NUCLEAR-DATA NEEDS FOR INERTIAL-CONFINEMENT FUSION (ICF)

Robert C. Haight
University of California
Lawrence Livermore National Laboratory
Livermore, CA 94550

Henry T. Motz
University of California
Los Alamos National Laboratory
Los Alamos, NM 87545

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Robert C. Haight
University of California, Lawrence Livermore National Laboratory
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Henry T. Motz
University of California, Los Alamos National Laboratory
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ABSTRACT

Some nuclear-data needs for inertial-confinement fusion (ICF) are presented.

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Nuclear Data Needs for Inertial Confinement Fusion (ICF)

I. Introduction

In response to the action by the INDC to survey the ICF community for their nuclear data needs, we have done so and submit this report on our findings.

Our survey was limited to ICF programs in the United states. It included researchers in laser and heavy ion fusion, target design, target diagnostics, and conceptual reactor design. We asked each of these people to read the current data needs for magnetic fusion energy and to comment on additional data that they require.

Two general conclusions emerged. First, because the magnetic fusion list of materials is so extensive, the ICF community has, at present, only a few additional data needs. This conclusion holds despite the many differences in the uses of these materials between magnetic and inertial confinement schemes. The second conclusion is that ICF is both closer to and farther from high priority data needs. It is somewhat farther away from designing a break-even reactor and, in the reactor sense, the needs for data of high accuracy are somewhat less than in magnetic fusion. On the other hand deuterium-tritium is used routinely as a fuel in ICF experiments, and 14-MeV neutrons are being produced and in fact used to infer pellet performance. The specific data to interpret activation measurements are needed now with high priority.

II. Specific Data Needs

We divide the specific needs into application areas.

Pellet Performance - The only material not on the magnetic fusion request list is Ta. Cross sections for neutron transport are important (Total, elastic, neutron emission, capture,...) between E_n = 0 and 15 MeV.

Diagnostics for Pellet Performance - The $^{28}Si(n,p)^{28}Al$ reaction is used as a diagnostic for microballoon performance (rho x radius). The uncertainty in the cross section is assumed to be $\pm 12\%$ at E_n = 14 MeV and is thus larger than the counting statistics. A more accurate (more reliable?) cross section is needed. Other diagnostic reactions are on materials that could be added to the D-T gas. Some typical reactions are $^{78}Kr(n,p)^{78}Br$, $^{80}Kr(n,2n)^{79}Kr^m$, and $^{136}Xe(n,2n)^{135}Xe^m$.

Optical Components for Laser Fusion - The material not on the magnetic fusion request list is Mg. For all elements of glass, coatings and mirrors, accurate values of local and non-local energy deposit (Kerma and gamma-ray production) are required. For heavy elements conversion-electron production should be evaluated separately. The materials include many of the OFE list: Si, O, Na, K, B, and Al for glasses; Al and Ca for mirrors; W, Ta, Cr, and Au for high-Z coatings; and Mg, Si, F, O and C for low-Z coatings.

Heavy-Ion Fusion - Interactions of heavy ions from Xe to U with all targets that result in light charged particles, neutrons or gamma rays are sources of protecting the pellet. The energy range is 0-100 MeV/amu. All these data are needed. (Because of the lack of specific needs, we recommend that this blanket request not be included in WRENDA).

Reactor Design - A wet-wall vapor-pressure control material could be Sn. In the blanket, Bi has been proposed. Both should be added to the request list for all important nuclear reactions. Cross sections for neutron transport (Total, elastic, neutron emission, neutron capture...) from 0 to 15 MeV are of importance.

III. Summary

In summary the new materials are Ta, Mg, Sn and Bi. Activation cross sections such as outlined above for diagnostic purposes are the only other high priority requests.