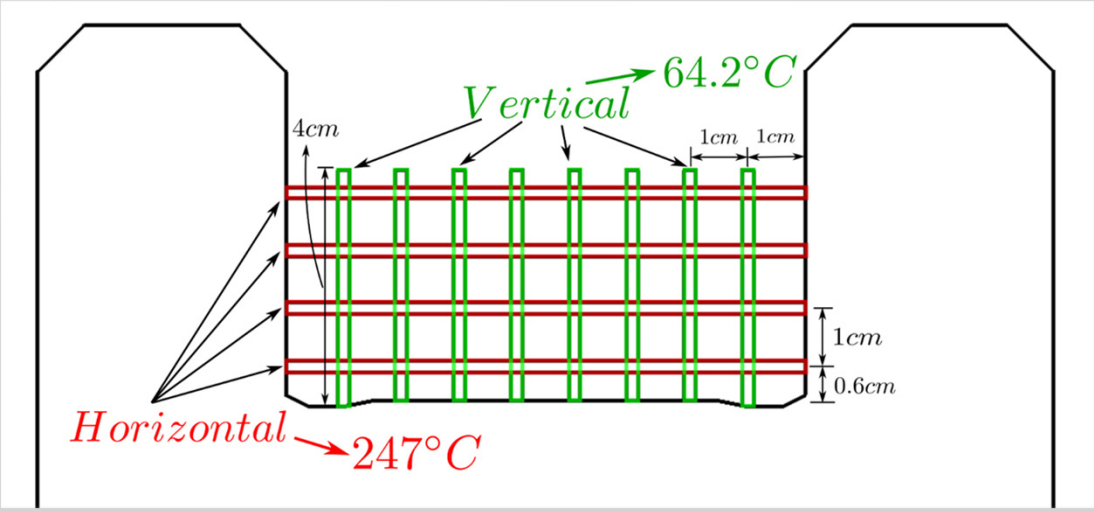


Unoptimized Model



- SLITS
  - Slits Direction



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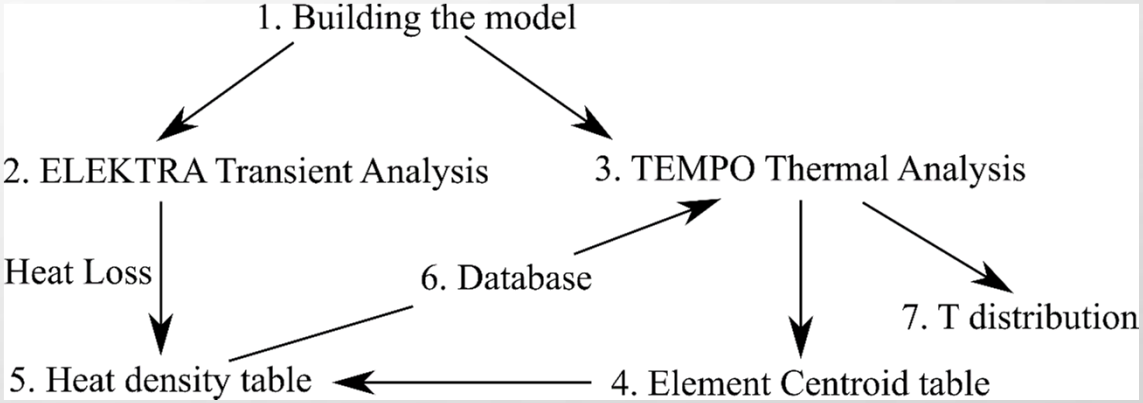

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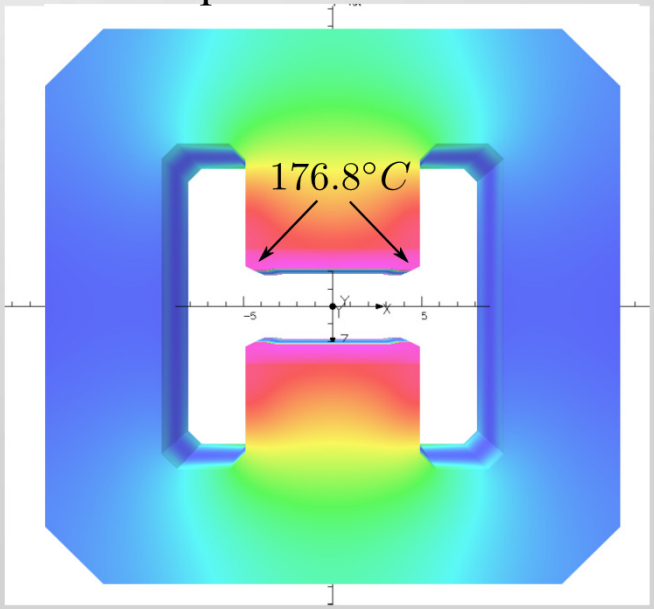
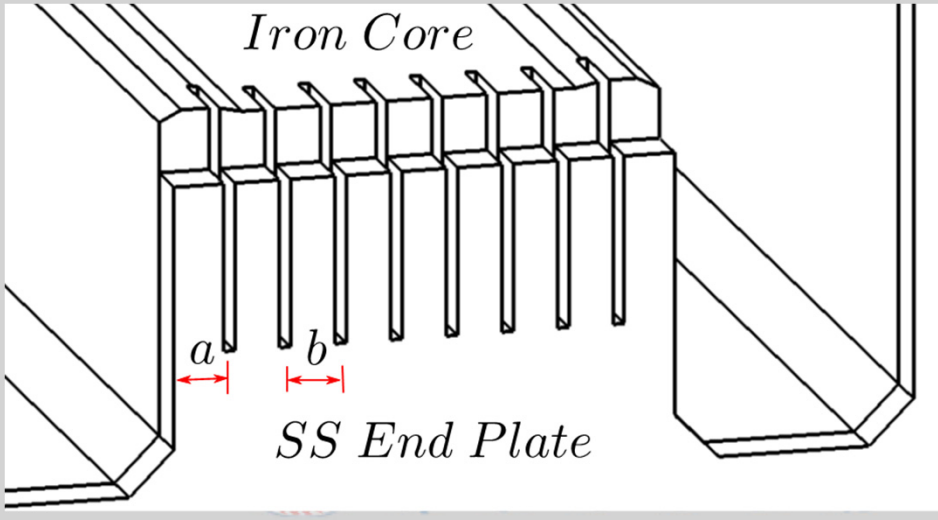


- SLITS
  - Slits Direction
  - Slits Distribution

Num_slits	a/mm	b/mm	Max. T/℃
7	15	10	72.29
8	10	10	64.16
9	5	10	73.06



Eddy Current Effect

- Simulation method (SMX)

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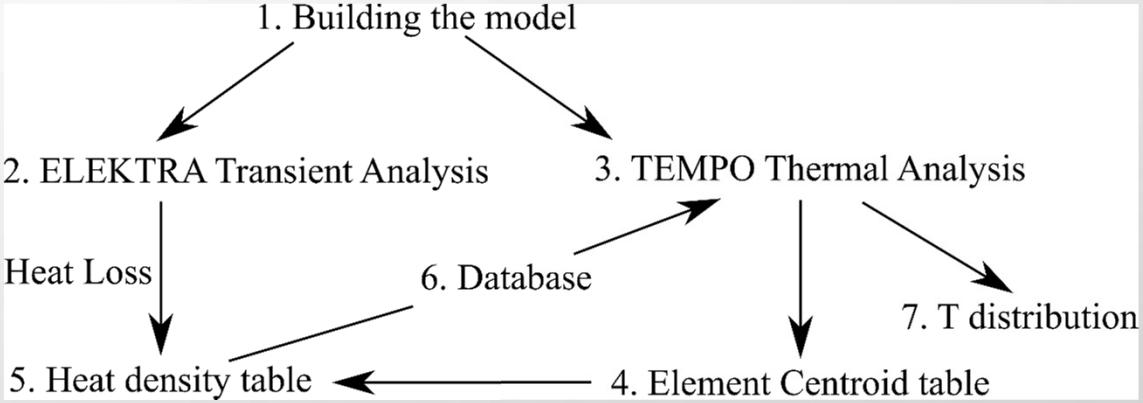
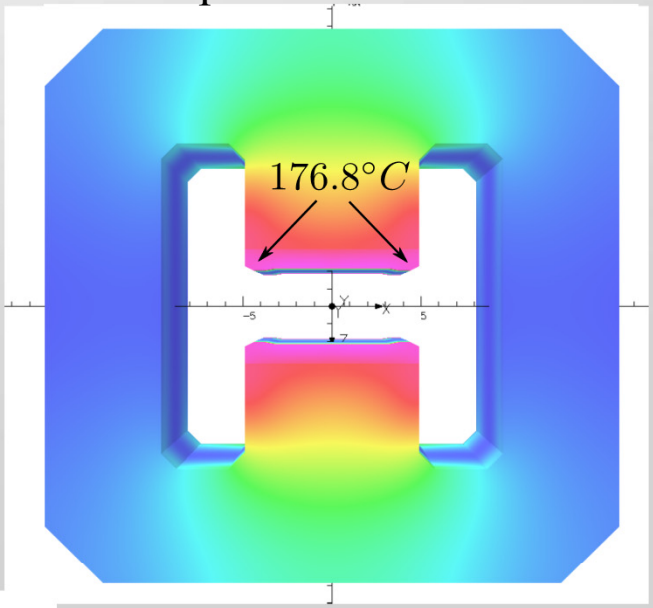
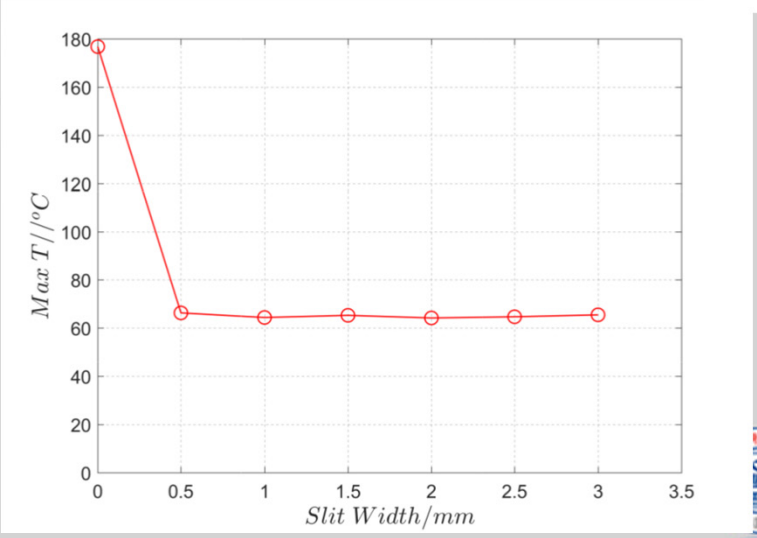


Unoptimized Model



- SLITS
  - Slits Direction
  - Slits Distribution
  - Slit Width



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Eddy Current Effect

- Simulation method (SMX)

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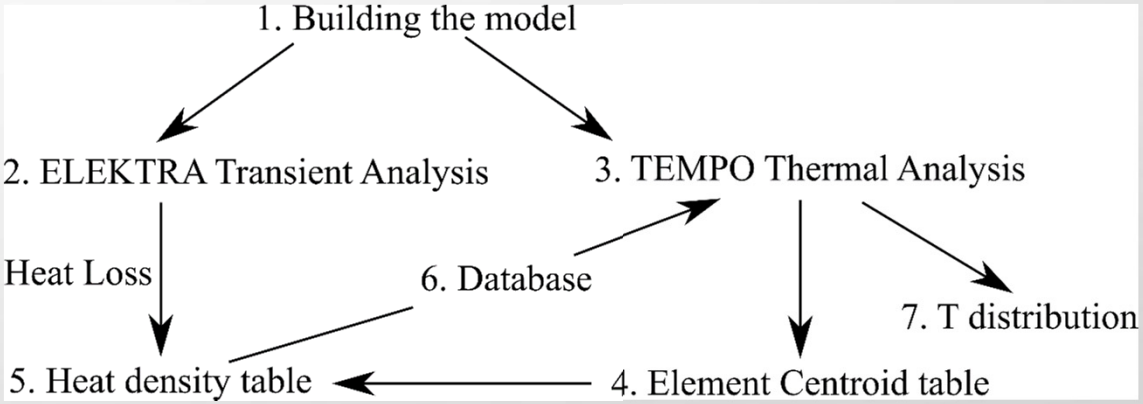
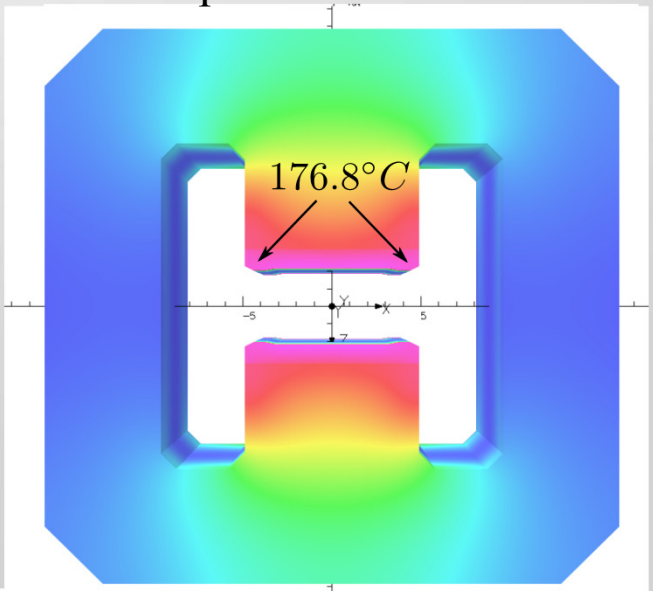
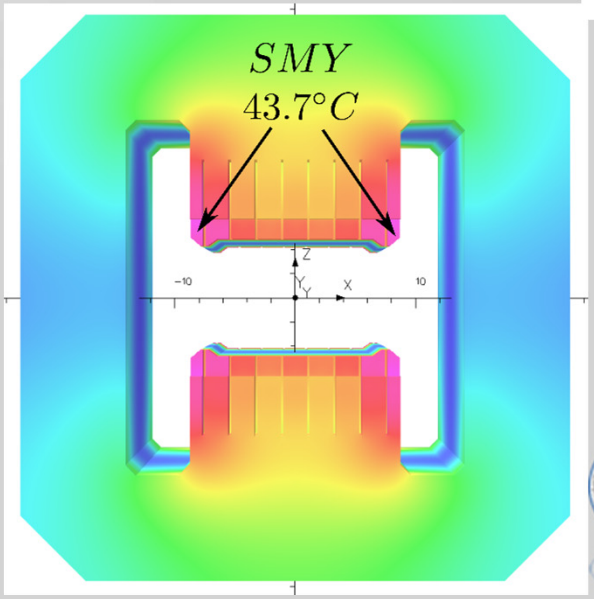
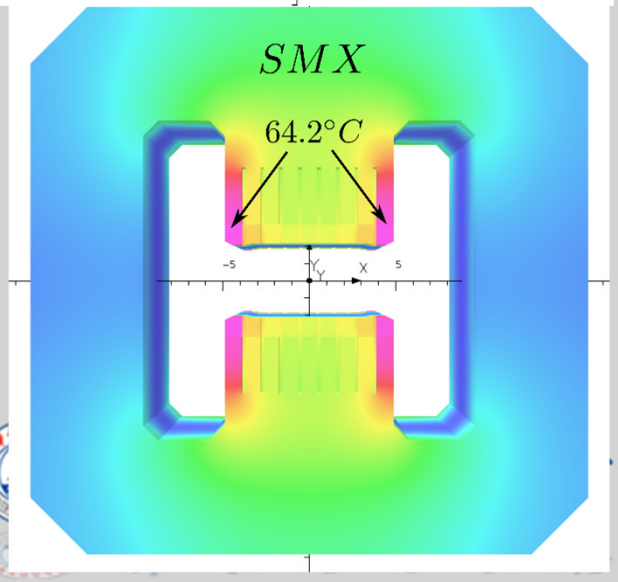


Unoptimized Model



- SLITS
  - Slits Direction vertical
  - Slits Distribution 8 slits
  - Slit Width 2mm wide





Conclusion

- The length of SAD is optimized to 2.8m.
- The effect of eddy currents in the scanning magnets is large and the temperature rise will destroy the magnets.
- Slits in the edge of the pole are an effective method to reduce the eddy current:
  - Vertical slits can reduce the eddy currents; horizontal slits will concentrate the eddy currents and increase the temperature.
  - The distance between the outermost slit and the edge of the pole is important, wide or tight length is not suitable.
  - The temperature is not sensitive to the slit width.
- The maximum temperature of these two magnets is reduced to 64.2℃ and 43.7℃, lowing the allowance temperature rise.

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Thanks for your listening

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