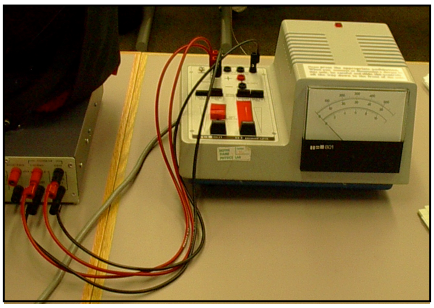
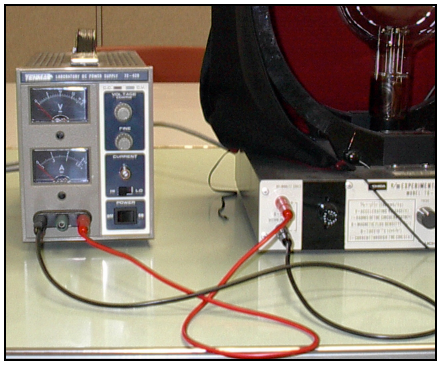
Helmholtz Apparatus

The Helmholtz apparatus is used for different laboratory exercises. We will explore its properties as a particle accelerator here. It consists of a bulb containing low-pressure helium. In the bulb, electrons are boiled off a hot filament. Then they are accelerated by the potential difference between two plates and focused by electrodes. The black rings around the bulb are just covered coils of wire. They will become electromagnets when current is applied to them. There are three power supplies in the two boxes connected to the bulb/ring assembly. The first controls the current in the filament. One controls the accelerating voltage to the plates, while the third controls the current to the coils.





To use the Helmholtz apparatus, turn on the power supplies. Allow the filament of the electron tube to warm up for a minute or so. When the filament is glowing, slowly turn up the accelerating voltage. Then you can adjust the current to the coils to see what happens.

Cautions:

- This is a high-voltage device. Do not exceed 300V as marked by the tape on the power supplies.
- The bulb is fragile; however, it can be rotated about 10-20 degrees in either direction around the vertical axis to see other effects. Hold it near the base while turning it.

After investigating the path of the electrons in the Helmholtz coils, make sure you can answer these questions.

1. How does the strength of the perpendicular uniform magnetic field affect the radius of the beam of electrons?
2. How does the momentum of the electron affect the ability of the magnetic field to deflect the electron from its path?
3. What phenomena do you see in the Helmholtz apparatus that are found in large particle accelerators?
4. When you turn the bulb, what is the relationship between the shape of the spiral and the components of the momentum (perpendicular and parallel to the magnetic field)?