LAMS-1640 Revised
CONTROLLED THERMONUCLEAR PROCESSES
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LOS ALAMOS SCIENTIFIC LABORATORY
OF THE UNIVERSITY OF CALIFORNIA LOS ALAMOS NEW MEXICO

REPORT WRITTEN: June 20, 1961
REPORT DISTRIBUTED: June 30, 1961

THERMONUCLEAR REACTION RATES

by

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Contract W-7405-ENG. 36 with the U. S. Atomic Energy Commission
Physicists working on controlled thermonuclear reactions in the laboratory have had little occasion to consult tables of $\langle \sigma \cdot v \rangle$ so far. Happily the indications are that this situation will soon be changed.

To provide some measure of consistency, the following newly revised curves of $\langle \sigma \cdot v \rangle$ for DD, DT and DHe$^3$ are offered. The results given here supersede the writer's earlier compilation, Los Alamos Manuscript No. 1640 (1954), itself a revision of a still earlier one.

The $\langle \sigma \cdot v \rangle$ s are based on $\sigma$-s which comprise in part the following values:

<table>
<thead>
<tr>
<th>Deuterium Energy in Lab. system kev</th>
<th>DD$_n$</th>
<th>DD$_p$</th>
<th>DT</th>
<th>DHe$^3$</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>$6.5 \times 10^{-2}$</td>
<td>$6.5 \times 10^{-2}$</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>1.15</td>
<td>1.10</td>
<td>278</td>
<td></td>
</tr>
<tr>
<td>60</td>
<td>6.8</td>
<td>6.5</td>
<td>2180</td>
<td>2.3</td>
</tr>
<tr>
<td>120</td>
<td>23</td>
<td>20</td>
<td>4700</td>
<td>31</td>
</tr>
<tr>
<td>250</td>
<td>46</td>
<td>38</td>
<td>1720</td>
<td>290</td>
</tr>
<tr>
<td>500</td>
<td>74</td>
<td>59</td>
<td>660</td>
<td>630</td>
</tr>
<tr>
<td>1000</td>
<td>96</td>
<td>78</td>
<td>280</td>
<td>230</td>
</tr>
</tbody>
</table>

The latter moves $\frac{\sigma_{DD_n}}{\sigma_{DD_p}}$ upward at low energies so that the branching ratio now declines to unity at the lowest energies, instead of to 0.92. The $\sigma$-s at energies above 120 kev come from many sources tabulated in Los Alamos Report No. 2014. The Maxwell averages given here are in close agreement with values given at 5, 10, 25, 50, 100 and 150 kev temperatures by T. Hesselberg Jensen, O. Kofoed-Hansen, A. H. Sillesen and C. F. Wandel, Risø Report No. 2 (1958).
TABLE FOR ESTIMATING NEUTRON YIELD FROM TOTAL DD YIELD

\[
\frac{\langle \sigma V \rangle_{DD}}{\langle \sigma V \rangle_{DD,\text{tot}}} \quad T_{\text{keV}}
\]

\[
\begin{array}{cc}
0.508 & 2 \\
0.510 & 5 \\
0.516 & 10 \\
0.535 & 20 \\
0.543 & 50 \\
0.550 & 100 \\
0.555 & 200 \\
\end{array}
\]

\[
R_{2}^{2} n_{1} n_{2} <\sigma V>
\]

\[
R_{2}^{2} \frac{1}{2} n_{1}^{2} <\sigma V>
\]
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MAXWELL AVERAGES FOR
THERMONUCLEAR
REACTION RATES
LOS ALAMOS SCIENTIFIC LAB.
JUNE 1961 J.L.T.

TABLE FOR ESTIMATING
NEUTRON YIELD FROM
TOTAL DD YIELD

<table>
<thead>
<tr>
<th>$&lt;\sigma v&gt;_{DD_n}$</th>
<th>$&lt;\sigma v&gt;<em>{DD</em>{TOT}}$</th>
<th>$T_{\text{keV}}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.508</td>
<td></td>
<td>2</td>
</tr>
<tr>
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<td>100</td>
</tr>
<tr>
<td>0.555</td>
<td></td>
<td>200</td>
</tr>
</tbody>
</table>

$R_{12} = n_1 n_2 <\sigma v>$

$R_{11} = \frac{1}{2} n_1^2 <\sigma v>$