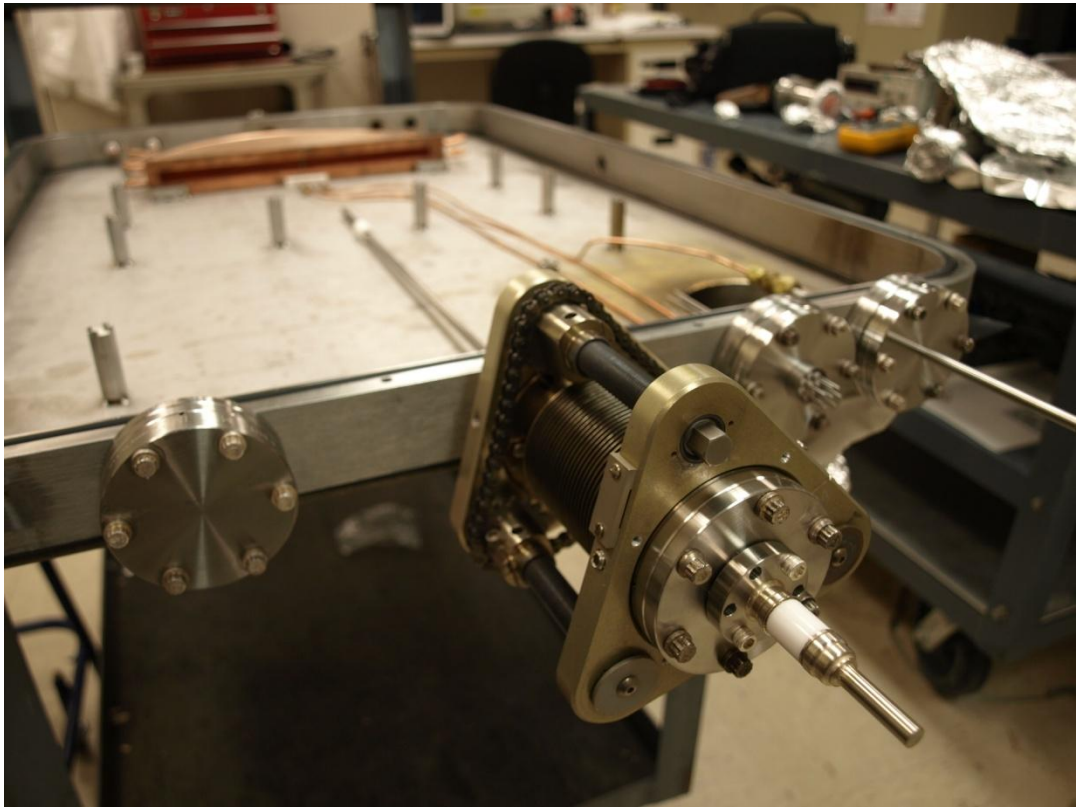


“The Cyclotron Kids”

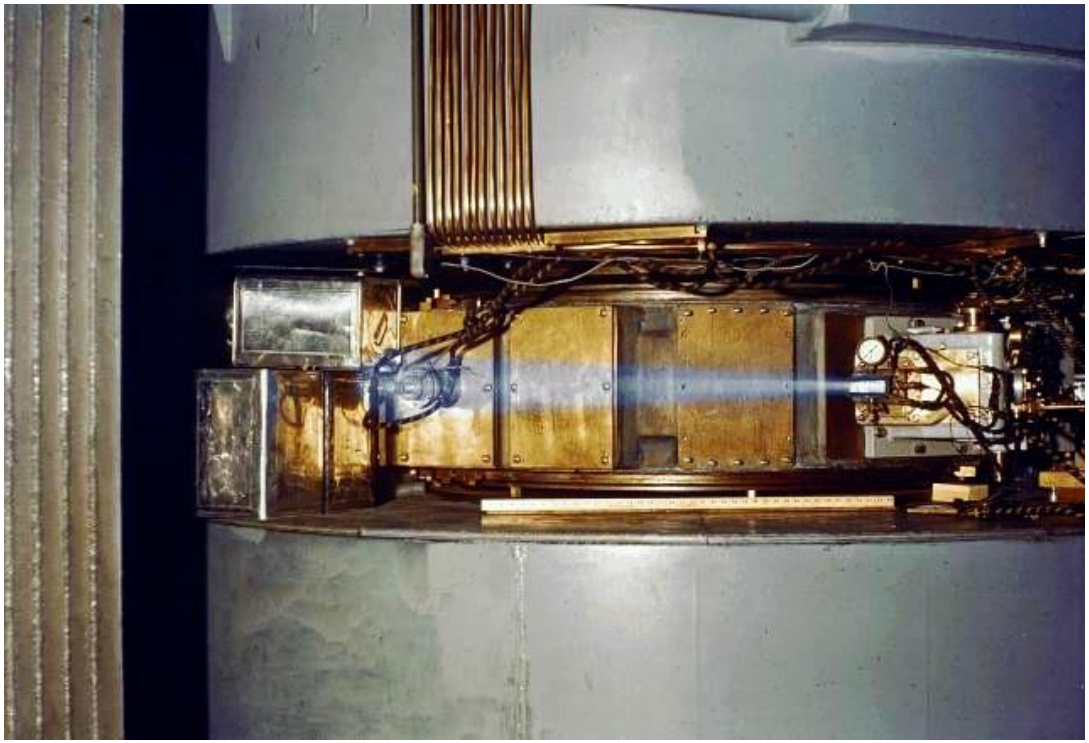
Peter Heuer
University of Rochester, Class of ‘14

Jefferson Lab

What is a Cyclotron?

- A *cyclical* particle accelerator

- Uses a large magnet and high voltage electrodes to accelerate charged particles in a relatively compact space

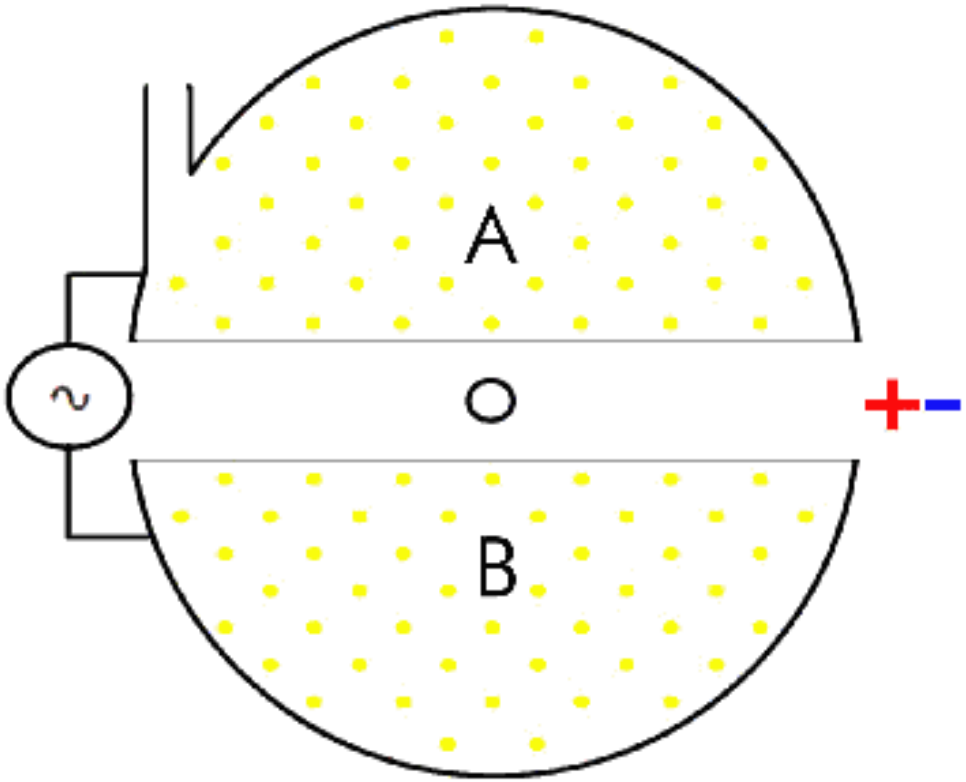


Early cyclotron venting beam into air

Jefferson Lab

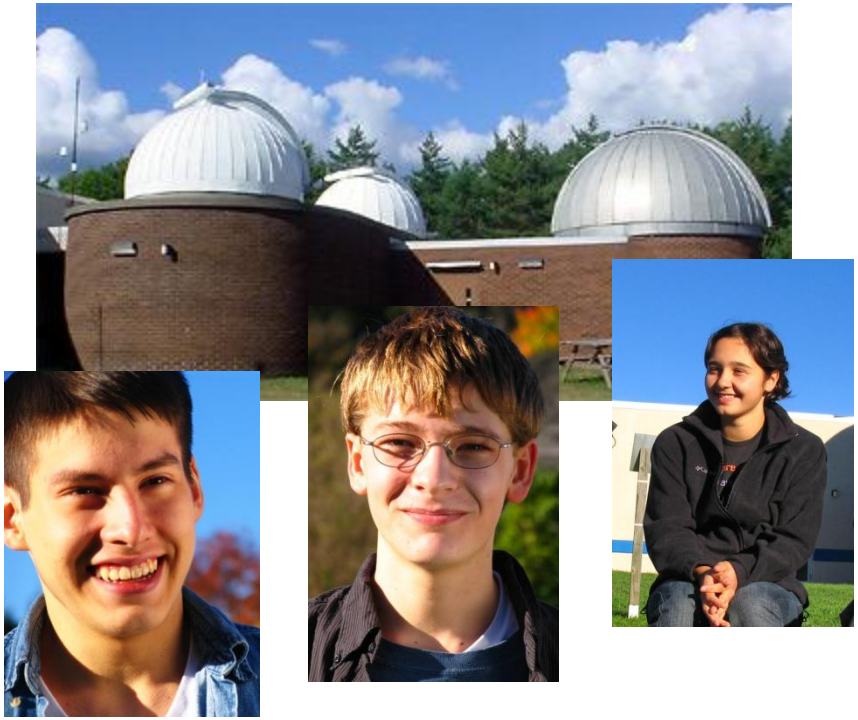
How does a Cyclotron work?

- Ions emitted at the center
- Electrodes push and pulls ions across gap
- Magnetic field forces particles to follow circular paths
- Beam radius increases with energy

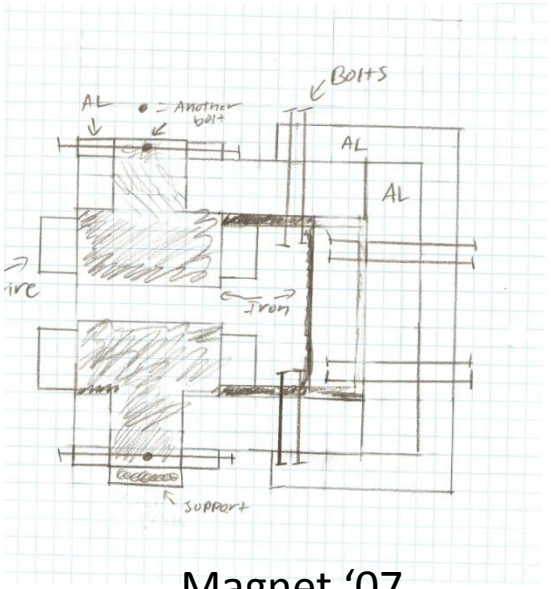


Jefferson Lab

How did this project happen?



Fall 2006: Idea arises out of a conversation during a meteor shower at Kopernik Observatory

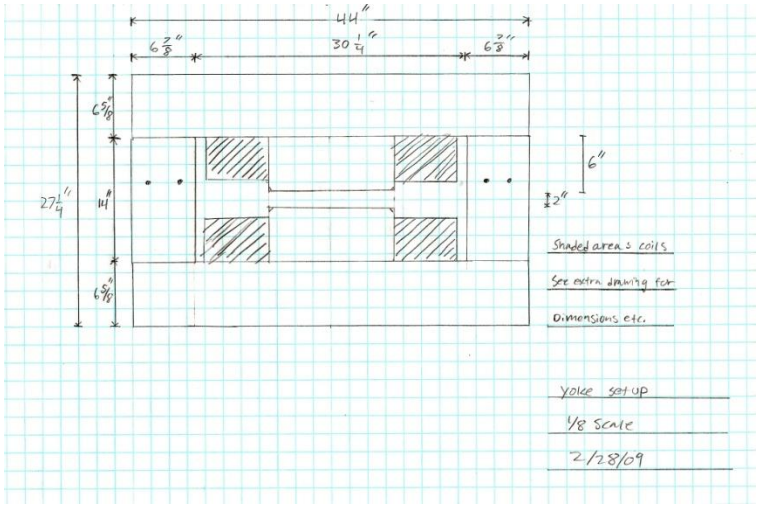


Magnet ‘07

Spring 2007: We start working on our first designs, but have no money to work with

Jefferson Lab

How did this project happen?



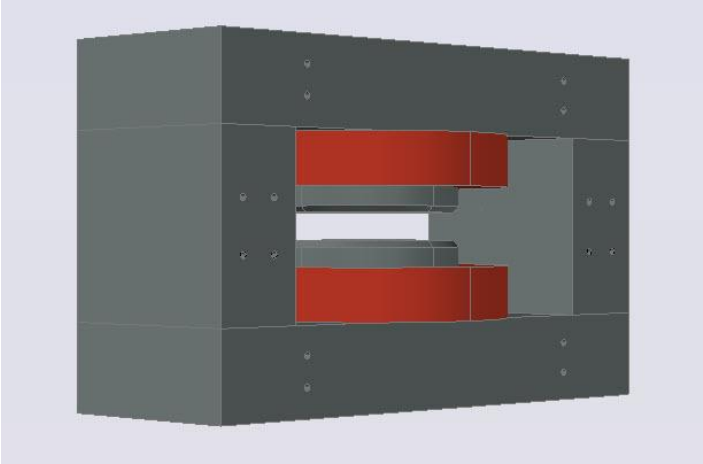
Magnet '08

Spring 2008: A letter sent out to many scientific leaders asking for help finds Dr. Hutton at Jlab; he offers us funding!

Fall 2008: We first visit JLab, double the size of our accelerator, and refine our design

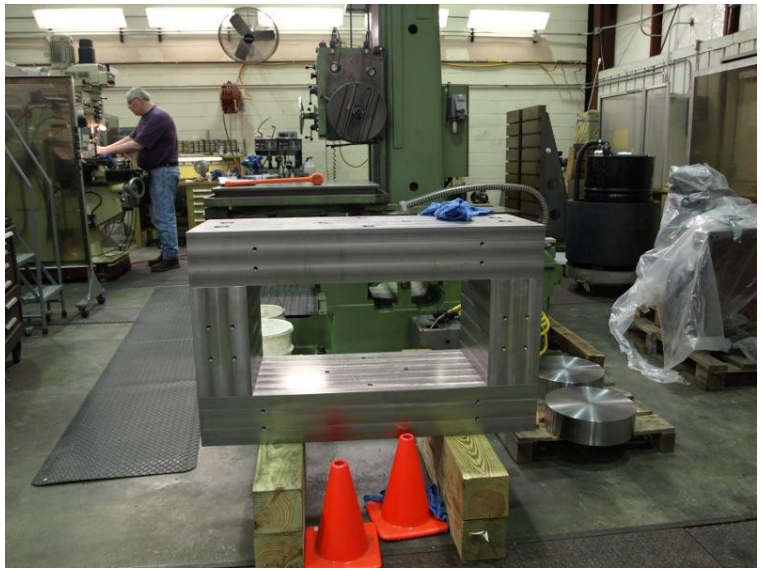
Jefferson Lab

How did this project happen?



Magnet ‘09

Spring/Summer 2009 : We further refine our design with more visits to Jlab.

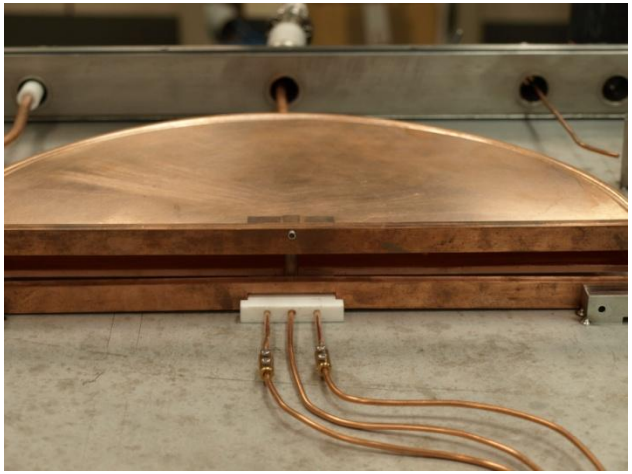


Magnet ‘10

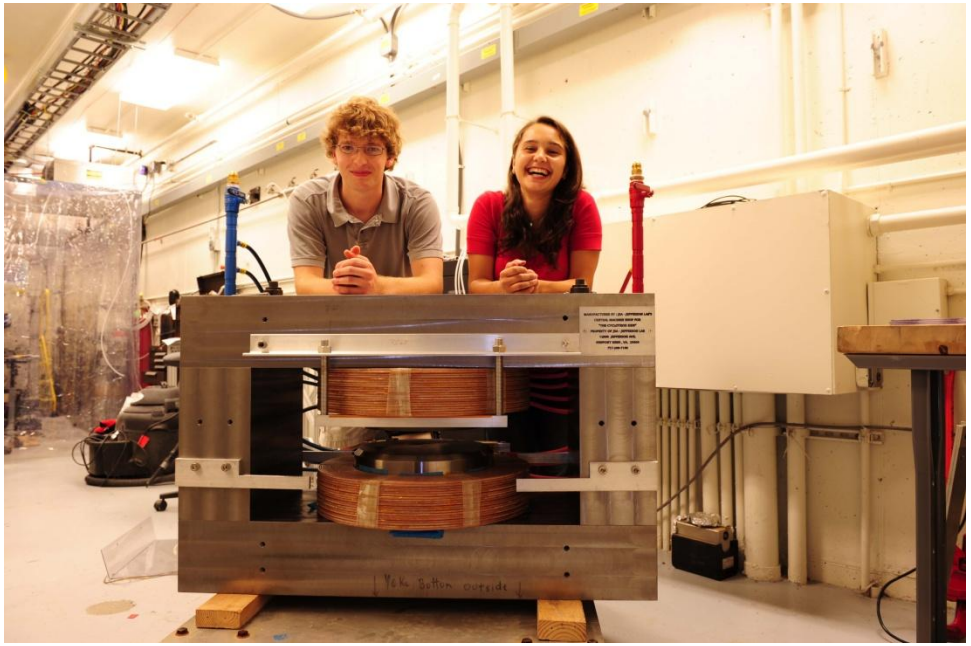
Spring 2010: Our design is finished! Our first parts are made at JLab

Jefferson Lab

How did this project happen?



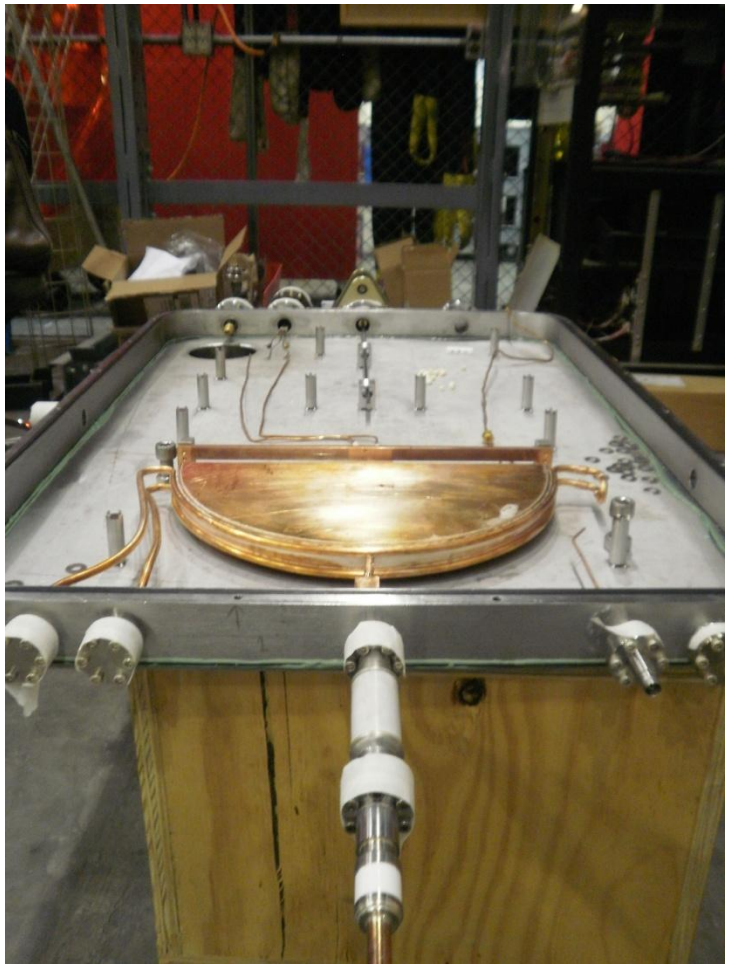
Summer 2010: LOTS of parts are built!



Magnet ‘10

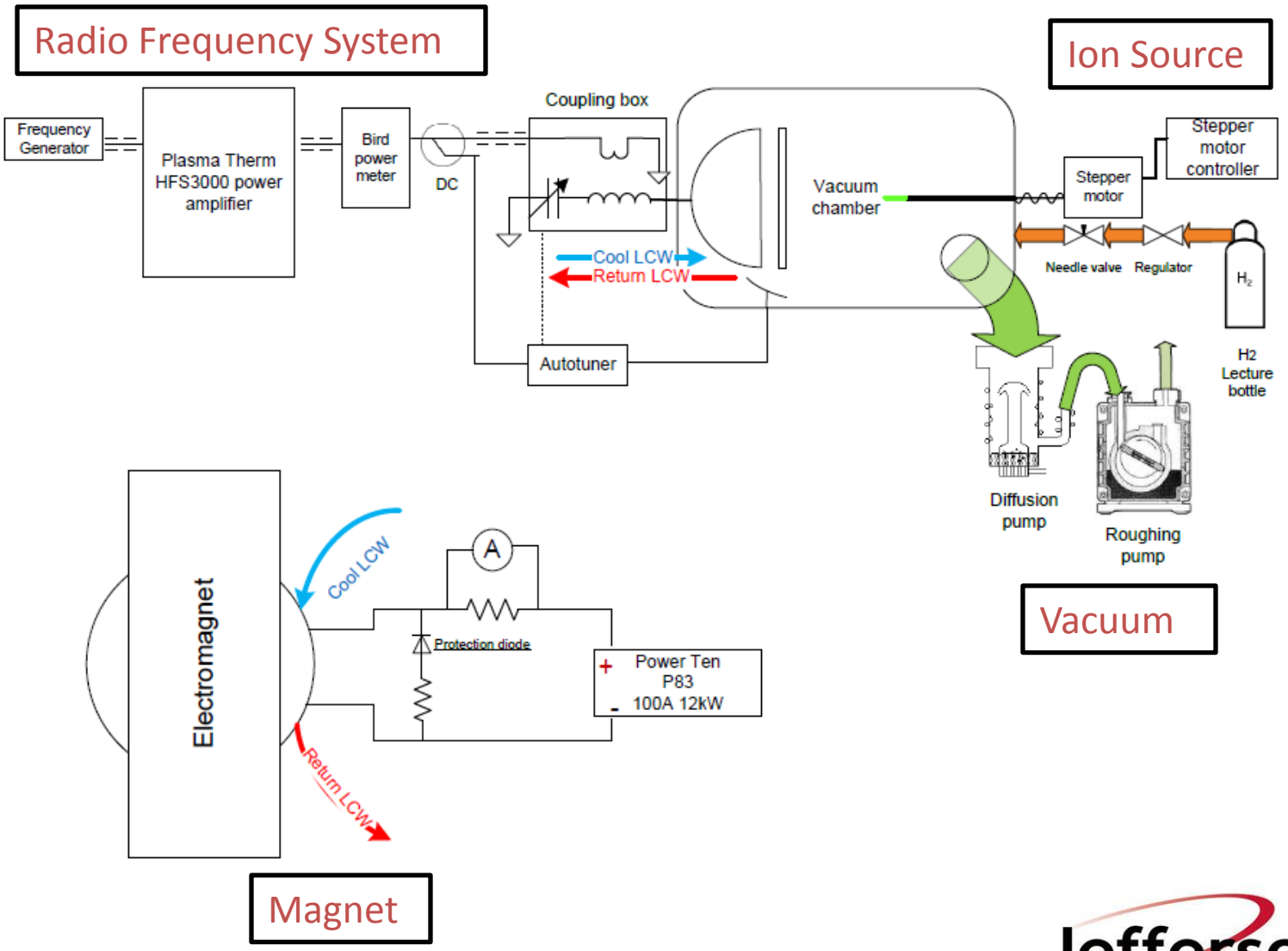
Jefferson Lab

Now



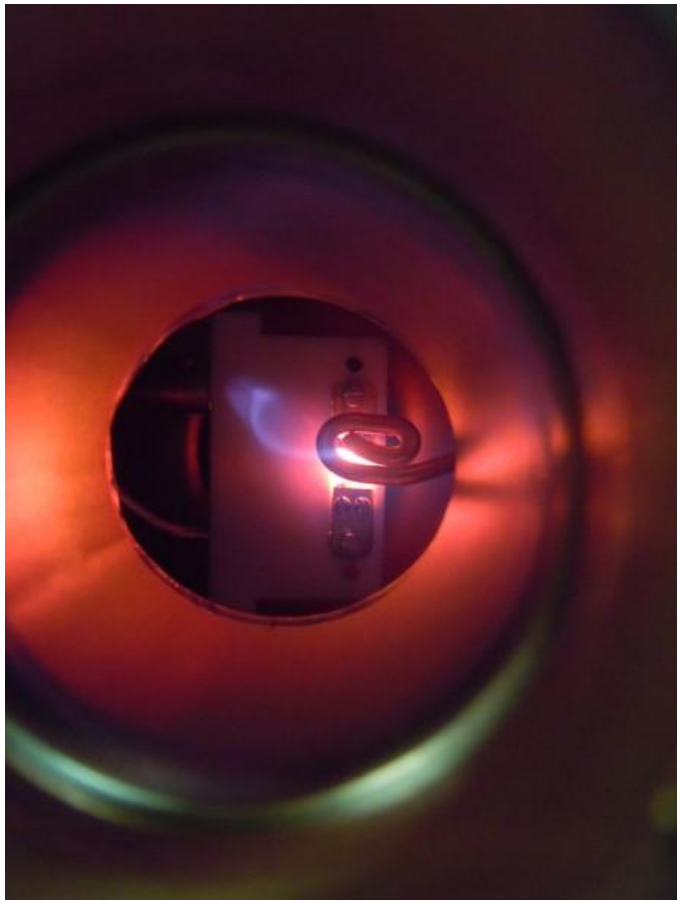
Jefferson Lab

Cyclotron Systems



Jefferson Lab

The Ion Source



•High current through filament forces electrons out of the wire

•Electrons knock electrons off hydrogen atoms, leaving protons

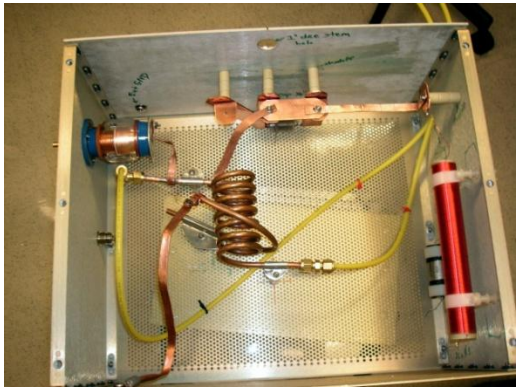
•Copper “chimney” delivers protons to the correct height in the chamber

Jefferson Lab

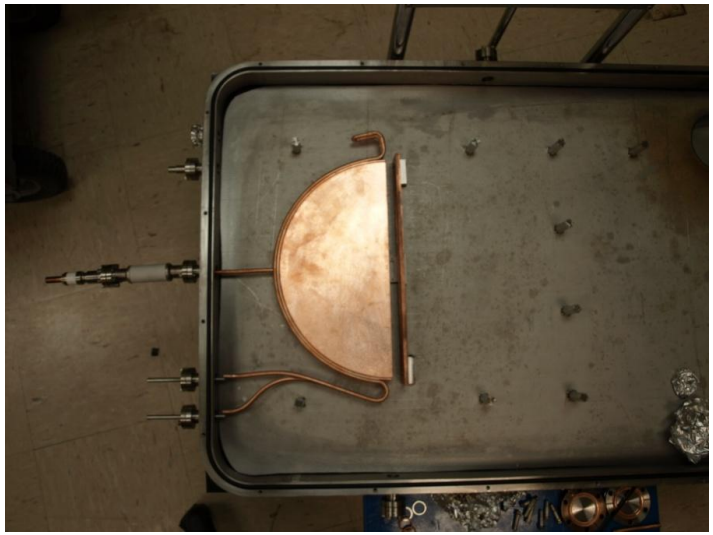
The RF System

3kW Amplifier

Impedance matching circuit



Electrode in chamber

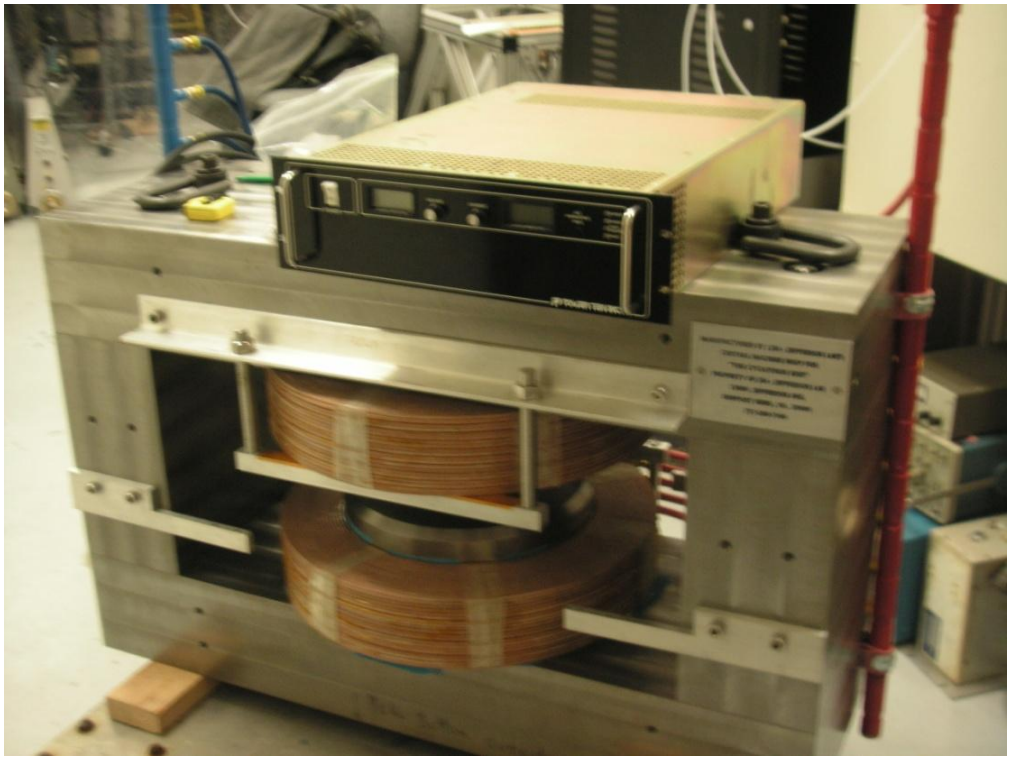


5V signal source

- Steps small signal up to 10,000V to push and pull protons
- Amplifier uses vacuum tubes instead of modern semiconductors

Jefferson Lab

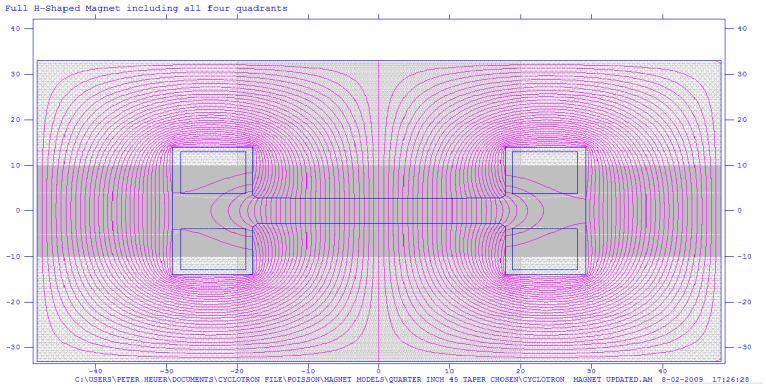
The Magnet



- Draws over 14kW of power and weighs over 4500lbs!

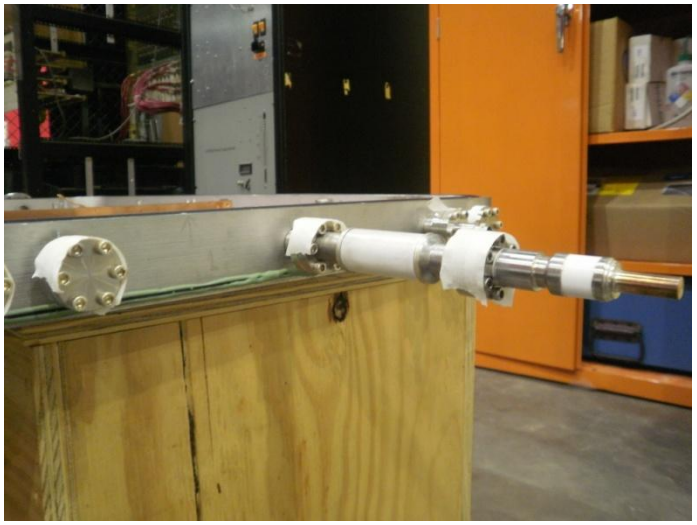
•Wires are internally cooled with deionized water

•Legs have 50% larger cross-sectional area than the pole tips.



Jefferson Lab

The Vacuum System

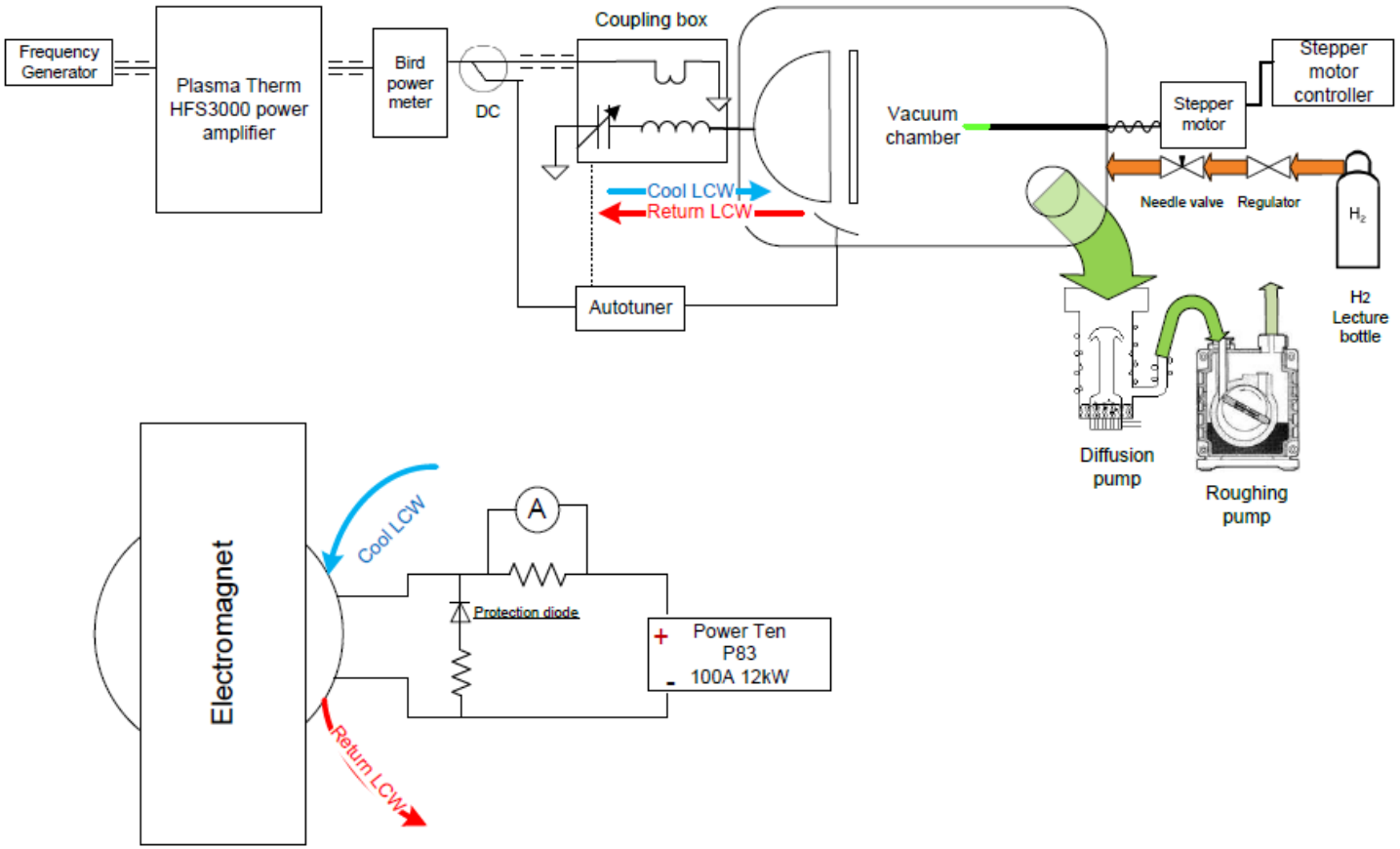


•Roughing pump backs large diffusion pump to pull vacuum down to ~10^-7 torr

•Vacuum flanges allow vacuum tight connections with external equipment

Jefferson Lab

Any Questions?



Website: www.thecyclotronkids.org

My blog: madscientistdiary.tumblr.com

Jefferson Lab