The Extended Elastic Model Applied to the Reaction \( ^{3}\text{He}(^{3}\text{He}, 2p)^{4}\text{He} \).

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Summary. — The extended elastic model is applied to the reaction \( ^{3}\text{He}(^{3}\text{He}, 2p)^{4}\text{He} \), the cross-section factor is obtained, a comparison with the values reported in the literature is shown.

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1. – Introduction.

The reaction \( ^{3}\text{He}(^{3}\text{He}, 2p)^{4}\text{He} \) completes one branch of the proton-proton chain of nuclear reactions, the dominant energy generation mechanism in stars such as the sun. The reaction rate of this reaction is important to determine the relative importance of different branches of the proton-proton chain. In the present paper the extended elastic model (EEM)[1-3] is modified to reproduce the experimental values of the excitation function of the reaction \( ^{3}\text{He}(^{3}\text{He}, 2p)^{4}\text{He} \). The cross-section factor is obtained and a comparison with the values reported in literature is shown.

2. – The extended elastic model.

Following the (EEM)[1-3] the fusion cross-section can be written

\[
\tilde{\sigma}_f = \sigma_f (1 - g(y)),
\]
with

\[
\overline{\tau}_t = \pi \left( \frac{2\gamma}{k} \right)^2 G(y)(1 + G(y)),
\]

\[
G(y) = \exp \left[ - \exp \left[ \exp [y] \right] \right],
\]

\[
g(y) = \exp \left[ - \left( \frac{d - y}{d - \overline{y}_m} \right)^{\gamma_1} \right],
\]

\[
y = \frac{E_B - E}{E_S}, \quad d = \frac{E_B}{E_S}.
\]

\( k \) is the wave number, \( \gamma \) is the Coulomb parameter, \( E_B \) and \( E_S \) are two parameters, expressed in MeV, which are determined by comparing the experimental values of fusion cross-section[4] with \( \overline{\tau}_t \), \( \overline{y}_m \) is the value of \( y \) at which \( \overline{\tau}_t \) attains the minimum value, \( \gamma_1 \) is a parameter which depends from the reaction, it is determined by comparing the experimental values of fusion cross-section with \( \overline{\tau}_t \). To determine \( \overline{y}_m \) we consider the solution of the equation [1]

\[
\frac{2}{d - y} = M_1(y) \frac{1 + 2G(y)}{1 + G(y)},
\]

which satisfies the inequality

\[
\overline{y}_m > 0.19,
\]

\( M_1(y) \) is defined

\[
M_1(y) = \left[ \exp \left[ \exp [y] \right] \right] \exp [y].
\]

The values of \( E_B, E_S, \overline{y}_m, \overline{E}_m = E_B - \overline{y}_m E_S \) are reported in table I. By using eqs.

<table>
<thead>
<tr>
<th>TABLE I.</th>
<th>(^{3}\text{He}(^{3}\text{He}, 2p)^{4}\text{He} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reaction</td>
<td>(^{3}\text{He}(^{3}\text{He}, 2p)^{4}\text{He} )</td>
</tr>
<tr>
<td>( \overline{E}_m \text{(keV)} )</td>
<td>1.136 \cdot 10^2</td>
</tr>
<tr>
<td>( \overline{y}_m )</td>
<td>0.867</td>
</tr>
<tr>
<td>( E_m \text{(keV)} )</td>
<td>1.691 \cdot 10^2</td>
</tr>
<tr>
<td>( y_m )</td>
<td>0.829</td>
</tr>
<tr>
<td>( T_m \text{(K)} )</td>
<td>1.209 \cdot 10^9</td>
</tr>
<tr>
<td>( E_B \text{(keV)} )</td>
<td>1.379 \cdot 10^3</td>
</tr>
<tr>
<td>( E_S \text{(keV)} )</td>
<td>1.460 \cdot 10^3</td>
</tr>
<tr>
<td>( \gamma_1 )</td>
<td>1.5</td>
</tr>
<tr>
<td>( \gamma_2 )</td>
<td>10</td>
</tr>
</tbody>
</table>