Precompound Particles in the $^{118}$Sn(p, n)$^{118}$Sb Reaction.

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Summary. — The $^{118}$Sn(p, n)$^{118}$Sb reaction spectra at three bombarding energies of 14, 12 and 10 MeV are analysed for precompound particles utilizing the expressions of Griffin. It has been found that the region of dominance of precompound particles increases as the bombarding energies increases. A qualitative explanation of the variation of the nuclear temperature with bombarding energy as well as with residual excitation energy is presented.

1. — Introduction.

The evaporation of particles from compound nuclei occurs only after statistical equilibrium has been established. But the spectrum of emitted particles consists not only of these statistical-decay particles but of direct-interaction particles also. However, neutron spectra resulting from proton bombardment, on the other hand, showed no evidence of contributions from direct interactions and hence they should follow the predictions of the statistical model. Wood et al. (1) made exhaustive experiments on tin isotopes at various proton bombarding energies. They concluded that their measurements disagree with the predictions of the statistical model. They also failed to explain the disagreement on the basis of angular-momentum effects or of the available inverse cross-sections. They found that the statistical model applies only to that part of the spectrum which contains low-energy neutrons. The present

investigation is an attempt to explain the discrepancy observed by Wood et al. (1) between theory and experiment on the basis of the precoumpound theory put forth by Griffin (2).

2. – Precoumpound particles.

Griffin (2) proposed a theory for the formation and decay of the precoumpound particles along with those of coumpound particles. He calculated the probabilities for the precoumpound decays for the case of the $^{117}$Sn(p, n)$^{117}$Sb reaction at 14 MeV bombarding energy, analysed the experimental spectrum and showed, from the constancy of the value of $N/W_p$ ($N$ is the intensity of the emitted particles and $W_p$ is the precoumpound decay probability), that precoumpound particles predominate in the high-energy tail of the neutron spectrum up to 6 MeV. He also showed that above a residual excitation energy of 6 MeV the coumpound particles dominate as in indicated by an exponential increase in the value of $N/W_p$. In the present investigation a similar analysis in $^{118}$Sn(p, n)$^{118}$Sb has been carried out to offer a reliable explanation for the discrepancies observed by Wood et al. (1) in their investigations.

3. – Results and discussion.

The data used in the present investigation are given in Table I. The probabilities $W_p$ for precoumpound decay have been calculated using the expression given by Griffin (2) for the reaction $^{118}$Sn(p, n)$^{118}$Sb at the three

<table>
<thead>
<tr>
<th>Reaction</th>
<th>Bombarding energy (MeV)</th>
<th>Angle of observation (degrees)</th>
<th>Reference</th>
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</thead>
<tbody>
<tr>
<td>$^{118}$Sb(p, n)$^{118}$Sb</td>
<td>14</td>
<td>60</td>
<td>(1)</td>
</tr>
<tr>
<td>$^{118}$Sb(p, n)$^{118}$Sb</td>
<td>12</td>
<td>60</td>
<td>(1)</td>
</tr>
<tr>
<td>$^{118}$Sb(p, n)$^{118}$Sb</td>
<td>10</td>
<td>60</td>
<td>(2)</td>
</tr>
</tbody>
</table>

bombarding energies, 14, 12 and 10 MeV. The neutron intensitites $N$ are taken from the data of Wood et al. (1). The ratio $N/W_p$ is plotted against $U$, the residual excitation energy, in Fig. 1 a), 1 b) and 1 c) for the three bombarding energies. According to Griffin (2), the energy region in which $N/W_p$