Lawrence Berkeley National Laboratory
Recent Work

Title
SUMMARY OF RESEARCH PROGRESS MEETING OF NOV. 13, 1952.

Permalink
https://escholarship.org/uc/item/7b15n94c

Author
Shewchuck, Sergey.

Publication Date
1952-12-23
DISCLAIMER

This document was prepared as an account of work sponsored by the United States Government. While this document is believed to contain correct information, neither the United States Government nor any agency thereof, nor the Regents of the University of California, nor any of their employees, makes any warranty, express or implied, or assumes any legal responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by its trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof, or the Regents of the University of California. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof or the Regents of the University of California.
SUMMARY OF RESEARCH PROGRESS MEETING OF NOVEMBER 13, 1952

Sergey Shewchuck

December 23, 1952

"Some of the results reported in this document may be of a preliminary or incomplete nature. It is the request of the Radiation Laboratory that the document not be circulated off the project nor the results quoted without permission."

Berkeley, California
I. Alpha Particle Energy Distributions Following the Decays of B$^8$ and Li$^8$

F. C. Gilbert.

The purpose of the experiment was to look for possible energy levels in the short-lived Be$^8$ nucleus. The work had been started by Barkas and Tyren with bombardments on Be and C from the 184-inch synchrocyclotron. In this experiment 375 Mev particles were used on Be foils. Many hammer tracks were observed from the breakup of B$^8$ and Li$^8$. The reactions studied were:

\[ \text{Li}^8 \rightarrow e^- + \text{Be}^8 \]  
\[ \text{B}^8 \rightarrow e^+ + \text{Be}^8 \]

Tracks due to B$^8$ were distinguished from those due to Li$^8$ of the same radius of curvature by their range and by their difference in grain density, both of which are functions of the charge difference. The energy distributions of the alphas from both processes were the same within statistics. Fig. 1 shows good agreement for both Li$^8$ and B$^8$ in the alpha range from the disintegration of Be$^8$ following their decay. Also, it can be seen that the observations agree quite well with theory (single resonance). The theoretical distribution was computed from the following equation:

\[ N_a \, dE_a = \frac{(Q - 2E_a)^5 \, P_a j}{(E_0 - 2E_a)^2 + 1/4} \, dE_a \]

where

- $N_a$ is the number of alphas,
- $E_a$ is the energy of one alpha particle,
- $Q$ is the cutoff energy ($\sim 15 - 16$ Mev),
- $E_0$ is resonance energy ($\sim 3.0$ Mev),
- $\Gamma$ is proportional to the width at half maximum (.8 Mev), and
- $P_a j$ is the penetration of one alpha Coulomb barrier by the other alpha particle for a Be$^8$ nucleus with J units of angular momentum.

Besides the level at 3 Mev there is a possibility of another level, or peak, at 9 Mev. However, as yet there are insufficient statistics to substantiate this; although measurements are being continued to obtain better
data. It is expected, also, to be able to check the theory of charge symmetry and the hypothesis of the mirror nucleus.

II. \( \pi^- \) Meson Production by Neutrons on Oxygen. F. C. Ford.

This experiment concerns cloud chamber work with the neutron beam from the 184-inch cyclotron. The target used was LiD, exposed to a 340 Mev proton beam. About 200 \( \pi^- \) tracks were observed and quite a number of stars ranging from "simple" two prong stars to "complex" seven prong stars. An analysis showed 162 \( \pi^- \) mesons and 8 \( \pi^+ \) mesons found in the gas. A distribution of the stars according to the number of prongs was as follows:

<table>
<thead>
<tr>
<th>No. of prongs</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of stars</td>
<td>40</td>
<td>20</td>
<td>10</td>
<td>8</td>
<td>4</td>
<td>3</td>
</tr>
</tbody>
</table>

A third of the 40 two prong stars included above represent deuteron events, the remainder being protons and a few alphas. Some of the stars clearly indicated a short prong, or stub, due probably to oxygen with an energy limit of 10 Mev and an angle usually within \( \sim 25^\circ \), but some even backwards. There was a ratio of one \( \pi^- \) meson to 125 stars as well as a plus to minus ratio of one \( \pi^+ \) to 20 \( \pi^- \). The energy ranges were from 0 to 160 Mev with a peak at 28 Mev.

Possible reactions were

\[
\begin{align*}
n + n & \rightarrow d + \pi^- \\
p + n & \rightarrow \pi^- \\
\end{align*}
\]

One could not tell which reaction was involved specifically. The angular distribution was not the expected one from two free particles interacting when d is produced. The angle varied from 0\(^\circ\) to 20\(^\circ\) rather than falling within a cone of 8\(^\circ\). The \( \pi^+ \) energies as indicated by the lesser data available appeared to vary the same as the \( \pi^- \). The eight \( \pi^+ \) mesons observed gave stars which suggested the reaction \( n + p \rightarrow n + n + \pi^+ \) since they appeared as "simple" stars.

The maximum neutron energy was 340 Mev, with the bulk around 305 to 310 Mev. A distribution curve of the number of mesons per unit solid angle vs the scatter angle revealed a distinct peak at 180\(^\circ\). No explanation could be had for this. It was attributed more to the lower energy mesons.
For particles above 30 Mev the curve shows no backward peak. The present work is being directed toward deuterium stars. Fig. 2 shows a star indicating a typical reaction involved in this study. The $\pi^-$ meson shown has a long track with a curvature distinctly opposite to that of the other particles leaving the star.
SINGLE α - PARTICLE RANGE (MICRONS)

- L\textsuperscript{8} \textsuperscript{11} EVENTS NORMALIZED TO 100
- \textsuperscript{8} EVENTS

α - RANGE FROM THE DISINTEGRATION OF \textsuperscript{8}\textsuperscript{11} FOLLOWING
THE DECAY OF \textsuperscript{8}\textsuperscript{11} AND \textsuperscript{8}

\textsuperscript{8} EVENTS

\textsuperscript{8} EVENTS

Fig. 1