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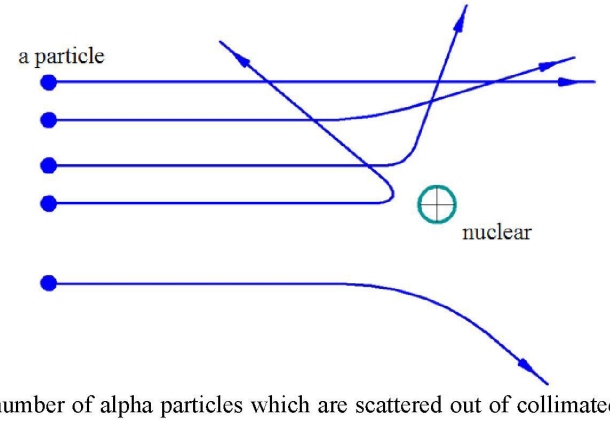
CALCULATION AND ANALYSIS OF RUTHERFORD SCATTERING

Annotation: Consider the scattering of Rutherford into 35 and 45 degrees. In order to analyse the results, the techniques such as Full width at half maximum (FWHM), angular distribution and Gaussian distribution had been used on the research.

Key words: scattering, width, angular distribution, cross section.

Introduction

Rutherford scattering is an elastic scattering of charged particles by Coulomb interaction. It was first referred to Coulomb scattering because it relies only upon static electric (Coulomb forces), and the minimal distance between particles is a set only by this potential. The classical Rutherford scattering of alpha particles against gold nuclei is an example of "elastic scattering" because the energy and velocity of the outgoing scattered particle are the same as that with which it began [1].



- measure the number of alpha particles which are scattered out of collimated beam upon hitting a thin metal foil
- They determined the angular distribution of scattered particles for several different materials, thicknesses and alpha energies

Kinematics. We use the following formulas to calculate the energy of particles for each scattering angles [2].

$$P_0 = \mathrm{P_m} \cos\theta + \mathrm{P_M} \cos\theta \quad (1)$$

$$E_0 = E_m + E_M \quad (2)$$

$$P_m \sin\theta = P_M \sin\phi \quad (3)$$

$$E_0 = \frac{p_0^2}{2m} \quad (4)$$

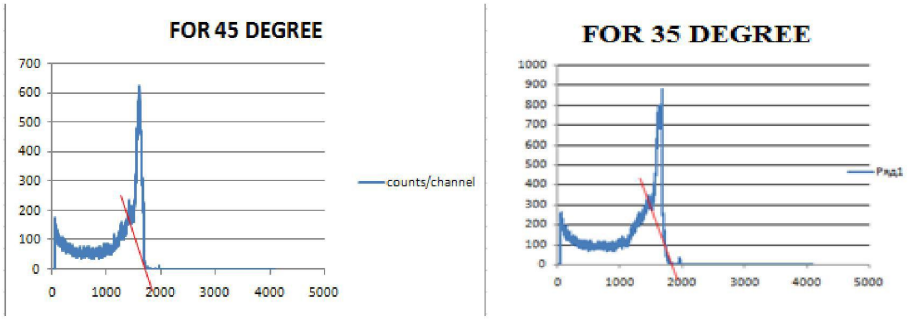
$$E_0 = \frac{p_m^2}{2m} \quad (5)$$

$$E_0 = \frac{p_M^2}{2m} \quad (6)$$

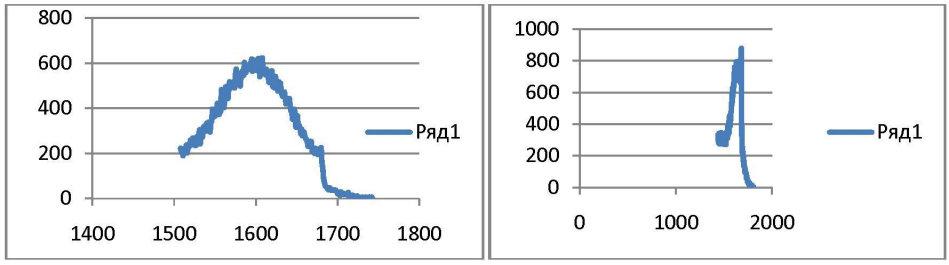
Analysis of results

For calculations, a value of the amplitude in Excel program had been used.

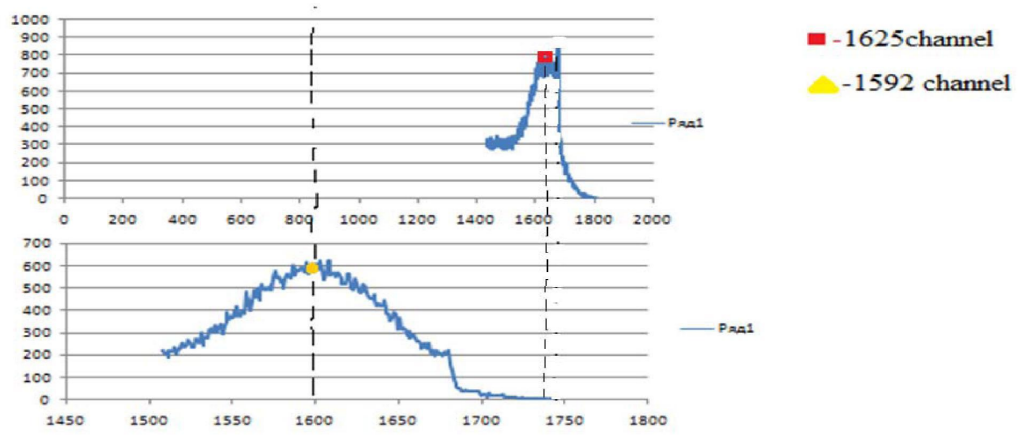
1. The angle of scattering of alpha particles by 35 and 45 degrees had been measured by the research team. The first, there were obtained 2 graphs for two angles:



2. Only the peak that points when graph increased and decreased had been cut out for the research convenience.



3. Then, the research team compared the two pick of angles in order to find the difference of channels.

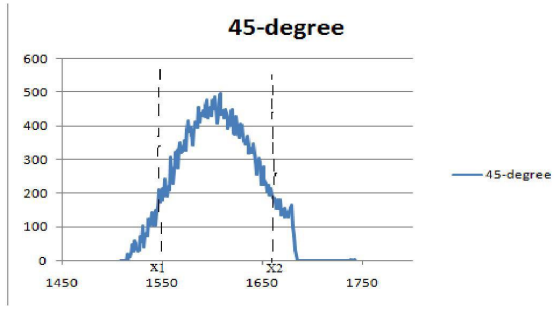


1625-1592=33channel

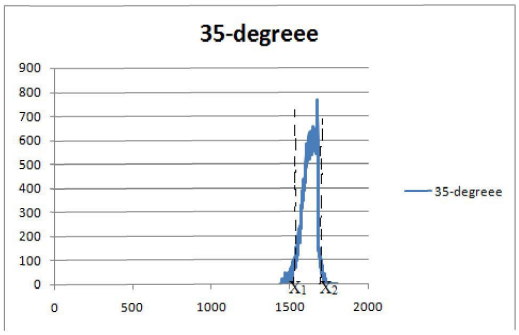
4. Moreover, calculations of the energy for each angles had been made by using (5) and (6) formulas:
Energy for 35 degree: E=29.604MeV
Energy for 45 degree: E=29.355MeV

5. Using the difference of energies the energy for each channels can be found.
ΔE=E2-E1= 250KeV
ΔE/channel=250keV/33C\ch=7.5keV

6. The next step is to find the width of scattering. For this step, there been used the method of Gauss in order to calculate the distance between two extreme values. If the number of events is very large, then the Gaussian distribution function may be used to describe the physical events [3]. Furthermore, the methods as a FWHM had been used. Full width at half maximum (FWHM) is an expression of the extent of a function given by the difference between two extreme values of the independent variable at which the dependent variable is equal to half of its maximum value [4]. In other words, it is the width of a spectrum curve measured between those points on the *y*-axis which are half of the maximum amplitude [5].



Δx=x2-x1
the width of scattering
X1=1550
X2= 1665
Δx=1665-1550=115



X1=1556
X2= 1691
Δx=1691-1556=135

7. Angular distribution is the distribution of relatives to the scattered particles and product of nuclear reactions [6].

$$\frac{d\sigma}{d\Omega} = \frac{N_i n L Z^2 k^2 e^2}{4r^2 K E^2 \sin^4(\theta_1/2)} \quad \text{for 35 degree}$$

$$\frac{d\sigma}{d\Omega} = \frac{N_i n L Z^2 k^2 e^2}{4r^2 K E^2 \sin^4(\theta_2/2)} \quad \text{for 45 degree}$$

Integer35/integer45=sin4(Θ_1/2)/sin4(Θ_2/2)
Integer35=∑yi Integer45=∑yi

- Integer35=∑yi = 71334
- Integer45=∑yi = 131361

Integer35\ Integer45=0.54
sin4(Θ_1/2)/sin4(Θ_2/2)= 0.0081/0.0256=0.32

Conclusion

Undoubtedly, the planetary model of an atom was proposed by Rutherford, a major step forward to the development of knowledge about the structure of an atom [7]. It was absolutely necessary to explain the experiments on the scattering of α-particles. α-scattering particles 35 and 45 degree were investigated during the study. The aim of our work was to get the scattering of spectrum of α-particles in the corners 35 and 45 degrees and make calculations by analyzing them. There were used methods, such as: full width at half maximum (FWHM), angular distribution, Gaussian distribution and so on. The results of angles were compared between each other. Calculations were made on energy, width, angular distribution and cross section. Comparison with the final value of section was made. According to the perceived data, it had to be the same, but on identified errors in the experiment they had a minimum difference to 0.22. Consequently there was accomplished all the set of purpose.

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РЕЗЕРФОРД ШАШЫРАУЫН ЕСЕПТЕУ ЖӘНЕ ТАЛДАУ

Аннотация: Бұл жұмыста біз Резерфорд тәжірибесіндегі α-бөлшектің 35 және 45 градустарға шашырауын зерттедік. Алынған нәтижелерді талдау үшін бұрыштық үлестіру, Гаусс үлестіруі, енін анықтау тәсілдерін және т.б әдістерді қолдандық.

Тірек сөздер: шашырау, ені, бұрыштық үлестіру, қима

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РАСЧЕТ И АНАЛИЗ РАССЕЯНИЯ РЕЗЕРФОРДА

Аннотация: Мы рассматривали рассеяние Резерфорда на 35 и 45 градусов. Для анализа результатов мы использовали методы, такие как полуширина (FWHM), угловое распределение, Гауссовое распределение и т.д.

Ключевые слова: рассеяния, ширина, распределения углов, сечение