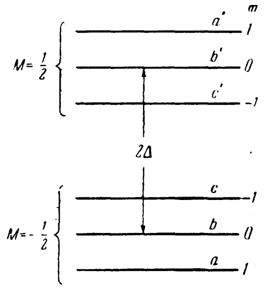

FIG. 1

lower one. Because of that, a signal of frequency $\nu_{a'b'}$ (or ν_{ab}) acting on the crystal should bring about stimulated atomic radiation (emission) at the same frequency. The above-mentioned frequencies will be of the order of 10^8 cps for ions of the iron group and approximately 10^9 cps for rare-earth ions. At $H_0 = 5000$ oe, $T = 2$ to 4°K, and $N = 10^{19}$ (number of paramagnetic ions), the stored energy for one pair of hyperfine levels (e.g., a′, b′) will be on the order of 1 to 2 ergs. When pulsing with pulse durations of 10^{-4} sec, the output power may reach 10^{-3} w.

Negative differences between the populations of lower and higher adjacent hyperfine levels appear also upon saturation of "forbidden" electron transitions (M, m) → (M+1, m−1) (cf. references 5 and 6).

In conclusion, the authors would like to thank A. S. Altschuler for helpful discussions of the results.

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A STUDY OF FAST DEUTERONS AT 3200 m ABOVE SEA LEVEL

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A study of cosmic ray deuterons was carried out at 3200 m above sea level (Mt. Aragats) using new and improved apparatus — a magnetic spectrometer used in conjunction with two multiplate cloud chambers.[1]

The deuterons were identified by their momentum as measured in the magnetic spectrometer, and by their ionization range in the lower cloud chamber. The new apparatus was different from all previous magnetic mass spectrometers in that it permitted, first, to distinguish properly between particles stopped ionization losses and those stopped by nuclear collisions and, second, to follow the paths of the particles in the upper chamber and to observe the events of local particle production in the matter of the chamber. The total equivalent of the chamber, including the top and the bottom, amounted to ~ 87.5 g/cm² Pb.

In all, ~242 deuterons with range in the lower chamber between 1.2 and 5.4 cm Pb were registered. Of these, 81 entered the chamber from the air, 104 were produced in nuclear processes in the matter of the top chamber, and the remaining 57 deuterons could not be traced in the upper chamber for various reasons (the tracks were invisible due to incidence upon non-illuminated region of the chamber, etc.). Simultaneously with these deuterons, ~3200 protons were detected.

The fraction of deuterons which came from the air, traversed the top chamber, and were stopped in the lower chamber within the stated range interval, amounts to 0.063 ± 0.0072 of the analogous number of protons, in agreement with references 2 and 3 (taking into account corrections for the optical aperture and nuclear absorption). If one considers the fraction of air deuterons compared with the number of protons of the same momentum range (1.2 to 1.39 Bev/c), the result, 0.086 ± 0.010, coincides with the data of Aivazian.[4]

An analysis fo the produced particles revealed that the number of deuterons produced by primary neutrons is (2.64 ± 0.62) times the number of

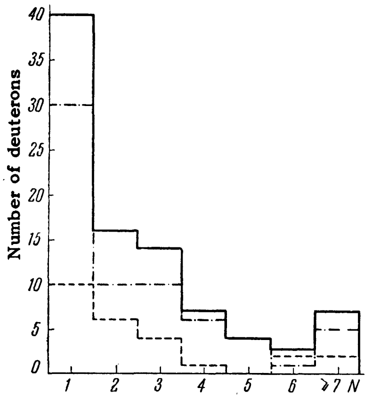

FIG. 1. Distribution of produced deuterons with respect to the number of prongs in the star (N). The dotted lines represent production by charged particles, dot-dash – by neutral particles, solid – total production.

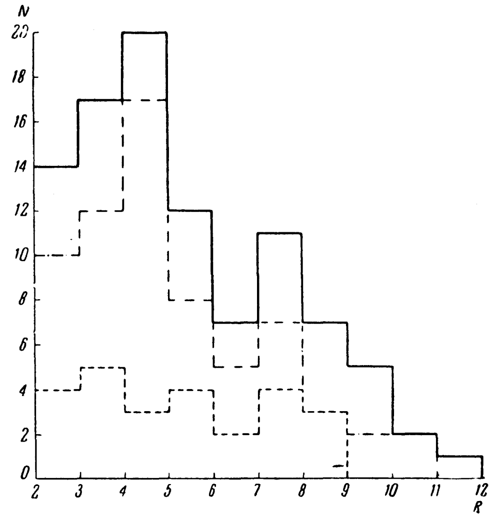

FIG. 2. Distribution of produced deuterons with respect to the total range R (cm Pb). Dotted line represents production by charged particles, dot-dash – by neutral particles, solid – total production.

proton produced deuterons. This is due to the fact that the deuterons are mainly produced in low-energy stars, for which the number of primary neutrons is larger than that of primary protons.

It follows from Figs. 1 and 2 that the number of produced deuterons decreases sharply with increasing number of prongs (energy) of the star, or with the total range of the deuteron itself. The ratio of deuterons produced by neutrons to deuterons produced by charged particles decreases also.

The momentum spectrum of deuterons produced in 1 g/cm^2 of matter, calculated by us with allowances for all the necessary corrections, is shown in Fig. 3. For $p \gtrsim 1$ Bev/c, the spectrum can be approximated by the expression

$$n(p)\,dp = (7.85 \pm 1.48) \cdot 10^{-7} \cdot p^{-3.14 \pm 0.44}\, dp \text{ particles/g-sec-sterad}$$

i.e., it is clearly somethat steeper than the spectrum of the primary producing particles.

An estimate of the cross section for the production of deuterons with momentum between 0.785 and 1.38 Bev/c in lead by cosmic ray nucleons with $E \gtrsim 200$ Mev, based on our data, yields the value $\sigma = 38 \pm 4.3$ millibarns. This is lower than that obtained in reference 5, where the primary particles possessed an energy of ≈ 90 Mev. The results obtained are in agreement with the conception of the direct or indirect "pickup" production of fast deuterons,[6,7] according to which the probability of deuteron production decreases with increasing energy of the incident nucleons.

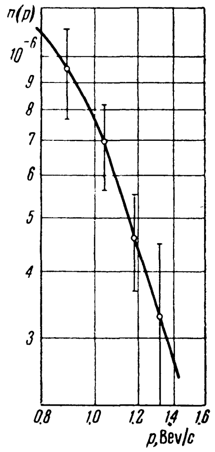

FIG. 3. Differential momentum spectrum of deuteron production.

A full presentation of the work will be given in Bulletin (Izvestria) of the Academy of Sciences, Armenian S.S.R.

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