Heavy Particle with Long Life in Cosmic Rays above $10^{15}$ eV.

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Summary. — Delayed showers are investigated for extensive air showers with primary energy above $10^{15}$ eV. The experimental results are reported on the delay time frequency, the correlation between the delay time and the distance from the core axis and the lateral distribution. It is concluded that the delayed showers are caused by a heavy particle. By taking a model in which the delayed shower originates from decay products of a heavy particle, the mass and lifetime are estimated as $(40 \pm 60)$ GeV/c$^2$ and $0.8 \cdot 10^{-6}$ s, respectively.

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In the energy region above $10^{15}$ eV extensive air showers (EAS) show some characteristic features as compared with the lower-energy region. Here we give some of them. A salient change is observed in the development of EAS at $10^{15}$ eV (1). The inelasticity becomes very high and the average transverse momentum ranges from a few to several tens of GeV/c, and heavy particles are expected to be produced as high-energy secondaries rather than multiple pions (2). There are penetrating showers observed as anomalous

bursts in underground experiments (3). Above $10^{15}$ eV air showers are accompanied with delayed showers (4,5).

It is the purpose of this paper to report on experimental results on the

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Fig. 1. – a) Two $1 \text{ m}^2$ fast scintillation detectors are telescoped. One is set under $1 \text{ m}$ concrete and $3 \text{ cm}$ lead and one above. The output from this is connected with the oscilloscope by using a coaxial cable. The recorder consists of a $35 \text{ mm}$ automatic camera. The output from this is connected with the oscilloscope by using a coaxial cable. The recorder consists of a $35 \text{ mm}$ automatic camera. b) Akeno air shower array $S$-1 station: $1 \text{ m}^2$ fast scintillation detector, $0.25 \text{ m}^2$ plastic scintillation detectors.

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