Tabletop Fusion Revisited

I DO NOT THINK THAT IT IS POSSIBLE FOR R. P. Taleyarkhan *et al.* ("Evidence for nuclear emissions during acoustic cavitation," Research Articles, 8 March, p. 1868) to have observed 2.5-MeV neutrons for the simple reason that the pulse-height threshold used in their experiment is greater than the maximum possible pulse height a 2.5-MeV neutron could have produced in their scintillation detectors.

Information on their threshold is given in the paper in note (*26*); details are in Web supplement 1 (*1*). For deducing a calibration of pulse height versus neutron energy, the best data shown there are in supplemental Fig. 2.4(b). This figure shows that the maximum pulse height produced by 14-MeV neutrons corresponds to channel number ~100. If the response of the scintillators was linear, the maximum output from 2.5-MeV neutrons would be in channel (2.5/14)(100) = channel 18. Two points must be recognized, however: (i) A neutron of energy E is detected when it strikes a proton of the scintillator, and that recoiling proton, of maximum E in a head-on collision, excites scintillator molecules; and (ii) only a fraction of the proton's energy makes light, and, in an organic scintillator, that fraction becomes ever smaller as the proton energy gets smaller; i.e., the response is not linear. In particular, it disfavors 2.5-MeV protons versus 14-MeV protons. The above points are clearly given by G. F. Knoll (*2*) [and cited in reference (*23*) of Taleyarkhan *et al.*]. From the well-known data given by Knoll, the maximum pulse height from 2.5-MeV neutrons would be in channel 9 rather than 18.

Taleyarkhan *et al.* may have used faulty γ-ray spectra such as the spectrum in supplemental Fig. 2.2(a) to conclude in their note (*26*) that "the 2.5-MeV threshold was found to lie around channel 40..."

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References
1. Web supplement 1 is available at www.sciencemag.org/cgi/content/full/295/5561/1868/DC1.
2. G. F. Knoll, *Radiation Detection and Measurement* (Wiley, New York, 1989), pp. 222–225.

Response

WE THANK GALONSKY FOR POINTING OUT the difficulties arising from interpretation of the threshold for detecting 2.5-MeV neutrons. We concur that the response of the scintillator should be close to linear (but not precisely so). We also note that our NE-213 detector was calibrated with both Cs-137 and Co-60 sources, and we equated the intercept of the Compton edge with the x-axis to the energy of the forward scattered electron, namely, 478 keV for the 662-keV Cs-137 γ-ray and 1.12 MeV for the 1.33-MeV Co-60 γ-ray. These two edges appeared approximately in channel numbers 29 and 40, respectively. A 2.5-MeV proton emits the same light as a 0.881-MeV electron (*1*), which corresponds approximately to channel 34. Thus, counts from 2.5-MeV neutrons can only appear below channel ~34.

The Taleyarkhan *et al.* report is also under discussion in this week's Technical Comments (www.sciencemag.org/cgi/content/full/297/5587/1603a).

It is important to recognize that we had a ~21-channel offset in the multichannel analyzer (MCA) channel corresponding to zero pulse height. Thus, ~21 channels need to be subtracted from our pulse-height data. In comparing the ratio of the maximum pulse height for a 14-MeV neutron that fell in channel ~110 and a 2.5-MeV neutron in channel ~34, we compute the light output ratio $R = (110 - 21)/(34 - 21) = \sim 7$. According to Hawkes *et al.* (*2*), the ratio of maximum light from a 14-MeV neutron to a 2.5-MeV neutron ranges from ~7.5 to 10 using the database they compared their data against. Additionally, according to Schmidt *et al.* (*3*), the ratio of light output from various databases at the energy range of 2.5 MeV for neutrons can encompass a spread of up to 50% depending on the age, size, electronics settings, and so forth of NE-213–based detection systems. Therefore, the estimated value of $R \sim 7$ from our calibration is reasonably close to the published values and within the range of variations reported by other researchers in the literature. Because of this fact, and the fact that we deliberately measured the threshold via calibration with Co-60, Cs-137, and 14-MeV neutrons from our pulse-neutron generator, we maintain that 2.5-MeV neutrons were indeed measured using our detection system.

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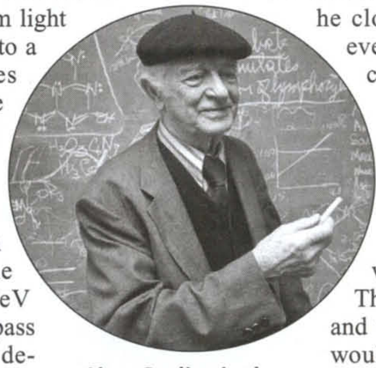
References
1. J. H. Lee, C. S. Lee, *Nuclear Instrum. Methods Phys. Res.* **402**, 147 (1998).
2. N. P. Hawkes *et al.*, *Nuclear Instrum. Methods Phys. Res.* **476**, 190 (2002).
3. D. Schmidt *et al.*, *Nuclear Instrum. Methods Phys. Res.* **476**, 186 (2002).

Someday Everyone Will Be a Chemist

MARK BURNS' PERSPECTIVE "EVERYONE'S A (future) chemist" (7 June, p. 1818) brought back memories of a morning when I was a TA in Linus Pauling's freshman chemistry class at Caltech. With a broad smile and that defining twinkle in his eye, he began the lecture with "Some day, when everybody is a chemist..." This brought forth a few good-natured chuckles from the students. Pauling continued with the lecture in his normal manner. As he closed it, he said, "Now, if everybody is going to be a chemist, we need to get started." Randomly pointing to one of the freshmen, he asked "How would you like to work with me this summer?" The flabbergasted student was of course speechless. This element of spontaneity, and the belief that individuals would rise to their potential, were but some of the characteristics that made Pauling not only a great scientist but a great teacher.



Linus Pauling in the classroom

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