The Houghton College Cyclotron

A Study of Weak Magnetic Focusing

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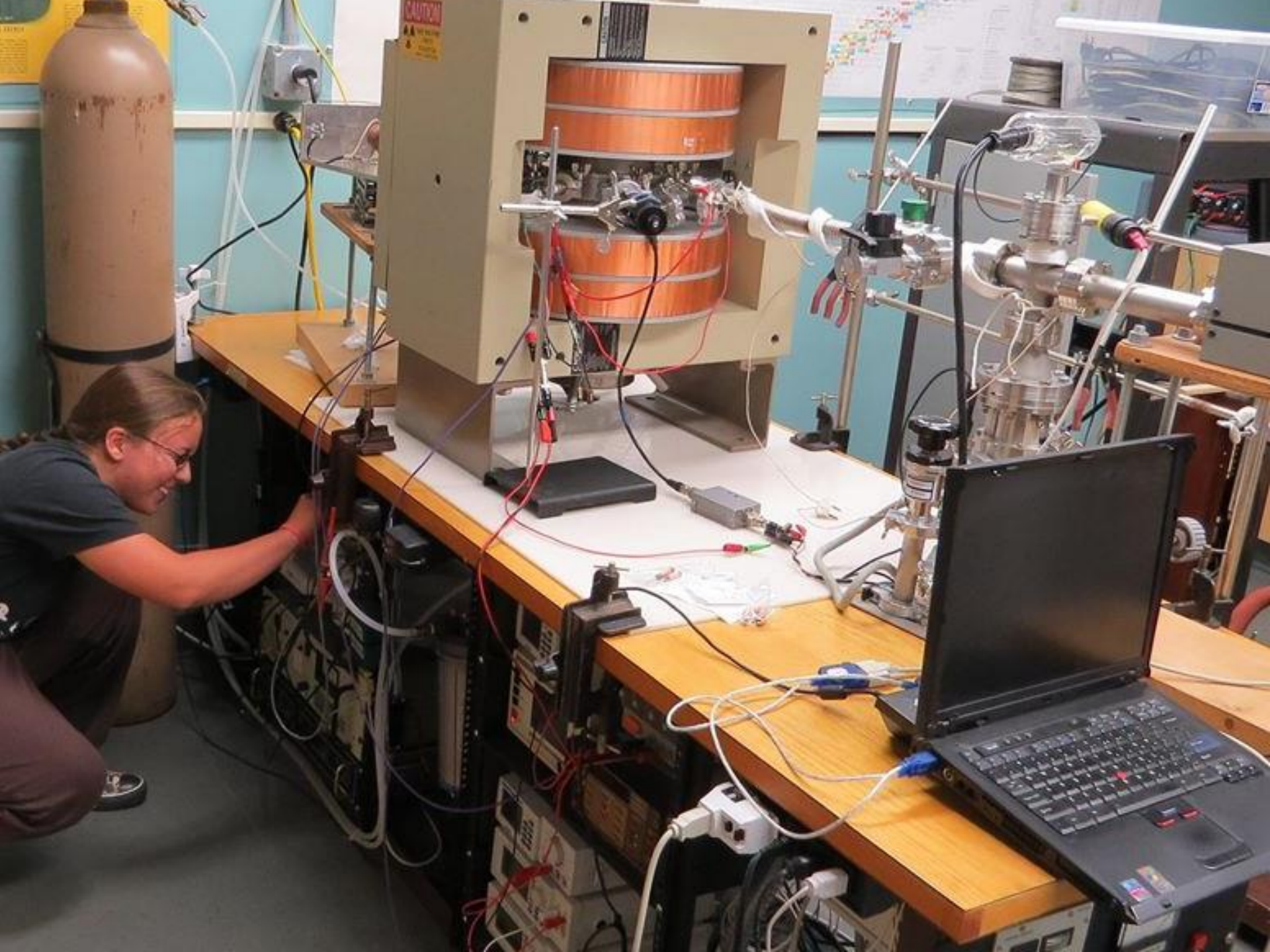
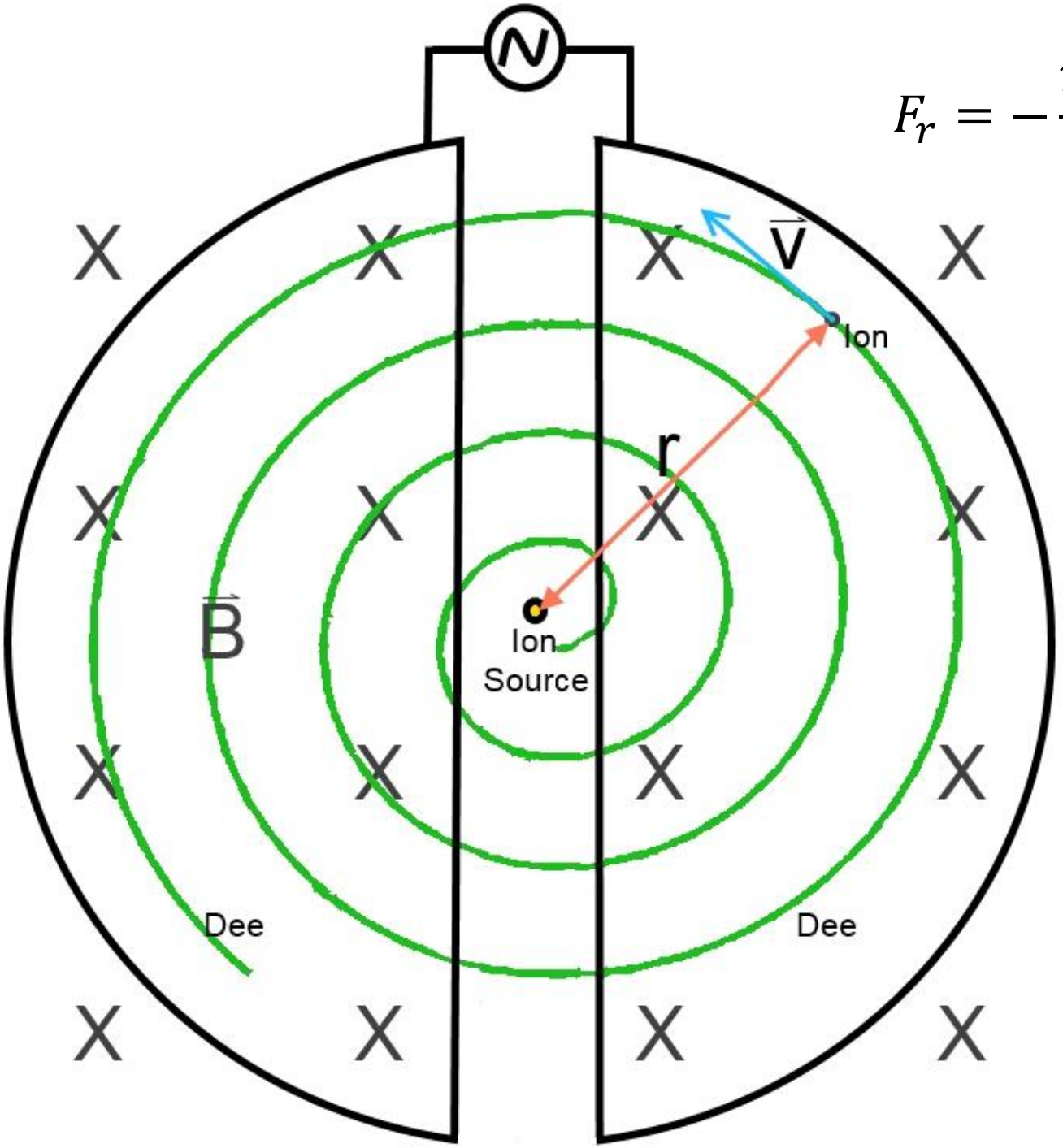
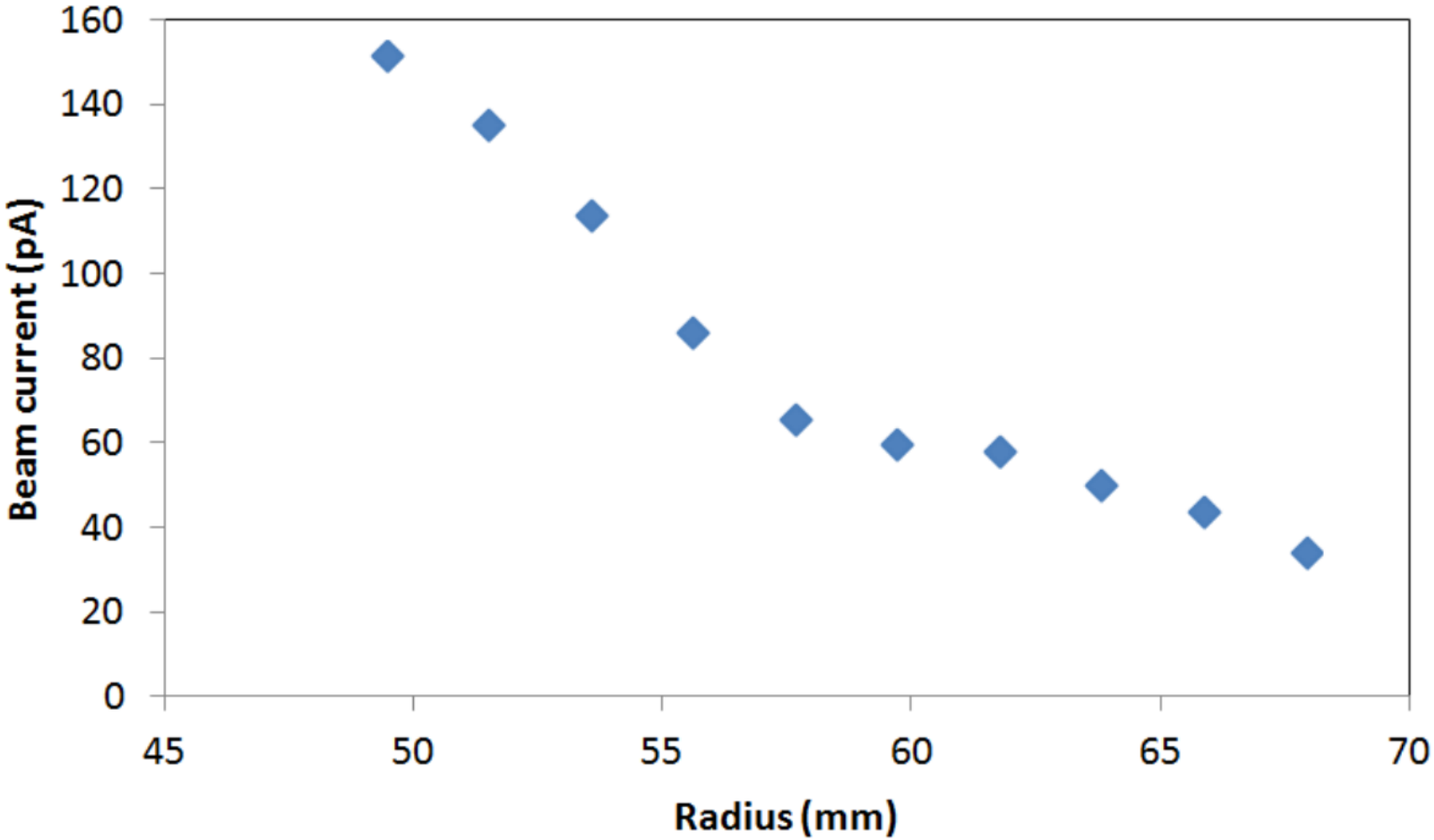


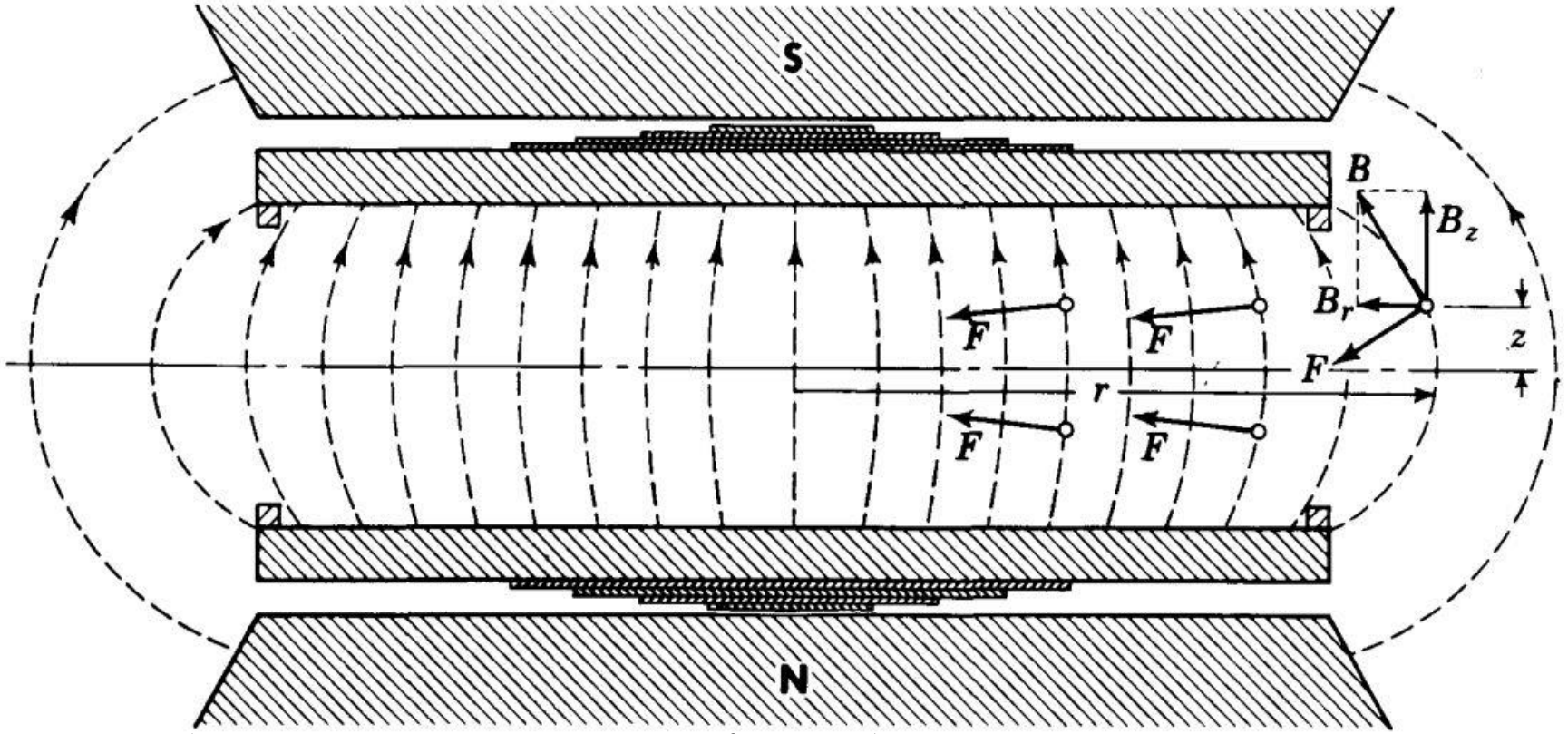
$$F_r = -\frac{mv^2}{r} = -qvB$$





$$T = \frac{q^2 B^2 r^2}{2m}$$

Set to the He+/3 resonance.

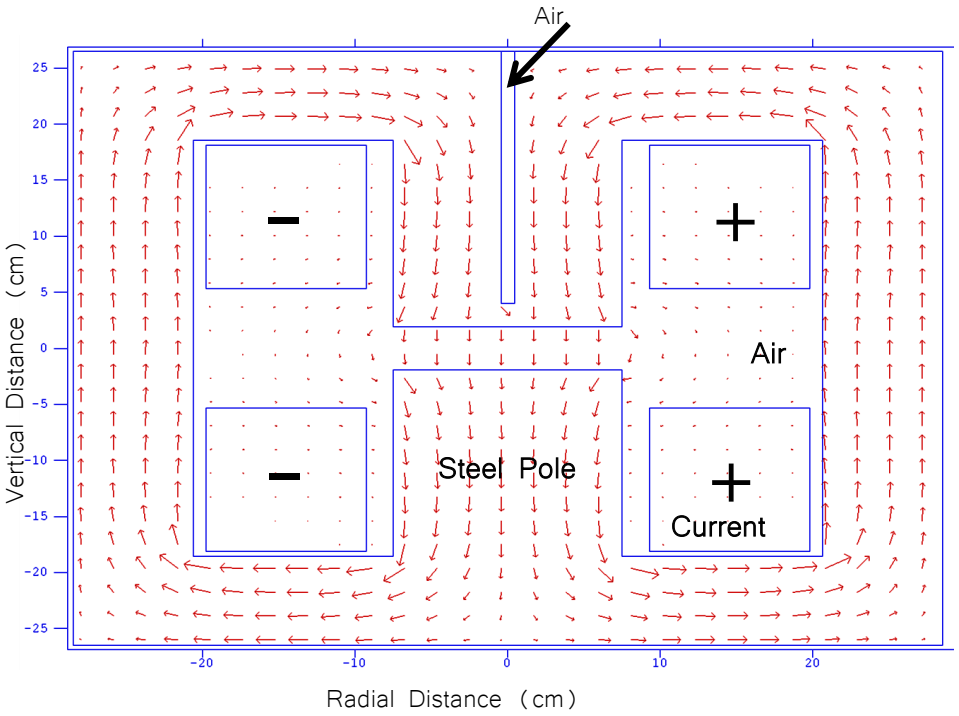


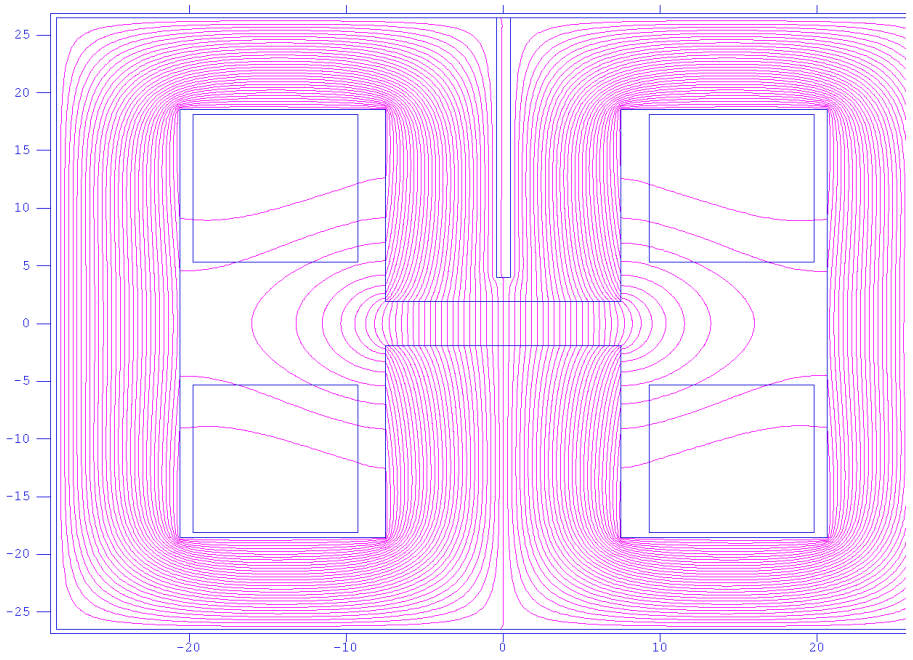
(Livingston and Blewett, *Particle Accelerators*, Fig. 6-7, pg 144).

$$\boldsymbol{F} = q(\boldsymbol{E} + \boldsymbol{v} \times \boldsymbol{B})$$

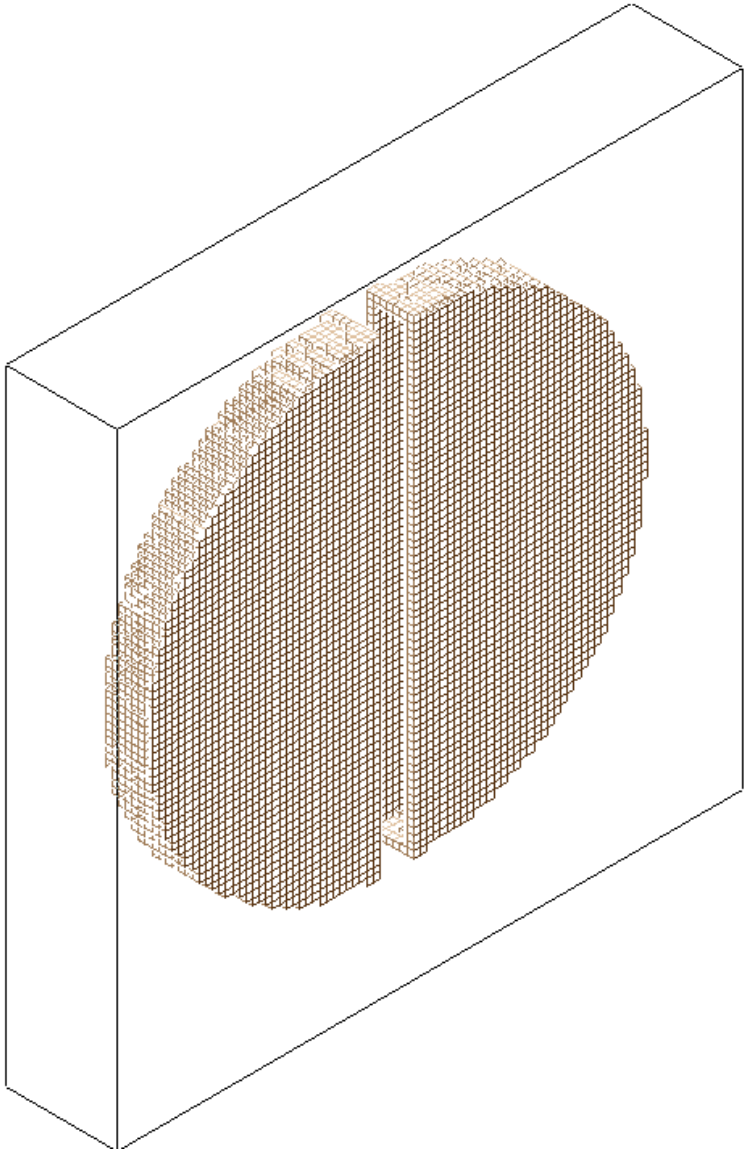
Linearly decrease B_z by 2% from the middle to the outer edge.

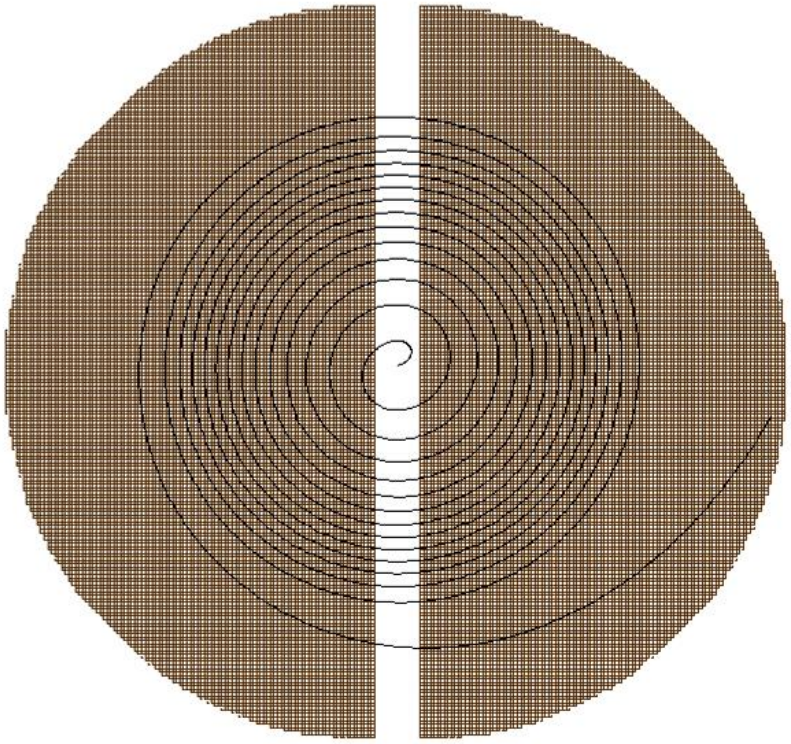
Poisson Superfish (LANL)



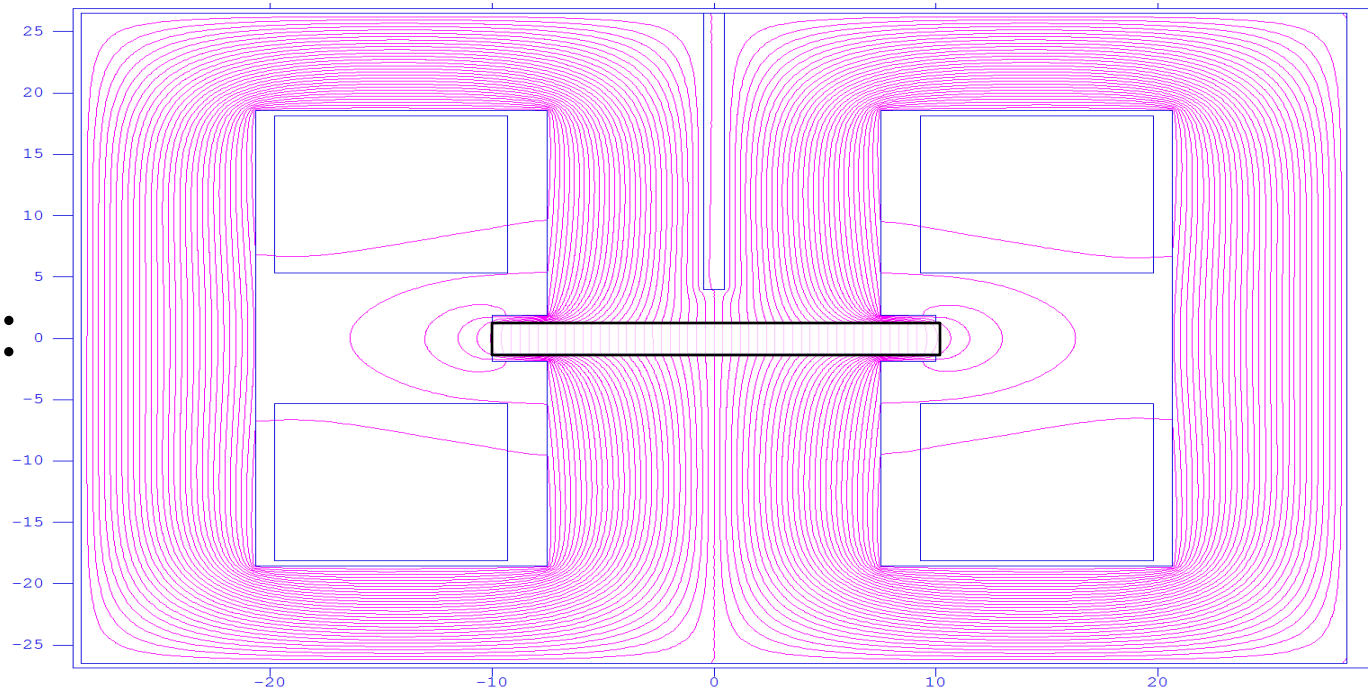


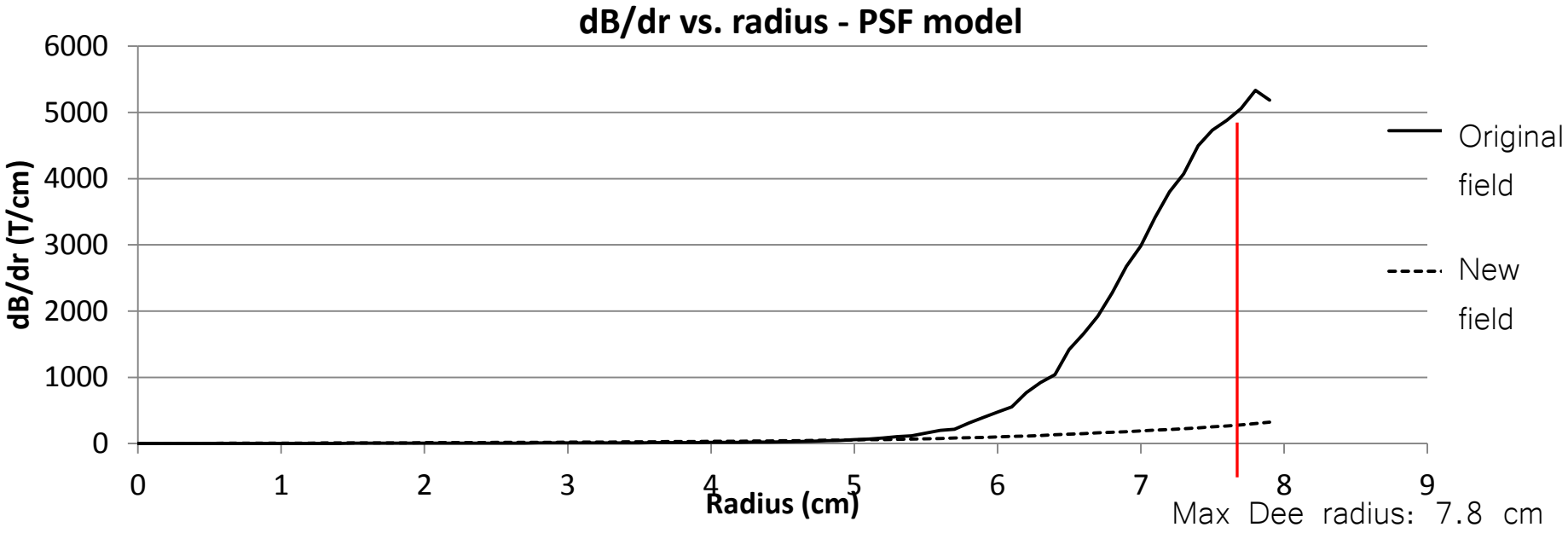
Simion (SIS)

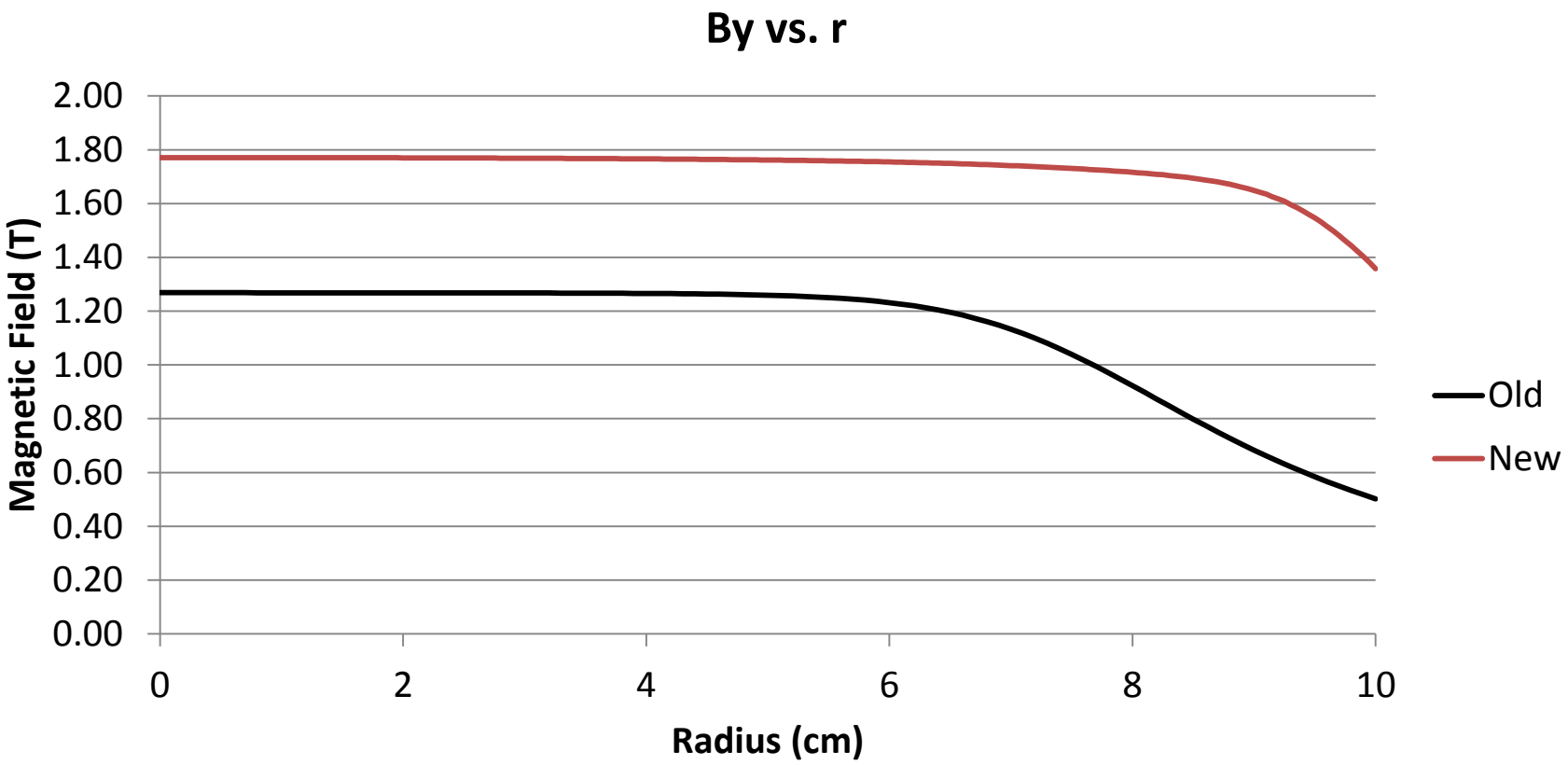




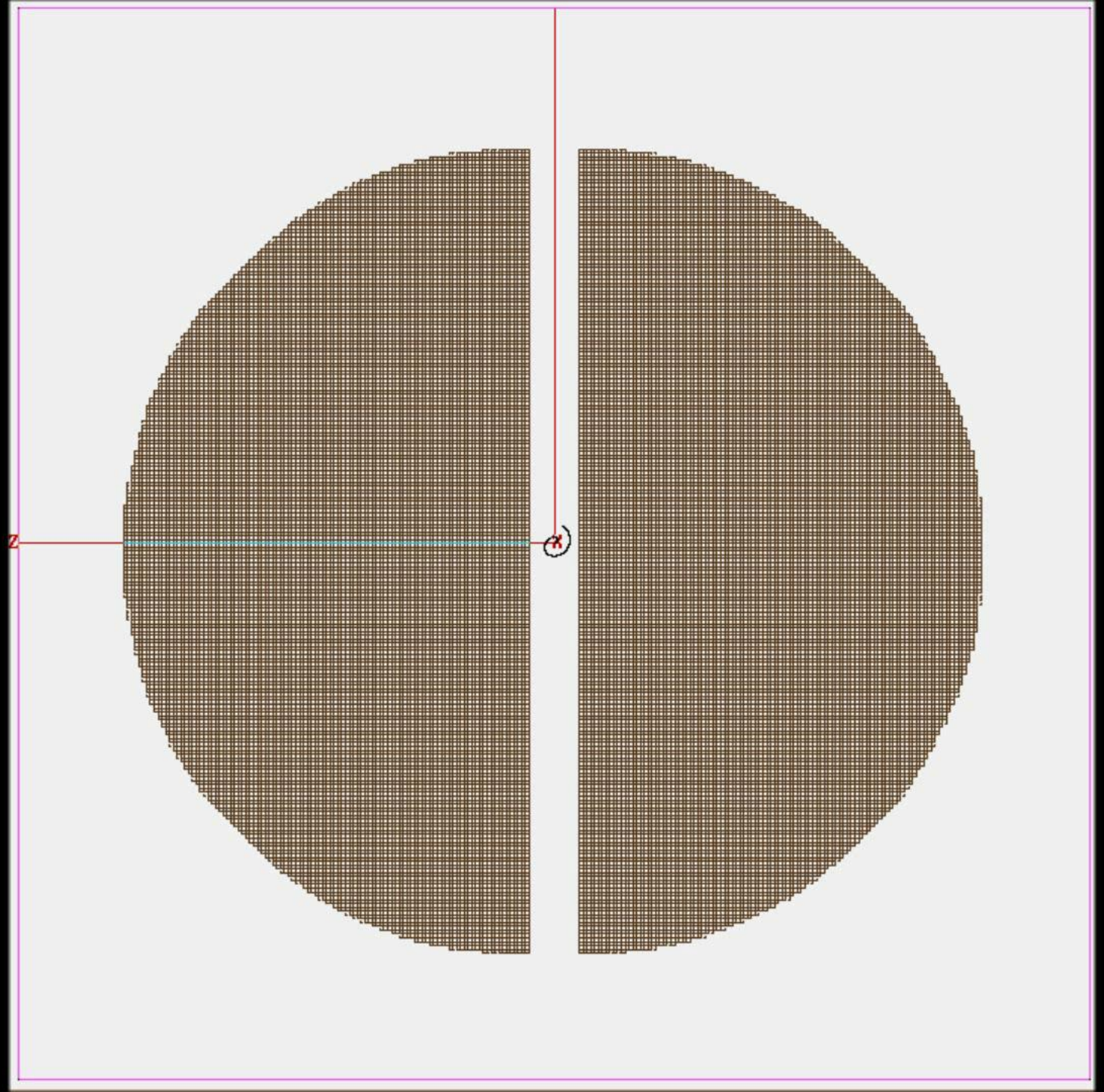
New Design:


25
20
15
10
5
0
-5
-10
-15
-20
-25
-20
-10
0
10
20

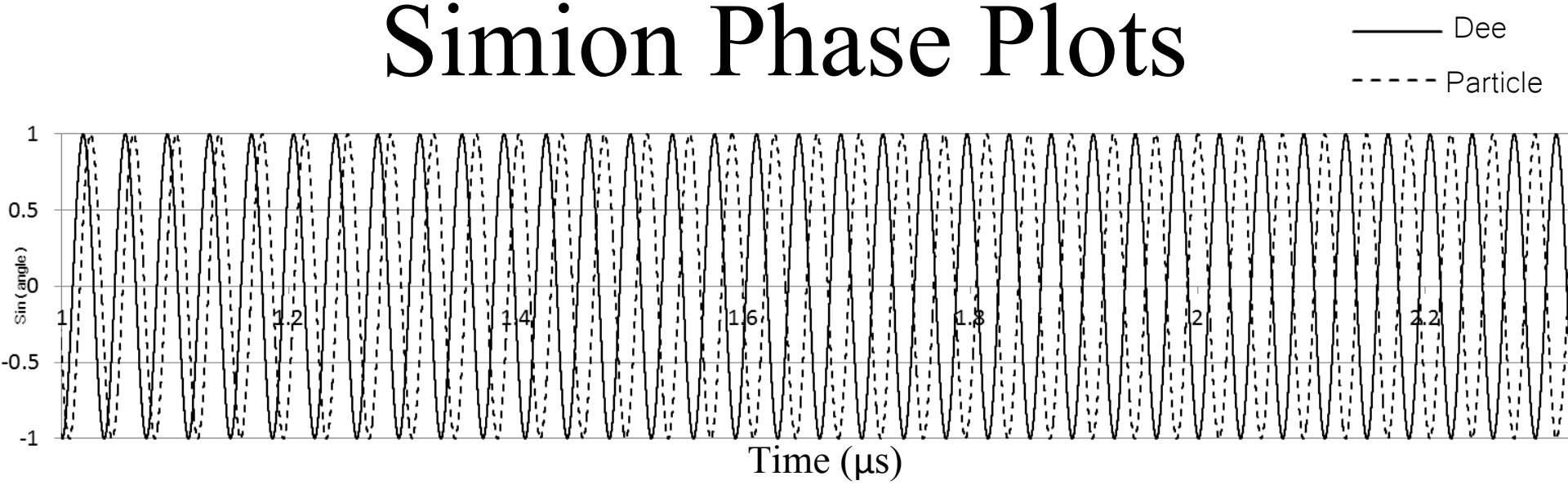

dB/dr vs. radius - PSF model
dB/dr (T/cm)
6000
5000
4000
3000
2000
1000
0
0
1
2
3
4
5
6
7
8
9
Radius (cm)
Original field
New field
Max Dee radius: 7.8 cm

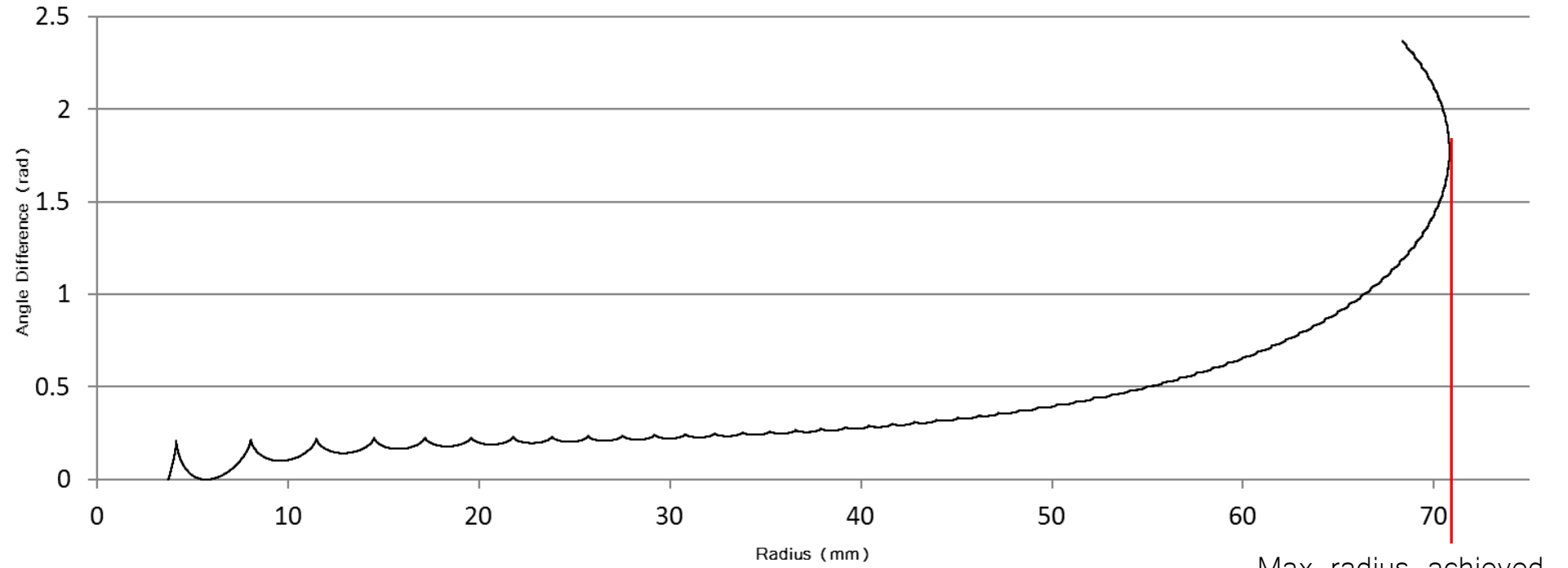


$$T = \frac{q^2 B^2 r^2}{2m}$$

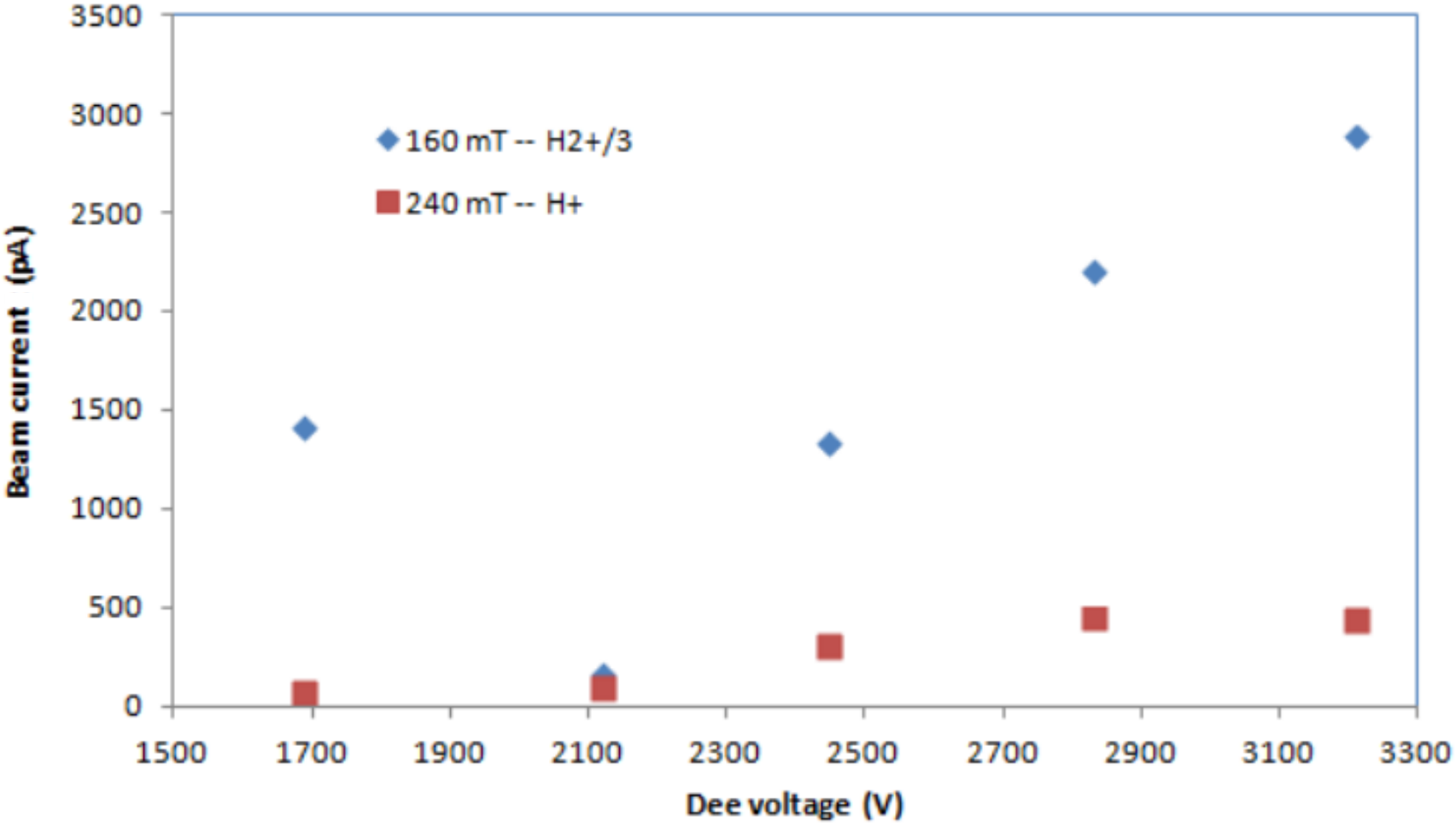

Z
X

Simion Phase Plots





Max radius achieved


3500
3000
2500
2000
1500
1000
500
0
Beam current (pA)
160 mT -- H2+/3
240 mT -- H+
1500
1700
1900
2100
2300
2500
2700
2900
3100
3300
Dee voltage (V)

What we really need: increased Dee voltage.

What we can do realistically: optimize parameters to get as close to the maximum radius as possible.

Questions?