Name PIXE Homework #1 - Physics 100 Union College Fall 2014

Union College recognizes the need to create an environment of mutual trust as part of its educational mission. Responsible participation in an academic community requires respect for and acknowledgement of the thoughts and work of others, whether expressed in the present or in some distant time and place.

Matriculation at the College is taken to signify implicit agreement with the Academic Honor Code, available at <u>honorcode.union.edu</u>. It is each student's responsibility to ensure that submitted work is his or her own and does not involve any form of academic misconduct.

For the homework assignments, you may consult for guidance only, if needed; your instructors lecture notes, the physics department help center, the writing center, your instructor, other physics and astronomy department instructors, other textbooks, or the Internet. Any work that is not explicitly your own must be cited. You may not copy solutions from anywhere. If you are unclear on anything, you are expected to ask your instructor for clarification regarding, but not limited to, collaboration, citations, and plagiarism. Ignorance is not an excuse for breaching academic integrity.

1. In your own words, explain the main components of the Pelletron particle accelerator and the significance of each.

2. In your own words, explain the charge exchange process that occurs for a helium ion on a 1.1MV Pelletron accelerator.

3. What is the final speed of an alpha particle after it leaves the accelerator? The bias voltage applied across the quartz source bottle is 3.6kV for Helium. (Hint: the alpha particle (2 protons + 2 neutrons) has a charge of -1e when it leaves the bottle, a-1e charge when it is accelerated towards the terminal from ground, and a+2e charge when it is accelerated away from the terminal back to ground.)

4. What is the kinetic energy the helium ion after our machine has accelerated it?

5. If the radius of the alpha particle's orbit is 34.4cm (exactly the same as the proton,) what magnitude of magnetic field is required to steer the alpha particle down the  $30^{\circ}$  beamline?