Comment on "Precise Determination of the Unperturbed ^{8}B Neutrino Spectrum"

We point out a likely source of systematic error that was not discussed in the above Letter by Roger *et al.* [1]. From their experiment the authors deduce an apparently significant disagreement with previous measurements of the shape of the beta-delayed alpha spectrum of ^{8}B. The previous, presently accepted, measurements in which some of us participated [2,3], were later independently confirmed [4]. The difference in the new results of [1] is characterized by an $\sim$18 keV shift of the broad peak in the summed beta-delayed alpha-particle energy spectrum. The summed alpha-particle spectrum is important since it determines (after corrections for recoil and radiative effects) the primary ^{8}B neutrino spectrum used to interpret many solar neutrino experiments.

A significant difference between the experiments is in the type of detector used and in the calibration procedure. While Refs. [2–4] used simple Si-wafer detectors, the measurements of [1] (and [5] by the same group) were carried out with a double-sided Si strip detector (DSSD). Here we focus on comparing the results from [1,2], which both use implanted ^{8}B nuclei to measure the summed alpha spectrum. Many of our remarks also apply to the measurement with an external source [5].

In a DSSD detector with 300 μm wide strips, used in [1], there are interstrip gaps of about 35 μm where the electric field in the Si is altered. Particles incident on the surface of this gap will still produce a pulse, but there is a charge loss, and the fraction of the charge collected will be reduced in a way that depends on the details of the field configuration and how the particles traverse the affected regions. These regions extend to depths comparable to the gap width [6,7]. The details of these losses in charge-collection efficiency are complicated.

Such effects are not addressed in [1]. The DSSD was calibrated with alpha particles from an external source with energies between 3–6 MeV. The line shape was parameterized by a Gaussian with two exponential tails. However, the alpha particles from the implanted ^{8}B have an energy of $\sim$1.5 MeV near the peak of the distribution with a range of $\sim$5.5 μm and originate 26 μm inside the detector. They necessarily sample the detector volume *differently* from the calibration alphas from external sources, whose ranges are $\sim$24 μm. This is a source of systematic error, not mentioned in the discussion, and is likely to be significantly larger than the 2 keV uncertainty in the energy scale quoted in the Letter. A precise correction for such effects is difficult, but would be in a direction to bring the new measurement into better agreement with the previous work.

The primary calibration in [2] was from the delayed alpha-decay lines from implanted ^{20}Na, similar to the implanted ^{8}B. The primary calibration in [1] came from external sources, and implanted ^{20}Na was used only to help determine the dead layer on the detector. With the complicated response of a DSSD to low-energy alphas, the external calibration presents an additional problem.

Finally, Bahcall *et al.* [8] showed that older discrepancies in the inferred neutrino spectrum of ^{8}B could be removed by a small shift in the alpha energy scale, using the measured shape of the ^{8}B positron distribution [9] as a reference. Like the neutrinos, the positrons at high energies are also very sensitive to the low-energy alpha spectrum. The agreement between the positron spectrum and the neutrino spectrum of [2–4] is excellent. The difference in the high-energy neutrino spectrum deduced by Roger *et al.* is enough to spoil this agreement.

In view of the unaccounted-for systematic errors and the inconsistency with the positron data, the statement in the abstract of [1] that their spectrum "represents a benchmark for future measurements of the solar neutrino flux as a function of energy" seems unjustified.

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