ASTROPHYSICAL S-FACTOR of p^3H RADIATIVE CAPTURE

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Let us consider the possibility of description of S-factor of radiative p^3H capture in the potential cluster model with forbidden states. The calculations of differential cross-sections of p^3H decay of ^4He nucleus were made in the frames of this approach [1]. In work [2] we calculated the total cross-sections for this process on the basis of the potential cluster model, where it is considered that the main contributions to E1 cross-section of photodecay of ^4He into p^3H channel or radiative p^3H capture are made by processes with isospin change $\Delta T=1$. That is why, we may use $^1P_1$ potential of scattering with "pure" isospin with T=1 singlet state of p^3He system and potential of the ground «pure» state of ^4He nucleus with T=0 for p^3H system [2].

Since there are several variants of phase shifts analyses for $^1P_1$ singlet and $^3P_1$ triplet waves, the parameters of potentials are chosen so that they would lead to a kind of a compromise between the different phase shift analyses. There are no ambiguities in finding phase shifts of p^3H system and they lead to certain parameters of interaction "mixed" by isospin and Young shemes [2]. The "pure" phase shifts of p^3H scattering are constructed on the basis of known phase shifts in p^3He and p^3H systems and the "pure" potentials of p^3H interaction, shown in Table, are obtained.

The "pure" potentials of p^3H interaction in accordance with Young schemes [2] in a singlet channel. E_{BS} – calc. energy of the BS, E_{EXP} – its exp. value.

V_0, (MeV)	α, (fm^{-2})	E_{BS}, (MeV)	$E_{EXP.}$ (MeV)
-62.90714	0.17	-19.81400	-19.814

The calculation results of astrophysical S-factor at the energy range up to 10 keV, which we

did in work [2], are shown below in Figure. In Figure: blocks - experiment of works [3], points - [4], triangles - [5], circles - [6]. The experimental data are taken from works [3] and at that time only experimental data higher than 700 keV were known. Later on, the new experimental data of S-factor at the energy range up to 12 keV were given in works [4, 5, 6], also shown on the same Figure. It can be seen from Figure that the calculations which we did about 15 years ago give a good description of S-factor at the energy range up to 50 keV [2].

In this paper we continue these calculations and find S-factor at the energies up to 1 keV, which you can see in Figure. At the energy 1 keV its value equals 1.1(1) 10^{-3} keVb and the calculation results of its value at the energy range lower than 50 keV lie slightly below the new data [6], where for S(0) the value of 2.0(2) 10^{-3} keVb was received. The parameters of the ground state in p^3H system in ^4He nucleus were corrected in the process of calculation, the difference from the results of work [2] being 0.19289 MeV. It is basically due to the fact of using exact mass values of p and ^3H. For controlling calculation of bound energy of p^3H system the variational method was used, which allowed receiving the energy -19.81398 MeV. These results lead to a conclusion that the exact energy for this potential equals -19.81399(1) MeV.

Thus, we managed to predict the behavior of S-factor of p^3H capture at the energy range up to 50 keV, since our calculations in the energy range up to 10 keV were done about 15 years ago [2], when only experimental data higher than 700 keV were known [3]. Although, the results of calculations at lower energies are slightly lower than new data of works [6], these data have a relatively big error and it seems that they should be adjusted.

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