

III-6-14. Some Features of Nuclear Interactions of Energy between 10^{12} and 10^{15} ev*

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1. The experimental material was obtained from the assemblies described in the communication to this conference by Duthie *et al.* (III-6-15)

2. The energy spectrum of electromagnetic cascades produced by nuclearactive particles was determined and can be represented by:

$$N(>E) = \text{const. } E^{-\beta}$$

The values of β are given in Table I.

Table I.

Exposure on	Altitude	$360 < E < 5000$ Bev	Fig.
Aircraft	220g/cm ²	$2.1 \pm .1$	1
Balloon	~ 30 g/cm ²	$1.9 \pm .2$	2

The experimental results are shown in Figs. 1 and 2 of III-6-15. The energy of each cascade was estimated from its maximum central density in the way described by Duthie *et al.*¹⁾. Effects due to the divergence of the initial γ -rays generating the cascade and due to secondary nuclear disintegrations alter the energy estimate only slightly. The energy estimates were corrected for fluctuations. Our present results of improved statistical weight do not confirm the change in exponent of the nuclear spectrum previously reported by us ($1500 < E < 4000$ Bev), Duthie *et al.*¹⁾. The different shapes of the nuclear and γ -ray spectra can be explained

by an increase in the effective multiplicity of high-energy γ -rays emitted nuclear interactions. We have also investigated the longitudinal and lateral developments of nuclear and γ -ray cascades.

3. The interaction mean free path of nuclear-active particles producing cascades in the energy range 400-1500 Bev has been measured, using a Bartlett-type analysis. The results correspond to an I. M. F. P. of 39 ± 12 cm in G-5 emulsion. The established value for 9 Gev protons is 37 ± 8 cm. Thus no variation of the M. F. P. with energy has been detected.

4. Five high energy ($> 10^{15}$ ev) nuclear interactions have been detected in several exposures. The angular distributions of the secondary particles, the energy radiated in the soft component and, in two cases, the energy spectra of individual photons have been measured.

5. Four cases of anomalous longitudinal development of very high energy cascades, apparently produced by single γ -rays have been observed. The frequency and degree of anomaly of these events is such that they cannot be explained by fluctuations.

References

- 1) J. Duthie, C. Fisher, P. Fowler, A. Kaddoura, D. Perkins, K. Pindau, and W. Wolter: Phil. Mag., **6** (1961) 89.

* This paper was read by C. F. Powell. No manuscript has been received and the preprint is reprinted.