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V.G.Ableev¹, A.P.Kobushkin², A.B.Kurepin¹,
D.K.Nikitin³, A.A.Nomofilov, N.M.Piskunov,
V.I.Sharov, I.M.Sitnik, E.A.Strokovsky,
L.N.Strunov, G.G.Vorobiev, S.A.Zaporozhets

**Δ -ISOBAR EXCITATION
IN CARBON NUCLEI AT $4.4 \div 10.7$ GeV/c
IN CHARGE-EXCHANGE REACTION (${}^3\text{He}$, t)**

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In the last years an important role is attributed to the consideration of non-nucleon degrees of freedom in nuclei, in particular of the excitations of a Δ_{33} -"nucleon hole" type ($\Delta - h$). It is important to investigate the properties of the $\Delta - h$ states at excitation energies about 300 MeV. At such the energy the on-mass-shell Δ -isobars may turn out to be bounded in a nucleus and to form an isonucleus^{/1/}.

We have investigated the ($^3\text{He}, t$) reaction at the JINR synchrotron at 4.36, 6.78 and 10.7 GeV/c using the ALPHA-spectrometer^{/2/} with momentum resolution $\approx 0.4\%$. Hydrogen data were obtained using the $\text{CH}_2\text{-C}$ method. The results of the absolute cross section measurements performed with the normalization accuracy $\lesssim 7\%$ are presented in the figure.

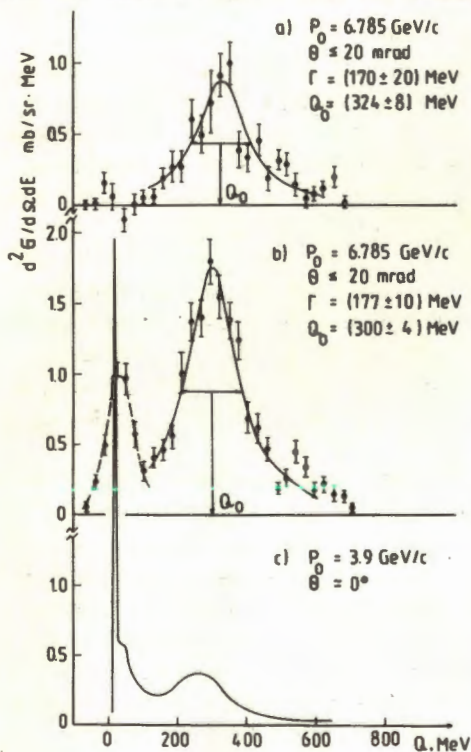
The triton spectrum obtained for the reaction on a carbon exhibits 2 peaks. There are a gaussian peak with $Q \approx 42$ MeV at $Q < 100$ MeV and a peak due to the excitation of the Δ -degrees of freedom (around $Q \sim 300$ MeV). The cross section, integrated over Q in the region of this peak, is about 490 mb/sr and about 5 times as large as the one under the 1-st peak of the spin-isospin excitations. Comparing our data with the Saclay one^{/3/}, one can see that the values of the last cross section remain almost unchanged with increasing of the beam momentum, while the cross section for the Δ -isobar excitation in nucleus increases more than 7 times when one goes from 3.9 to 6.78 GeV/c. At 10.7 GeV/c the form of the spectrum is almost entirely determined by the Δ -excitations in a nucleus. In this connection it is worthwhile to note that the "elementary" reaction of the $pp \rightarrow n \Delta^{++}$ -type has a cross section which falls off as a power with increasing beam energy.

The triton spectrum obtained on hydrogen has a single peak which corresponds to the Δ^{++} -isobar production. We observed a shift (≈ 24 MeV) of this peak position to the higher Q values in comparison with that

on a carbon. Kinematically, the shift implies a larger "target" mass in the reaction on a nucleus than that in the ${}^3\text{He} p \rightarrow \Delta^{++}$ reaction.

We have not observed any P_{\perp}^2 dependence of the cross section on carbon in the region $P_{\perp}^2 \lesssim 0.013 \text{ GeV}^2/c^2$, while for the reaction on hydrogen it is consistent with the $\exp(-BP_{\perp}^2)$ law with the B of an order of $100 \text{ GeV}^{-2}/c^{-2}$.

In summary, our results for the $({}^3\text{He}, t)$ reaction on nucleus show that at momenta higher than $1.2 \text{ GeV}/c/\text{nucleon}$ the mechanism via the



Δ -degrees of freedom excitation is essential and at momenta higher than $\sim 3 \text{ GeV}/c/\text{nucleon}$ it becomes dominant.

Being taken together with the shift of the " Δ -peak" position on the nucleus relative to that on hydrogen, mentioned above, it could be interpreted as an indication to the collective nature of the Δ -excitations of a nucleus.

The $Q = E_{3\text{He}} - E_t$ dependence of the cross section of the reaction $({}^3\text{He}, t)$ on hydrogen (a) and carbon (b,c). The full lines in figs.(a,b) are the Breit-Wigner resonance formula fit. The dashed line in fig.(b) is the gaussian fit. The data presented in fig.(c) are taken from paper /3/.

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Аблеев В.Г. и др.

E1-83-486

Возбуждение Δ -изобар в ядрах углерода в реакции перезарядки ($^3\text{He}, t$) при $4,4 + 10,7$ ГэВ/с

Представлены предварительные данные о реакции ($^3\text{He}, t$) на ядра водорода и углерода при импульсе ядер гелия-3 6,78 ГэВ/с, полученные на синхрофазотроне ОИЯИ.

Обнаружено, что при этом импульсе основным механизмом реакции ($^3\text{He}, t$) на ядре является возбуждение Δ -изобары в ядре.

Из сравнения с данными при $4,4$ и $10,7$ ГэВ/с, полученными в этом же эксперименте, а также данными Сакле при $3,9$ ГэВ/с следует, что с ростом энергии снаряда роль механизма с возбуждением Δ -степеней свободы в ядре резко возрастает. При $10,7$ ГэВ/с он практически целиком определяет сечение этой реакции, тогда как при промежуточных энергиях /Сакле/ заметный вклад в сечение перезарядки вносят также и спин-изоспиновые возбуждения ядерных уровней в ядре отдачи.

Полученные данные указывают на коллективную природу Δ -возбуждений ядра.

Работа выполнена в Лаборатории высоких энергий ОИЯИ.

Препринт Объединенного института ядерных исследований. Дубна 1983

Ableev V.G.

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Δ -Isobar Excitation in Carbon Nuclei at $4.4 + 10.7$ GeV/c in Charge-Exchange Reaction ($^3\text{He}, t$)

The preliminary data on ($^3\text{He}, t$) reaction on hydrogen and carbon nuclei at helium-3 momentum of 6.78 GeV/c are presented. The data were obtained at Dubna Synchrophasotron.

It is found that at this momentum the main mechanism of the ($^3\text{He}, t$) reaction on a nucleus is the Δ -isobar excitation in the nucleus.

From the comparison with our data at 4.4 and 10.7 GeV/c, obtained in this experiment, and also with the Saclay data at 3.9 GeV/c, one can see that the mechanism via the Δ -degrees of freedom excitation in a nucleus becomes dominant with the beam energy increasing. At 10.7 GeV/c it almost entirely determines the reaction cross section, while at the intermediate energy (Saclay) the sizeable contribution to the reaction cross section stems from the spin-isospin excitations of a nuclear levels in the recoil nucleus.

This data indicates to the collective nature of the Δ -excitations in nuclei.

The investigation has been performed at the Laboratory of High Energies, JINR.

Preprint of the Joint Institute for Nuclear Research. Dubna 1983