Generation of the Soft Component of the Cosmic Radiation in Lead

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The Rossi transition curve as obtained for the soft component of the cosmic radiation in the atmosphere, is compared with the curves obtained with a 10-cm absorbing lead layer just above and 86 cm above a counter arrangement. The stronger maximum of the curve obtained with the lead layer in the higher position may be attributed to unstable neutral particles emerging from the lead layer.

THE recording of the variation of the shower rate with the thickness of material above shower-detecting counters shows a pronounced maximum at about 1.2 cm of lead. This maximum of the well-known Rossi transition curve is attributed to cascades of electrons and photons generated in the lead. After this maximum, the transition curve slopes down to a more or less constant low-intensity shower rate at larger thicknesses of lead. At and above about 10 cm of lead, the soft component of the cosmic rays generated in the atmosphere is completely absorbed and only a low intensity due to the hard component remains.

Underneath a lead absorber thick enough to absorb the electron-photon component of the cosmic rays in the atmosphere, a maximum shower intensity will again be obtained at 1.2 cm of lead for the radiation filtered by the absorber. This maximum must be due to electrons and photons generated by the hard component in the lead.

An experiment has been performed to obtain a relative measure for the maximum rate of shower production of the electron-photon component in the atmosphere and that generated in the lead. A set of eight Geiger counters covering a total horizontal area of 35.5 cm×18 cm was placed 6 cm underneath a roof of $\frac{1}{16}$ inch of flat galvanized iron. Directly underneath this set at a distance of 180 cm, a second set of nine Geiger counters covering a total horizontal area of 53 cm×35 cm was arranged. Threefold coincidences of the counters of the lower set were registered in coincidence with any counter of the upper set. A layer of lead was put directly above the lower set of counters. Only a fairly wide shower generated in this layer would cause a threefold coincidence.

The rate of threefold coincidence in coincidence with the upper counters recorded without any lead on the roof above the upper counter set as a function of the thickness of lead above the lower counter set, is represented by curve I of Fig. 1. Curve II was found with a 10-cm absorber of lead on the roof directly above the upper counter set, whereas curve III represents the same variation but with the 10-cm lead absorber 80 cm above the roof. Care was taken to have the solid angle extended by the sets of counters well covered by the 10-cm lead absorber.

Whereas curve I is due to showers initiated by the electron-photon component of the cosmic radiation in the atmosphere, shower curves II and III may be considered to be due to electrons and photons generated in the 10 cm of lead absorber. It is remarkable that the Rossi maximum is much stronger with the lead absorber further away from the sets of counters. This suggests that within the 86-cm distance between the lead

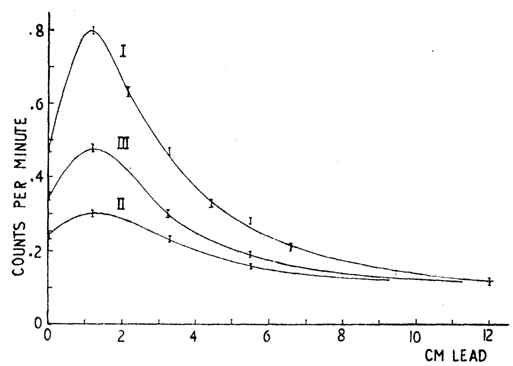

FIG. 1. Shower curves. I: Without lead absorber; curves II and III: 10 cm of lead absorber directly above and 86 cm above the sets of counters, respectively.

absorber and the upper counter set, electrons or possibly photons together with charged particles have resulted from neutral particles generated in the lead, initiating a pulse in the upper counter set and a coincidence pulse in the lower set. With the lead absorber just above the upper counters, the neutral particles caused no pulse in one of those counters. This conclusion is in accordance with the results found recently by Bothe and Kraemer.[1]

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[1] W. Bothe and H. Kraemer, Phys. Rev. 94, 1402 (1954).