**Rutherford Backscattering Spectrometry (RBS)**

In the early years of the twentieth century physics was living the golden age. Among the genius contributing to unveil the secrets of matter was Ernest Rutherford. He gave birth to an atomic model with a nucleus with electrons moving around. More than a century after we still see the atom the way Rutherford “created” it. To achieve his discoveries he used a beam of α particles impinging a gold foil.

In this work we will used the same experimental procedure of Rutherford to measure the composition of film. For that we will use the cross section evaluated by him and the stopping power model of charge particle slowing down in matter.

The objective of the work is to learn the fundamentals about the experimental procedure to use the Rutherford experiment to identify and measure the profile of the elements present in a sample of unknown composition.

The research work will be divided in 4 sections.

1. The first part is dedicated to obtain the 4He+ beam from the Van de Graaff accelerator. A detailed description of the accelerator and its operation will be provided.
2. After having the beam available all the electronic and acquisition systems will be identified and described in detail and the sample inserted in the experimental chamber.
3. Now all the conditions are in place to start measuring. First a calibration sample will be measured to establish the energy conversion of the experimental set-up. After several backscattering spectra will be collected and analyzed.
4. Finally the results will be discussed and a report is issued. In the annex all the information necessary to elaborate the report is available.

Each group are expected to elaborate a short report (maximum 6 pages, letter TNR 11) addressing the content of the 4 sections.

**Annex**

The experimental spectra allows us to obtain a vast amount of information about the samples. The 4 important quantities are:

1. Kinematic factor relating the energy before and after the collision of the particle with the target atom.





1. The cross section giving the probability of the particle to be scattered along a determined direction after the collision:



1. The stopping cross section which provides information on the energy loss during the path inside the material allowing the calculation the depth at which the collision occurs.





1. The energy straggling which quantifies the fluctuations in the particle energy during the path in the material.



**Areal density of an element i in a matrix a**

**(Nt)i = Ai σa δE/Ha σi [ ɛ ]a**

Where **Ai** is the area in the spectra, **δE** the energy per channel**, Ha**is the hight at the surface of the matrix spectrum, **σ** the Rutherford cross sections and with,

**[ ɛ ]a = Ki (dE/dx)E + 1/(cosθ) (dE/dx)Ef**

**[ ɛ ]a = (1/N)[ S ]a**