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NUCLEAR PHYSICS B
PROCEEDINGS
SUPPLEMENTS

Relativistic Nuclear Physics in the 1m Hydrogen Bubble Chamber of LHE JINR

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General pecularities 1m HBC [1] and series investigation are presented. These works have been done in nuclear beams such as deuterium, ^{3}He, ^{4}He, ^{16}O at the proton synchrotron of the Laboratory of High Energy JINR (Dubna).

1. THE 1m HBC

The general scheme of the 1m hydrogen bubble chamber is shown in figure 1.

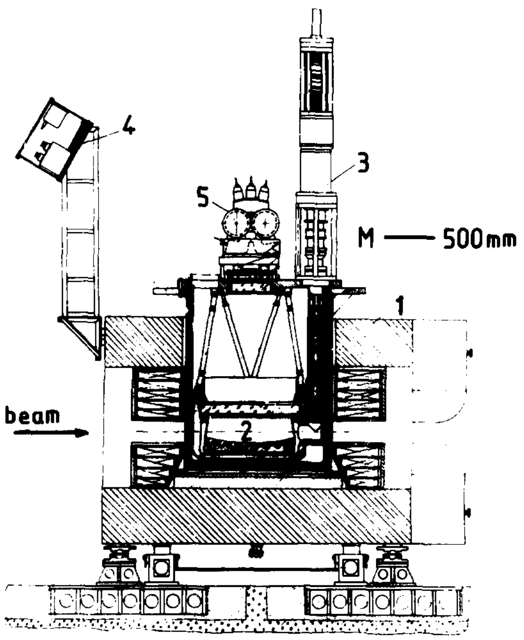

Figure 1. 1m hydrogen bubble chamber.
1. - Magnet of the chamber
2. - Bubble chamber
3. - Expanding piston
4. - Data box
5. - Cameras and light source

The principal pecularities of the chamber are:
a) low - vacuum dewar system, b) the illumina_ tion system with original total reflection prizmatic glass elements at the bottom of the chamber, c) 1,85 T magnetic field in the middle plane of the chamber.

The chamber operated at the JINR (Dubna) from 1966 till now. First exposition was made in 5 GeV/c π^-– beam, all next in beams of accelerated light nuclei (near two million foto).

The event with full desintegration of fluorine nucleus is presented for example in figure 2.

2. EXPERIMENTS

Series of investigation have been done in beams of nuclei such as unpolarised and vector polarized deuterons, ^{3}He, ^{4}He, ^{16}O at the proton synchrotron (JINR,Dubna). Hydrogen bubble chamber is at the same time a pure proton target and full solid angle detector. It allowes to study some reaction channels in exclusive approach.

Main directions of the investigation were:
- The spectators and wave functions [2]
- Virtual isobaric states [3]
- Charge exchange processes on the deuteron and spin flip [4]
- Final state interactions and coalescence [5]

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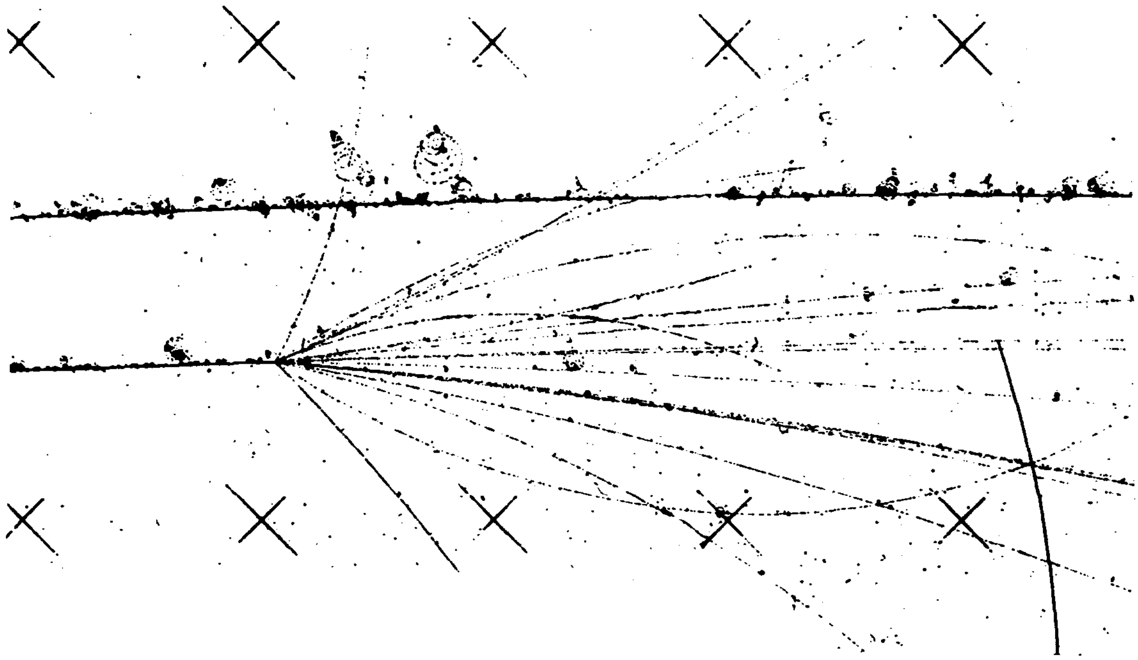

Figure 2. Full desintegration of fluorine nucleus.

- The dibaryon effects [6]
- Comparison of dp and np-interactions [7]
- Fragmentation of the nuclei on hydrogen [8]
- The investigations in the beams of polarized deuterons [9].

On the films from the chamber was working by the Collaboration consisting for near 200 physicist from 23 laboratories (12 countries). Only selected works it is possible to discusse in the short time, such as virtual isobaric states,final state interactions, fragmentation of nuclei.

Some of the results is usefull to demonstrate on example of the simplest nuclear reaction dp-->ppn at 3.35 GeV/c.

The invariant differencial cross section have an enchancement for protons flying backward in deuteron rest system (cosΘ[-1.,-0.66]) from the dp-->pX reaction above 0.2 GeV/c. This effect is stronger in charge-exchange reaction.

. The emission of protons is amplified relative to the emission of neutrons at an angle of 180^{o}, especially for the events with large transfered momenta ($x>T/T_{max}>0.5$). This p/n relation goes up to 5 from izotopic relation if full reaction goes throw intermediate isobaric state Δ..You can good see it on the next Figure3.

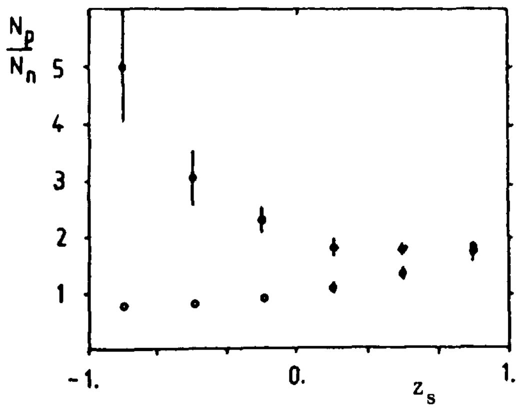

Figure 3. The ratio of slowest in the reaction dp-->ppn protons to neutrons versus $Z_S=\cos\Theta_S$:
o– x<0.5,
o- x>0.5.

Similar effects can be also seen in the interactions of the ^4He nucleus with protons. In particular, there is a qualitative difference in the behaviour of the invariant differencial cross sections of the reaction without and with pions.

We observed asymmetry in the angle between the fast proton 3-momentum transfer and direction of the spectator nucleon in the break-up reaction pd-->ppn. This asymmetry strongly dependence from the spectator momentum and four momentum transfer. We see it on the Figure 4.

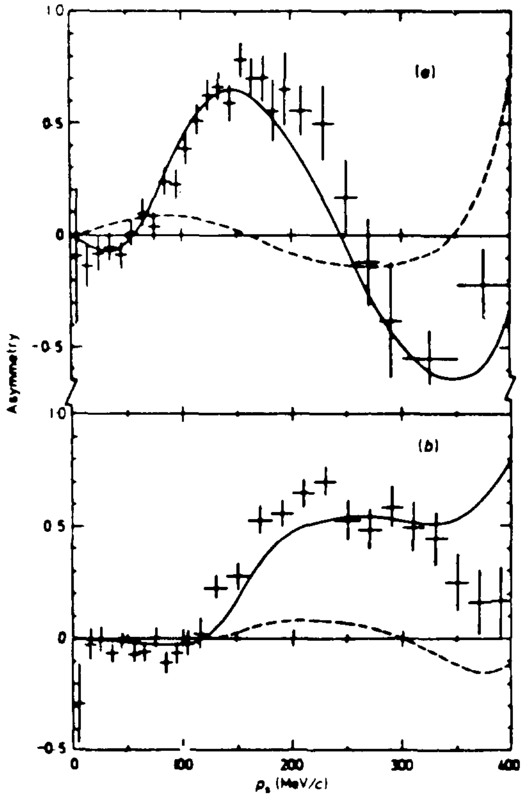

Figure 4. The asymmetry in the angle $\alpha = acos[(P_0 - P_f)P_s]/(|P_0 - P_f| \, |P_s|)$ with (a) $|t| < 0.1 (GeV/c)^2$ and (b) $0.1 < |t| < 0.4 (GeV/c)^2$. The full curve follows from the model with FSI, the broken one without.

The last expositions of the chamber were made in the beams of vector-polarized deuterons and oxigen nuclei.

We stadied multiplicity ,fragmentation, separation of hydrogen and helium isotopes. For example, in full desintegration of oxigen nuclei there are near 30% deuterons and 10% tritons; there are 90% α-particles in $^{16}O + p \to 4\,^4He + p$ reaction.

The hydrogen chamber is good model of interstellar space (1m liquid hydrogen at $\rho = 0.0584$ g/cm^3 is equivalent to 10^6 parsec). It is intresting for astrophysics to know a development of fragmentation process in hydrogen medium. We tried to make it on example of oxigen nuclei It is possible in frame of the one experiment to obtain the picture of change chemical composition of nuclear components from helium to oxygen.

The program of investigation on the chamber will be able to prolong in connection with sucsessful start new Dubna accelerator ("Nuclotron") and the accelerating nuclei up to uranium.

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