Title
NUCLEON-MOMENTUM DISTRIBUTION IN HELIUM

Permalink
https://escholarship.org/uc/item/3451342r

Author
Stubbins, Warren Fenton.

Publication Date
1958-10-15
UNIVERSITY OF CALIFORNIA

Radiation Laboratory

TWO-WEEK LOAN COPY

This is a Library Circulating Copy
which may be borrowed for two weeks.
For a personal retention copy, call
Tech. Info. Division, Ext. 5545

BERKELEY, CALIFORNIA
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.
NUCLEON-MOMENTUM DISTRIBUTION IN HELIUM

Warren Fenton Stubbs

October 15, 1958
NUCLEON-MOMENTUM DISTRIBUTION IN HELIUM
Warren Fenton Stubbins
Radiation Laboratory
University of California
Berkeley, California
October 15, 1958

An analysis of the energy spectrum of neutrons produced by 910-Mev alpha particles in the 184-inch cyclotron striking an internal beryllium target has been made by assuming the nucleons to have a momentum distribution relative to the center of the alpha particle which itself has 0.6 the velocity of light. In the forward direction, at which the neutrons were observed, the elastic collisions between nucleons of helium and beryllium reveal only the momentum distribution in the helium nucleus. A Gaussian momentum distribution for helium nucleons of the form

\[ N(p) \propto \exp\left(-\frac{p^2}{p_0^2}\right) = \exp\left(-\frac{E}{E_0}\right) \]

fits the experimentally determined shape of the neutron spectrum very closely when \( E_0 \) is chosen as 5 Mev. This is much less than the expected value. The quasielastic collisions that occur lower the energy of the observed neutrons by their binding energy so that the computed distribution must be shifted to lower energy by about 10 Mev to coincide with the measured distribution.

Because of the small value above, an independent measurement of the distribution of helium-nucleon momentum was made by the technique of Chamberlain and Segrè using a liquid helium target. The angular distributions of coincidences between counter telescopes (one was pivoted at the target to vary its angle to the fixed telescope) were obtained for helium and carbon. A comparison shows the angular distribution for helium to be much narrower, about 60% of that for carbon. This is consistent with the value obtained from the neutron spectrum.

* Work done under the auspices of the U. S. Atomic Energy Commission.
It is suggested by Heckrotte that the neutron distribution may be sharp owing to final-state interactions between the neutrons and the residual nucleons of the alpha particle. Greider suggests that the carbon angular distribution may be wider than that for helium because in the larger carbon nucleus scattering predicted according to the optical model is greater. Both these possibilities would increase the estimate of the nucleon internal energies. A tendency for internal nucleon momentum to become small as nuclei become lighter has been observed.

REFERENCES

5. Kenneth Greider (UCRL), private communication.