From
P Dunn
12-12-2004
(picked up by Pervin)

Re: November 19, 2007 letter
4. Reference 30 on page 17

Points of interest

1) Although a department head ordinarily is not involved in approval of news releases, we consulted extensively with Lefteri Tsoukalas during preparation of this release. This was because he was supervising, or sponsoring, the two listed authors of this paper, Yiban Xu and Adam Butt. In fact, Lefteri enthusiastically approved this news release in an email message the night before it was issued, and that email message is included here.
2) Although Rusi Taleyarkhan was not one of the listed authors, we did interview Rusi and Yiban because Yiban's English language skills were such that it was difficult to communicate effectively with him, especially in such matters as complex physics and the details of the research findings.
3) We include here a transcript of my interview with Rusi and Yiban.

Emil Venere, Purdue University News Service

Begin forwarded message:

From: Rusi Taleyarkhan <rusi@ecn.purdue.edu>
Date: Thu Jul 7, 2005 7:23:55 PM America/Indianapolis
To: Emil Venere <venere@purdue.edu>
Cc: Lefteri Tsoukalas <tsoukala@ecn.purdue.edu>, rusi@purdue.edu
Subject: Re: Press Announcement / Sonofusion Confirmation Report

Dear Emil:

A seminal development has come to our attention that is need of a press release. Purdue researchers from the School of Nucl.Engr. have successfully published results of their experiments to confirm the essential sonofusion results published by the team I led while at ORNL. While assistance was provided by ORNL/DOE for design details of test reactor cells under NDA, the independent experiments were conducted and data successfully obtained by Purdue researchers Xu, Butt from Schools of Nuclear, Aeronautical and Astro Engr. The overall Purdue initiative was initiated by Dr. Tsoukalas about 2y ago well before I joined Purdue and gained momentum early last year when a PhD graduate became available and was commissioned to undertake this work on a full-time basis for several months during an interim period.

Their work was submitted by them to the peer reviewed Elsevier Journal - Nuclear Engineering and Design which is a flagship journal for the nuclear engineering discipline; it successfully passed peer review and is appearing in print this week. A separate paper has also been accepted by that group consisting of Xu, Butt and Revankar for the forthcoming Intl. Nuclear Reactor Thermal-Hydraulics (NURETH-11) conference in Avignon, France.

Dr. Tsoukalas (Lefteri) and I have discussed these developments and feel that a Press Release from Purdue is in order before things get out of hand since reporters are getting wind of this development. Unlike for Science or Nature, engineering journals do not make Press releases - at least Elsevier's NED does not. We've prepared a brief description/checklist of questions and associated clarifications (see attached) mentioning key aspects of this seminal development that needs to be publicized rapidly.

Thx for your help.

Rusi Taleyarkhan

--

Dr. Rusi P. Taleyarkhan
Arden L. Bement,Jr. Professor of Nuclear Engineering
School of Nuclear Engineering
400 Central Drive
Purdue University
W. Lafayette, IN 47907-2017, USA
Tel: 765-494-0198(off); 765-420-7537(lab.)
Fax: 765-494-9570 (off); 765-420-7539(lab.)

Begin forwarded message:

From: Rusi Taleyarkhan <rusi@ecn.purdue.edu>
Date: Fri Jul 8, 2005 12:40:42 PM America/Indianapolis
To: Emil Venere <venere@purdue.edu>
Subject: Re: Press Announcement / Sonofusion Confirmation Report

Emil: You must (as I trust you do) realize this development will have impact on my ongoing programmatic research work, future funding that we're negotiating,etc. on sonofusion that I'm heading for Purdue. I will trust that you and Purdue's press office under Jeanne Norberg will do your best, act promptly and remain sensitive towards serving needs of Purdue's faculty and it's engineering research enterprise. I have left a message for you to call me to discuss this matter which Martin Jischke has also had discussions with me on. Pl. do so at your earliest convenience. Thx, Rusi

Rusi:

Great !

Boy, I sure wish people had told me about this sooner !!!!!!

Now we are going to have to rush the news release, and it won't be very good.

Regards,

Emil (4-4709)

On Thursday, July 7, 2005, at 07:23 PM, Rusi Taleyarkhan wrote:

Dear Emil:

A seminal development has come to our attention that is need of a press release. Purdue researchers from the School of Nucl.Engr. have successfully published results of their experiments to confirm the essential sonofusion results published by the team I led while at ORNL. While assistance was provided by ORNL/DOE for design details of test

corrections
from
R. Taleyarkhan

Begin forwarded message:

From: Rusi Taleyarkhan <rusi@ecn.purdue.edu>
Date: Mon Jul 11, 2005 5:14:02 PM America/Indianapolis
To: Emil Venere <venere@purdue.edu>
Cc: tsoukala@purdue.edu
Subject: Message from Lefteri +Re: revised paragraph!

Emil:

1) Lefteri just called me to say he is quite occupied with personal issues but wanted to communicate that it is OK with him if you wrote that Yiban Xu and Adam Butt conducted their seminal confirmation-experimental work under direct sponsorship and oversight from Lefteri Tsoukalas (Head of School of Nuclear Engineering).

2) I must applaud your efforts at accuracy of depiction. Only a small change is needed for your paragraph. Your latest version looks great (as an aside, fusion reactions produce about 20 MeV of energy per fusion reaction versus 200 MeV from a single U-235 fission reaction. However, deuterium is more than a hundred times lighter due to which on a unit "mass" basis, fusion fuel gives off 10 times more energy than fission fuel). Also, it is more appropriate to say energy than electricity (since the path one chooses for conversion from heat to electricity could be different). The revised version is given below:

*Whereas conventional nuclear fission reactors make waste products that take thousands of years to decay, the waste products from fusion plants are short-lived, decaying to non-dangerous levels in a decade or two. For the same unit mass of fuel, a fusion power plant would produce 10 times more energy than a fission reactor, and because deuterium is contained in seawater, a fusion reactor's fuel supply would be virtually infinite. A cubic kilometer of seawater would contain enough heavy hydrogen to provide a thousand years' worth of power for the United States.

Cheers,
Rusi
*

Begin forwarded message:

From: Rusi Taleyarkhan <rusi@ecn.purdue.edu>
Date: Mon Jul 11, 2005 2:59:37 PM America/Indianapolis
To: Emil Venere <venere@purdue.edu>
Cc: tsoukala@ecn.purdue.edu, nehead@ecn.purdue.edu
Subject: Re: second draft, quick question

Emil:

Responses follow in the text of your message. Thx, Rusi

Emil Venere wrote:

*
_Rusi:

Thanks for your edits! I appreciate all of your time and effort!

I made them all but some of the wording didn't work because of style or other reasons.

For example, the official name for AAE is the School of Aeronautics and Astronautics, so I couldn't get "engineering" in the name. Also, if we said "schools of Nuclear Engineering and Aeronautics and Astronautics" the word schools has to be lower case because of style reasons.

There were also a few minor style things.

Also, just a few questions:

1) My editor asks, were Yiban and Adam working under the supervision of anyone? If so, can we say that?
*

Yiban was a PhD holding scientist when this work was entrusted to him. A PhD from Purdue's School of Nuclear Engr. is someone who has proven himself/herself able to conduct independent research. Yiban and Adam received sponsorship from the School of Nuclear Engineering via Tsoukalas (to conduct and complete on full-time basis the confirmation-based initiative Tsoukalas had started). Adam Butt worked together and alongside Yiban during this activity.

*

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Therefore, I want to add that Yiban and Adam worked under the supervision of Lefteri. Is that correct????? No. Accurate to say "worked under the sponsorship of Lefteri Tsoukalas, head of ..."

*

*

Here is the sentence: *The two researchers used an identical "carbon copy" of the original test chamber designed by Taleyarkhan and his team* and worked under the supervision of Lefteri Tsoukalas, head of the School of Nuclear Engineering.

2) Lefteri, can I use you as a source in this news release?

3) Adam, also, can I list you as a source for journalists? If so, could you please email me your contact information (or I can easily get it from you this afternoon because I will be with the photographer.

*

emil: Adam should be able to respond to journalists. contact: butt@purdue.edu; phone: 317-514-8585

*4) Is the following segment correct? I just want to make sure:

*Whereas conventional nuclear fission reactors produce waste products that take thousands of years to decay, the waste products from fusion plants are short-lived, decaying to non-dangerous levels in a decade or two. Fission reactors produce heat by splitting atoms, and the heat is then used to turn water into steam to drive electric generators. A fusion power plant, on the other hand, would be far more efficient than a fission plant and could produce energy directly without needing steam-driven electrical generators.*

_*

The last sentence is incorrect. A fusion power plant would ultimately need to have the heat convected away somehow to produce steam (most likely) in a secondary heat exchanger the same as a PWR. It would be best to merely state that fusion power plants would produce energy from fuel that has a million times greater energy density, and that, the fuel itself is virtually infinite.

*

_Thanks again!

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Emil (4-4709)

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NEWS RELEASE_*_

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July 2005
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Note to Journalists: HAVE TO TAKE PHOTOS AND VIDEOS ON MONDAY IF AT
ALL POSSIBLE. SHORT NOTICE ON THIS ONE!.
**Purdue findings support earlier nuclear fusion experiments
*WEST LAFAYETTE, Ind. — WEST LAFAYETTE, Ind. — Researchers at Purdue
University have new evidence supporting earlier findings by other scientists who designed an inexpensive "tabletop" device that uses sound waves to produce nuclear fusion reactions.
The technology might one day, in theory, lead to a new source of clean energy and a host of portable detectors and other applications.
The new findings are detailed in a peer-reviewed paper appearing in the current issue of the journal Nuclear Engineering and Design. The paper was written by Yiban Xu, a post-doctoral research associate in the School of Nuclear Engineering, and Adam Butt, a graduate research assistant in both nuclear engineering and the School of Aeronautics and Astronautics.
A key component of the experiment was a glass test chamber about the size of two coffee mugs filled with a liquid called deuterated acetone, which contains a form of hydrogen known as deuterium, or heavy hydrogen. The researchers exposed the test chamber to subatomic particles called neutrons and then bombarded the liquid with a specific frequency of ultrasound, which caused cavities to form into tiny bubbles. The bubbles then expanded to a much larger size before imploding, apparently with enough force to cause thermonuclear fusion reactions.
Fusion reactions emit neutrons that fall within a specific energy range of 2.5 mega-electron volts, which was the level of energy seen in neutrons produced in the experiment. The experiments also yielded a radioactive material called tritium, which is another product of fusion, Xu and Butt said.
"The two key signatures for a fusion reaction are emission of neutrons in the range of 2.5 MeV and production of tritium, both of which were seen in these experiments," Xu said.

The same results were not seen when the researchers ran control experiments with normal acetone, providing statistically significant evidence for the existence of fusion reactions.

"The control experiments didn't show anything," Xu said. "We changed just one parameter, substituting the deuterated acetone with normal acetone."

Deuterium contains one proton and one neutron in its nucleus. Normal hydrogen contains only one proton in its nucleus.

The Purdue research began two years ago, and the findings represent the first independent confirmation of findings reported earlier by Rusi Taleyarkhan, who discovered the fusion-related acoustic-cavitation phenomenon while he was a scientist working at the Oak Ridge National Laboratory. Taleyarkhan led a research team that first reported the phenomenon in a 2002 paper published in the journal Science. Those researchers later conducted additional research at Oak Ridge National Laboratory, Rensselaer Polytechnic Institute and Russian Academy of Sciences and wrote a follow-up paper that appeared in the journal Physical Review E in 2004, just after Taleyarkhan had come to Purdue as the Arden L. Bement Jr. Professor of Nuclear Engineering.

Scientists have long known that high-frequency sound waves cause the formation of cavities and bubbles in liquid, a process known as "acoustic cavitation," and that those cavities then implode, producing high temperatures and light in a phenomenon called "sonoluminiscence." In the Purdue research, however, the liquid was "seeded" with neutrons before it was bombarded with sound waves. Some of the bubbles created in the process were perfectly spherical, and they imploded with greater force than irregular bubbles. The research yielded evidence that only spherical bubbles implode with a force great enough to cause deuterium atoms to fuse together, similar to the way in which hydrogen atoms fuse in stars to create the thermonuclear furnaces that make stars shine.

Nuclear fusion reactors have historically required large, expensive machines, but acoustic cavitation devices might be built for a fraction of the cost. Researchers have estimated that temperatures inside the imploding bubbles reach 10 million degrees Celsius and pressures comparable to 1,000 million earth atmospheres at sea level.

Xu and Butt now work in Taleyarkhan's lab, but all of the research on which the new paper is based was conducted before they joined the lab, and the research began at Purdue before Taleyarkhan had become a Purdue faculty member. The two researchers used an identical "carbon copy" of the original test chamber designed by Taleyarkhan and his team and worked under the supervision of Lefteri Tsoukalas, head of the School of Nuclear Engineering.

Athough the test chamber was identical to Taleyarkhan's original experiment, and the Purdue researchers were careful to use deuterated acetone, they derived the neutrons from a less-expensive source than the Oak Ridge researchers. The scientists working at Oak Ridge seeded the cavities with a "pulse neutron generator," an apparatus that emits rapid pulses of neutrons. Xu and Butt derived neutrons from a radioactive material that constantly emits neutrons, and they simply exposed the test chamber to the material.

Development of a low-cost thermonuclear fusion generator would offer the potential for a new, relatively safe and low-polluting energy source. Whereas conventional nuclear fission reactors produce waste products that take thousands of years to decay, the waste products from fusion plants are short-lived, decaying to non-dangerous levels in a decade or two. Fission reactors produce heat by splitting atoms, and the heat is then used to turn water into steam to drive electric generators. A fusion power plant, on the other hand, would be far more efficient than a fission plant and could produce energy directly without needing steam-driven electrical generators. Such a technology also could result in a new class of low-cost, compact detectors for security applications that use neutrons to probe the contents of suitcases; devices for research that use neutrons to analyze the molecular structures of materials; machines that cheaply manufacture new synthetic materials and efficiently produce tritium, which is used for numerous applications ranging from medical imaging to watch dials; and a new technique to study various phenomena in cosmology, including the workings of neutron stars and black holes.

The desktop experiment is safe because, although the reactions generate extremely high pressures and temperatures, those extreme conditions exist only in small regions of the liquid in the container — within the collapsing bubbles, Xu said.

Purdue researchers plan to release additional data from related experiments during an international conference in France in October.

The 2004 paper was written by Taleyarkhan while a distinguished scientist at Oak Ridge National Laboratory, postdoctoral fellow J.S Cho at Oak Ridge Associated Universities; Colin West, a retired scientist from Oak Ridge; Richard T. Lahey Jr., the Edward E. Hood Professor of Engineering at Rensselaer Polytechnic Institute (RPI); R.C. Nigmatulin, a visiting scholar at RPI and president of the Russian Academy of Sciences' Bashkortonstan branch; and Robert C. Block, active professor emeritus in the School of Engineering at RPI and director of RPI's Gaerttner Linear Accelerator Laboratory.

esv/Xu.fusion

Writer: Emil Venere, (765) 494-4709, venere@purdue.edu
Sources: Yiban Xu, (765) 418-0755, yiban@purdue.edu
Rusi Taleyarkhan, (765) 494-0198, Lab: 420-7537, rusi@ecn.purdue.edu
Lefteri Tsoukalas, (765) 494-5742, Fax: (765) 494-9570,
tsoukala@ecn.purdue.edu

*Related Web sites:
*Purdue University Home Page: http://www.purdue.edu

PHOTO CAPTION:
*NEED TO TAKE PHOTOS AND VIDEO ON MONDAY!!!!)
* (Purdue News Service photo/David Umberger)
/A publication-quality photo is available at
ftp://ftp.purdue.edu/pub/uns/cook.groundbreak.jpeg.
/*
*
*ABSTRACT
Confirmatory experiments for nuclear emissions during acoustic cavitation
/Yiban Xua,, Adam Butta,b
A School of Nuclear Engineering
b School of Aeronautics and Astronautics
Purdue University
/

Confirmatory experiments were conducted to assess the potential for nuclear fusion related emissions of neutrons and tritium during neutron-seeded acoustic cavitation of deuterated acetone. Corresponding control experiments were conducted with normal acetone. Statistically significant (5-11 S.D. increased) emissions of 2.45 MeV neutrons and tritium were measured during cavitation experiments with chilled deuterated acetone. Control experiments with normal acetone and irradiation alone did not result in tritium activity or neutron emissions. Insights from imaging studies of bubble clusters and shock trace signals relating to bubble nuclear fusion are discussed.
*
*

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Dr. Rusi P. Taleyarkhan
Arden L. Bement,Jr. Professor of Nuclear Engineering
School of Nuclear Engineering

400 Central Drive
Purdue University
W. Lafayette, IN 47907-2017, USA
Tel: 765-494-0198(off); 765-420-7537(lab.)
Fax: 765-494-9570 (off); 765-420-7539(lab.)

Begin forwarded message:

From: Lefteri Tsoukalas <tsoukala@ecn.purdue.edu>
Date: Mon Jul 11, 2005 8:50:28 PM America/Indianapolis
To: Emil Venere <venere@purdue.edu>
Cc: Rusi Taleyarkhan <rusi@ecn.purdue.edu>, tsoukala@purdue.edu
Subject: Re: Thanks for the information !

Dear Emil,
Thanks. This is a great story and you did a great job.
Cheers.
Lefteri

Emil Venere wrote:

Rusi:

Thanks for clarifying this!

Emil (4-4709)

Emil:

1) Lefteri just called me to say he is quite occupied with personal issues but wanted to communicate that it is OK with him if you wrote that Yiban Xu and Adam Butt conducted their seminal confirmation-experimental work under direct sponsorship and oversight from Lefteri Tsoukalas (Head of School of Nuclear Engineering).

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Cheers,
Rusi

--
****
Lefteri H. Tsoukalas, PhD
Professor and Head
Purdue University
School of Nuclear Engineering
400 Central Drive
West Lafayette, IN 47907-2017
Tel: (765) 494-5742, Fax: (765) 494-9570
Email: nehead@ecn.purdue.edu, tsoukala@ecn.purdue.edu
URL: https://Engineering.Purdue.edu/NE/
****

PURDUE
UNIVERSITY

NEWS RELEASE

Final version

PURDUE NEWS SERVICE
http://news.uns.purdue.edu

July 12, 2005

Note to Journalists: A publication-quality photograph of Yiban Xu and Adam Butt in their lab at Purdue University can be downloaded at http://news.uns.purdue.edu/images/+2005/xu-taleyarkhan-fusion.jpg. An electronic copy of the research paper is available from Emil Venere, (765) 494-4709, venere@purdue.edu. Video b-roll also is available by contacting Jesica Webb at (765) 494-2079, jwebb@purdue.edu.

Purdue findings support earlier nuclear fusion experiments

WEST LAFAYETTE, Ind. — Researchers at Purdue University have new evidence supporting earlier findings by other scientists who designed an inexpensive "tabletop" device that uses sound waves to produce nuclear fusion reactions.

The technology, in theory, could lead to a new source of clean energy and a host of portable detectors and other applications.

The new findings were detailed in a peer-reviewed paper appearing in the May issue of the journal *Nuclear Engineering and Design.* The paper was written by Yiban Xu, a post-doctoral research associate in the School of Nuclear Engineering, and Adam Butt, a graduate research assistant in both nuclear engineering and the School of Aeronautics and Astronautics.

A key component of the experiment was a glass test chamber about the size of two coffee mugs filled with a liquid called deuterated acetone, which contains a form of hydrogen known as deuterium, or heavy hydrogen. The researchers exposed the test chamber to subatomic particles called neutrons and then bombarded the liquid with a specific frequency of ultrasound, which caused cavities to form into tiny bubbles. The bubbles then expanded to a much larger size before imploding, apparently with enough force to cause thermonuclear fusion reactions.

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The Purdue research began two years ago, and the findings represent the first confirmation of findings reported earlier by Rusi Taleyarkhan. Now at Purdue, Taleyarkhan, the Arden L. Bement Jr. Professor of Nuclear Engineering, discovered the fusion phenomenon while he was a scientist working at the Oak Ridge National Laboratory.

... more ...

"The two key signatures for a fusion reaction are emission of neutrons in the range of 2.5 MeV and production of tritium, both of which were seen in these experiments," Xu said.

The same results were not seen when the researchers ran control experiments with normal acetone, providing statistically significant evidence for the existence of fusion reactions.

"The control experiments didn't show anything," Xu said. "We changed just one parameter, substituting the deuterated acetone with normal acetone."

Deuterium contains one proton and one neutron in its nucleus. Normal hydrogen contains only one proton in its nucleus.

Taleyarkhan led a research team that first reported the phenomenon in a 2002 paper published in the journal *Science*. Those researchers later conducted additional research at the Oak Ridge National Laboratory, Rensselaer Polytechnic Institute and the Russian Academy of Sciences and wrote a follow-up paper that appeared in the journal *Physical Review E* in 2004, just after Taleyarkhan had come to Purdue.

Scientists have long known that high-frequency sound waves cause the formation of cavities and bubbles in liquid, a process known as "acoustic cavitation," and that those cavities then implode, producing high temperatures and light in a phenomenon called "sonoluminescence."

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Such a technology also could result in a new class of low-cost, compact detectors for security applications that use neutrons to probe the contents of suitcases; devices for research that use neutrons to analyze the molecular structures of materials; machines that cheaply manufacture new synthetic materials and efficiently produce tritium, which is used for numerous applications ranging from medical imaging to watch dials; and a new technique to study various phenomena in cosmology, including the workings of neutron stars and black holes.

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esv/Xu.fusion

Writer: Emil Venere, (765) 494-4709, venere@purdue.edu

Sources: Yiban Xu, (765) 418-0755, yiban@purdue.edu
Rusi Taleyarkhan, (765) 494-0198, Lab: 420-7537, rusi@ecn.purdue.edu
Adam Butt, (317) 514-8585, butt@purdue.edu; phone
Lefteri Tsoukalas, (765) 494-5742, tsoukala@ecn.purdue.edu

Related Web sites:
Purdue University Home Page: http://www.purdue.edu

PHOTO CAPTION:

Purdue University researchers Yiban Xu, standing, and Adam Butt, in the foreground, look at a monitor connected to a camera trained on a nearby experiment. The research has yielded evidence supporting earlier findings by other scientists who designed an inexpensive "tabletop" device that uses sound waves to produce nuclear fusion reactions. Xu is a post-doctoral research associate in the Purdue's School of Nuclear Engineering, and Butt is a graduate research assistant in both nuclear engineering and the School of Aeronautics and Astronautics. The technology might one day, in theory, lead to a new source of clean energy and a host of portable detectors and other applications. (Purdue News Service photo/David Umberger)

A publication-quality photo is available at http://news.uns.purdue.edu/images/+2005/xu-taleyarkhan-fusion.jpg

ABSTRACT

Confirmatory experiments for nuclear emissions during acoustic cavitation

Yiban Xu[a,*], *Adam Butt*[a,b]

[A] *School of Nuclear Engineering*

[b] *School of Aeronautics and Astronautics*

Purdue University

Confirmatory experiments were conducted to assess the potential for nuclear fusion related emissions of neutrons and tritium during neutron-seeded acoustic cavitation of deuterated acetone. Corresponding control experiments were conducted with normal acetone. Statistically significant (5-11 S.D. increased) emissions of 2.45 MeV neutrons and tritium were measured during cavitation experiments with chilled deuterated acetone. Control experiments with normal acetone and irradiation alone did not result in tritium activity or neutron emissions. Insights from imaging studies of bubble clusters and shock trace signals relating to bubble nuclear fusion are discussed.

Interview on July 8, 2005, with Rusi Taleyarkhan, cell phone is 418-0756, and Yiban (pronounced EE-Bahn) Xu, cell is 418-0755, (lab is 420-7537, but that rings in Rusi's lab), use the cell phone number.

Just coming out in press this week or next. The May-June issue.

He tried to put in key points of what exactly was done, what does it mean, these are very similar in scope to what was done earlier. This was not as extensive because it was more limited. A scooping effort that the university itself funded. Even before I had joined Purdue the university had shown a lot of commitment to sonofusion which was one of the reasons that attracted me to Purdue.

So, we had focused two main things. A charter that Lefteri had for the group. Around January (this year or last?), Yiban finished his Ph.D., so he had just finished and was looking for something to do. Studying under Professor Ishii ... he was given this assignment. The main purpose of this effort was to conduct confirmatory experiments to see if fusion could be introduced.

All the nuances about light and timing that we had to do is not focus in this work. Not necessary ... just trying to figure out whether fusion could be introduced. There are two key signatures that one has to look for. One of them is neutrons of the correct energy and the other one is tritium. They got the neutrons with 11 standard deviations. Anything more than 3 standard deviations (means the findings are very good). And I guess 5 standard deviations for tritium.

200,000 to 300,000 neutrons per second is that they produced in their experiment, whereas in the earlier experiment with the ? neutron generator and all those things was about 400,000 to500,000. so this was not as efficient a system but that's a totally different subject. The important finding is that fusion conditions can be introduced using a carbon copy apparatus. That's why they had problems with that BBC work that was done. It was not carbon copy. they tried to do something ...

lefteri got in touch with me while I was in oak ridge and discussed it ... since this is ? patent that the u.s. government has filed on behalf of the nation, there has to be a nondisclosure agreement signed and Lefteri signed off so we offered that information to Purdue and ... conducted the experiments, obtained data, analyzed and presented it for publication. Work started about two years ago. Authors are Xu and Adam Butt, from aero and astro. He got in touch with us early last year saying he was interested in using sonofusion as a power source for spacecraft. High energy density fuel cells. One coffed cup full of this material is equivalent to all the fuel carried by the space shuttle. A fusion engine for spacecraft.

We used isotopic neutron source. At oak ridge had a very expensive accelerator based source for timing of neutrons and all that ... to make a fundamental discovery claim.

This is confirmation of the basic phenomenon of fusion.

The neutrons used to seed the bubbles have to come from someplace. Either you can spend a lot of money and get a pulse source that we had ... gives it in a timed fashion so you can know exactly when it started ... it makes for a nice scientific study. But ... implosion stage of those bubbles that have been nucleated with neutrons you get neutrons out, you get tritium out. So that's the key signature that we've got to look for the basic aspect of whether or not this process works.

Purdue did not have access to the pulse neutron generator setup that the national laboratory has ... so, used a isotope source, a plutonium beryllium source, a californium source, that emit neutrons. They can be used to nucleate bubbles to form bubbles. The material is in ... you start the bubbles at the nanometer level, they grow huge, they implode and when they implode they create conditions like in the interior of stars, to produce thermonuclear fusion.

They did part of their work in the pharmacy building.

Prof. Revankar teamed up with Xu and Butt to oversee the data and there is another paper coming out in ?, in France, in October.

Paper in France will elaborate more on the thermal hydraulic aspects, whereas this is more for nuclear science engineering. It talks about the fact that the ? of the experiments using carbon copy apparatus, used neutrons to nuclear, deuterated acetone and they did the control experiments. The control experiments didn't show anything. You just change one parameter, the heavy hydrogen to normal hydrogen, normal acetone.

The controls were null results.

What you are seeing here is cavitation on and off. Blue is on and red if off . cavitation on with the deuterated ... you see signal indicating the neutrons coming out are 2.5 mev neutrons.

The bubbles have to spherical and implode, just like a bomb. If they are dissipating everywhere, then there is nothing.

So, this confirms you can get thermonuclear fusion with neutron-seeded cavitation when the liquid is deuterated. If its not deuterated its impossible to get fusion.

Tritium produced.

They also showed that even if you get cavitation with fusion, unless it's a deuterated liquid, you do not get fusion.

High speed pictures in paper.

Late Wednesday he goes on travel.

(now walking around in the lab)

working in homeland security. Detection devices. Very simple handheld cavitation ...

a lot of paraffin blocks used to shield neutrons.

Here is a very simple low cost tension metastable fluid based neutron gamma alpha special nuclear material detection system. Someone trying to smuggle in heu, highly enriched uranium for bombs ... it detects ... need to be able separate the neutrons from the gammas.

Nuclear materials that give off neutrons ... need to have a means to separate neutrons from gammas in a simple way. Current systems cost tens of thousands of dollars. Come up with one that ... centrifugal force ... a couple of hundred of dollars. Working on commercializing that.

com

Also, the physics, the mechanisms for placing fluids in a tension state, just like stretching a rubber band, storing energy ... can do the same thing with fluids ... compared to black powder and ... best explosive today is hmx, high melting explosive, like C4, this has three times the energy content of that explosive ... potential to provide energy at will ... using it to launch a projectile. A new type of weapon. Have demonstrated a system.

Using this mechanism to come up with a next generation combustion engine. instead of using injectors like they use in a diesel engine, use acoustic power to cause atomization.

Sound turns fuel into a vapor.

His work is funded by darpa. But Xu's research not initially ... now Xu works in Rusi's lab.

A high pressure chamber to pressurize items. A ship's propeller , they cavitate and Russians know exactly where U.S. subs are, found a way to cause healing of interfaces to prevent premature cavitation, so I guess you could take systems with very high intensity ... this allows you to pressurize objects inside it.

This is part of metastable fluid technology development where we come up with a metastable based detector system. One thing you have to do is prevent cavitation from taking place. See what happens to a ship's propeller. Its just eaten up. The same thing can happen with fuels inside detection systems. We want want to prevent spurious nucleation and cavitation ... (only) cavitate when you've got a strike from a nuclear based particle.

Also, creating a simple x-ray machine. Now x-rays produced with a very high voltage source that throws ions, they hit a target and decelerate, giving off x-rays. That's the way people have done it for the past 150 years, ever since Roentgen came out and saw the famous hand ... this is a trd, thermoluminescent? dosemeter, give it to radiological environment, management services group ... send it to a lab, take off the plastic, count the number of tracks to find out how much dosing you've got.

For the homeland security demonstration we are helping out quantify what happens when a radiological bomb, 3,000 pounds of explosives with about 3,000-4,000 Curies of radioactive cesium 137, the stuff people use for radiators for cancer therapy ... put it in a truck and blow it up. What happens to the environment? How do the police react? How do the first responders react? Who gets dosed up? Who dies? Who does not die? Who gets contaminated? How are buildings decontaminated? How soon can they be put back into operation? What are the psychological impacts?

That exercise has not been done so I think Purdue is offering it to the nation for the first time.

Nuclear Engineering and Design

Volume 235, Issues 10-12, Pages 1041-1324 (May 2005)
Festschrift Edition Celebrating the 65th Birthday of Prof. Richard T. Lahey, Jr.

20-24 September 2004
Edited by Ruis P. Taleyarkan, Paolo Di' Marco and Gunther Lohnert

23. **Confirmatory experiments for nuclear emissions during acoustic cavitation** • ARTICLE
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