Experimental status of ^{6}H

There are 4 papers discussing 6H states observation “on the market”.

Paper 1

D. Aleksandrov, E. Ganza, Yu.A.Glukhov, B.G.Novatsky, A.A.Ogloblin, D.N.Stepanov, Yad. Fiz. 39 (1984) 513.

The 6H is searched in quite a complicated reaction 7Li(7Li,8B)6H reaction, which is “bidirectional transfer (-2p,+1n). One can see in the original plot that the statistics is poor, while the background conditions are very complicated. The 2.7(4) MeV energy for the 6H g.s. is assigned.

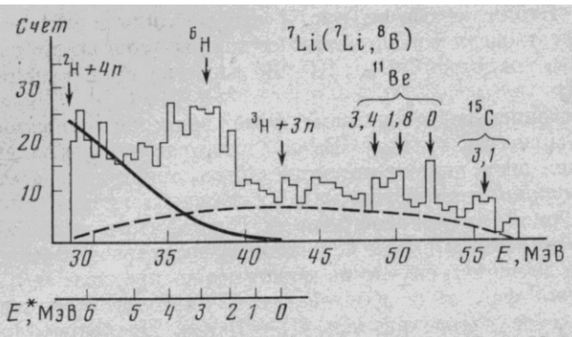


Рис. 1. Реакции ^{7}Li(^{7}Li, ^{8}B)^{6}H, спектр измерен при $E_{^7Li}$=82 МэВ, θ=10° л.с.; сплошная кривая соответствует расчету пятичастичного фазового пространства для развала ^{7}Li+^{7}Li→^{8}B+^{3}H+3n, штриховая кривая – распределение фона наложенных событий. Стрелками обозначены состояние ^{6}H и пороги образования ^{3}H+3n, ^{2}H+4n. Верхняя шкала – энергия вылетающей частицы ^{8}B. Нижняя шкала – энергия возбуждения, отсчитанная от нулевой энергии связи ^{6}H

Paper 2

A. Belozyorov, C. Borcea, Z. Dlouhy, A. Kalinin, R. Kalpakchieva, N. H. Chau, Y. Oganessian, Y. Penionzhkevich, Nuclear Physics A 460 (1986) 352–360.

Important feature of this experiment is limited energy range, resulting in a kinematical cut-off straight lower than 52 MeV in this plot (this cut-off is “masked” by the left frame of the figure). The 2.6(5) MeV energy for the 6H g.s. is assigned. It is clear that the 2.6 MeV “peak” (also having a marginal statistical significance) could be easily induced by the energy cut-off.

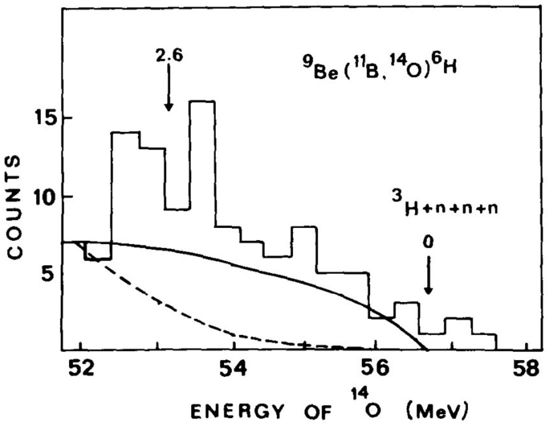
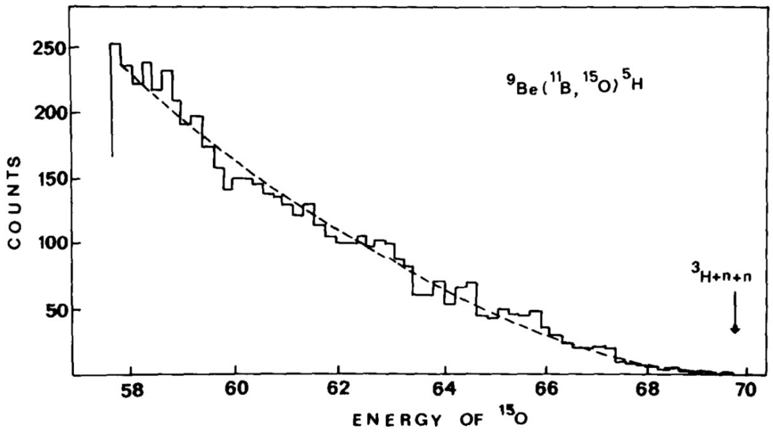


Fig. 5. Energy spectrum of ^{14}O ions from the ^{9}Be(^{11}B, ^{14}O)^{6}H reaction. The phase space corresponding to the five-body exit channel (^{15}O + ^{3}H + n + n + n) is shown by a dashed line. The phase space corresponding to the three-body exit channel (^{15}O + ^{5}H + n) is shown by the full line.

Important doubts on this result are also shed by non-observation of 5H in this type of experiment. 5H is a "natural part" of 6H and it is very curious, how it is possible to populate 6H without 5H population...



Paper 3

Y. Gurov, B. Chernyshev, S. Isakov, V. S. Karpukhin, S. Lapushkin, I. V. Laukhin, V. A. Pechkurov, N. O. Poroshin, V. Sandukovsky, The European Physical Journal A 32 (3) (2007) 261–266.

The search for 6H is performed in the pion-absorbtion reactions on 9Be and 11Be targets. In the first case the lowest 6.6 MeV state in 6H is fitted to some distortion on the left slope of the 10.7 MeV peak. In the second case the 10.7 MeV state is not observed at all, while the 7.3 MeV peak can be seen as consistent with the possible scale of statistical fluctuations.

Table 1. States in ^{6}H relative to the t+3n threshold (the energies and widths of the states are given in MeV).

Reaction channel			
$^{9}Be(\pi^{-},pd)^{6}H$		$^{11}B(\pi^{-},p^{4}He)^{6}H$	
E_r	Γ	E_r	Γ
6.6 ± 0.7	5.5 ± 2.0	7.3 ± 1.0	5.8 ± 2.0
10.7 ± 0.7	4 ± 2	–	–
15.3 ± 0.7	3 ± 2	14.5 ± 1.0	5.5 ± 2.0
21.3 ± 0.4	3.5 ± 1.0	22.0 ± 1.0	5.5 ± 2.0

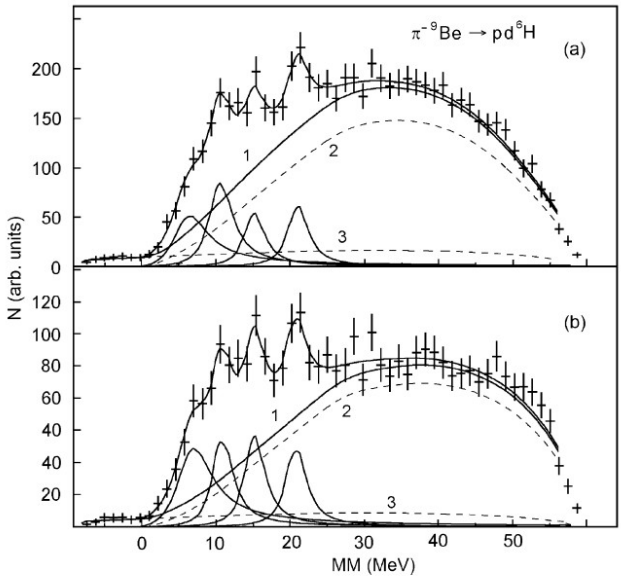


Fig. 4. Missing-mass spectra for the $^9Be(\pi^-, pd)X$ reaction: (a) without and (b) with restriction on the momentum of residual nuclei. The solid lines are the fit and the Breit-Wigner distributions. Curve 1 is the sum of space phase distributions; curve 2 is the phase space distribution for the breakup of ^9Be into $p + d + {}^4H + {}^2n$; curve 3 is the background from accidental coincidences.

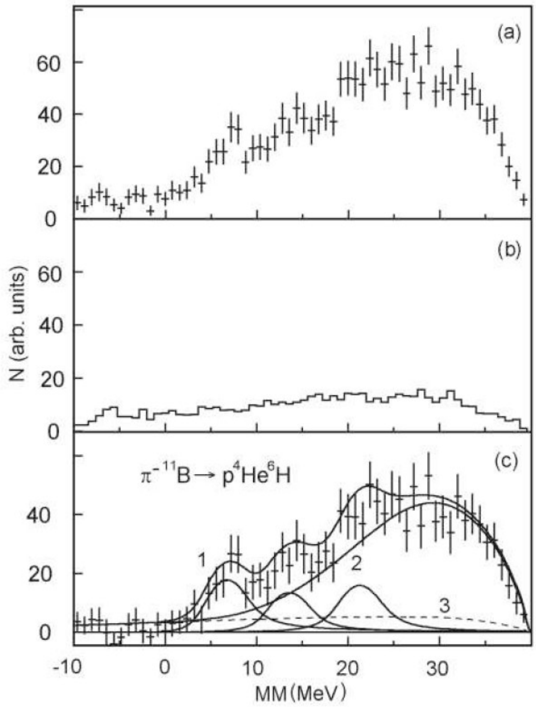


Fig. 5. Missing-mass spectra for the $^{11}B(\pi^-, p^4He)X$ reaction: (a) spectrum measured on the ^{11}B target; (b) spectrum for the $^{12}C(\pi^-, p^4He)X$ reaction (the spectrum is normalized to the content of impurity ^{12}C in the ^{11}B target); (c) spectrum resulting on subtraction of the impurity contribution. The solid lines are the Breit-Wigner distributions, curve 1 is the fit; curve 2 is the sum of phase space distributions; curve 3 is the background from accidental coincidences.

Paper 4

M. Caamano, D. Cortina-Gil, W. Mittig, H. Savajols, M. Chartier, C. E. Demonchy, B. Fernandez, M. B. Gomez Hornillos, A. Gillibert, B. Jurado, O. Kiselev, R. Lemmon, A. Obertelli, F. Rejmund, M. Rejmund, P. Roussel-Chomaz, and R. Wolski, PHYSICAL REVIEW C 78, 044001 (2008).

The search for the heavy H isotopes in this experiment was performed by impinging the 8He beam on a isobutane (C4 H10) gas target in TPC. The 3H fragment was identified outside the TPC. The mass identification for N isotopes in the TPC was not possible. Therefore there was no channel identification and the reactions

12C(8He, 7H → 3H+4n)13N,
12C(8He, 6H → 3H+3n)14N,
12C(8He, 5H → 3H+2n)15N,

can not be distinguished. All the events observed in this work can belong either to 5H or to 6H or to 7H and there is no method to distinguish, which event belongs to which nuclide. Therefore all 3 MM spectra were constructed simultaneously.

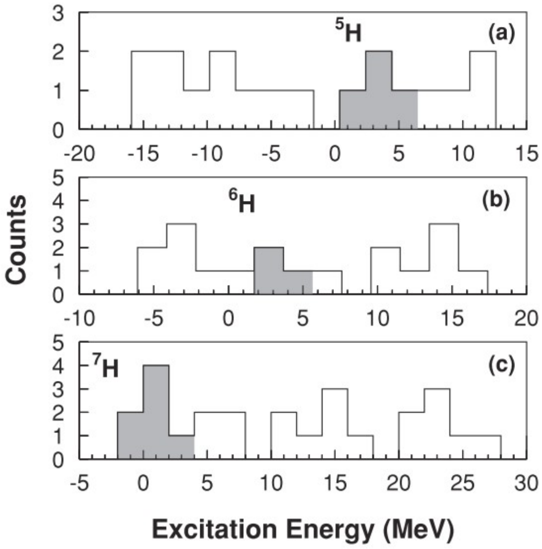


FIG. 7. Excitation energy distributions calculated under the assumptions of (a) ^{5}H, (b) ^{6}H, and (c) ^{7}H production channels. The grey histograms in the ^{5}H and ^{6}H channels correspond to those events lying in the regions where the resonances were already observed in previous experiments. The grey histogram in the ^{7}H corresponds to those events identified as ^{7}H production. See text for details.

The 6H g.s. energy was assigned in this work as $2.91^{+0.85}_{-0.95}$ MeV with a resonance width of $1.52^{+1.77}_{-0.35}$ MeV (see Fig. 10). It was done by ASSUMING that 5 events observed in the range from 0 to 7.5 MeV are all representatives of THE SAME 2.6-2-7 MeV 6H g.s. suggested by [Aleksandrov] and [Belozyorov]. It should be also kept in mind that the individual energy resolution of these events is DIFFERENT and UNKNOWN and vary between 1 and 6 MeV ("average" value of 2.5 MeV was assumed in the analysis). For example, according to kinematics for 8He beam at the energy of 123 MeV, for recoil angle of 30 degrees the energy of 14N at E(6H) = 2.9 MeV is equal to 3.94 MeV while the energy of 13N at E(7H) = 0.57 MeV is 2.85 MeV. So, within energy resolution of the experiment there is no way to distinguish these two events.

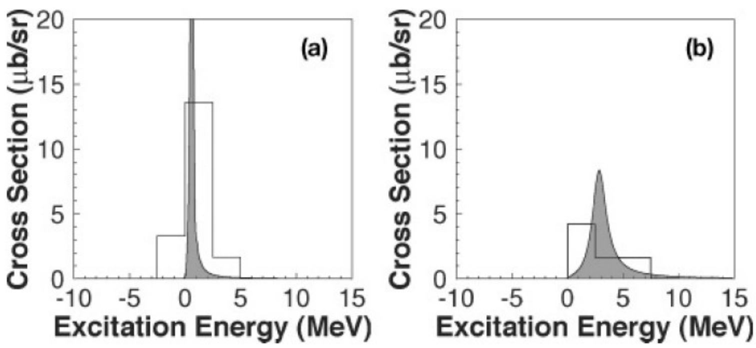


FIG. 10. Excitation energy distribution for the identified (a) ^{7}H and (b) ^{6}H events. The solid function is the Breit-Wigner distribution resulting from the fit to the experimental events. The data is represented with the empty histograms, merely as a guide to the eye, with a 2.5 MeV binning corresponding to the average estimated uncertainty.