PHYSICS

Bubble Counting on Low-Energy Particle Tracks

THE possibility of distinguishing between the tracks of mesons and protons in bubble chambers by measurements of linear bubble density has been investigated.

In the course of an investigation of photomeson and photoproton production from an external target, irradiated by 340 MeV. bremsstralung, using a bubble chamber as particle detector, identification was often provided by inspection of the track ending. Thus a π^+ meson track commonly terminates with a decay $\mu^+ \rightarrow e^+$, and a π^- meson with a disintegration star. Ambiguity exists, however, between π^- meson tracks which have no visible star products and proton tracks. It may be possible to overcome this ambiguity by an examination of multiple coulomb scattering; but this method applies only if the track is at least 2 cm. long, and even then is not always reliable. An investigation was therefore made of the possibility of using bubble-counting methods to aid this identification.

To count bubbles the film was examined under a microscope. The number of bubbles over a range of 0·1 gm./cm.^{2} was counted at a measured distance back from the ending of a track, and this number was converted to bubbles per cm. The bubble density as a function of the mean range is shown in Fig. 1.

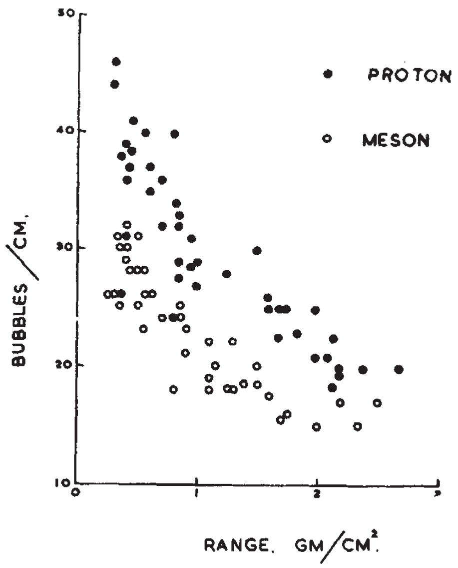

Fig. 1. Bubble density against particle range

Points indicated as circles represent meson tracks identified by their end products. Points indicated by full dots represent tracks showing no such end products. Some of these latter tracks have not been included in this graph since they were long enough to be identified as mesons by examination of the scattering. The separation of mesons and protons into two groups is very striking, the few exceptions being reasonably attributed to mesons which had not been identified as such by scattering considerations.

Within the rather inadequate statistics, the relative numbers of mesons and protons conform to the numbers expected from cross-section calculations.

It appears from these results that bubble counting provides a satisfactory method for the separate identification of protons and mesons.

Since it is believed that δ-rays or secondary electrons are in some way responsible for the creation of bubbles, graphs of bubble density against $1/\beta^2$ have been constructed, notably by Glaser[1] and Blinov[2] and a linear relationship found.

In the present experiment, the energy of the particle of range R was obtained from tables, and from this $1/\beta^2$ was calculated. Graphs of bubble density against $1/\beta^2$ constructed from the results shown in Fig. 1 are shown in Fig. 2.

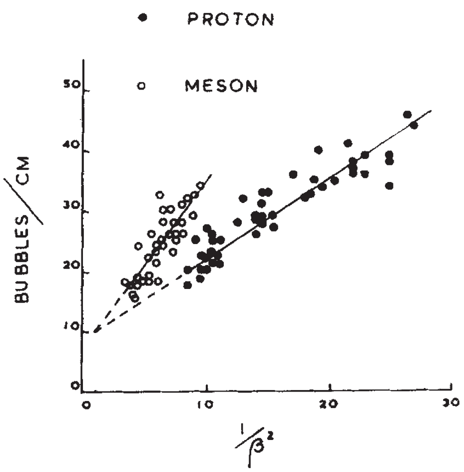

Fig. 2. Bubble density against $1/\beta^2$ ($\beta = V/C$; V = particle velocity)

A straight line is obtained for both mesons and protons, agreeing with the earlier results of Glaser and Blinov. It can be seen, however, that the slope of the curves depends on the mass of the particle, a result not readily explained by current theories. Both curves extrapolate to a value at $1/\beta^2 = 1$ which is identical with the bubble density found on minimum ionizing electron tracks.

Further experiments are being performed to investigate these effects more thoroughly.

I. R. BIRSS

Department of Natural Philosophy,
The University,
Glasgow, W.2.
Sept. 17.

[1] Glaser, Proc. C.E.R.N. Conference (1956).
[2] Blinov, *J.E.T.P.*, **31**, 762 (1956).

Electron Microscopy of Autoradiographed Radioactive Particles

THE combination of the techniques of electron microscopy and autoradiography was first described by Liquier-Milward[1]. O'Brien and one of us (L.A.G.) later described the application of a similar technique to ultra-thin sections of yeast[2]. This communication describes a further modification of the technique for the identification of radioactive particles collected on millipore filters. This work was in support of an investigation into the effects of the inhalation of radioactive particles.

In this procedure, millipore filters, which are an integral part of chambers used to expose lungs of animals to radioactive dusts, are collected and processed for examination with the electron microscope by the method described by Kalmus[3]. Small areas of approximately 2 mm.^{2} are cut out of the central portion of the millipore filter (type *AA*; plain,