Fine beam tube transcript

This apparatus will allow you to examine the behaviour of electrons in a uniform magnetic field and to calculate the charge to mass ratio for an electron. It consists of an electron gun situated in an evacuated glass sphere backfilled with a small amount of hydrogen. For historical reasons, this is called a ‘fine beam tube’.

The magnetic field is provided by an external pair of coils called a Helmholtz pair and when current is passed through them, they create a uniform magnetic field in the central region within the glass sphere.

The electron gun produces a thermionic emission of electrons. It consists of a cathode at the top and the anode at the bottom. Increasing the potential difference or voltage between the cathode and the anode increases the thermal energy of the electrons in the metal of the cathode, and some will escape and accelerate towards the anode. However, the anode has a little hole in its base and some of these electrons pass through it, forming an electron beam.

Whilst it is not possible to see the electrons, it is possible to see their path in the form of emitted energy from excited hydrogen molecules. At any point along the beam path, a small fraction of the electrons in the beam collide with the hydrogen molecules in the glass sphere, exciting the molecules to higher energy states that then rapidly decay releasing photons, which are seen here as a blue light.

The energy of the electrons is controlled by varying the potential applied to the electron gun.

And the path taken by the electron beam can be altered by changing the current flowing through the Helmholtz pair.

The diameter of a circular path can be measured by using the measuring slider, which is accessed by clicking the button and rotated using the slider control.

The diameter is measured by moving the moveable sliders so that they align with the edges of the electron beam.

If you need a reminder on how to use this application, click on the help button to access further instructions on how to use the apparatus.