

Tutorial Four

1. Particles:

- a. Given the interface of the Particle class in **Particle.h**, implement all the required member functions in the source file. Do not change the header file. Can one create an object of type Particle? If not, why not.
- b. Write 3 derived classes: Electron, Muon and Photon, which inherit from the Particle class. These should correctly set the mass, charge and id plus provide any remaining implementations that are necessary.
- c. Create a default instance of each type of particle and add it to a STL vector. Using iterators, loop over the vector and write the particle's data to a file in the form of a table having:
 - i. Columns with a width of 10 characters,
 - ii. Characters left aligned and numbers right aligned,
 - iii. Mass in MeV to 3 decimal places.
- d. Reading the data from the file **Muon.data**, create a vector of muons.
- e. Sort the data within the vector in order of ascending energy. Print the ordered energies to the screen (this time don't use iterators).
- f. Clear the vectors and release any memory before the end of the program.

Hints for Question 5:

- The question uses data on muons from the ATLAS experiment but again you don't need to know anything about particle physics to complete the question.
- The necessary masses and Ids for the particles are:

Electron:	Mass = 0.510998918,	ID = 11
Muon:	Mass = 105.658369,	ID = 13
Photon:	Mass = 0,	ID = 22
- When calculating phi you may find the **cmath** function **atan2** useful.

