Discrepancies in the UCLA-UIUC Failed Replication Attempt [1] of the Oak Ridge National Laboratory "Sonofusion" Experiment [2]

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Outline of the Discrepancies with the Experiment and Results

1. UCLA-UIUC Claims
2. Configuration Discrepancies
3. Process Discrepancies
4. Results Discrepancies
5. UCLA-UIUC Interpretation Discrepancies

UCLA-UIUC Claims – Seth Putterman Statements

1. "**identical** parts" [3]
   UCLA did not use parts that were identical.

2. "observed **no nuclear fusion**" [3]
   UCLA misstated. Cannot observe fusion. Can only observe products: tritium and neutrons.

3. "**found** alternate explanation ... **not…nuclear fusion**." [3]
   UCLA did not find an explanation. UCLA speculated, made a guess. ORNL group proved the UCLA guess wrong. [4]

UCLA-UIUC Claims – Kenneth Suslick Statement

1. “an exact duplicate of Taleyarkhan’s reactor was built.” [3]

UCLA-UIUC Reference to Shapira/Saltmarsh Report

1.“Shapira and Saltmarsh, Tsoukalas et al.* and Saglime have also reported null results.”[1]

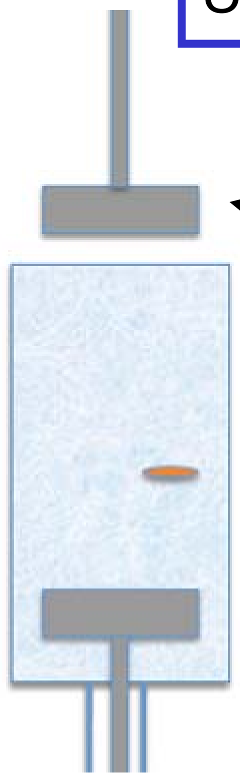
- Internal, unpublished ORNL documents show that Shapira confirmed excess neutrons when he independently measured data during one of the Taleyarkhan group’s experiment.
- ORNL documents show that Shapira knew that positive results of tritium were measured.
- Tsoukalas et al. performed an independent replication. They, too, measured positive results of tritium.

*** Putterman and Suslick had cited Tsoukalas et al., but that paper had not yet published.**

Configuration Discrepancies – Top Reflector (1)

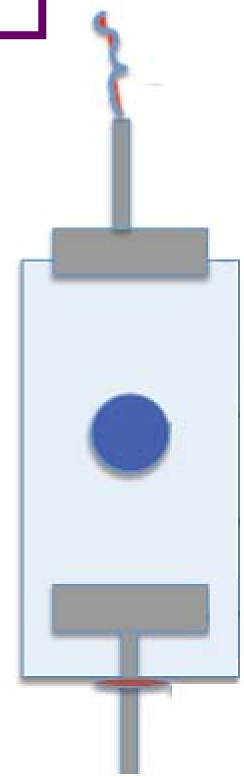
UCLA-UIUC Cell [1]

ORNL Cell



Fixed

Free



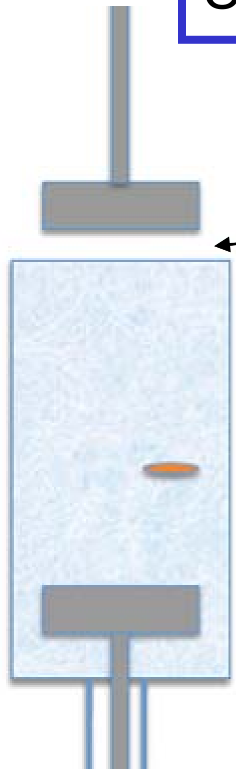
The top reflector must be able to move and be in contact with the liquid-acetone surface. Tests by ORNL showed that a fixed-location reflector does not allow the successful implosion of bubbles.

(See Appendix A)

Configuration Discrepancies – Top Reflector (2)

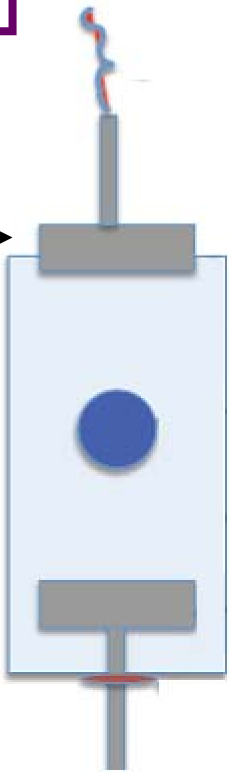
UCLA-UIUC Cell [1]

ORNL Cell



Reflector surface is above and out of liquid

Reflector surface is in liquid

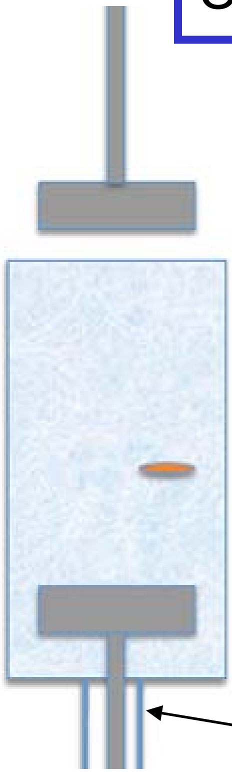


Required to attain standing acoustic wave intensification.

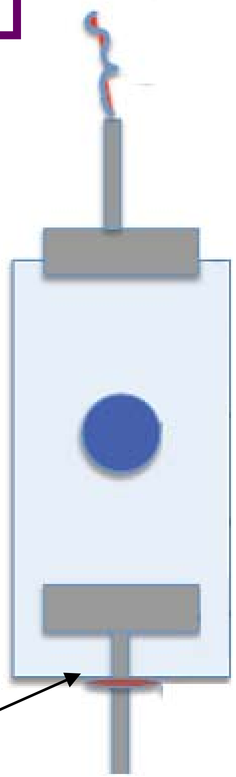
Configuration Discrepancies – Bottom Reflector

UCLA-UIUC Cell [1]

ORNL Cell



Affects energy concentration behavior of resonant acoustic system.



Slides through outer tube

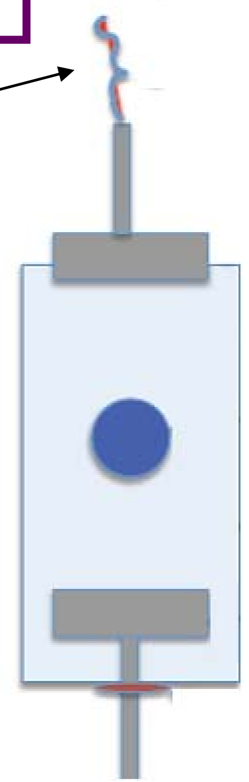
Stem sealed into chamber with a rubber-like compound

Configuration Discrepancies – Reflector Wire

UCLA-UIUC Cell [1]

ORNL Cell

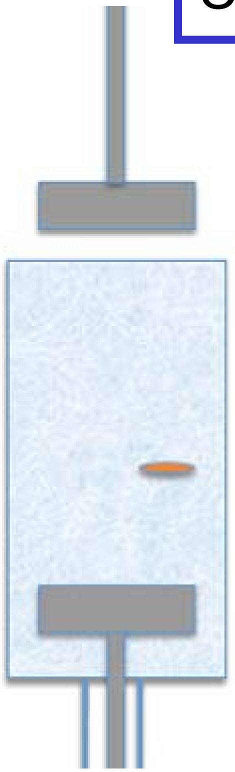
Wire in stem



Permits reflector freedom of motion to self-adjust to properly amplify acoustic wave energy.

Process Discrepancies - Gas

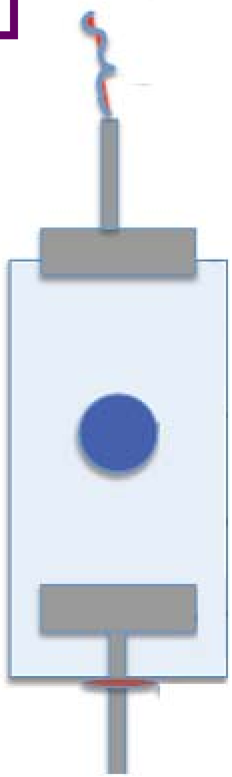
UCLA-UIUC Cell [1]



Removed gas, then re-added

ORNL Cell

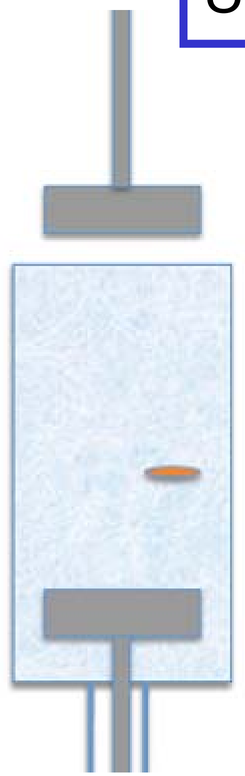
Removed gas



Adding gas to the experiment will enhance SL light flash. But gas will impede supercompression and therefore kill any possibility of a positive MBSL result.

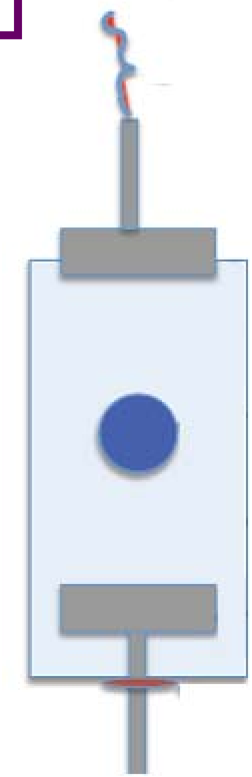
Process Discrepancies - Tritium

UCLA-UIUC Cell [1]



No evidence of search for tritium

ORNL Cell

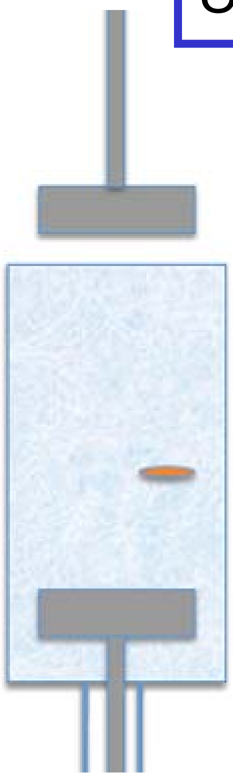


Searched for and found tritium

Tritium production is one of the two signals of fusion.

Results Discrepancies – Bubble Cluster Shape

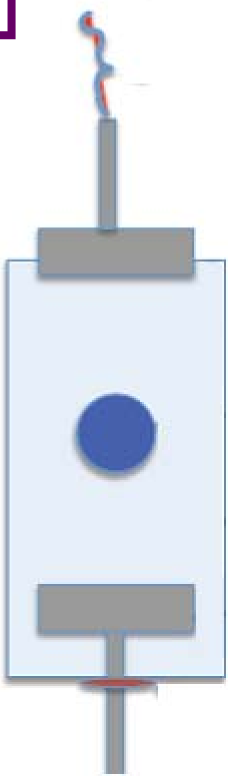
UCLA-UIUC Cell [1]



Elongated [5]

Elongated bubble cluster. Also known as streamer or comet.

ORNL Cell



Spherical [6]

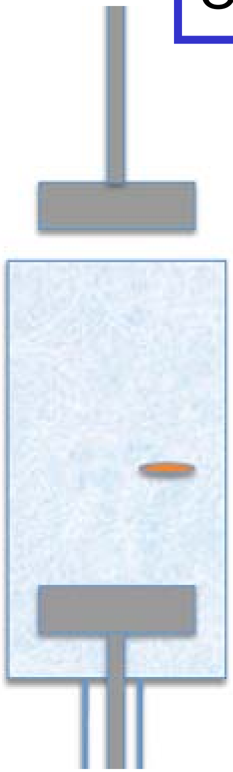
Round bubble cluster.

Nobody has ever seen evidence of fusion when the bubble clusters are elongated.[7]

Results Discrepancies – Bubble Cluster Rate

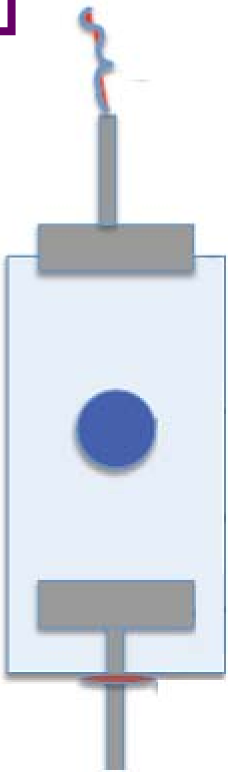
UCLA-UIUC Cell [1]

ORNL Cell



0.1 / second

30 / second

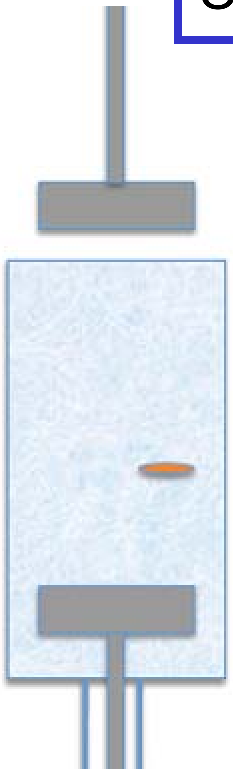


Rate Difference: 1:300

Results Discrepancies – Bubble Cluster Duration

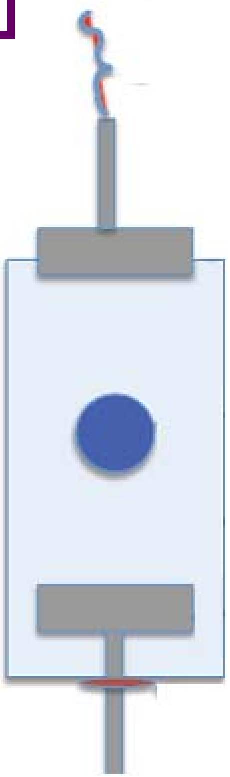
UCLA-UIUC Cell [1]

ORNL Cell



5 Seconds

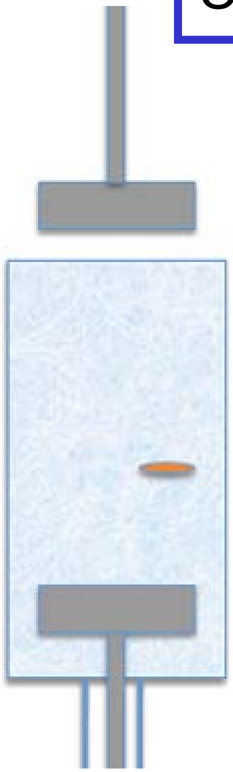
0.005 Seconds



Duration Difference: 1,000:1

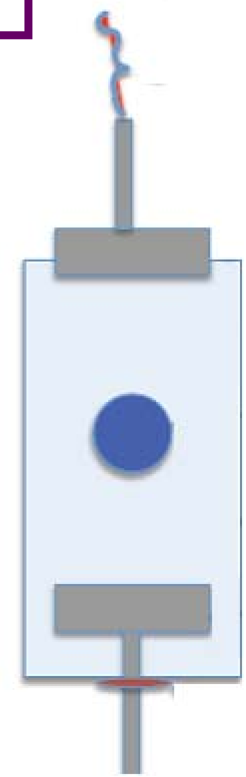
Results Discrepancies – Bubble Size

UCLA-UIUC Cell [1]



10-50 Micron

ORNL Cell



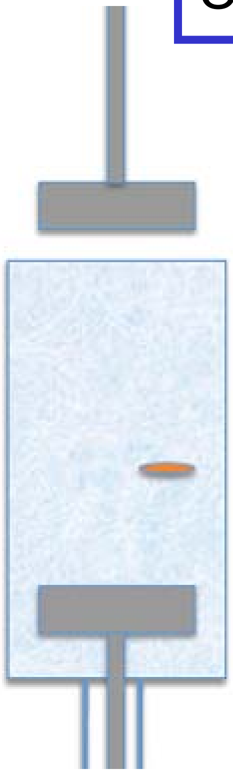
5,000 Micron

Volume Difference: 1:100 Million

Large volume required to provide stored energy for use during supercompression implosion.

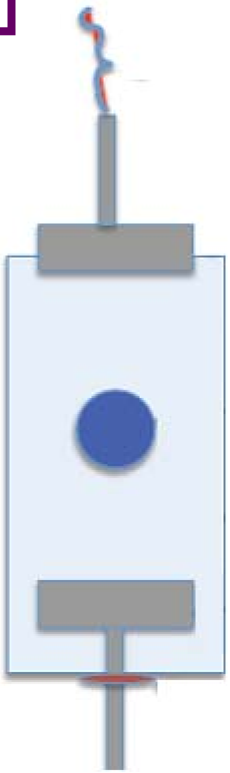
Results Discrepancies – Bubble Quantity

UCLA-UIUC Cell [1]



100,000s in Cluster

ORNL Cell



100s in Cluster

Quantity Difference: 1,000:1

Textbook Definition of Detection of D-D Fusion

The D-D fusion reaction can have one of two outcomes that occur with almost equal probability:

1. Production of Helium-3 and **2.45-MeV neutrons**

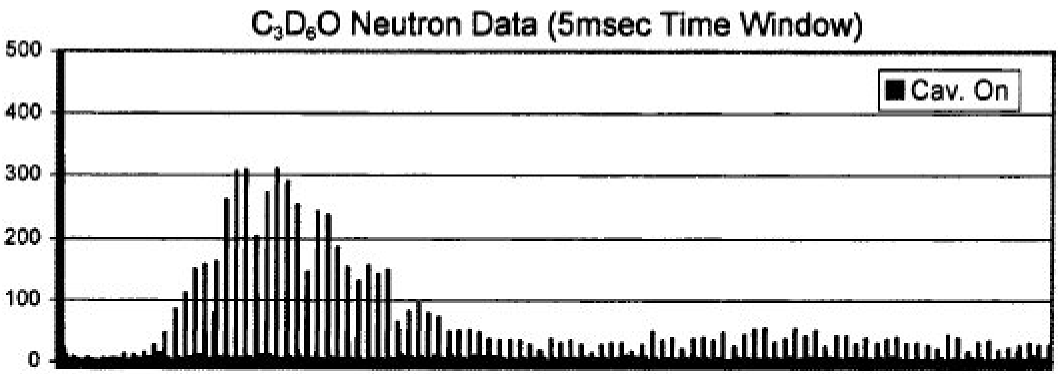
2. Production of **Tritium** and protons.

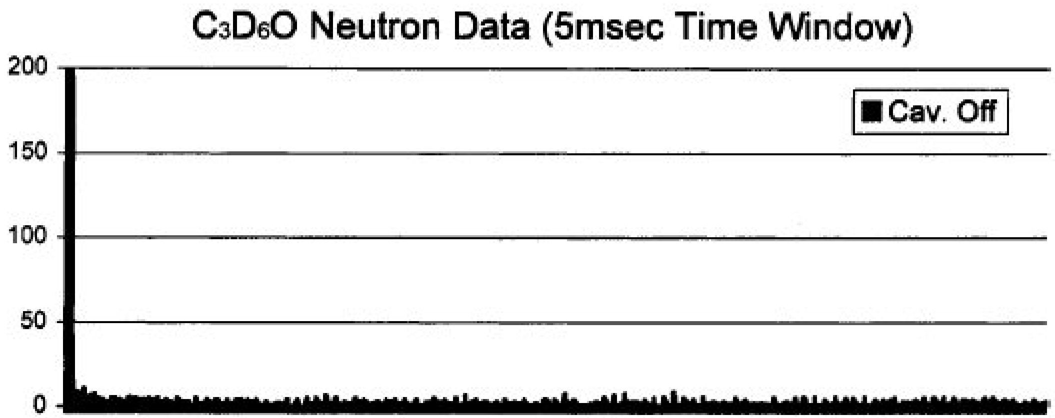
Interpretation Discrepancies - UCLA/UIUC *Ad Hoc* Criterion for Fusion

Neutron and Sonoluminescence Flashes Timed
Within a 1 μs-10 ns window
=
Confirmation of Fusion [1]

UCLA-UIUC's irrelevant *ad hoc* criterion of timing coincidences in multi-bubble sonoluminescence (MBSL) virtually guaranteed that, even if UCLA-UIUC researchers (experts in *single-bubble* sonoluminescence), found evidence of neutrons or tritium, they could still assert that the Taleyarkhan group's result was negative.
(See Appendix C)

Meaningful Analysis – Positive Neutron Signal





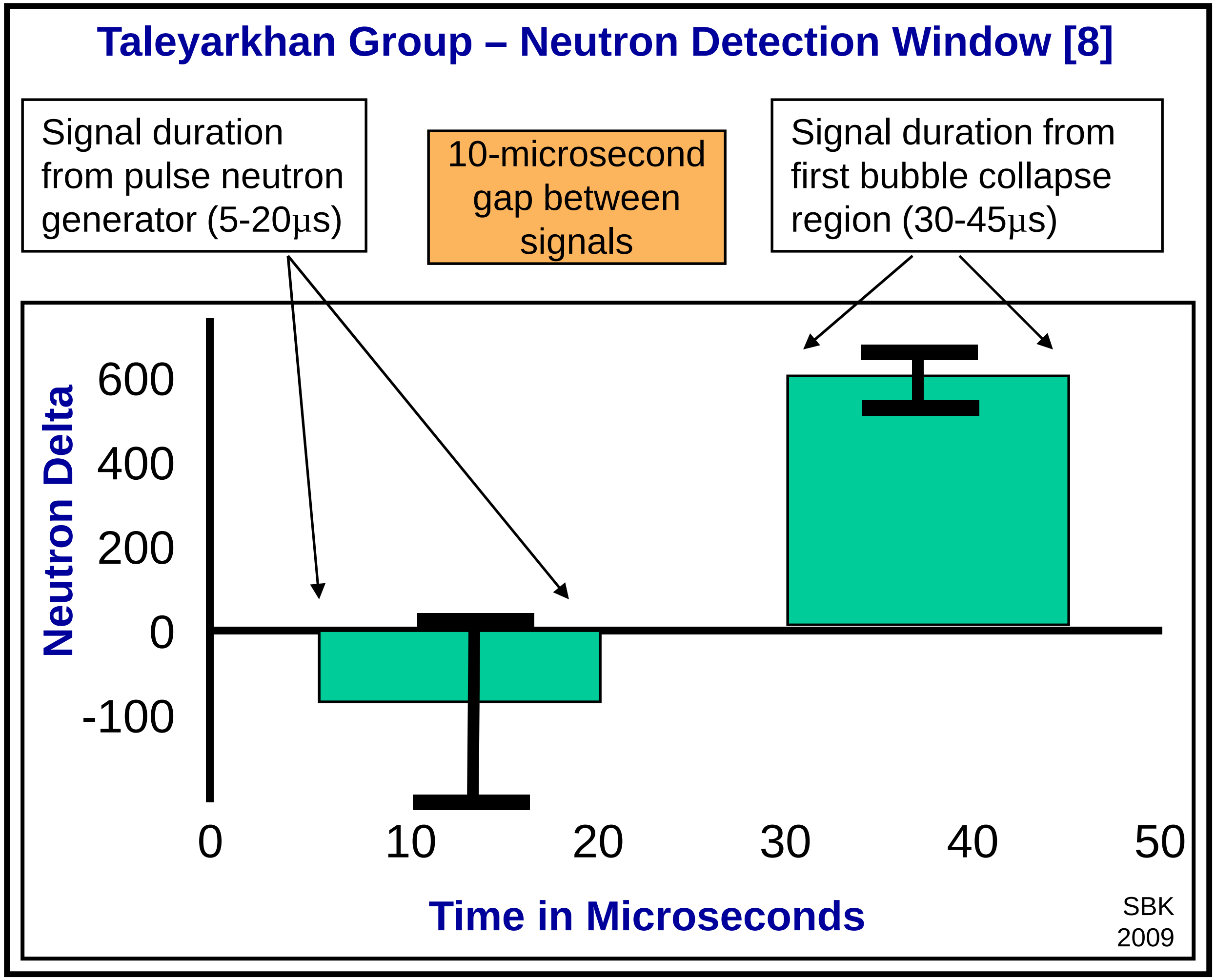
Acoustic Cavitation On [8]

Neutron pulses from generator are the same in both. The only v*ariable is cavitation.*

Acoustic Cavitation Off [8]

That's a statistical significance of 20-30+ standard deviation; it translates to 99.9999999999999999999% confidence.

Meaningful Analysis – Clear Separation Between Pulse Neutron Generator and "Sonofusion" Neutrons



Summary of UCLA/UIUC Report to Federal Government

1. UCLA/UIUC said that they had performed a mirror *experiment,* and they implied that they had mirrored the ORNL *process*. Yet they failed to mirror ***critical aspects*** of the ORNL configuration, process and results.
2. UCLA/UIUC invented their own criterion (timing coincidences) for confirmation of fusion. Timing coincidences are the weakest possible confirmatory measurement for fusion.
3. UCLA/UIUC failed to seek the strongest possible data measurement (tritium) as confirmation of fusion.
4. UCLA/UIUC told the government that timing coincidences were the most important criterion to confirm fusion.

Appendix A
Taleyarkhan Explains Importance of Acoustic Cell Design

Think of how a ball thrown against a wall would bounce back after hitting a hard wall versus how the ball would behave if, instead, it hit an elastic, energy-absorbing net. The ball would have a radically different force profile in each case. By not using a hard-wall reflector at the liquid surface, the bounced-back wave, if any, would have significantly less force intensity for aiding in the required compression of imploding bubbles.

Appendix B
Putterman and Suslick Explain Their *Ad Hoc* Criterion for Fusion

The search for fusion from collapsing bubbles is facilitated by gating on individual flashes of light.

In none of the cases in which 2 PMTs recorded an SL event was that event coincident with a neutron within a 1 μs window. There is only one event in which a neutron was coincident with the response of a single SL PMT within the ~10 ns window that would characterize a bubble fusion event.

We propose that claims of new routes to fusion should be backed up with coincidence data of the type presented in this figure.[1]

Appendix C
Colin West Explains Why Putterman and Suslick's Invented Criterion for MBSL Is Irrelevant

I don't know how to put it more politely, but the demand for timing coincidence is bullshit, for two reasons. The first reason is that you can't be sure that you will detect every sonoluminescence flash. As we wrote in our earlier papers, we believe there is not a single bubble but a cloud of bubbles. There is absolutely no possible way of knowing whether the same bubble that generated the measured neutron was the one that generated the observed flash.

Now, it is worth attempting, and we did try to observe such coincidences, but in their absence, there're many other data - for example, the energies of the neutrons, the control experiments, and the self-nucleated experiments - that are much better for confirming that the measured neutrons are from the experiment and not from the neutron pulse generator.

References

1. Camara, C.G., Hopkins, S.D., Suslick, K.S. and Putterman, S.J., "Upper Bound for Neutron Emission from Sonoluminescing Bubbles in Deuterated Acetone," *Physical Review Letters*, **98**, p. 064301 (2007)

2. Taleyarkhan, R.P., West, C.D., Cho, J.S., Lahey, Jr., R.T., Nigmatulin, R.I., Block, R.C., "Evidence for Nuclear Emissions During Acoustic Cavitation," Supplement #1, Supplement #2, *Science* **295**, p. 1868 (March 8, 2002)

3. Final Report of UCLA/UIUC/Purdue/DARPA/ONR Project to Reproduce Nuclear Fusion in Collapsing Bubbles Surrounded by D-Acetone

4. Taleyarkhan, R.P., Block, R.C., Lahey, Jr., R.T., Nigmatulin, R.I., and Xu, Y., Reply to [Naranjo] 'Comment on 'Nuclear Emissions During Self-Nucleated Acoustic Cavitation," *Physical Review Letters*, **97**, p. 149404, (Oct. 6, 2006)

5. "UCLA-UIUC Faulty Nuclear Cavitation Replication" http://www.youtube.com/watch?v=h20_dL19k7U

6. "Sound of Neutrons: What a Working Nuclear Cavitation Reaction Experiment Looks Like" http://www.youtube.com/watch?v=rypgH41yqeQ

7. Xu, Y., and Butt, A., "Confirmatory Experiments for Nuclear Emissions During Acoustic Cavitation," *Nuclear Engineering and Design*, **235**, p. 1317

8. Taleyarkhan, R.P., Cho, J.S., West, C.D., Lahey, Jr., R.T., Nigmatulin, R.I., Block, R.C., "Additional Evidence of Nuclear Emissions During Acoustic Cavitation," *Physical Review E*, **69**, p. 36109-1, (March 22, 2004) (Erratum)