Tareas 6 Tópicos de la Física Moderna

6 de Octubre 2020

1. Why is the wavelength of an α–particle that comes from a nuclear decay about equal to the size of a nucleus?

2. In the Rutherford experiment, is it possible to choose the impact parameter? Explain.

3. Could x–rays have been used to discover the nucleus?

4. The strong interaction has a short range, approximately 1 fm. Use this fact to estimate the cross section for the strong interaction of two energetic protons ($E \gg mc^2$). Compare your answer to 40 mb.

5. When a particle has structure, why does a deviation from the Rutherford scattering formula at a fixed energy show up at large scattering angles rather than at small angles?

6. Why is it convenient to write the differential cross section as $d\sigma/d\cos\theta$ rather than $d\sigma/d\theta$? Show that if we write the differential cross section as $d\sigma/d\theta$ and integrate over all angles to get the total cross section that we get the same result as integrating $d\sigma/d\cos\theta$ over all values of $\cos\theta$.

7. How important was it for Geiger and Marsden to evacuate their chamber? For α–particles estimate the thickness of air that would have the same cross section as scattering in a gold foil of thickness 0.2 μm. (The density of gold is $1.9{\cdot}10^4\,\mathrm{kg/m^3}$ and the density of air is $1.2\,\mathrm{kg/m^3}$ at atmospheric pressure and room temperature.)

8. A 10 MeV α–particle scatters from a silver nucleus at an angle of 90°. (a) Calculate the impact parameter. (b) Calculate the distance of closest approach.

9. Calculate the kinetic energy of an α–particle if the distance of closest approach to a gold atom is 10 fm when scattered at 90°.

10. Read SELEX Collaboration, I. Eschrich et al.: Measurement of the Σ^- Charge Radius by Σ^-–Electron Elastic Scattering, Physics Letters B 522 (2001) 233-239, arXiv:hep–ex/0106053.

11. Only for very interested people: Read SELEX Collaboration, U. Dersch et al.: Total Cross Section Measurements with π^-, Σ^- and Protons on Nuclei and Nucleons around 600 GeV/c. Nuclear Physics B579 (2000) 277-312, arXiv:hep–ex/9910052.