

Bubble Chamber ~ Project

Name: _____

Potential Credits: /10

Using a pencil, answer the following questions/report. The lab is marked based on clarity of responses, completeness, neatness, and accuracy. Do your best! Please ensure that any data measured (or recorded) includes the appropriate number of significant digits (only one uncertain digit).

Modern physics has primarily become the study of quantum mechanics and particle physics. Particle accelerators such as CERN "smash" fundamental particles together and examine the shrapnel of the collisions using a simple and effective method involving a Bubble chamber. The short-lived particles resulting from these collisions leave visible trails through these chambers that allow physicists to determine the fundamental properties of these particles.

Your task is to research how a bubble chamber is constructed and then to apply the laws of electromagnetism and circular motion to describe the characteristics of four particles that have left a trail in a mock bubble chamber photo.

While there are many good sites explaining how these bubble chambers work and can be interpreted, one particularly good site can be found at the link below to get you started:

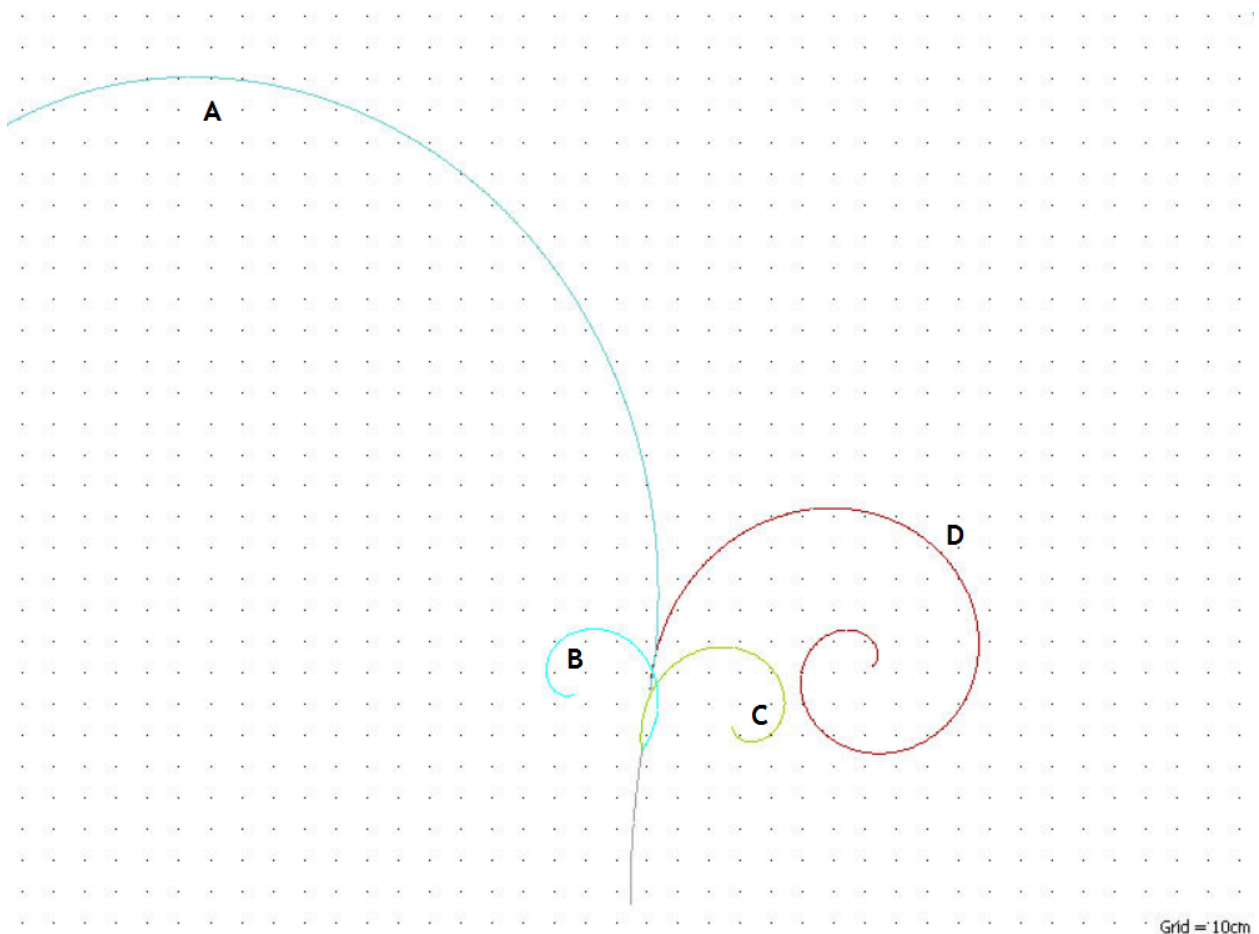
http://teachers.web.cern.ch/teachers/archiv/HST2005/bubble_chambers/BCwebsite/index.htm

Part 1: How does a Bubble chamber work?

Answer the following questions in the form of a short essay. Keep it simple and ensure that all points below are covered:

- What is a Bubble chamber? Describe the basic components.
- How are the trails created?
- How does one "read" the trials photographed inside a bubble chamber? Why do charged particles follow a curved or spiral path once inside the chamber? What must be present for this to happen?
- Why do some particles spiral clockwise while others spiral counter clockwise?
- Describe all of the variables that are responsible for the direction and diameter of the path created.
- What does it mean if a particle does not curve inside the chamber?
- What is *bremstrahlung* and why does this cause some particles to spiral inside the chamber?

Be sure to include a **bibliography** citing all of the sources you used to find answers to the above. Be sure that you interpret the information to a grade 12 level and answer in **your own words** as this will ultimately lead to better understanding.

Part 2: Interpret the Bubble chamber picture below

- The simulated Bubble chamber picture above shows four unknown particles created as a result of a collision between two particles following circular paths.
- The magnetic field, B , is represented by the dots on the page (out of the page).

Write the equation of motion that represents to four, charged particles above. Solve your equation for r . You may include the following variables in your formula: m , r , v , q , B and any fundamental constants.

Equation of Motion

Using the picture above complete the table below that fully describes the nature of the four particles. Use the following constraints:

- You may assume that the **magnetic field is constant** for all.
- Particles **D** and **C** were used as a controls and are both Alpha particles (Helium Nuclei)
- **A and D** move at the **same speed, v_1** .
- Particle **A** has a charge of $\pm 2e$
- v_C is five times that of v_B
- Particle **B** has a charge of $\pm e$
- Note that the diagram is scaled. Each of the magnetic field dots are 10 cm away from adjacent dots.

Justify your decisions with your **equation of motion** above.

<i>Path</i>	<i>Charge (explain)</i>	<i>Relative mass</i>	<i>Relative Velocity</i>
A			
B			
C			
D			