

OLLSCOIL NA hÉIREANN
GAILLIMH

NATIONAL UNIVERSITY OF IRELAND
GALWAY

SUMMER EXAMINATIONS 2000

3rd year B. Sc. Unit EP323: Nuclear and Astrophysics

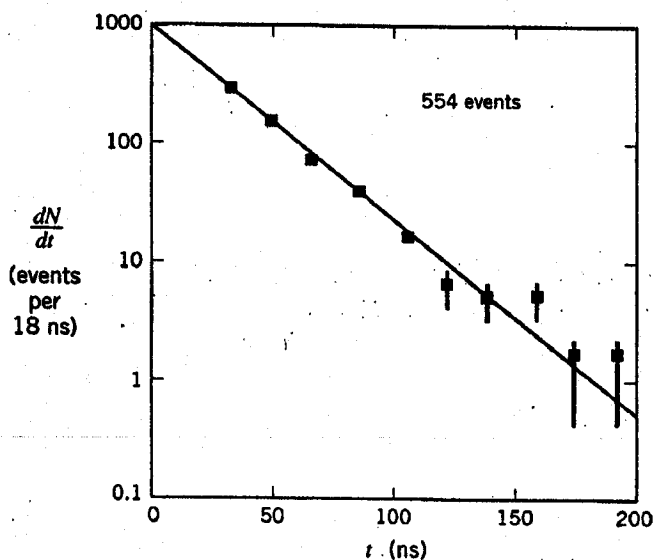
Prof. R.M. Redfern
Dr. J.M. Woolsey
Dr. G. Gillanders
Dr. C. Flynn

Answer THREE questions

Time allowed: TWO hours

- Q.1 (a) Define the following terms: hadrons, leptons, baryons, and mesons.
(b) For the pion (π) list the following:
(i) Whether it is a hadron, baryon, or meson.
(ii) The charge varieties it comes in and their quark contents. Check that the total charge of the constituent quarks is correct.
(c) The first accurate measurement of the π^+ lifetime was made in 1950. The pions were created in the interaction: $\gamma + p \rightarrow \pi^+ + n$. The pions decayed and the decay products were detected.

1. What is the decay sequence of the pion? Show that the relevant lepton conservation laws are satisfied.
2. How were the charged particles detected and what was the signature for a π decay?
3. The graph opposite shows the results of the 1950 experiment. dN/dt is the number of pion decay events per 18 ns. From the graph estimate the lifetime of the pion. Show your reasoning.



- Q.2 In a particle accelerator, a particle of rest mass m_1 and total energy E_1 collides with a particle of mass m_2 at rest in a fixed target. New particles are produced in the collision. Beginning with the formula

$$E_{CM}^2 = m_1^2 c^4 + m_2^2 c^4 + 2E_1 m_2 c^2$$

(where E_{CM} is the total energy in the centre-of-mass system), show that K_{th} , the threshold kinetic energy in the laboratory frame (of the particle fired at the target) required for particle production, is

Continued....

