Gap Density Measurements in Nuclear Emulsions.

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(riccuto il 2 Agosto 1955)

Summary. — The technique of gap counting has been extended by using measurements of the variation of the number of gaps with range. This extension is particularly useful in heavily developed G5 emulsions.

In machine exposures where background radiations are often of high intensity, it is sometimes expedient to use heavily developed emulsions in order to render light particles outgoing from K-particles and hyperons more apparent in scanning. Although heavy development has made grain counting of ending particles more difficult at short ranges, this has not generally been of importance since the particles could be provided with adequately long ranges by directing them along the lengths of the emulsion strip (1). In some cases, however, tracks which have emerged from stars produced in the emulsion were too short for grain density measurements and it was then necessary to resort to gap length measurements. The present note is concerned with some features that have become apparent in the method of gap counting in heavily developed emulsions.

Proceeding in the usual way (2) of determining gap lengths, it was observed that on account of the heavy development of the emulsions, the numbers and lengths of gaps starting from the ends of the tracks were so small and the

(*) Assisted by the joint program of the U. S. Office of Naval Research and the U. S. Atomic Energy Commission. Assisted also by a grant from the University of Illinois, Graduate College.


consequent statistical fluctuation so large that no clear separation of K-particles and protons was possible for less than 2-3 mm of track length. Examples of such observations are given in Fig. 1 where gap lengths per 100 μm of track are plotted vs range. Included on the same plot are three π-mesons (solid points), two K-mesons (open circle points) and two protons (solid triangle points). A minimum gap-length cut-off of 30 divisions (0.64 μm) was used, and for our emulsions the mean gap length for plateau-ionization tracks was 3.0 μm. A best line was fitted to the pion points and the K-meson and proton lines were drawn according to the known mass ratios of these particles to the π-meson.

Instead of continuing gap length measurements to large ranges, numbers, only, of gaps greater than a certain cut-off minimum were measured. This is essentially the same as counting blobs, except that by imposing a condition of a minimum gap length on the counting, all the advantages of compensating for finite resolving power losses and for subjective observational errors, as well as of allowing for dipping tracks, are gained. Examples of such observations taken in this way are given in Fig. 2, where three cases of π-mesons, three cases of K-particles and two cases of protons are plotted together. Each point represents the number of gaps (per 100 μm) greater than 30 divisions (0.67 μm) in length. It is clear from Fig. 2 that, although the statistical errors are still large (*), there is good discrimination between the different particles, and especially when counted at those ranges for which the gap densities are approximately the same. The ease of counting merely the number of gaps is a great advantage.

Curves relating blob and grain densities vs range in G5 emulsions, for different degrees of development, have been given by O’Ceallaigh (2). The proton curve of Fig. 2 and the grain count curve for protons (4) agree with

(*) The variation of the number of gaps per 100 μm from the mean is everywhere only of the order or less than the square root of the mean number of gaps.
