3C59 - Object Oriented Programming

Consolidation exercise 1:
An analysis of Compton scattering data

http://www.hep.ucl.ac.uk/~bjw/

- Compton scattering
- Description of the problem
- Reminder of the topics covered so far
- Group discussion
- Some guiding words

Compton scattering - theory
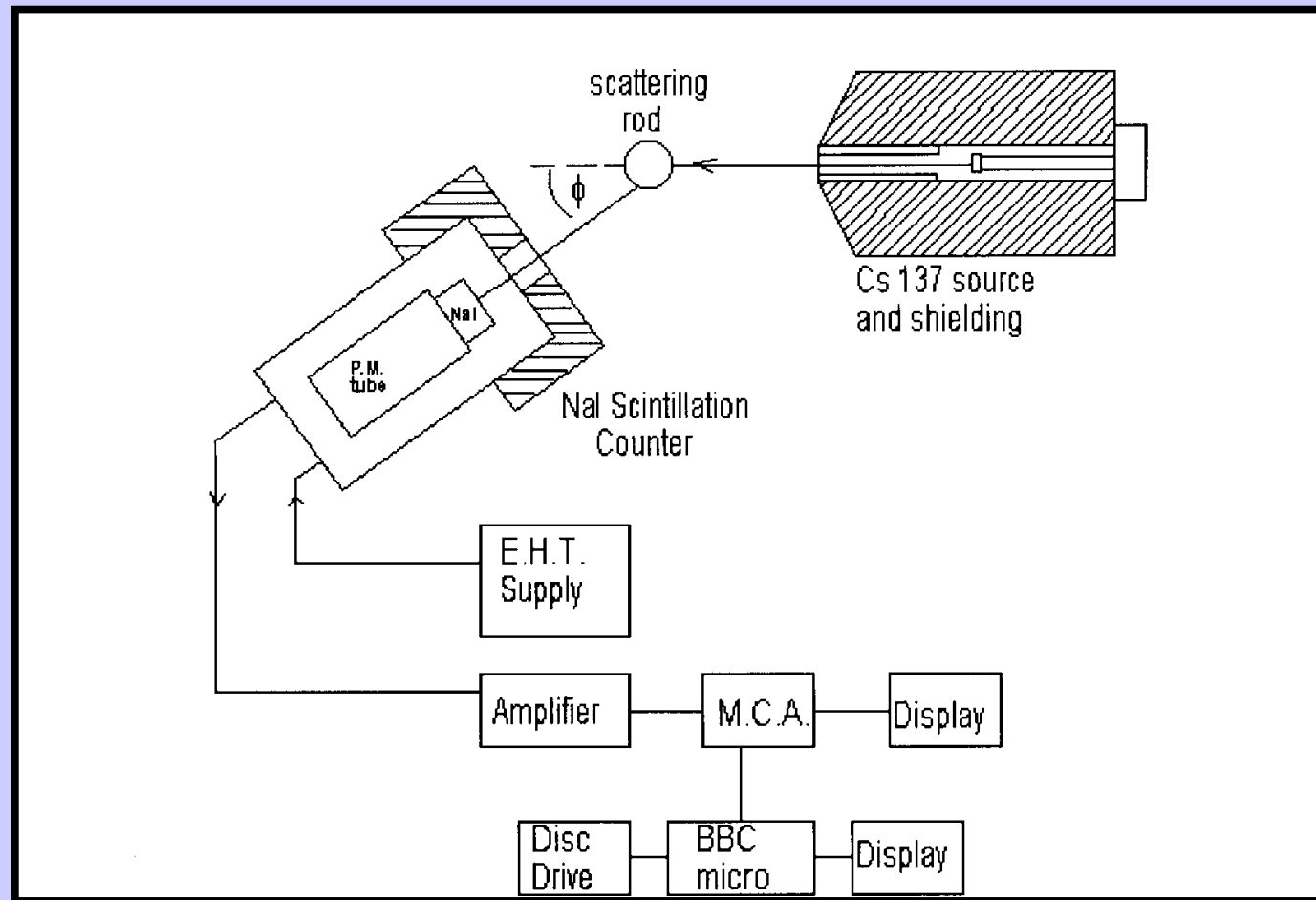
Compton scattering

Recoil electron

Incident photon

Target electron at rest

ϕ

θ

λ_i

Scattered photon

$$\lambda_f - \lambda_i = \Delta\lambda = \frac{h}{m_0 c}(1 - \cos\theta)$$

λ_f
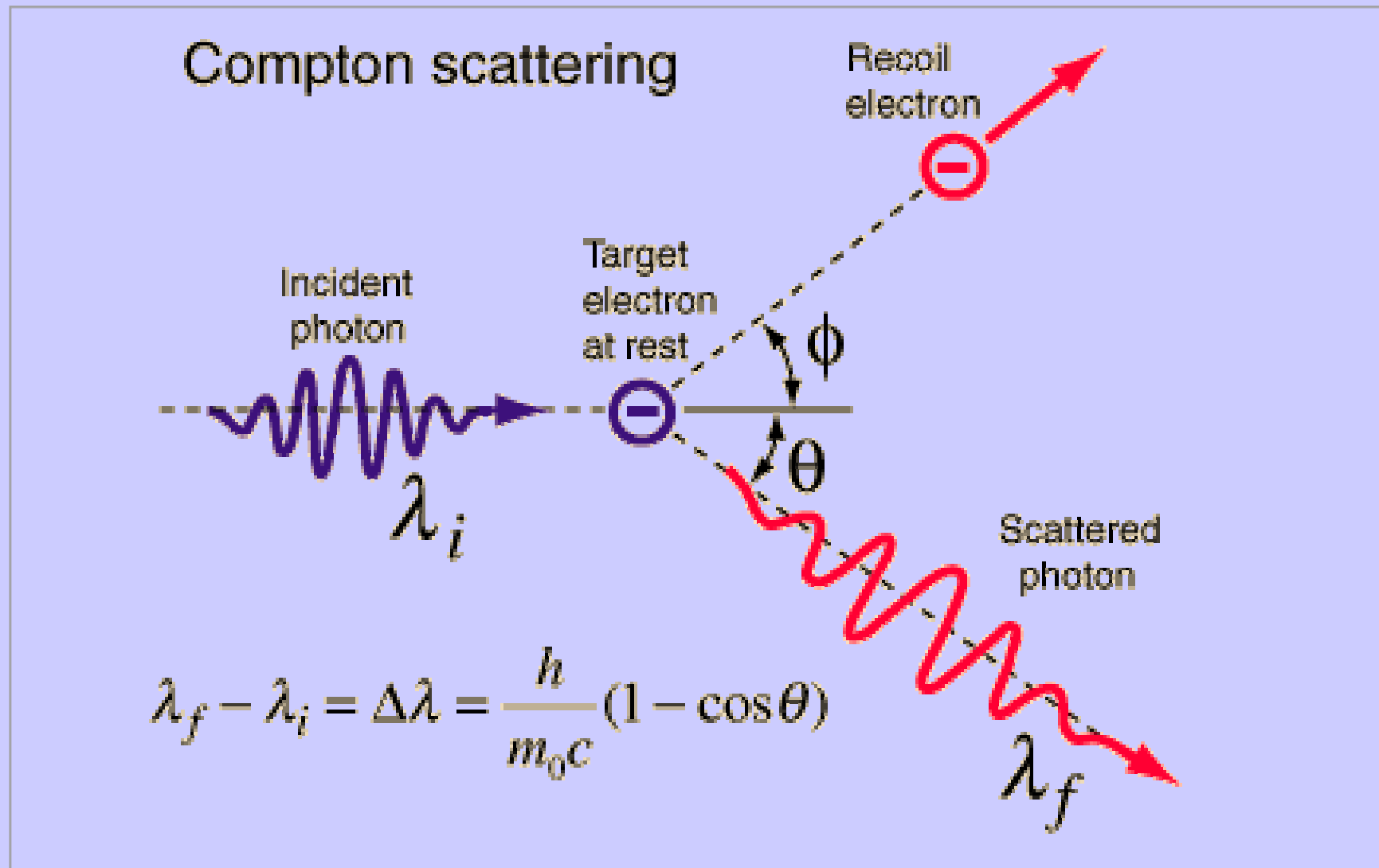
Compton scattering - experiment

3rd year lab experiment:
http://www.hep.ucl.ac.uk/~clarke/ThirdYearLaboratories/ComptonEffect/r3_rev.doc

Description of the problem

You will be provided with three data files (data.dat, model1.dat, model2.dat) which are formatted as follows:

angle (Deg)   energy (KeV)

e.g.

```
0.225227       933.131
54.7191        283.047
...
80.4224        318.277
```

Your task is to write an (object oriented) analysis suite to analyse the data and determine which model best describes the data.

Requirements: Your programme should…

$\Rightarrow$ **Read the data from the files**

$\Rightarrow$ **Fill histograms of the angle and energy distributions for each sample**

$\Rightarrow$ **Print out the details of each histogram (contents, error and range of each bin, number of entries and mean)**

$\Rightarrow$ **Determine which model best describes the angular distribution of the data (use the χ^2 method)**

Reminder of the topics covered so far

- **Classes are user designed data types that contain**
  - **Data**
  - **Methods**

- **Steering elements**
  - **If, else, while, do…**

- **Input and output**
  - **To/from the console - <iostream>**
  - **To/from a file - <fstream>**

- **Collections**
  - **For a collection of integers we would use std::vector <int>**
  - **Standard method such as push_back …**

Group discussion

- How should the program be structured?

- What classes do we need?

- What should they do? (i.e. what methods should they have?)

Some guidance

- **Example code will be available at:**

  http://www.hep.ucl.ac.uk/~bjw/Compton/

- **Code suggestions:**
  - **A datum class for each measurement (each set of measurements can the be stored in a vector of datum objects)**
  - **A function which reads in data from a file and returns a vector of datum objects**
  - **A histogram class (and a bin class) which has a χ^2 method**

- **Calculating χ^2 of two histograms:**

$$\chi^2 = \sum_{bins} \frac{(a_i - b_i)^2}{\sigma^2_{a,i} + \sigma^2_{b,i}}$$

- **Start by writing a datum class, then the file reader, then test these on the supplied files**