## Čerenkov Radiation Counter*

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GETTING[1] has proposed a high speed fast-particle counter using, to actuate a photo-multiplier tube, Čerenkov radiation[2] produced as a charged particle traverses a plastic rod. The advantages of such a system for fast counting, timing, and velocity measurement are evident. Furry has recently proposed a measurement of meson mass using a modification of the velocity measurement feature.[3]

A device similar to Getting's Fig. 3 was tried at Princeton last summer. The apparatus consisted of a Geiger counter, Lucite flared rod, lens system, and photo-multiplier, all in a vertical line. A fast charged particle would actuate the Geiger counter, then produce in the Lucite Čerenkov radiation which would in turn be detected by the photo-multiplier and associated amplifiers. The apparatus was run for 4500 hours between August 1, 1946, and October 18, 1946, with amplifier discrimination set at various levels; coincidence counts definitely attributable to Čerenkov radiation were not obtained.

Recently another attempt to demonstrate operation of the device was made using electrons generated in lead by x-rays from a 20-Mev betatron. In Fig. 1 is shown the arrangement of components. The x-rays strike a $\frac{1}{8}$-inch piece of lead; electrons and positrons generated therein pass down a collimating hole in a lead plug and then into the Lucite rod. Čerenkov radiation from the rod is focused onto the 1P28 photo-multiplier. The latter operates at liquid nitrogen temperature in an evacuated envelope not shown. Photo-multiplier pulses are fed from a cathode follower into a long transmission line, thence into a Los Alamos Model 501 amplifier. Pulses from the amplifier are fed into a scaler with a calibrated pulse height discriminator. The betatron, run at reduced intensity, was monitored by a Geiger counter.

Figure 2 shows the result of one set of measurements. Curve *A* represents the number of pulses greater than a certain height plotted against this height. Each point was taken for a definite Geiger-monitored x-ray flux. Curve *B* is obtained from *A* by subtracting dark pulses observed with the betatron off. Curve *C* is obtained from *B* by subtracting the x-ray background counts measured by interposing a thin piece of blackened cardboard between lens and photo-tube (Fig. 1). Curve *C* thus represents the distribution of photon pulses. As a check on "pile up" a run was made with betatron intensity reduced by a factor of 2.5; the resulting photon distribution is represented by the circles in Fig. 2.

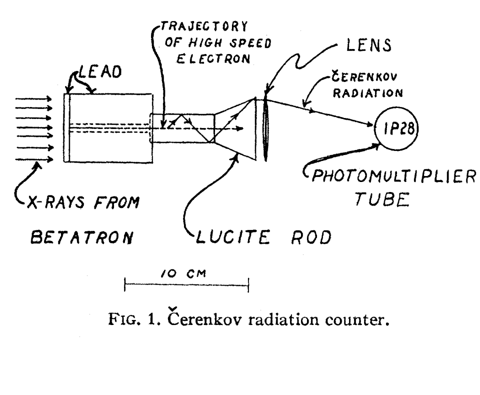


FIG. 1. Čerenkov radiation counter.

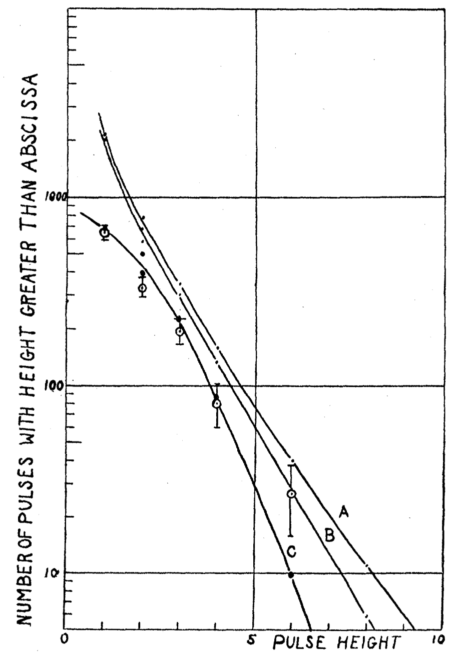


FIG. 2. *A*—total pulses. *B*—total pulses minus dark pulses. *C*—light pulses (total minus dark minus x-ray background). Circles—light pulses from reduced intensity run.

Curve *C* is in agreement with the energy distribution of electrons produced in lead by bremsstrahlung from 20-Mev electrons. Comparison of curve *C* with the distribution of pulses from single photons (unfortunately not taken at the same time) indicates probably no more than 5 photo-electrons in the largest pulses. This is about $\frac{1}{4}$ of the computed[2] maximum (for photoelectric efficiency see RCA Tube Manual).

In conclusion it can be stated that photon pulses are obtained from the counter shown in Fig. 1. The data are in reasonable agreement with the hypothesis that the photon counts are caused by Čerenkov radiation. Considering the geometry of the counter it seems unlikely that fluorescence is an important source of photons. However, fluorescence cannot be definitely ruled out as a contributing factor.

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[3] W. H. Furry, Bull. Am. Phys. Soc. **22**, No. 2, p. 27 (1947), to be published in *The Physical Review*.