A Global Evaluation for ^{7}Li system

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Abstract

A global evaluation has been finished for ^{7}Li system. A new evaluation method RAC-CERNGEPLIS has been used, the RAC-CERNGEPLI have been used independently for long times by many peoples, but the S that is the Systematic error is updated with the error of fitted values is a new idea. It is correct or wrong? This should be discussed deeply. It is found that the evaluation value of ^{6}Li (n, tot) of ENDF/B7.1 has systematical deviation from the experimental data, maybe this should be improved.

I. The RAC-CERNGEPLIS method is used to produce Neutron Standard Cross Section.

RAC—R-matrix Analysis Code with multi-levels and multi-channels theory (Ref. 1, Lane1958);

C—Covariance statistics and generalized least squares fitting are used (Ref. 2, Smith1991);

E—Error propagation law is used to get accurate Covariance Matrix (Ref.3, Chen2004);

R—Relativistic calculation for energy;

N—Normalization for relative data (Scaling factor) and absolute data (Normalized factor);

G—Global database for a nuclear system is used;

E—Elimination of channel is used to expended energy range (Ref. 1, Lane1958);

P—PPP modification is considered (Ref. 4, Carlson2007);

L—Lettes criteria is used to minimize the effect from occasional ‘outliers’;

I—Iterative fitting procedure is used to get expectation values (Ref. 5, An2015);

S— Systematic error is updated with the mean square errors of fitted values.

In The **RAC-CERNGEPLIS method, the RAC-CERNGEPLI** have been used independently for long times by many peoples, **but The S-Systematic error is updated with the mean square errors of fitted values is a new idea. Maybe there will have different opinions for it.**

Let us think a problem that, which kind of systematic error should be used to calculate the covariance matrix of evaluated values with the error propagation law in ‘General least-squares’ fitting.

For a data-set (Y), in fitting procedure it is modified with normalization factor (or scaling factor) (N) to minimum χ^2. If the N is good enough, it means that YN is the data-set actually used. By now, what is the systematic error of YN (ε) ? It should not be the original one absolutely, it should be a new one, it should be the **residual** of original systematic error. In this case maybe exist the follow relation:

$$E-\sigma < YN < E+\sigma$$

The E is the expectation value, and σ is the error of E. Maybe the σ (or middle value ε) can be consider as the systematic error of YN.

In ‘General least-squares’ both statistic error and systematic error are needed to construct the covariance-matrix of a data-set, when the YN is consider as the real used data-set, so the systematic error should take theσ.

In the iterative procedure, the calculated values approach the expectation value step by step, the error of calculated values(ε) can be calculate out in iterative procedures, the systematic error is replaced with ε automatically to start a new iterative fitting. It will need much more loops of iterative procedure to get satisfactory results. Finally the YN approach E, and the ε approach σ.

In ‘General least-squares’ fitting the PPP is a big problem, experiences show that if the systematic error is larger than 20% of statistic error, the PPP will happen. By now, the experimental paper often give out rather small statistic error and rather larger estimate value of systematic error, with this kind of data, the ‘General least-squares’ fitting can’t be used absolutely. So at first the ‘Conventional least-squares’ fit is used, and the Lette's criteria not be used. In this way no PPP will happen. After get good fitting, the error of evaluated value is taken as systematic error, usually it is much less the statistic error, and the ‘General least-squares’ fitting and the Lette's criteria can be used. The iterative procedure for searching the best parameter-set carry out many times, maybe more than 1000 times. In the iterative procedures, every experimental data play an effect to determine expectation value, and every experimental data is improved for its normalizing factor and systematical error, until all parameters, all normalization factors, all calculation value approach very stable, so the final evaluated value can be think very near the expectation value. In this way using different priors will get the same final results.

The R-matrix Analysis Code with multi-levels and multi-channels theory (Ref. 1, Lane1958) has been used for IAEA-STD-2006; the book (*Smith1991*) is the modern classical literature which include the advanced theory for evaluation of nuclear data, and an Encyclopedia to guide program composition. The literatures (*Carlson2009; STD-NDS-IAEA-2007*) are the best example of applied the theory and summary of experiences. In the theory and self-contained methods, the theory for error distribution, the theory for error propagation, the formulae for covariance fitting, the theory of generalized least squares, the experience method for modification of PPP, and the Lettes criteria for minimize the effect from occasional ‘outliers’, the test for the definite of covariance matrix, and so on, are the key elements for trying to get accurate evaluating value, in which no anyone can be ignored. This is because only with a suitable model in which using these theories and methods the experimental data (ED) can be described objectively with high precision. The basic evidence is that in the measure process for nuclear data, the long range error, middle range error and short range error of observables are existing objectively, which are never be avoided absolutely. The long range and middle range error have correlation ship. The code RAC13 make use of the suitable theory model, employ the most advanced evaluation theory and methods, is able to use the most complete global database, the obtained evaluated values must be the closest to the expectation value, and the obtained error information must be the most reasonable. The 'ordinary least squares' fitting, in theory which cannot give the unbiased estimation for complex samples, but without the PPP problem introduced under the paragraph. In our work the 'covariance fitting' is quoted, this is because, in theory, the system error does always exist no matter how exact the evaluation of ED is. As long as the system error existed, the correlation of ED and the off-diagonal elements of the covariance matrix can never be removed. The 'ordinary least squares' fitting only considered the diagonal elements of the covariance matrix, which ignore the off-diagonal element and the part of correlation of ED. So the optimal calculation is only a rough approximation of the expected value according to the 'maximum like lihood principle'. The covariance fitting is an accurate method, inverse of the covariance matrix using in the optimization, the obtained evaluated values are expected to the accurately estimate value.

Suppose U_i^2, S_i^2, L_i^2, M_i^2 and Y_i^2 are total variance, statistical variance, long-range component (LERC) of systematic variance, medium-range component (MERC) of systematic variance and total systematic variance of the i[th] ED point respectively, and let $U_i^2 = S_i^2 + L_i^2 + M_i^2$, $Y_i^2 = L_i^2 + M_i^2$. The diagonal elements C_{jj} of correlation coefficient matrix C are 1 for all. The non-diagonal elements for integral cross section are

$$C_{ij} = C_{ij}^L + C_{ij}^M \qquad 1.1$$

Here C_{ij}^L refers to the LERC of systematic errors, C_{ij}^M to the MERC of systematic errors, and

$$C_{ij}^L = L_i L_j/(U_i U_j) \qquad 1.2$$

$$C_{ij}^M = M_i M_j/(U_i U_j) \cdot f_{ij} \qquad 1.3$$

$$f_{ij} = \mathrm{Exp}\{-[(E_i - E_j)/\mathrm{W}]^2/2\} \qquad 1.4$$

Where, W is a distribution width parameter, and E_i and E_j stand for energy points of the data. The non-diagonal elements of C for AD are

$$C_{ij} = (C_{ij}^L + C_{ij}^M) \cdot G_{ij} \qquad 1.5$$

$$G_{ij} = \mathrm{Exp}\{-[(\theta_i - \theta_j)/\mathrm{x}]^2/2\} \qquad 1.6$$

Here x is a distribution parameter related to angle, θ_i and θ_j are angle values.

It can be seen from the formulas given above that correlation coefficient is determined by total error and systematic error, and a larger systematic error leads to a larger correlation coefficient. The absolute covariance matrix elements of simulation data can be calculated from the corresponding correlation coefficients as follows:

$$V_{ij} = C_{ij} \cdot U_i \cdot U_j \qquad 1.7$$

The theoretical formula about error propagation with R-matrix model fitting is as following:

$$\mathrm{y} - y_0 = D(P - P_0) \qquad 1.8$$

$$D_{ki} = (\partial y_k/\partial P_i)_0 \qquad 1.9$$

Here y refers to vector of calculated values, D to sensitivity matrix, P to vector of R-matrix parameters. Subscript 0 means optimized original value, k and i are for fitted data and R-matrix parameter subscript respectively. The covariance matrix of parameter P is

$$V_P = (D^+ V^{-1} D)^{-1} \qquad 1.10$$

Here V refers to covariance matrix of the data to be fitted, and its inversion matrix can be expressed as following:

$$V^{-1} = \begin{pmatrix} V_1^{-1} & & 0 \\ & V_2^{-1} & \\ & & \ddots \\ 0 & & V_k^{-1} \end{pmatrix} \qquad 1.11$$

Here V_1, $V_2 \cdots V_k$ refer to the covariance matrixes of the sub-set data, which are independent with each other. The covariance matrix of calculated values is

$$V_y = D V_P D^+ \qquad 1.12$$

Formula adopted for optimizing with R-matrix fitting is

$$\boldsymbol{\chi}^{\mathbf{2}} = (\boldsymbol{\eta} - \boldsymbol{y})^{+} \boldsymbol{V}^{-\mathbf{1}} (\boldsymbol{\eta} - \boldsymbol{y}) \Rightarrow minimun \qquad 1.13$$

Here η refers to the vector of ED, y refers to the vector of calculated values.

If the non-diagonal elements of covariance matrixes V are ignored, the fitting will become 'Original least square' fitting. In this case the minimum χ^2 is the sum of diagonal elements of (1.13), no PPP will happened, as usually the fitting value are more closed to the experimental data than using 'General least square' fitting. But the covariance matrixes of evaluated values have some problem, as usually the error are less than these obtained by using 'General least square' fitting.

Two ED input files are set up in RAC. One file named with INP.ORI is a fixed record file of the original ED, which is used to provide the original statistical error and the type of data. Another file named with INP.EVA is a dynamic ED file recording the evaluation process, which role is to provide the actually used ED in fitting and is updated in the iterative process, where the original relative values of the ED are replaced with the new absolute value, the systematic error values are updated by the mean square errors of newly fitted values, the statistical errors are renewed with the original one at the beginning, but corrected according to the Letts criteria. The ratio of the corresponding data in there two documents is the new 'Scaling factor' or 'normalization coefficient'. The Scaling factor is adjustable in RAC, which is recorded in the parameter file INP.PAR together with the new R-matrix parameters.

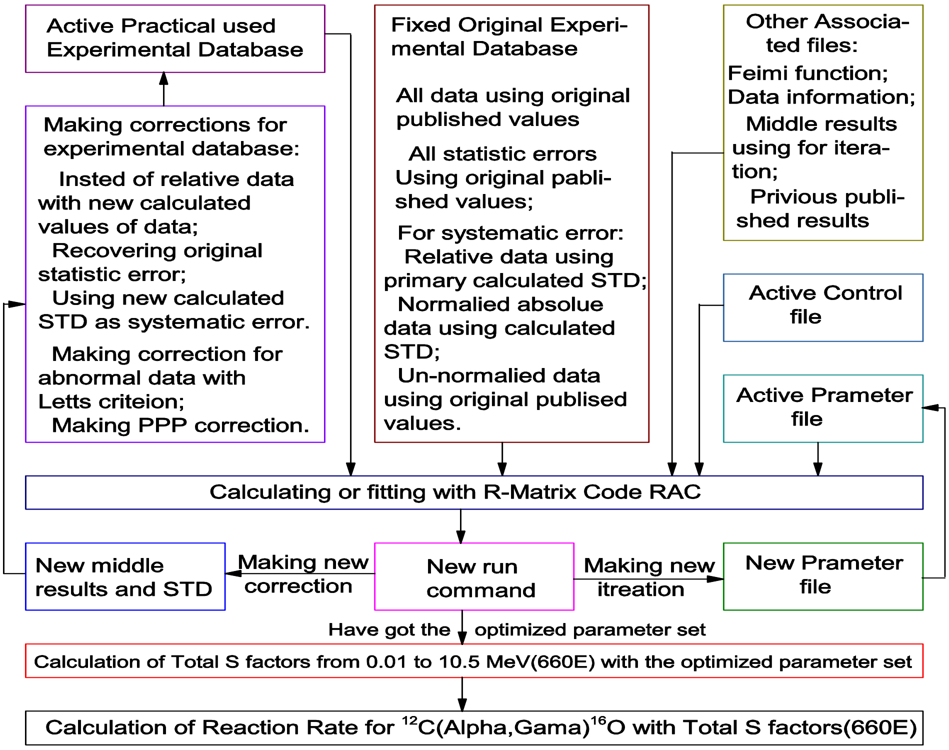
Reference section: Repeated Iterative fitting Procedure

This section taken from a report about the '**Global Evaluation for Astrophysical S factor and Reaction Rate of ^{12}C (α, γ) ^{16}O With Reduced R-matrix Theory'.**

With the use of systematic research, some of the best selection and the initial values of the key factors in the fitting are obtained, these best choices including: 8 reaction channels, 33 levels, 128 to 144 adjustable parameters, 6.5 fm of channel radius, ±3σ of Letts criteria, Schürmann-Stot taking 1.03 as the normalization coefficient, and so on.

The heart of the matter in evaluation of nuclear data is to get accurate systematic error. The system error is the deviation from expectation value, due to the expectation value can be get only by global fitting, the deduced conclusion is that the systematic error for someone data set cannot be obtained by isolated analysis, it can be get only with systematical and accurate analysis. According to the error propagation law, if a sub-Dataset get its normalized absolute values, then its statistic errors take its original values, its systematic errors take its standard deviation (σ).

Two ED input files are set up in RAC. One file named with CA12.EXP-ORI is a fixed record file of the original ED, which is used to provide the original statistical error and the type of data. Another file named with CA12.EXP-EVA is a dynamic ED file recording the evaluation process, which role is to provide the actually used ED in fitting and is updated in the iterative process, where the original relative values of the ED are replaced with the new absolute value, the systematic error values are updated by the mean square errors of newly fitted values, the statistical errors are renewed with the original one at the beginning, but corrected according to the Letts criteria. The ratio of the corresponding data in there two documents is the new 'Scaling factor' or 'normalization coefficient'. The Scaling factor is adjustable in RAC, which is recorded in the parameter file CA12.APAR together with the new R-matrix parameters. Fig.S5.2 shows the flow chart for iterative fitting procedure. The flow chart FIG. 3 in ref. *PHYSICAL REVIEW C* **92**, 045802 (2015) is a simplified diagram, it has the same mean as Fig.S5.2. The paper is an early work of our group, which have got big progress in evaluation method and reducing the uncertainty of evaluated stot, but have some obvious defects in theory and the final evaluated Stot.



The flow chart for the iterative fitting procedure.

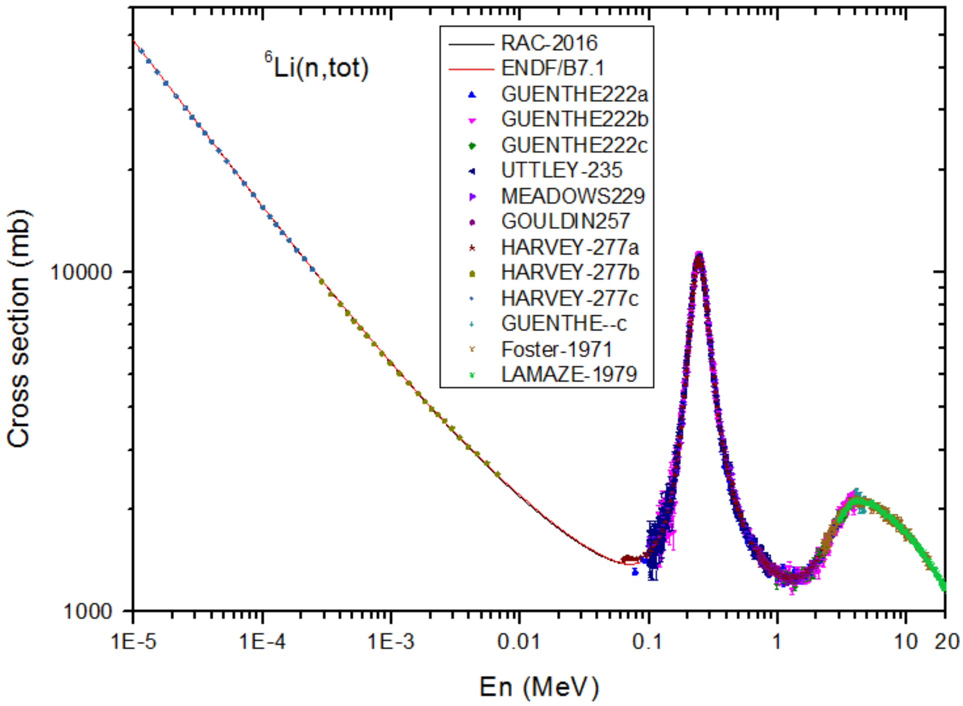
II. Table. The global experimental data-base used in RAC for ^{7}Li system

Reaction /Channel	En or Et /MeV	Experimental data (total number 8503)			Note
		Integrated	Differential	Polarization	
^{6}Li (n, tot)	1e-11 to 25.0	1908	0	0	2006
^{6}Li(n, n)^{6}Li	1e-4 to 18.0	2198	631	81	2006
^{6}Li(n, t)^{4}He	1e-8 to15.0	1143	1399	0	2006
^{6}Li(n, t)^{4}He	2e-1 to15.0	0	698	0	2016-added
^{6}Li(n,n1) ^{6}Li*	2.8 to 15.0	27	0	0	2016-added
^{6}Li (n, p) ^{6}He	10.0 to 15.0	41	25	0	2016-added
^{6}Li (n, d) ^{5}He	5.0 to 15.0	23	33	0	2016-added
^{6}Li(n,n2)^{6}Li*	5.0 to 15.0	10	0	0	2016-added
^{6}Li (n, 2n) ^{5}Li	12.0 to 15.0	4	0	0	2016-added
^{4}He (t, t) ^{4}He	2.0 to 17.0	0	1132	657	2006
^{4}He(t,n1)^{6}Li*	2.0 to 17.0	0	19	0	2016-added
^{4}He(t,n1)^{6}Li*	2.0 to 17.0	0	2	0	2016-added
^{4}He(t,n1)^{6}Li*	2.0 to 17.0	0	53	0	2016-added
10B(n, a)/ ^{6}Li(n, t)	0.18E-5 to 0.37E-04	7	0	0	2016-added
Total: 14					

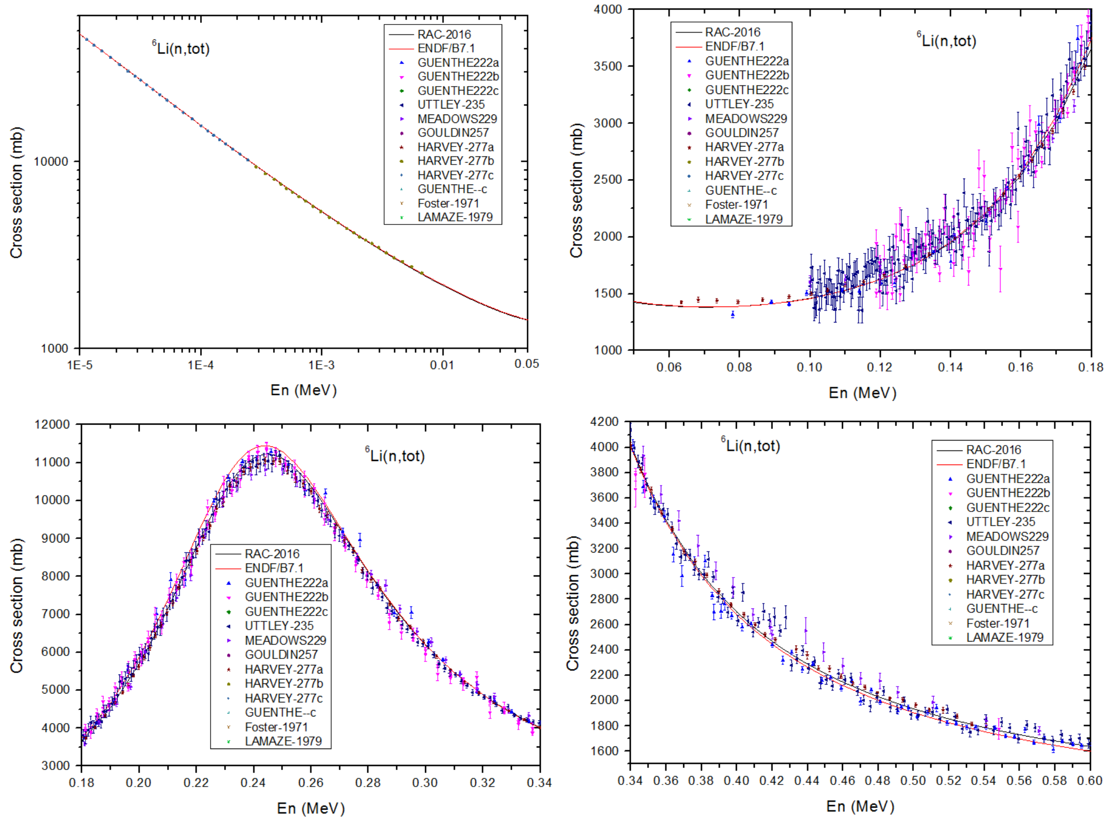
Note: The 2006 means the data-base used for IAEA-STD-2006, the 2016-added means the new data have been added on the data-base used for IAEA-STD-2006.

III. Figures for integrated data

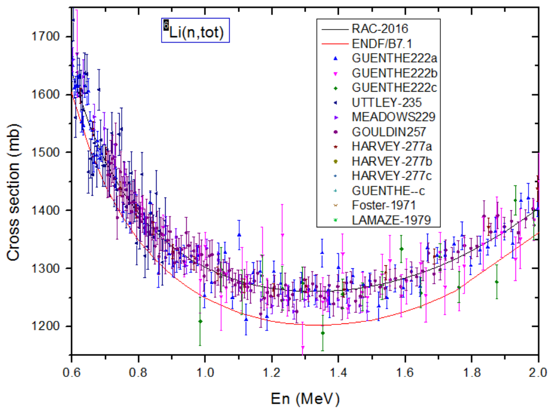
III.1 Figs. for ^{6}Li(n, tot)

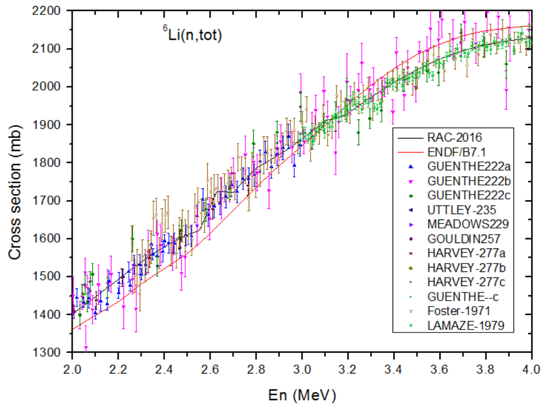


The fitting of ^{6}Li (n, tot) for En=1e-5 to 20 MeV

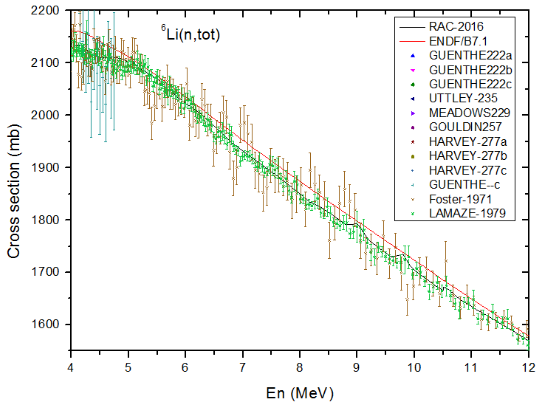


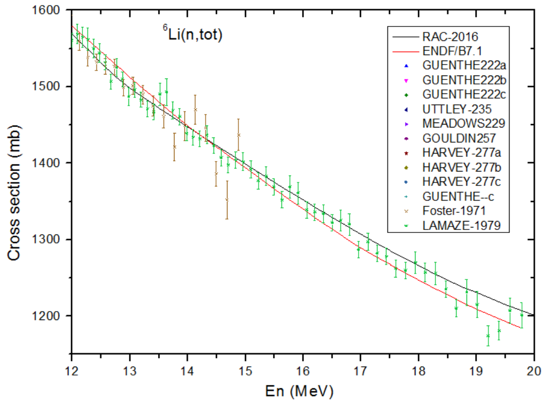
The Figs. shows that the ENDF/B7.1 is systematically higher than experimental data of ^{6}Li (n,tot) for En=0.22 to 0.28 MeV.





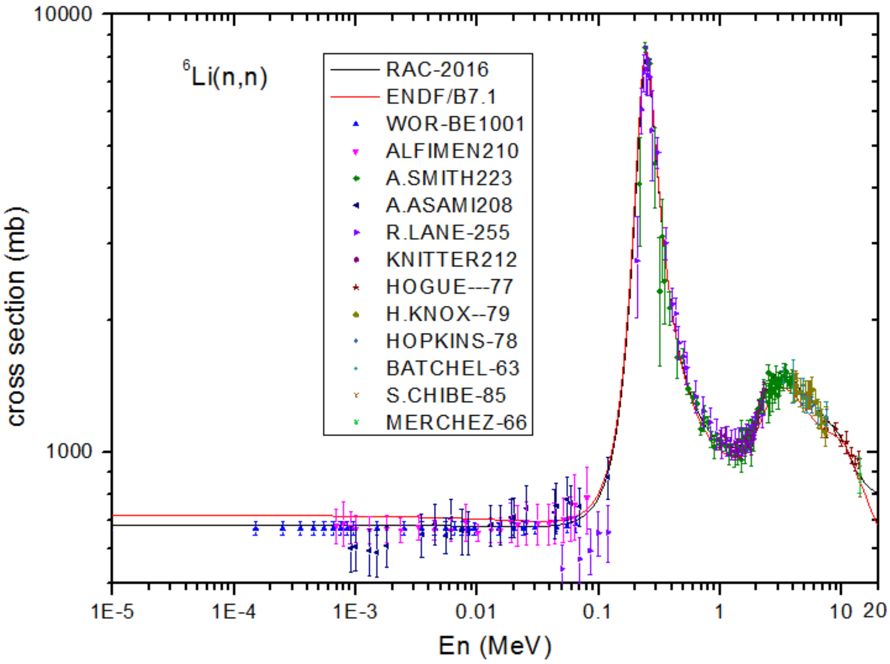
The Figs. shows that the ENDF/B7.1 is systematically lower than experimental data of ^{6}Li (n,tot) for En=0.6 to 3 MeV.



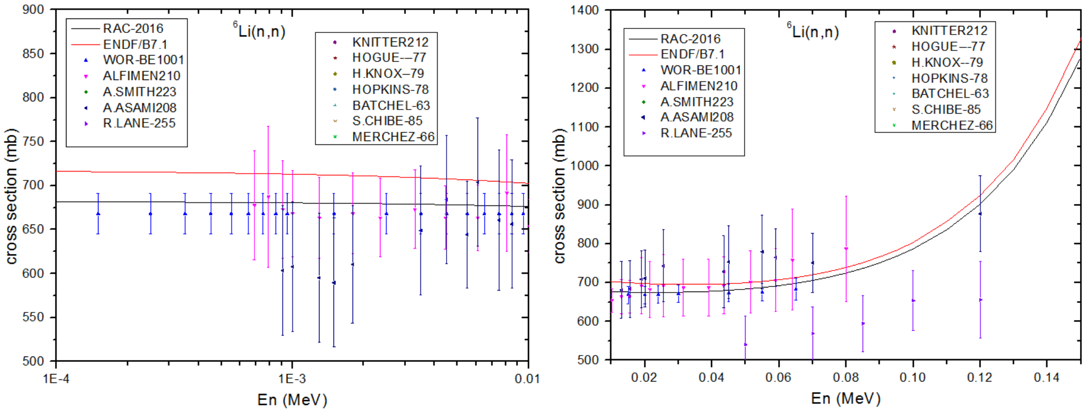


The Figs. shows that the ENDF/B7.1 is systematically higher than experimental data of ^{6}Li (n,tot) for En=4 to 12 MeV.

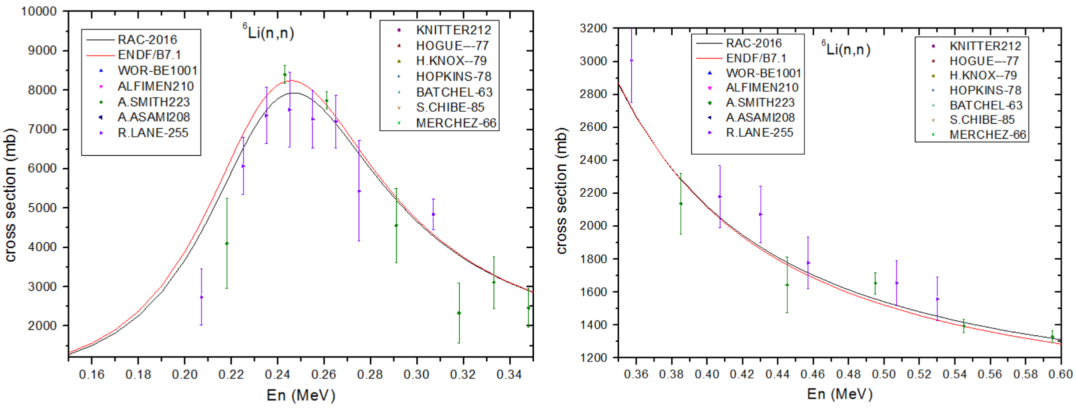
III.2 Figs. for ^{6}Li(n,n)



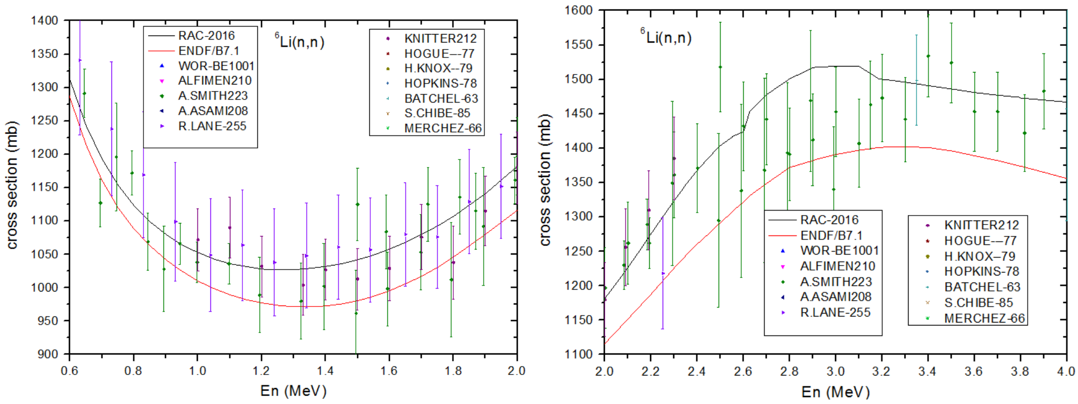
The fitting of ^{6}Li (n,n) for En=1e-5 to 20 MeV



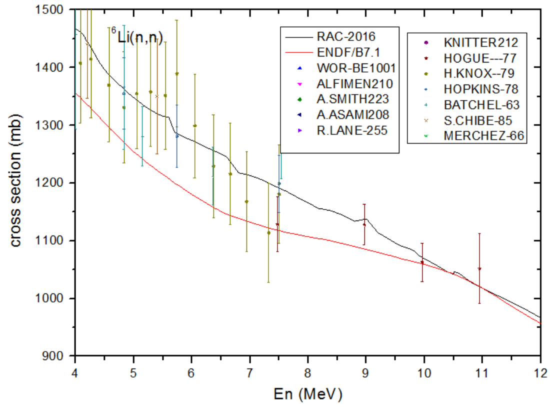
The Figs. shows that the ENDF/B7.1 is systematically higher than experimental data of ^{6}Li (n,n) for En=0.0001 to 0.01 MeV.

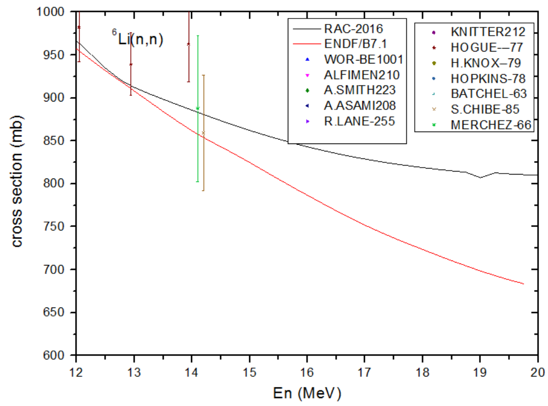


The Figs. shows that the ENDF/B7.1 is systematically higher than experimental data of ^{6}Li (n,n) for En=0.2 to 0.28 MeV.



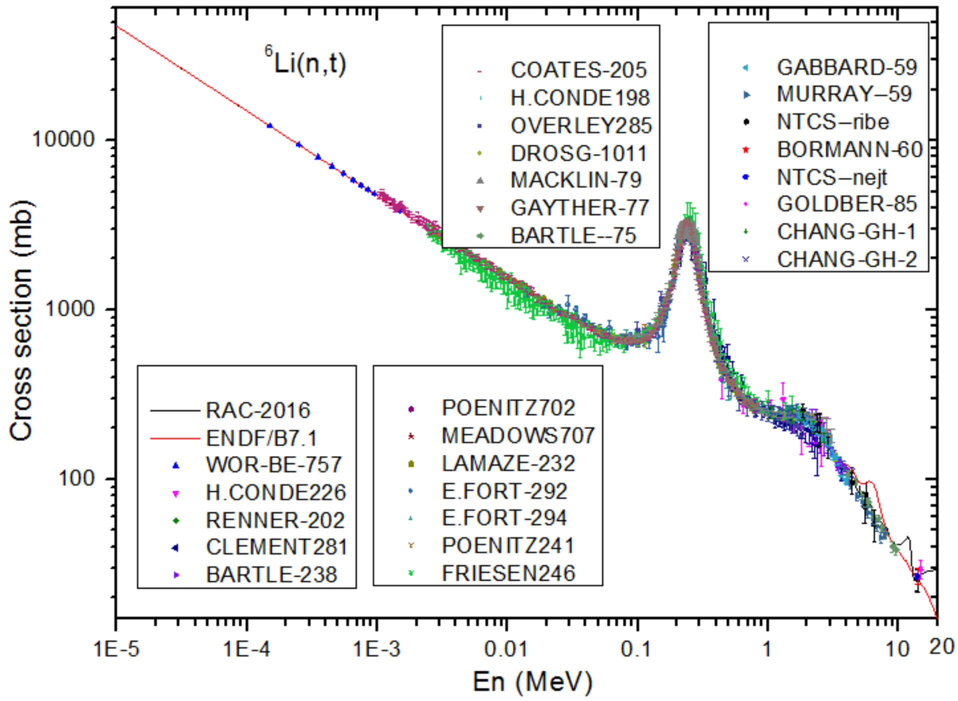
The Figs. shows that the ENDF/B7.1 is systematically lower than experimental data of ^{6}Li (n,n) for En=0.6 to 4 MeV.



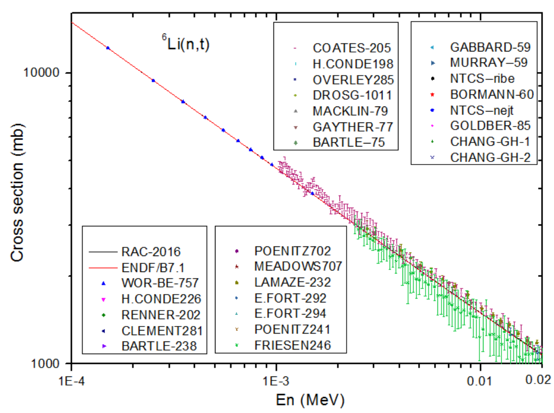


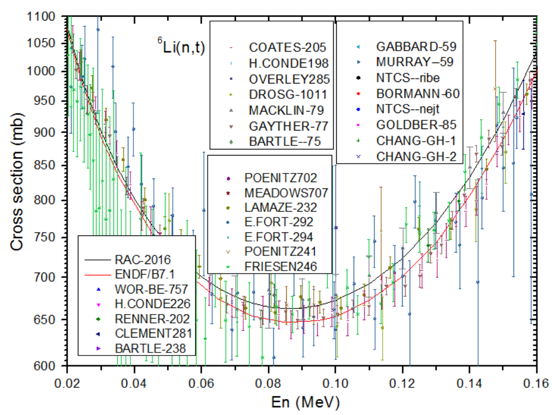
The Figs. shows that the ENDF/B7.1 is systematically lower than experimental data of ^{6}Li (n,n) for En=4 to 9 MeV.

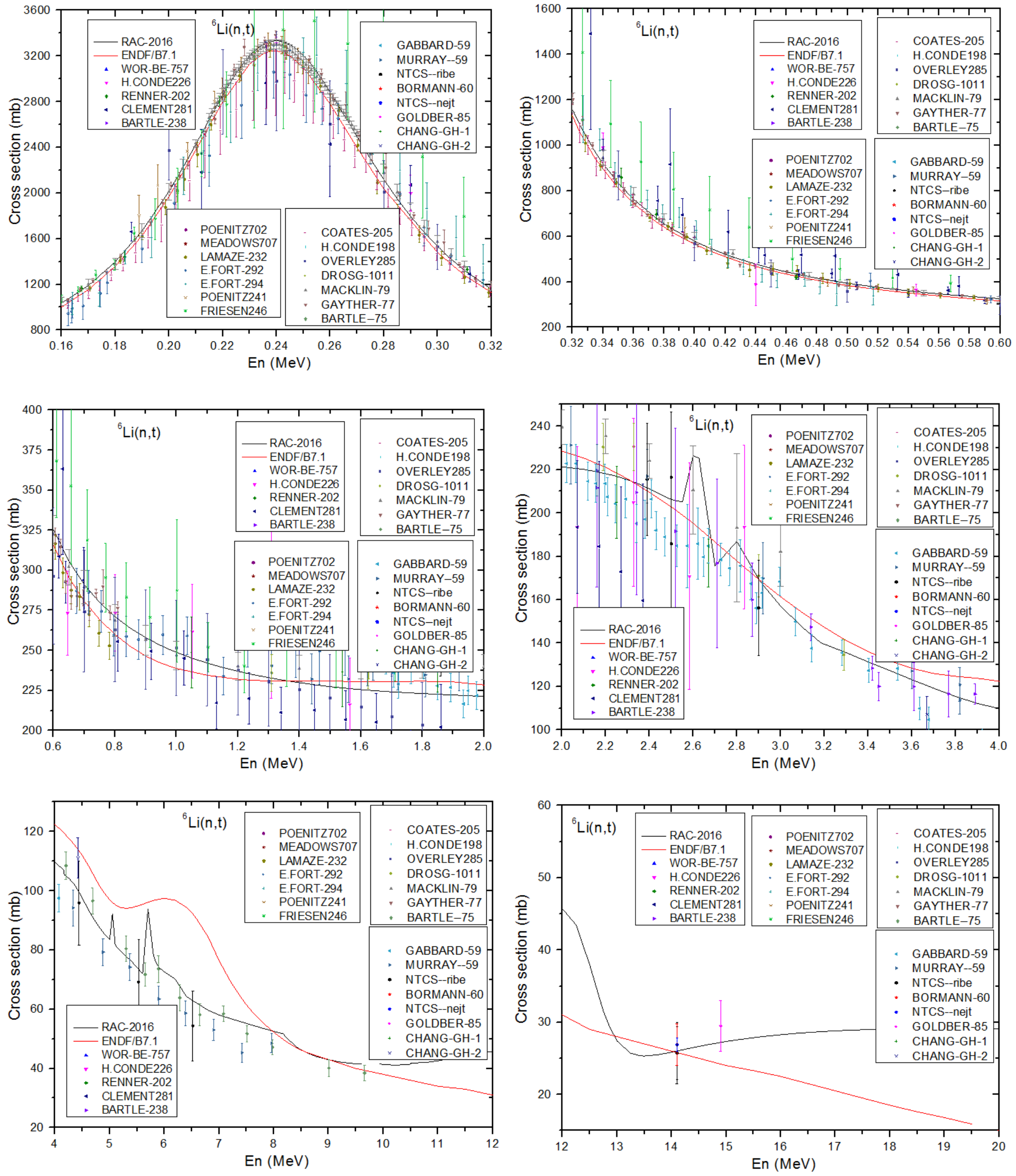
III.3 Figs. for ^{6}Li(n, t)



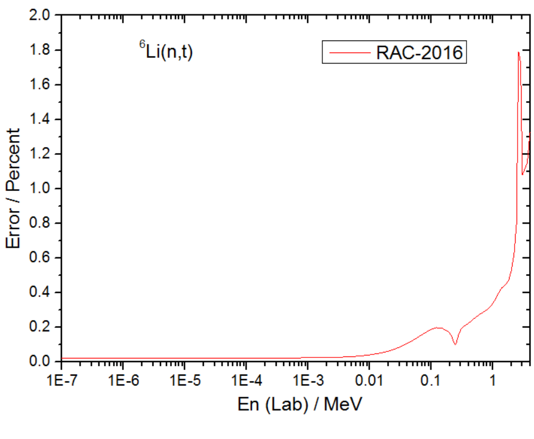
The fitting of ^{6}Li (n, t) for En=1e-5 to 20 MeV





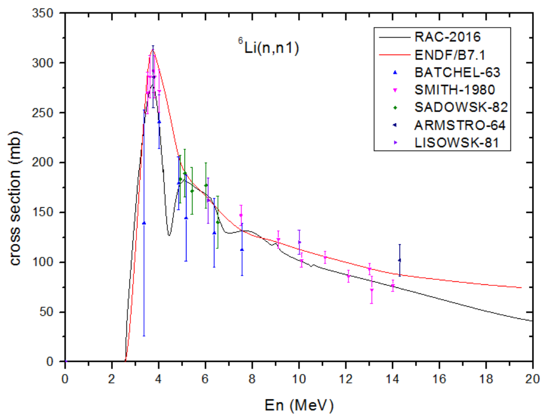


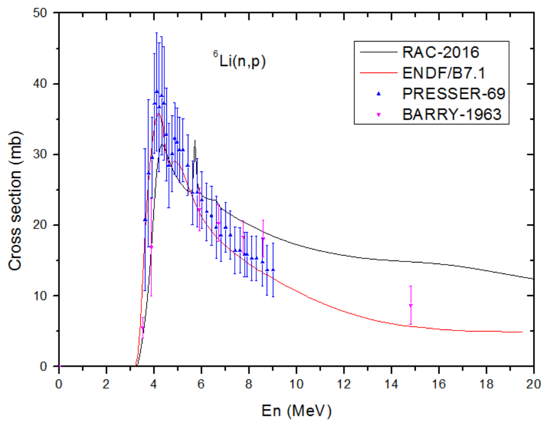
The Figs. shows that the ENDF/B7.1 is systematically higher than experimental data of ^{6}Li (n,t) for En=3 to 8 MeV.

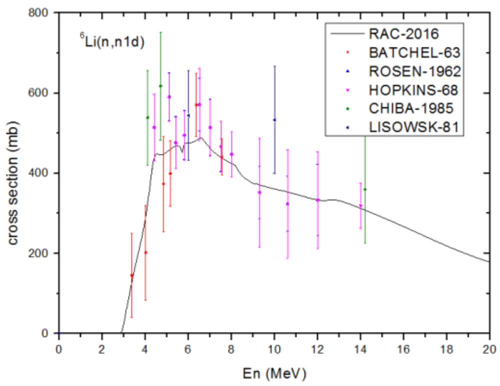


The error of evaluated ^{6}Li (n, t)

III.4 Figs. for ^{6}Li(n, n1), ^{6}Li(n, p), ^{6}Li(n, n1d)







The different evaluated covariance matrix mainly produced by using different evaluated methods in RAC and EDA.

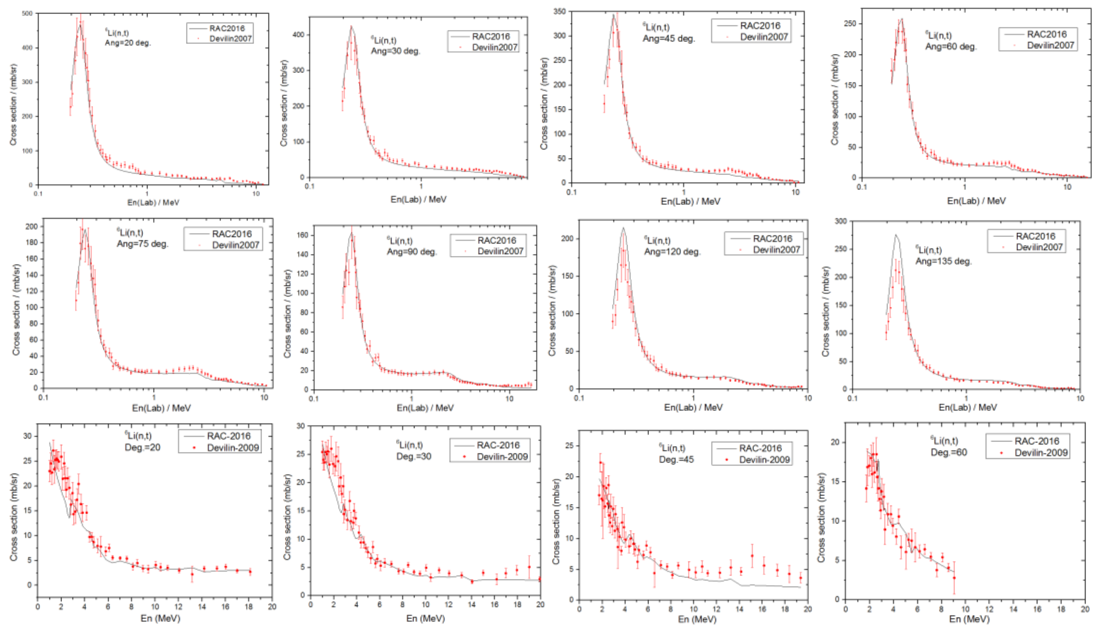
In our work the 'covariance fitting' is quoted, this is because, in theory, the system error does always exist no matter how exact the evaluation of ED is. As long as the system error existed, the correlation of ED and the off-diagonal elements of the covariance matrix can never be removed. The 'ordinary least squares' fitting only considered the diagonal elements of the covariance matrix, which ignore the off-diagonal element and the part of correlation of ED. So the optimal calculation is only a rough approximation of the expected value according to the 'maximum like lihood principle'. The covariance fitting is an accurate method, inverse of the covariance matrix using in the optimization, the obtained evaluated values are expected to the accurately estimate value.

IV. Figures for added new differential data of ^{6}Li(n, t)^{4}He

REFERENCE (C,2007NICE,2,1243,2007) 14159001 7

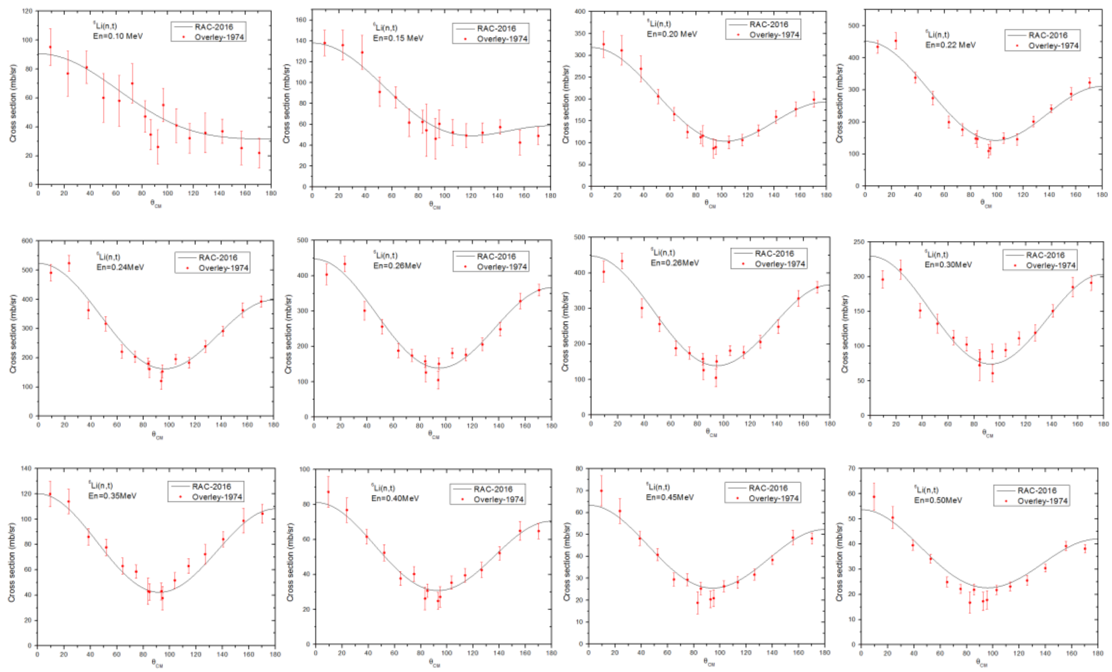
(S,AIP-1090,215,2009) 14159001 8

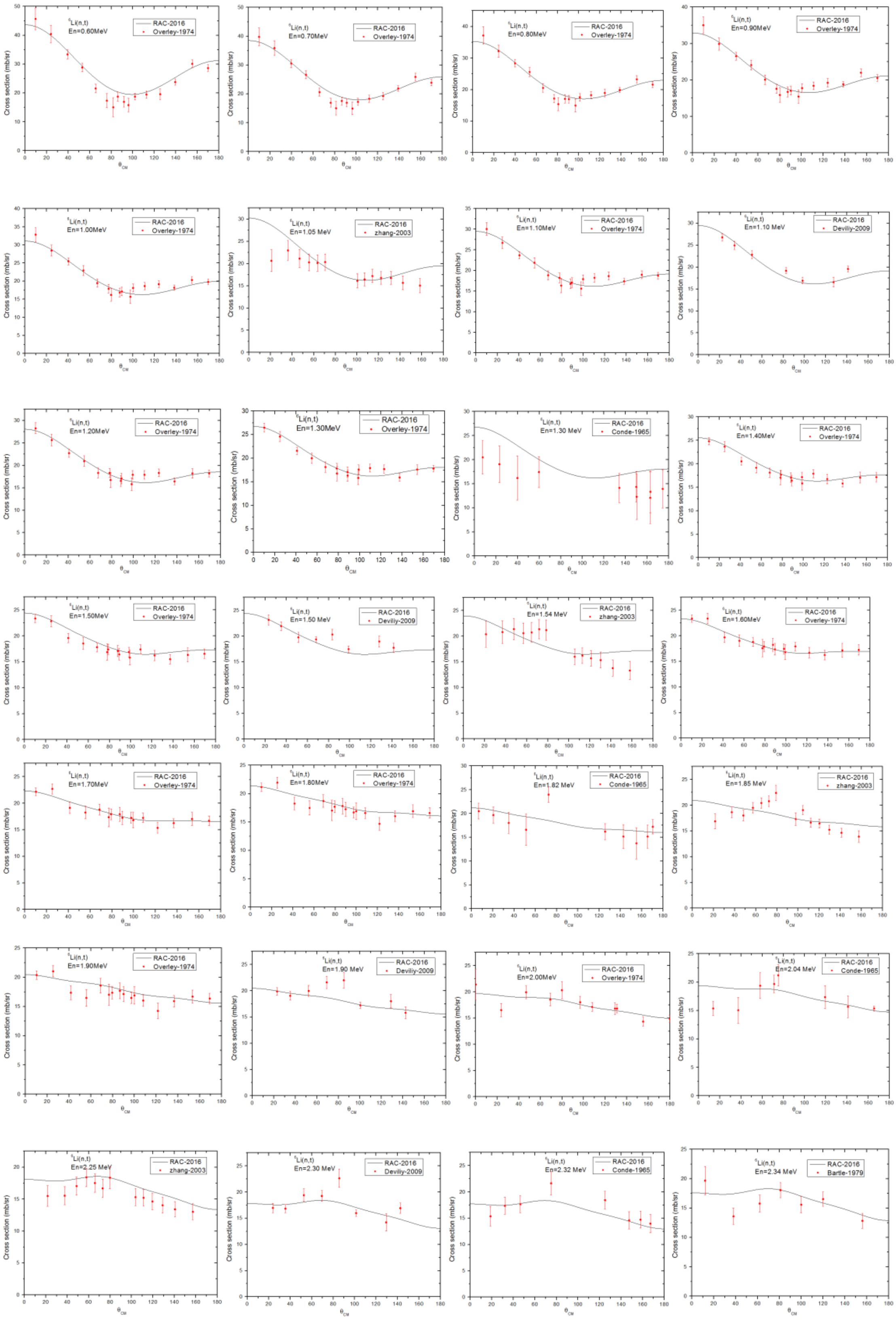
These data play an important function in RAC-2016 fitting.



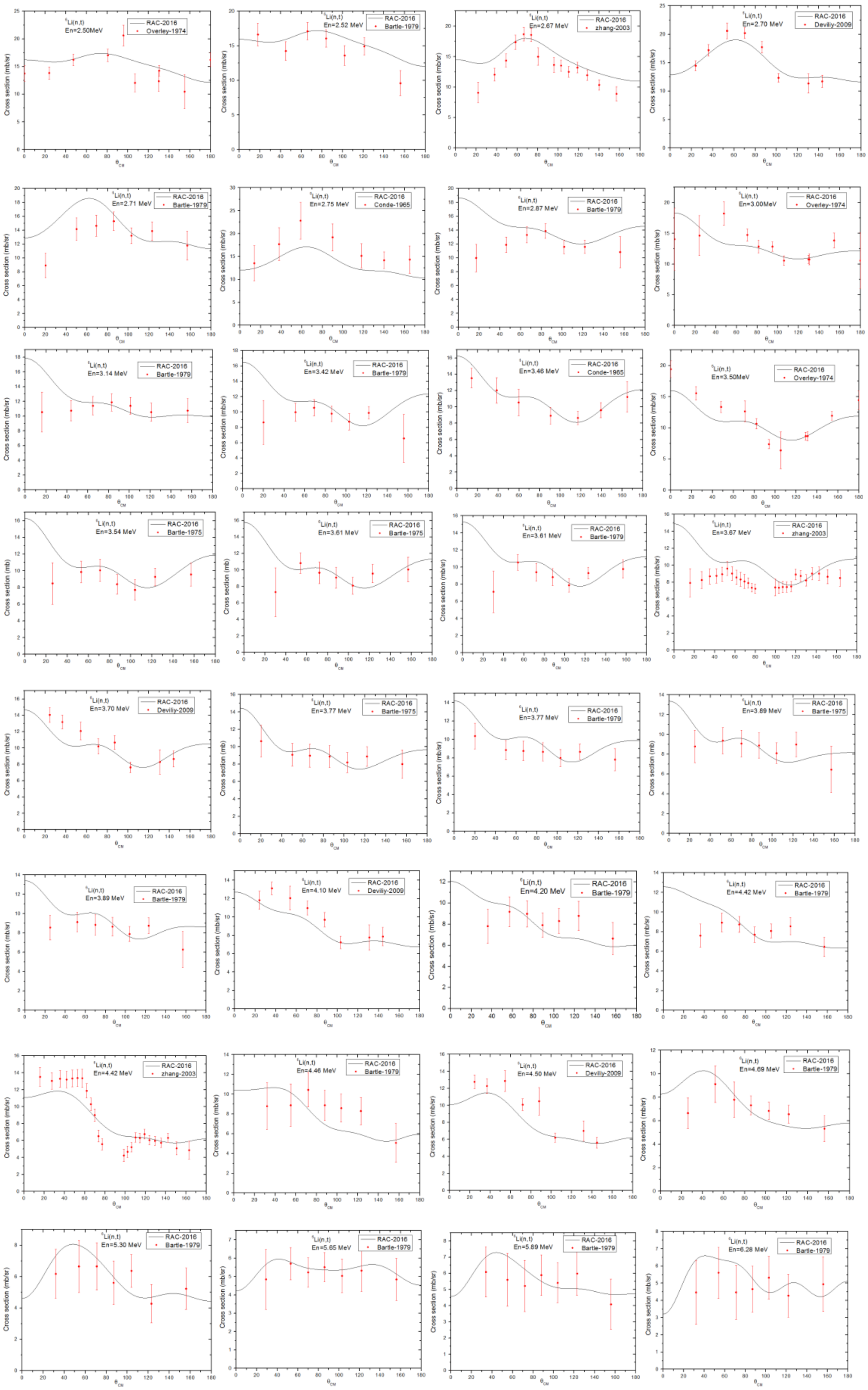
The RAC-CERNGEPLIS method is used to produce Neutron Standard Cross Section. In this method every item can’t be ignored. A key idea is that what is the ‘systematical error’. I think the real ‘systematical error’ is the **standard error of value of expectation**. In RAC fitting procedure, the statistic error keep original value, but the systematical error changed in iterative process. The Lette’s criteria is used to minimize the effect from occasional ‘outliers’(χ^2>9); this ‘bad data’ is not be through away, its error is amplified to get χ^2=9; may be in next iterative process, its fitting become better, its original error is recovered. More 1000 loops of iterative process have been done automatically. In final plot the final total error is used.

V. Figures for the differential data of ^{6}Li (n, t) ^{4}He;

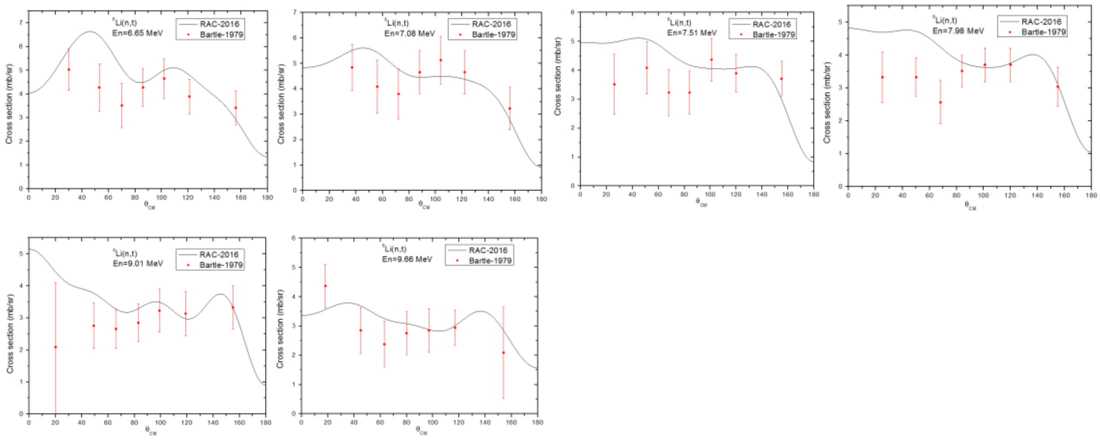




Cross section (mb/sr)
θCM
6Li(n,t)
En=0.60MeV
En=0.70MeV
En=0.80MeV
En=0.90MeV
En=1.00MeV
En=1.05 MeV
En=1.10MeV
En=1.10 MeV
En=1.20MeV
En=1.30MeV
En=1.30 MeV
En=1.40MeV
En=1.50MeV
En=1.50 MeV
En=1.54 MeV
En=1.60MeV
En=1.70MeV
En=1.80MeV
En=1.82 MeV
En=1.85 MeV
En=1.90MeV
En=1.90 MeV
En=2.00MeV
En=2.04 MeV
En=2.25 MeV
En=2.30 MeV
En=2.32 MeV
En=2.34 MeV
RAC-2016
Overley-1974
zhang-2003
Devilly-2009
Conde-1965
Bartle-1979

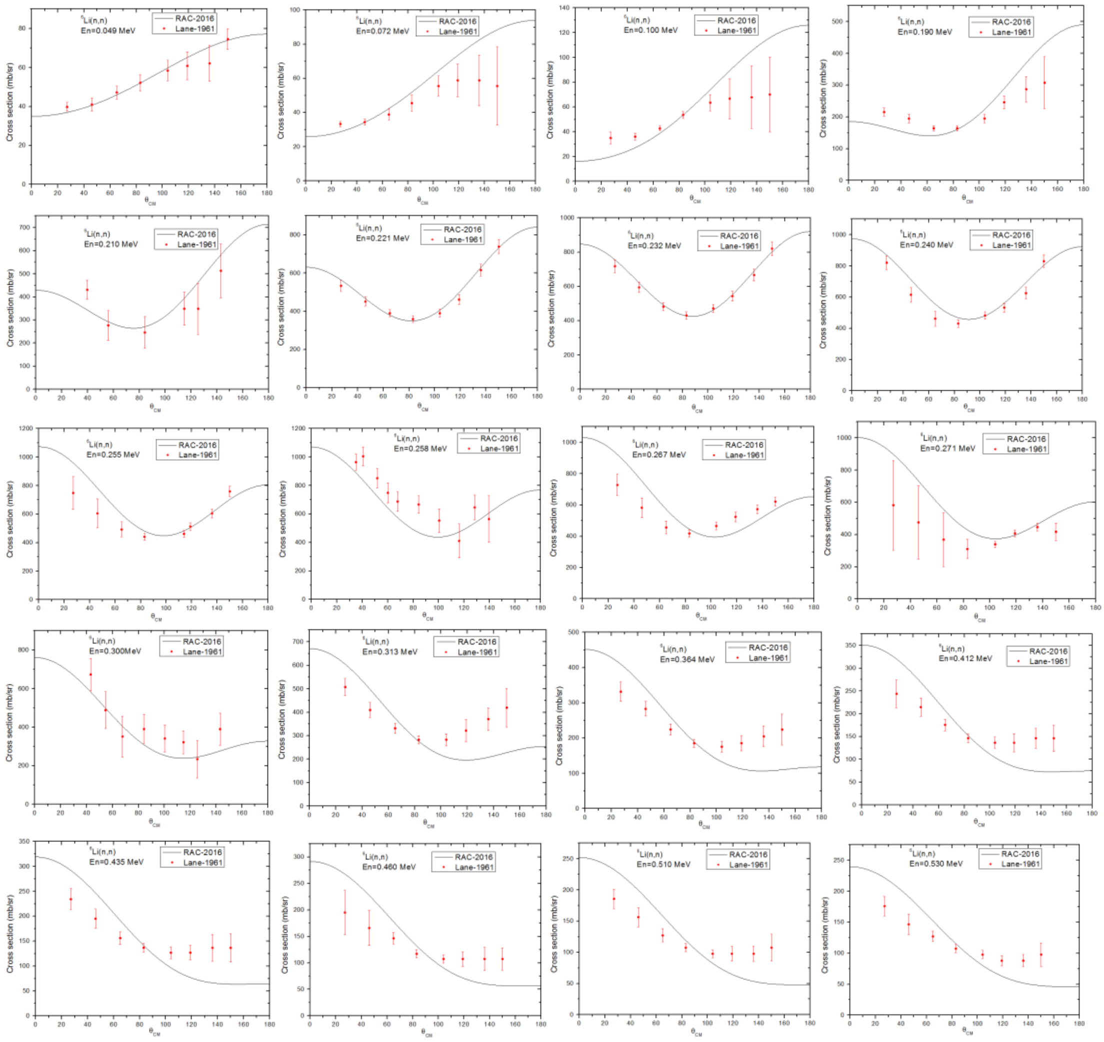


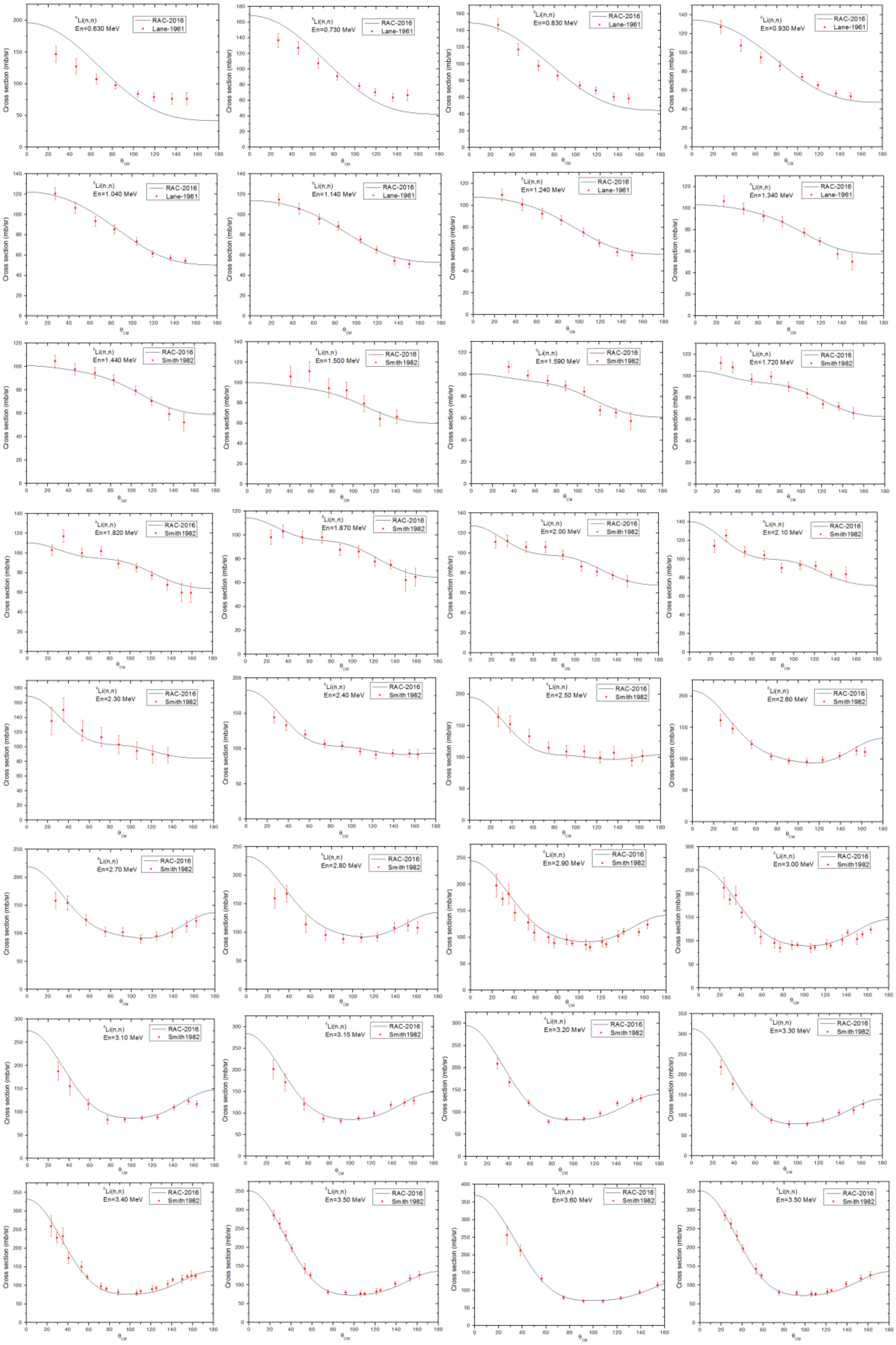
6Li(n,t) En=2.50MeV RAC-2016 Overley-1974
6Li(n,t) En=2.52 MeV RAC-2016 Bartle-1979
6Li(n,t) En=2.67 MeV RAC-2016 zhang-2003
6Li(n,t) En=2.70 MeV RAC-2016 Devilly-2009
6Li(n,t) En=2.71 MeV RAC-2016 Bartle-1979
6Li(n,t) En=2.75 MeV RAC-2016 Conde-1965
6Li(n,t) En=2.87 MeV RAC-2016 Bartle-1979
6Li(n,t) En=3.00MeV RAC-2016 Overley-1974
6Li(n,t) En=3.14 MeV RAC-2016 Bartle-1979
6Li(n,t) En=3.42 MeV RAC-2016 Bartle-1979
6Li(n,t) En=3.46 MeV RAC-2016 Conde-1965
6Li(n,t) En=3.50MeV RAC-2016 Overley-1974
6Li(n,t) En=3.54 MeV RAC-2016 Bartle-1975
6Li(n,t) En=3.61 MeV RAC-2016 Bartle-1975
6Li(n,t) En=3.61 MeV RAC-2016 Bartle-1979
6Li(n,t) En=3.67 MeV RAC-2016 zhang-2003
6Li(n,t) En=3.70 MeV RAC-2016 Devilly-2009
6Li(n,t) En=3.77 MeV RAC-2016 Bartle-1975
6Li(n,t) En=3.77 MeV RAC-2016 Bartle-1979
6Li(n,t) En=3.89 MeV RAC-2016 Bartle-1975
6Li(n,t) En=3.89 MeV RAC-2016 Bartle-1979
6Li(n,t) En=4.10 MeV RAC-2016 Devilly-2009
6Li(n,t) En=4.20 MeV RAC-2016 Bartle-1979
6Li(n,t) En=4.42 MeV RAC-2016 Bartle-1979
6Li(n,t) En=4.42 MeV RAC-2016 zhang-2003
6Li(n,t) En=4.46 MeV RAC-2016 Bartle-1979
6Li(n,t) En=4.50 MeV RAC-2016 Devilly-2009
6Li(n,t) En=4.69 MeV RAC-2016 Bartle-1979
6Li(n,t) En=5.30 MeV RAC-2016 Bartle-1979
6Li(n,t) En=5.65 MeV RAC-2016 Bartle-1979
6Li(n,t) En=5.89 MeV RAC-2016 Bartle-1979
6Li(n,t) En=6.28 MeV RAC-2016 Bartle-1979
Cross section (mb/sr)
θCM



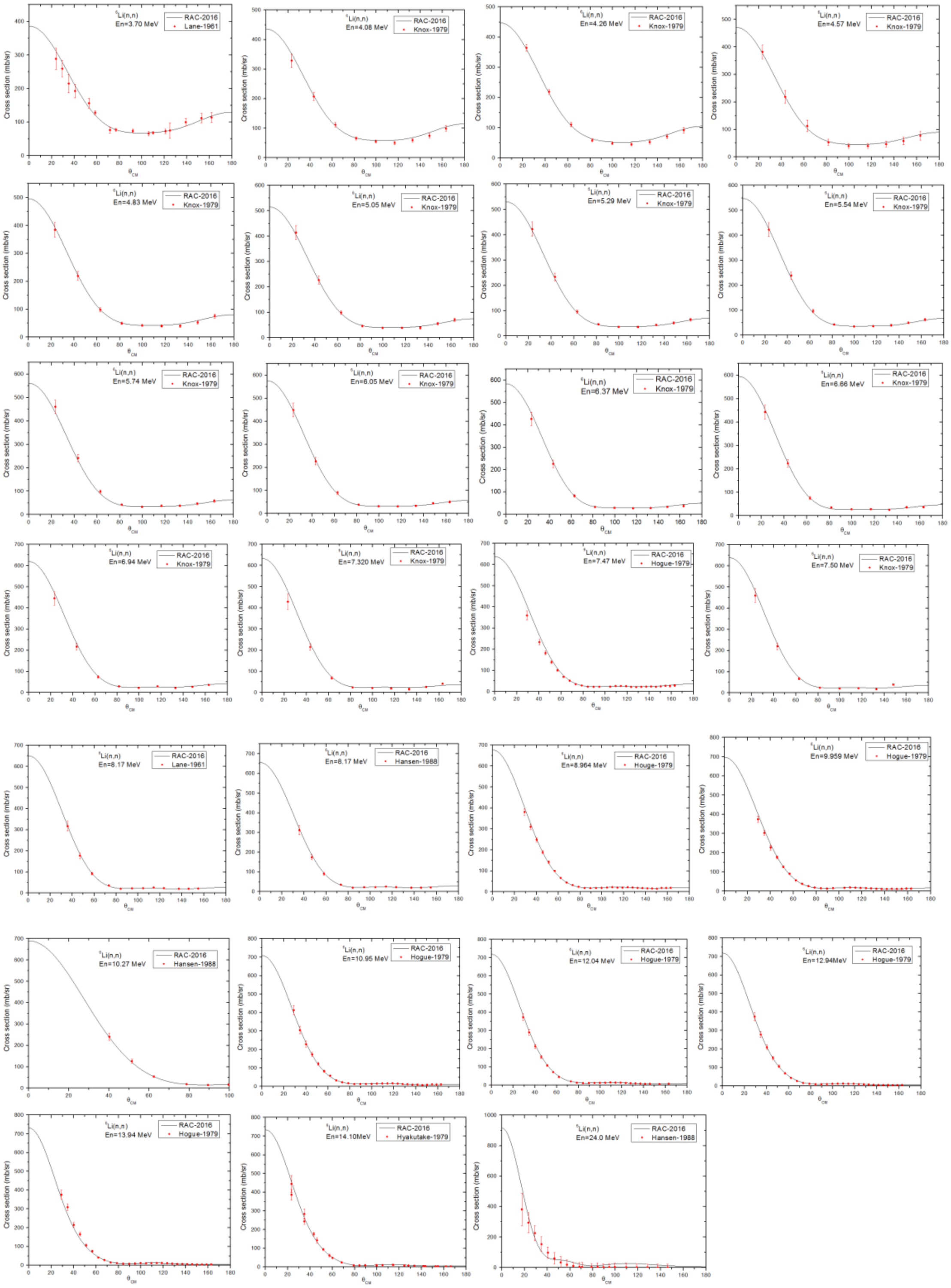
VI. Figures for the differential data of ^{6}Li (n, n) ^{6}Li;

VI. 1.   Figures for DA of ^{6}Li (n, n) ^{6}Li

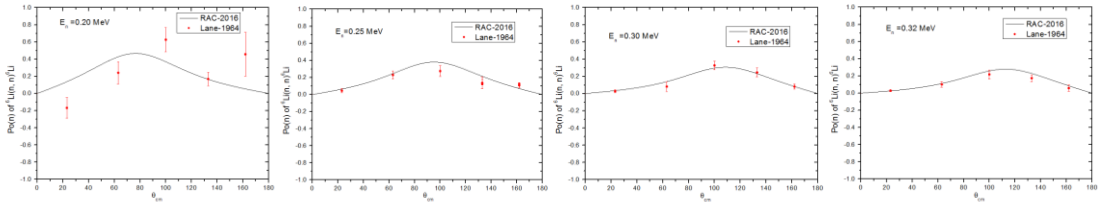


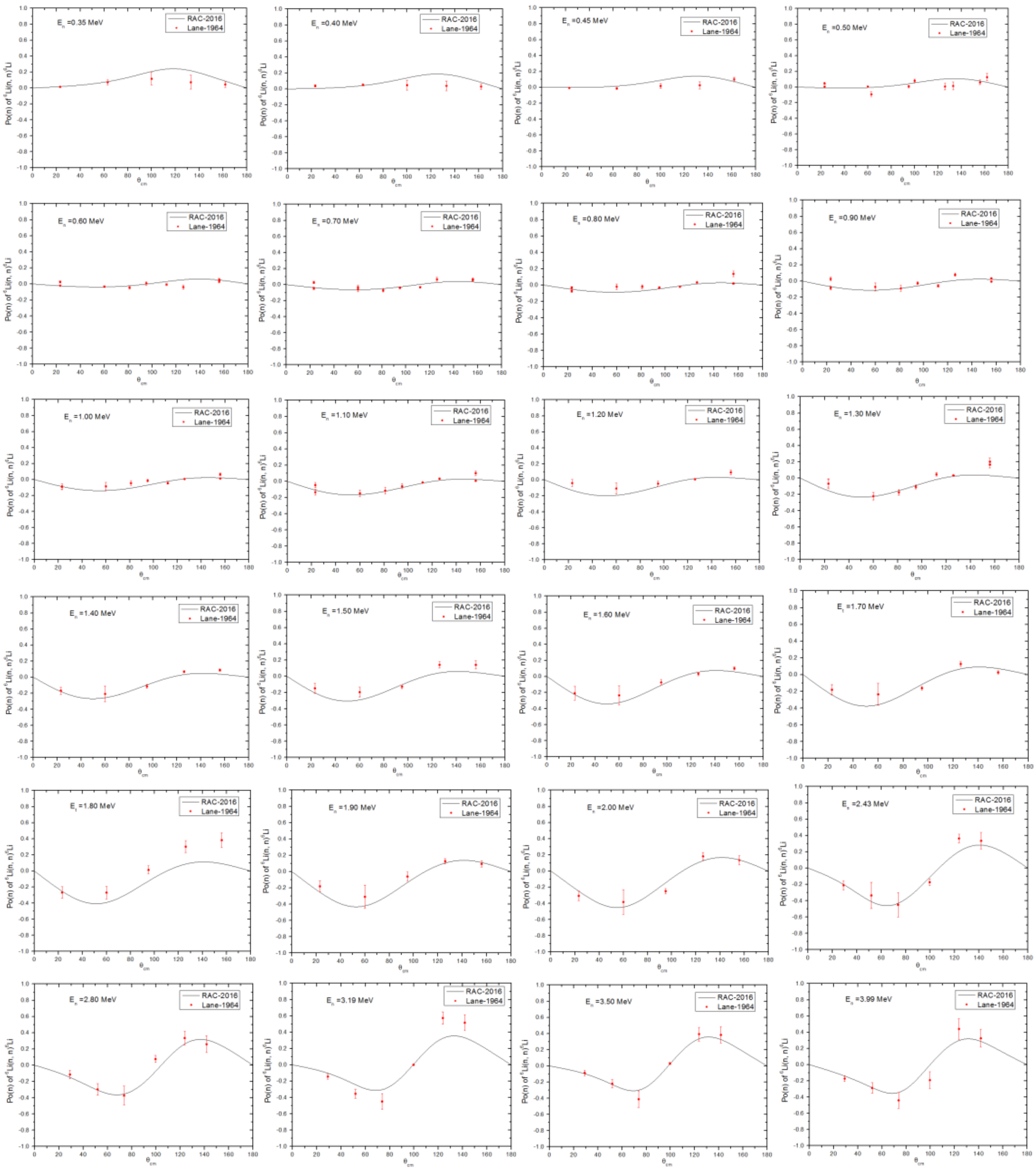


6Li(n,n)
En=0.630 MeV
En=0.730 MeV
En=0.830 MeV
En=0.930 MeV
En=1.040 MeV
En=1.140 MeV
En=1.240 MeV
En=1.340 MeV
En=1.440 MeV
En=1.500 MeV
En=1.590 MeV
En=1.720 MeV
En=1.820 MeV
En=1.870 MeV
En=2.00 MeV
En=2.10 MeV
En=2.30 MeV
En=2.40 MeV
En=2.50 MeV
En=2.60 MeV
En=2.70 MeV
En=2.80 MeV
En=2.90 MeV
En=3.00 MeV
En=3.10 MeV
En=3.15 MeV
En=3.20 MeV
En=3.30 MeV
En=3.40 MeV
En=3.50 MeV
En=3.60 MeV
En=3.50 MeV
RAC-2016
Lane-1961
Smith1982
Cross section (mb/sr)
θCM



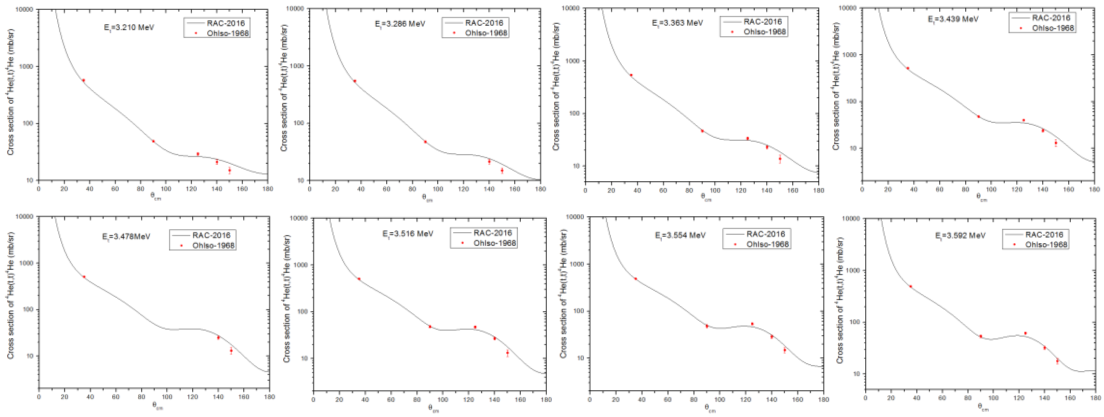
VI. 2. Figures for AY of ^{6}Li (n, n) ^{6}Li

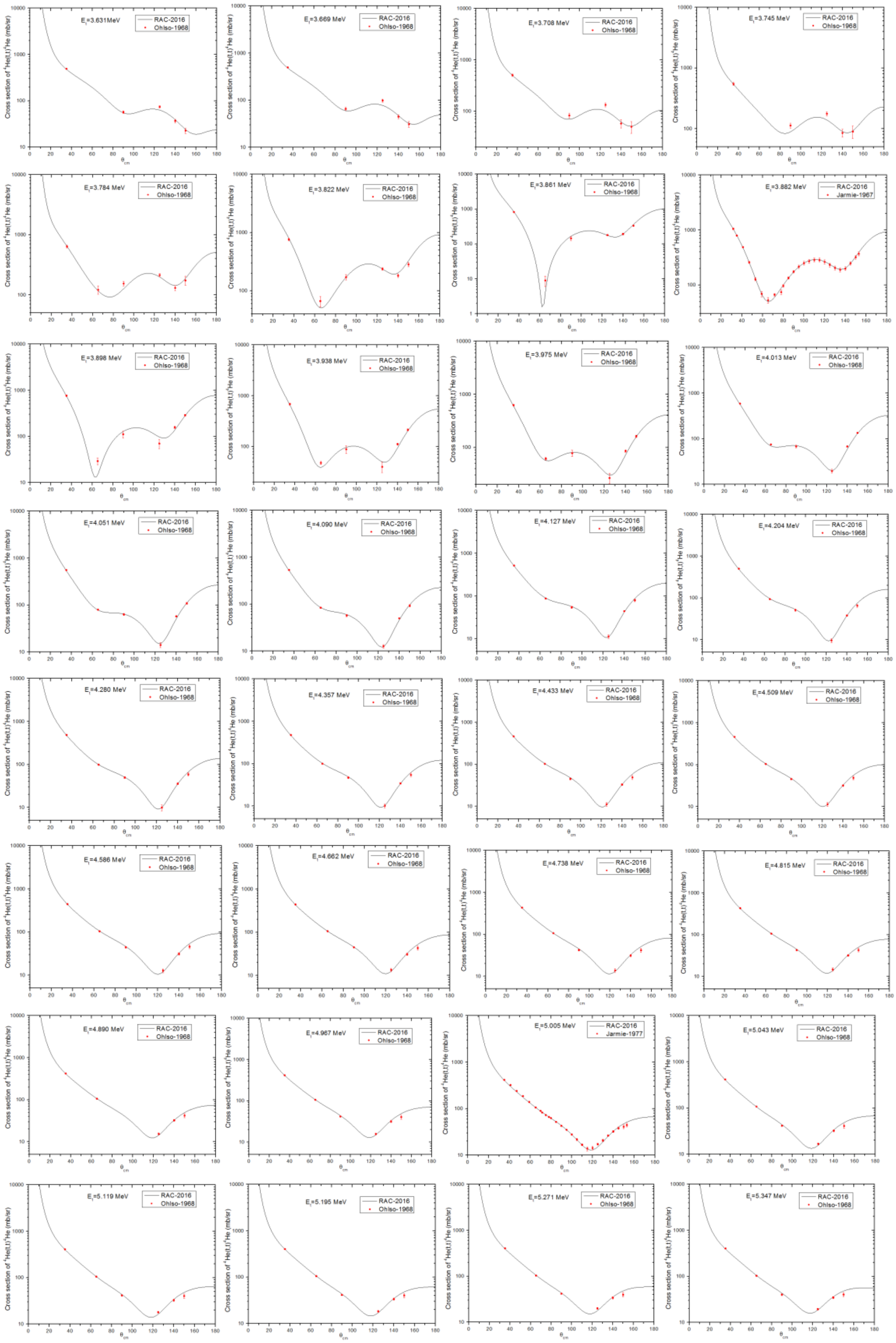


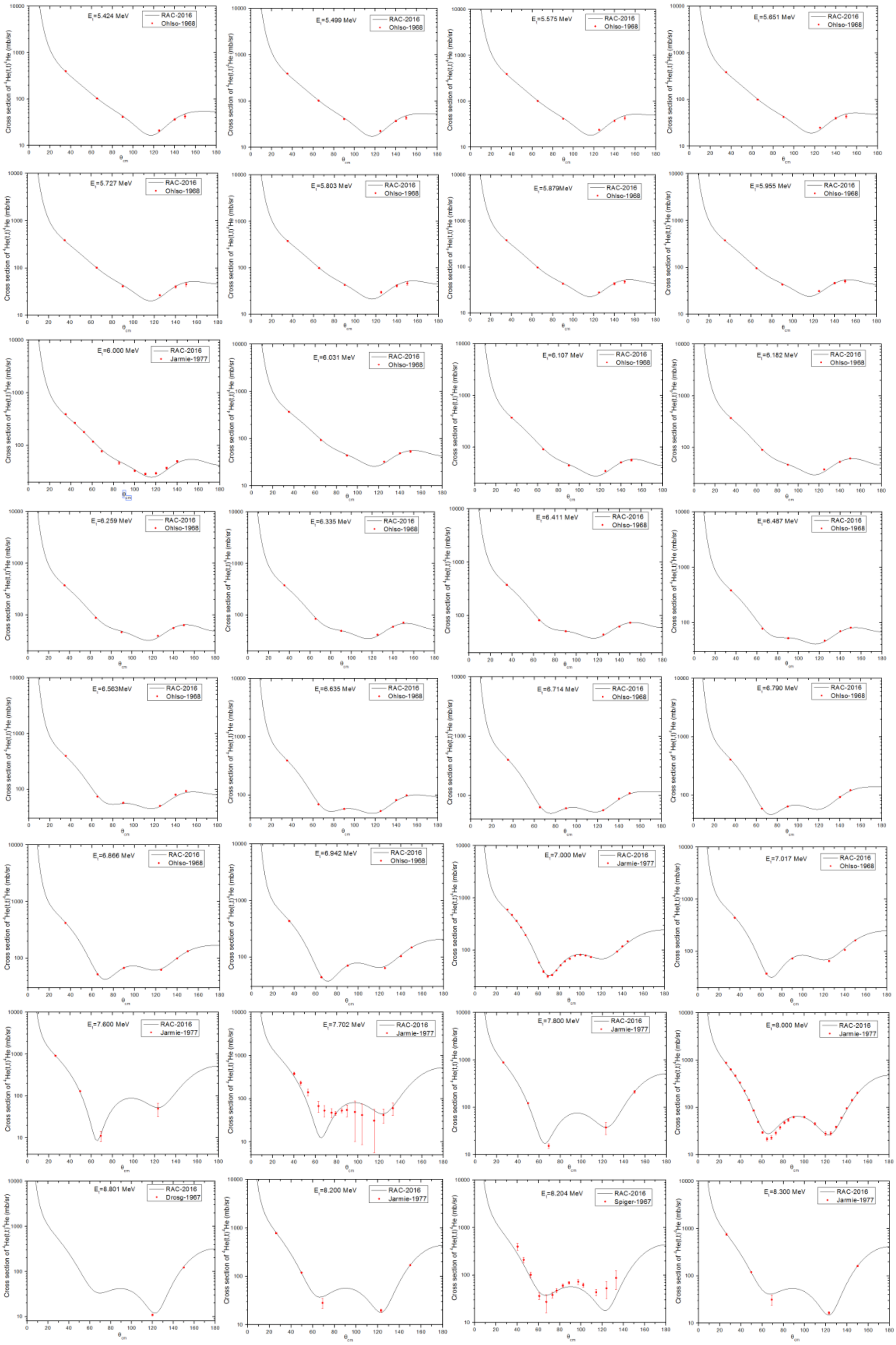


VII. Figures for the differential data of ^{4}He (t, t) ^{4}He;

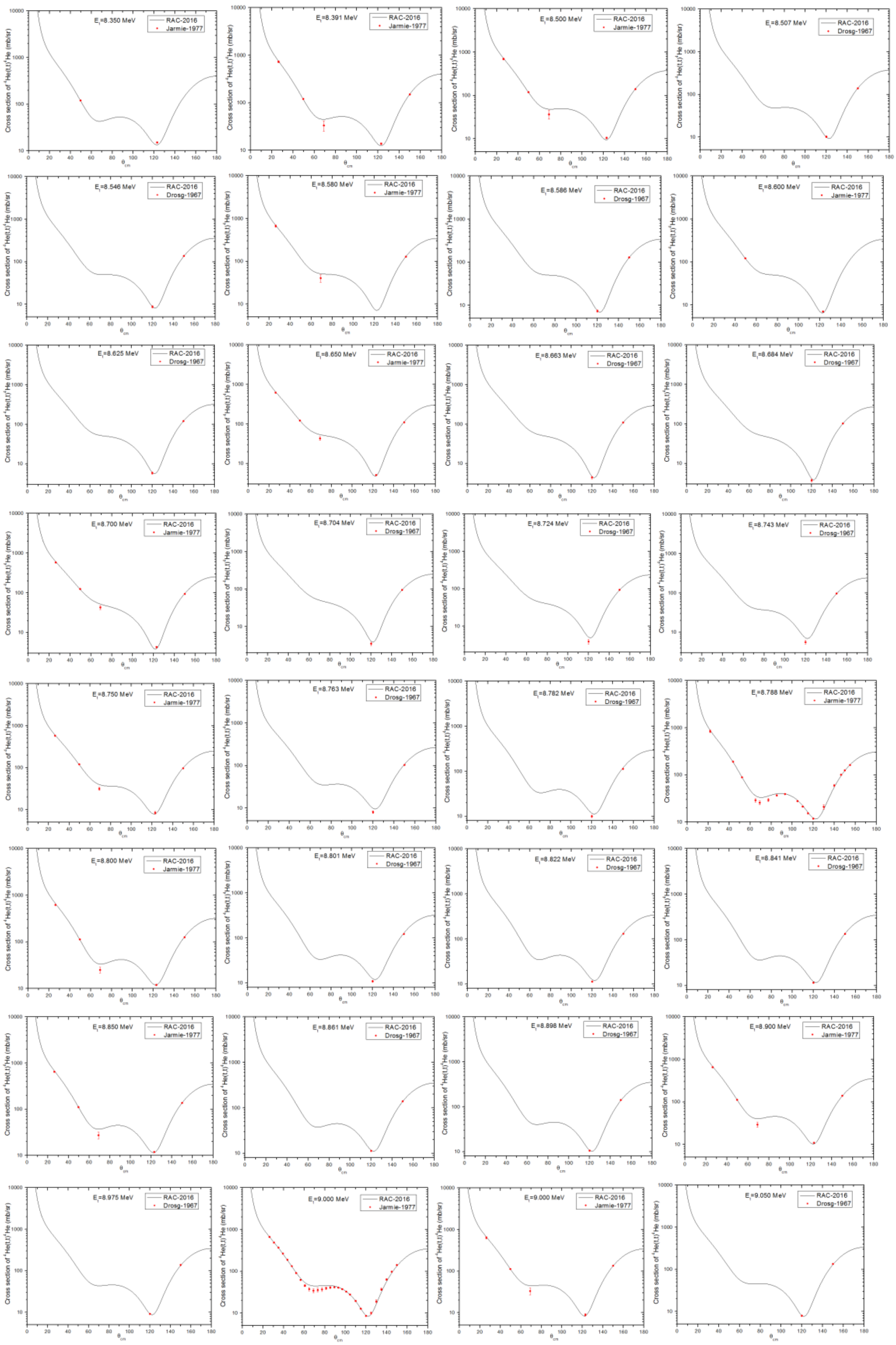
VII. 1.   Figures for DA of ^{4}He (t, t) ^{4}He



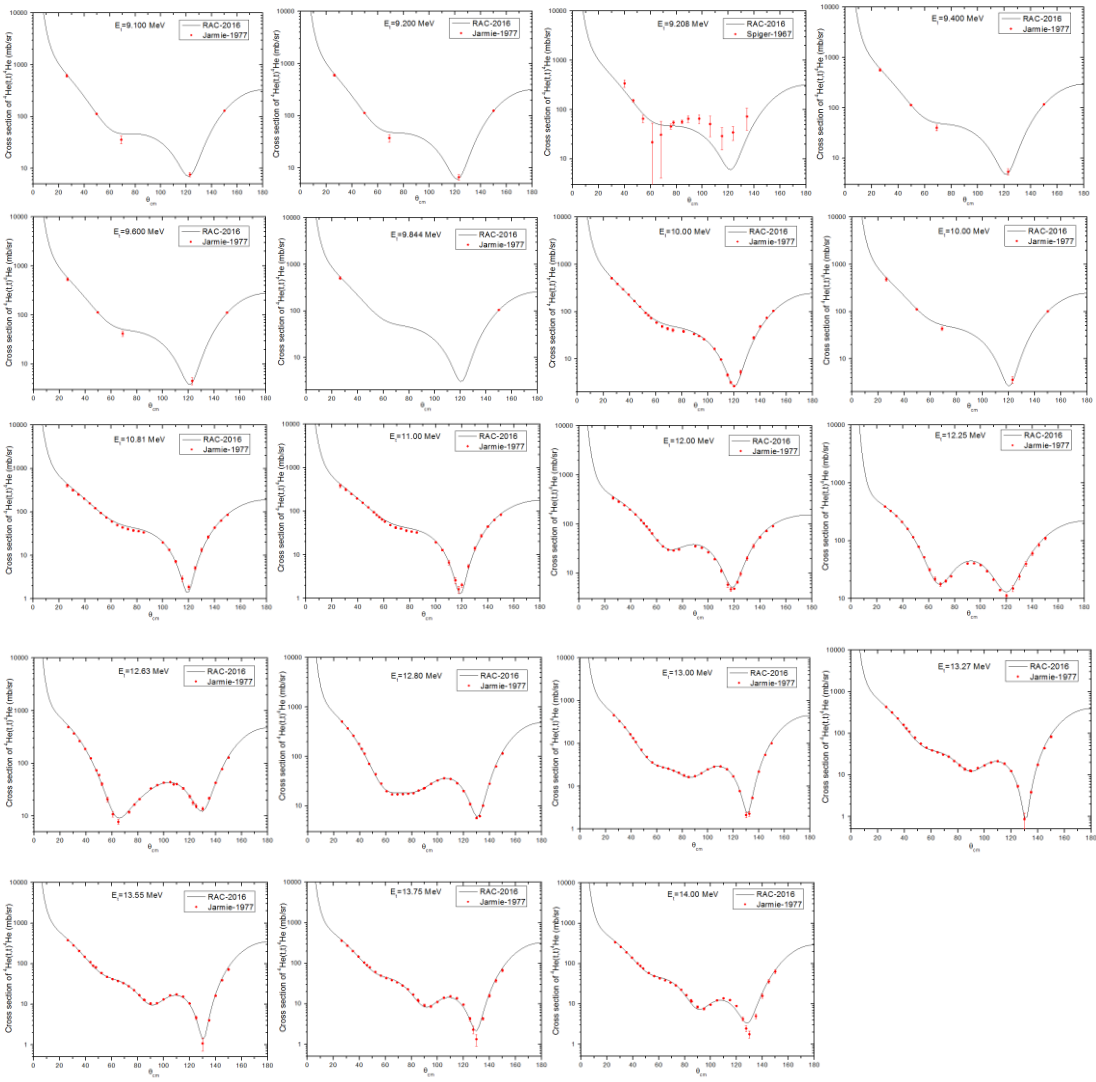

E_t=3.631MeV
E_t=3.669 MeV
E_t=3.708 MeV
E_t=3.745 MeV
E_t=3.784 MeV
E_t=3.822 MeV
E_t=3.861 MeV
E_t=3.882 MeV
E_t=3.898 MeV
E_t=3.938 MeV
E_t=3.975 MeV
E_t=4.013 MeV
E_t=4.051 MeV
E_t=4.090 MeV
E_t=4.127 MeV
E_t=4.204 MeV
E_t=4.280 MeV
E_t=4.357 MeV
E_t=4.433 MeV
E_t=4.509 MeV
E_t=4.586 MeV
E_t=4.662 MeV
E_t=4.738 MeV
E_t=4.815 MeV
E_t=4.890 MeV
E_t=4.967 MeV
E_t=5.005 MeV
E_t=5.043 MeV
E_t=5.119 MeV
E_t=5.195 MeV
E_t=5.271 MeV
E_t=5.347 MeV
RAC-2016
Ohlso-1968
Jarmie-1967
Jarmie-1977
Cross section of 4He(t,t)4He (mb/sr)
θcm



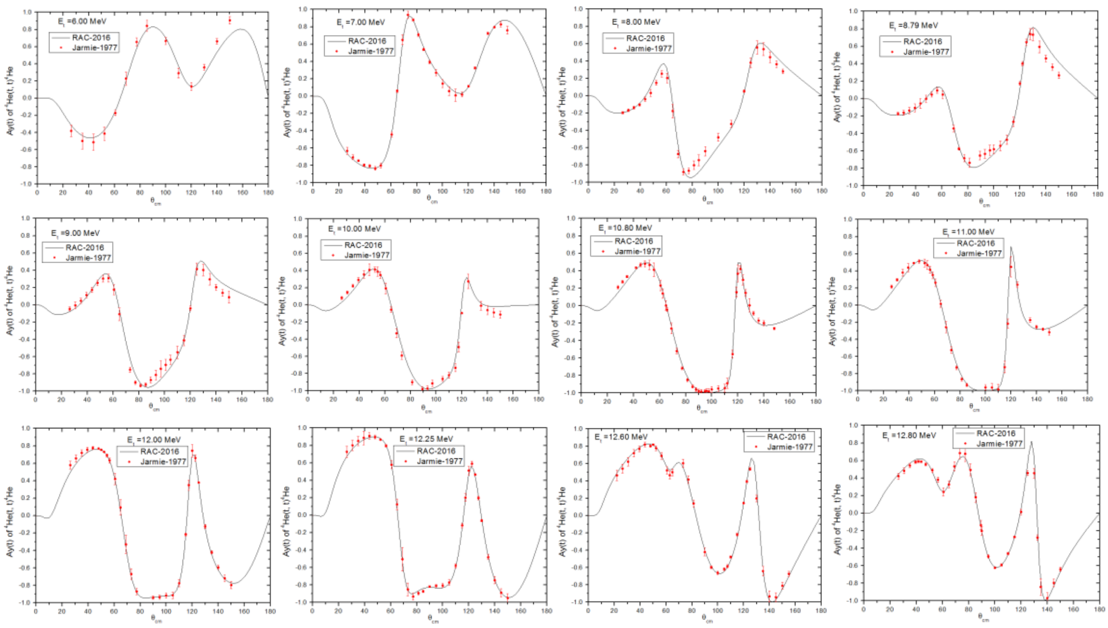
E_t=5.424 MeV
RAC-2016
Ohlso-1968
E_t=5.499 MeV
RAC-2016
Ohlso-1968
E_t=5.575 MeV
RAC-2016
Ohlso-1968
E_t=5.651 MeV
RAC-2016
Ohlso-1968
E_t=5.727 MeV
RAC-2016
Ohlso-1968
E_t=5.803 MeV
RAC-2016
Ohlso-1968
E_t=5.879MeV
RAC-2016
Ohlso-1968
E_t=5.955 MeV
RAC-2016
Ohlso-1968
E_t=6.000 MeV
RAC-2016
Jarmie-1977
E_t=6.031 MeV
RAC-2016
Ohlso-1968
E_t=6.107 MeV
RAC-2016
Ohlso-1968
E_t=6.182 MeV
RAC-2016
Ohlso-1968
E_t=6.259 MeV
RAC-2016
Ohlso-1968
E_t=6.335 MeV
RAC-2016
Ohlso-1968
E_t=6.411 MeV
RAC-2016
Ohlso-1968
E_t=6.487 MeV
RAC-2016
Ohlso-1968
E_t=6.563MeV
RAC-2016
Ohlso-1968
E_t=6.635 MeV
RAC-2016
Ohlso-1968
E_t=6.714 MeV
RAC-2016
Ohlso-1968
E_t=6.790 MeV
RAC-2016
Ohlso-1968
E_t=6.866 MeV
RAC-2016
Ohlso-1968
E_t=6.942 MeV
RAC-2016
Ohlso-1968
E_t=7.000 MeV
RAC-2016
Jarmie-1977
E_t=7.017 MeV
RAC-2016
Ohlso-1968
E_t=7.600 MeV
RAC-2016
Jarmie-1977
E_t=7.702 MeV
RAC-2016
Jarmie-1977
E_t=7.800 MeV
RAC-2016
Jarmie-1977
E_t=8.000 MeV
RAC-2016
Jarmie-1977
E_t=8.801 MeV
RAC-2016
Drosg-1967
E_t=8.200 MeV
RAC-2016
Jarmie-1977
E_t=8.204 MeV
RAC-2016
Spiger-1967
E_t=8.300 MeV
RAC-2016
Jarmie-1977
Cross section of 4He(t,t)4He (mb/sr)
θcm

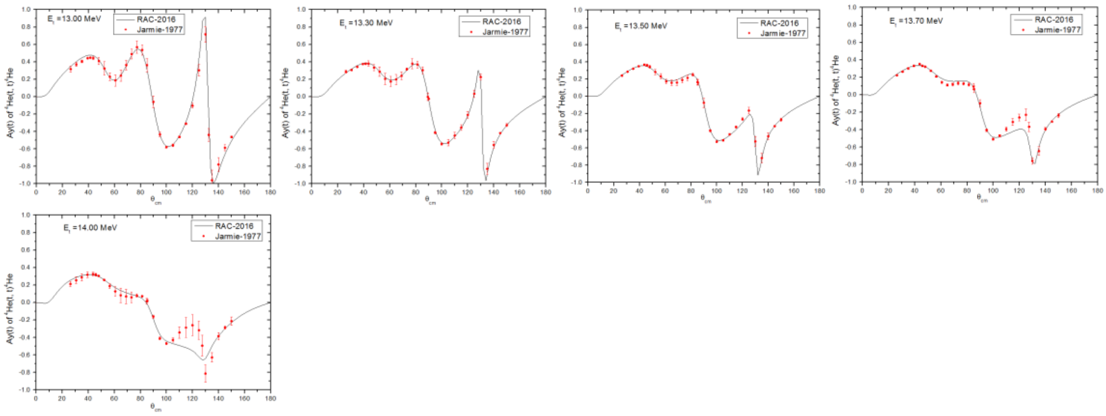


Cross section of 4He(t,t)4He (mb/sr)
θcm
Et=8.350 MeV RAC-2016 Jarmie-1977
Et=8.391 MeV RAC-2016 Jarmie-1977
Et=8.500 MeV RAC-2016 Jarmie-1977
Et=8.507 MeV RAC-2016 Drosg-1967
Et=8.546 MeV RAC-2016 Drosg-1967
Et=8.580 MeV RAC-2016 Jarmie-1977
Et=8.586 MeV RAC-2016 Drosg-1967
Et=8.600 MeV RAC-2016 Jarmie-1977
Et=8.625 MeV RAC-2016 Drosg-1967
Et=8.650 MeV RAC-2016 Jarmie-1977
Et=8.663 MeV RAC-2016 Drosg-1967
Et=8.684 MeV RAC-2016 Drosg-1967
Et=8.700 MeV RAC-2016 Jarmie-1977
Et=8.704 MeV RAC-2016 Drosg-1967
Et=8.724 MeV RAC-2016 Drosg-1967
Et=8.743 MeV RAC-2016 Drosg-1967
Et=8.750 MeV RAC-2016 Jarmie-1977
Et=8.763 MeV RAC-2016 Drosg-1967
Et=8.782 MeV RAC-2016 Drosg-1967
Et=8.788 MeV RAC-2016 Jarmie-1977
Et=8.800 MeV RAC-2016 Jarmie-1977
Et=8.801 MeV RAC-2016 Drosg-1967
Et=8.822 MeV RAC-2016 Drosg-1967
Et=8.841 MeV RAC-2016 Drosg-1967
Et=8.850 MeV RAC-2016 Jarmie-1977
Et=8.861 MeV RAC-2016 Drosg-1967
Et=8.898 MeV RAC-2016 Drosg-1967
Et=8.900 MeV RAC-2016 Jarmie-1977
Et=8.975 MeV RAC-2016 Drosg-1967
Et=9.000 MeV RAC-2016 Jarmie-1977
Et=9.000 MeV RAC-2016 Jarmie-1977
Et=9.050 MeV RAC-2016 Drosg-1967



VII. 2. Figures for AY of ^{4}He (t, t) ^{4}He





VIII. Table. Information about every data set;

N-factor normalized factor

Weight weight for a data set

χ^2-Dia the mean χ^2 only for Diagonal elements of covariance

χ^2-Cov the mean χ^2 only for all elements of covariance

Nu. The data number for a data set

No.	Name	N-factor		weight	χ^2-Dia	χ^2-Cov		Nu.
2	'NTOTa222'	1.0078	1.0000	1.0000	2.7507	2.7701	2.7507	217
3	'NTOTb222'	1.0001	1.0000	1.0000	2.8432	2.8412	2.8432	293
4	'NTOTc222'	1.0021	1.0000	1.0000	1.9267	1.9299	1.9267	49
5	'NTOT 235'	1.0241	1.0000	1.0000	1.5295	1.5276	1.5295	372
6	'NTOT 229'	0.9886	1.0000	1.0000	3.4264	3.4133	3.4264	86
7	'NTOT 257'	0.9746	1.0000	1.0000	0.5115	0.5109	0.5115	122
8	'NTOTa277'	1.0056	1.0000	1.0000	2.2737	2.2255	2.2737	130
9	'NTOTb277'	1.0027	1.0000	1.0000	2.1684	2.1737	2.1684	23
10	'NTOTc277'	1.0112	1.0000	1.0000	0.3546	0.3532	0.3546	23
11	'NTOTguen'	1.0015	1.0000	1.0000	0.6420	0.6432	0.6420	15
12	'NTOTfost'	1.0009	1.0000	1.0000	1.0459	1.0616	1.0459	238
13	'NTOTlama'	0.9966	1.0000	1.0000	2.1374	1.2912	2.1374	341
16	'NNCS1001'	0.9973	1.0000	1.0000	0.2281	0.1799	0.2281	27
17	'NNCS 210'	0.9480	1.0000	1.0000	0.0917	0.0910	0.0917	24
18	'NNCS 223'	1.0230	1.0000	1.0000	0.9402	0.9149	0.9402	65
19	'NNCS 208'	0.8929	1.0000	1.0000	0.5003	0.5004	0.5003	22
20	'NNCS 255'	1.0473	1.0000	1.0000	1.1064	1.1052	1.1064	34
21	'NNCS 212'	1.0481	1.0000	1.0000	0.4508	0.4515	0.4508	14
22	'NNCShogu'	1.0333	1.0000	1.0000	0.8363	0.8551	0.8363	7
23	'NNCSknox'	1.0578	1.0000	1.0000	0.2296	0.2327	0.2296	14
24	'NNCShopk'	1.0039	1.0000	1.0000	0.0493	0.0501	0.0493	3
25	'NNCSbatc'	1.0634	1.0000	1.0000	0.6472	0.6737	0.6472	6
26	'NNCSchib'	1.0072	1.0000	1.0000	0.0650	0.0662	0.0650	3
27	'NNCSmerc'	1.0824	1.0000	1.0000	0.0025	0.0025	0.0025	1
29	'NNDAla11'	1.1935	1.0000	1.0000	0.4275	0.4283	0.4275	8
30	'NNDAla12'	1.2211	1.0000	1.0000	6.7021	6.8155	6.7021	8

31 'NNDAla13'	1.0679	1.0000	1.8000	8.7316	8.9789	8.7316	8
32 'NNDAla14'	1.0819	1.0000	1.8000	8.3550	8.6133	8.3550	8
33 'NNDAla21'	0.9371	1.0000	1.0000	9.9211	9.9866	9.9211	8
34 'NNDAla22'	1.0099	1.0000	1.0000	7.8386	7.8659	7.8386	6
35 'NNDAla23'	1.0431	1.0000	1.0000	1.3606	1.3742	1.3606	8
36 'NNDAla24'	1.0407	1.0000	1.0000	0.4525	0.4533	0.4525	8
37 'NNDAla25'	1.1010	1.0000	1.0000	2.2975	2.3028	2.2975	8
38 'NNDAla26'	1.0504	1.0000	1.0000	5.4675	5.5171	5.4675	8
39 'NNDAla27'	0.9000	1.0000	1.0000	2.4807	2.4861	2.4807	10
40 'NNDAla31'	0.9545	1.0000	1.0000	8.5330	8.5522	8.5330	8
41 'NNDAla32'	1.1143	1.0000	1.0000	5.9927	6.0093	5.9927	8
42 'NNDAla41'	0.8478	1.0000	1.0000	5.2744	5.3340	5.2744	8
43 'NNDAla42'	0.8307	1.0000	1.8000	8.7476	8.8054	8.7476	8
44 'NNDAla43'	0.8971	1.0000	2.5000	4.3472	4.3869	4.3472	8
45 'NNDAla44'	0.8819	1.0000	2.2000	6.3587	6.4504	6.3587	8
46 'NNDAla45'	0.8776	1.0000	2.4000	5.2461	5.3172	5.2461	8
47 'NNDAla46'	0.8340	1.0000	1.8000	9.6072	9.7845	9.6072	8
48 'NNDAla51'	0.8958	1.0000	1.8000	8.3566	8.4987	8.3566	8
49 'NNDAla52'	0.9107	1.0000	1.8000	8.0000	8.1497	8.0000	8
50 'NNDAla53'	0.8881	1.0000	1.6000	8.7074	8.9565	8.7074	8
51 'NNDAla54'	0.9535	1.0000	1.0000	5.6506	5.7817	5.6506	8
52 'NNDAla55'	0.9553	1.0000	1.0000	2.2249	2.2405	2.2249	8
53 'NNDAla56'	0.9921	1.0000	1.0000	1.0188	1.0431	1.0188	8
54 'NNDAlan6'	0.9976	1.0000	1.0000	1.0163	1.0264	1.0163	40
55 'NNDAanls'	0.9802	1.0000	1.0000	1.1428	0.9171	1.1428	257
56 'NNDAknox'	1.0238	1.0000	1.0000	0.8577	0.7214	0.8577	125
57 'NNDAhoug'	0.9953	1.0000	1.0000	0.8432	0.8415	0.8432	190
58 'NNDAbaba'	1.0303	1.0000	1.0000	1.1949	1.2185	1.1949	12
59 'NNDAhyak'	1.1100	1.0000	1.0000	1.2159	1.0721	1.2159	16
60 'NNDAhans'	0.9950	1.0000	1.0000	0.6250	0.6617	0.6250	21
61 'NNDAruan'	0.9794	1.0000	1.0000	0.3326	0.3744	0.3326	21
62 'NNAYlane'	0.8502	1.0000	1.0000	1.9583	1.9564	1.9582	5
63 'NNAYlan0'	1.1412	1.0000	1.0000	0.9381	0.9380	0.9381	10
64 'NNAYla10'	1.5856	1.0000	1.0000	0.2929	0.2930	0.2929	5
65 'NNAYla20'	2.0102	1.0000	1.0000	0.0563	0.0564	0.0563	5
66 'NNAYla30'	2.7523	1.0000	1.0000	0.5848	0.5866	0.5848	5
67 'NNAYla11'	0.3303	1.0000	1.0000	2.8688	2.9117	2.8688	5
68 'NNAYla21'	0.3514	1.0000	1.0000	3.7033	3.6042	3.7033	5
69 'NNAYla31'	0.3211	1.0000	1.0000	3.8546	4.3957	3.8546	10
70 'NNAYla41'	0.3248	1.0000	1.0000	2.8114	2.8522	2.8114	9
71 'NNAYla51'	0.3116	1.0000	1.0000	2.6855	2.8131	2.6855	10
72 'NNAYla12'	0.3229	1.0000	1.0000	4.6783	4.1661	4.6783	9
73 'NNAYla22'	0.3134	1.0000	1.0000	7.5555	9.3302	7.5555	9
74 'NNAYla32'	0.3145	1.0000	1.0000	7.1761	5.7754	7.1761	9

75	'NNAYlan3'	0.3158	1.0000	1.0000	4.5038	4.7634	4.5038	53
76	'NNAYlan4'	0.6707	1.0000	1.0000	1.1351	1.2562	1.1351	35
77	'NABSmmac'	1.1310	1.0000	1.0000	1.3538	1.3667	1.3538	3
78	'NABSgorb'	0.9823	1.0000	1.0000	2.4241	2.4241	2.4241	1
80	'NTCS 757'	0.9992	1.0000	1.0000	0.6860	0.7015	0.6860	12
81	'NTCS 226'	1.0306	1.0000	1.0000	0.6375	0.6377	0.6375	15
82	'NTCS 202'	1.0277	1.0000	1.0000	1.0248	1.0315	1.0248	12
83	'NTCS 281'	1.0471	1.0000	1.0000	1.0551	1.0515	1.0551	45
84	'NTCS 238'	1.0526	1.0000	1.0000	0.3791	0.3986	0.3791	11
85	'NTCS 702'	1.0000	1.0000	1.0000	0.5417	0.5417	0.5417	1
86	'NTCS 707'	1.0000	1.0000	1.0000	0.5417	0.5417	0.5417	1
87	'NTCS 232'	1.0129	1.0000	1.0000	2.0166	1.9475	2.0166	84
88	'NTCS 292'	1.0141	1.0000	1.0000	1.0938	1.0943	1.0938	82
89	'NTCS 294'	1.0314	1.0000	1.0000	1.0782	1.0785	1.0782	40
90	'NTCS 241'	1.0191	1.0000	1.0000	0.5488	0.5496	0.5488	23
91	'NTCS 246'	1.0569	1.0000	1.0000	0.6412	0.6394	0.6412	151
92	'NTCS 205'	0.9982	1.0000	1.0000	1.4842	1.4184	1.4842	170
93	'NTCS 198'	1.0511	1.0000	1.0000	0.0000	0.0000	0.0000	1
94	'NTCS 285'	1.0439	1.0000	1.0000	0.4511	0.4510	0.4511	25
95	'NTCS1011'	1.0106	1.0000	1.0000	1.1476	1.1458	1.1476	16
96	'NTCSmack'	1.0402	1.0000	1.0000	0.6391	0.6317	0.6391	106
97	'NTCSgayt'	1.0278	1.0000	1.0000	2.0666	1.9957	2.0666	112
98	'NTCSbar2'	1.0396	1.0000	1.0000	1.0824	1.0439	1.0824	12
99	'NTCSgabb'	1.0267	1.0000	1.0000	2.1853	1.9571	2.1853	44
100	'NTCSmurr'	0.8891	1.0000	1.0000	1.6115	1.3354	1.6115	21
101	'NTCSribe'	0.9885	1.0000	1.0000	0.3942	0.3928	0.3942	10
102	'NTCSborm'	1.0757	1.0000	1.0000	0.0919	0.0919	0.0919	1
103	'NTCSnejt'	0.9960	1.0000	1.0000	0.9480	0.9480	0.9479	1
104	'NTCSgold'	0.9217	1.0000	1.0000	0.4196	0.4196	0.4196	1
105	'NTCSchan'	1.0139	1.0000	1.0000	0.4709	0.4756	0.4709	5
106	'NTCScha2'	1.0046	1.0000	1.0000	2.5985	2.6651	2.5985	2
108	'NTDAov01'	0.8913	1.0000	1.0000	0.2829	0.2839	0.2829	16
109	'NTDAov02'	0.7985	1.0000	1.0000	0.5759	0.5826	0.5759	16
110	'NTDAov03'	0.8714	1.0000	1.0000	1.0002	1.0005	1.0002	16
111	'NTDAov04'	0.9783	1.0000	1.0000	2.5971	2.6442	2.5971	16
112	'NTDAov05'	1.1106	1.0000	1.0000	1.5063	1.5185	1.5063	16
113	'NTDAov06'	1.1038	1.0000	1.0000	1.5077	1.5172	1.5077	16
114	'NTDAov07'	1.0808	1.0000	1.0000	1.4351	1.4435	1.4351	16
115	'NTDAov08'	1.0472	1.0000	1.0000	1.5681	1.5841	1.5681	16
116	'NTDAove3'	1.0727	1.0000	1.0000	1.1865	1.1847	1.1865	64
117	'NTDAove4'	1.0591	1.0000	1.0000	1.3986	1.3605	1.3986	80
118	'NTDAove5'	1.0438	1.0000	1.0000	0.8792	0.8813	0.8792	80

119	'NTDAove6'	1.1050	1.0000	1.0000	0.6928	0.7048	0.6928	64
120	'NTDAknox'	0.9769	1.0000	1.0000	1.8172	2.0126	1.8172	43
121	'NTDAcond'	1.3104	1.0000	1.0000	1.5916	1.6008	1.5916	20
122	'NTDAcon1'	0.9588	1.0000	1.0000	1.2574	1.3139	1.2574	16
123	'NTDAcon2'	0.8591	1.0000	1.0000	1.7688	1.8081	1.7688	14
124	'NTDAbart'	0.9500	1.0000	1.8000	1.4889	1.7400	1.4889	168
125	'NTDAb000'	1.0780	1.0000	1.0000	1.3695	1.4913	1.3695	14
126	'NTDAb180'	0.9471	1.0000	1.0000	1.4171	1.5532	1.4171	11
127	'NTDAzhan'	0.9442	1.0000	1.0000	2.4921	1.9152	2.4921	67
128	'NTDAzha2'	0.8112	1.0000	1.5000	4.0724	2.7850	4.0724	49
129	'NTDAD-20'	0.9640	1.0000	1.0000	5.1000	3.1483	5.1000	54
130	'NTDAD-30'	0.9640	1.0000	1.0000	4.6177	3.7196	4.6177	53
131	'NTDAD-45'	0.9640	1.0000	1.0000	3.9746	3.3567	3.9746	55
132	'NTDAD-60'	0.9640	1.0000	1.0000	2.6131	2.1668	2.6131	59
133	'NTDAD-75'	0.9640	1.0000	1.0000	2.7206	1.7427	2.7206	58
134	'NTDAD-90'	0.9640	1.0000	1.0000	2.4429	2.3399	2.4429	65
135	'NTDAD120'	0.9640	1.0000	1.0000	1.7474	1.1067	1.7474	55
136	'NTDAD135'	0.9640	1.0000	1.0000	3.8339	1.4733	3.8339	53
137	'NTDADevi'	0.9640	1.0000	1.0000	3.0896	2.6656	3.0896	63
138	'NTDAD020'	0.9640	1.0000	1.0000	3.5666	2.8573	3.5666	49
139	'NTDAD030'	0.9640	1.0000	1.0000	4.5857	3.7738	4.5857	53
140	'NTDAD045'	0.9640	1.0000	1.0000	3.0327	2.8112	3.0327	49
141	'NTDAD060'	0.9640	1.0000	1.0000	1.5534	1.6275	1.5534	32
142	'RATIcarl'	4.1151	1.0000	1.0000	0.0002	0.0002	0.0002	7
143	'NINLbatc'	0.9973	1.0000	1.0000	0.4483	0.4411	0.4483	6
144	'NINLsmit'	0.9550	1.0000	1.0000	1.2198	0.9900	1.2198	13
145	'NINLsado'	0.9870	1.0000	1.0000	0.0880	0.1105	0.0880	5
146	'NINLarms'	0.9543	1.0000	1.0000	1.6537	1.6211	1.6537	2
147	'NINLliso'	0.9543	1.0000	1.0000	1.1942	1.2899	1.1942	2
148	'NPCSpres'	1.0953	1.0000	2.2000	1.2157	1.5488	1.2157	34
149	'NPCSbarr'	1.2253	1.0000	1.0000	1.1941	1.2211	1.1941	7
150	'NPDArosa'	0.9540	1.0000	2.0000	1.6856	2.6879	1.6856	17
151	'NPDAros0'	0.9590	1.0000	2.0000	2.0651	1.5781	2.0651	9
152	'NDCSbatc'	1.0379	1.0000	1.0000	0.4690	0.4835	0.4690	6
153	'NDCSrose'	0.9534	1.0000	1.0000	0.7982	0.7675	0.7982	11
154	'NDCShopk'	0.9520	1.0000	1.0000	0.6417	0.5918	0.6417	12
155	'NDCSchip'	0.8152	1.0000	2.0000	1.6591	1.5034	1.6591	3
156	'NDCSliso'	0.8152	1.0000	1.2000	1.0175	0.9931	1.0175	2
157	'NDDArosa'	0.9412	1.0000	1.0000	0.7022	1.0008	0.7022	12
158	'NDDAhigu'	1.1557	1.0000	1.0000	0.3843	0.3316	0.3843	11
159	'NN2Cpres'	0.9542	1.0000	1.0000	0.8234	1.0099	0.8234	10
160	'NN2Cbeso'	1.2325	1.0000	1.0000	1.2446	1.2446	1.2446	1
161	'N2NCashb'	1.1199	1.0000	1.0000	0.5459	0.5783	0.5459	2
162	'N2NCmath'	0.9926	1.0000	1.0000	0.0036	0.0036	0.0036	1

163	'N2NCarms'	0.9440	1.0000	1.0000	2.9026	2.9026	2.9026	1
164	'N2NCmika'	1.2325	1.0000	1.0000	0.1504	0.1504	0.1504	1
165	'TTDAolso'	0.9650	1.0000	2.2000	2.4134	2.5085	2.4134	4
166	'TTDAolse'	0.9683	1.0000	1.6000	2.8480	2.9466	2.8479	11
167	'TTDAolsf'	0.9785	1.0000	1.4000	2.8891	2.7789	2.8891	9
168	'TTDAolsg'	0.9663	1.0000	1.3000	2.8153	2.7969	2.8153	13
169	'TTDAolsh'	0.9600	1.0000	1.2000	2.6858	2.6221	2.6858	20
170	'TTDAolsi'	0.9646	1.0000	2.1000	2.6089	2.8704	2.6089	22
171	'TTDAolsj'	0.9667	1.0000	1.7000	3.2264	2.7834	3.2264	24
172	'TTDAolsk'	0.9624	1.0000	1.0000	2.7669	2.6409	2.7669	30
173	'TTDAolsl'	0.9856	1.0000	1.0000	0.8644	0.8718	0.8644	18
174	'TTDAolsm'	0.9931	1.0000	1.0000	0.8401	0.8459	0.8401	18
175	'TTDAolsn'	0.9935	1.0000	1.0000	1.1204	1.1290	1.1204	23
176	'TTDAols2'	0.9905	1.0000	1.0000	1.5592	1.5692	1.5592	18
177	'TTDAols3'	0.9955	1.0000	1.0000	1.8303	1.8431	1.8303	18
178	'TTDAols4'	0.9860	1.0000	1.0000	2.7005	2.7183	2.7005	18
179	'TTDAols5'	0.9847	1.0000	1.1000	2.6261	2.6303	2.6261	24
180	'TTDAols6'	0.9814	1.0000	1.1000	2.5441	2.5590	2.5441	18
181	'TTDAols7'	0.9819	1.0000	1.0000	2.1816	2.2130	2.1816	18
182	'TTDAols8'	0.9790	1.0000	1.0000	1.7163	1.7478	1.7163	24
183	'TTDAols9'	1.0056	1.0000	1.0000	1.0838	1.1006	1.0838	23
184	'TTDAjari'	0.9717	1.0000	1.0000	0.5482	0.6015	0.5482	25
185	'TTDAjar1'	0.9582	1.0000	1.0000	1.4694	1.4809	1.4694	26
186	'TTDAjar2'	0.9608	1.0000	1.9000	2.5406	2.5743	2.5406	11
187	'TTDAjar3'	1.0136	1.0000	1.0000	1.8908	1.8844	1.8908	20
188	'TTDAjar4'	0.9997	1.0000	1.8000	2.7970	2.6753	2.7970	25
189	'TTDAjar5'	0.9841	1.0000	2.2000	3.4570	2.9974	3.4570	17
190	'TTDAjar6'	1.0098	1.0000	1.3000	3.0285	3.0149	3.0285	29
191	'TTDAjar7'	1.0479	1.0000	1.1000	2.7760	2.8333	2.7760	27
192	'TTDAjar8'	1.0357	1.0000	1.1000	3.9136	3.4392	3.9136	26
193	'TTDAjar9'	1.0315	1.0000	1.3000	3.8970	3.3996	3.8970	29
194	'TTDAjara'	1.0368	1.0000	1.0000	2.1363	1.9286	2.1363	30
195	'TTDAjarb'	1.0447	1.0000	1.1000	2.6260	2.3107	2.6260	26
196	'TTDAjarc'	1.0379	1.0000	1.0000	2.3588	2.4836	2.3588	29
197	'TTDAjard'	1.0004	1.0000	1.0000	2.7729	2.4627	2.7729	31
198	'TTDAla80'	1.0091	1.0000	1.0000	1.0573	1.0998	1.0573	30
199	'TTDAla81'	0.9865	1.0000	1.0000	1.9367	2.0795	1.9367	30
200	'TTDAla82'	0.9736	1.0000	1.0000	1.3058	1.4135	1.3058	30
201	'TTDAla83'	0.9793	1.0000	1.0000	1.9293	1.8972	1.9293	31
202	'TTDAla84'	0.9790	1.0000	1.0000	1.7880	1.5543	1.7880	31
203	'TTDAja75'	1.0048	1.0000	1.3000	2.3750	2.4293	2.3750	5
204	'TTDAja7a'	0.9552	1.0000	2.6000	1.6899	1.7056	1.6899	10
205	'TTDAja7b'	0.9645	1.0000	1.4000	1.4914	1.5469	1.4914	12
206	'TTDAja7c'	0.9685	1.0000	1.3000	2.6161	2.8026	2.6161	10

207	'TTDAja7d'	0.9804	1.0000	1.4000	2.8984	3.3261	2.8984	10
208	'TTDAja7e'	0.9974	1.0000	1.6000	3.2129	3.5652	3.2129	10
209	'TTDAja7f'	0.9841	1.0000	1.3000	3.2455	3.3334	3.2455	10
210	'TTDAja7g'	0.9867	1.0000	1.0000	2.2341	2.3045	2.2341	15
211	'TTDAja7i'	0.9943	1.0000	1.0000	1.0429	1.0397	1.0429	15
212	'TTDAja7j'	1.0056	1.0000	1.0000	1.2360	1.2419	1.2360	10
213	'TTDAla76'	0.9646	1.0000	1.8000	3.7129	2.4125	3.7129	36
214	'TTDAspig'	0.9641	1.0000	2.0000	2.8963	2.8970	2.8963	14
215	'TTDAspi1'	0.9641	1.0000	2.5000	2.7754	2.7260	2.7754	14
216	'TTDAspi2'	0.9641	1.0000	2.5000	2.9376	2.8949	2.9376	14
217	'TTAYjar2'	0.9843	1.0000	3.4000	2.6459	2.6881	2.6459	14
218	'TTAYjar3'	1.0205	1.0000	1.3000	3.3553	3.5457	3.3553	26
219	'TTAYjar4'	1.0388	1.0000	2.1000	3.3669	3.1935	3.3669	25
220	'TTAYjar5'	1.0302	1.0000	1.9000	3.0881	3.4862	3.0881	29
221	'TTAYjar6'	0.9767	1.0000	2.6000	2.8545	2.8935	2.8545	28
222	'TTAYjar7'	0.9873	1.0000	2.8000	3.5851	4.2772	3.5851	27
223	'TTAYjar8'	0.9790	1.0000	1.5000	2.8567	3.1615	2.8567	38
224	'TTAYjar9'	0.9713	1.0000	1.4000	3.4970	3.6128	3.4970	28
225	'TTAYjara'	0.9889	1.0000	1.0000	1.4879	1.0535	1.4879	30
226	'TTAYjarb'	1.0002	1.0000	1.0000	1.4615	1.5611	1.4615	31
227	'TTAYjarc'	1.0335	1.0000	1.1000	1.9579	2.2518	1.9579	32
228	'TTAYjard'	1.0471	1.0000	1.0000	1.8024	1.6974	1.8024	31
229	'TTAYla80'	1.0449	1.0000	1.3000	2.8808	2.6928	2.8808	30
230	'TTAYla81'	1.0415	1.0000	1.0000	0.7496	0.8638	0.7496	30
231	'TTAYla82'	1.0308	1.0000	1.0000	0.7335	0.8469	0.7335	30
232	'TTAYla83'	1.0242	1.0000	1.0000	3.9304	4.2303	3.9304	31
233	'TTAYla84'	0.9791	1.0000	1.0000	3.8928	4.4176	3.8928	31
234	'TTAYh050'	1.0285	1.0000	1.0000	0.8505	0.8702	0.8505	60
235	'TTAYh123'	0.9716	1.0000	1.2000	3.4522	2.2527	3.4522	15
236	'TN1DAdro'	1.0322	1.0000	1.0000	3.6027	2.5136	3.6027	16
237	'TN1DAdr0'	1.0488	1.0000	1.0000	1.0084	1.1796	1.0084	4
238	'TN2DAdro'	0.9476	1.0000	1.5000	4.3809	4.0882	4.3809	3
239	'TNDAdros'	0.9560	1.0000	1.0000	1.4090	1.9081	1.4090	39
240	'TNDAdro1'	0.9545	1.0000	1.2000	2.2661	2.5081	2.2661	15

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