Measurement of γ-rays from cold fusion

SIR—Petrasso *et al.*[1] have recently published a critique of the γ-ray spectrum given by three of us[2] as supporting evidence for the solid-state fusion of deuterons in palladium host lattices. The basis of this critique was the nature of a γ-ray spectrum displayed during a television broadcast. One of us (M.H.) denies the accuracy of ref. 6 of Petrasso *et al.*; M.H. did not state that the quoted television spectrum was made in these laboratories, as it most certainly was not. In view of this somewhat strange approach to the collection of scientific data and, as we cannot vouch for the authenticity of the spectrum transmitted (we have now confirmed that the "curious structure" in the television 'data' given by Petrasso *et al.* — their Fig. 1*b* and legend[1] — is simply the trace of a screen cursor on the multi-channel analyser visual display unit!), we give in the first place one of the complete set of spectra recorded at that time (Fig. 1).

In the work reported by us[2], γ-ray spectra were measured principally to check on the safety of our operations and, as we have repeatedly pointed out, we are well aware of the deficiencies of these spectra. Figure 1 gives the background spectrum ('sink'; solid line) taken over a sink containing identical shielding materials but at a distance of 5 m from the tank containing the experimental cell. This cell contained a 0.4×10 cm palladium electrode polarized at a current density of 64 mA cm^{-2}; during the period of the measurement it was generating excess heat at the rate of 1.7–1.8 W (over and above that due to the electrode reactions).

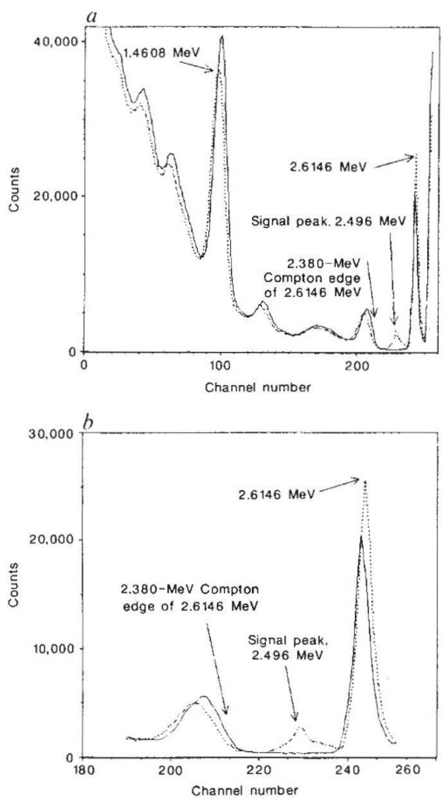

FIG. 1 The γ-ray spectrum accumulated over the water bath containing the electrolytic cells ('tank'; dotted line) and over a sink 5 m away ('sink'; solid line). Detector is a 3×3 in. NaI right circular cylinder. Spectral accumulation times: 50 h. *b* is an expanded version of the most relevant region of *a*.

The 'peak' under discussion is centred at 2.496 MeV, and it can be seen in Fig. 1*a* that all the peaks in the background spectrum on the low-energy side of 2.496 MeV are displaced to higher energies whereas that on the high-energy side (due to ^{208}Tl) is displaced to a lower energy. (Scaling of the spectrum made near the electrolytic cell with a quadratic interpolation formula generated the spectrum we reported: this scaling produced a shift and narrowing of the 2.496-MeV peak.) The observed shifts are due to a combination of zero shift in the analyser and a gain shift of the NaI detector resulting from drift of the pre-amplifier. Over the long data-acquisition times, the shifts are of little importance. The spectra do indicate, however, that the nature of the background radiation in the two areas of the laboratory is essentially the same. The only significant difference between the spectra is the signal peak. This is very convincing evidence that the signal peak is not due to products of radon decay.

It can be seen, however, that there is another unexplained feature in these spectra: there is a rising tail at the end of the spectra. This is due to pulse pile-up in the last few channels as a result of a peak at slightly higher energy than the 2.6146-MeV peak (Fig. 2). Figure 2 represents a background spectrum that was acquired with a slightly reduced gain so that the energy window could be extended.

The exact interpretation of the 2.496-MeV peak is in doubt; certainly, the peak from the reaction $^{1}H + n \rightarrow {}^{2}D + \gamma$ (2.22 MeV) would be expected to lie to the left of the Compton peak that arises from the thorium decay chain. The search for this peak does not seem to be feasible using NaI detectors. In spite of the problems underlying the interpretation of these spectra, we consider that the measurements show the emission of γ-rays from the cell environment: removal of the cells leads to the removal of the signal peak. A possible interpretation is that the signal peak is a single- or double-escape peak from 3.01- or 3.52-MeV peaks, or from summing of other unidentified peaks at lower energies. The unusual shape of the signal peak suggests that it may be a combination of such peaks. The size and energy of the signal peak imply that any associated Compton edge or escape peak will be lost beneath the rest of the spectrum.

Petrasso *et al.*[1] have also commented on

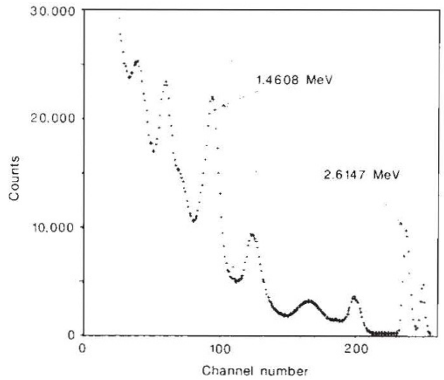

FIG. 2 The γ-ray spectrum accumulated in a similar manner to those in Fig. 1 in a remote laboratory at reduced gain.

the integrated peak intensity of the γ-ray spectrum reported by us and imply that we sought to relate this to the neutron count observed close to a similar cell operated in the open air. We point out that we made no such comparison but instead sought to relate the neutron count rate to the tritium production which we and others have observed. Clearly, further work on the γ-ray spectra should include the characterization at high resolution with solid-state intrinsic germanium detectors of the γ-ray emissions in the energy region above 2 MeV.

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PETRASSO *ET AL.* REPLY—Our criticism[1] of the published 2.22-MeV neutron-capture-on-hydrogen γ-ray line of Fleischmann *et al.*[2], claimed by them as compelling evidence of neutron production in their electrochemical cells (Fig. 1*a* of erratum of ref. 2; Fig. 2 of ref. 1; our Fig. 1 here), raised two fundamental points: Fleischmann *et al.*'s γ-ray line first is a factor of two narrower than their instrumental resolution would allow, and, second, lacks a Compton edge, which should be distinctly evident at 1.99 MeV (Fig. 1). We therefore concluded that their γ-ray signal line was an instrumental artefact, and we argued that the energy position of their signal line was unlikely to be at 2.22 MeV as they claimed. We suggested that the energy of the signal line could easily be verified by publication of their full γ-ray spectrum, because prominent, naturally occurring background lines from ^{40}K (1.46 MeV) and ^{208}Tl (2.61 MeV) calibrate their spectra absolutely[1,3,4].

In their response above, Fleischmann