A LARGE ČERENKOV COUNTER FOR THE DETECTION OF HIGH ENERGY PHOTONS AND ELECTRONS

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(presented by G. Bernardini)

A Čerenkov counter of the type already described by J. M. Cassels has been used at Illinois for the detection of high energy photons (180 Mev $\leqslant$ E $\leqslant$ 300 Mev) scattered by protons.

The Čerenkov radiator was made of two cylindrical pieces of leadglass of the type already mentioned. They were stuck together by Canada balsam. The index of refraction of the glass was n = 1.67, the characteristic radiation length was $\simeq$ 2.5 cm. The total length of the radiator was $\simeq$ 35 cm. Its diameter was $\simeq$ 30 cm. A lead screen (5 cm. thick) limited the effective aperture to 16.5 cm. Previous Monte-Carlo evaluations have shown that these effective dimensions were good enough to ensure the detection of a high energy photon or electron (E $\geqslant$ 100 Mev) with an efficiency of 100%. The light detection was obtained by twelve 5819 RCA phototubes symmetrically arranged on the back flat wall of the cylinder. The counter has been tested with monochromatic electrons obtained by magnetic deflection. The spread in momentum was $\approx \pm 1\%$. The electrons collimated by the coincidences between two small thin scintillator-counters (about $2.5 \times 2.5 \times 1\ \mathrm{cm}^3$) crossed the glass cylinder along the axis. The electron-energies are given in fig. 1.

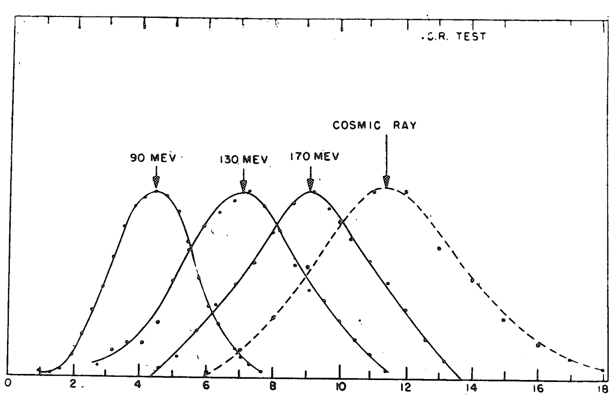

Fig. 1. Pulse height distribution for monochromatic electrons of several energies.

In fig. 1 the corresponding pulse-height distributions are presented together with that due to cosmic ray μ mesons, which crossed the glass cylinder more or less vertically to the axis. A supplementary test of the efficiency has also been done for electrons crossing the cylinder out of the axis $\simeq$ 8 cm. The efficiency was systematically found to be 100% without appreciable change in the pulse height distribution as can be seen in fig. 1. The peaks of the several pulse height curves have their expected relative positions. The widths, on the other hand, are quite large and much larger (at least twice as much) than those which could be predicted by the Monte-Carlo evaluations * where all

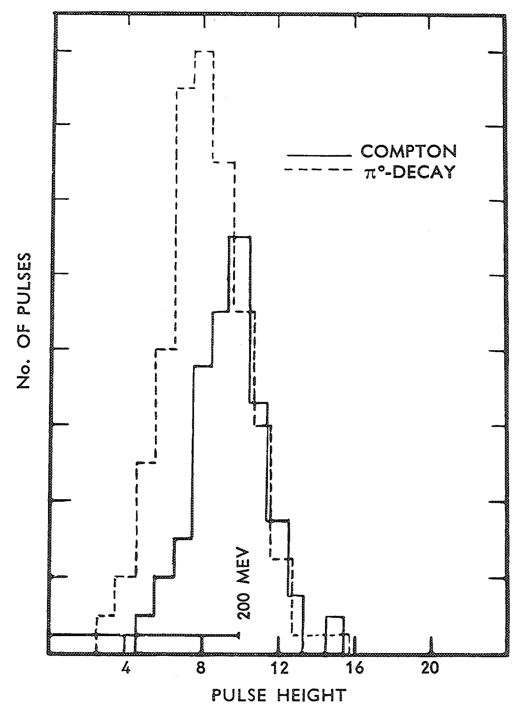

Fig. 2. Pulse height distribution for Čerenkov counter, ΔE_γ = 250-220
θ_γ = 120°

* The important contribution of Mr. Yoshimine to these evaluations should be mentioned.

photon-losses were neglected. They are essentially due to 1) the glass-absorption; 2) the lack of a good matching in the indexes of refraction of the several optical mediums involved; 3) the glass of the phototubes.

On actually comparing the curve of glass-transparency with that given by RCA for the cathode sensitiveness it was found that the overlapping is so poor that only $\approx 10\%$ or less of the produced photons can be considered as effective in producing electrons. The lack of matching in the refractive indexes reduces these residual photons by another factor of two or more. Thus it is plausible that the relatively large statistical fluctuations on the number of photo-electrons is the main cause of the enlargement of the pulse-height width.

This fact belongs to the category of difficulties which will be quickly eliminated by the improvement of the quality of the industrial products. Apart from these, it should be added that in performing the experiment on photon-scattering by protons the counter now described was found to be satisfactory in all respects. The elimination of the photoneutron background, the fast time-rise and its 100% efficiency make it an ideal tube for the detection of high energy photons and electrons.

An example is given in fig. 2. The two curves are respectively due: 1) to photons scattered by protons; see L.B. Auerbach et al., p. 291; 2) to photons coming out from π^0 decays. Both (scattered photons and π^0) being due to about the same interval of incident photons spectrum.