Brief Reports

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$^{10}B(p,n)^{10}C$ Q value

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The $^{10}B(p,n)^{10}C$ Q value has been determined to be $Q_{pn} = -4430.17 \pm 0.34$ keV. This seems to resolve the disagreement between two sub-keV measurements reported in the literature.

[NUCLEAR REACTION Measured $^{10}B(p,n)^{10}C$ threshold energy.]

The determination of the $^{10}B(p,n)^{10}C$ Q value was the first in a series of studies at Auckland which were aimed at providing information on the pure Fermi $0^+ \rightarrow 0^+$, $T=1$ nuclear beta decays.[1] The value obtained, $Q_{pn} = -4433.0 \pm 0.6$ keV was in good agreement with the result of a similar, earlier experiment from Harwell, $Q_{pn} = -4433.7 \pm 1.5$ keV.[2] (Both values have been corrected for the subsequent change in the value of the alpha particle calibration energy.) However, a later measurement of the $^{12}C(p,t)^{10}C$ Q value from Michigan State[3] implied $Q_{pn} = -4429.7 \pm 0.7$ keV (evaluated using the 1971 mass tables,[4] since it is not obvious how to update the Michigan result to the newer 1977 mass table). These results are in obvious disagreement, and the discrepancy should be resolved, particularly since one of the present authors is also a coauthor in each of Refs. 1 and 3.

We have therefore remeasured the Q_{pn} for the $(^{10}B+p)$ reaction using essentially the same technique as was discussed in Ref. 5 for the $(^{14}N+p)$ reaction. In this method, the beam energy is determined with an accuracy of a few parts in 10^5, relative to a maintained 1 V standard. Technical details are discussed in Ref. 6. The targets were of freshly evaporated ^{10}B and the reaction yield was monitored using the 720 keV gamma ray which follows the decay of ^{10}C. The reaction energy was varied by applying an offset voltage to the target. A yield curve in the region of threshold is shown in Fig. 1, in which the solid curve is a fit to a function of the form $Y = a(V - V_{th})^{3/2} + b$.

A total of nine such yield curves gave a mean threshold energy of 4876.90 ± 0.37 keV and hence a Q_{pn} of -4430.17 ± 0.34 keV where the size of the error bar is essentially a consequence of the poor yield of the reaction.

Corrections to Q_{pn} for possible beam energy spread and atomic effects, and for the nonuniform energy loss of the protons in the target, are negligible in comparison to the quoted error.

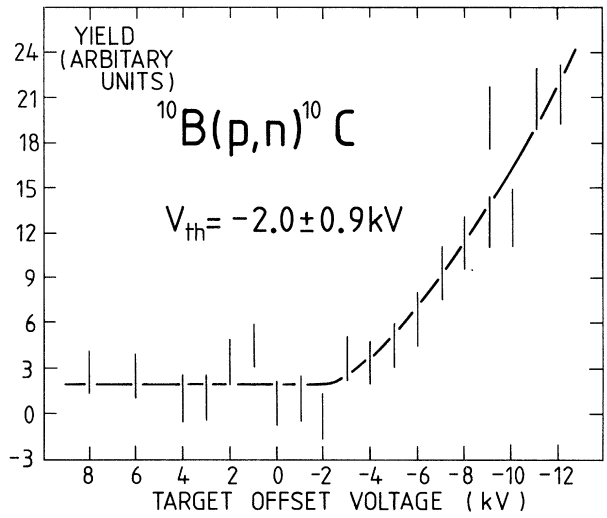

FIG. 1. A $^{10}B(p,n)^{10}C$ yield curve in the region of threshold.

This present result seems to be in agreement with the Michigan value, and to be significantly lower than the old Auckland value. This latter we attribute to our then ignorance of the degree of surface purity necessary for targets. (Our 1974 ^{10}B target was a "used" one, borrowed from the Atomic Energy Research Establishment, Harwell.)

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