Progress Report on the NEANSC International Inter-laboratory Collaboration on the B-10(n,alpha) Standard Cross Sections

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The B-10(n,alpha) cross sections are important neutron cross section standards, particularly in the low energy region. There is a need to extend the energy range over which this cross section can be used as a standard so that a smooth and easy transition to higher energy standards such as H(n,n) can be obtained. Then cross section measurements relative to standards can be made from low energies to very high energies using two standards which have a large region of overlap in their useful ranges. The quality of the B-10(n,alpha) standard is significantly reduced at the higher neutron energies due to inconsistencies in the experimental measurements. There is general interest on the part of the community of cross section measurers, evaluators and users in improving the B-10(n,alpha) standards. These standards have received much attention lately as a result of their relatively poor data base and the problems they caused in the ENDF/B-VI standards evaluation process.

An Inter-Laboratory collaboration was formed to provide a mechanism for improving these cross sections. This collaboration has representatives from the measurement, evaluation and user communities. The objective is to have many laboratories collaborate on programs to improve the data base of cross sections for reactions of neutrons with B-10.

The considerable amount of activity since the second meeting of this collaboration at the Juelich nuclear data meeting led to the suggestion that another meeting be held at the Gatlinburg conference. The nuclear data conference should provide a means for obtaining the travel funds necessary for many of the collaboration members to attend the meeting. Several papers are being presented at the Gatlinburg conference on the work of this collaboration. The meeting of the collaboration has been scheduled for Tuesday, May 10 at 7:00 pm in the conference hotel.

A number of measurements have been made or are underway which should make a meeting at this time quite valuable. Work has been done on the branching ratio, the B-10(n,alpha 1 gamma) cross section, the total cross section and the differential cross section for the B-10(n,alpha)Li-7 reaction. The ORNL branching ratio work of Weston and Todd has been published. This work suggests a problem with the ratios of the ENDF/B-VI cross sections at the 10 to 30% level in the 100 to 600 keV energy region. Schrack et al., in an NIST-ORNL collaboration have continued their investigation of the B-10(n,alpha 1 gamma) cross section at the ORELA facility. The first of these measurements employed a black detector to obtain the neutron fluence and data was obtained from 0.3 to 4.0 MeV. The shape of these data are consistent with that of ENDF/B-VI to about 1 MeV, but differ by up to 40% for energies above 1 MeV. These data have recently been published. New data are now being obtained using a hydrogen gas proportional counter for the fluence measurement and the energy range covered is from 10 keV to 1 MeV.

A beryllium photoneutron linac target is now being employed to reduce possible effects associated with the gamma-flash.

Two separate measurements of the B-10 total cross section are now being made at the GEEL GELINA and ORNL ORELA facilities. These measurements can be effectively utilized in helping to define the B-10(n,alpha) cross sections when used in an R-matrix analysis. Such an analysis can use information including the total, scattering and (n,alpha) cross sections to define the parameters needed to accurately calculate the (n,alpha) cross sections. Brusegan et al of GEEL have obtained total cross section data at the GELINA facility with a Li-6 glass detector and recently fabricated Boron-10 carbide samples. Backgrounds were evaluated with the black resonance technique. Measurements were also made of the carbon and B-11 total cross sections. The measurements extend from 100 eV to about 2 MeV. Additional data have also been obtained at the Van de Graaff accelerator facility for the energy region from 1 to 19 MeV. Also Wasson et al, in an NIST-ORNL collaboration, recently made measurements of the total cross sections of B-10 and B-11 at the ORELA facility. The neutron energy region extended from 0.2 to 20 MeV using a 200 m flight path. An NE-110 plastic scintillator was used as the neutron detector for the measurements. Two boron powder samples with an isotopic enrichment of 99.82% B-10 were used. The total cross sections measured with the two different sample thicknesses agreed within 0.2%. Samples of CH2 were also measured as a test of the accuracy of the measurement and analysis techniques. The cross sections measured were in excellent agreement with the ENDF/B-VI evaluation values for H and C. The B-10 total cross section agrees with the ENDF/B-VI evaluation for neutron energies greater than approximately 1.5 MeV, but deviates by more than 4% for the lower energies. The B-11 total cross section has also been measured; that analysis is still in progress.

Measurements of the differential cross section for the B-10(n,alpha)Li-7 reaction have been obtained by Haight et al. The data obtained from these experiments will be analyzed soon.

Though no action has been taken, experiments have been suggested to improve the B-10(n,alpha 0) cross section. Also a high priority request for such a measurement has been submitted to the U.S. Compilation of Requests for Nuclear Data.