

PHYS3710 Short Experimental Projects I
Department of Physics
The Chinese University of Hong Kong, Hong Kong
Topic: Rutherford Scattering

Designed by
H.K. Wong

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Topics you should know first:

1. Derivation of differential cross-section for Rutherford scattering.
2. Principle of nuclear detector.

Objectives:

1. Verify Rutherford scattering.
2. Prepare targets for Rutherford scattering experiment.

Check-list for the project:

1. Learn derivation of differential cross-section for Rutherford scattering (Appendix 13 of PHYS 3202) and review some experimental techniques for this experiment. (See papers in the Ref. folder.)
2. Get familiar with the vacuum chamber & pumping procedure. (Ref. 2)

Caution: This detector must be operated in vacuum.

3. Get familiar with PIN detector for α particles (Ref. 3), detector electronics & the source handling. In particular, calibrate the multichannel analyzer with an α source, ^{226}Ra .

Caution: Pay attention to radiation safety. α sources may also emit x-rays or gamma rays.



Figure 1 A ^{226}Ra source

- Without any target, measure the energy spectrum of the collimated ^{241}Am source as a function of angle θ ($\leq \pm 5^\circ$). Plot count rate as a function of angle to determine the actual zero angle position $\theta = 0^\circ$.

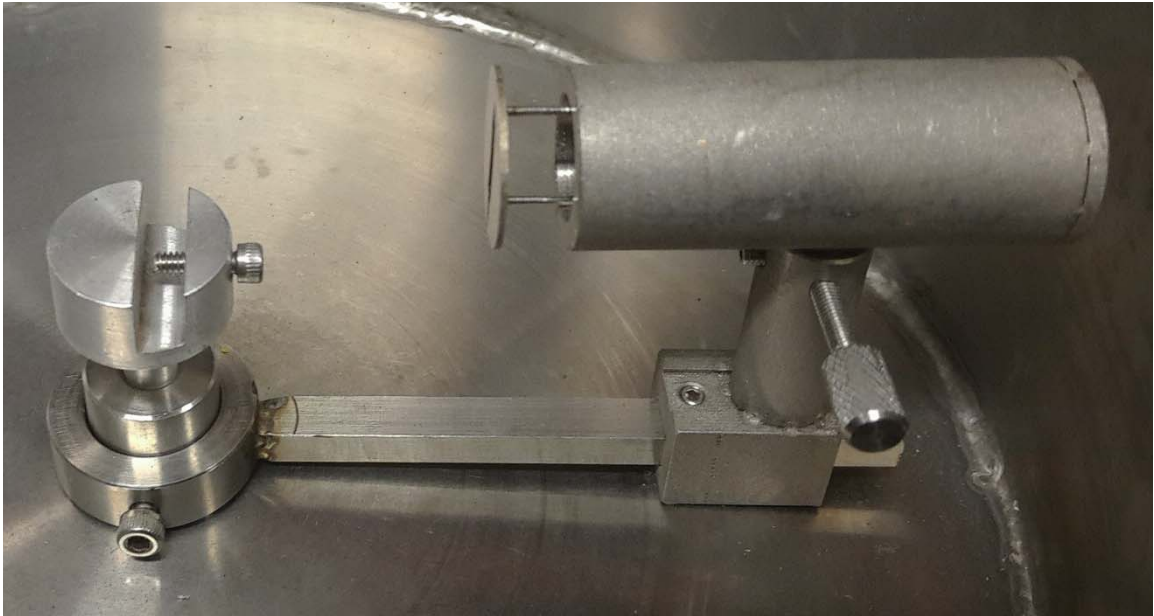


Figure 2 A collimated ^{241}Am source (loaded inside vacuum chamber)

- Turn off detector voltage and then mount an Au foil target into the vacuum chamber.

Caution: Au/Al foil targets are fragile, please handle with care!

- Pump down chamber (Pressure < 20 micron) and then turn on detector voltage.

Measure spectrum as a function of detector angle θ .

Get more data point in small angle range.

For large angle $\theta > 10^\circ$, take data every 10° .

Collect sufficient counts. (Note: The error in counts N is $\sqrt{N}$.)

- Analyze data by fitting to the differential cross-section equation.
- Use other metal foils to repeat. Make sure that there is no attenuation or multiple scattering.
- Verify equation for different elements (e.g. Al).

References:

- Reference folder is available.
- Equipment notes on pump (available on Course WebPage).
- Notes on nuclear detectors (Appendix 11 of PHYS 3202).