Q1APF

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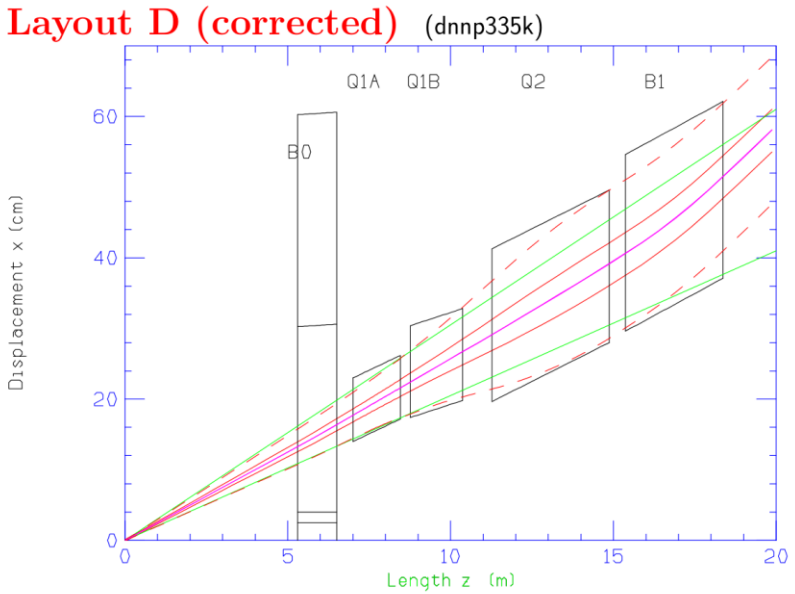
Collider-Accelerator Department

1808-forward-v2

BROOKHAVEN NATIONAL LABORATORY



August 13

Magnets D (corrected) (mnnp335)

Chrom y 15.61 ' Chrom x 3.91 ' mom = 275

		L1	DL	gap	x	θ	IR1	IR2	OR	B1	B2	B	Grad1	Grad2
		m	m	m	cm	mrad	cm	cm	cm	T	T	T	T/m	T/m
B0	3	5.30	1.20	0.50	13.3	3.00	17.00	17.00	30.0	0.000	0.000	1.300	0.000	0.000
Q1A	5	7.00	1.46	0.30	19.5	15.00	4.50	4.50	0.0	3.506	3.506	0.000	-77.903	-77.903
Q1B	7	8.76	1.61	0.90	23.9	15.00	6.50	6.50	0.0	4.097	4.097	0.000	-63.028	-63.028
Q2	9	11.27	3.60	0.50	34.5	12.00	10.80	10.80	0.0	4.29	4.29	0.000	39.736	39.736
B1	11	15.37	3.00	20.90	42.1	25.00	12.50	12.50	0.0	0.000	0.000	4.570	0.000	0.000

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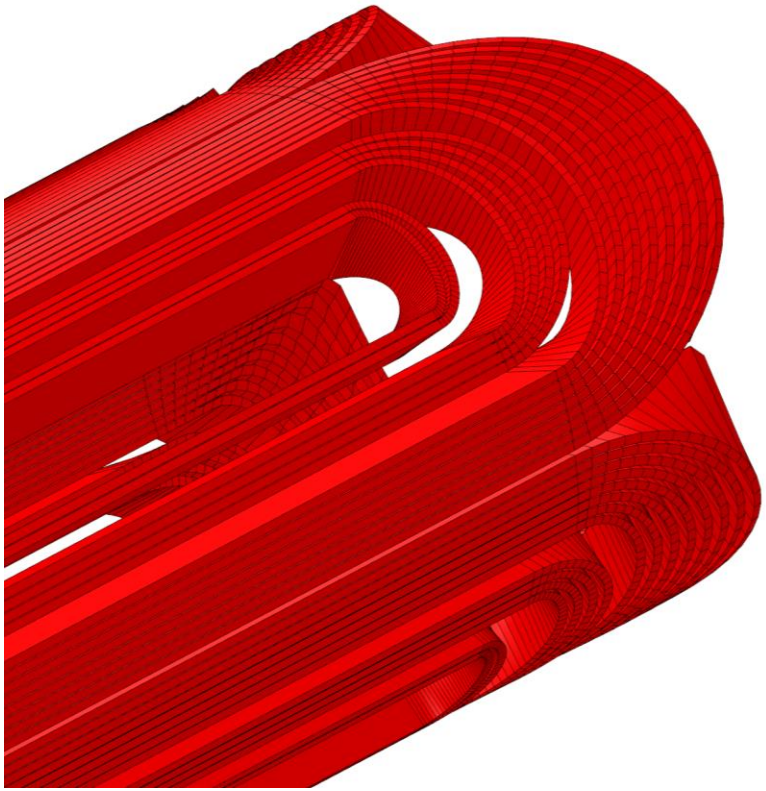
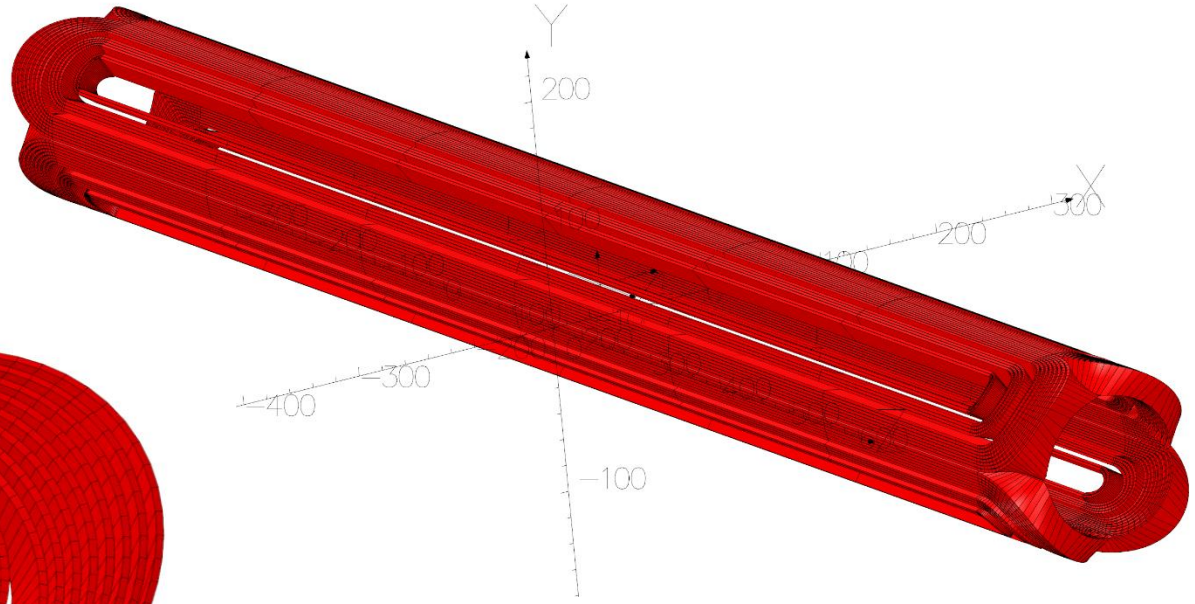
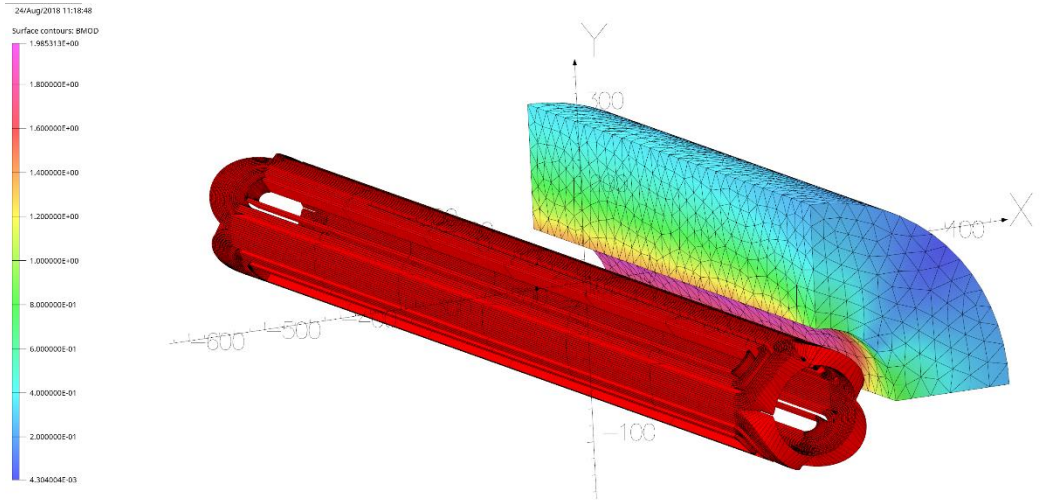


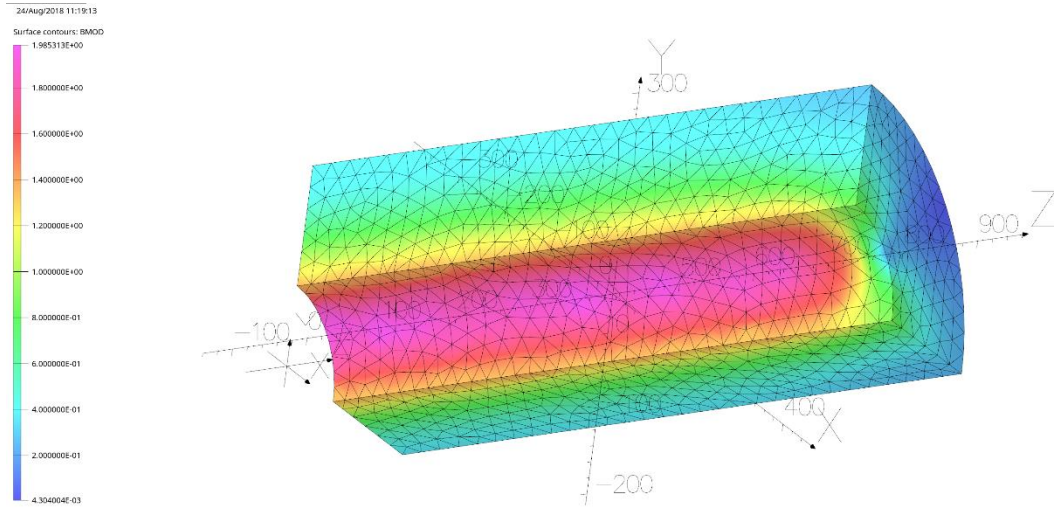


Slotted quad
Designed/optimized in ROXIE
Exported to Opera

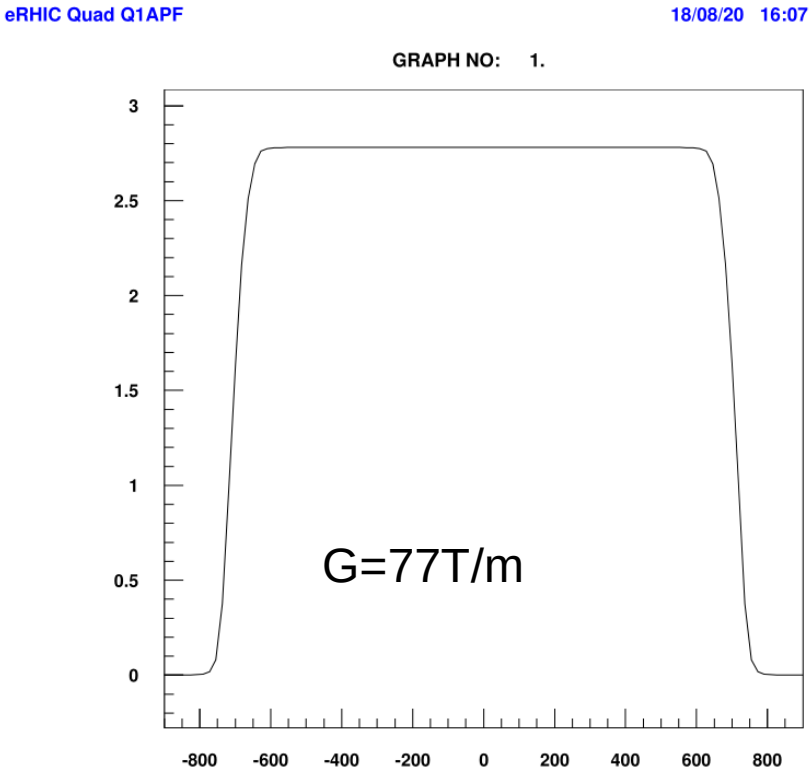
Magnetization



‘arbitrary yoke’



R=36mm

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HARMONIC ANALYSIS NUMBER ..........................          1
MAIN HARMONIC .....................................          2
REFERENCE RADIUS (mm) .............................      36.0000
X-POSITION OF THE HARMONIC COIL (mm) ..............       0.0000
Y-POSITION OF THE HARMONIC COIL (mm) ..............       0.0000
NUMBER OF ANALYSES ALONG Z ........................        100
LENGTH OF VIRTUAL COIL (mm) .......................    1800.0000
REFERENCE POSITION NUMBER .........................           0
MEASUREMENT TYPE ..................... ALL FIELD CONTRIBUTIONS
ERROR OF HARMONIC ANALYSIS OF Br ..................   0.3895E-03
SUM (Br(p) - SUM (An cos(np) + Bn sin(np))

3D AVERAGE MAIN FIELD (T) .........................       2.1554
AVERAGE MAGNET STRENGTH (T/(m^(n-1)) ..............      59.8728

NORMAL 3D AVARAGE RELATIVE MULTIPOLES (1.D-4):
b 1:       0.00000  b 2:  10000.00000  b 3:       0.00000
b 4:      -0.00991  b 5:       0.00000  b 6:       0.12337
b 7:       0.00000  b 8:       0.00034  b 9:       0.00000
b10:       0.00164  b11:       0.00000  b12:       0.00001
b13:       0.00000  b14:       0.00011  b15:       0.00000
b16:       0.00000  b17:       0.00000  b18:      -0.07602
b19:       0.00000  b20:       0.00000  b

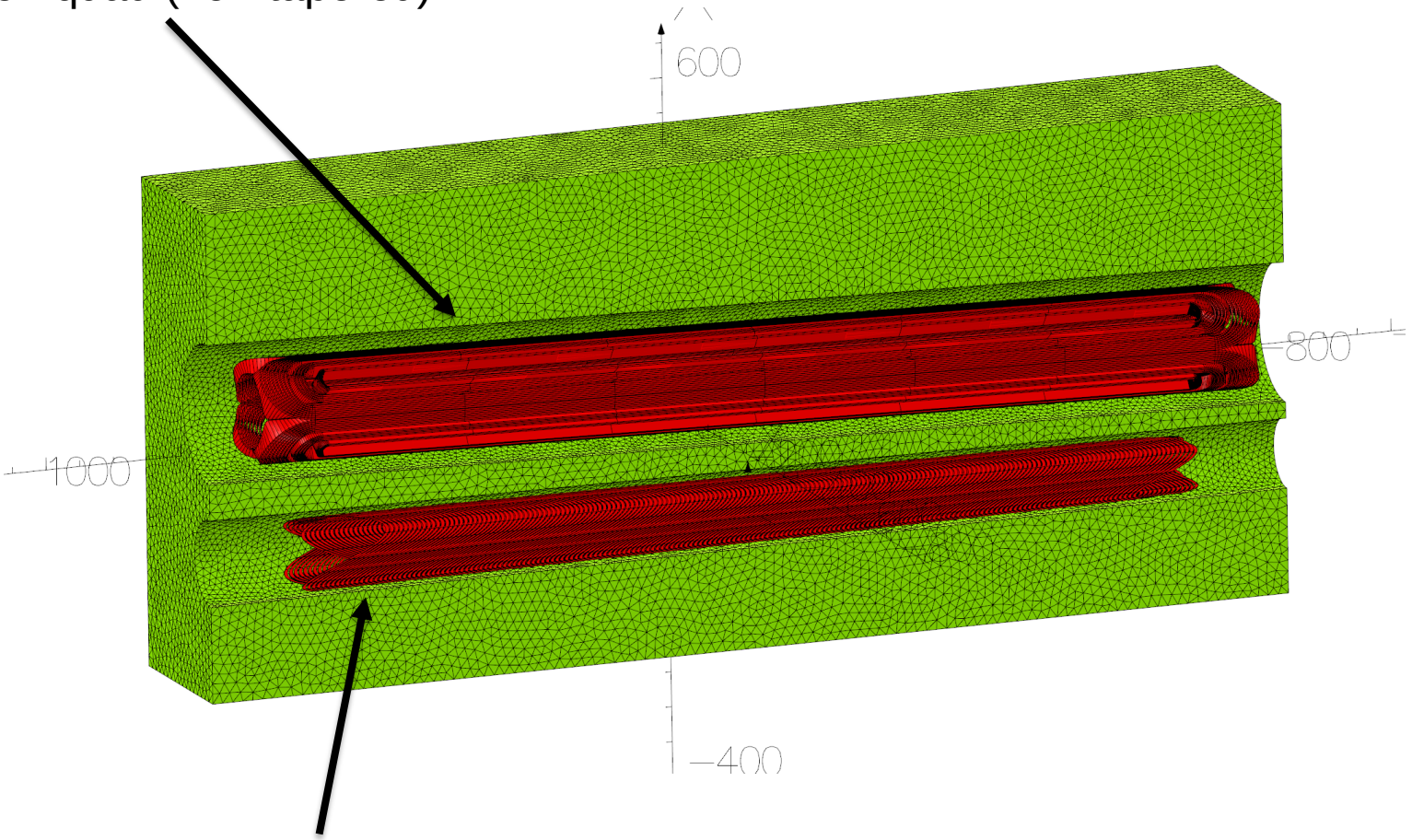
SKEW 3D AVARAGE RELATIVE MULTIPOLES (1.D-4):
a 1:       0.00000  a 2:       0.00000  a 3:       0.00000
a 4:       0.00000  a 5:       0.00000  a 6:       0.00000
a 7:       0.00000  a 8:       0.00000  a 9:       0.00000
a10:       0.00000  a11:       0.00000  a12:       0.00000
a13:       0.00000  a14:       0.00000  a15:       0.00000
a16:       0.00000  a17:       0.00000  a18:       0.00000
a19:       0.00000  a20:       0.00000  a
```

Includes iron yoke (little change without)

Opera Model

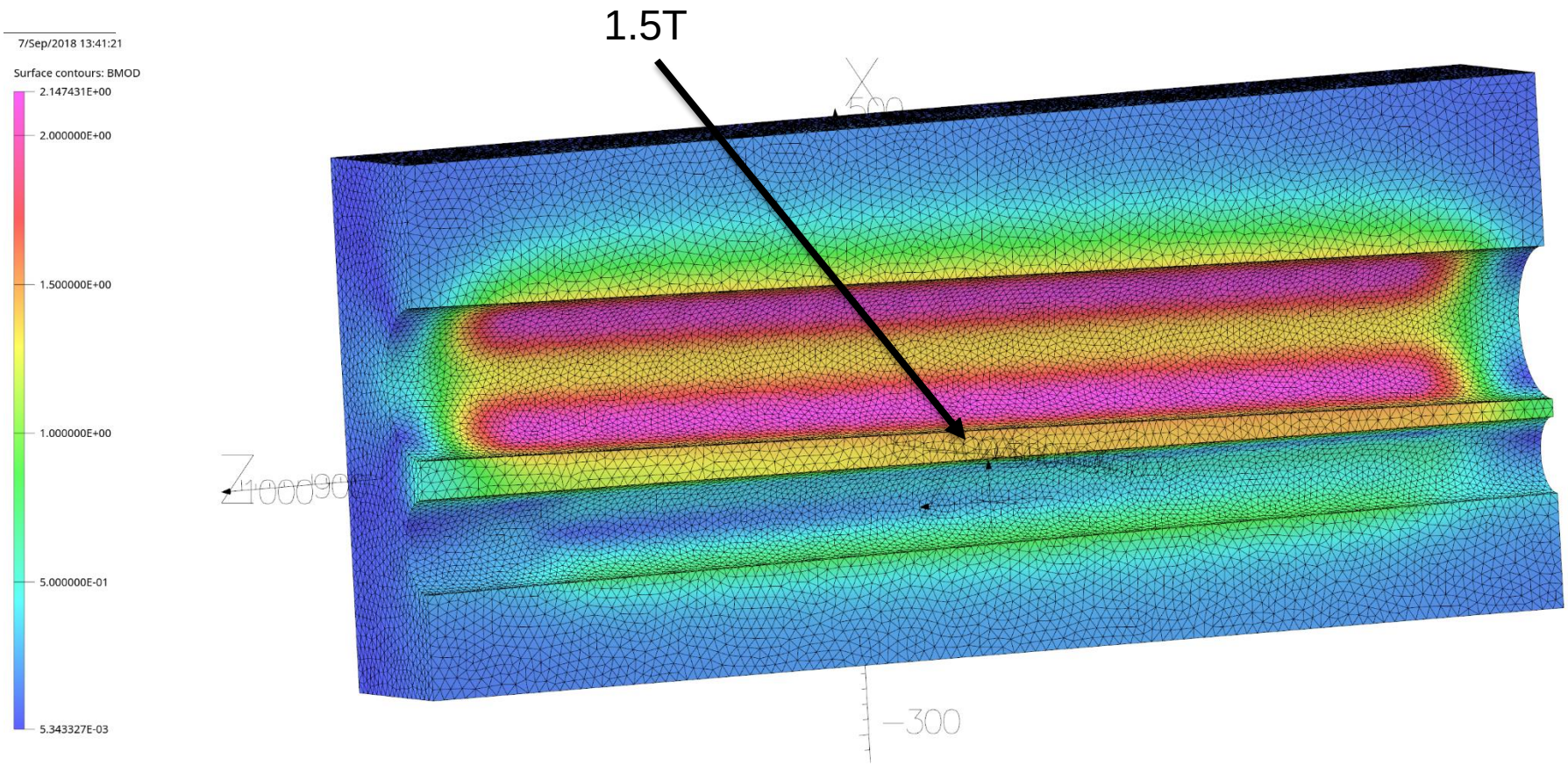
Hadron quad (non-tapered)

Yoke not optimized



Electron quad (tapered double-helix coil)

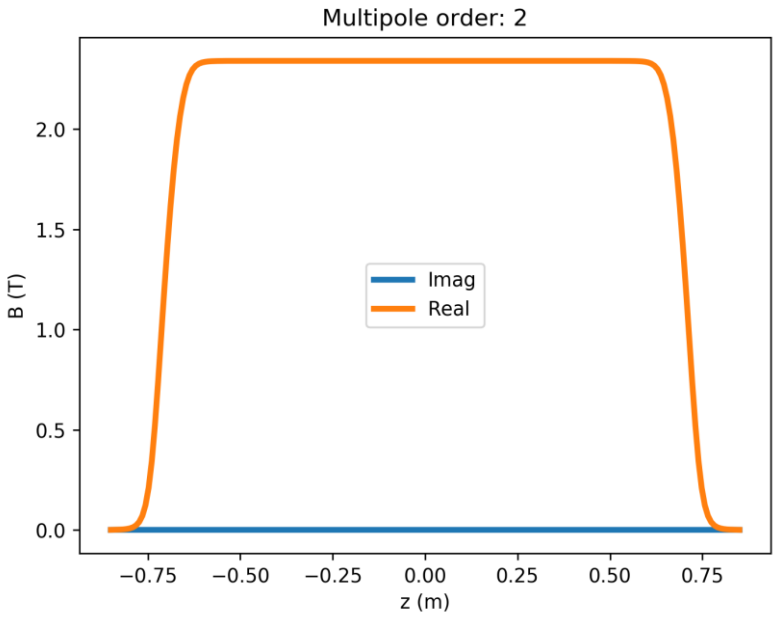
Magnetization



Agrees well with 2D simulations

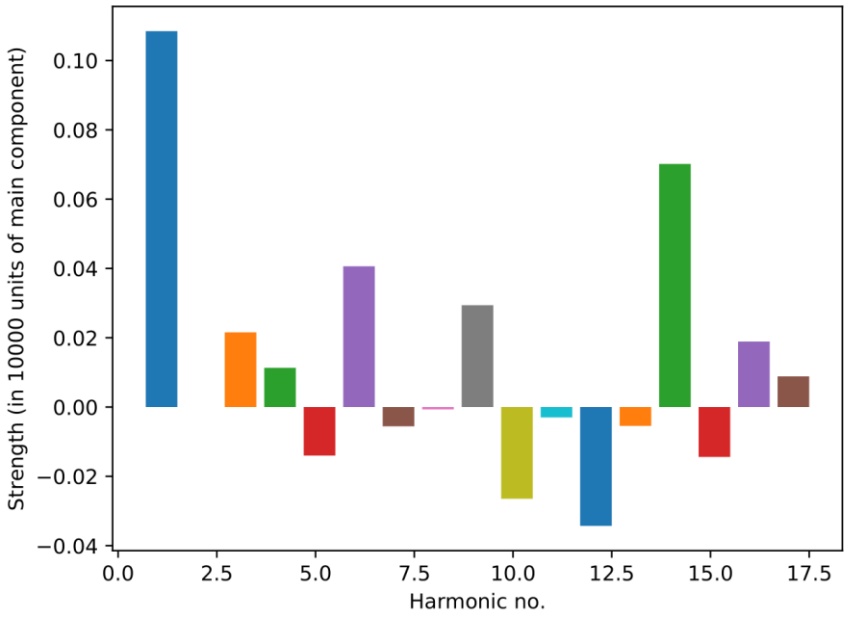
Q1APF_hqd

G=75.3T/m



R=30mm

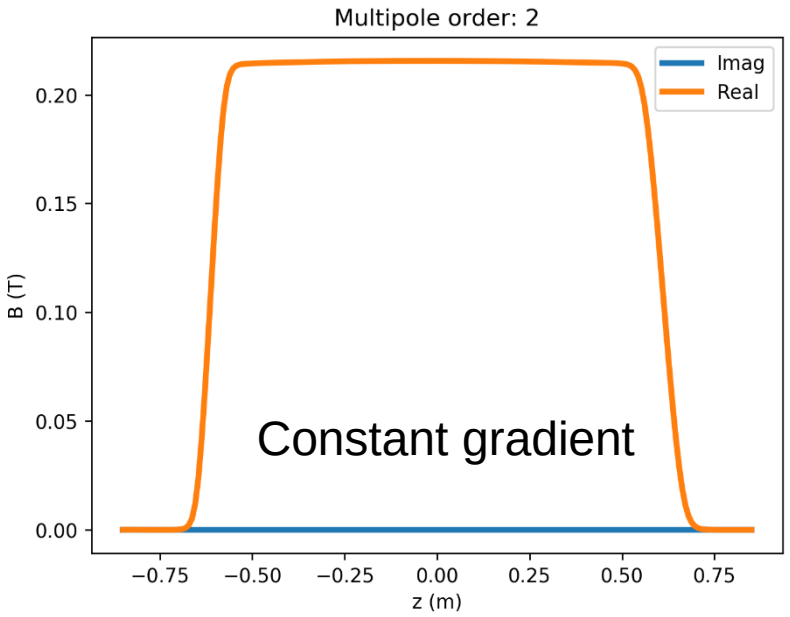
Real Harmonics



(no skew components)

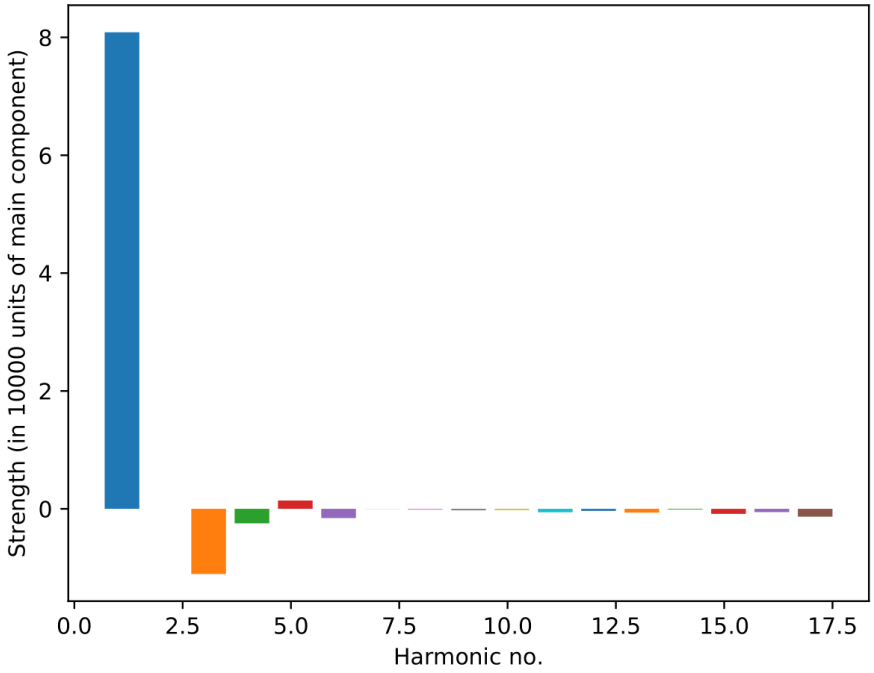
Q1APF_eqd

G=9T/m



R=20mm

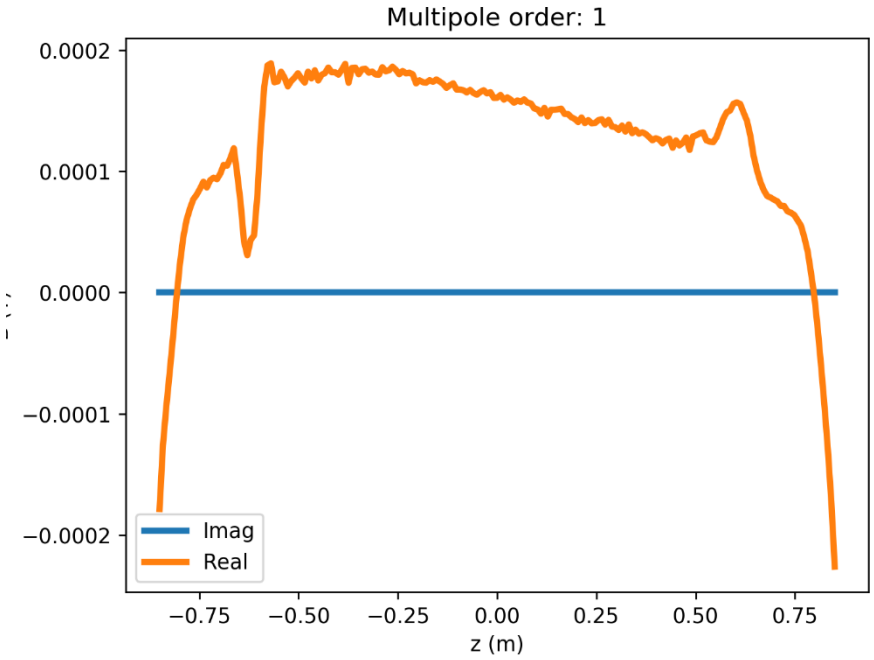
Real Harmonics



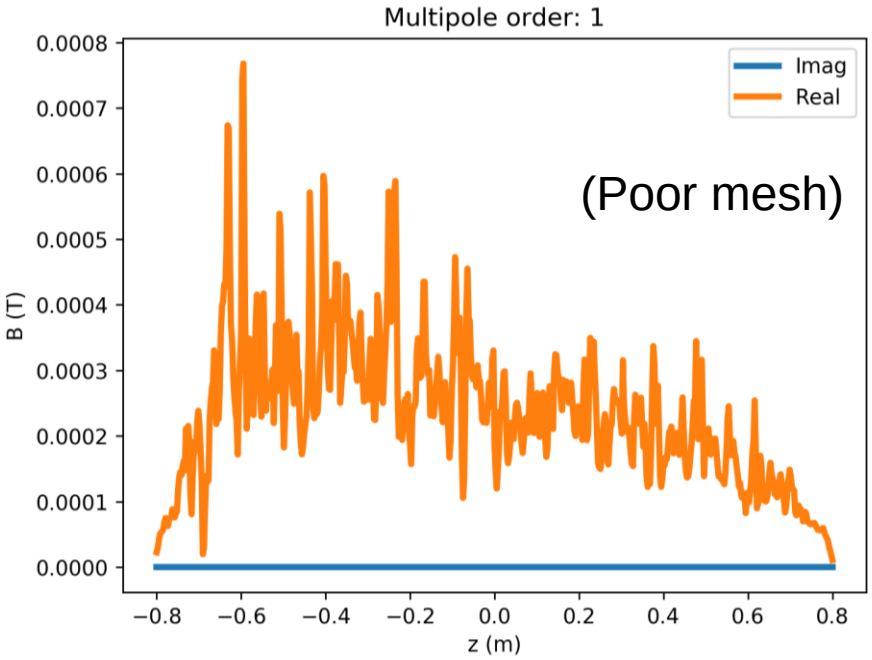
8 units of dipole, small sextupole component

Origin of Dipole

Full model

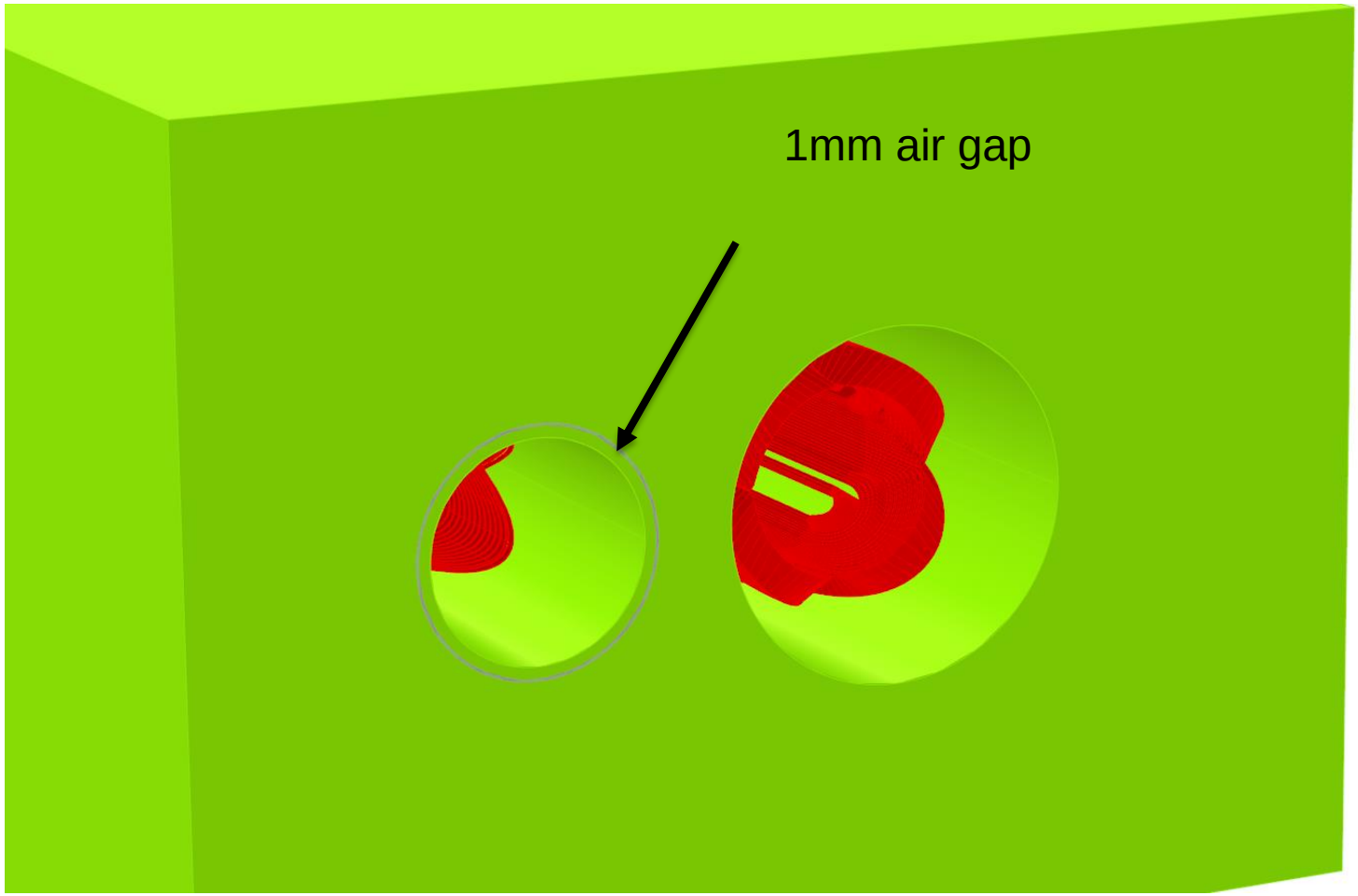


Without electron quad

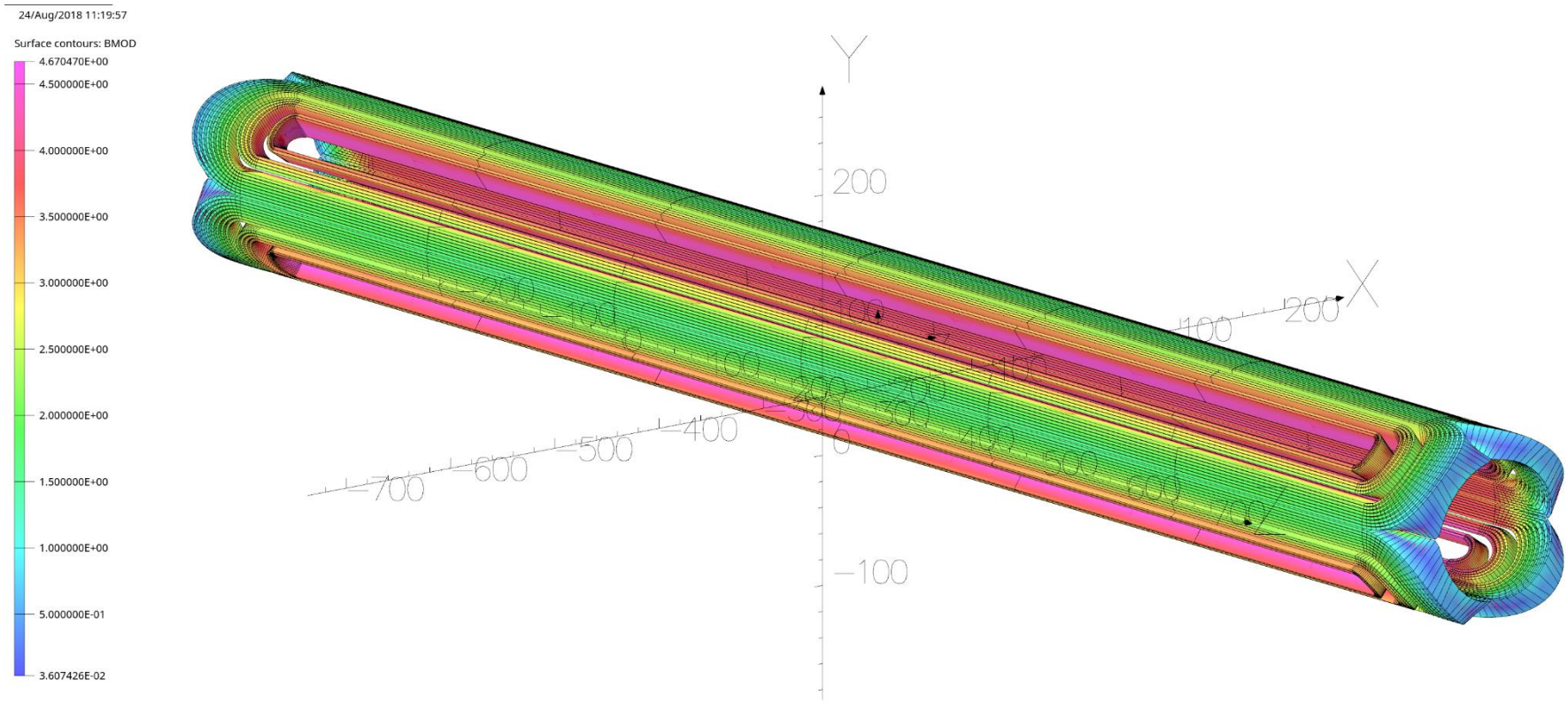


Dipole component with and without electron quad
Caused by crosstalk

Air Gap around Q1APF_eqd

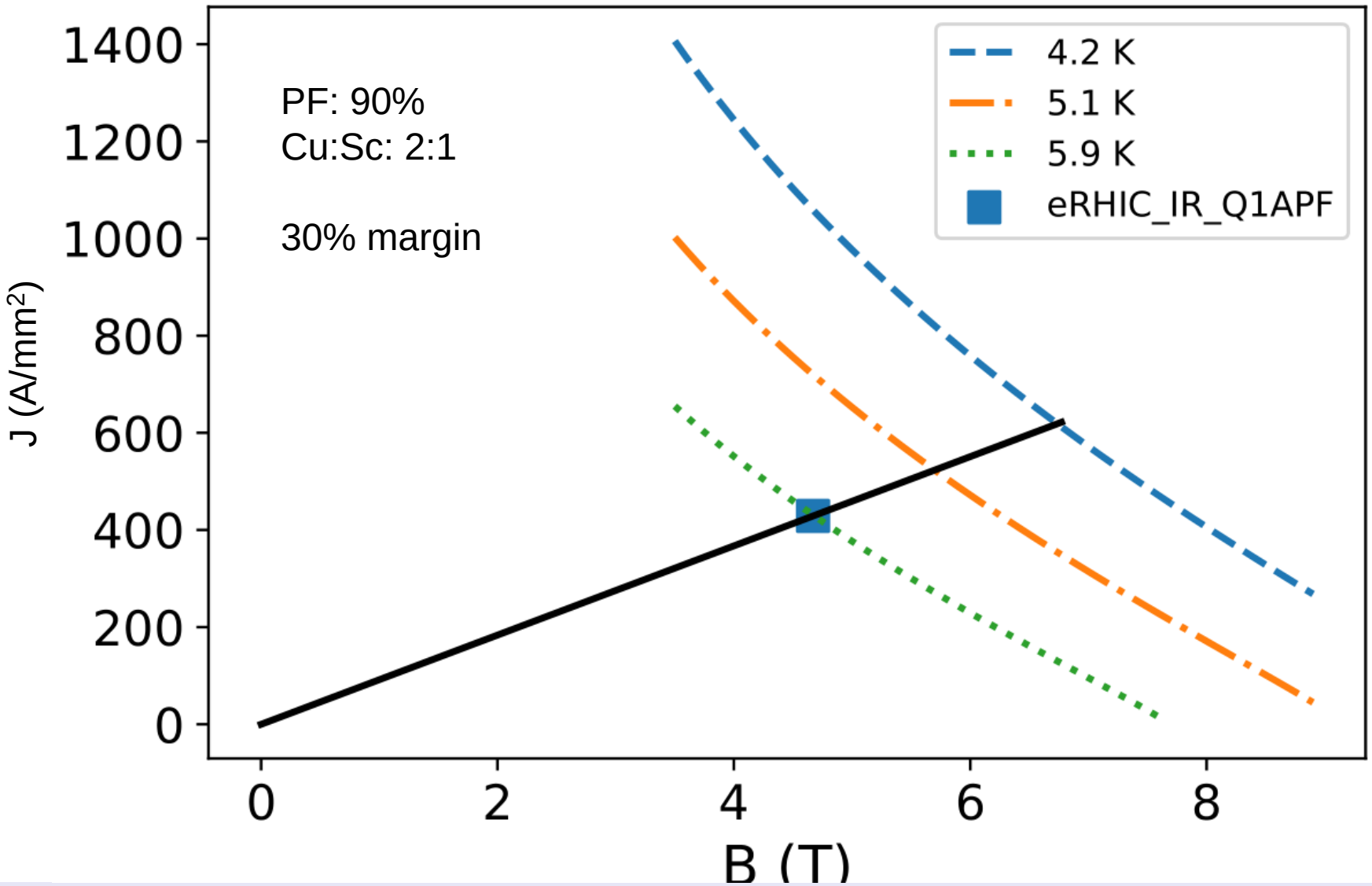


Peak Field Wire



B_{max}=4.67T

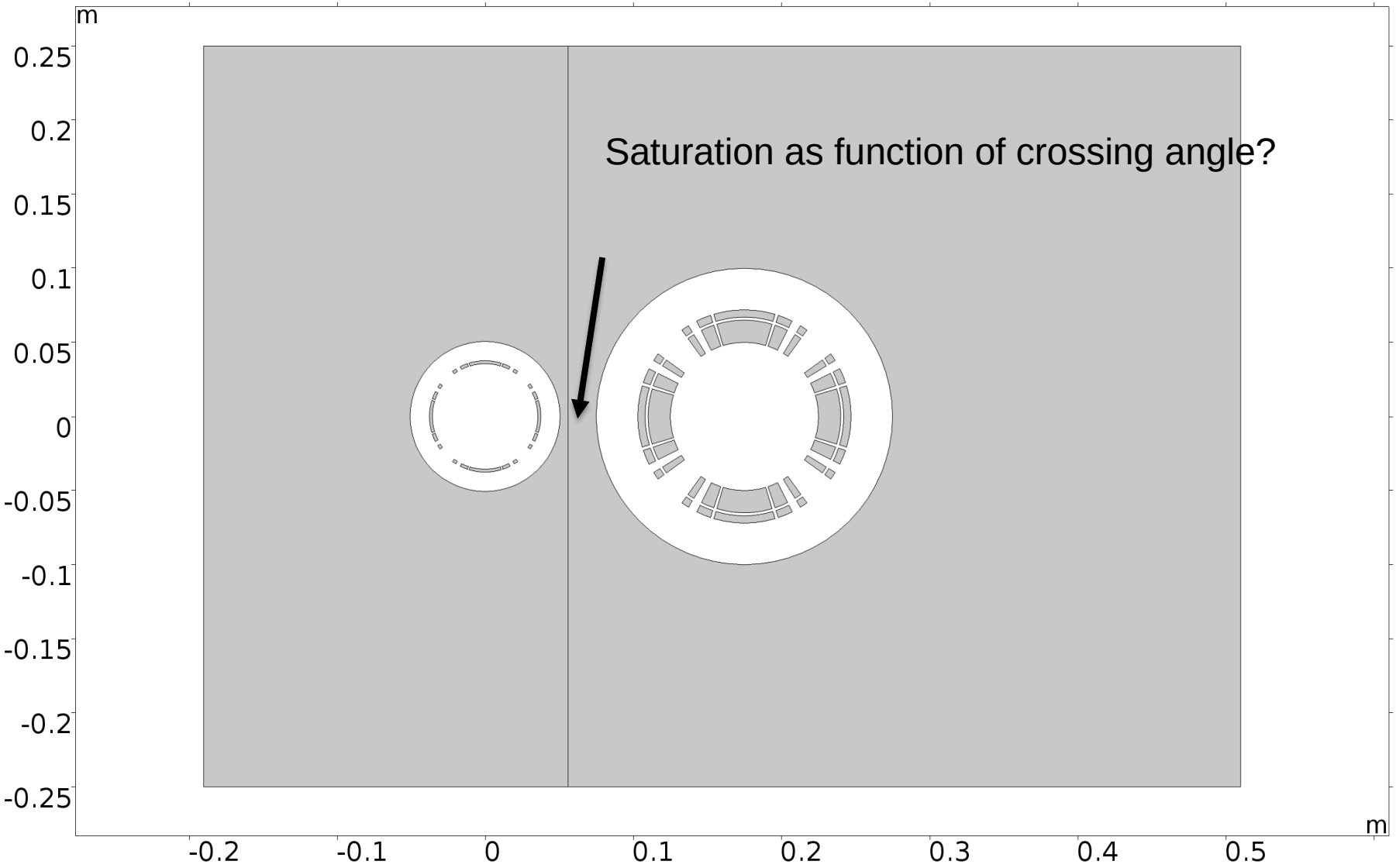
Load Line


PF: 90%
Cu:Sc: 2:1
30% margin
4.2 K
5.1 K
5.9 K
eRHIC_IR_Q1APF
J (A/mm²)
B (T)
1400
1200
1000
800
600
400
200
0
0
2
4
6
8

Summary

- Saturation does not improve fast with crossing angle
- Better: Bob's version 1808-forward-v2
  - Lower gradients
- Hadron magnet looks ok
- Electron magnet included
  - Crosstalk
  - Can be addressed with thin air gap around quad
  - Better iron

Homework


m
0.25
0.2
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
-0.2
-0.25
-0.2
-0.1
0
0.1
0.2
0.3
0.4
0.5
m
Saturation as function of crossing angle?

Saturation vs Crossing Angle