SOLAR NEUTRINO DETECTOR GT STRENGTH DISTRIBUTIONS VIA (p,n) REACTIONS

J.N. Bahcall
Institute for Advanced Study, Princeton University, Princeton, NJ 08540

J. Rapaport and T.N. Taddeucci
Ohio University, Athens, Ohio 47501

E. Sugarbaker
Ohio State University, Columbus, Ohio 43212

C.D. Goodman and C.C. Foster
Indiana University Cyclotron Facility, Bloomington, Indiana 47405

D. Horen
Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830

C. Gaarde and J. Larsen
Niels Bohr Institute, Copenhagen, Denmark

T. Masterson
University of Colorado, Boulder, CO 80309

S. Austin
Michigan State University, East Lansing, MI 48824

The observed and predicted capture rates for the chlorine solar neutrino experiment indicate a large discrepancy. This has stimulated new efforts to establish empirically whether this disagreement is caused by inadequate solar models or by a decrease in the detectable neutrino flux in transit from the sun. The most recent experimental results[1] for the capture rate, (2.1 ± 0.3) SNU, are very different from the model predictions,[2] (8 ± 3.5) SNU.

Four detectors are presently being considered as most likely candidates for new solar neutrino experiments. They are: ^{71}Ga, ^{81}Br, ^{98}Mo and ^{115}In. The ^{71}Ga and ^{115}In detectors are primarily sensitive to the flux of proton-proton neutrinos while the ^{81}Br detector is most sensitive to the neutrino line from electron capture by ^{7}Be. The reaction $^{98}Mo(\nu,e^-)^{98}Tc$ will determine the average ^{8}B neutrino flux over the past several million years by analyzing neutrino absorption products in deeply buried molybdenum ore.

In all these cases the cross sections for capture of neutrinos by these detectors must be known accurately in order to interpret the results of these expensive and difficult experiments. The technique to be used in order to get these cross sections has been described in a recent paper.[3] We have measured at IUCF (p,n) cross sections at $\theta = 0°$ and $\theta = 5°$ using 120 MeV protons on ^{69}Ga, ^{71}Ga, ^{81}Br, ^{98}Mo and ^{115}In. We also obtained (p,n) spectra at θ=0° and θ=3° for 200 MeV protons on the same targets. We show some of the 120 MeV spectra in Figs. 1-3. Analysis of these data is in progress.

Both Ga targets were made as an alloy with ^{24}Mg. The latter was used because of its large negative (p,n) Q-value (Q = -14.67 MeV). The ^{81}Br target was fabricated from a compound with natural Ca. Ca was chosen because of its large negative Q-value.

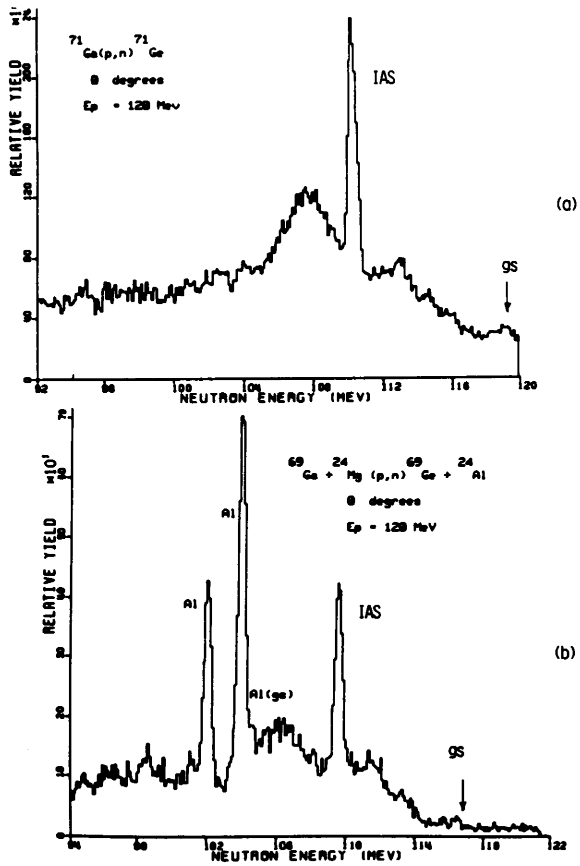

Figure 1. Neutron energy spectra for the ^{71}Ga(p,n) and ^{69}Ga(p,n) reactions at θ=0° and E_p=120 MeV. Both Ga targets were made as an alloy with ^{24}Mg. In the ^{71}Ga(p,n) spectrum, the ^{24}Mg(p,n) contribution has been subtracted.

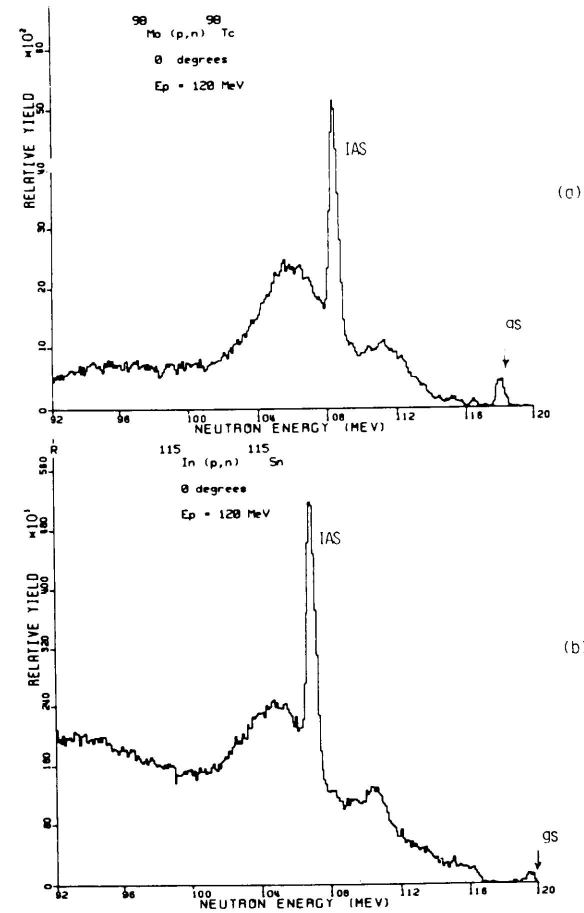

Figure 2. Neutron energy spectra for the ^{98}Mo(p,n) and ^{115}In(p,n) reactions at θ=0° and E_p=120 MeV. Background and time-of-flight wrap-around contributions have been subtracted.

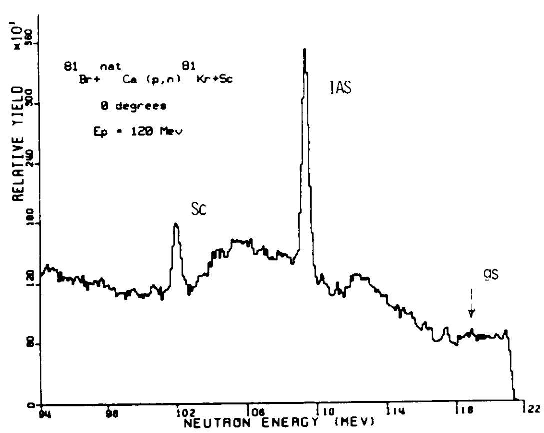

Figure 3. Neutron energy spectra obtained at θ=0° and Ep=120 MeV for the (p,n) reaction on a (^{81}Br + ^{nat}Ca) target.

1) B.T. Cleveland, R. Davis, Jr. and J.K. Rowley in "Weak Interactions as Probes of Unification", ed. by Collins, Chang and Ficenec (AIP Conf. Proc. #72 1981), p. 322.

2) J.N. Bahcall et al., Phys Rev. Lett. 45, 945 (1980).

3) J. Rapaport et al., Phys. Rev. Lett. 47, 1518 (1981).