Appendix J – IqC Comment on Additional Evidence to Inquiry Committee Submitted by R. P. Taleyarkhan, R. C. Block, Y. Xu, and J. Lapinskas[135]

The pulse height spectrum shown in Figure 4 of PRL **96** is very different from the response of a liquid scintillation detector to 2.45 MeV neutrons. Such a difference can easily be attributed to scattering in the sample, the cell, the thermal shield, and the external shielding. Furthermore, details of the electronic signal processing of the signals from the scintillation detector can cause additional distortion. The simulation presented by Taleyarkhan et al. in their August 2007 document address the first of these issues. Taleyarkhan et al. use the MCNP5[136] code for nuclear transport and either the SCINFUL[137] code or empirical spectra from Lee and Lee[138] for detector response. With a sufficiently detailed model of the experimental arrangement, the results of these simulations should provide great insight into the measured pulse height spectrum. Indeed, the results shown in their document, quite possibly still preliminary, are very interesting. In this regard, the Inquiry Committee would mention the simulation published by Naranjo[139] that has generated so much discussion in many forums. This simulation was offered as a comment to PRL **96**. Although a speculation, it is quite likely that if work similar to that shown in the August 2007 document had been submitted to the editors of Physical Review Letters and reviewers of PRL **96**, the comment by Naranjo would not have been published in the form that it was submitted.

Scattering in the sample, the cell, the thermal shield, and the external shielding reduce the neutron energy. The spectrum of Figure 4 of PRL **96** shows counts above the maximum possible for 2.45 MeV neutrons. This feature of the data is discussed in the second part of the August 2007 document. In this discussion Taleyarkhan et al. consider spectral distortion from finite detector resolution, from leakage in the pulse shape processing, and from pulse pile-up. Each of these effects will contribute to the counts above the proton recoil edge, and their contributions are a detailed, quantitative matter. Again, the IqC would mention the work of Naranjo where the matter of counts above the proton recoil edge is an important issue. Work similar to that shown in the August 2007 document would have likely affected the judgment of the editors of Physical Review Letters and reviewers of PRL **96**.

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[135] ONR IqC 2007 070806 RT.1-25

[136] MCNP5 is distributed by Los Alamos National Laboratory. See http://mcnp-green.lanl.gov/index.html for publications and documentation.

[137] SCINFUL is distributed by Oak Ridge National Laboratory. See http://www-rsicc.ornl.gov/codes/psr/psr2/psr-267.html for publications and documentation.

[138] J. H. Lee and C. S. Lee, "Response function of NE213 scintillator for 0.5-6 MeV neutrons measured by an improved pulse shape discrimination," Nucl. Instr. Meth. **A402**, 147 (1998).

[139] B. Naranjo, Phys. Rev. Lett. **97**, 149403 (2006) with supplement E-PRLTAO-97-071640. Naranjo's comment is continued in arXiv:physics/0702009v1, 1 Feb 2007.

As the IqC has endeavored to understand the science of sonofusion in its efforts to evaluate the allegations of research misconduct on the part of Professor Taleyarkhan, the Inquiry Committee naturally also has an interest in the science of the abovementioned technical matters. However, the Inquiry Committee does not put itself in the role of reviewing the science of this work. Allegations F1, F3, G1 and G2 are closely associated with the work of Naranjo. In its consideration of these allegations, the IqC has evaluated the process, i.e. the conduct, and not the science.

The third matter discussed in the August 2007 document is the distortion in the pulse height discrimination spectrum obtained by Professor Taleyarkhan on September 19, 2003. The importance of these data is in relation to Allegation K. Again, the IqC has evaluated the process, i.e. the conduct, and not the science. The judgment of the IqC is that these data are so flawed that they cannot be used to claim a signal for sonofusion and that in making this claim, in a demonstration to his Purdue colleagues, that Taleyarkhan has displayed a level of scholarship that is far below that expected of a named professor. The August 2007 document suggests a cause for this spectral distortion, and further suggests that this spectral distortion is also present in the sonofusion experiment of Camara et al.[140] Again, the Inquiry Committee naturally has a scientific interest in this technical matter, and, in this case as a scientific matter, the Inquiry Committee, comparing the published two-dimensional scatter plots of Camara et al. and the one-dimensional histograms obtained by Professor Taleyarkhan in September 19, 2003 sees no similar distortion. Professor Taleyarkhan and his collaborators are being disingenuous in their claim of a similarity.

[140] C. G. Camara, S. D. Hopkins, K. S. Suslick, and S. J. Putterman, "Upper bound for neutron emission from sonoluminescing bubbles in deuterated acetone," Phys. Rev. Lett . **98** 064301 (2007).

APPENDIX K – List of Sonofusion Experiments

In the simplest terms, the success or failure of a sonofusion experiment requires the proper enumeration and sorting of electrical pulses that are produced by radiation detectors monitoring a sonofusion cell. It is implicitly assumed that any pulses recorded are the result of nuclear radiation interacting with the radiation detectors. Furthermore, it is assumed that the source of the nuclear radiation is the sonofusion cell. In addition, unavoidable background radiation, usually assumed to occur at a small but constant rate, produces a "background" signal. If there is a low rate at which radiation is produced, and if the efficiency of the radiation interacting with the detectors is also small, then an experimentalist is obligated to demonstrate that the assembled equipment is capable of accurately counting and properly sorting the resulting small number of pulses.

Specially designed electronic circuits are used to monitor and detect the characteristic pulse shape that each detector produces (except the track detectors which are visually scanned). The circuits record and count all pulses at their inputs, sorting them by pulse height and pulse width, irrespective of whether the pulses are produced by the detectors. Thus spurious noise pulses on input lines, noise signals from external equipment, signals produced by background radiation, etc. can and do contribute to the final pulse spectrum. If the signal of interest is large, these extraneous signals are not of much consequence. However, when the signal of interest is small, then the proper care must be taken to properly interpret the measured spectra.

A well-designed experiment that is executed with care checks to make sure that the pulses counted are in fact due to the nuclear radiations interacting with the detectors. If the experiment is not well designed or not executed with aptitude, or if the pulses produced are few in number, then extreme skill must be exercised to properly *interpret* the resulting data.

During the course of this investigation, the IqC has documented reports that claim both the successful and unsuccessful observation of sonofusion. For future purposes, it might be worthwhile to simply compile a list of these occurrences without further comment. The list is believed to be complete up to the July 2007 timeframe.

CLAIMS OF SUCCESSFUL SONOFUSION EXPERIMENTS [141]

- Evidence for Nuclear Emissions During Acoustic Cavitation" by R. P. Taleyarkhan, C. D. West, J. S. Cho, R. T. Lahey Jr., R. I. Nigmatulin, and R. C. Block, *Science* **295**, 1868 (2002).

- RHPH G60 demonstration at Purdue University; Sept. 19, 2003 (unpublished). This demonstration prompted Taleyarkhan, Tsoukalas, and Jevremovic to sign the wall in G60 on 9/19/2003 proclaiming: "Bubble Fusion Was Achieved." [142]

- "Additional evidence of nuclear emissions during acoustic cavitation" by Taleyarkhan, Cho, West, Lahey, Nigmatulin and Block, Phys. Rev. **E69**, 036109 (2004).

- Draft of manuscript *circa* 2004 entitled "Tritium Evidence in Acoustic Cavitation Nuclear Emission Experiments" by A. Bougaev, J. Walters, T. Jevremovic, M. Bertodano, F. Clikeman, E. Merritt, S. Revankar, L.H. Tsoukalas, (unpublished).[143]

- "Confirmatory experiments for nuclear emissions during acoustic cavitation" by Y. Xu and A. Butt, Nucl. Eng.. Des. **235**, 1317 (2005) and "Bubble Dynamics and Tritium Emission During Bubble Fusion Experiments" by Y. Xu, A. Butt, and S. T. Revankar in the Proceedings of the 11th International Topical Meeting on Nuclear Reactor Thermal-Hydraulics (*NURETH-11*), Avignon, France, October 2-6, 2005, p. 548.

- Abstract titled "Innovative Confinement Concepts Workshop" by D.F. Gaitan and R. Tessian, Austin Texas, Impulse Devices, Inc, Feb. 13-16, 2006 (unpublished) see http://icc2006.ph.utexas.edu/abstract.php?view=155[144]

- "Nuclear Emissions During Self-Nucleated Acoustic Cavitation" by R.P. Taleyarkhan, C.D. West, R.T. Lahey Jr., R.I. Nigmatulin, R.C. Block and Y. Xu, Phys. Rev. Lett. **96**, 034301 (2006).

- March 2006 – signed testimonial by President of IDI, Ross Tessian (unpublished).

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[141] See transcript of interview of R.Taleyarkhan on July 23, 2007 for a recitation of the list provided below, pgs. 170-177.

[142] See transcript of interview of R.Taleyarkhan on July 23, 2007, pg. 49-50.

[143] provided as an attachment to the letter from L. Selander to W. Kealey on July 20, 2007.

[144] Note that the authors themselves do not claim confirmation but Taleyarkhan does. See page 170 of July 23, 2007 transcript.

- "Confirmation of Neutron Production During Self-Nucleated Acoustic Cavitation", E.R. Forringer, D. Robbins, J. Martin, Trans. Amer. Nuc. Soc. **95**, 736 (2006).

CLAIMS OF UNSUCCESSFUL SONOFUSION EXPERIMENTS (culled from the literature)

- "Nuclear Fusion in Collapsing Bubbles – Is It There? An Attempt to Repeat the Observation of Nuclear Emissions from Sonoluminescence" by D. Shapira and M. Saltmarsh, Phys. Rev. Lett. **89**, 104302 (2002).

- Experimental Results for the RPI Bubble Fusion Project by F. J. Saglime III, MSc thesis, Rensselaer Polytechnic Institute, July 2004.

- "Search for neutron emission in laser-induced cavitation" by R. Geisler, W.D. Schmidt-Ott, T. Kurz and W. Lauterborn, Europhys. Lett. **66**, 435-440 (2004)

- "Search of fusion reactions during the cavitation of a single bubble in deuterated liquids" by M. Barbaglia, P. Florido, R. Mayer, and F. Bonetto, Physica Scripta, **72**, 75-78 (2005).

- "Tritium Measurements in Neutron Induced Cavitation of Deuterated Acetone" by L. Tsoukalas, F. Clikeman, M. Bertodano, T. Jevremovic, J. Walter, A. Bougaev and E. Merritt, Nuc. Technol. **155**, 248-251 (2006).

- "Upper Bound for Neutron Emission from Sonoluminescing Bubbles in Deuterated Acetone" by C. G. Camara, S. D. Hopkins, K. S. Suslick, and S. J. Putterman, Phys. Rev. Lett. **98**, 064301 (2007).

APPENDIX L – Authorship Standards

The IqC strongly asserts that proper attribution of credit is the responsibility of authors and is critical to the foundation of science which depends, in part, on the ability of institutions, policy makers, and the public to identify who is responsible for published work and its interpretation.[145] The IqC also understands that, except for copyright law and federal definitions of research misconduct, most aspects of authorship are covered by time-honored traditions as well as ethical principles and guidelines published by journals and professional societies.

Methods for assigning authorship vary, and it is possible to find many authoritative discussions of this issue. While it is generally agreed that authorship should be based on a substantial contribution, reasonable people can differ considerably over the definition of "authorship" and "substantial." In spite of this disclaimer, most professional societies adopt a "high road" approach by encouraging an **accurate identification** of those truly involved with the work rather than those merely funding or contributing to the work. While the implementation may prove difficult, the intent in all cases seems clear.

It is perhaps worthwhile to review a few of the declarations regarding this important topic.

One well-stated definition of authorship was formulated by the International Committee of Medical Journal Editors.[146] This definition states that someone is an author if and only if they have done all of the following:

- Made substantial contributions to the conception and design, or acquisition of data, or analysis and interpretation of data;
- Drafted the article or revised it critically for important intellectual content;
- Approved the final version of the manuscript to be published

Since some of the publications in question appear in journals published by the American Physical Society, it is worthwhile to consult the guidelines of the American Physical Society[147] which state:

> Authorship should be limited to those who have made a significant contribution to the concept, design, execution or interpretation of the research study. All those who have made significant contributions should be offered the opportunity to

[145] See for example, http://www.uaf.edu/ori/RCR_Course/assignments/authorship.html
[146] See for example, International Committee of Medical Journal Editors: Uniform Requirements for Manuscripts Submitted to Biomedical Journals, JAMA3/4277, 927-34 (1997). **See also** http://www.icmje.org

> be listed as authors. Other individuals who have contributed to the study should be acknowledged, but not identified as authors. The sources of financial support for the project should be disclosed.

Lastly, since the journal *Nuclear Engineering and Design* published by Elsevier was used as a venue for publication on sonofusion, the web site for this journal was also consulted for authorship standards. On the Elsevier web site a document entitled "Ethical Guidelines for Journal Publication," under the heading "Authorship of the Paper," states as follows:[148]

> Authorship should be limited to those who have made a significant contribution to the conception, design, execution, or interpretation of the reported study. All those who have made significant contributions should be listed as co-authors. Where there are others who have participated in certain substantive aspects of the research project, they should be acknowledged or listed as contributors.

[147] See, for example, "02.2 APS Guidelines for Professional Conduct" at http://www.aps.org/policy/statements/02_2.cfm

[148] see http://www.elsevier.com/wps/find/intro.cws_home/ethical_guidelines