

2010 ACS Review of Low-Energy Nuclear Reaction Research

Steven B. Krivit
Editor, *New Energy Times*
Executive Director, New Energy Institute

San Francisco, CA, March 2010
Prepared for ACS National Meeting

Paper withdrawn in January by symposium organizer Jan Marwan because schedule was "extremely full and very tight." Inexplicably, when the schedule published, Marwan gave some speakers multiple time slots.

THIS PRESENTATION HAS BEEN RATED

S

SCIENTIFIC



SBK
2010

Contains Graphic Scientific
Images and Hard Facts

NOT RECOMMEND FOR PEOPLE WHO
FOLLOW DOGMA OR HAVE FIXED BELIEFS

"Cold Fusion" People Assumed a Modified Third Branch of D-D Fusion

**"He-4 was the only product that I found
that could explain the [amount of]
excess heat."**

Miles, Melvin, March 16, 2010, Private Communications

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It was a GOOD assumption at the time!

Miles, Melvin, March 16, 2010, Private Communications

"Cold Fusion" People Assumed a Modified Third Branch of D-D Fusion

"He-4 was the only product that I found
that could explain the [amount of]
excess heat."

*It was a GOOD assumption at the time!
Did not know about electroweak interactions.
Only newly recognized (in physics) few years earlier.*

Hypothetical D-D "Cold Fusion" Reaction



More Precise Equation



LENR

**Far More Complex Than
“Cold Fusion”**

LENR Phenomena Includes...

Tritium	Low-Flux Neutrons
Heavy Z Transmutations	Isotopic Shifts
Energetic Alphas	Heat and Helium-4

How Does “Cold Fusion” Explain Tritium?

D+D? → 4He + Heat (24 MeV) + Tritium

Equation Still Does Not Add Up

Assuming Satisfactory Explanation of “3 Miracles”

BARC Studies in Cold Fusion Government of India Atomic Energy Commission April - September 1989 Edited by P.K. Iyengar and M. Srinivasan December 1989

"Cold Fusion"?

Tritium	Low-Flux Neutrons
Heavy Z Transmutations	Isotopic Shifts
Energetic Alphas	Heat and Helium-4

Can Neutron Capture Explain Tritium?



Yes

*Assuming Satisfactory Explanation of
Source of Neutrons*

Does "Cold Fusion" Explain Low-Flux Neutrons?

D+D? → 4He + Heat (24? MeV) + Neutrons

No

BARC Studies in Cold Fusion Government of India Atomic Energy Commission April - September 1989 Edited by P.K. Iyengar and M. Srinivasan December 1989

"Cold Fusion"?

Tritium	Low-Flux Neutrons
Heavy Z Transmutations	Isotopic Shifts
Energetic Alphas	Heat and Helium-4

Can Weak Interactions Explain Creation of Neutrons?

Ultra Low Momentum Neutrons →
Spallation Neutrons

Yes

Widom, A., Larsen, L., "Ultra Low Momentum Neutron Catalyzed Nuclear Reactions on Metallic Hydride Surfaces," *European Physical Journal C - Particles and Fields*, Vol. 46(1), p.107 (2006)

Does “Cold Fusion” Explain Heavy Element Transmutations?

**Mo Increases At the Same Time
Sr Decreases**

It Doesn't

Y. Iwamura, M. Sakano and T. Itoh, Elemental Analysis of Pd Complexes: Effects of D₂ Gas Permeation, Japanese Journal of Applied Physics A, 2002, 41, 4642–4648.

"Cold Fusion"?

Tritium	Low-Flux Neutrons
Heavy Z Transmutations	Isotopic Shifts
Energetic Alphas	Heat and Helium-4

Can Neutron Capture Explain Heavy Element Transmutations?

**Mo Increases At the Same Time
Sr Decreases**
*(Series of Neutron Captures and
Intermediate Beta Decays)*

Yes

How Does "Cold Fusion" Explain Isotopic Shifts?

Transmutation Pd-108 → Pd-110

**D+D? → 4He (<100 KeV) + Heat (~24? MeV) +
2 Neutron Captures (10MeV)**

It Doesn't Add Up

Bush, Ben F. and Lagowski, J.J., "Trace Elements Added to Palladium by Electrolysis in Heavy Water," EPRI TP-108743, November 1999

"Cold Fusion"?

~~Tritium~~

~~Low-Flux Neutrons~~

~~Heavy Z Transmutations~~

~~Isotopic Shifts~~

Energetic Alphas

Heat and Helium-4

Can Neutron Capture Explain Isotopic Shifts?

Transmutation Pd-108 → Pd-110



Yes

Bush, Ben F. and Lagowski, J.J., "Trace Elements Added to Palladium by Electrolysis in Heavy Water," EPRI TP-108743, November 1999

How Does "Cold Fusion" Explain 11-16 MeV Alphas?

**D+D? → 4He (~13 MeV Alpha)
+ Heat (~24? MeV)**

It Doesn't

Lipson, A.G., Roussetski, A. S., Miley, G. H., Saunin, E. I., "Phenomenon of an Energetic Charged Particle Emission From Hydrogen/Deuterium Loaded Metals," Tenth International Conference on Cold Fusion. 2003. Cambridge, MA

"Cold Fusion"?

~~Tritium~~

~~Low-Flux Neutrons~~

~~Heavy Z Transmutations~~

~~Isotopic Shifts~~

~~Energetic Alphas~~

Heat and Helium-4

Can Neutron Capture Explain 11-16 MeV Alphas?

11-16 MeV Alphas

${}_{7}\text{N-18}$ Beta-delayed alpha decay \rightarrow 4He (11.8 MeV)

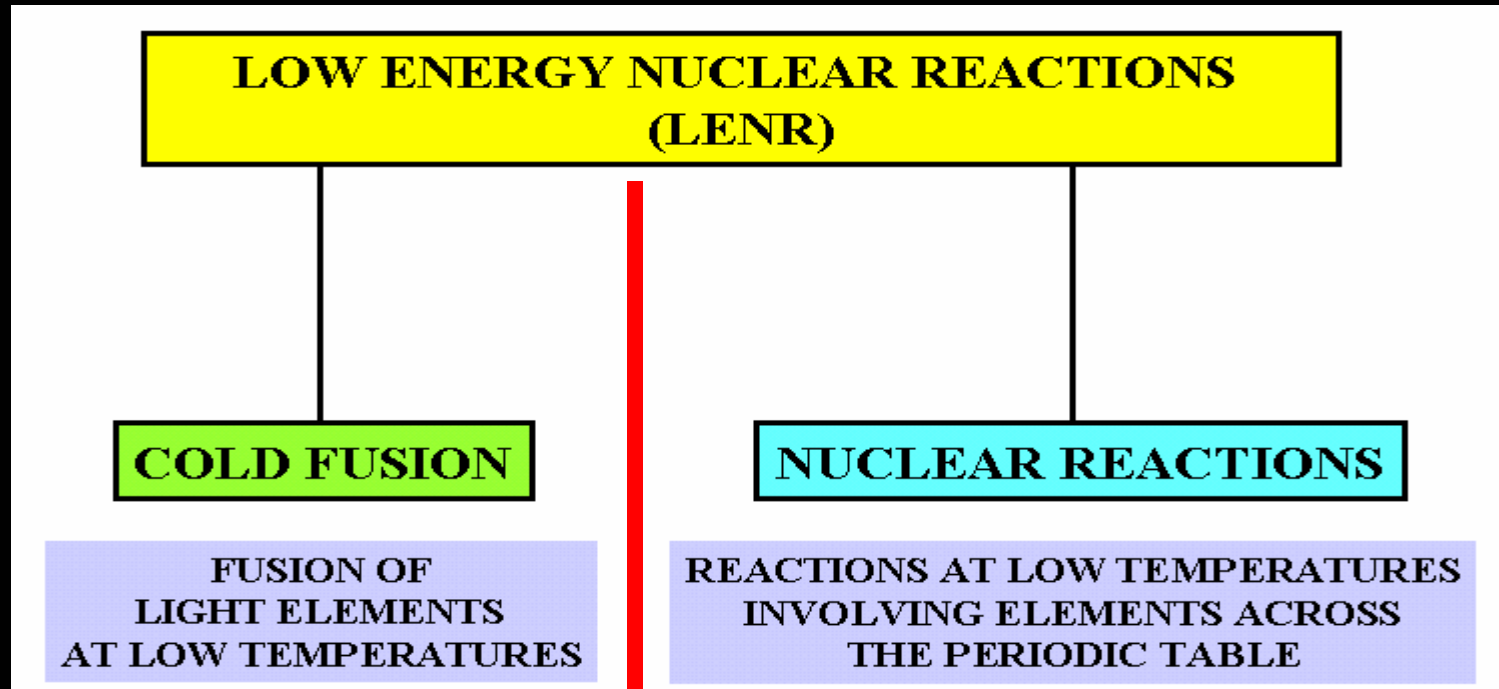
Yes

Larsen Lewis, Sept. 3, 2009, Slide #11

How Do "Cold Fusion" People Explain This?

	
Heavy Z Transmutations	Isotopic Shifts
Energetic Alphas	Heat and Helium-4

Explanation 1 (Nagel): Two Branches



Explanation 2

Ad Hoc Conclusion

“Heat and Helium-4 is the Main Reaction Channel.
All other LENR phenomena are **minor effects**.”

They “Know” That
No Other Energetic Phenomena
Exists in LENR Cells

- Bob Bass, March 7, 2009, Private Communications

Let's Talk about the 24 MeV!

**“The proof is the 24 MeV!
McKubre nailed it.”**

- Scott Chubb (2007)

Sherlock Holmes on Making Theories Without Data

“Insensibly one begins to twist facts to suit theories, instead of theories to suit facts.”

- Sir Arthur Conan Doyle

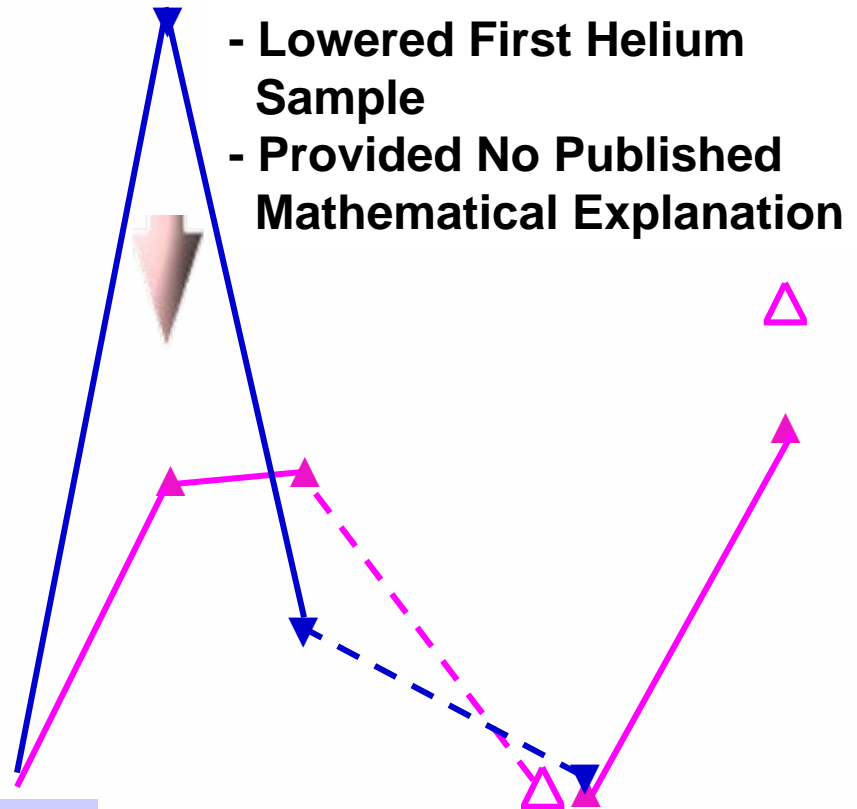
How Did SRI Get “24 MeV”?

“Cold Fusion” Helium Measurements vs. Predictions: 1998 Data vs. 2000/2004 Data		
	Percent of 24 MeV	
	Before	After
S1	41	62
S2	147	69
S3	0	0
S4a	[0]	84
S4b	[0]	104

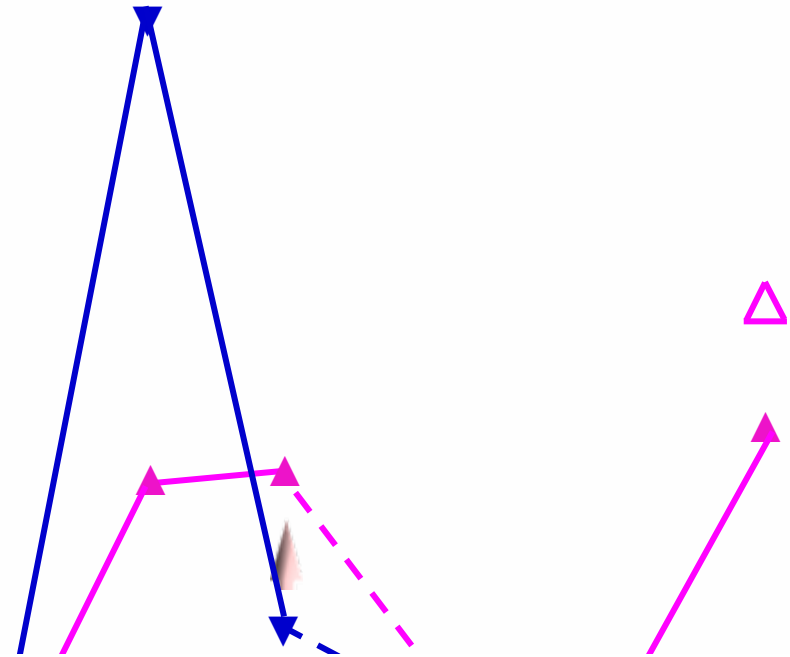
(EPRI TR-107843-V1 pgs. 350-352)

Two out of the 13 authors changed data from the 1994 experiment 6 years later.

See New Energy Times Issue 34 for Full Investigation

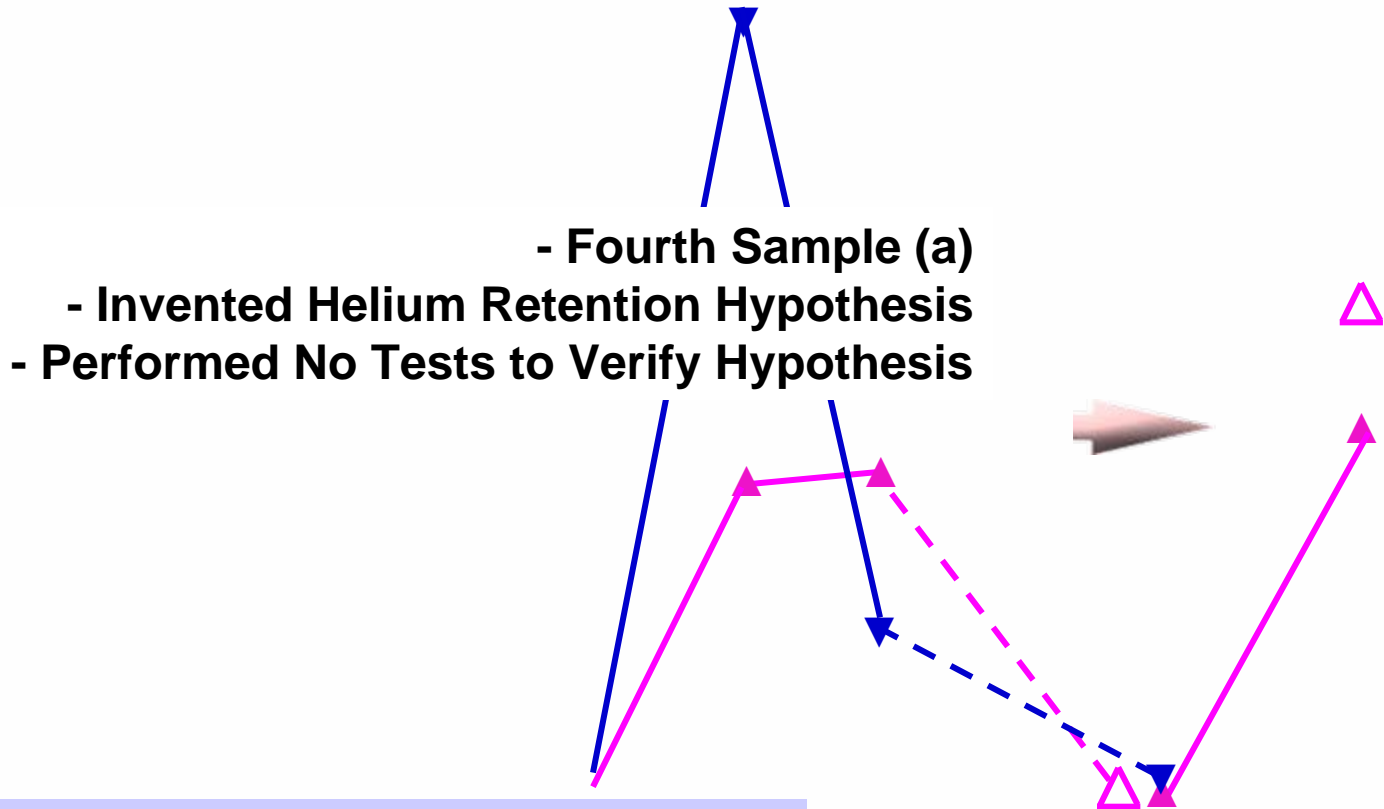


How Did SRI Get “24 MeV”?



**Raised Second Helium Sample
No Published Mathematical Explanation**

How Did SRI Get “24 MeV”?



See appendix for facts regarding helium retention hypothesis.

Conan Doyle Extended: Invent New Theories

(See Appendix A)

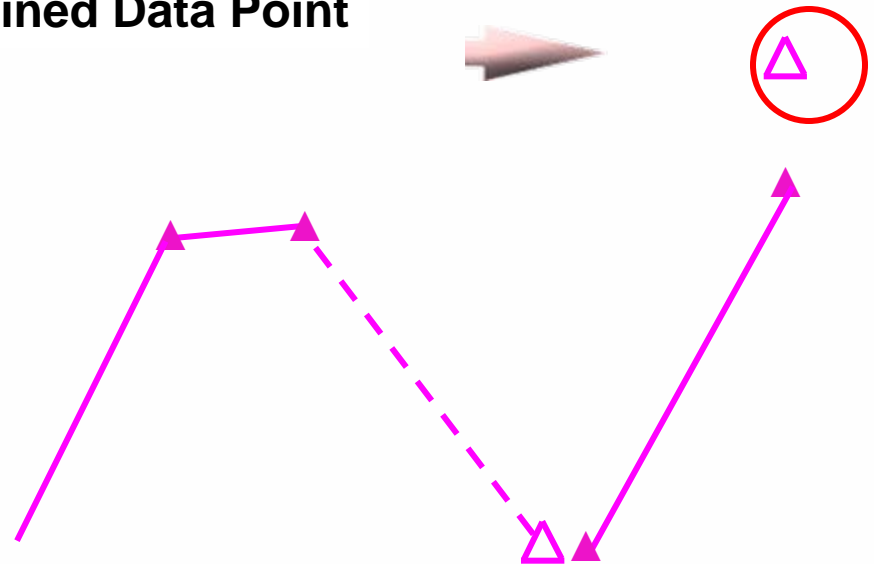
“The most precise experiment that documents this finding involved a recycling procedure in which helium-4 that had been trapped inside heat-producing experiments is released into the atmosphere.”

- Scott Chubb (March 2010)

How Did SRI Get “24 MeV”?

- Fourth Sample (b) Invented
- Unexplained Data Point

▲ Measured helium
△ Not Measured helium



How Did SRI Get “24 MeV”?

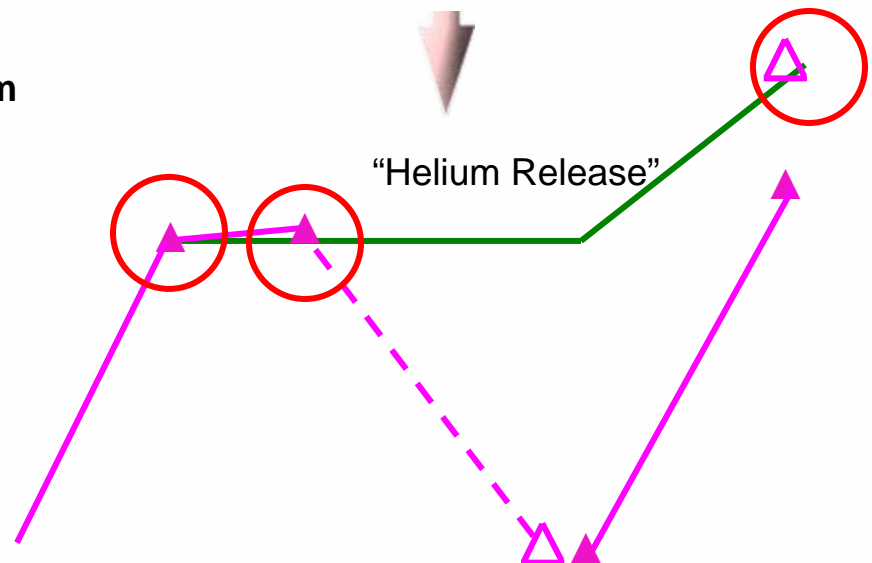
Green line source: Peter Hagelstein, Michael McKubre, David Nagel, Talbot Chubb, Randy Hekman, "New Physical Effects In Metal Deuterides," Submitted to the 2004 U.S. Department of Energy LENR Review

**Green line through three points.
Gives false appearance of helium
accumulation.**

**The four helium measurements
were separate ppm values.**

Not cumulative values.

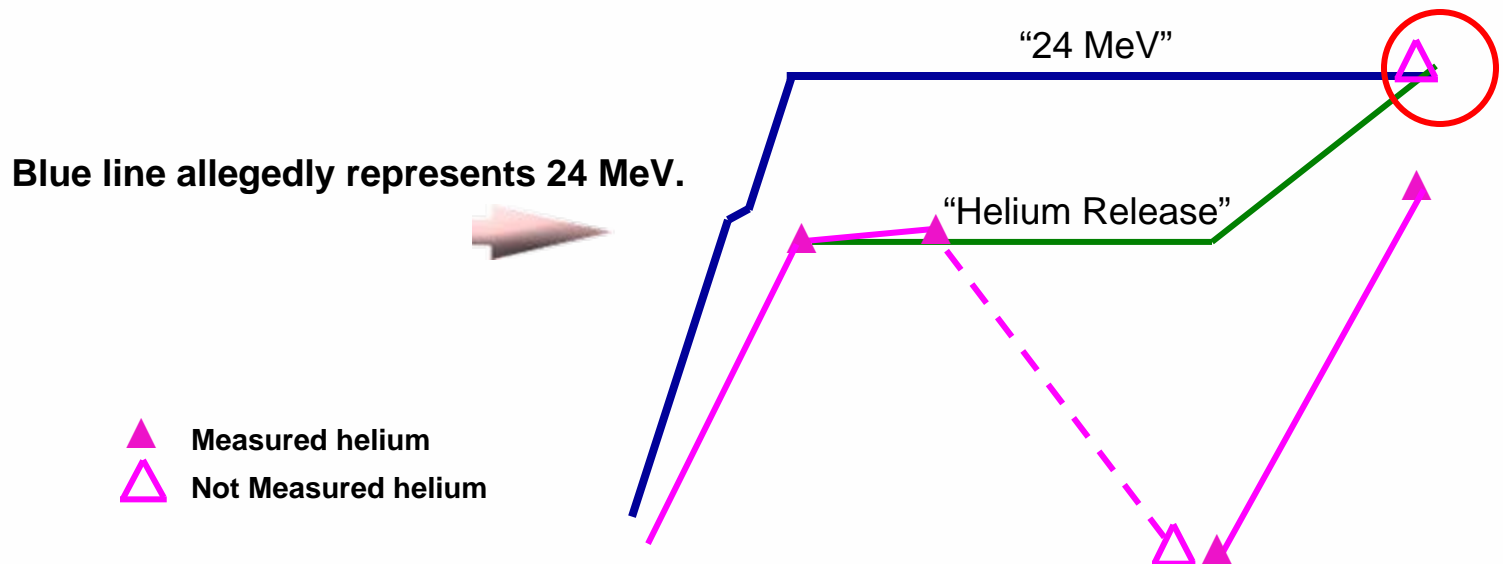
- ▲ Measured helium
- △ Not Measured helium



(EPRI TR-107843-V1 pgs. 350-352)

How Did SRI Get “24 MeV”?

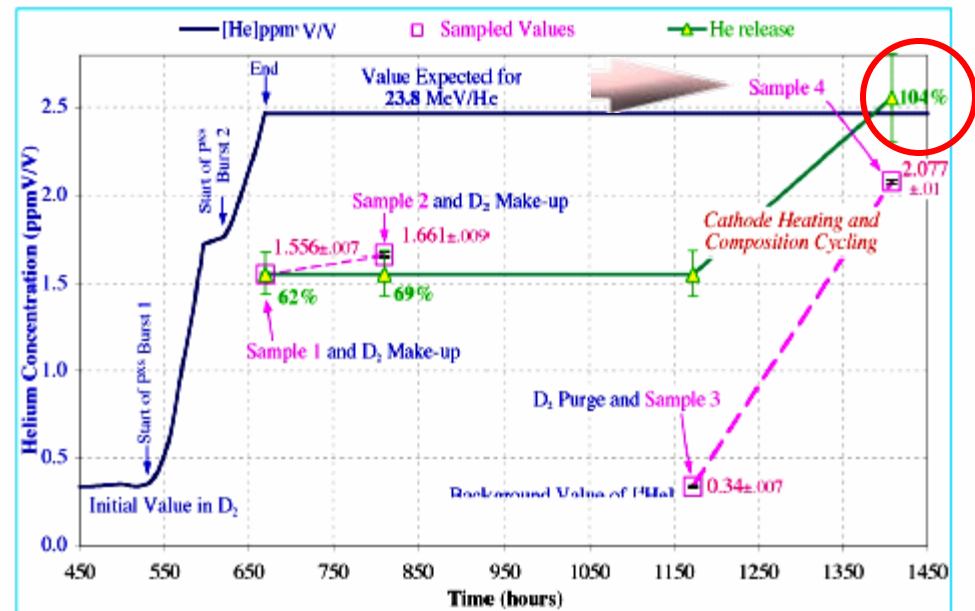
Blue line source: Peter Hagelstein, Michael McKubre, David Nagel, Talbot Chubb, Randy Hekman, "New Physical Effects In Metal Deuterides," Submitted to the 2004 U.S. Department of Energy LENR Review



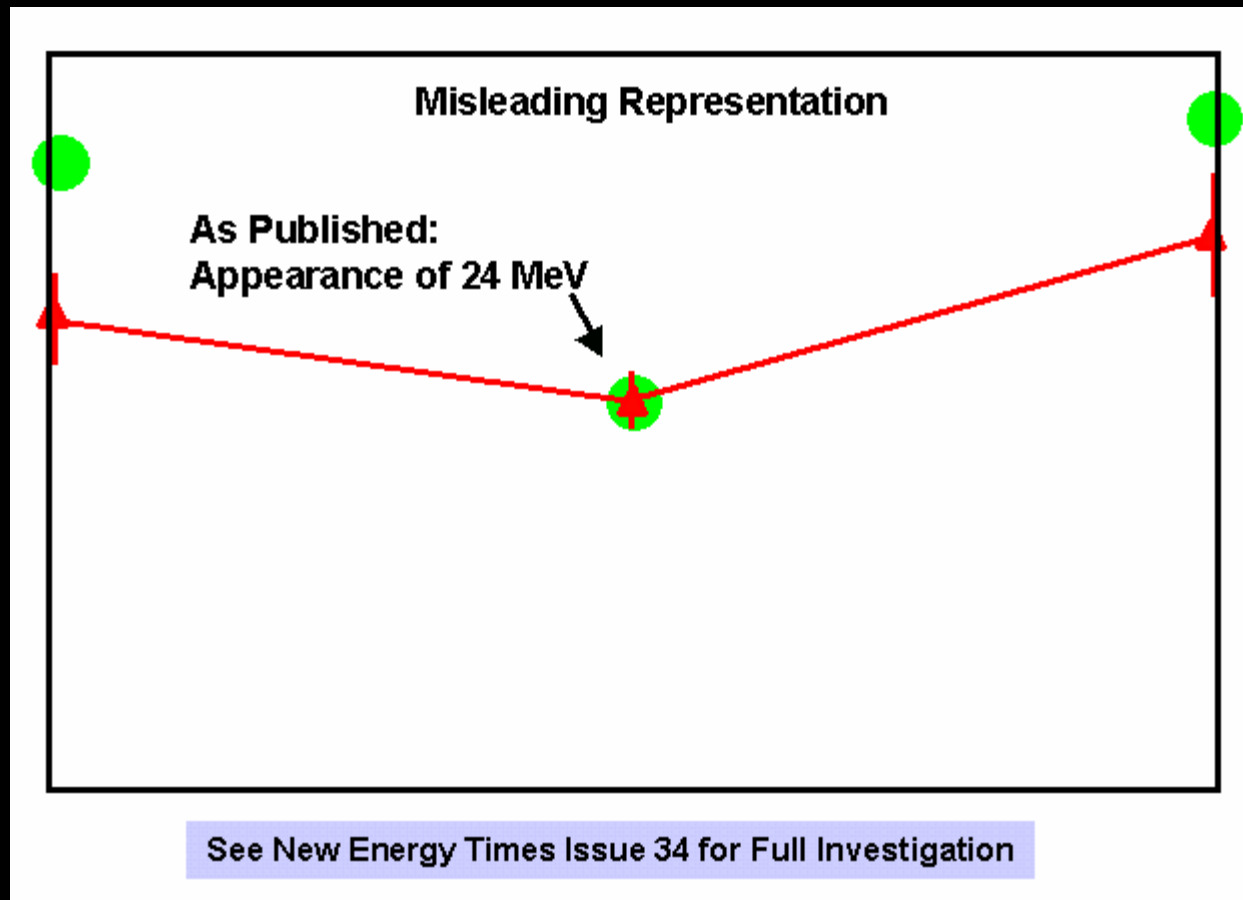
How Did SRI Get “24 MeV”?

Graph Source: Peter Hagelstein, Michael McKubre, David Nagel, Talbot Chubb, Randy Hekman, "New Physical Effects In Metal Deuterides," Submitted to the 2004 U.S. Department of Energy LENR Review

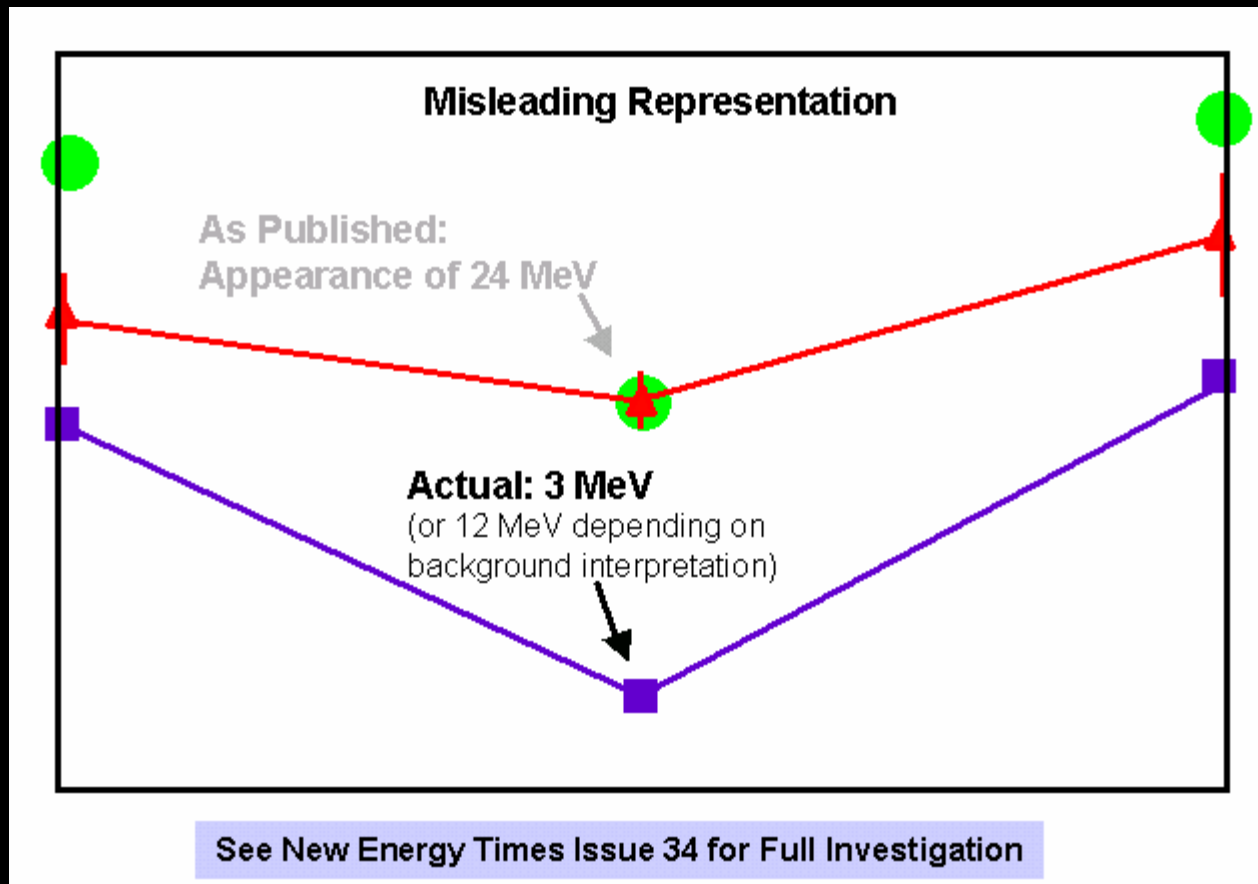
The Final Helium
“Accumulation”
Allegedly
Represents
24.75 MeV.



How Did ENEA Get “24 MeV”?

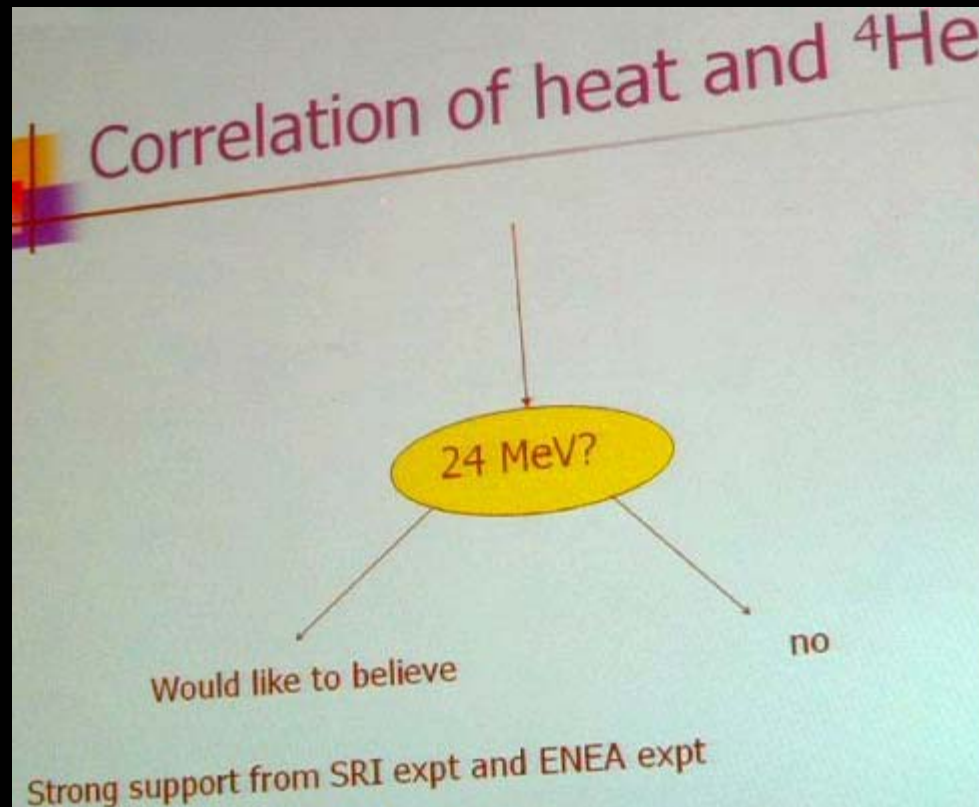


How Did ENEA Get “24 MeV”?



“Would Like to Believe”

(Hagelstein, Melich, Johnson)



“Strong Support” From SRI and ENEA?

What About the “Missing” 24 MeV in Other Experiments?

An order of magnitude is close enough.
“Within the range of experimental errors.”

- Melvin Miles, Feb. 14, 2009, Comment in Response to New Energy Times Issue 34

However – “24 MeV” is Meaningless

For 24 MeV to signify the precise mass-energy deficit of D-D fusion, there must be no other nuclear products in the system.

$D+D \rightarrow 4He (<100 \text{ KeV}) + \text{Heat} (\sim 24 \text{ MeV}) + \underline{\text{No Other Nuclear Products}}$

Occam's Razor?

$2 + 2 = 4$

Yes

Occam's Razor?

$$2 + 2 = 4$$

Yes



Occam's Razor?

$2 + 2 = 4$ **Yes**

D+D → 4He + 24 MeV Heat

Nice and Tidy: Yes

Occam's Razor?

$$2 + 2 = 4$$

Yes



Nice and Tidy: Yes

Nature Says: *Not Happening.*

~~"Cold Fusion" Theory?~~

~~Tritium~~

~~Low-Flux Neutrons~~

~~Heavy Z Transmutations~~

~~Isotopic Shifts~~

~~Energetic Alphas~~

~~Heat and Helium-4~~

“But it’s still possible...”

**“Just Because There is no
Evidence Doesn’t Mean ‘Cold
Fusion’ Doesn’t Exist.”**

- Anon

**“Absence of Evidence is not
Evidence of Absence”**

Clever Phrase? Yes.

**“Absence of Evidence is not
Evidence of Absence”**

Clever Phrase? Yes.

Scientifically Useful? No.

**“Absence of Evidence is not
Evidence of Absence”**

Clever Phrase? Yes.

Scientifically Useful? No.

“Absence of Evidence is Belief”

How Does Hagelstein Explain Energetic Alphas?

Theoretical Speculations on “Upper Limits”:
“The alpha particle must be born with an energy less than 20.3 KeV.”

(Pay no attention to Lipson et al. 2002 – 11-16 MeV alphas,
Oriani and Fisher, SPAWAR)

- Hagelstein, Peter L. (Communicated by Edmund Storms) "Constraints on Energetic Particles in the Fleischmann–Pons Experiment," Naturwissenschaften, DOI 10.1007/s00114-009-0644-4, Feb. 9, 2010

How Does Scott Chubb Explain Miley's Light Water LENR?

**2 in 12,000 Atoms In Water are Deuterium:
“D-D Fusion Still Possible”**

- “Cold Fusion Theorist Scott Chubb

How Do “Cold Fusion” People Explain Nickel-Hydrogen LENR?

Pathological Skepticism:

“I don't believe Piantelli because his work is full of holes. People who have visited him have been unimpressed” – Jed Rothwell

Focardi, S., Gabbani, V., Montalbano, V., Piantelli, F. and Veronesi, S., "Large Excess Heat Production in Ni-H Systems," Nuovo Cimento, Vol. 111A, p. 1233-1242, (1998)

How Does Kidwell (NRL) Explain Increase of Pr?

(Rome ICCF-15 Conference)

“Individual doing extraction left MHI”

“Possible Contamination”

““Lucky’ tweezers??”

Dr. Kidwell: Did you recover the “lucky tweezers”?

NRL “Replication” Team: Michael Melich (Project Manager), David Nagel, David Knies, Graham Hubler, Ken Grabowski, David Kidwell

How Does Kidwell (NRL) Explain Simultaneous Decrease of Cs?

(Rome ICCF-15 Conference)

“No Comment – Not Allowed to Talk with Press”

(Suggest Review Iwamura’s Rebuttal)

- K. Grabowsky, D.A. Kidwell, C. Cetina, C. Carosella - Evaluation of the Claim of Transmutation of Cesium to Praseodymium with the MHI Structure - Iwamura Rebuttal to NRL - <http://newenergytimes.com/v2/conferences/2009/ICCF15/ICCF15Recordings.shtml>

Does The "Cold Fusion" Idea Really Explain LENR?

It Doesn't

Does The "Cold Fusion" Idea Really Explain LENR?

It Doesn't

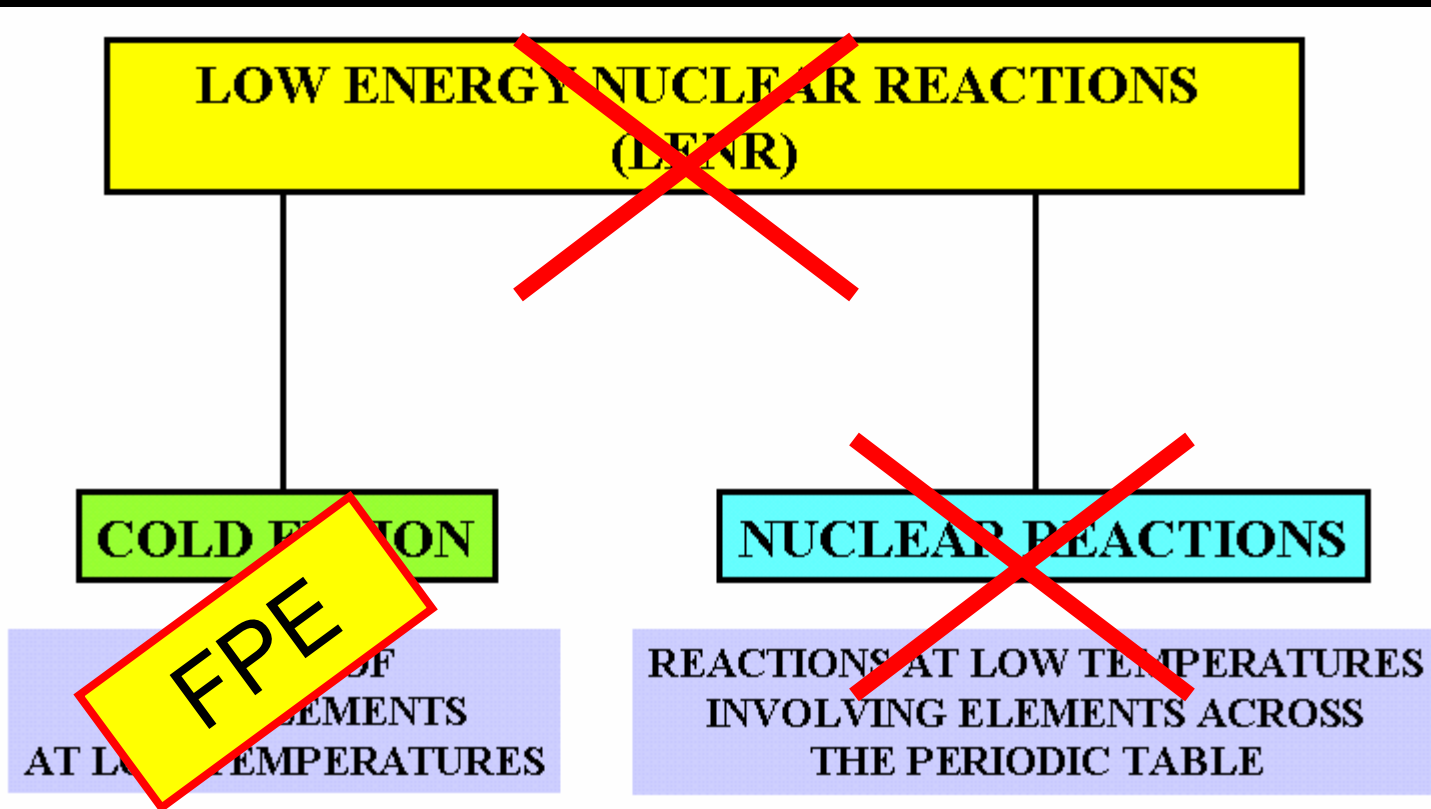
**Cold Fusion Peoples' Transition Term:
"Fleischmann-Pons Effect"**

(Disregard the Iwamura Effect, the Letts-Cravens Effect,
Kasagi Effect, Preparata Effect etc., etc.)

- Hagelstein, Peter L. et al., "Constraints on Energetic Particles in the Fleischmann-Pons Experiment," *Naturwissenschaften*, DOI 10.1007/s00114-009-0644-4, Feb. 9, 2010
- Nagel, David J., "Scientific Overview of ICCF15," *Infinite Energy*, Nov/Dec., 2009, Issue 88
- Nagel, Melich, ICCF-14 Conference Web Site

Nagel and Melich 2008: FPE

<http://www.iccf-14.org/terminology.html>



McKubre: New Definition of Neutron Capture

Redefine Neutron Capture as Fusion:

“I submit that John Fisher's **neutron addition** reactions also qualify as **fusion.**”

- McKubre, Michael, May 13, 2009 CMNS E-mail List

Chubb: Nonsensical, Novel Use of the Word “Fusion”

“**Transmutations** of ^{133}Cs into ^{141}Pr apparently are **fused** to a substrate nucleus during gas-loading experiments.”

Chubb, Scott, "At 21, Cold Fusion Is Still in Its Infancy" Infinite Energy, Issue #90, March 2010

1989: “Cold Fusion” Derailed by
Pathological Sceptics (“Outsiders”)

2000: Progress in LENR Delayed by
Pathological Science (“Insiders”)

1989: Critics Were Right –
It's Not "Cold Fusion"

2010: Critics Were Wrong –
It is Nuclear, and it's LENR

The “Proof” of “Cold Fusion”

**“The proof is the 24 MeV!
McKubre nailed it.”**

- Scott Chubb (2007)

“You Are on VERY Thin Ice
Stating Excess Heat is
Consistent with $24 \text{ MeV}/4\text{He}$.”

- Gene Mallove
March 17, 2004

Krivit:

It Doesn't Look Like Fusion

**New Energy Times
2005 - 2008**

New Energy Times

www.newenergytimes.com

Phone: (310) 721-5919
steven1@newenergytimes.com

Appendix A
Helium in Metals Analysis (pg. 1)

Behavior in Metals at or Near STP	Hydrogen	Helium
Permeates (Diffuses) Through Intact and Defect-Free Metal	Yes	No
Permeates (Diffuses) Through Defects and Grain Boundaries	Yes	Yes
Soluble (Dissolves) in Metal	Yes	No

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Appendix A

Helium in Metals Analysis (pg. 2)

References:

SRI did not test helium retention hypothesis during experiment.

EPRI TR-107843-V1 pg. 357

Bockris et al. showed helium on near-surface areas on cathode can be retained if quickly immersed in liquid nitrogen.

Chien, Chun-Ching, Hodko, Dalibor, Minevski, Zoran and Bockris, John O'M. "On an Electrode Producing Massive Quantities of Tritium and Helium," Journal of Electroanalytical Chemistry, Vol. 338, p. 189–212, (April 1992)

Gozzi showed that helium does not show up in the bulk if the cathode is vaporized.

Gozzi, D., et al., "X-Ray, Heat Excess and 4He in the D:Pd System," Journal of Electroanalytical Chemistry, Vol. 452, p. 253, (1998) and Erratum, 452, 251–271, (1998)

Helium won't dissolve in metal even at high temperature.

Ramsay, W.; Travers, M.W. "An Attempt to Cause Helium or Argon to Pass through Red-Hot Palladium, Platinum, or Iron." Proceedings of the Royal Society of London (1854-1905). 61 (-1), p. 266-267. Jan. 1897, doi:10.1098/rspl.1897.0034

Defect-free metal will not allow helium to pass through.

Schultheis, D., "Permeation Barrier for Lightweight Liquid Hydrogen Tanks," Ph. D. thesis, University of Augsburg, 2007

Helium does not outgas from metals easily or quickly.

Bowman, Jr., Robert C., "NMR Studies of 3He Retention and Release in Metal Tritides -A Review," Hydrogen & Helium Isotopes in Materials Conference, Albuquerque, NM, USA, Feb. 7 2007

Helium may pass through metals above 350 kPa.

Rothenberger, Kurt S. et al., "High Pressure Hydrogen Permeance of Porous Stainless Steel Coated with a Thin Palladium Film via Electroless Plating," Journal of Membrane Science, Volume 244, Issues 1-2, 15 November 2004, Pages 55-68

Helium is known to have low solubility in metals, grain boundaries support permeation.

Xia, Ji-xing, Hu, Wang-yu, Yang, Jian-yu, Ao, Bing-yun, " Diffusion Behaviors of Helium Atoms at Two Pd Grain Boundaries," Trans. Nonferrous Met. SOC. China 16(2006) s804-s807

Appendix B
**- Summary of Factual Inconsistencies With SRI 24 MeV “Cold Fusion” Claim -
1998 [1], 2000 [2] and 2004 [3] Papers Compared (Page 1)**

1998: Helium sample 1 shown as 42 percent.

2000: Helium sample 1 shown as 62 percent with no published mathematical explanation for difference.

1998: Helium sample 2 shown as 147 percent.

2000: Helium sample 2 shown as 69 percent with no published mathematical explanation for difference.

1998: Helium sample 4 percentage not stated.

2000: Helium sample 4 shown as 84 percent with no published mathematical explanation.

2004: Helium sample 4 shown as 84 percent.

2004: Helium sample 4 shown as 104 percent with no published mathematical explanation for difference.

2000 Statement: “A second sample showed an increase in [4He] despite the fact that the helium content of the vessel had been diluted with D2 containing low levels of 4He, in order to make up the initial gas volume after the first gas sample.” 2000 statement gives appearance of support for release of helium.

1998 Fact: Sample two shows not merely an increase but an increase of more helium than authors predicted: prima facie evidence that disproves the helium retention hypothesis.

1998 Statement: “Induce loading variation by switching the current on alternate measurement cycles between 3.1A cathodic and 0.001A anodic.” 1998 report says nothing about any effort to scrub “hiding” helium.

2008 Hagelstein Statement [4]: “At SRI they made a serious effort to scrub the remaining – the hiding – helium out by running the cathode anodically and cathodically, and the total balance by the time things were over was 24 MeV – 104 percent of 24 MeV. So at the moment, this is our best evidence we have for 24 MeV.”

1998: Report shows and describes a rapid period of electrolytic heating (“mini boil-off”) temporally correlated with a rapid rise in loading.

2000/2004: Omits report of heat burst.

Appendix B

- Summary of Factual Inconsistencies With SRI 24 MeV “Cold Fusion” Claim - 1998 [1], 2000 [2] and 2004 [3] Papers Compared (Page 2)

1998: Authors considered possibility that helium was produced from heat burst in period just before helium sample 4 taken.

2000: Authors assumed that helium was not produced from that heat burst. They assumed that helium was “evidence of sequestered 4He.”

2000: Reported that the metal cell was leak-tested and implied that helium could not leak through metal.

2000: Reported that the helium not only could find a way into the cathode bulk but that it would somehow stay there until coaxed to release. Reported that the helium could be and was released at STP with 3 amps of current.

1998 Statement: “The possibility of 4He hideout and slow emergence into the gas phase must be tested by experiment” (EPRI TR-107843-V1 pg. 357). Apparently, no evidence for such tests exists.

2004 Statement: “Several important conclusions can be drawn from [experiment M4] ... [H]elium is partially retained, and dissolved helium is released only slowly to the gas phase for analysis.”

1998 Paper: No mention, even remotely, of any “compositional and temperature cycling.”

2000 Statement: “The cathode was subjected to an extended period (~200 hours) of compositional and temperature cycling ... after exercising the cathode to release trapped gases ...”

References:

1. Development of Energy Production Systems from Heat Produced in Deuterated Metals - Energy Production Processes in Deuterated Metals, Volume 1, TR-107843-V1, Thomas Passell (Project Manager,) Michael McKubre, Steven Crouch-Baker, A. Huaser, N. Jevtic, S.I. Smedley, Francis Tanzella, M. Williams, S. Wing (Principal Investigators,) B. Bush, F. McMohon, M. Srinivasan, A. Wark, D. Warren (Non-SRI Contributors,) June 1998
2. Michael McKubre, Francis Tanzella, Paolo Tripodi and Peter Hagelstein, "The Emergence of a Coherent Explanation for Anomalies Observed in D/Pd and H/Pd Systems; Evidence for 4He and 3He Production" 8th International Conference on Cold Fusion. 2000. Lerici (La Spezia), Italy: Italian Physical Society, Bologna, Italy.
3. Peter Hagelstein, Michael McKubre, David Nagel, Talbot Chubb, Randy Hekman, "New Physical Effects In Metal Deuterides," Submitted to the 2004 U.S. Department of Energy LENR Review
4. Peter Hagelstein, Michael Melich and Rodney Johnson, “Physical Mechanisms in Theories of Condensed Matter Nuclear Science,” ICCF-14

Appendix B

Facts Regarding New Energy Times SRI M4 Investigation

Francis Tanzella

New Energy Times sent Francis Tanzella, and copied two SRI International media relations officers, a news inquiry on Jan. 21. Tanzella replied the next day: “I can't speak on the record about a report that was primarily written by Mike [McKubre].”

Paolo Tripodi

New Energy Times sent Paolo Tripodi, and copied a company officer, a news inquiry on Jan. 21. Tripodi replied the same day and asked about the response deadline.

Michael McKubre

New Energy Times sent Michael McKubre, and copied two SRI International media relations officers, a news inquiry on Jan. 22. McKubre has not responded.

Peter Hagelstein

New Energy Times sent Peter Hagelstein, and copied an MIT media relations officer, a news inquiry on Jan. 24. Hagelstein has not responded.

Pamela Mosier-Boss

Pamela Mosier-Boss was not involved in the M4 research. The investigation was triggered in December 2009 by a paper she wrote about LENR nuclear products. She submitted the paper for publication.

New Energy Times Publication

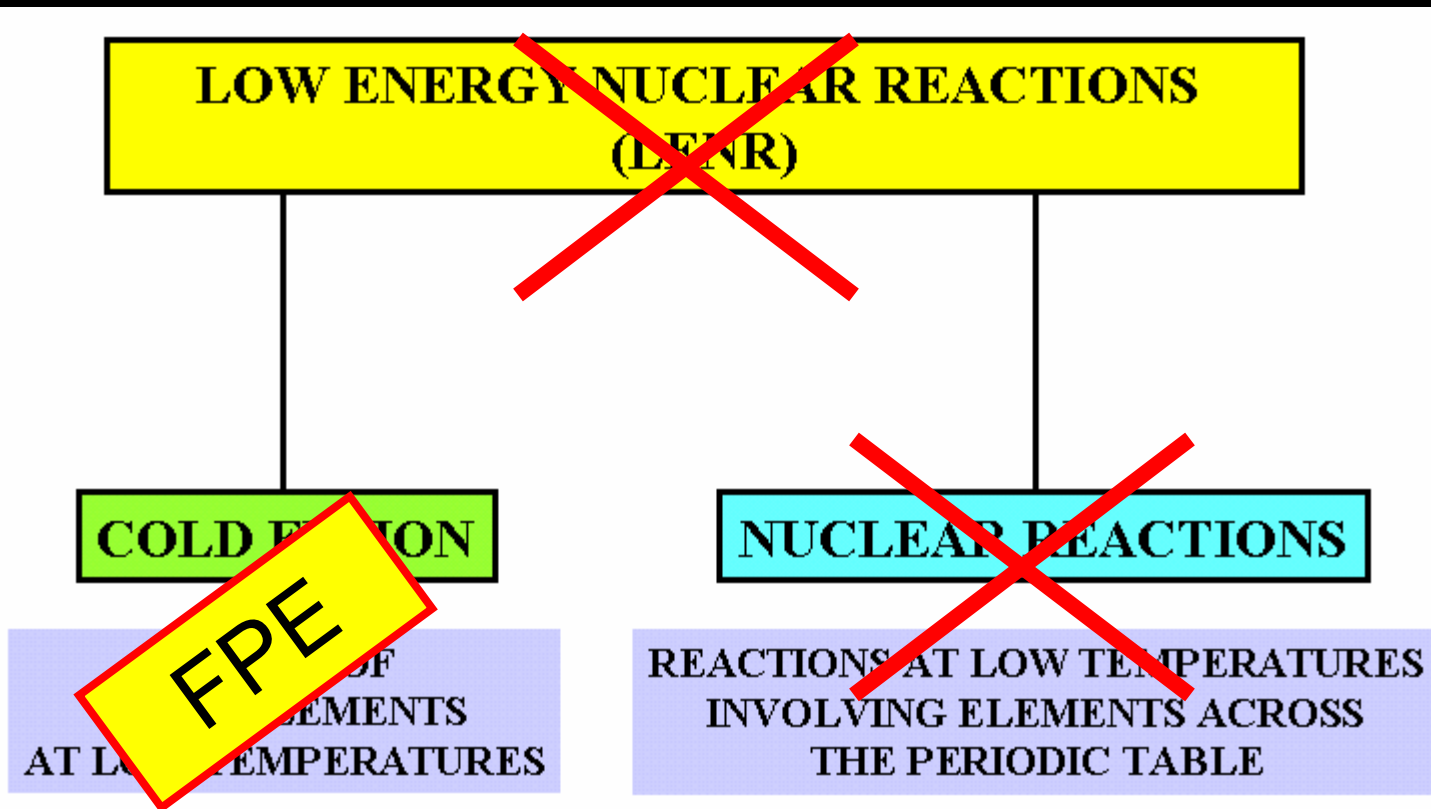
New Energy Times published the SRI M4 Investigation in Issue 34 on Jan. 29, 2010.

Post-Publication Response From Key Identified Parties

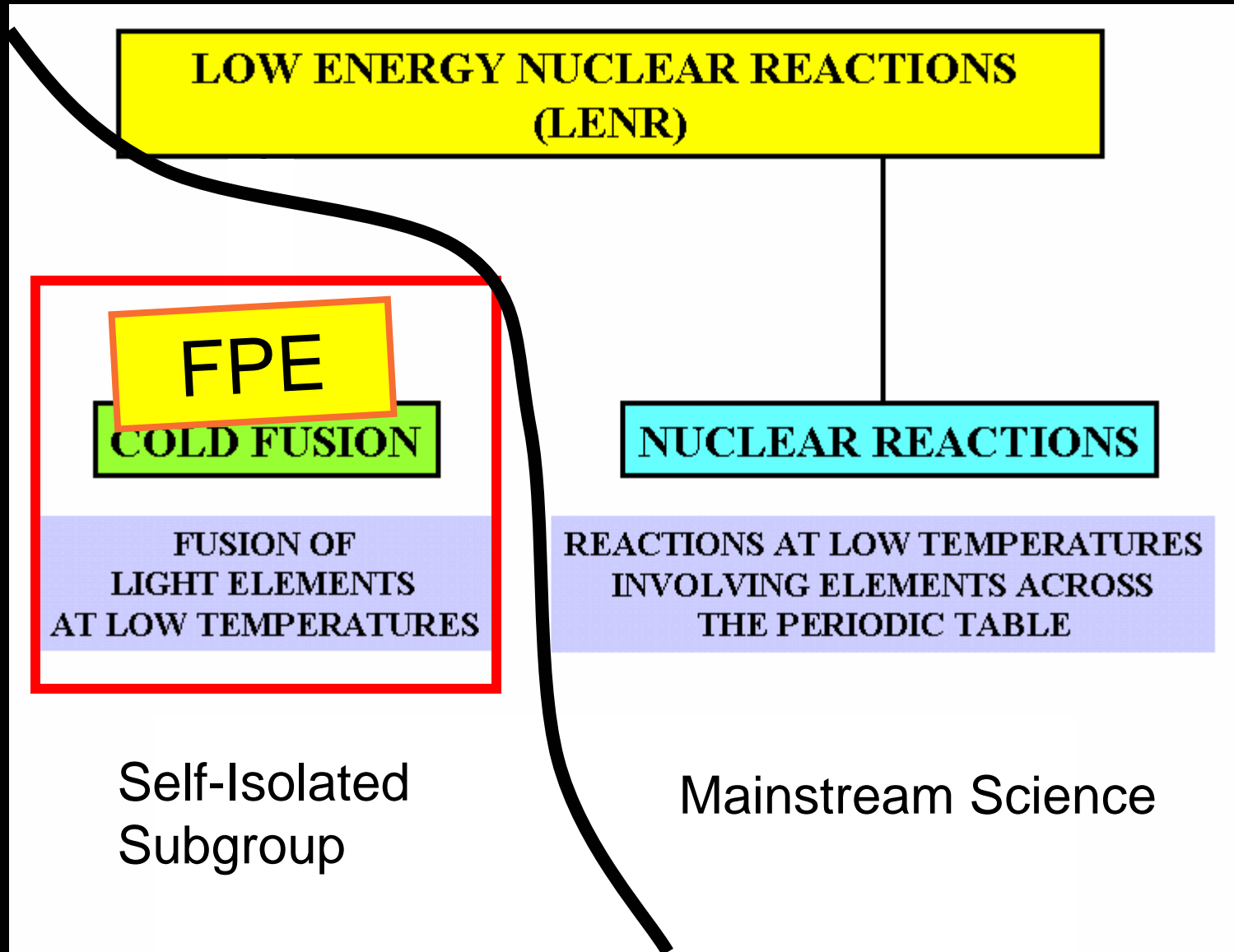
New Energy Times received no responses from Tanzella, Tripodi, McKubre or Hagelstein after the publication of issue 34.

Nagel and Melich 2008: FPE

<http://www.iccf-14.org/terminology.html>



Nagel and Melich 2012: FPE



This presentation was originally published on March 20, 2010.
Some text was modified on Jan. 3, 2012 in preparation for a remastered audio track for the accompanying video of these slides.

Slide 15 has been edited from "Can Neutron Capture Explain Creation of Neutrons?" to "Can Weak Interactions Explain Creation of Neutrons?"

Slide 54 has been edited to identify the source.

The response on Slide 64 has been edited to state "No."

Slide 59 has been edited to remove personal text about Mallove.

The slide that stated a comment from U.S. LENR researchers has been removed.

The slide that stated an opinion from this writer has been removed.