

**Today:** Ch 21 Magnetic Force and Field 2<sup>nd</sup> ½  
**Monday:** Ch 22 E&M Induction 1<sup>st</sup> ½  
**Lab** Lab5 Magnetism and Induction

HW 15

HW 16

### 21.1 The Motion of a Charged Particle in a Magnetic Field

- **Comparing Particle Motion in Electric and Magnetic fields**
- **The Circular Trajectory**
  - **Mathematical Relationship**

**Ex1 : Electron / Positron.** Say an electron is traveling with a speed of  $6.0 \times 10^6$  m/s straight in the + x. Then it enters a region with a uniform magnetic field of strength  $8.70 \times 10^{-4}$  T pointing in the + z direction.

- A) In what direction does the electron's path bend?
- B) What is the radius of curvature of its trajectory?

**Ex2: Proton** What if our particle were a proton instead?

- A) Would you expect it to curve in the same or opposite direction to the electron?
- B) Would you expect it to have a greater or lesser radius of curvature?

- **Bubble Chambers**

### 21.2 The Mass Spectrometer

**Ex3:** Say you have a mass spectrometer with a radius of curvature of 0.02 m, an accelerating voltage of 1.00 kV. Panning through magnetic field strengths, you get a peak with field at 0.45 Tesla. Assuming the gas is only singly ionized ( $q = e$ ) What is the molecular mass of the gas?

#### 21.2.1 The Work Done on a Charged Particle Moving through Electric and Magnetic Fields

##### HW16

11. An electron moves at a speed of  $6.0 \times 10^6$  m/s perpendicular to a constant magnetic field. The path is a circle of radius  $1.3 \times 10^{-3}$  m. (a) Draw a sketch showing the magnetic field and the electron's path. (b) What is the magnitude of the field? (c) Find the magnitude of the electron's acceleration.
14. The solar wind is a thin, hot gas given off by the sun. Charged particles in this gas enter the magnetic field of the earth and can experience a magnetic force. Suppose a charged particle traveling with a speed of  $9.0 \times 10^6$  m/s encounters the earth's magnetic field at an altitude where the field has a magnitude of  $1.2 \times 10^{-7}$  T. Assuming that the particle's velocity is perpendicular to the magnetic field, find the radius of the circular path on which the particle would move if it were (a) an electron and (b) a proton.
18. The ion source in a mass spectrometer produces both singly and doubly ionized species,  $X^+$  and  $X^{2+}$ . The difference in mass between these species is too small to be detected. Both species are accelerated through the same electric potential difference, and both experience the same magnetic field, which causes them to move on circular paths. The radius of the path for the species  $X^+$  is  $r_1$ , while the radius for species  $X^{2+}$  is  $r_2$ . Find the ratio  $r_1/r_2$  of the radii.