New reaction rates

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Work in progress....... (Just a compilation of the datasets used in NACRE, etc... with tentative error assignments.)

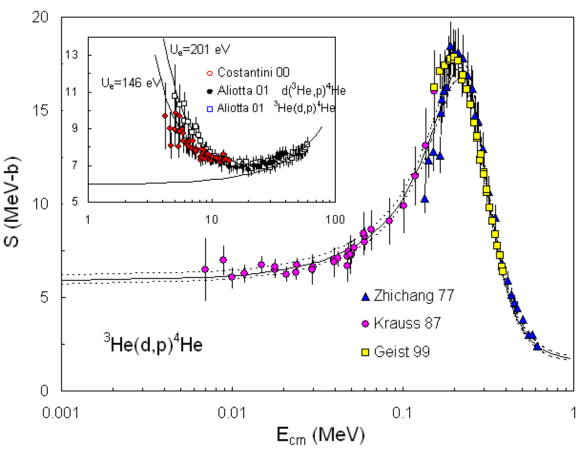

FIG. 1. ^{3}He(d,p)^{4}He S–factor from Descouvemont *et al.* [4].

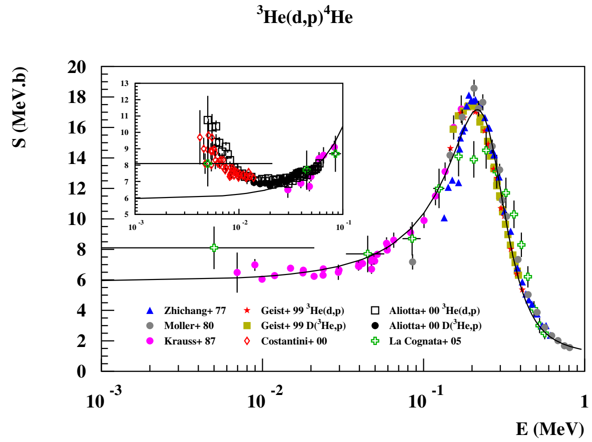

FIG. 2. ^{3}He(d,p)^{4}He S–factor, this work. The curve is from Descouvemont *et al.* [4].

I. THE ^{3}He(d,p)^{4}He DATA

The S–factor is related to the total cross section by

$$S(E) = \sigma(E)E\exp(2\pi\eta) = \sigma(E)E\exp\left(\frac{2.17446277}{\sqrt{E}}\right) \tag{1.1}$$

(MeV and barn units).

Figure 1 is taken from the online version of Descouvemont *et al.* [4]. The data that were used in this evaluation was collected again from the original source or from EXFOR [1] and are displayed in Fig. 2. Error bars may be different because, here, only statistical errors are shown while, systematic errors were, presumably, added to each data point by Descouvemont *et al.*. In addition, the Möller & Besenbacher [21] and La Cognata et al. [12], are also displayed. Other data sets obtained in the 50's can be found in Fig. 2 and are briefly discussed in § I H.

A. The THM, La Cognata et al. data

The S–factor data are taken from Table I in La Cognata *et al.* [12] where the errors (10–20%) include statistical and normalization errors as well as the error coming from the subtraction of the sequential decay contribution.

B. The Aliotta *et al.* data

The S–factor data for the ^{3}He(d,p)^{4}He direct, and D(^{3}He,p)^{4}He inverse reactions are taken from Tables 1 and 2 in Aliotta *et al.* [11] where the quoted uncertainties include only statistical and accidental (2.6%) errors, to which a systematic error of $\epsilon = 0.03$ (target pressure, calorimeter and efficiency) has to be added.

C. The Costantini *et al.* data

The S–factor data are taken from Table 1 of The Costantini *et al.* [10]: effective energy, S–factor, accidental and systematical error, found in the 3rd to 6th columns.

D. The Geist *et al.* data

The cross section data is presented in Fig. 5 of Geist *et al.* [9] and is available in tabular form from EXFOR [1] as

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communicated by the authors. There are three data sets, one for the ^{3}He(d,p)^{4}He direct reaction and two for the D(^{3}He,p)^{4}He reverse reaction, depending on the detected particle. Our Table I displays the ^{3}He(d,p)^{4}He S–factor (Eq. 1.1), while in Table II, is the weighted means of the p, and α, S–factors, both with statistical error only. The systematic uncertainties are obtained by adding quadratically, contributions from the d(d,p)^{3}H monitor cross section scale and fitting procedure (1.3 and 3%), the incident energy and energy loss (2%), and beam integration (2%), leading to $\epsilon = 0.043$.

TABLE I. Geist *et al.* [9] ^{3}He(d,p)^{4}He data

E_{CM} (keV)	S (MeV.b)
152.7	15.89± 0.12
164.5	16.76± 0.21
176.2	17.07± 0.14
188.0	17.36± 0.20
189.9	17.42± 0.07
199.9	17.39± 0.16
201.7	17.56± 0.09
211.7	17.38± 0.23
223.6	16.36± 0.21
225.5	16.63± 0.07
237.4	15.86± 0.12
249.3	15.08± 0.12
261.2	14.12± 0.10
273.2	13.30± 0.05
274.6	13.40± 0.05
285.1	12.18± 0.08
286.6	12.46± 0.08
297.1	11.52± 0.08
298.5	11.43± 0.06
308.9	10.47± 0.09
310.5	10.60± 0.06
322.4	9.65± 0.05
334.4	8.96± 0.03
346.3	8.27± 0.05
358.3	7.64± 0.04
370.2	7.13± 0.04
382.1	6.57± 0.04
388.0	6.31± 0.04

E. The Krauss *et al.* data

The Krauss *et al.* [7] experiments took place in Münster ($30 \lesssim E_{CM} \lesssim 171$ keV) and at Bochum ($7 \lesssim E_{CM} \lesssim 60$ keV). Table 3 in Krauss *et al.* [7] provides S–factors and statistical uncertainties. A normalization error of 6% comes from an absolute ^{3}He(d,p)^{4}He cross section measurement at $E_{CM} = 59.66$ keV, to which a 5% error of due to variations in the alignment of beam and jet target profiles has to be added for the the Münster data. Hence, we use $\epsilon = 0.06$ for the Bochum data and, following the authors, $\epsilon = 0.078$ for the Münster data.

TABLE II. Geist *et al.* [9] D(^{3}He,p)^{4}He data

E_{CM} (keV)	S (MeV.b)
146.8	14.64± 0.22
170.2	16.94± 0.23
178.0	16.63± 0.23
209.2	17.02± 0.22
217.0	17.02± 0.22
240.4	15.79± 0.21
252.2	14.90± 0.08
254.2	14.75± 0.06
271.7	13.27± 0.11
285.5	12.68± 0.12
302.9	10.69± 0.14
316.9	10.17± 0.11
348.2	8.01± 0.08
379.6	6.39± 0.07
410.8	5.35± 0.06

TABLE III. Krauss *et al.* [7] data

Bochum		Münster	
E_{CM} (keV)	S (MeV.b)	E_{CM} (keV)	S (MeV.b)
6.95	6.48±1.32	29.6	6.5±0.5
8.95	6.98±0.39	39.5	6.9±0.3
9.94	6.05±0.22	47.6	6.7±0.3
11.87	6.28±0.13	49.3	7.3±0.3
14.92	6.76±0.08	59.0	8.4±0.4
17.83	6.46±0.04	65.3	8.6±0.5
17.91	6.63±0.08	83.0	9.1±0.4
20.89	6.24±0.06	100.7	9.9±0.5
23.79	6.31	118.4	11.5±0.6
23.88	6.72	136.0	13.1±0.6
29.84	6.65	153.7	16.0±0.8
39.68	7.05	171.3	17.2±0.9
39.75	6.88		
41.78	7.08		
47.64	7.21		
47.75	7.46		
49.70	7.24		
53.69	7.67		
59.52	7.96		
59.66	8.26		

F. Möller & Besenbacher data

In this experiment, the D(^{3}He,p)^{4}He differential cross section was measured at two angles, relative to the d(d,p)^{3}H cross section. The total cross section is was calculated using the angular distributions from Yarnel et al. [17]. The statistical error is <3% except for the lowest energy (7%). The systematic error is estimated to be 3.9% (normalization, d(d,p)^{3}H cross section and anisotropy coefficient). The EXFOR cross section data [1] are presumably scanned from Fig. 3 [21]. The corresponding S–factors can be found in our Table IV.

TABLE IV. Möller & Besenbacher [21] data

E_{CM} (keV)	S (MeV.b)	Stat. (MeV.b)	Syst (MeV.b)
85.6	7.17	0.50	0.28
146.0	14.18	0.43	0.55
173.6	16.68	0.50	0.65
205.6	18.58	0.56	0.72
219.6	17.24	0.52	0.67
233.6	17.65	0.53	0.69
266.8	14.77	0.44	0.58
296.4	13.22	0.40	0.52
308.8	11.22	0.34	0.44
328.0	10.16	0.30	0.40
385.6	7.34	0.22	0.29
446.0	5.02	0.15	0.20
506.4	3.87	0.12	0.15
564.8	2.89	0.09	0.11
625.6	2.34	0.07	0.09
683.6	2.01	0.06	0.08
750.4	1.68	0.05	0.07
806.8	1.55	0.05	0.06

G. Zhichang *et al.* data

The Zhichang *et al.* [20] cross section data, reported in EXFOR [1], originate from a private communication from the authors; it corresponds to Fig. 2 in the original article (in chinese). The S–factors together with their statistical errors (0.6%) are reported in Table V. The systematic error is [1] $\epsilon = 0.034$, including uncertainty on target, solid angle and beam intensity. (Note that in one table of EXFOR, a 8% error is affected to the S–factor.)

TABLE V. Zhichang *et al.* [20] data

E_{CM} (keV)	S (MeV.b)
134.4±4.8	10.07±0.06
142.2±4.7	12.08±0.07
150.6±4.7	12.54±0.08
165.0±4.6	12.38±0.07
167.7±4.5	14.59±0.09
169.2±4.5	15.31±0.09
174.6±4.5	15.76±0.09
180.0±4.4	15.99±0.10
185.4±4.4	17.41±0.10
191.4±4.4	18.12±0.11
197.4±4.4	17.76±0.11
204.0±4.4	17.73±0.11
210.0±4.4	17.83±0.11
224.7±4.3	17.50±0.11
240.0±4.3	16.64±0.10
252.0±4.2	15.99±0.10
255.9±4.2	15.95±0.10
267.6±4.2	14.51±0.09
273.6±4.1	14.19±0.09
274.8±4.1	14.23±0.09
294.9±4.1	12.76±0.08
318.6±4.1	10.51±0.06
346.8±4.0	9.19±0.06
382.2±4.0	6.77±0.04
411.0±3.9	5.86±0.04
431.4±3.8	5.07±0.03
450.0±3.7	4.70±0.03
471.0±3.7	4.41±0.03
507.0±3.6	3.76±0.02
546.6±3.5	3.00±0.02
577.2±3.4	3.00±0.02
613.5±3.3	2.36±0.01

H. Other data

1. *Kunz data*

The cross section data [1] come from Fig. 4 in Kunz [19]. The errors are estimated to be 10% from 100 kev to 400 kev, and 5% from 400 to 800 kev.

2. *Arnold et al. data*

Table III in Arnold *et al.* [8], provides the ^{3}He(d,p)^{4}He ross section data from E_d = 36. to 93. keV with a detailed error analysis: 2.4–1.5% total, including 1.7–0.4% from statistics, finally inflated by a factor of 2, i.e. 4.8–3.0% (40–80 keV). The S–factor can be found in our Ta-

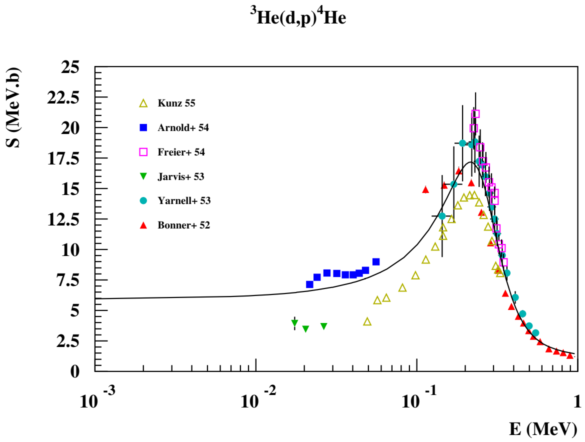

FIG. 3. ^{3}He(d,p)^{4}He S–factor, this work.

ble VI. Note however that it was suggested [6], that an unaccounted systematic error affected the d(d,n)^{3}He cross section measured in that same experiment.

TABLE VI. Arnold *et al.* [8] [^{3}He(d,p)^{4}He] data

E_{CM} (keV)	S (MeV.b)	Stat. (MeV.b)	Syst (MeV.b)
21.6	7.14	0.12	0.12
24.0	7.72	0.13	0.13
27.6	8.07	0.03	0.12
31.8	8.04	0.03	0.12
36.0	7.92	0.03	0.11
40.2	7.92	0.03	0.11
43.8	8.05	0.03	0.12
48.0	8.29	0.03	0.12
55.8	8.99	0.04	0.13

3. *The Freier & Holmgren data*

The cross section data is extracted [1] from Fig. 1 in Freier & Holmgren [18]. The reported errors are 8% and 15% for the S–factor and energy.

4. *The Yarnell et al. data*

The cross section (at 86°) [1] is extracted from Fig. 6 in Yarnell *et al.* [17] and has to be multiplied by 4π. The uncertainties on both the energy (3–14%) and cross section (5–26%) are large.

5. *The Jarvis & Roaf data*

The cross section data can be found in Table 1 of Jarvis & Roaf [16] for three energies but the origin of the errors (6–14%) is unclear and the technique (photographic plates) is dated.

6. *Bonner et al. data*

The cross section data is taken from Table I in Bonner *et al.* [15]. The statistical error is 1–2% and the systematic error is 3.2%. The S–factor can be found in our Table VII.

TABLE VII. Bonner *et al.* [15] data

E_{CM} (keV)	S (MeV.b)	Stat. (MeV.b)	Syst (MeV.b)
113.3	14.92	0.30	0.47
147.7	15.27	0.31	0.48
182.4	16.46	0.33	0.52
217.8	15.48	0.31	0.49
252.2	13.06	0.26	0.41
287.6	10.55	0.21	0.33
321.3	8.29	0.17	0.26
355.0	6.42	0.13	0.20
387.6	5.33	0.11	0.17
428.3	4.52	0.09	0.14
461.1	3.96	0.08	0.13
496.5	3.35	0.07	0.11
530.6	2.88	0.06	0.09
583.3	2.44	0.05	0.08
662.4	1.85	0.04	0.06
737.4	1.68	0.03	0.05
813.0	1.54	0.03	0.05
894.6	1.32	0.03	0.04
958.2	1.21	0.02	0.04

II. THE ^{3}H(d,n)^{4}He DATA

The S–factor is related to the total cross section by

$$S(E) = \sigma(E) E \exp\left(2\pi\eta\right) = \sigma(E) E \exp\left(\frac{1.08727243}{\sqrt{E}}\right) \tag{2.1}$$

(MeV and barn units).

Except for the most recent experiments, it is difficult from the publication only to disentangle relative from systematic uncertainties. In addition, several total cross section data sets used in NACRE's correspond in fact to differential cross sections at a single angle multiplied by 4π. They can hardly be put aside because of the

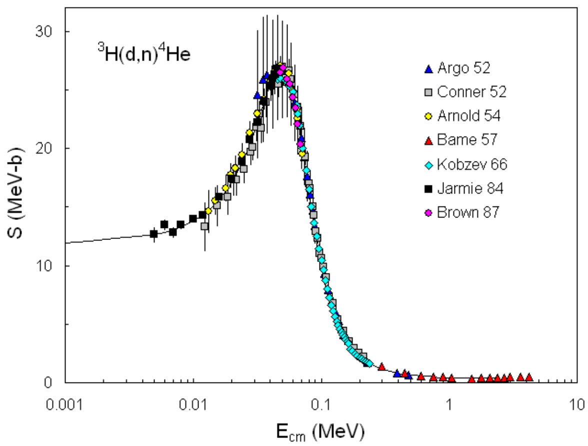

FIG. 4. ^{3}H(d,n)^{4}He S–factor from Descouvemont *et al.* [4].

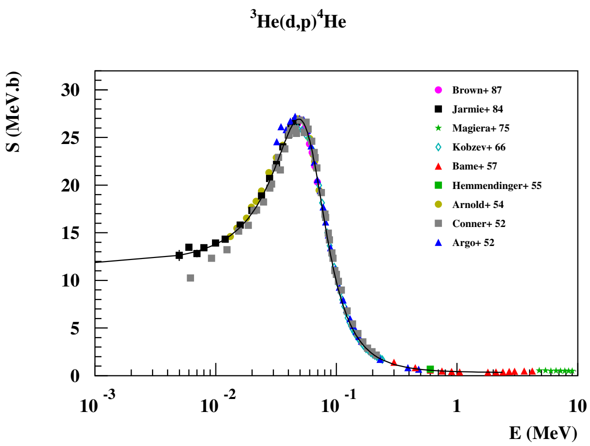

FIG. 5. ^{3}H(d,n)^{4}He S–factor, this work. The curve is from Descouvemont *et al.* [4].

otherwise scarcity of experimental data in the region of highest interest for BBN.

A. Brown *et al.* data

The S–factor data ($E_d = 80$ to 116 keV) is taken from Table I in Brown *et al.* [29] who quote a 0.8% relative error and a 1.4% scale error.

B. Jarmie *et al.* data

The S–factor data ($E_t = 12.5$ to 117 keV) is taken from Table VI in Jarmie *et al.* [28] together with the associated relative errors (0.5–4.6%) to which a 1.26% scale error has to be added.

C. Kobzev *et al.* data

Kobzev *et al.* [26] measured the ^{3}H(d,n)^{4}He cross section at 90° from $E_t = 115$ to 1650 keV. We follow NACRE [3] and DAACV [4] by assuming isotropy below 600 keV [22, 25] and calculate the total cross section by multiplying the differential cross section by 4π. The deduced S–factor can be seen in our Table VIII. The "total" error on the differential cross section is given to be 2% below 800 keV.

D. Bame & Perry data

The cross section data is taken from Table I in Bame & Perry [25] and the calculated S–factor are displayed in our Table IX. The statistical error is 1% while the "total" error is 5%. Even though the sources of errors are listed, it is not always obvious to assign them to systematics or not; e.g. 2% from density in different sealed targets. Nevertheless, since the S–factors are very small at these energies, the absolute errors remain very small.

E. Conner *et al.* data

The cross section data at 90° is taken from Tables I and II in Conner *et al.* [23] corresponding to different experiments at different accelerators. As for Kobzev experiment, we assumed C.M. isotropy below $E_d = 400$ keV [22, 25] and multiplied the differential cross section by 4π and calculated the corresponding S–factors reported in our Table X. A systematic error of 2% (solid angle+target) together with a 1.5% counting error are quoted (p. 472).

F. Hemmendinger & Argo data

The Hemmendinger & Argo data [24] consist of a single pout at $E_t = 1.5$ MeV : $\sigma = 280\pm8$ mb or $S = 0.684$ ±0.020 MeV.b.

G. Arnold *et al.* data

Table III in Arnold *et al.* [8], provides the ^{3}H(d,n)^{4}He ross section data from $E_d = 22.$ to 120. keV with a detailed error analysis: 1.8–1.4% total, including 0.2–0.1% from statistics, finally inflated by a factor of 2, i.e. 3.6–2.8% (20–100 keV). The S–factor can be found in our Table XI. The first four values (E_d <20 keV) in their Table III are just extrapolations and are not used here. Note again, as for the ^{3}He(d,p)^{4}He reaction, that it was suggested [6], that an unaccounted systematic error affected the d(d,n)^{3}He cross section measured in that same experiment.

H. Argo *et al.* data

The cross section data come from Table I in Argo et al. [22] and the calculated S–factor can be found in Table XII. They claim that "These data have an estimated overall accuracy of 10%" and their Fig. 4 doesn't show a significant scatter around their fit. Our Fig. 5 also shows that their data agree very well with those of Kobzev et al..

I. Magiera *et al.* and other high energy data

The cross section data is taken from Table 3 in Magiera *et al.* [27] data that includes the total error (6–7%), out of which 1.3% is attributed to the absolute normalization. Calculated (Eq. 2.1) S–factors, together with total uncertainties are found in our Table XIII. These data were used in NACRE but the covered energy range (>4.8 MeV) limits its usefulness. We leave aside other datasets [30–34] measured at energies above 1 MeV.

[1] `http://www.nndc.bnl.gov/exfor/exfor.htm`

[2] Y. Xu, K. Takahashi, S. Goriely, M. Arnould, M. Ohta, and H. Utsunomiya, Nucl. Phys. A **918**, 61 (2013).

[3] C. Angulo, M. Arnould, M. Rayet, P. Descouvemont, D. Baye *et al.*, Nucl. Phys. A **656**, 3 (1999) and `http:pntpm.ulb.ac.be/Nacre/nacre.htm`.

[4] P. Descouvemont, A. Adahchour, C. Angulo, A. Coc, and E. Vangioni-Flam, At. Data Nucl. Data Tables **88**, 203 (2004) and `http://pntpm.ulb.ac.be/bigbang/`.

[5] E. G. Adelberger, A. García, R. G. Hamish Robertson, *et al.*, Rev. Mod. Phys. **83**, 195 (2011).

[6] A. Coc, P. Petitjean, J.-Ph. Uzan, E. Vangioni, P. Descouvemont, C. Iliadis and R. Longland, Phys. Rev. **D92** (2015) 123526 (20 pages), `arXiv:1511.03843 [astro-ph.CO]`.

[7] A. Krauss, H.W. Becker, H.P. Trautvetter and C. Rolfs, Nucl. Phys. **A467** (1987) 273.

[8] W. R. Arnold, J. A. Phillips, G. A. Sawyer, E. J. Stovall, Jr., and J. L. Tuck, Phys. Rev. **93**, 483 (1954).

[9] W. H. Geist, C. R. Brune, H. J. Karwowski, E. J. Ludwig, K. D. Veal, G. M. Hale, Phys. Rev. **C60** (1999) 054003.

[10] H. Costantini, A. Formicola, M. Junker, R. Bonetti, C. Broggini, L. Campajola, P. Corvisiero, A. D'Onofrio, A. Fubini, G. Gervino, L. Gialanella, U. Greife, A. Guglielmetti, C. Gustavino, G. Imbriani, A. Ordine, P.G. Prada Moroni, P. Prati, V. Roca, D. Rogalla, C. Rolfs, M. Romano, F. Schümann, O. Straniero, F. Strieder, F. Terrasi, H.P. Trautvetter, S. Zavatarelli, Phys. Lett. B 482 (2000) 43-49.

[11] M. Aliotta, F. Raiola, G. Gyürky, A. Formicola, R. Bonetti, C. Broggini, L. Campajola, P. Corvisiero, H. Costantini, A. D'Onofrio, Z. Fülöp, G. Gervino, L. Gialanella, A. Guglielmetti, C. Gustavino, G. Imbriani, M. Junker, P.G. Moroni, A. Ordine, P. Prati, V. Roca, D. Rogalla, C. Rolfs, M. Romano, F. Schümann, E. Somorjai, O. Straniero, F. Strieder, F. Terrasi, H.P. Trautvetter, S. Zavatarelli, Nucl. Phys. A 690 (2001) 790-800.

[12] M. La Cognata, C. Spitaleri, A. Tumino, S. Typel, S. Cherubini, L. Lamia, A. Musumarra, R.G. Pizzone, A. Rinollo, C. Rolfs, S. Romano, D. Schürmann, F. Strieder, Phys. Rev. C72 (2005) 065802.

[13] S. Engstler, A. Krauss, K. Neldner, C.Rolfs, U. Schröder, K. Langanke, Phys. Lett. B 202 (1988) 179-184.

[14] P. Prati, C. Arpesella, F. Bartolucci, H.W. Becker, E. Bollotti, C. Broggini, P, Corvisiero, G. Fiorentini, A. Fubini, G. Gervino, F. Gorris, U. Greife, C. Gustavino, M. Junker, C. Rolfs, W.H. Schulte, H.P. Trautvetter, D. Zahnow, Z. Phys. A 350 (1994) 171-176.

[15] T. W. Bonner, J. P. Conner, A. B. Lillie, Phys. Rev. 88 (1952) 473-476.

[16] R.G. Jarvis, D. Roaf, Proc. R. Soc. Lond. A 218 (1953) 432-438.

[17] J.L.Yarnell, R.H. Lovberg, W.R. Stratton, Phys. Rev. 90 (1953) 292-297.

[18] G. Freier, H. Holmgren, Phys. Rev. 93 (1954) 825-826.

[19] W.E. Kunz, Phys. Rev. 97 (1955) 456-462.

[20] Electrostatic accelerator charged-particle nuclear reaction group, Atom. Ener. Sci. Tech. (1977) 129-134 (in Chinese); EXFOR/IAEA cites the authors as Li Zhichang, Yang Jingang, Ding Xunliang.

[21] W. Möller, F. Besenbacher, Nucl. Instrum. Meth. 168 (1980) 111-114.

[22] H.V. Argo, R.F. Taschek, H.M. Agnew, A. Hemmedinger, W.T. Leland, Phys. Rev. 87 (1952) 612.

[23] J.P. Conner, T.W. Bonner, J.R. Smith, Phys. Rev. 88 (1952) 468.

[24] A. Hemmendinger, H. V. Argo, Phys. Rev. 98 (1955) 70.

[25] S.J. Bame, Jr., J.E. Perry Jr., Phys. Rev. 107 (1957) 1616.

[26] A.P. Kobzev, V.I. Salatskii, S.A. Telezhnikov, Yad. Fiz. 3 (1966) 1060-1063 [Sov. J. Nucl. Phys. 3 (1966) 774-776].

[27] E. Magiera, M. Bormann, W. Scobel, P. Heiss Nucl. Phys. A246 (1975) 413.

[28] N. Jarmie, R.E. Brown, R.A. Hardekopf, Phys. Rev. C 29 (1984) 2031; Erratum: Phys. Rev. C 33 (1986) 385.

[29] R.E. Brown, N. Jarmie, G.M. Hale, Phys. Rev. C 35 (1987) 1999; Erratum: Phys. Rev. C 36 (1987) 1220.

[30] J.E. Brolley, Jr., J.L. Fowler, E.J. Stovall, Jr., Phys. Rev. 82 (1951) 502.

[31] Stratton T.F. and Freier G.D. Phys. Rev. 88 (1952) 261.

[32] A. Galonsky, C. H. Johnson, Phys. Rev. 104 (1956) 421.

[33] M.D. Goldberg, J.M. Le Blanc, Phys. Rev. 122 (1961) 164.

[34] D.K. McDaniels, M. Drosg, J.C. Hopkins, J.D. Seagrave, Phys. Rev. C 7 (1973) 882.

TABLE VIII. Kobzev *et al.* [26] data

E_{CM} (keV)	S (MeV.b)
46.0±1.1	25.93
48.0±1.2	25.96
52.0±1.3	25.76
56.0±1.4	25.28
60.0±1.5	24.77
64.0±1.3	23.66
66.0±1.3	22.85
68.0±1.4	21.89
72.0±1.4	19.98
76.0±1.5	18.14
80.0±1.6	16.53
84.0±1.7	15.01
88.0±1.8	13.65
92.0±1.8	12.50
96.0±1.9	11.41
100.0±2.0	10.45
104.0±2.1	9.59
108.0±2.2	8.76
112.0±2.2	7.98
116.0±2.3	7.28
120.0±2.4	6.65
124.0±2.5	6.08
128.0±2.6	5.61
132.0±2.6	5.23
136.0±2.7	4.89
140.0±2.8	4.60
144.0±2.9	4.32
148.0±3.0	4.11
152.0±3.0	3.88
156.0±3.1	3.69
160.0±3.2	3.50
164.0±3.3	3.32
168.0±3.4	3.15
176.0±3.5	2.83
184.0±3.7	2.62
192.0±3.8	2.42
200.0±4.0	2.26
208.0±4.2	2.13
216.0±4.3	2.00
224.0±4.5	1.89
232.0±4.6	1.79
240.0±4.8	1.69

TABLE IX. Bame & Perry [25] data

E_{CM} (keV)	S (MeV.b)
300.0	1.406
450.0	0.840
600.0	0.598
750.0	0.503
900.0	0.450
1050.0	0.410
1500.0	0.364
1800.0	0.379
2100.0	0.393
2400.0	0.412
2700.0	0.445
3000.0	0.464
3600.0	0.491
4200.0	0.497

TABLE X. Conner *et al.* [22] data

E_{CM} (keV)	S (MeV.b)
6.2	10.25
9.2	12.34
12.4	13.23
15.5	15.17
18.6	15.79
20.7	17.33
21.8	17.38
24.9	18.23
28.0	19.70
29.1	20.13
31.2	21.80
33.2	22.91
34.3	21.59
37.4	23.80
40.5	25.31
41.6	25.73
43.7	25.93
45.7	25.90
46.8	25.44
50.0	26.83
54.2	25.53
56.2	26.60
58.3	25.89
62.4	24.61
65.4	23.43
66.6	22.90
69.0	21.82
75.0	19.23
81.6	16.60
87.6	14.27
93.6	12.33
100.2	10.63
80.4	16.97
85.8	14.96
91.8	12.90
97.2	11.02
103.8	9.91
109.8	8.99
123.0	6.79
136.2	5.44
150.6	4.43
165.6	3.55
181.2	2.90
197.4	2.51
214.2	2.16

TABLE XI. Arnold *et al.* [8] [^{3}H(d,n)^{4}He] data

E_{CM} (keV)	S (MeV.b)	Stat. (MeV.b)	Syst (MeV.b)
13.2	14.61	0.03	0.26
15.0	15.49	0.03	0.28
18.0	16.55	0.02	0.25
19.8	17.70	0.02	0.26
21.6	18.30	0.02	0.27
24.0	19.38	0.02	0.29
27.6	21.31	0.02	0.32
31.8	22.90	0.02	0.32
36.0	24.18	0.02	0.34
40.2	25.68	0.03	0.36
43.8	26.55	0.03	0.37
48.0	26.97	0.03	0.38
55.8	26.39	0.03	0.37
60.0	24.89	0.02	0.35
64.2	23.21	0.02	0.32
66.0	22.50	0.02	0.31
67.8	21.80	0.02	0.30
72.0	19.46	0.02	0.27

TABLE XII. Argo *et al.* [22] data

E_{CM} (keV)	S (MeV.b)
32.0	24.57
34.8	26.13
38.4	25.84
41.6	26.73
45.6	27.22
49.6	27.02
53.6	26.89
57.6	25.76
61.6	24.12
65.6	22.42
69.6	20.59
73.6	19.44
77.6	17.73
81.6	16.15
85.6	14.78
89.6	13.45
97.6	11.22
105.6	9.29
113.6	7.95
121.6	6.98
129.6	6.00
137.6	5.26
145.6	4.65
153.6	4.11
161.6	3.62
230.0	1.71
392.0	0.85
480.0	0.69

TABLE XIII. Magiera *et al.* [27] data

E_{CM} (MeV)	S (MeV.b)
4.8	0.53±0.03
5.4	0.54±0.04
6.0	0.50±0.03
6.6	0.53±0.03
7.2	0.50±0.03
7.8	0.50±0.03
8.4	0.50±0.03
9.0	0.49±0.03
9.6	0.51±0.03