Design and Simulation of Strong Focusing Pole Tips for the Houghton University Cyclotron

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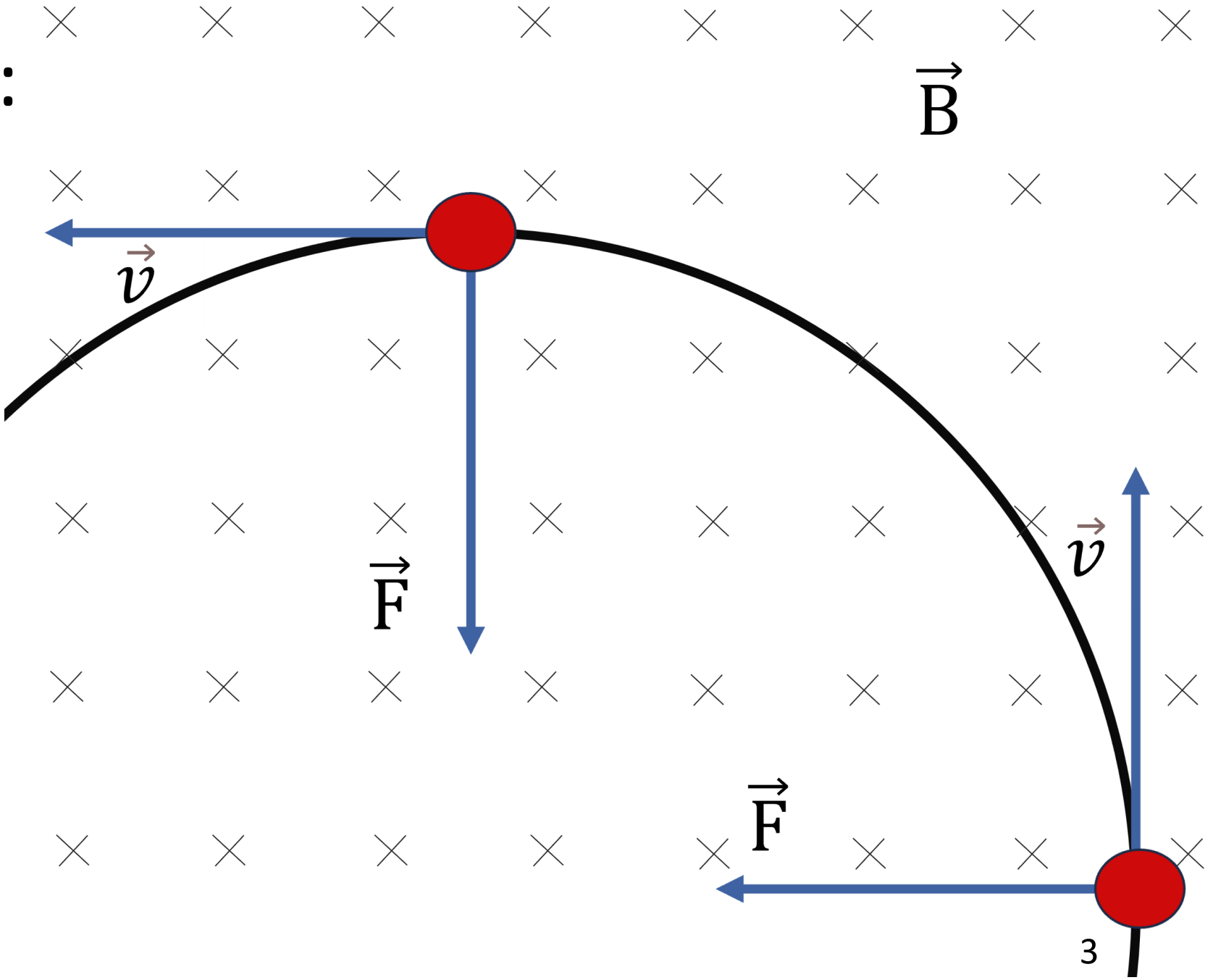
Motivation

It would be of great scientific interest… to have a supply of electrons and atoms of matter in general… with great individual energy. This would allow for investigation not only into the constitution and stability of atomic nuclei but in many other directions.
-Ernest Rutherford (1927)

Cyclotron Basics: Lorentz Force

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



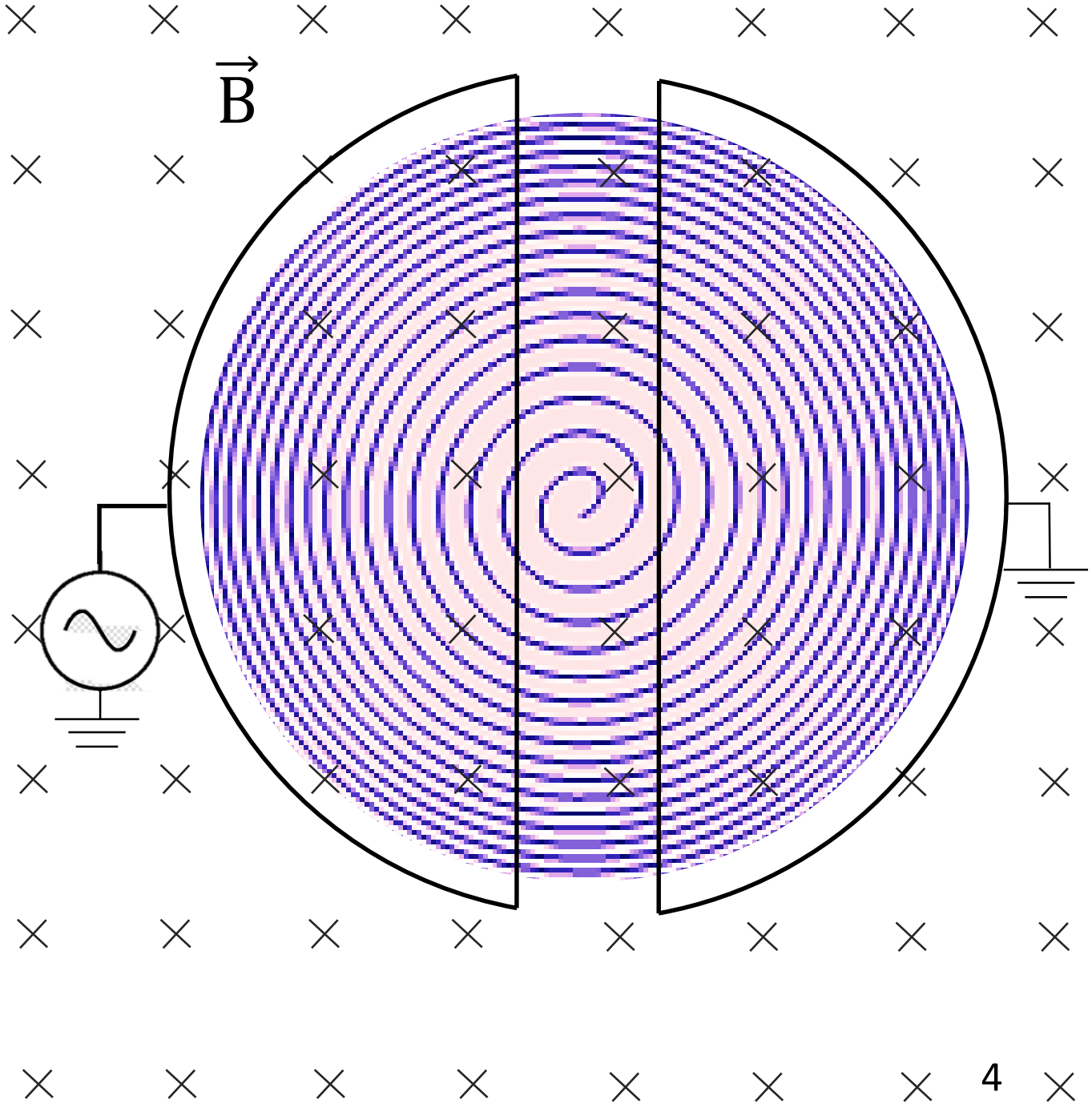
Cyclotron Basics: Lorentz Force

$$\vec{\mathrm{F}} = \mathrm{q}\left(\vec{E} + \vec{v} \times \vec{\mathrm{B}}\right)$$

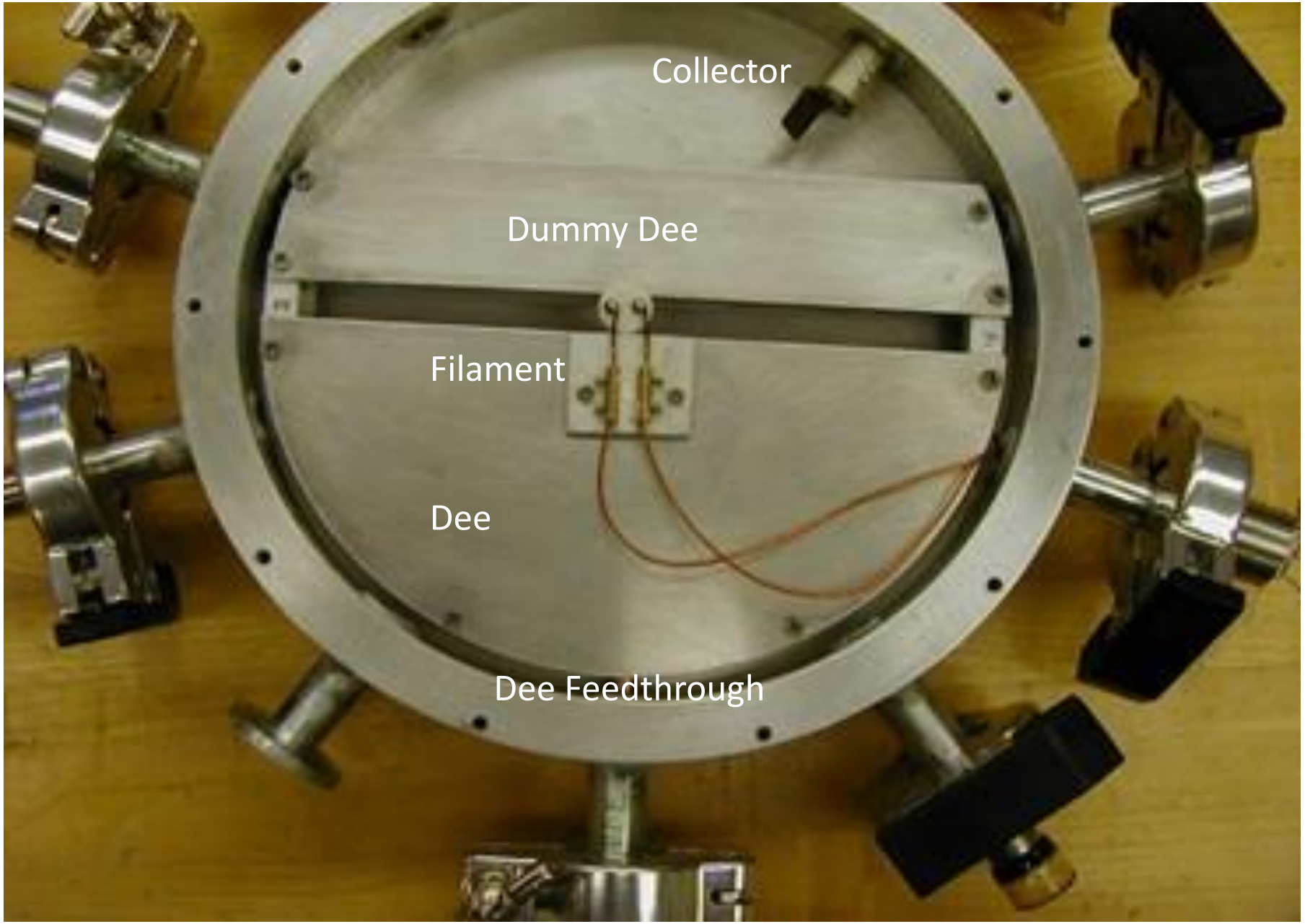
$$\vec{F} = q\left(\vec{v} \times \vec{B}\right) = qvB(-\hat{r}) = m\vec{a}$$

$$\vec{F} = qvB(-\hat{r}) = \frac{mv^2}{r}(-\hat{r})$$

$$f = \frac{v}{2\pi r} = \frac{qB}{2\pi m}$$



Cyclotron Chamber



Houghton's Cyclotron

symmetry topics

The do-it-yourself cyclotron

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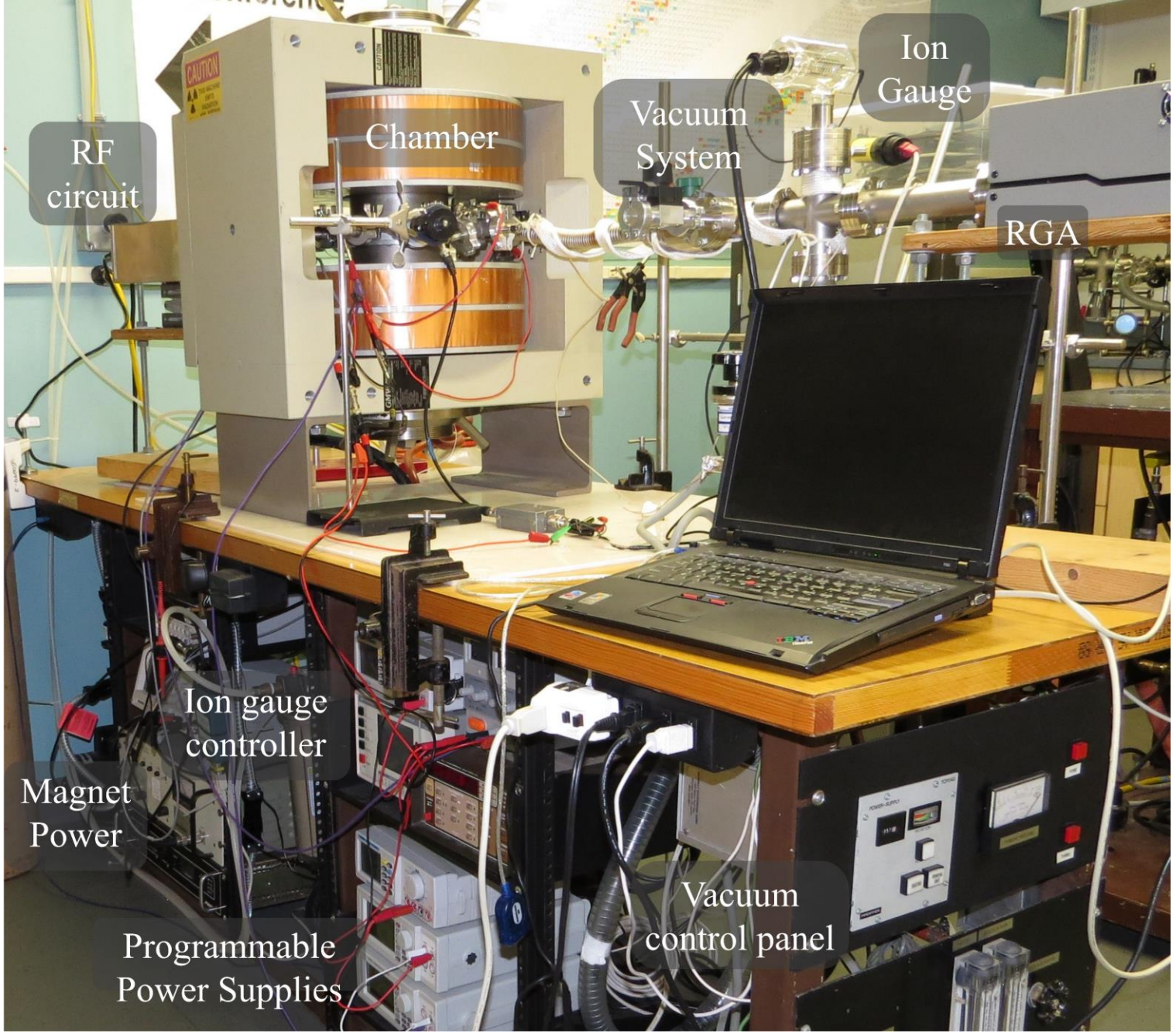
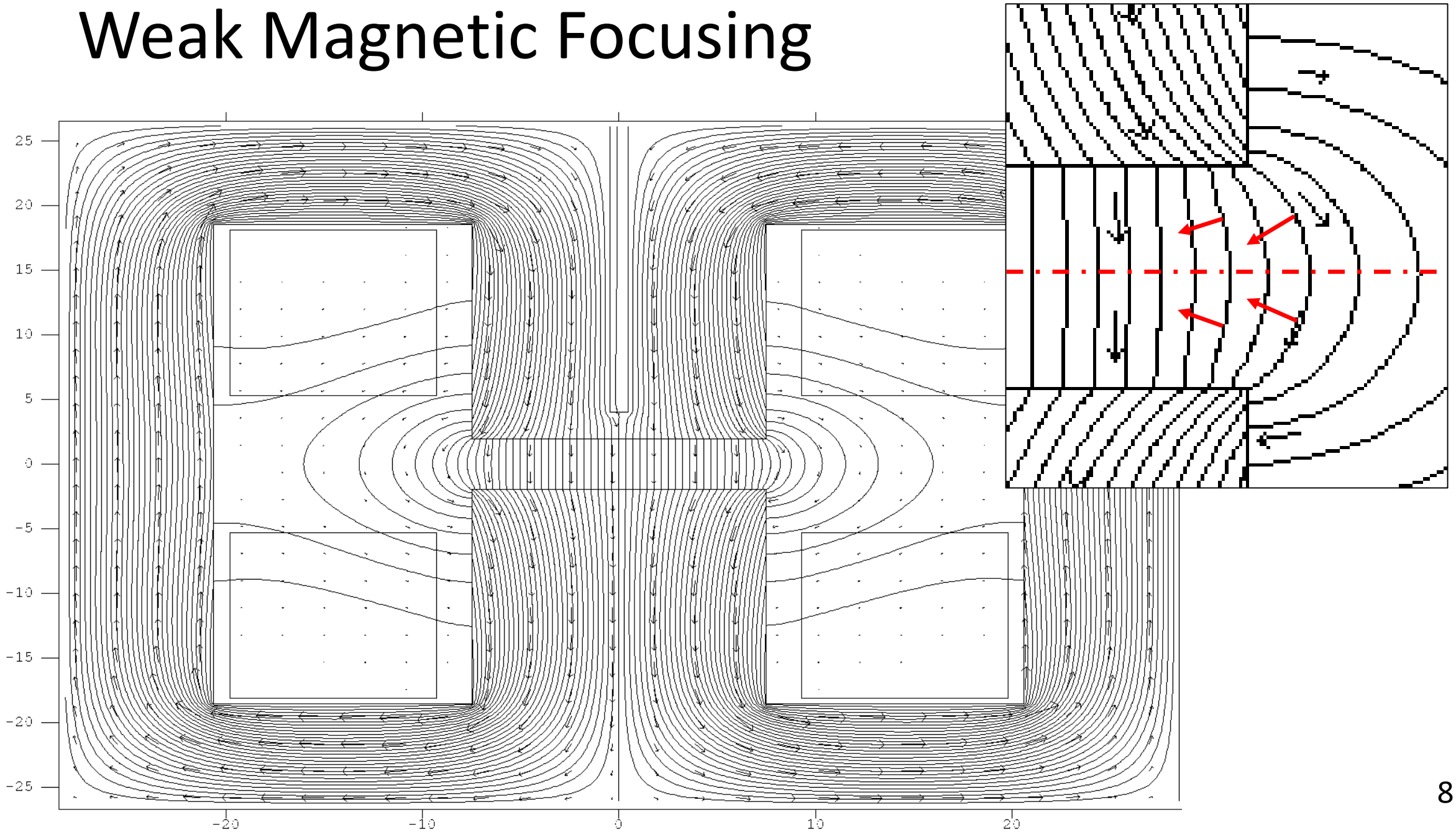
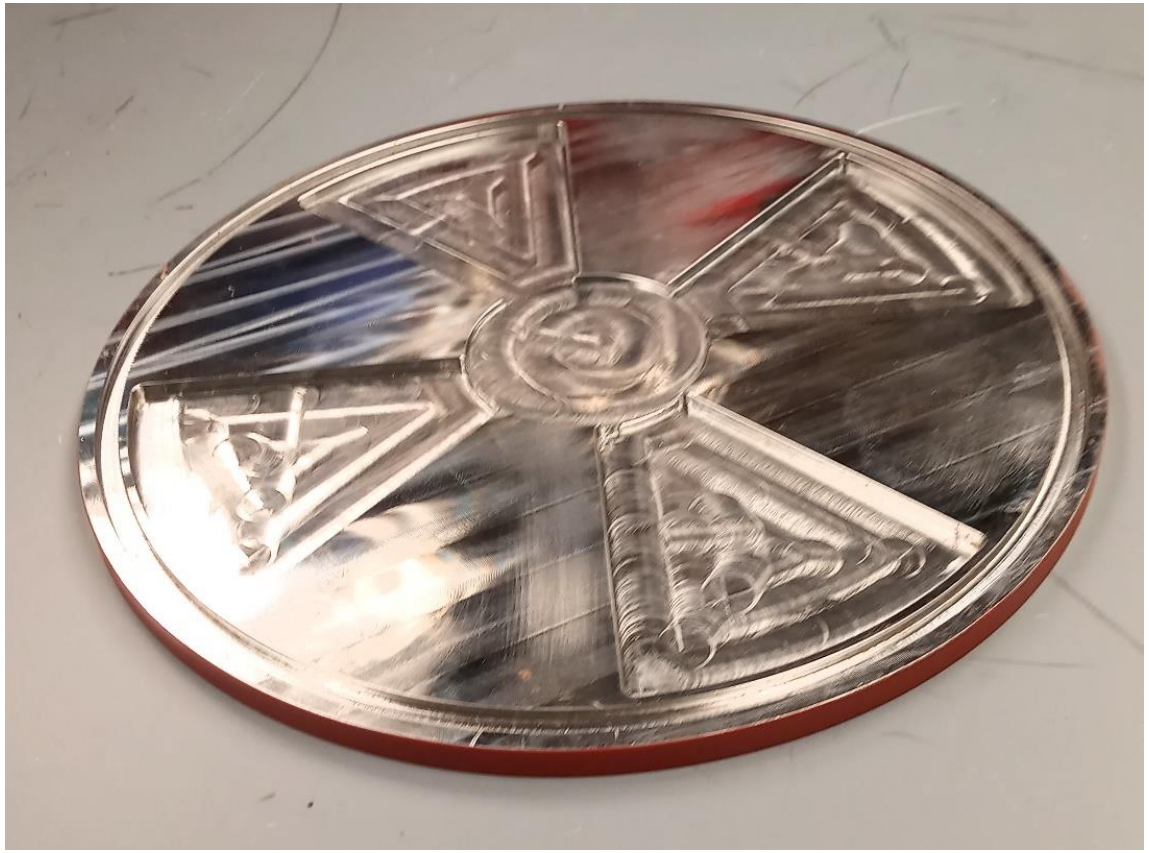
Houghton's Cyclotron

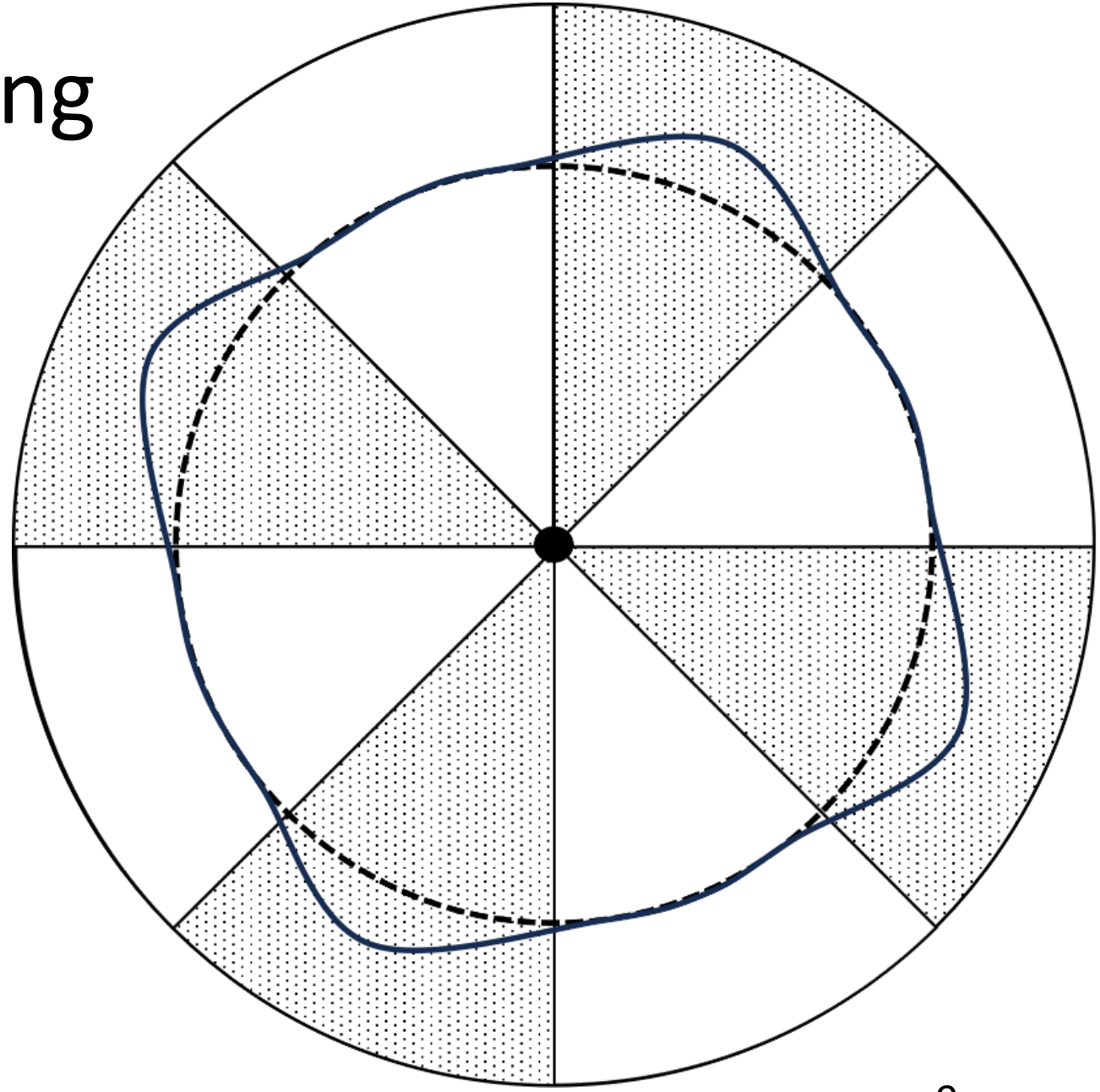


Weak Magnetic Focusing

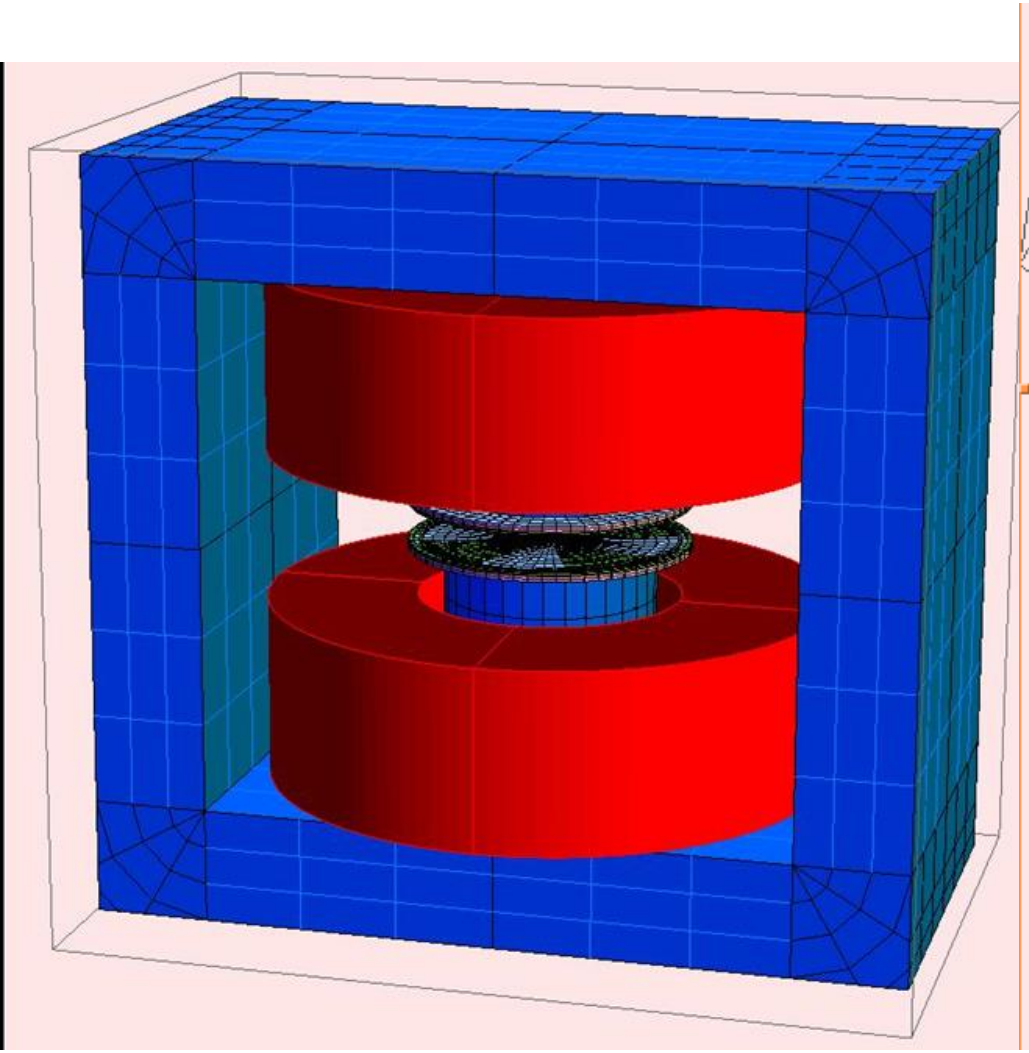


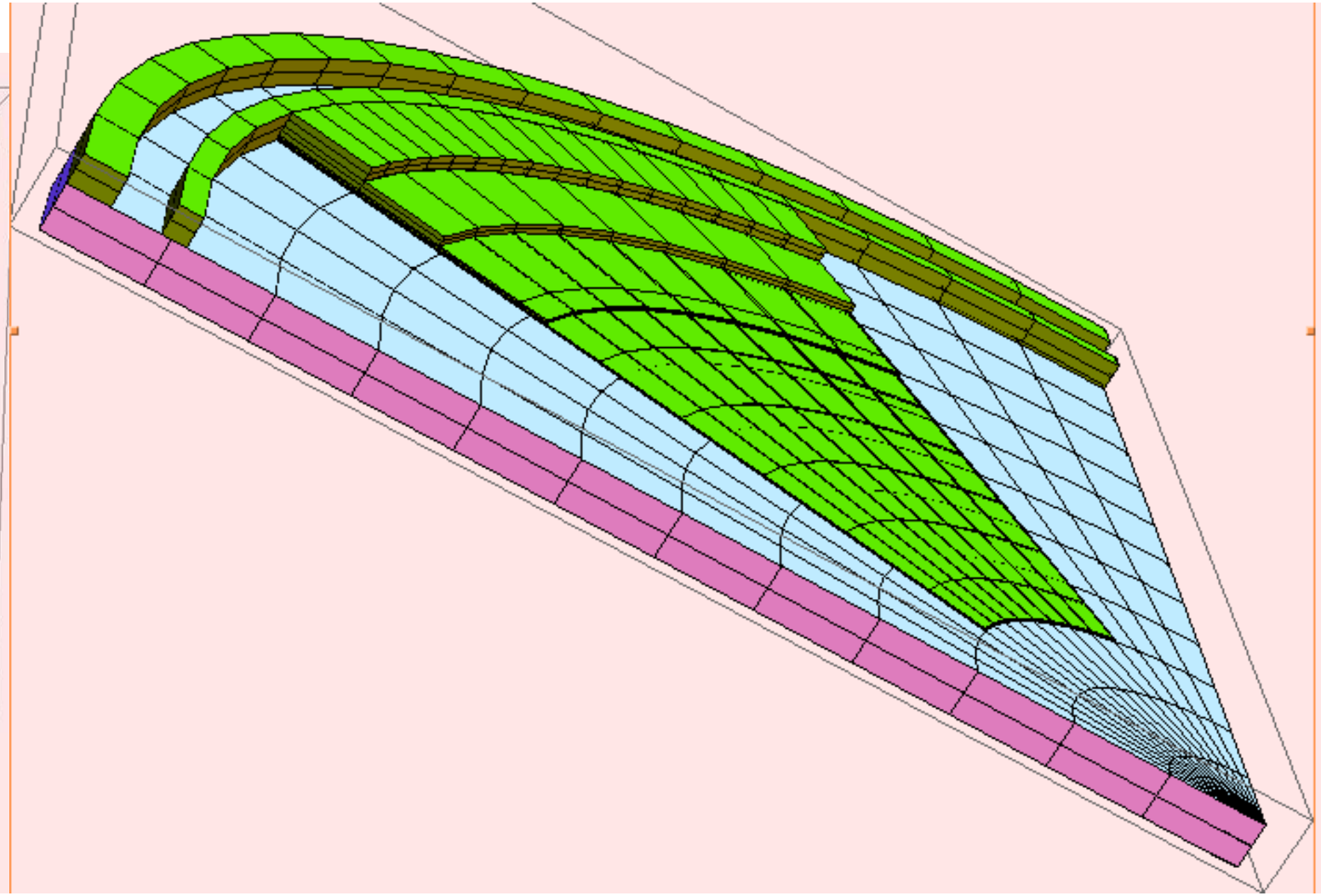
Strong Magnetic Focusing



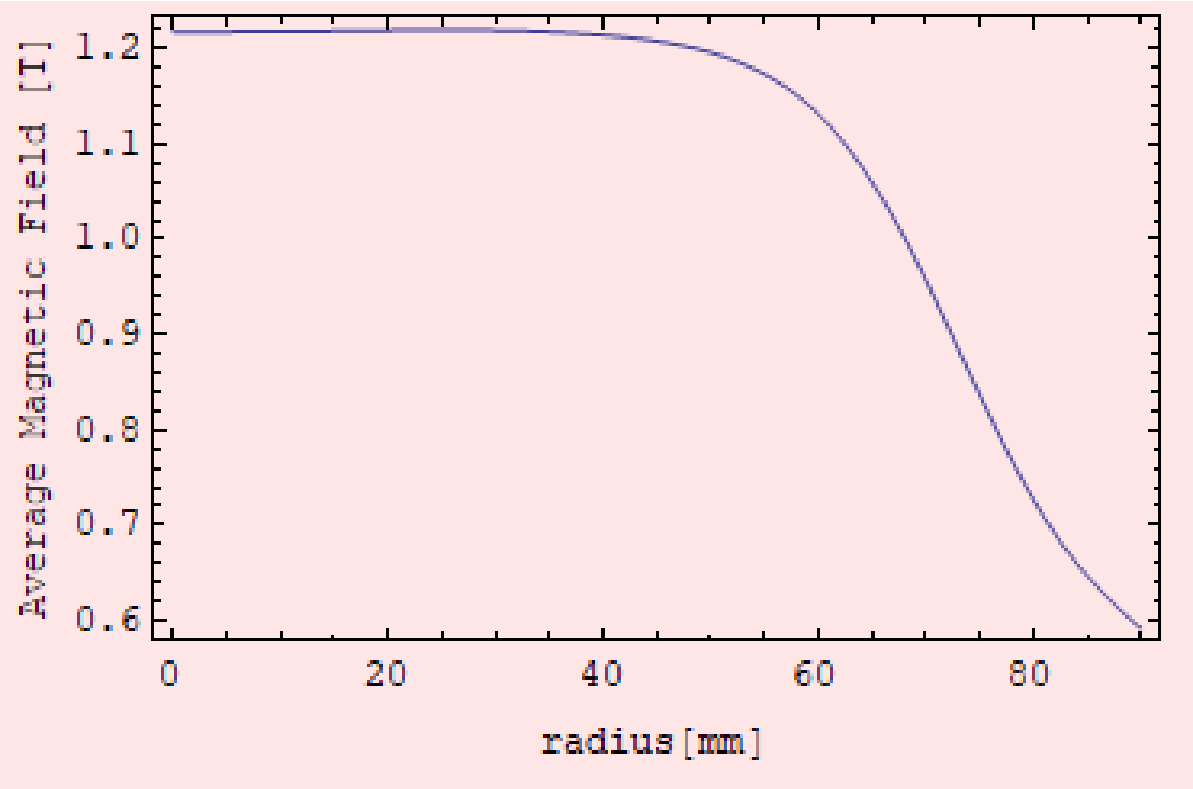


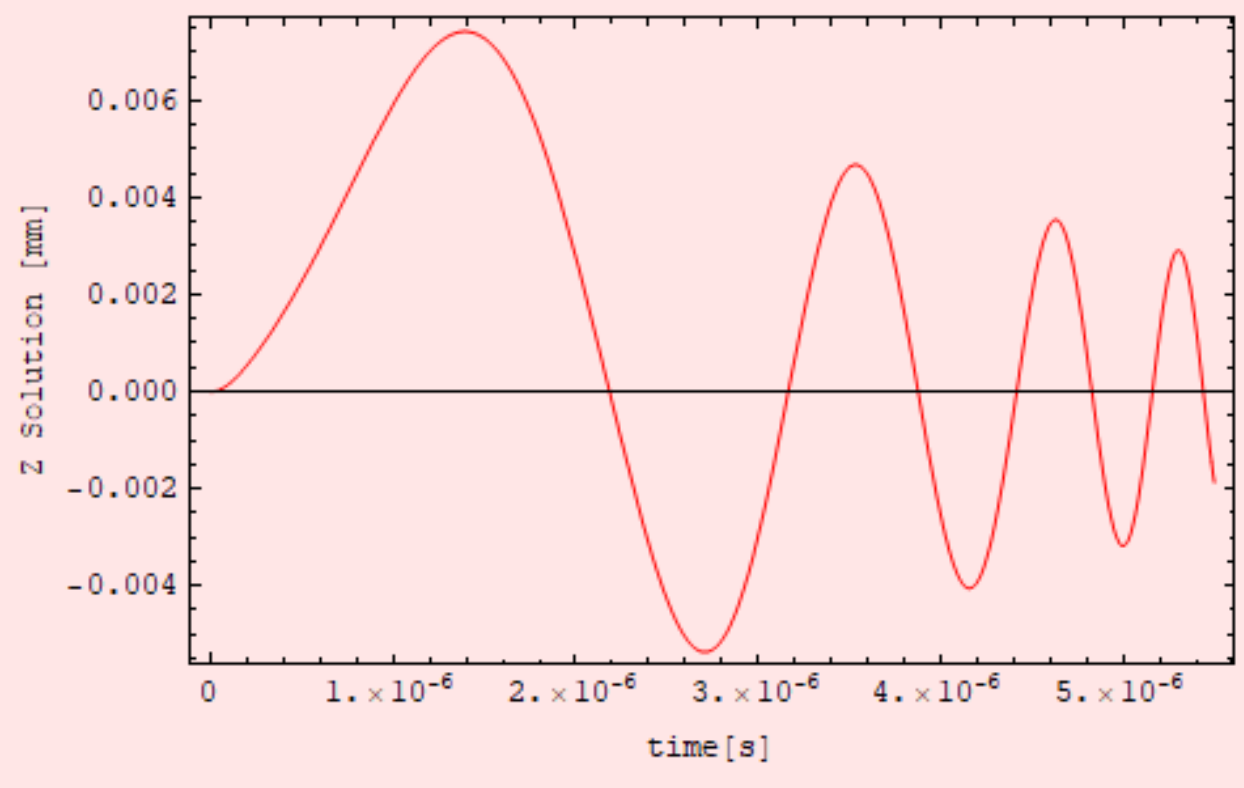
Simulating Strong Focusing



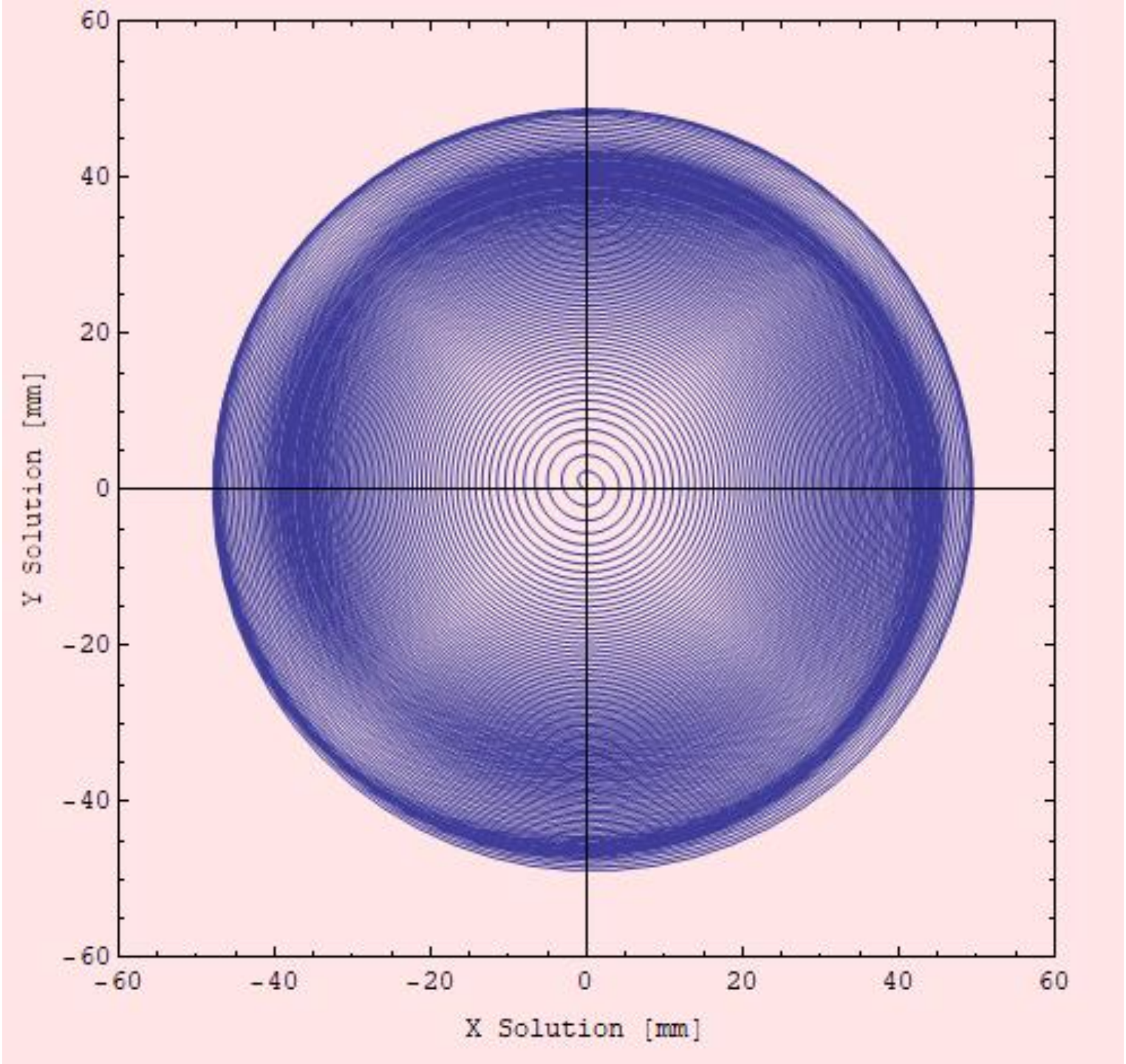


Simulating Strong Focusing





Simulated Orbit



Sources

- https://www.symmetrymagazine.org/article/august-2010/do-it-yourself-cyclotron?language_content_entity=und
- https://www.wired.com/2015/05/table-top-physics/