RE-PRINTS

The Method of Shower Anticoincidences for Measuring the Meson Component of Cosmic Radiation

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THE meson intensity measured in counter experiments where absorbers are used to filter out the soft electronic component refers only to fast mesons. The slow mesons which get cut out by the absorber can so far be estimated only indirectly, as, for instance, by the method adopted by Auger[1] and Greisen.[2] There is evidence, however, that the proportion of slow mesons increases rapidly with altitude, and it would be of great advantage if there were a direct method for measuring the total meson intensity. Bhabha[3] has recently suggested on grounds of reducing the weight of lead carried by balloons measuring the meson intensity in the stratosphere that the production of secondaries by the electronic component can be used to advantage in cutting them out. But this principle could be used for the more important purpose of bringing for the first time the slow mesons in the field of direct experimental observations. While a great proportion of cosmic-ray electrons in the atmosphere are already associated with other ionizing particles, the number so associated can be increased by a lead plate of thickness corresponding to the maximum of the Rossi curve. By means of an anticoincidence arrangement working along with a vertical counter telescope, it is possible to exclude events in which associated particles arrive in the telescope. This can be done with side anticounters arranged as shown in Fig. 1*a*, but here the

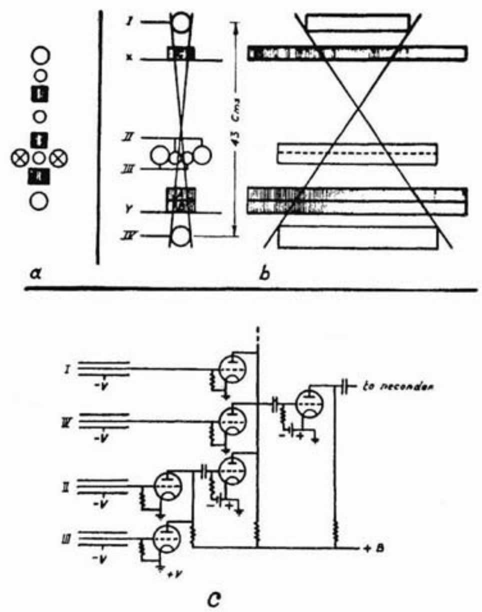

FIG. 1. *a*. Arrangement showing anticounters outside the main cone of measured radiation. *b*. Arrangement used for measuring shower anticoincidences. *c*. Basic circuit for registering shower anticoincidences.

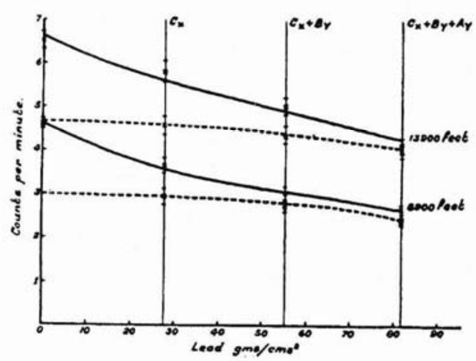

FIG. 2. Curves showing for two altitudes the absorption of the total intensity measured by coincidence rate I, IV (full line) and the meson intensity measured by shower anticoincidence rate I, IV-(II, III) (broken lines).

main cone of measured radiation is not utilized for detecting the showers and those that are generated in the lead above on account of their narrow angular spread might avoid detection. The actual arrangement used is shown in Fig. 1*b*, where the sets of counter II and III are used to register the showers. A shower coincidence II, III gives rise to an antipulse which is fed to the coincidences of the main telescope formed by counters I, IV. The lead placed in position X is to increase the associated soft particles, and the lead placed in position Y is to study the absorption of the radiation without interfering with the efficiency of shower anticoincidences. The basic circuit used has been shown in Fig. 1*c*.

Preliminary results obtained with this arrangement of the total intensity given by coincidences I, IV and the meson intensity given by shower anticoincidences I, IV-(II, III) at various altitudes up to 13,900 ft. in Kashmere illustrate the working of the arrangement. Figure 2 shows the absorption curve at two altitudes of these two counting rates with lead placed at positions X and Y. The difference between the two curves diminishes rapidly with increasing thickness of lead absorber as the electronic component gets progressively absorbed; and while the slope of the total intensity curve increases with diminishing thickness of lead, the slope of the meson intensity curve varies in an opposite direction. The tendency of the shower anticoincidence curve to become horizontal for zero thickness of lead is a striking indication of the fact that it measures chiefly the meson intensity. The altitude intensity curves from readings at 4 elevations in Kashmere at geomagnetic latitude 25°N show that above 10,000 ft. the meson intensity increases less rapidly than the total intensity and the atmospheric shower intensity. At 13,900 ft. the proportion of mesons was 64 percent of which about 18 percent consisted of slow mesons, but the accuracy of these estimates is not high. A full report of the results obtained at Kashmere and repeated with the same arrangement at Bangalore will appear shortly.[4]

The errors in this experiment might be due to three causes. Firstly, due to the contribution of side showers to the double coincidences that were measured. This would give an under-estimate of the proportion of electrons. Secondly, due to electrons of low energy which do not produce large enough showers to be detected and cut out by the anticoincidence arrangement, and lastly, due to mesons which are associated by other mesons or knock-on electrons and which get cut out by the anticoincidence arrangement. These two errors will tend to give an over-estimate of the proportion of slow mesons. With the help of an accurate experiment that is now being performed with quadruple coincidences measuring the vertical intensity, it is hoped to correct for these errors.

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[1] P. Auger, Phys. Rev. **61**, 684 (1942).
[2] K. Greisen, Phys. Rev. **63**, 323 (1943).
[3] Bhabha, Proc. Ind. Acad. Sci. (A), in press.
[4] Sarabhai, Proc. Ind. Acad. Sci. (A), in press.