

### 1.5. Production of fact nuclei of $A = 3$ together with hypernuclei induced by 1.5 GeV/c $K^-$ mesons on heavy nuclei\*

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In this work an analysis has been made of the production of helium nuclei and tritons of energy greater than 70 MeV in events with hypernuclei. The results of measurement of the helium nuclei show that the nuclei are predominantly  ${}^3\text{He}$ . The energy spectra and angular distributions of  ${}^3\text{He}$  nuclei and tritons are similar. The distributions of the total number of black and gray tracks ( $N_h$ ) for events in which fast  ${}^3\text{He}$  nuclei and tritons are emitted also are similar. These facts point out that the production mechanism of  ${}^3\text{He}$  nuclei and tritons is the same. In events in which an  $A = 3$  nucleus is emitted with energy higher than 200 MeV the number of detected cascade particles is lower than in events in which an  $A = 3$  nucleus is emitted with an energy in the interval 70–200 MeV. This difference in the number of cascade particles is most likely due to different mechanisms of their production. In this work the production mechanisms of these nuclei are discussed. It is shown that fast nuclei of  $A = 3$  most likely arise from the absorption of secondary  $\pi$  mesons and of the primary  $K^-$  meson in  ${}^4\text{He}$ -clusters present in the outer regions of heavy nuclei.

### 1.6. ${}^8_2\text{He}$ nuclei amongst hammer fragments in the interaction of $K^-$ mesons with emulsion nuclei

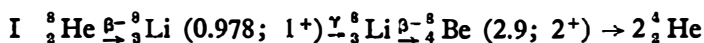
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An investigation has been carried out on fragments of a charge  $Z = 2, 3$  and 5 with the characteristic decay into two alpha particles and one electron, the so-called hammers in the interaction of 10.1 and 1.5 GeV/c  $K^-$  mesons and of  $K^-$  mesons at rest with emulsion nuclei.

Using the method of measuring track width and detecting 2 electrons, fragments have been found belonging to  ${}^8_2\text{He}$ . The yield production of these fragments is determined.

Theoretical investigations<sup>1,2)</sup> concerned with determination of the stability limits of light nuclei point to the possibility of the existence of  ${}^8_2\text{He}$  nuclei formed during rapid disintegrations of the heavy nuclei and emitted together with the fragments of different masses and charges.

There are two modes of decay proposed for the  ${}^8_2\text{He}$  nucleus:



\*Work published in Fizika 4 (1972) 77–85.

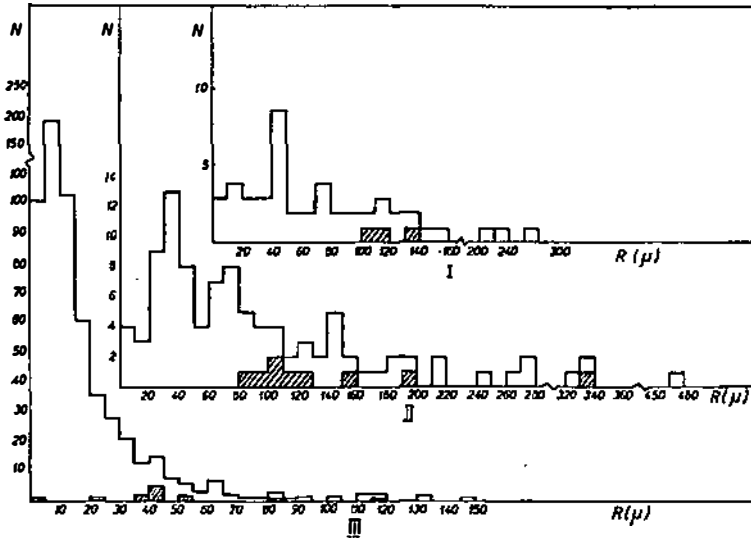


Fig. 1. The range distribution of hammer tracks in emulsions irradiated by:  
 I  $K^-$  10,1 GeV/c,  
 II  $K^-$  1,5 GeV/c,  
 III  $K^-$  low energy.

According to Paskanzer<sup>3</sup> et al. the probability of the first kind of decay is 88% for the second is 12%.

In nuclear emulsions, the first mode of the decay appears as a characteristic T-shape track, so called hammer, which is similar to those obtained for the  ${}^3_3\text{Li}$  and  ${}^8_5\text{B}$  nuclei. Such tracks can be separated determining the charge by the track-width measurement in the emulsion, or by the identification pairs at the decay vertex. Several papers<sup>4-7)</sup> have been published so far, with the aim to prove the existence of the  ${}^8_2\text{He}$  and to find out the frequency of its appearance. As the results obtained differ and the statistics is low, further work on this problem is still of interest.

TABLE 1

| $P_{K^-}$<br>GeV/c | Total stars<br>investigated | HAMMERS |                   |      |   |                          |              |    |        |
|--------------------|-----------------------------|---------|-------------------|------|---|--------------------------|--------------|----|--------|
|                    |                             | Found   | Electron emission |      |   | Track width measurements |              |    |        |
|                    |                             |         | 1 el              | 2 el | — | Number                   | With $z = 2$ |    |        |
| 0                  | 262 783                     | 616     | 511               | 83%  | 3 | ~0.5%                    | 82           | 13 | ~16%   |
| 1.5                | 15 300                      | 98      | 84                | 86%  | 1 | ~1%                      | 71           | 9  | ~12.7% |
| 10.1               | 6 660                       | 45      | 35                | 78%  | 0 | —                        | 25           | 3  | ~12%   |

In the present paper the interaction of 10.1 GeV/c, 1.5 GeV/c  $K^-$  mesons and of  $K$  mesons at rest with the emulsion nuclei, has been investigated. The track of stars were analysed to separate the events with the  ${}^8_2\text{He}$  hammers.

Three stacks of Ilford G-5 emulsion were used in this analysis; the first was exposed to the  $K^-$  mesons beam of 10.1 GeV/c, the second to the  $K^-$  mesons beam of 1.5 GeV/c and the third to the  $K^-$  mesons at rest. The irradiation carried out at CERN.

Identification of the hammers was performed by investigations the T-shape tracks taking into account the presence of an electron at the decay vertex and measuring the widths of hammer tracks.

The tracks of all hammers were carefully examined to identify electron pairs at decay vertices. In order to identify  $Z$  hammers only those ones were selected which satisfied following criteria:

- a) the projected range of the track should be  $R > 20 \mu\text{m}$ ,
- b) the dip in the processed emulsion should not exceed  $45^\circ$ , and
- c) the track should not lie within  $25 \mu\text{m}$  from either surface of the emulsion.

The widths of the tracks were measured by a well known method also developed by us<sup>8)</sup>.

The results of measurements are given in Table 1.

The range distribution of hammer tracks is shown in Fig. 1. the shaded aerea correspondes to  ${}^8_2\text{He}$ .

Investigations and measurements on hammers led us to the following conclusion: The percentages of  ${}^8_2\text{He}$  nuclei found by the two methods show significant differences; therefore the proportion of  ${}^8_2\text{He}$  obtained by the electron pair identification method, amounting to 0,5%, may be considered as the lower limit for the production rate.

TABLE 2

| Authors           | Primary particles   | Number of hammers | Number of ${}^8_2\text{He}$ |               |
|-------------------|---|-------------------|-----------------------------|---------------|
| Yu Batusov et al. | $\bar{u}^-$ at rest   | 7145              | 3                           | $\sim 0.04\%$ |
| Ct̄er et al.      | $K^-$ 1.5 50 GeV/c<br>$P^-$ 25 GeV/c<br>$\bar{u}^-$ 17 GeV/c<br>$\bar{P}^-$ 5.0 GeV/c | 1916              | 10                          | $\sim 0.5\%$  |
| G. C. Deka et al. | $\bar{u}^-$ 3.5 GeV/c   | 348               | 7                           | $\sim 2\%$    |
| M. Jurić et al.   | $K^-$ at rest   | 616               | 3                           | $\sim 0.5\%$  |

Our results are in good agreement with those found in the literature<sup>5)</sup> (Table 2).

## References

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- 3) A. M. Paskanzer et al. Phys. Rev. Lett. 15 (1965) 1030;
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- 8) M. Jurić et al. N. C. B8 (1968) 565.