CHARGED PION PRODUCTION BY 600 MEV PROTONS ON CARBON

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The basic principle of the method adopted is that used by Rosenfeld [1] (1954) and Sidorov [2] (1955) in their synchrocyclotron experiments, but is its first application to proton synchrotron conditions. A proton beam is allowed to strike a carbon target and the charged mesons produced are detected in G-special emulsions placed to detect mesons emitted at different angles.

The bombarding protons are obtained in the following manner. A copper outside target is so placed in the machine that when the internal proton beam strikes it, that part of the beam which is scattered outwards at a small angle ($3^3/_4°$) emerges from the synchrotron through a thin stainless steel window at a point where the vacuum box changes from being composed of large sections (47 cm. wide) to small sections (35 cm. wide) [3]. Some of the internal beam which is scattered inwards through a smaller angle ($1^3/_4°$) goes round the machine once and also emerges through the same window and follows very nearly the same path as the beam scattered out directly. The effect of the fringing field brings these two beams to an approximate focus in a horizontal plane at about $1^3/_4$ metres distance from the window and about 30 cm. away from the outside wall of the synchrotron vacuum box. A channel of G.E.C. heavy alloy (density ~ 17) 35 cm. long, 5 cm. high and $2^1/_2$ cm. wide is placed immediately outside the stainless steel window.

The beam then travels in air and comes to a focus of size 1.2 cm. high by 5 cm. long (determined using X-ray films). The intensity of this beam at the focus is of the order of 3×10^4 protons per cm² per pulse. This is determined by exposing G 5 emulsions at this position.*

The carbon target is placed at the focus and is 1.2 cm. high, 1.25 cm. in depth and 17 cm. wide. For a 90° exposure (lab angle) a stack of 12 G-special stripped emulsions 12.5 cm. by 5 cm. by 400 μ (surrounded by 'pseudite') was placed above the target. The distance from the bottom of the emulsion to the target was 3.6 cm. For 600 Mev protons incident on protons the maximum energy of produced π mesons is 127 Mev in the C-system. The energy of a meson ejected at 90° in the laboratory system is then 100 Mev. The emulsion stack was surrounded by a large amount of heavy alloy shielding to

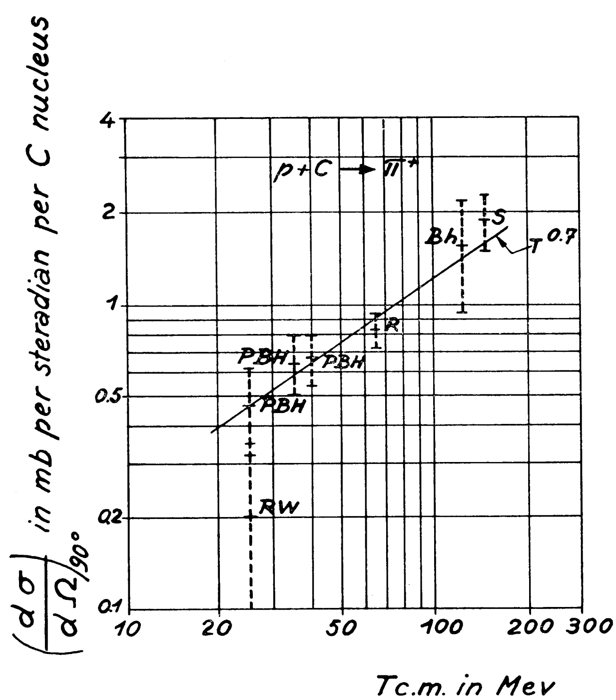

Fig. 1. Differential cross-section for π^+ production by protons on C under 90° (l. s.) as a function of the maximum available kinetic energy in the c.m.s. under the assumption of a free nucleon-nucleon collision

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reduce the general background of radiation from the synchrotron.

Preliminary results have been obtained for the 90° exposure. The differential cross-section is $1.6 \pm 0.7 \times \times 10^{-27}$ cm^2 per carbon nucleus; this is plotted on fig. 1 which gives $(d\sigma/d\Omega)_{90°}$ as a function of T.c.m., the maximum kinetic energy of a created π meson in the C-system, assuming a free nucleon-nucleon collision. The other results plotted are those of Richman and Wilcox at 340 Mev [4], Passman, Block and Havens at 340, 360 and 385 Mev [5], and Sidorov at 657 Mev [1]. The data are consistent with the statement that $(d\sigma/d\Omega)_{90°}$ varies as $T^{0.7}$ (or $\eta^{1.3}$ where η is the maximum momentum of the pion). The energy spectrum of the pions is substantially the same as that found by Sidorov.

A similar experiment is now being carried out at 800 Mev; exposures have been made at laboratory angles of 60, 90 and 125°, using both carbon and polythene targets.

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