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MULTIGROUP CONSTANTS FOR CHARGED PARTICLE ELASTIC NUCLEAR (PLUS INTERFERENCE) SCATTERING OF LIGHT ISOTOPES

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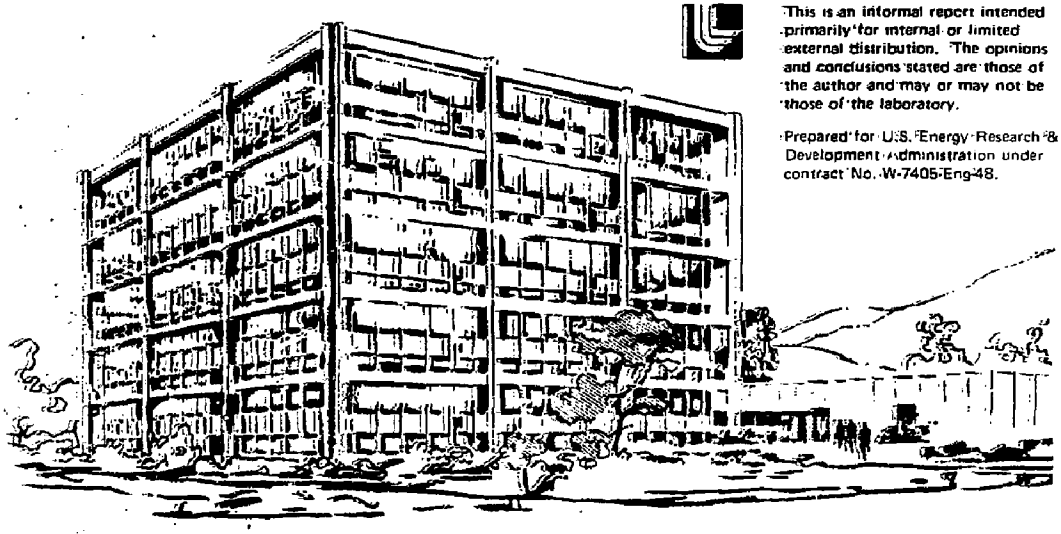

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Abstract

Multi-group averaged reaction rates and transfer matrices have been calculated for charged particle induced elastic nuclear (plus interference) scattering. Results are presented using a ten group structure for all twenty-five permutations of projectile and target for the following charged particles: p, d, t, ^{3}He and α. Transfer matrices are presented in a simplified form for both incident projectile and the knock-ons; these matrices explicitly conserve energy.

Introduction

The objective of this study was to produce multi-group averaged reactions rates $< \sigma(E)V >$ and simplified transfer matrices to describe both the slowing down of the projectiles and the energy gain of the knock-ons. The charged particle induced nuclear (plus interference) scattering from the ENDL[1] library was used for this purpose. Group averaged reaction rates were defined in the normal manner. The transfer matrix for the incident particle includes only up to two final groups (the source group and one other). The final groups and their transition probabilities are selected to give the scattered projectiles the correct secondary energy distribution. Similarly, the transfer matrix for the knock-ons includes only up to two final groups (the thermal sea and one other). Again, the final groups and their transition probabilities are selected to give the knock-on particle

exactly the energy lost by the projectile slowing down. With this simplified scheme, the correct average secondary energy and an energy balance is guaranteed.

Multi-Group Definitions

The group-averaged quantities calculated are:

1.) The group-averaged reaction rate

$$< V\sigma(E) >_g = \int_{E_g}^{E_{g+1}} V\sigma(E)\, n(E)\, dE \Big/ \int_{E_g}^{E_{g+1}} n(E)\, dE \quad , \qquad (1)$$

2.) The group-averaged secondary energy

$$< E' >_g = \int_{E_g}^{E_{g+1}} E' V\sigma(E)\, n(E)\, dE \Big/ \int_{E_g}^{E_{g+1}} V\sigma(E)\, n(E)\, dE$$

$$= \int_{E_g}^{E_{g+1}} [E - D(E)]\, V\sigma(E)\, n(E)\, dE \Big/ \int_{E_g}^{E_{g+1}} V\sigma(E)\, n(E)\, dE$$

$$= < E >_g - < D(E) >_g \quad , \qquad (2)$$

where

$V\sigma(E)$ – reaction rate

$D(E)$ – average energy loss per collision

$n(E)$ – number density weighting spectrum.

The group averaged reaction rate was calculated for each group. The secondary energy was used to define the average secondary group and transition probability. Relative to the center of each energy group the effective energy loss is given by

$$< D''(E) >_g = \frac{1}{2} (E_{g+1} + E_g) - < E' >_g \quad . \tag{3}$$

Note that the effective energy loss $< D''(E) >_g$ is only equal to the energy loss $< D(E) >_g$ if the average energy of a collision $< E >_g$ is equal to the average energy of the group $[\frac{1}{2} (E_{g+1} + E_g)]$. Usually $< D''(E) >_g$ is close to $< D(E) >_g$ except near the threshold of a reaction. Near the threshold, in order to reproduce the correct probability of scattering out of the group, it is important to use the correct averaged secondary energy $< E' >_g$ and effective energy loss $< D''(E) >_g$, as opposed to defining the secondary energy by subtracting the energy loss $< D(E) >_g$ from the group averaged energy $[\frac{1}{2} (E_{g+1} + E_g)]$.

The selection of the average secondary group was simply based upon which group the averaged secondary energy $< E' >_g$ fell into. The transition probability was introduced in order to exactly conserve the effective energy loss $< D''(E) >_g$

Allowing for two final groups for either the projectile or knock-on and explicitly conserving the effective energy loss we have the two equations

$$< D''(E) >_g = \Delta_{g \to g'} f_{g \to g'} + \Delta_{g \to g''} f_{g \to g''} \tag{4}$$

$$1 = f_{g \to g'} + f_{g \to g''}$$

where

$< D'(E) >_g$ - effective energy loss

$f_{g \to g'}$ - transition probability from group g to g'

$\Delta_{g \to g'}$ - absolute value of energy change due to transition from group g to g'

$= \left| 1/2(E_{g+1} + E_g) - 1/2(E_{g'+1} + E_{g'}) \right|$.

Once the two final groups g' and g" have been selected, $\Delta_{g \to g'}$ and $\Delta_{g \to g''}$ are known and it is possible to uniquely solve for the transition probabilities,

$$f_{g \to g''} = \frac{\Delta_{g \to g'} - < D'(E) >_g}{\Delta_{g \to g'} - \Delta_{g \to g''}} \tag{5}$$

$$f_{g \to g'} = \frac{< D'(E) >_g - \Delta_{g \to g''}}{\Delta_{g \to g'} - \Delta_{g \to g''}} \tag{6}$$

These transition probabilities will be physically acceptable (i.e., both in the range 0 to 1) if g' and g" are selected such that,

$$\Delta_{g \to g'} \geq < D'(E) >_g > \Delta_{g \to g''} \quad . \tag{7}$$

The most accurate treatment is obtained by selecting g" and g' such that they are adjacent groups (i.e., $g' = g'' \pm 1$) and energy loss or gain terms straddle the effective energy loss,

$$\Delta_{g \to g'' \pm 1} \geq < D'(E) >_g > \Delta_{g \to g''} \quad . \tag{8}$$

However, in the present calculations one of the two final groups was defined to be the initial group (i.e., $g'' \equiv g$) for both the projectile and knock-on.

In this case, for the projectile a fraction of the particles are transferred to a final group and the remainder stay in the source group. The average energy loss is then given by

$$< D''(E) >_g = 0 f_{g\to g} + \Delta_{g\to g'} f_{g\to g'} ,$$

where

$f_{g\to g}$ - fraction remaining in group g

$f_{g\to g'}$ - fraction transferring to group g'

$\Delta_{g\to g'}$ - energy loss due to transfer from group g to g'

$$= \left| \frac{1}{2}(E_{g+1} + E_g) - \frac{1}{2}(E_{g'+1} + E_{g'}) \right|$$

$< D''(E) >_g$ - effective energy loss .

In the multi-group approximation there is no energy loss due to a scattering that remains in group g. The group g' is selected as the nearest group to g in which

$$\Delta_{g\to g'} \geq < D''(E) >_g . \tag{10}$$

The transition probabilities are then defined as

$$f_{g\to g'} = < D''(E) >_g / \Delta_{g\to g'} \leq 1 , \tag{11}$$

$$f_{g\to g} = 1 - f_{g\to g'} . \tag{12}$$

For the target a fraction of the particles are transferred to a final group and the remainder stay in the thermal sea. The average energy gain is then

$$< D'(E) >_g = 0 f_{0\to 0} + \Delta_{0\to g''} f_{0\to g''} \quad , \tag{13}$$

where

$f_{0\to 0}$ - fraction remaining in the thermal sea

$f_{0\to g''}$ - fraction transferring to group g''

$\Delta_{0\to g''}$ - energy gain due to transfer from thermal sea to group g''

$= \frac{1}{2}(E_{g''+1} + E_{g''})$

$< D'(E) >_g$ - effective energy loss .

The group g'' is selected as the lowest energy group in which

$$\Delta_{0\to g''} \geq < D'(E) >_g \quad . \tag{14}$$

The transition probabilities are then defined as

$$f_{0\to g''} = < D'(E) >_g / \Delta_{g\to g''} \leq 1 \quad , \tag{15}$$

$$f_{0\to 0} = 1 - f_{0\to g''} \quad . \tag{16}$$

The above conventions guarantee energy conservation since the projectile average energy loss and the target average energy gain are both exactly equal to the effective energy loss $< D'(E) >_g$.

Only one special convention had to be adopted to use the above scheme. In the group containing the reaction threshold it is possible to have the average secondary energy $< E' >_g$ be greater than the group averaged energy $[\frac{1}{2}(E_{g+1} + E_g)]$. In this case the effective energy loss $< D'(E) >_g$ is negative. This indicates there is little or no probability of scattering out of the group. In this case by convention the final

group is defined to be equal to the initial group ($g' = g$; $g'' = 0$) and the transition probabilities are defined as unity ($f_{g\to g} = 1$, $f_{0\to 0} = 1$). Again, energy is conserved.

Corrections for Finite Material Temperature

In the case where the projectiles are interacting with a hot media, the energy loss is decreased, which should affect the transfer matrices. A simple approximate method of accounting for this effect is available.[2] The average energy loss should be modified as follows.

$$\langle \widetilde{D(E)}_g \rangle = \langle D(E) \rangle_g - \frac{1-\alpha}{2} E_A \tag{17}$$

where

$\langle \widetilde{D(E)}_g \rangle$ - Hot group averaged energy loss

$\langle D(E) \rangle_g$ - Cold group averaged energy loss

α - $[(A_p - A_T)/(A_p + A_T)]^2$

A_p - Atomic weight of projectile

A_T - Atomic weight of target

E_A - $\frac{3}{2} kT$ - Average ion temperature of the media

Then re-define the hot average secondary energy, Eq. (2), as

$$\langle \widetilde{E'} \rangle_g = \langle E \rangle_g - \langle \widetilde{D(E)} \rangle_g = \langle E' \rangle_g + \frac{1-\alpha}{2} E_A \tag{18}$$

which in turn defines the hot effective energy loss, Eq. (3),

$$\langle \widetilde{D''(E)} \rangle_g = \frac{1}{2} (E_{g+1} + E_g) - \langle \widetilde{E'} \rangle_g = \langle D''(E) \rangle_g - \frac{1-\alpha}{2} E_A. \tag{19}$$

This may then be used with the simple algorithm presented (see the previous section) directly in any application code to simply and inexpensively define the final group and transition probabilities for both the projectile and the knock-ons.

Group Structure

A ten group structure was used.

Number	Lower energy limit-MeV	Average Energy-MeV
1	0.	0.0015
2	0.003	0.0165
3	0.03	0.09
4	0.15	0.325
5	0.50	1.35
6	2.20	3.50
7	4.80	6.02
8	7.24	8.62
9	10.00	12.00
10	14.0	14.05
	14.1	

In addition, by convention the group index 0 is used to denote the thermal sea, in which by assumption, the average energy is 0.0.

Weighting Spectrum

The flux weighting spectrum was based on continuous slowing down due to Coulomb scattering only,[3]

$$\phi(E) = \frac{1}{\frac{\partial E}{\partial S}} = \frac{1}{V\frac{\partial E}{\partial t}} = \frac{V}{\frac{\gamma}{E^{1/2}} + \frac{E}{t_e}} \quad , \tag{20}$$

where the energy loss terms are due to,

$\frac{\gamma}{E^{1/2}}$ - ions

$\frac{E}{t_e}$ - electrons.

Upon multiplying through and eliminating a constant factor, the flux is given by

$$\phi(E) = \frac{E}{\gamma t_e + E^{3/2}} \quad . \tag{21}$$

Since it is reaction rate averages that will be defined, it is the number density, not the flux, that should be used as the weighting spectrum. The number density is simply given by

$$n(E) = \frac{1}{v}\ \phi(E) \sim \frac{E^{1/2}}{\gamma t_e + E^{3/2}} \quad ,$$

where

$$\gamma t_e = 1.09514 Z^2 A^{1/2} \frac{\rho}{\langle A_i \rangle} \left\langle \frac{Z_i^2}{A_i} \right\rangle L_i \times 51.8155\ (kT_e)^{3/2} \times \frac{A \langle A_i \rangle}{Z^2 \langle Z_i \rangle \rho L_e}\ (\text{Mev}^{3/2}). \tag{22}$$

In this expression Z and A refer to the projectile slowing down, ρ, Z_i, and A_i refer to the plasma, L_i and L_e are the Coulomb logs and kT_e is the electron temperature.

A good approximation is

$$\frac{L_i}{L_e} \sim 1.5 \ ,$$

and for a DT plasma (i.e. plasma averages atom fraction weighted over all ion constituents).

$$< Z > = 1$$

$$< A > = 2.5$$

$$< \frac{Z^2}{A} > = .417 \ .$$

Therefore,

$$\gamma t_e = 35.5 \ (kT_e A)^{3/2} \ . \qquad (\text{Kev}^{3/2}) \qquad (23)$$

Use of a variety of electron temperatures between 10 and 100 Kev illustrated that the resulting group averages are fairly insensitive to the value of kT_e selected. Therefore, 10 Kev was used in all cases; thus, the number density weighting function used is given by

$$n(E) = \frac{E^{1/2}}{0.0355A^{3/2} + E^{3/2}} \ . \qquad (24)$$

Data Base

The ENDL[1] library of evaluated nuclear data contains angular distributions and integrated parameters for charged particle induced nuclear (plus interference) scattering over the laboratory energy range 0-20 Mev. Only low atomic weight charged particles are included in the library; specifically, only reactions in which the projectile and target include p, d, t, ^{3}He and α. By convention, the ENDL library only explicitly contains data for projectiles which are equal to or lighter than the target. Therefore, the data actually contained in the ENDL library includes.

(1) proton induced

^{1}H(p,p)^{1}H

^{2}H(p,p)^{2}H

^{3}H(p,p)^{3}H

^{3}He(p,p)^{3}He

^{4}He(p,p)^{4}He,

(2) deuteron induced

^{2}H(d,d)^{2}H

^{3}H(d,d)^{3}H

^{3}He(d,d)^{3}He

^{4}He(d,d)^{4}He,

(3) triton induced

$^{3}H(t,t)^{3}H$

$^{3}He(t,t)^{3}He$

$^{4}He(t,t)^{4}He$,

(4) ^{3}He induced

$^{3}He(^{3}He,^{3}He)^{3}He$

$^{4}He(^{3}He,\ ^{3}He)^{4}He$

(5) alpha induced

$^{4}He(\alpha\ \alpha)^{4}He$.

The data for the remaining combinations obtained by interchanging projectile and target (e.g. $^{4}He(p,p)^{4}He \rightarrow {}^{1}H(\alpha,\alpha)^{1}H$) can be exactly derived from the data for the above reactions by simple energy transformations.

The data from ENDL that was used to obtain group averages was the charged particle induced nuclear (plus interference) scattering reaction rate ($V\sigma(E)$) and energy loss ($D(E)$). The data in ENDL corresponds to interaction with a cold (nominally 0°K) medium. In order to obtain finite reaction rates by integrating angular distributions, a cut-off of 20° (cosine of .94) was used.

Data for reactions obtained by interchanging projectile and target are obtained by realizing that the reactions will be identical for the same relative speed between particles; i.e.,

$$E_2 = \left(\frac{A_2}{A_1}\right) E_1 \quad ,$$

where A_1 and A_2 are the atomic weights of the projectile and target, respectively. Therefore, the required reaction rate is given by

$$V_2\sigma(E_2) = V_1\sigma(E_1) \quad (V_2 = V_1), \tag{25}$$

and the energy deposit by

$$D(E_2) = \left(\frac{A_2}{A_1}\right) D(E_1) \tag{26}$$

Calculational Capabilities

The results presented in this report were obtained using the CPGROUP[4] code. This code is capable of calculating charged particle induced group averaged reaction rates and two element transfer matrices for both projectile and knock-ons. The calculation can be performed using any weighting function and up to 400 groups.

The CLYDE[5] code is presently capable of calculating charged particle induced group averaged reaction rates and the complete transfer matrix for the slowing down of the projectile. Only minor modifications to CLYDE would be required to include calculation of the complete knock-on transfer matrix. Therefore, if a more complete treatment than that presented herein is required for any application, contact the authors.

Results

The following tables present the ten group results. Results are grouped by incident projectile in increasing Z, A order; p,d,t, ^{3}He and α. For each incident projectile, results are presented in increasing target Z, A order; ^{1}H, ^{2}H, ^{3}H, ^{3}He and ^{4}He. All energies are in MeV. The meaning of each column read left to right is:

TARGET – Z, A of target in the form 1000x Z + A (e.g., 2004 – ^{4}He)

GR – Group index (group 1 is the lowest energy group and group 0 is the ion thermal sea).

GROUP-Mev – Lower energy limit of the group. For completeness the upper energy limit of the last group is also presented.

REACTIONS – Group averaged reaction rate in units of barn x cm/shake^6

E – Average reaction energy in group.

E' – Average secondary energy

E – E' – Average energy loss

EGROUP-E' – Effective energy loss (relative to the middle of the group)

PROJECTILE – Final group index and transition probability for the scattered projectile.

TARGET – Final group index and transition probability for the knock-ons.

PROTON INDUCED REACTIONS

TARGET	#	GR	GROUP-MEV	REACTIONS	E	E'	E-E'	EGROUP-E'	PROJECTILE		TARGET	
1001	*	1	0.	0.								
1001	*	2	3.0000E-03	0.								
1001	*	3	3.0000E-02	5.4743E-03	1.3884E-01	9.9617E-02	3.9222E-02	-9.6167E-03	3	1.00000	0	1.00000
1001	*	4	1.5000E-01	2.4021E-01	3.5548E-01	2.5505E-01	1.0042E-01	6.9946E-02	3	0.29764	3	0.77717
1001	*	5	5.0000E-01	4.8465E+00	1.5980E+00	1.1466E+00	4.5144E-01	2.0341E-01	4	0.19845	4	0.62589
1001	*	6	2.2000E+00	1.5593E+01	3.3804E+00	2.4111E+00	9.4931E-01	1.0889E+00	5	0.50647	6	0.80061
1001	*	7	4.8000E+00	1.4974E+01	5.9146E+00	4.2437E+00	1.6709E+00	1.7763E+00	5	0.70486	6	0.50752
1001	*	8	7.2400E+00	1.3322E+01	8.5175E+00	6.1113E+00	2.4062E+00	2.5087E+00	7	0.96488	6	0.71677
1001	*	9	1.0000E+01	1.1486E+01	1.1830E+01	8.4884E+00	3.3421E+00	3.5116E+00	7	0.58723	7	0.98333
1001	*	10	1.4000E+01	1.0365E+01	1.4050E+01	1.0081E+01	3.9691E+00	3.9692E+00	8	0.73098	7	0.65934
1001	*		1.4100E+01									
1002	*	1	0.	0.								
1002	*	2	3.0000E-03	0.								
1002	*	3	3.0000E-02	7.8252E-01	1.2510E-01	5.8380E-02	6.6720E-02	3.1620E-02	2	0.43020	3	0.35133
1002	*	4	1.5000E-01	6.3522E+00	3.4685E-01	1.6140E-01	1.8445E-01	1.6360E-01	3	0.69619	4	0.50340
1002	*	5	5.0000E-01	3.0781E+01	1.2881E+00	6.0113E-01	6.6699E-01	7.4887E-01	4	0.73060	5	0.55472
1002	*	6	2.2000E+00	4.1636E+01	3.3311E+00	1.7670E+00	1.5641E+00	1.7330E+00	5	0.80603	6	0.49513
1002	*	7	4.8000E+00	3.6937E+01	5.9149E+00	3.4351E+00	2.4798E+00	2.5649E+00	5	0.55350	6	0.73853
1002	*	8	7.2400E+00	3.4107E+01	8.5152E+00	5.2628E+00	3.2524E+00	3.3572E+00	5	0.65570	6	0.95920
1002	*	9	1.0000E+01	2.8007E+01	1.1824E+01	7.7179E+00	4.1063E+00	4.2821E+00	7	0.71808	7	0.71132
1002	*	10	1.4000E+01	2.5943E+01	1.4050E+01	9.4206E+00	4.6291E+00	4.6292E+00	8	0.85252	7	0.76897
1002	*		1.4100E+01									
1003	*	1	0.	0.								
1003	*	2	3.0000E-03	0.								
1003	*	3	3.0000E-02	7.5076E-01	1.2029E-01	6.6160E-02	5.4131E-02	2.3840E-02	2	0.32436	3	0.26489
1003	*	4	1.5000E-01	5.9541E+00	3.4325E-01	1.8879E-01	1.5447E-01	1.3621E-01	3	0.57961	4	0.41910
1003	*	5	5.0000E-01	2.5282E+01	1.3329E+00	7.7476E-01	5.5810E-01	6.7524E-01	4	0.56121	5	0.42610
1003	*	6	2.2000E+00	4.4820E+01	3.3477E+00	2.2145E+00	1.1332E+00	1.2855E+00	5	0.59791	5	0.95223
1003	*	7	4.8000E+00	4.5025E+01	5.9315E+00	4.2322E+00	1.6993E+00	1.7878E+00	6	0.70943	6	0.51079
1003	*	8	7.2400E+00	4.3340E+01	8.5351E+00	6.3468E+00	2.1882E+00	2.2732E+00	7	0.87429	6	0.64947
1003	*	9	1.0000E+01	4.0632E+01	1.1860E+01	9.1385E+00	2.7212E+00	2.8615E+00	8	0.94660	6	0.61757
1003	*	10	1.4000E+01	3.8620E+01	1.4050E+01	1.1007E+01	3.0425E+00	3.0426E+00	8	0.56633	6	0.86931
1003	*		1.4100E+01									
2003	*	1	0.	0.								
2003	*	2	3.0000E-03	0.								
2003	*	3	3.0000E-02	2.0702E-02	1.4259E-01	6.5593E-02	7.7001E-02	2.4407E-02	2	0.33266	3	0.27118
2003	*	4	1.5000E-01	1.9407E+00	3.5894E-01	1.6511E-01	1.9383E-01	1.5989E-01	3	0.68037	4	0.49196
2003	*	5	5.0000E-01	1.1533E+01	1.3827E+00	6.3792E-01	7.4480E-01	7.1208E-01	4	0.69471	5	0.52747
2003	*	6	2.2000E+00	3.1642E+01	3.4656E+00	1.8919E+00	1.5737E+00	1.6081E+00	5	0.74795	6	0.45946
2003	*	7	4.8000E+00	4.5200E+01	5.9546E+00	3.8745E+00	2.0801E+00	2.1459E+00	6	0.85140	6	0.61301
2003	*	8	7.2400E+00	4.6536E+01	8.5318E+00	5.9972E+00	2.5346E+00	2.6228E+00	6	0.51227	6	0.74937
2003	*	9	1.0000E+01	4.1365E+01	1.1834E+01	8.7278E+00	3.1063E+00	3.2722E+00	6	0.96809	6	0.93490
2003	*	10	1.4000E+01	3.7613E+01	1.4050E+01	1.0560E+01	3.4899E+00	3.4900E+00	6	0.64272	6	0.98714
2003	*		1.4100E+01									
2004	*	1	0.	0.								
2004	*	2	3.0000E-03	0.								
2004	*	3	3.0000E-02	6.8349E-02	1.3746E-01	9.0727E-02	4.6738E-02	-7.2662E-04	3	1.00000	0	1.00000
2004	*	4	1.5000E-01	2.4289E+00	3.5432E-01	2.3385E-01	1.2047E-01	9.1150E-02	3	0.38787	4	0.28046
2004	*	5	5.0000E-01	1.2072E+01	1.6179E+00	7.8576E-01	7.3219E-01	5.6424E-01	4	0.55046	5	0.41796
2004	*	6	2.2000E+00	6.5134E+01	3.3280E+00	2.4247E+00	9.0332E-01	1.0753E+00	5	0.50013	5	0.79650
2004	*	7	4.8000E+00	5.7082E+01	5.9141E+00	4.6130E+00	1.3011E+00	1.4070E+00	6	0.55833	6	0.40200
2004	*	8	7.2400E+00	5.1177E+01	8.5236E+00	6.7189E+00	1.8047E+00	1.9011E+00	7	0.73120	6	0.54318
2004	*	9	1.0000E+01	4.6741E+01	1.1846E+01	9.3771E+00	2.4693E+00	2.6229E+00	8	0.77601	6	0.74941
2004	*	10	1.4000E+01	4.2578E+01	1.4050E+01	1.1140E+01	2.9100E+00	2.9101E+00	8	0.53593	6	0.83145
2004	*		1.4100E+01									

DEUTERON INDUCED REACTIONS

TARGET	GR	GROUP-MEV	REACTIONS	E	E'	E-E'	EGROUP-E'	PROJECTILE		TARGET	
1001	1	0.	0.								
1001	2	3.0000E-03	0.								
1001	3	3.0000E-02	0.								
1001	4	1.5000E-01	2.9282E+00	3.7552E-01	1.7524E-01	2.0028E-01	1.4976E-01	3	0.63726	4	0.46079
1001	5	5.0000E-01	1.8547E+01	1.3869E+00	6.4724E-01	7.3970E-01	7.0276E-01	4	0.68562	5	0.62056
1001	6	2.2000E+00	3.7814E+01	3.3628E+00	1.6233E+00	1.7595E+00	1.8767E+00	5	0.87288	6	0.53620
1001	7	4.8000E+00	4.2003E+01	5.9400E+00	3.0839E+00	2.8561E+00	2.9361E+00	6	0.62871	6	0.83887
1001	8	7.2400E+00	4.1165E+01	8.5375E+00	4.6937E+00	3.8438E+00	3.9263E+00	6	0.76666	7	0.85221
1001	9	1.0000E+01	3.8815E+01	1.1860E+01	6.8907E+00	4.9694E+00	5.1093E+00	7	0.85440	7	0.84872
1001	10	1.4000E+01	3.6862E+01	1.4050E+01	8.4090E+00	5.6409E+00	5.6410E+00	7	0.70250	7	0.93705
1001		1.4100E+01									
1002	1	0.	0.								
1002	2	3.0000E-03	0.								
1002	3	3.0000E-02	1.0016E+00	1.3098E-01	1.0240E-01	2.8562E-02	-1.2398E-02	3	1.00000	0	1.00000
1002	4	1.5000E-01	1.2353E+01	3.4309E-01	2.6826E-01	7.4826E-02	5.6738E-02	3	0.24144	3	0.63042
1002	5	5.0000E-01	2.3480E+01	1.2257E+00	9.5837E-01	2.6732E-01	3.9163E-01	4	0.38208	5	0.28009
1002	6	2.2000E+00	2.9445E+01	3.3694E+00	2.6345E+00	7.3484E-01	8.6547E-01	5	0.40255	5	0.64109
1002	7	4.8000E+00	3.1989E+01	5.9413E+00	4.6455E+00	1.2958E+00	1.3745E+00	6	0.54542	6	0.39270
1002	8	7.2400E+00	3.2194E+01	8.5469E+00	6.6829E+00	1.8640E+00	1.9371E+00	7	0.74504	6	0.95346
1002	9	1.0000E+01	3.2200E+01	1.1890E+01	9.4078E+00	2.4819E+00	2.5922E+00	8	0.76691	6	0.74062
1002	10	1.4000E+01	3.2200E+01	1.4050E+01	1.1296E+01	2.7537E+00	2.7538E+00	8	0.50716	6	0.78680
1002		1.4100E+01									
1003	1	0.	0.								
1003	2	3.0000E-03	0.								
1003	3	3.0000E-02	7.6597E-01	1.2426E-01	5.8400E-02	6.5856E-02	3.1600E-02	2	0.42993	3	0.35111
1003	4	1.5000E-01	5.5759E+00	3.4137E-01	1.6044E-01	1.8092E-01	1.8456E-01	3	0.70025	4	0.50633
1003	5	5.0000E-01	1.1804E+01	1.2341E+00	5.0626E-01	7.2787E-01	8.4374E-01	4	0.62316	5	0.62499
1003	6	2.2000E+00	1.9503E+01	3.4916E+00	1.0176E+00	2.4740E+00	2.4824E+00	4	0.78187	6	0.70927
1003	7	4.8000E+00	3.5089E+01	5.9993E+00	2.5533E+00	3.4460E+00	3.4667E+00	5	0.74233	6	0.99048
1003	8	7.2400E+00	3.7660E+01	8.5274E+00	4.4980E+00	4.0294E+00	4.1220E+00	6	0.80507	7	0.68471
1003	9	1.0000E+01	3.6253E+01	1.1928E+01	7.4690E+00	4.4587E+00	4.5310E+00	7	0.75770	7	0.75266
1003	10	1.4000E+01	3.7410E+01	1.4050E+01	9.4863E+00	4.5616E+00	4.5617E+00	8	0.84010	7	0.76777
1003		1.4100E+01									
2003	1	0.	0.								
2003	2	3.0000E-03	0.								
2003	3	3.0000E-02	8.0438E-04	1.4800E-01	1.4800E-02	1.3320E-01	7.5200E-02	1	0.84972	3	0.83556
2003	4	1.5000E-01	8.2730E-01	3.7141E-01	3.7141E-02	3.3427E-01	2.8786E-01	2	0.93309	4	0.86572
2003	5	5.0000E-01	4.9609E+00	1.3866E+00	1.3866E-01	1.2479E+00	1.2113E+00	3	0.96136	5	0.89729
2003	6	2.2000E+00	1.4690E+01	3.5503E+00	6.0621E-01	2.9441E+00	2.8938E+00	4	0.91143	6	0.82680
2003	7	4.8000E+00	3.1034E+01	6.0202E+00	2.2067E+00	3.8135E+00	3.8133E+00	5	0.81655	7	0.63343
2003	8	7.2400E+00	3.7649E+01	8.5424E+00	4.6059E+00	3.9365E+00	4.0141E+00	6	0.78401	7	0.66680
2003	9	1.0000E+01	3.4263E+01	1.1853E+01	7.4153E+00	4.4376E+00	4.9847E+00	7	0.76666	7	0.76158
2003	10	1.4000E+01	3.2266E+01	1.4050E+01	9.1269E+00	4.9210E+00	4.9211E+00	8	0.90627	7	0.81745
2003		1.4100E+01									
2004	1	0.	0.								
2004	2	3.0000E-03	0.								
2004	3	3.0000E-02	2.6259E-02	1.4100E-01	1.2690E-01	1.4100E-02	-3.6897E-02	3	1.00000	0	1.00000
2004	4	1.5000E-01	1.4995E+00	3.6473E-01	3.2826E-01	3.6473E-02	-3.2566E-03	4	1.00000	0	1.00000
2004	5	5.0000E-01	1.2860E+01	1.3316E+00	6.4779E-01	6.8385E-01	7.0221E-01	4	0.68508	5	0.52016
2004	6	2.2000E+00	1.7603E+01	3.5354E+00	1.6244E+00	1.9110E+00	1.8756E+00	5	0.87236	6	0.53568
2004	7	4.8000E+00	2.7947E+01	5.8918E+00	2.9298E+00	2.9619E+00	3.0902E+00	5	0.66171	6	0.88291
2004	8	7.2400E+00	2.1632E+01	8.5043E+00	4.6062E+00	3.8981E+00	4.0138E+00	6	0.76395	7	0.66670
2004	9	1.0000E+01	1.8467E+01	1.1867E+01	6.9844E+00	4.8825E+00	5.0156E+00	7	0.83873	7	0.83316
2004	10	1.4000E+01	1.8743E+01	1.4050E+01	8.5994E+00	5.4505E+00	5.4506E+00	7	0.87677	7	0.90541
2004		1.4100E+01									

TRITON INDUCED REACTIONS

TARGET	GR	GROUP-MEV	REACTIONS	E	E'	E-E'	EGROUP-E'	PROJECTILE		TARGET	
1001	1	0.	0.								
1001	2	3.0000E-03	0.								
1001	3	3.0000E-02	0.								
1001	4	1.5000E-01	1.0876E+00	3.9266E-01	2.1696E-01	1.7669E-01	1.0904E-01	3	0.46400	4	0.33551
1001	5	5.0000E-01	6.3875E+00	1.4268E+00	7.8483E-01	6.4197E-01	5.6537E-01	4	0.55158	5	0.41660
1001	6	2.2000E+00	2.3412E+01	3.4929E+00	1.9829E+00	1.5101E+00	1.5171E+00	5	0.70565	6	0.43347
1001	7	4.6000E+00	3.9118E+01	5.9846E+00	3.6201E+00	2.3644E+00	2.3999E+00	6	0.95233	6	0.65568
1001	8	7.2400E+00	4.4665E+01	8.9552E+00	5.5171E+00	3.[illegible]81E+00	3.1029E+00	6	0.80603	6	0.66693
1001	9	1.0000E+01	4.5539E+01	1.1891E+01	8.9372E+00	3.8540E+00	3.9628E+00	7	0.88268	7	0.66628
1001	10	1.4000E+01	4.5531E+01	1.4060E+01	9.7206E+00	4.3294E+00	4.3294E+00	8	0.79732	7	0.71917
1001		1.4100E+01									
1002	1	0.	0.								
1002	2	3.0000E-03	0.								
1002	3	3.0000E-02	1.5728E-01	1.3619E-01	6.4009E-02	7.2180E-02	2.5991E-02	2	0.35362	3	0.28673
1002	4	1.5000E-01	3.7450E+00	3.6137E-01	1.6985E-01	1.9153E-01	1.5515E-01	3	0.56023	4	0.47740
1002	5	5.0000E-01	1.0189E+01	1.2836E+00	5.8010E-01	7.0354E-01	7.6990E-01	4	0.75112	5	0.57030
1002	6	2.2000E+00	1.4712E+01	3.4159E+00	1.0995E+00	2.3164E+00	2.4005E+00	4	0.75606	5	0.66566
1002	7	4.6000E+00	2.2779E+01	6.0341E+00	1.7589E+00	4.2752E+00	4.2611E+00	5	0.91244	7	0.70782
1002	8	7.2400E+00	3.4258E+01	8.6112E+00	3.5319E+00	5.0794E+00	3.0881E+00	6	0.99378	7	0.84521
1002	9	1.0000E+01	3.8207E+01	1.1873E+01	6.0406E+00	5.8320E+00	5.9394E+00	7	0.99656	7	0.98994
1002	10	1.4000E+01	3.6677E+01	1.4060E+01	7.7155E+00	6.3344E+00	6.3346E+00	7	0.76886	8	0.73486
1002		1.4100E+01									
1003	1	0.	0.								
1003	2	3.0000E-03	0.								
1003	3	3.0000E-02	4.7429E-02	1.2749E-01	8.9862E-02	3.7616E-02	1.1819E-04	2	0.00161	1	0.07879
1003	4	1.5000E-01	6.0221E-01	3.6074E-01	2.9432E-01	1.0642E-01	7.9675E-02	3	0.30074	3	0.78528
1003	5	5.0000E-01	2.2765E+00	1.3865E+00	9.7578E-01	4.0872E-01	3.7322E-01	4	0.36412	3	0.27646
1003	6	2.2000E+00	5.0972E+00	3.4266E+00	2.4168E+00	1.0109E+00	1.0842E+00	5	0.50429	3	0.60313
1003	7	4.6000E+00	5.9970E+00	5.9388E+00	4.1868E+00	1.7519E+00	1.8392E+00	6	0.72744	6	0.58376
1003	8	7.2400E+00	6.0000E+00	8.5467E+00	6.0255E+00	2.5213E+00	2.5946E+00	7	0.99796	6	0.74130
1003	9	1.0000E+01	6.0000E+00	1.1890E+01	8.3825E+00	3.5076E+00	3.6174E+00	7	0.60491	7	0.60089
1003	10	1.4000E+01	6.0000E+00	1.4050E+01	9.9052E+00	4.1447E+00	4.1446E+00	8	0.76331	7	0.68850
1003		1.4100E+01									
2003	1	0.	0.								
2003	2	3.0000E-03	0.								
2003	3	3.0000E-02	0.								
2003	4	1.5000E-01	3.2805E-01	3.8226E-01	1.6007E-01	2.2219E-01	1.6493E-01	3	0.70182	4	0.50747
2003	5	5.0000E-01	2.1136E+00	1.4090E+00	5.9000E-01	8.1896E-01	7.6000E-01	4	0.74146	5	0.56296
2003	6	2.2000E+00	3.5303E+00	3.4639E+00	1.4505E+00	2.0134E+00	2.0495E+00	5	0.93324	6	0.58556
2003	7	4.6000E+00	7.3408E+00	5.9471E+00	2.4904E+00	3.4568E+00	3.5296E+00	5	0.75581	7	0.58632
2003	8	7.2400E+00	7.2760E+00	8.5388E+00	3.5748E+00	4.9621E+00	5.0452E+00	6	0.98538	7	0.83607
2003	9	1.0000E+01	7.0988E+00	1.1903E+01	4.9844E+00	6.9187E+00	7.0156E+00	6	0.82536	8	0.81387
2003	10	1.4000E+01	7.4975E+00	1.4050E+01	5.8834E+00	8.1666E+00	8.1666E+00	6	0.77408	8	0.94740
2003		1.4100E+01									
2004	1	0.	0.								
2004	2	3.0000E-03	0.								
2004	3	3.0000E-02	1.0093E-02	1.4501E-01	1.6066E-01	4.4357E-02	1.0656E-02	3	1.00000	0	1.00000
2004	4	1.5000E-01	1.5975E+00	3.7316E-01	2.5802E-01	1.1414E-01	6.5983E-02	3	0.28078	3	0.73314
2004	5	5.0000E-01	8.7947E+00	1.3687E+00	9.5765E-01	4.1107E-01	3.9235E-01	4	0.38276	5	0.29063
2004	6	2.2000E+00	1.7985E+01	3.4395E+00	2.3322E+00	1.1073E+00	1.1678E+00	5	0.54317	5	0.86905
2004	7	4.6000E+00	2.1176E+01	6.0683E+00	3.9397E+00	2.1286E+00	2.0603E+00	6	0.82551	6	0.99437
2004	8	7.2400E+00	2.6311E+01	8.4282E+00	5.2040E+00	3.2243E+00	3.4160E+00	6	0.66719	6	0.97601
2004	9	1.0000E+01	2.0212E+01	1.1876E+01	8.5771E+00	3.2985E+00	3.4229E+00	7	0.97240	6	0.97798
2004	10	1.4000E+01	2.0000E+01	1.4060E+01	9.7803E+00	4.2996E+00	4.2997E+00	8	0.79182	7	0.71423
2004		1.4100E+01									

HELIUM-3 INDUCED REACTIONS

TARGET	*	GR	GROUP-MEV	REACTIONS	E	E'	E-E'	EGROUP-E'	*	PROJECTILE		*	TARGET	
1001	*	1	0.	0.					*			*		
1001	*	2	3.0000E-03	0.					*			*		
1001	*	3	3.0000E-02	0.					*			*		
1001	*	4	1.5000E-01	6.6005E-02	4.6031E-01	2.1174E-01	2.4857E-01	1.1326E-01	*	3	0.48194	*	4	0.34848
1001	*	5	5.0000E-01	3.0352E+00	1.4819E+00	6.8167E-01	8.0022E-01	6.6833E-01	*	4	0.65203	*	5	0.49506
1001	*	6	2.2000E+00	1.1086E+01	3.6290E+00	1.6234E+00	1.9057E+00	1.8766E+00	*	4	0.67286	*	6	0.53618
1001	*	7	4.8000E+00	2.0552E+01	6.0170E+00	2.8158E+00	3.2012E+00	3.2042E+00	*	5	0.66613	*	6	0.91549
1001	*	8	7.2400E+00	2.6133E+01	8.6095E+00	4.3745E+00	4.2350E+00	4.2455E+00	*	6	0.82921	*	7	0.70524
1001	*	9	1.0000E+01	3.6540E+01	1.1970E+01	6.7861E+00	5.1834E+00	5.2139E+00	*	7	0.87189	*	7	0.86610
1001	*	10	1.4000E+01	4.0974E+01	1.4050E+01	8.4529E+00	5.5971E+00	5.5971E+00	*	7	0.69703	*	7	0.92978
1001	*		1.4100E+01						*			*		
1002	*	1	0.	0.					*			*		
1002	*	2	3.0000E-03	0.					*			*		
1002	*	3	3.0000E-02	0.					*			*		
1002	*	4	1.5000E-01	3.6110E-01	4.0134E-01	4.0134E-02	3.6121E-01	2.8487E-01	*	2	0.82339	*	4	0.87651
1002	*	5	5.0000E-01	3.2241E+00	1.4324E+00	1.4324E-01	1.2891E+00	1.2066E+00	*	3	0.95775	*	5	0.89390
1002	*	6	2.2000E+00	9.3986E+00	3.4957E+00	3.7424E-01	3.1215E+00	3.1256E+00	*	4	0.98449	*	5	0.89306
1002	*	7	4.8000E+00	1.8119E+01	6.0624E+00	1.1842E+00	4.8782E+00	4.8358E+00	*	4	0.84913	*	7	0.80328
1002	*	8	7.2400E+00	2.9939E+01	8.6242E+00	2.9454E+00	5.6789E+00	5.6746E+00	*	5	0.78056	*	7	0.94263
1002	*	9	1.0000E+01	3.7398E+01	1.1912E+01	6.0485E+00	5.8629E+00	5.9514E+00	*	7	0.99521	*	7	0.98860
1002	*	10	1.4000E+01	3.7327E+01	1.4050E+01	8.1076E+00	5.9423E+00	5.9424E+00	*	7	0.74002	*	7	0.98710
1002	*		1.4100E+01						*			*		
1003	*	1	0.	0.					*			*		
1003	*	2	3.0000E-03	0.					*			*		
1003	*	3	3.0000E-02	0.					*			*		
1003	*	4	1.5000E-01	3.2907E-01	3.8215E-01	1.6003E-01	2.2213E-01	1.6497E-01	*	3	0.76201	*	4	0.50761
1003	*	5	5.0000E-01	2.1172E+00	1.4088E+00	6.8992E-01	8.1884E-01	7.6008E-01	*	4	0.74154	*	6	0.56302
1003	*	6	2.2000E+00	5.3369E+00	3.4638E+00	1.4505E+00	2.0133E+00	2.0495E+00	*	5	0.95328	*	6	0.58559
1003	*	7	4.8000E+00	7.3421E+00	5.8470E+00	2.4903E+00	3.4567E+00	3.5297E+00	*	5	0.75582	*	7	0.58633
1003	*	8	7.2400E+00	7.2744E+00	8.5369E+00	3.5748E+00	4.9621E+00	5.0452E+00	*	6	0.98536	*	7	0.83607
1003	*	9	1.0000E+01	7.1006E+00	1.1904E+01	4.9845E+00	6.9190E+00	7.0154E+00	*	6	0.83534	*	8	0.81385
1003	*	10	1.4000E+01	7.5079E+00	1.4050E+01	5.8834E+00	8.1666E+00	8.1666E+00	*	6	0.77408	*	8	0.94740
1003	*		1.4100E+01						*			*		
2003	*	1	0.	0.					*			*		
2003	*	2	3.0000E-03	0.					*			*		
2003	*	3	3.0000E-02	0.					*			*		
2003	*	4	1.5000E-01	3.6039E-04	4.3976E-01	2.6752E-01	1.7224E-01	8.7477E-02	*	3	0.24458	*	3	0.63863
2003	*	5	5.0000E-01	8.1375E-03	1.4622E+00	8.8953E-01	5.7271E-01	4.6047E-01	*	4	0.44924	*	5	0.34109
2003	*	6	2.2000E+00	2.8254E-02	3.5254E+00	2.1446E+00	1.3808E+00	1.3554E+00	*	5	0.63042	*	6	0.38726
2003	*	7	4.8000E+00	5.2588E-02	6.0264E+00	3.6661E+00	2.3603E+00	2.3539E+00	*	6	0.93410	*	6	0.67255
2003	*	8	7.2400E+00	7.7021E-02	8.6238E+00	5.2461E+00	3.3777E+00	3.3739E+00	*	6	0.65896	*	6	0.96396
2003	*	9	1.0000E+01	6.0748E-01	1.2841E+01	7.8477E+00	4.8932E+00	4.0523E+00	*	7	0.67764	*	7	0.67314
2003	*	10	1.4000E+01	1.8924E+00	1.4050E+01	8.8377E+00	5.2126E+00	5.2123E+00	*	8	0.95990	*	7	0.86583
2003	*		1.4100E+01						*			*		
2004	*	1	0.	0.					*			*		
2004	*	2	3.0000E-03	0.					*			*		
2004	*	3	3.0000E-02	0.					*			*		
2004	*	4	1.5000E-01	2.8282E-01	4.2106E-01	3.0176E-01	1.1930E-01	2.3243E-02	*	3	0.09891	*	3	0.25826
2004	*	5	5.0000E-01	3.7204E+00	1.4446E+00	1.0353E+00	4.0931E-01	3.1467E-01	*	4	0.30700	*	4	0.96823
2004	*	6	2.2000E+00	1.0332E+01	3.4787E+00	2.3878E+00	1.0909E+00	1.1122E+00	*	5	0.51728	*	5	0.82382
2004	*	7	4.8000E+00	1.0317E+01	5.9611E+00	3.4341E+00	2.5270E+00	2.5859E+00	*	5	0.55372	*	6	0.73882
2004	*	8	7.2400E+00	1.2857E+01	8.5702E+00	5.6846E+00	2.8856E+00	2.9354E+00	*	6	0.57331	*	6	0.83867
2004	*	9	1.0000E+01	1.3662E+01	1.1906E+01	7.9540E+00	3.9519E+00	4.0460E+00	*	7	0.67659	*	7	0.67210
2004	*	10	1.4000E+01	1.3995E+01	1.4050E+01	9.4127E+00	4.6373E+00	4.6373E+00	*	8	0.85402	*	7	0.77032
2004	*		1.4100E+01						*			*		

ALPHA INDUCED REACTIONS

TARGET	*	GR	GROUP-MEV	REACTIONS	E	E'	E-E'	EGROUP-E'	*	PROJECTILE		*	TARGET	
1001	*	1	0.	0.					*			*		
1001	*	2	3.0000E-03	0.					*			*		
1001	*	3	3.0000E-02	0.					*			*		
1001	*	4	1.5000E-01	1.1506E-02	4.8263E-01	3.1667E-01	1.6416E-01	6.3296E-03	*	3	0.02693	*	2	0.38361
1001	*	5	5.0000E-01	2.4617E+00	1.5142E+00	9.9540E-01	5.1885E-01	7.5460E-01	*	4	0.34596	*	5	0.26267
1001	*	6	2.2000E+00	6.5141E+00	3.4267E+00	1.8854E+00	1.5413E+00	1.6146E+00	*	5	0.75096	*	6	0.46132
1001	*	7	4.8000E+00	1.2461E+01	6.1450E+00	2.5982E+00	3.5467E+00	3.4216E+00	*	5	0.73271	*	6	0.97765
1001	*	8	7.2400E+00	4.8106E+01	8.7666E+00	5.3086E+00	3.4580E+00	3.3114E+00	*	6	0.84678	*	6	0.94611
1001	*	9	1.0000E+01	6.9259E+01	1.1872E+01	8.4692E+00	3.4026E+00	3.5308E+00	*	7	0.59044	*	7	0.58652
1001	*	10	1.4000E+01	6.6312E+01	1.4050E+01	1.0481E+01	3.5893E+00	3.5894E+00	*	8	0.66163	*	7	0.59625
1001	*		1.4100E+01						*			*		
1002	*	1	0.	0.					*			*		
1002	*	2	3.0000E-03	0.					*			*		
1002	*	3	3.0000E-02	0.					*			*		
1002	*	4	1.5000E-01	3.6658E-01	4.1298E-01	3.7169E-01	4.1298E-02	-4.6686E-02	*	4	1.00000	*	0	1.00000
1002	*	5	5.0000E-01	5.7721E+00	1.6033E+00	8.3095E-01	7.7237E-01	5.1905E-01	*	4	0.50639	*	5	0.38446
1002	*	6	2.2000E+00	1.7204E+01	3.2529E+00	1.5796E+00	1.6734E+00	1.9204E+00	*	5	0.69322	*	6	0.54669
1002	*	7	4.8000E+00	1.4362E+01	5.9623E+00	2.6720E+00	3.2902E+00	3.3480E+00	*	5	0.71691	*	6	0.95666
1002	*	8	7.2400E+00	2.4662E+01	8.6903E+00	4.0433E+00	4.6471E+00	4.5767E+00	*	6	0.69369	*	7	0.76025
1002	*	9	1.0000E+01	2.7947E+01	1.1824E+01	5.8926E+00	5.9312E+00	6.1074E+00	*	6	0.71652	*	8	0.70651
1002	*	10	1.4000E+01	2.4616E+01	1.4050E+01	7.2876E+00	6.7623E+00	6.7624E+00	*	7	0.84214	*	8	0.76450
1002	*		1.4100E+01						*			*		
1003	*	1	0.	0.					*			*		
1003	*	2	3.0000E-03	0.					*			*		
1003	*	3	3.0000E-02	0.					*			*		
1003	*	4	1.5000E-01	1.0167E+00	3.9066E-01	2.7116E-01	1.1950E-01	5.3838E-02	*	3	0.22910	*	3	0.59820
1003	*	5	5.0000E-01	6.9121E+00	1.4163E+00	9.8448E-01	4.3384E-01	3.6552E-01	*	4	0.35560	*	5	0.27076
1003	*	6	2.2000E+00	1.4639E+01	3.4215E+00	2.4671E+00	9.5438E-01	1.0329E+00	*	5	0.48040	*	5	0.76909
1003	*	7	4.8000E+00	2.0812E+01	5.8004E+00	3.8484E+00	1.9520E+00	2.1716E+00	*	6	0.86175	*	6	0.62046
1003	*	8	7.2400E+00	2.4177E+01	8.7086E+00	5.3233E+00	3.3853E+00	3.2967E+00	*	6	0.84388	*	6	0.94190
1003	*	9	1.0000E+01	2.4582E+01	1.1736E+01	7.6242E+00	4.1117E+00	4.3758E+00	*	7	0.73173	*	7	0.72687
1003	*	10	1.4000E+01	2.0597E+01	1.4050E+01	1.0463E+01	3.5864E+00	3.5865E+00	*	8	0.66050	*	7	0.59577
1003	*		1.4100E+01						*			*		
2003	*	1	0.	0.					*			*		
2003	*	2	3.0000E-03	0.					*			*		
2003	*	3	3.0000E-02	0.					*			*		
2003	*	4	1.5000E-01	6.2566E-02	4.5253E-01	3.2432E-01	1.2822E-01	6.8362E-04	*	3	0.00291	*	1	0.45576
2003	*	5	5.0000E-01	2.5962E+00	1.4662E+00	1.0651E+00	4.2108E-01	2.8492E-01	*	4	0.27797	*	4	0.87656
2003	*	6	2.2000E+00	8.2080E+00	3.4779E+00	2.4740E+00	1.0039E+00	1.0260E+00	*	5	0.47720	*	5	0.75999
2003	*	7	4.8000E+00	1.1963E+01	5.9055E+00	3.3941E+00	2.5114E+00	2.6259E+00	*	5	0.56230	*	6	0.75026
2003	*	8	7.2400E+00	1.0348E+01	8.6834E+00	5.6606E+00	3.0227E+00	2.9594E+00	*	6	0.57800	*	6	0.84563
2003	*	9	1.0000E+01	1.3019E+01	1.1920E+01	7.9158E+00	4.0041E+00	4.0842E+00	*	7	0.58297	*	7	0.67844
2003	*	10	1.4000E+01	1.3454E+01	1.4050E+01	9.3649E+00	4.6850E+00	4.6851E+00	*	8	0.86281	*	7	0.77626
2003	*		1.4100E+01						*			*		
2004	*	1	0.	0.					*			*		
2004	*	2	3.0000E-03	0.					*			*		
2004	*	3	3.0000E-02	0.					*			*		
2004	*	4	1.5000E-01	7.8867E-02	4.3035E-01	2.7256E-01	1.5779E-01	8.2445E-02	*	3	0.22317	*	3	0.58273
2004	*	5	5.0000E-01	1.2357E+00	1.4667E+00	9.2892E-01	5.3780E-01	4.2108E-01	*	4	0.41081	*	5	0.31191
2004	*	6	2.2000E+00	3.9904E+00	3.4962E+00	2.2861E+00	1.2101E+00	1.2139E+00	*	5	0.36462	*	5	0.69921
2004	*	7	4.8000E+00	4.7588E+00	5.6947E+00	4.2974E+00	1.3974E+00	1.7226E+00	*	6	0.68359	*	6	0.49216
2004	*	8	7.2400E+00	2.7712E+00	8.3471E+00	6.7471E+00	1.6000E+00	1.6729E+00	*	7	0.72035	*	6	0.53512
2004	*	9	1.0000E+01	2.7561E+00	1.2417E+01	1.0533E+01	1.8838E+00	1.4671E+00	*	8	0.43407	*	6	0.41618
2004	*	10	1.4000E+01	6.2247E+00	1.4051E+01	1.1835E+01	2.2152E+00	2.2146E+00	*	8	0.40785	*	6	0.63275
2004	*		1.4100E+01						*			*		

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6. 1 Shake = 10^{-8} Seconds.

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