Haiko Lietz wrote:

Dear Rusi, all,

Thanks for your answers.

[RT] There is a slight hump which is smeared around the 2.45 MeV edge due to some gamma photon leakage and of-course because a large number of 2.45 MeV neutrons have been slowed down due to scattering losses.

[HL] I see that this is very difficult terrain. ANother source told me, he is surprised that there is no clear edge at 2.45 MeV because he would expect that roughly a quarter of the fusion neutrons would reach the LS detector without scattering.

The source also said your argument would be stronger if you had modeled the neutron transport from the reactor site to the LS detector, saying this should be your next work. Are you working on this?

Best regards

Haiko

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Date: Tue, 25 Jul 2006 11:38:31 -0400
From: Rusi Taleyarkhan <rusi@ecn.purdue.edu>
To: hl@haikolietz.de
CC: [co-author list], Brian Josephson, Steve Krivit
Subject: Re: Naranjo's claims explanation (rpt->h.leitz; 7.25.06)

Bob Block can better answer this question due to his 50y+ field expertise (sorry Bob, I had to reveal your age here) than I but he can comment further if he chooses on what I am providing below.

We are in danger of over-simplication based on general comments that even well-meaning individuals make. For LS fast-timing based detectors the answer to your question depends on a complex combination of down-scattered neutrons of various energies as well as leakage gamma photons along with efficiency of detection at lower channel numbers (which is much higher), age of detector, type and speed of multi-channel analyzers, NIM electronic components,....

Getting a straight vertical edge is a theoretical possibility for monoenergetic neutrons with single scattering events. See figure 15.18 from Knoll's book (third edition). Even for ALL single energy 2.5 MeV neutrons, we see a predicted (theoretical) straight edge (90 degrees) for curve (a) representing single scattering in Fig. 15.18a for an ideal world, but a significantly smeared (30 to 45 degree) value from an actual detector where the imperfection in detection for "that" detector train is evident. Accounting for multiple scattering as well as recoils from carbon scattered neutrons one sees a significant smearing of the spectral curve with only a slight bump as shown for curve (e).

The value of edge jumps at the PRE will differ from experimental system to system. Important aspect is to to recognize that there is indeed a hump in our data at 2.5 MeV albeit smeared (that is absent from a pure Cf-252 spectrum) and more importantly, look at the differences in spectra related to control experiments and deuterated experiment data.

Yes, it is good to get more modeling/simulation work done and we are getting students to get started pending funding support. To do it right, this in itself can become a significant project (to first model all experimental systems in 3-D using Monte-Carlo code systems, then not just model but also consider uncertainties in modeling of the entire detector train including age of liquid scintillator, existing activation of various components from past experiments, coupling with PMTs, base dynamics, NIM electronics,...and the data acquisition systems).

Our first cut Monte-Carlo 2-D simulations for neutron transport indicate significant scattering induced reductions but that is not enough in itself and presenting half-baked material can confuse and mislead more than help. We relied instead on careful controls with non-deuterated liquids and data from 4 independent detector systems (3 for neutrons, 1 for gammas). All 3 neutron detector systems give the emission rate in the same range of about 10,000 n/s for the case of deuterated cavitated liquid. All 4 detectors give null results for control experiments.

People foget the forest for a tree which is why group likes to rely on primary sanity checks with non-electronic, passive detectors such as the time-honored neutron-track detector (which is completely insensitive to gammas) for direct unambiguous viewing for evidence of fast neutrons (as has been done in our PRL paper).

We did what we did in the time we spent on the reported data discoveries. Can and should any or all of the reported work be improved upon? You bet.

Rusi

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Date: Thu, 27 Jul 2006 14:55:39 -0400
To: hl@haikolietz.de
From: "Robert C. Block"
Subject: Fwd: Re: Naranjo's claims explanation (rpt->h.leitz; 7.25.06)
Cc: [coauthor list], Brian Josephson, Steve Krivit

Dear Haiko Lietz,

I cannot improve on Rusi Taleyarkhan's explanation of the liquid scintillator (LS) detector results. It is possible to model the detector response for incident neutrons--e.g. the SCINFUL code developed at Oak Ridge National Laboratory does an excellent job--and use Monte Carlo to determine the actual spectrum of neutrons and gammas incident upon the detector. These neutrons and gammas are the result of 2.5 MeV neutrons emitted in the middle of the sonic chamber.

For the gammas one has to apply the experimentally determined fraction of gamma ray pulses which are accepted in the neutron channel (the pulse shape discrimination is not 100% efficient in rejecting gammas), and then the gamma 'leakage' can be added to the neutron response to get an overall simulated experimental signal.

To me the 'smoking gun' is the 'bump' that is evident in the LS spectrum at an energy corresponding to ~2.5 MeV protons (180-degree-scattered 2.5 MeV neutrons). The only interpretation I have is that this is indeed the edge for the 2.5 MeV neutrons which strike the detector. To this spectrum is added the superpositon of all lower energy down-scattered neutrons. For events which exceed 2.5 MeV, we interpret them to be gamma rays which 'leak' into the neutron channel; these gamma rays can indeed produce >2.5 MeV pulses.

I hope this has been helpful.

* *

Robert C. Block

Director
Gaerttner LINAC Laboratory
Dept. of Mechanical, Aerospace
and Nuclear Engineering
Rensselaer Polytechnic Institute
Troy, New York 12180-3590
Tel. No.: (518) 276 6404
Fax. No.: (518) 276 4007
E-Mail : blockr@rpi.edu

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