

# Low Energy Nuclear Reactions: 2007 Update

**Steven B. Krivit, Editor**  
***New Energy Times***

International Conference on Emerging Nuclear Energy Systems  
Istanbul, Turkey  
June 8, 2007

# “Cold Fusion”: Major Problems !

1. Poor repeatability
2. No replicators to support independent confirmation
3. Weak corroborative nuclear evidence
4. Gamma / neutron data was in error
5. Appeared to contradict laws of physics

# 18 Years Later ... LENR (Low Energy Nuclear Reactions)

1. High repeatability
2. U.S. Navy SPAWAR co-deposition - narrow replications
3. Excess heat and transmutations - broad replications
4. Expansive corroborative nuclear evidence
5. Proposed Widom-Larsen theory

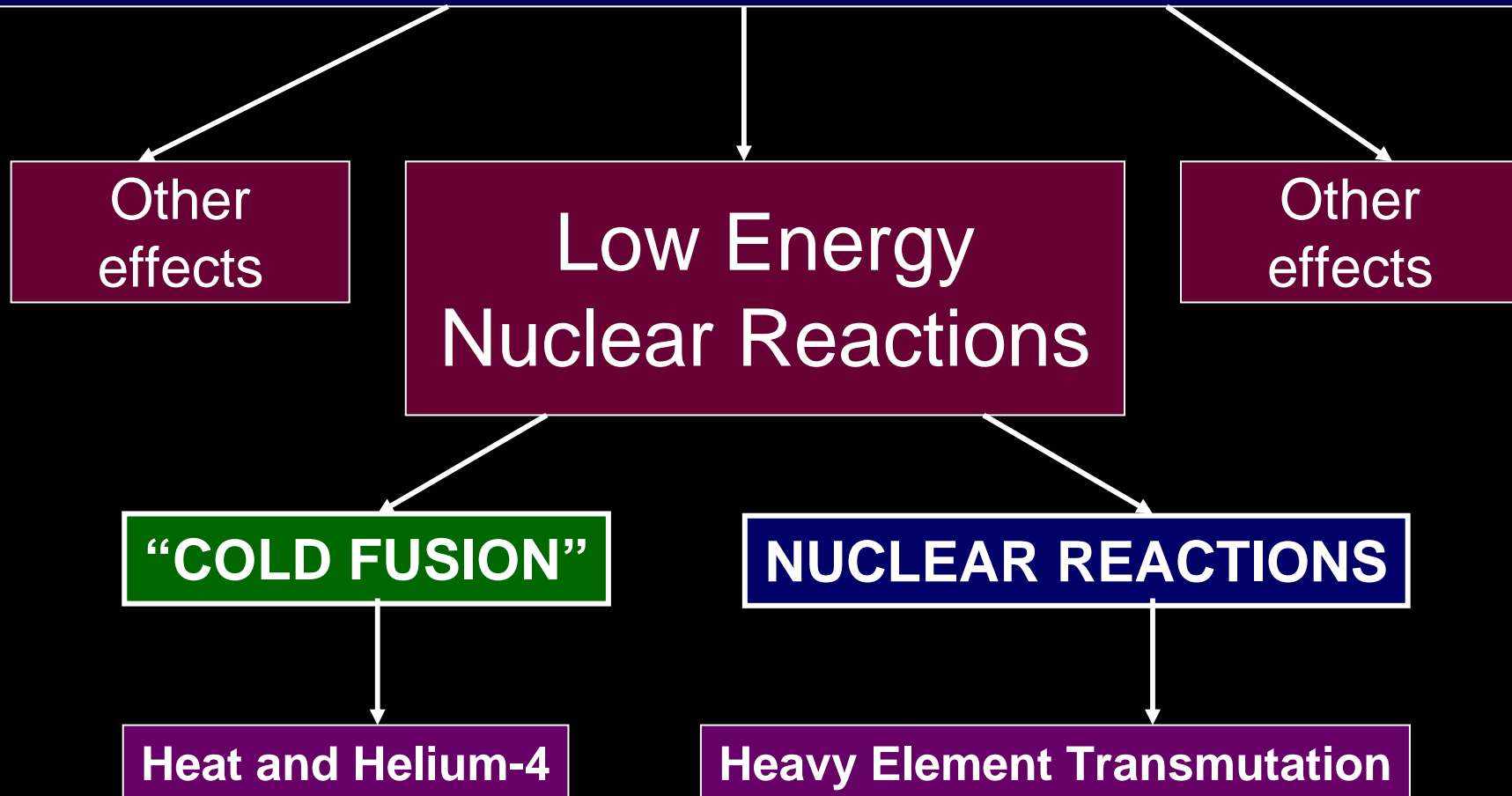
# Cold Fusion? Maybe, Maybe Not

Could be fusion ...

Could be something else ...

Either way – potentially significant

# Condensed Matter Nuclear Science



# Many Methods Claimed

For example:

- Electrolysis (3 methods)
- Gas (2 methods)
- Cavitation (3 methods)
- Others

# Threshold Parameters for the Excess Heat Reaction

(McKubre - SRI International)

1. Minimum Atomic Ratio D:Pd ( $> 0.90$ )
2. Minimum Current Density ( $250 \text{ mA/cm}^2$ )
3. Dynamic Trigger

It's a Materials  
Science Problem!

# U.S. Navy SPAWAR Co-Deposition CR-39 Nuclear Track Detector Experiment

- 1. Repeatable on Demand**
- 2. Tracks on front and back of CR-39 – both sets spatially correlated to cathode**
- 3. Emissions penetrate 1mm thick plastic**
- 4. “Dry” as well as “wet” geometries**
- 5. Energy calculations under way**

# Widom-Larsen Theory

## Highlights of Claims:

1. Not fusion/fission; weak interactions
2. Explains most anomalous experimental data in "cold fusion"
3. Matches Miley, possibly Iwamura data
4. Explains light and heavy hydrogen experiments
5. No "new physics"

[www.newenergytimes.com/wltheory](http://www.newenergytimes.com/wltheory)

# Nuclear Ash

Products/Effects	D/Pd	H/Pd
Heat	$10^{12}$ events/s/W	Minor
Helium-4	$10^{11}$ events/s/W	n/a
Tritium	$10^4$ events/s	n/a
(Fast? Slow?) Neutrons	Uncertain	Uncertain
Charged Particles	Yes	Uncertain
Heavy Element Transmutation	Minor	Major
Gamma-Rays	Yes	Unknown
X-Rays	Yes	Unknown
Hot Spots on Cathodes	Yes	Unknown
Craters, Melting, Vaporization	Yes	Unknown

[www.newenergytimes.com](http://www.newenergytimes.com)

[www.LENR.org](http://www.LENR.org)

## New Energy Times Magazine

Phone: (310) 721-5919

[steven1@newenergytimes.com](mailto:steven1@newenergytimes.com)

**ICCF-13**

**Sochi, Russia**

**June 25-29, 2007**

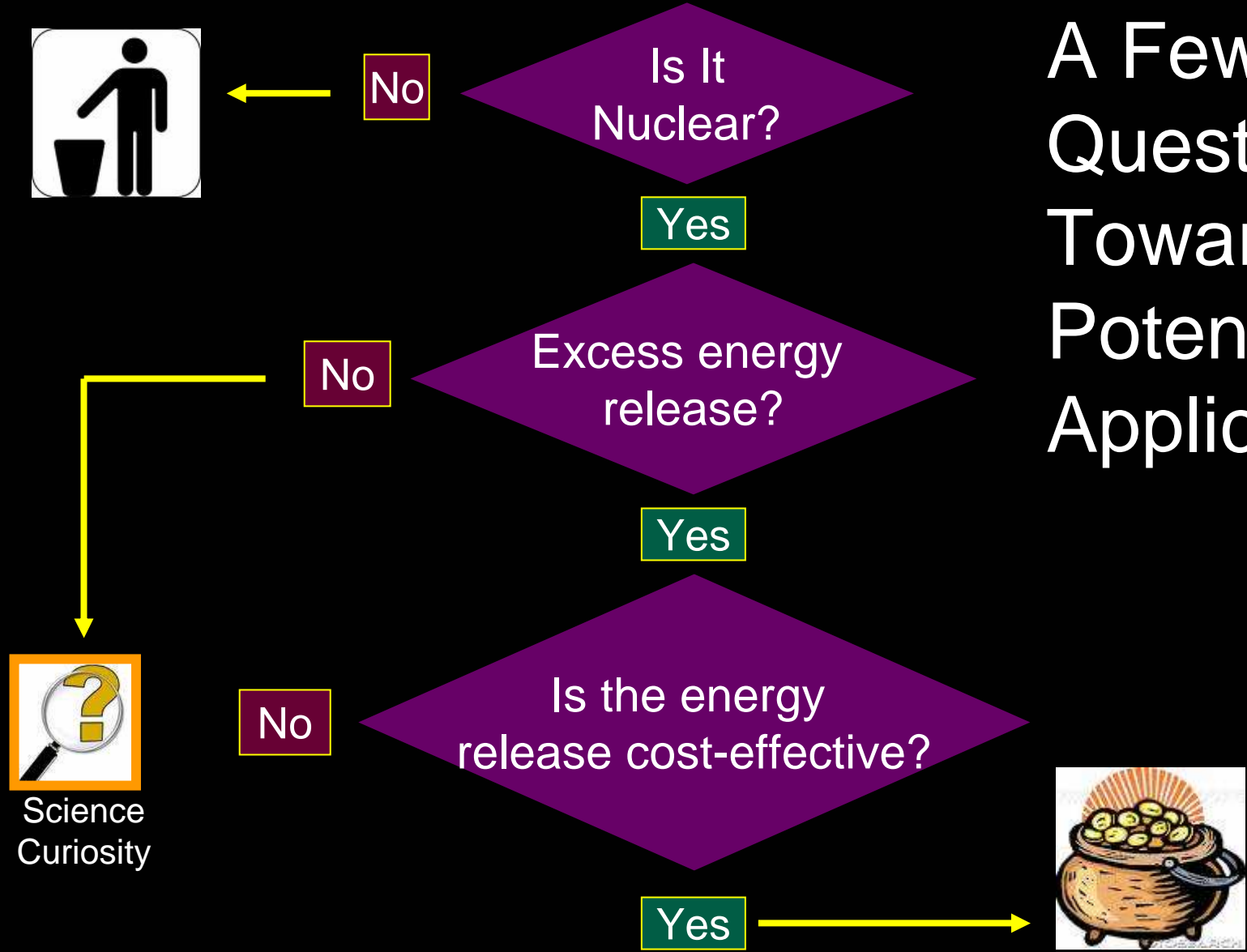
**ICCF-14**

**Washington, D.C.**

**2008 (date TBA)**

# EXTRA SLIDES

# A Few Questions Toward Potential Application



No

Is It Nuclear?

Yes

No

Excess energy release?

Yes

No

Is the energy release cost-effective?

Yes



Science Curiosity



# Selected Excess Heat Claims

Ref	Name	Year	Max.Excess Heat	% Excess Heat	Time	Excess Energy
1	Arata	1999	10w	No data	2000h	No data
2	El-Boher #56	2004	3.5w	80%	300h	3.1Mj
<b>2</b>	<b>El-Boher #64a</b>	<b>2004</b>	<b>34w</b>	<b>2500%</b>	<b>17h</b>	<b>1.1Mj</b>
<b>2</b>	<b>El-Boher #64b</b>	<b>2004</b>	<b>32w</b>	<b>1500%</b>	<b>80h</b>	<b>4.6Mj</b>
3	Stringham	2004	40w	No Data	No Data	No Data
4	Takahashi	1992	130w	70%	1440h	No Data

See appendix E for references

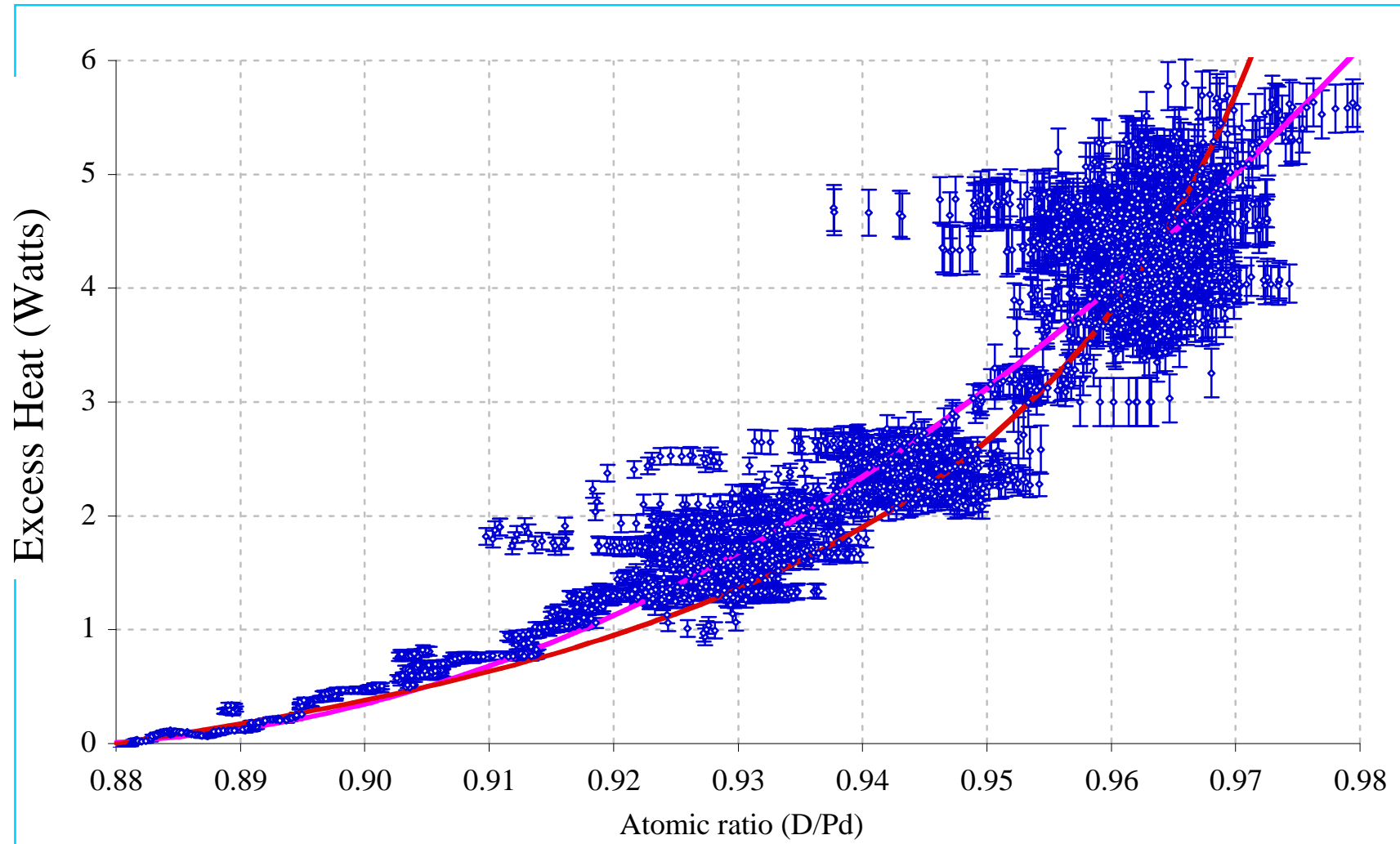
# Overview of the LENR Field

- 55 peer-reviewed journals
- 12 International Conferences
- 28 Regional Conferences
- 6 Recent books [Storms (in press), Kozima, Krivit/Winocur, Beaudette, Mizuno, Vysotskii/Kornilova]
- 200 researchers
- 13 nations

# Excess Heat vs. Loading Ratio

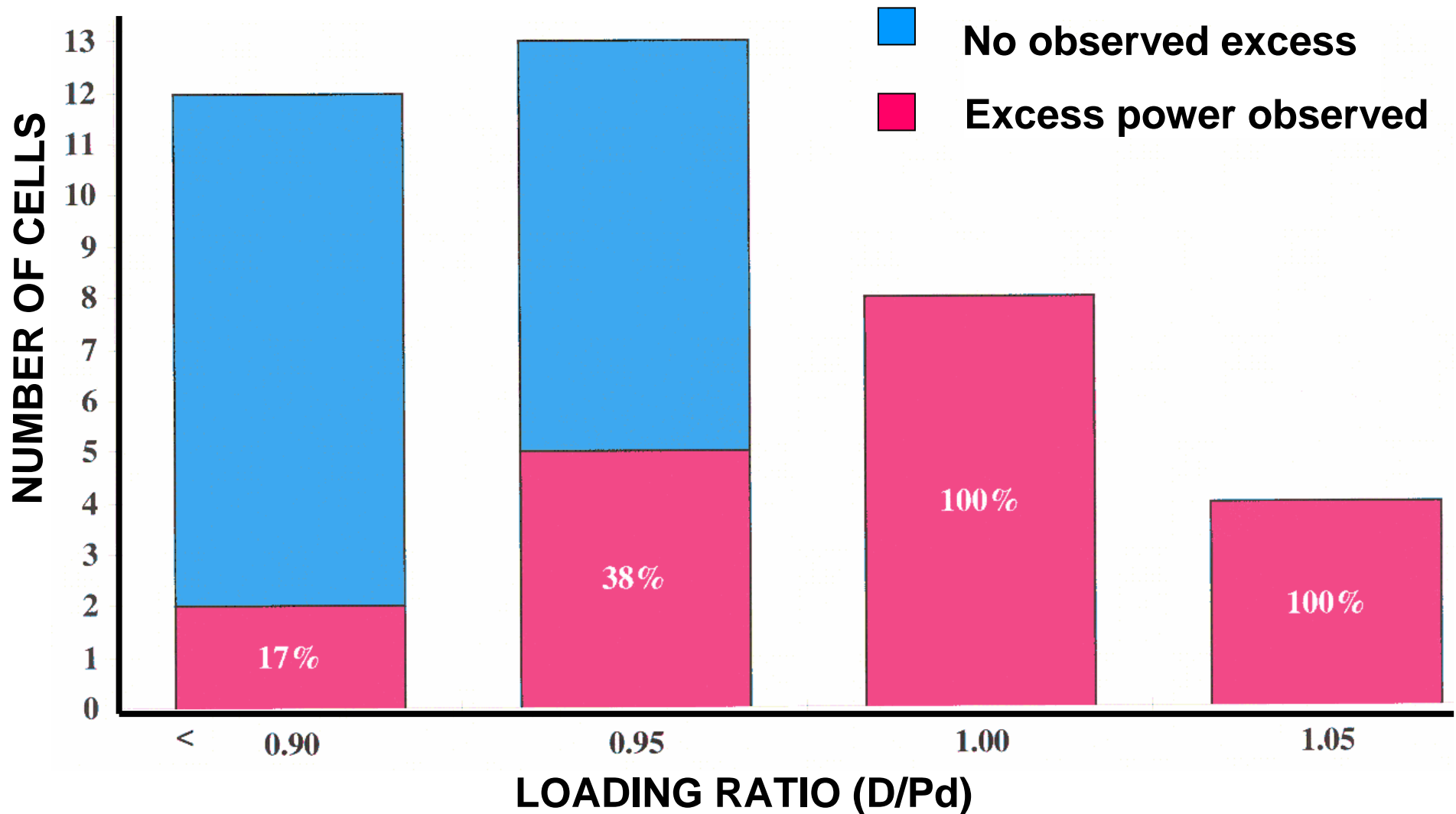
(Qualitative Analysis)

(McKubre - SRI International)

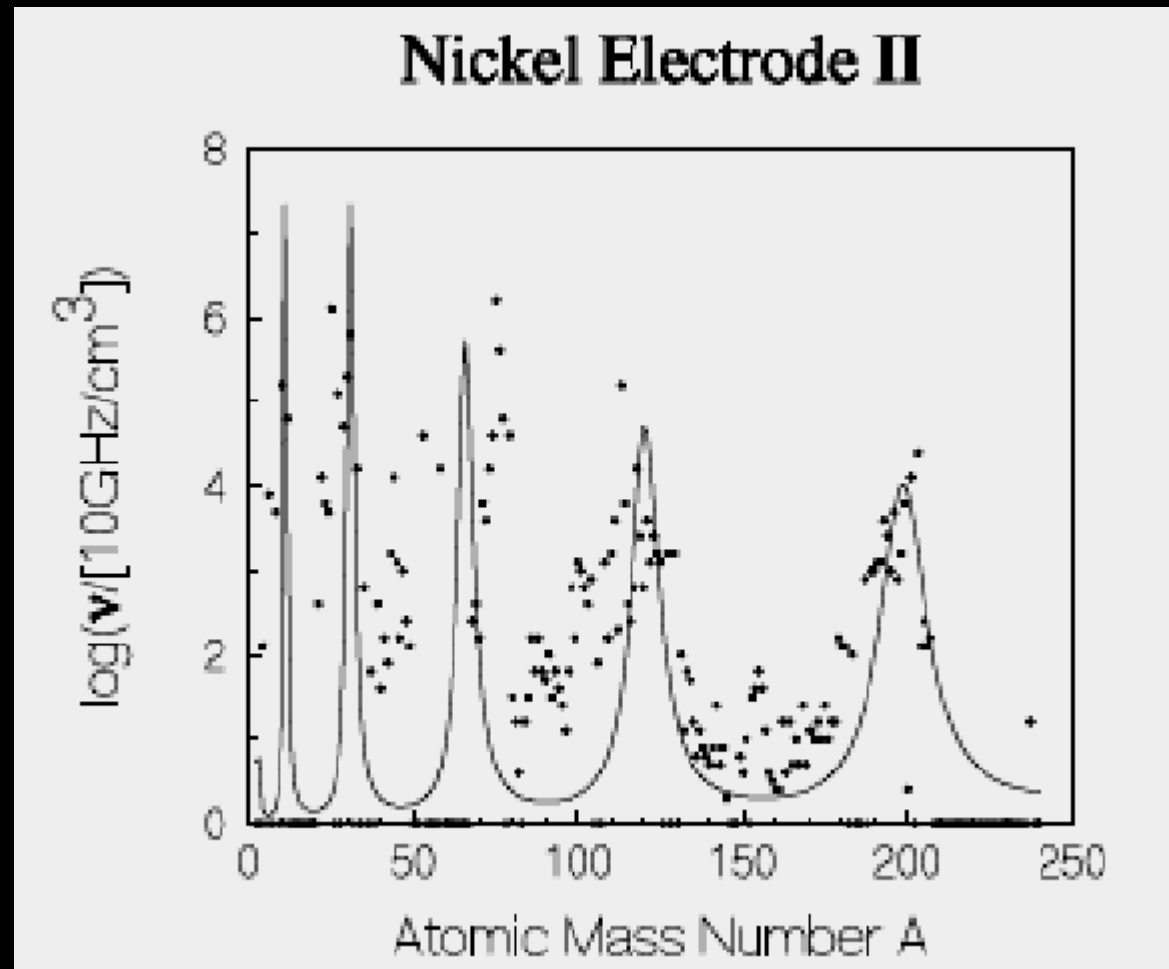


# Cells Showing Excess Heat vs. Loading Ratio

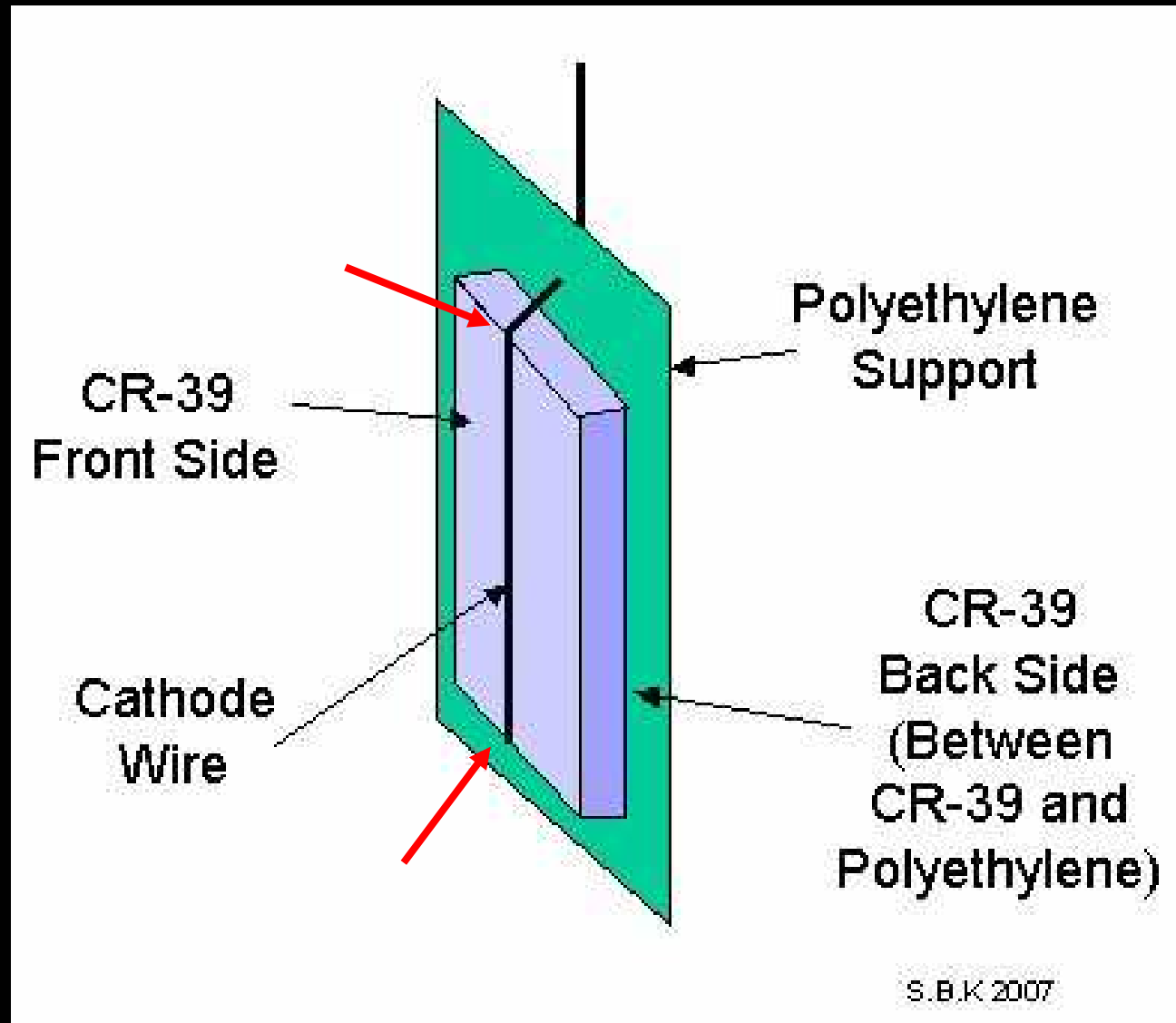
(Quantitative Analysis)  
(McKubre - SRI International)



# Widom-Larsen Theory Vs. Miley Experiment



# CR-39 – Cathode Assembly



# Tritium Spiking?

[www.sciencefabrication.com](http://www.sciencefabrication.com)

# Widom-Larsen Theory: Not Fusion!

Possibly answers Huizenga's "Three Miracles"

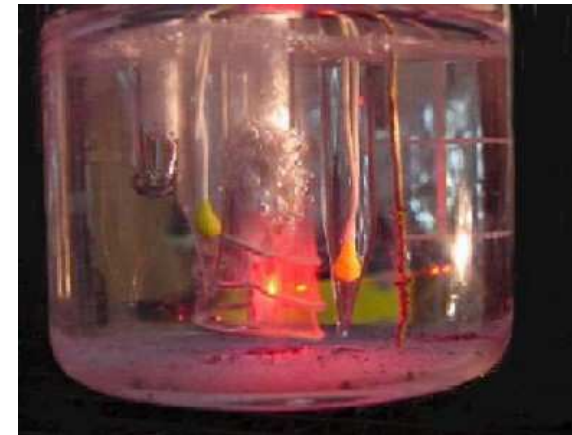
- 1) The lack of strong neutron emissions
- 2) The mystery of how the Coulomb barrier is penetrated
- 3) The lack of strong emission of gamma or x-rays.

# Hydrogen Fusion Energy Density

One drop of heavy water, made from deuterium, contains the equivalent energy of 48 gallons of gasoline.

# Threshold Parameters for the Excess Heat Reaction

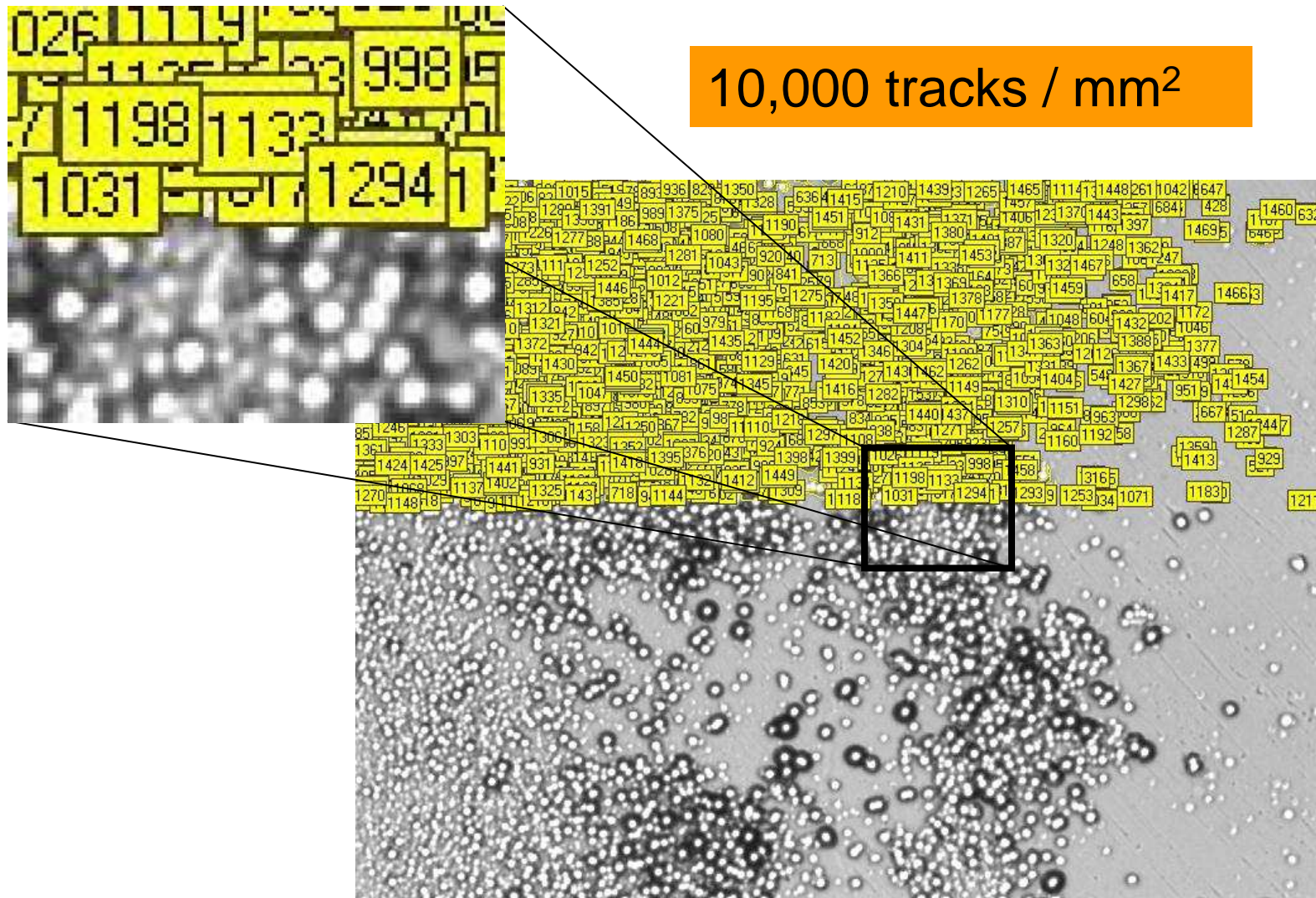
1. Minimum Atomic Ratio D:Pd ( $> 0.90$ )
2. Minimum Current Density ( $250 \text{ mA/cm}^2$ )
3. Dynamic Trigger
  - Δ Temperature
  - Δ Current flow
  - Δ Laser Irradiation
  - Δ External Electrical Field
  - Δ External Magnetic Field



Letts-Cravens  
Laser Effect

# SPAWAR San Diego Research

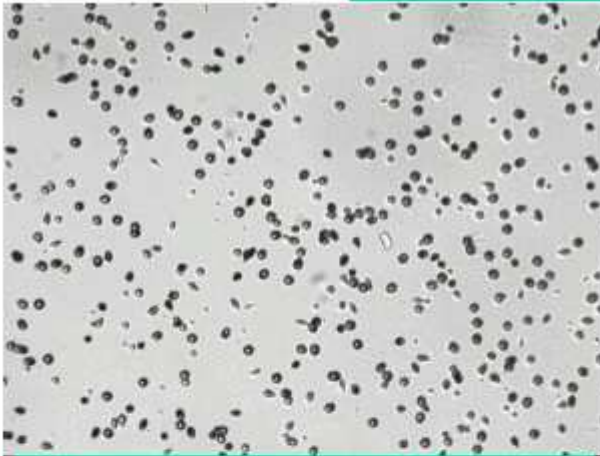
Szpak, Mosier-Boss, Gordon



# SPAWAR San Diego Research

Szpak-Mosier-Boss-Gordon

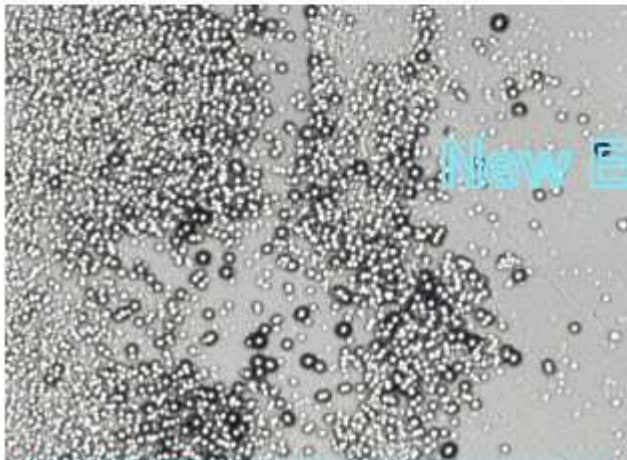
## CR-39 Scanning Analysis



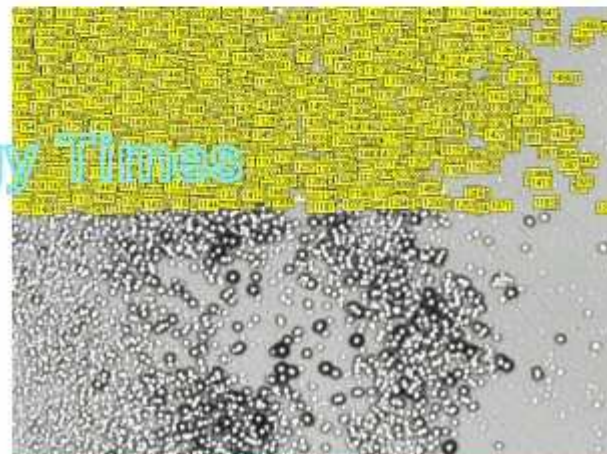
Tracks from Uranium-238 control



Track counting from Uranium-238



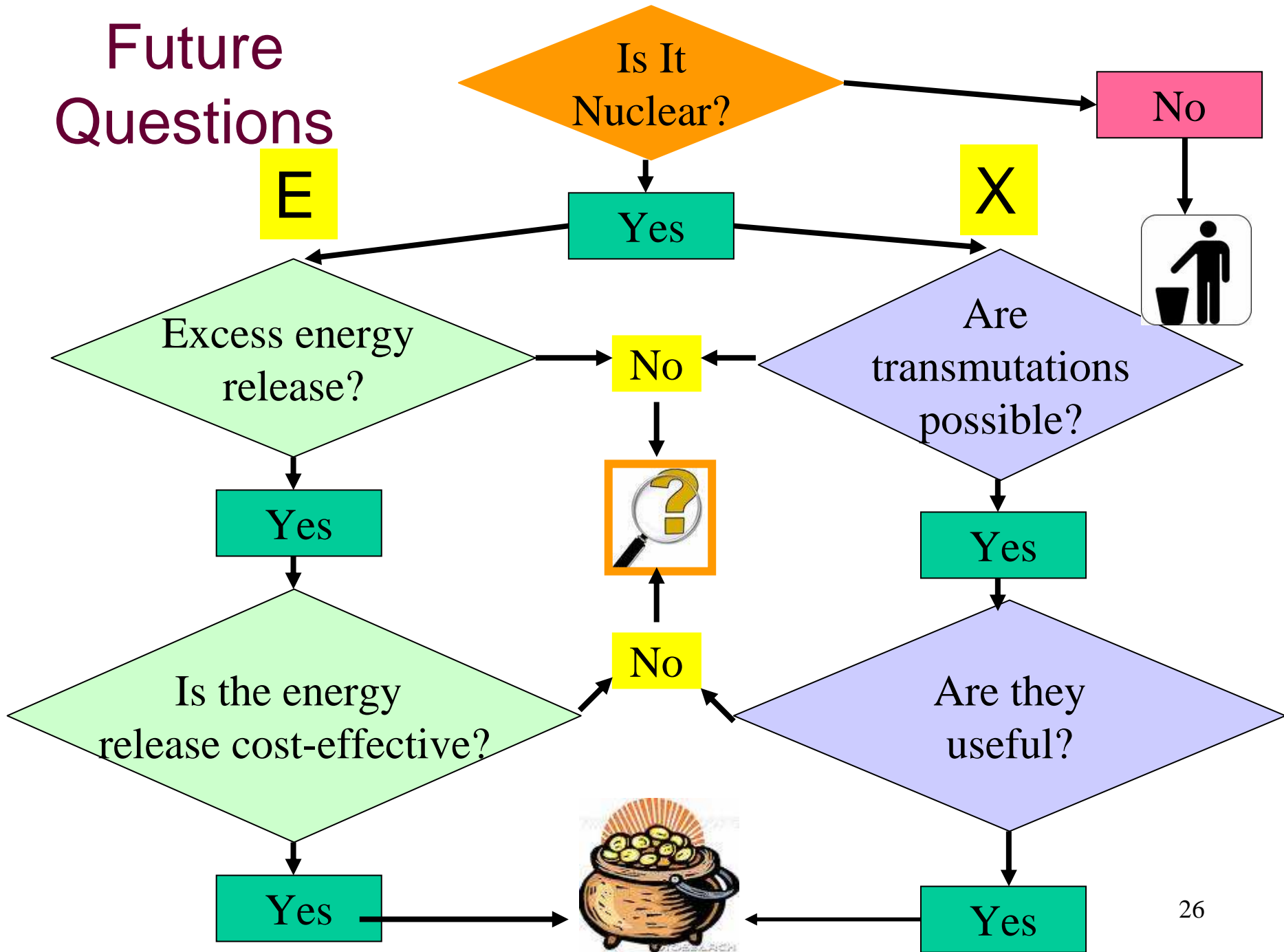
Tracks from LENR experiment



Track counting from LENR experiment

New Energy Times

# Future Questions



# SCIENCE SOCIOLOGY

# No Joy with the Journals

## **Refusal #1 to send out for review:**

"[The authors] would be best advised to seek publication elsewhere. I can only speak for [our journal], and we wouldn't want it, but I doubt that they'd get much joy at [our other journals], sorry."

## **Refusal #2 to send out for review:**

"We are not persuaded that the firm conclusions that can be drawn from this current work will have a sufficiently immediate impact on our broader readership to justify publication."

# No Joy with the Journals

## **Refusal #3 to send out for review:**

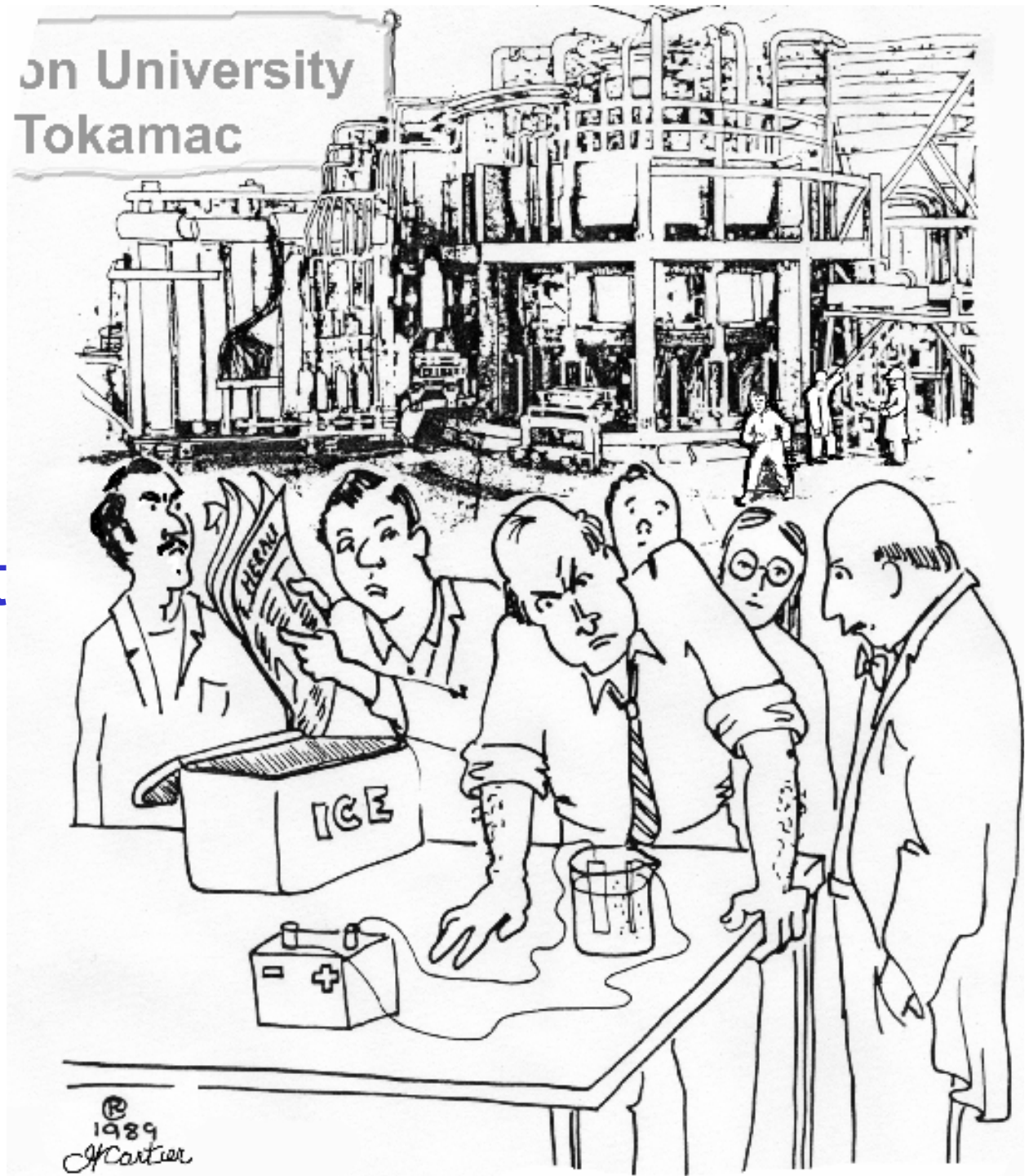
"While your observations of charged particles emitted during electrolysis may well be of some interest to others in the field, I am afraid that, based on the brief information provided, we are not persuaded that these specific results will be of sufficiently immediate and general conceptual and fundamental interest to a wide materials research readership or represent a sufficient technological advance. ... I hope you will rapidly receive a more favourable response elsewhere."

# Proof is Overrated



# Fear is Under-rated

“If this doesn't work we're going to look pretty silly.”



# New Science is Not Easy

“We searched for neutrons, gammas,  
X-rays, Helium, heat and found  
nothing” (Nathan Lewis, Caltech)

Lewis' D/Pd Loading ratio did not  
exceed 0.80

# New science is not for people fearful of violent opposition

- “Incompetent”

- “Delusional”

- “Charlatan”

- “Fraud”

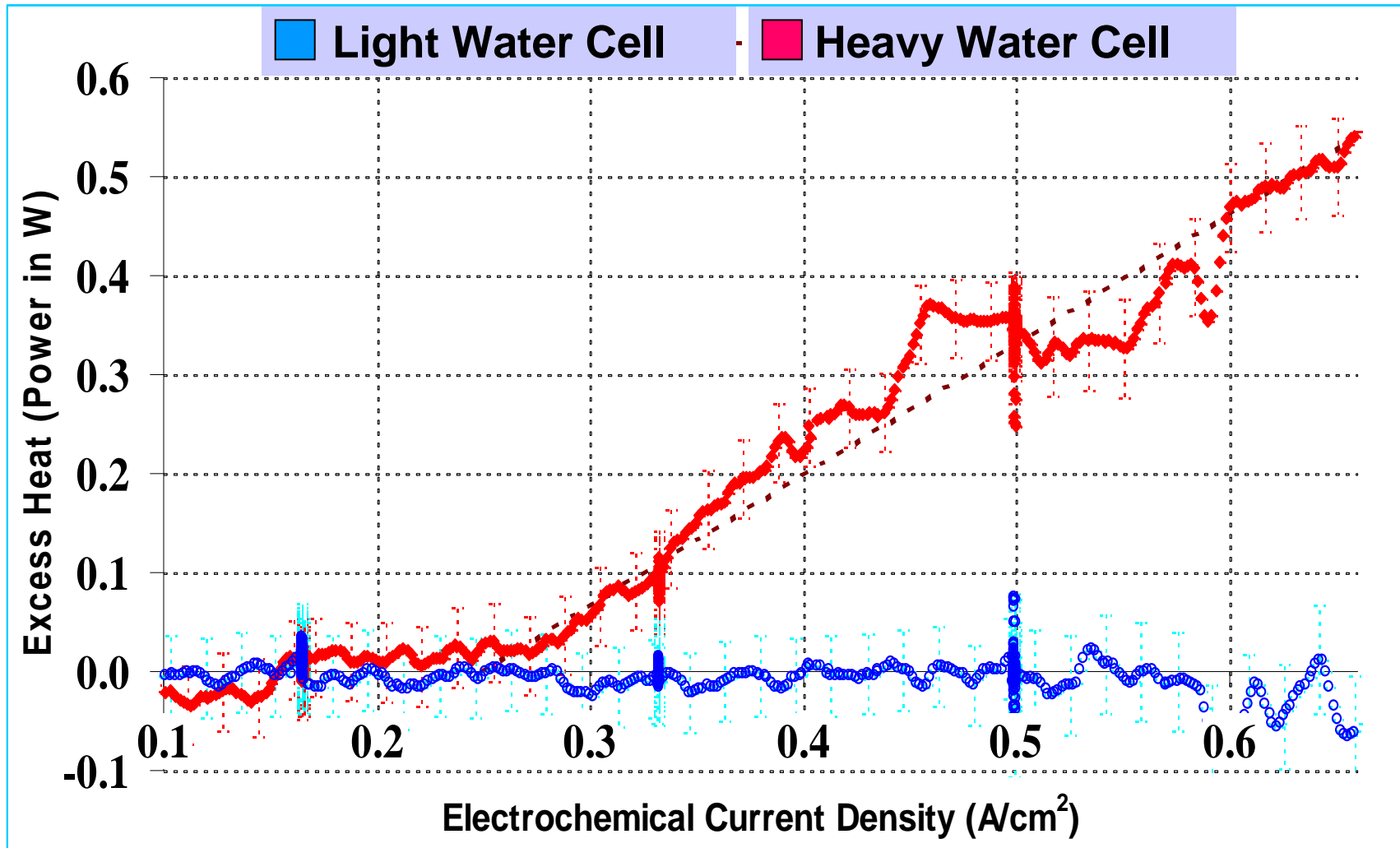
New science is not for people  
fearful of change

"If cold fusion is true, then all of  
this is wrong."

-Moshe Gai, Yale University

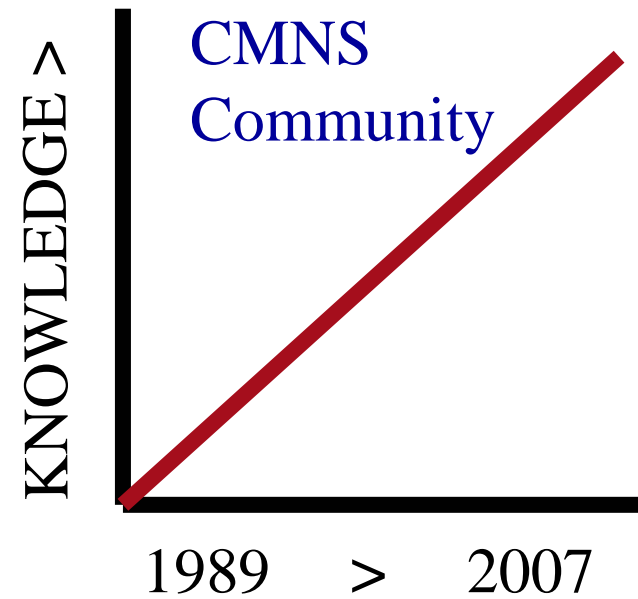
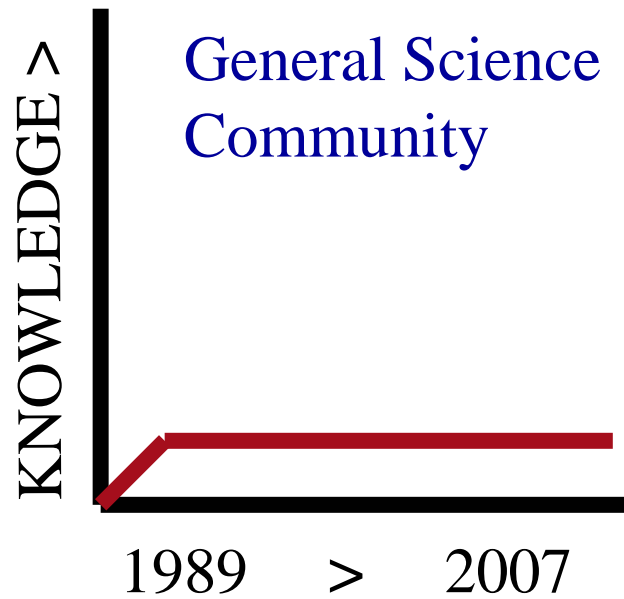
# Excess Heat vs. Current Density into Pd Cathode

(SRI International)

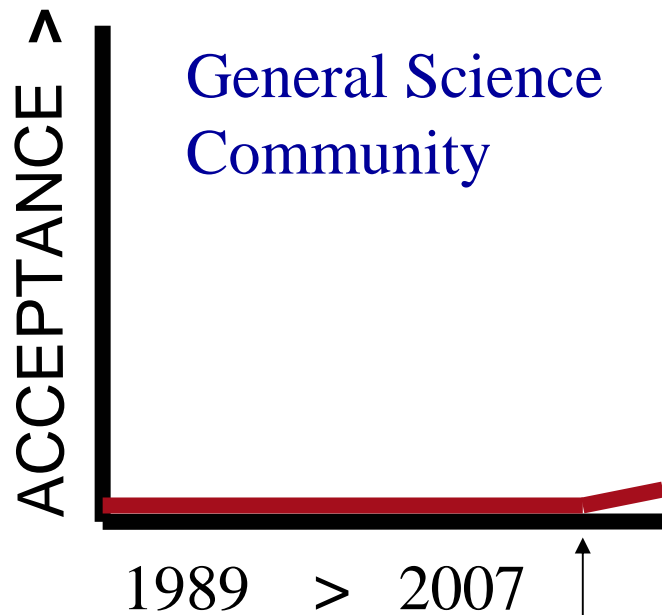


# TRENDS

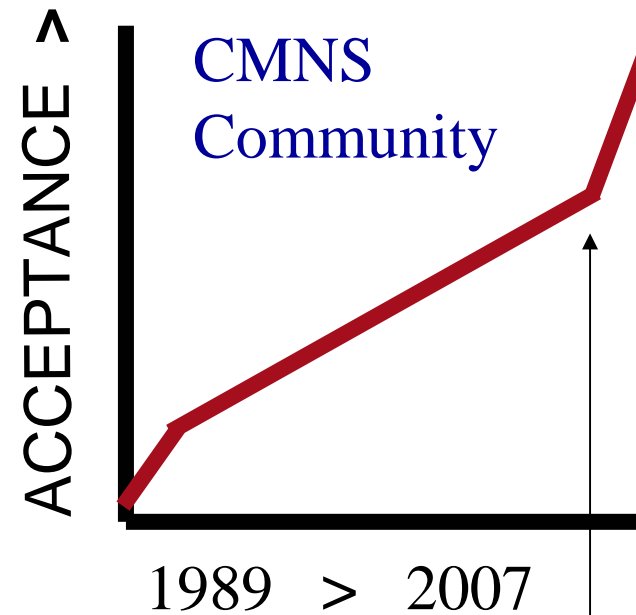
# Knowledge Base



# Acceptance of Nuclear Claim

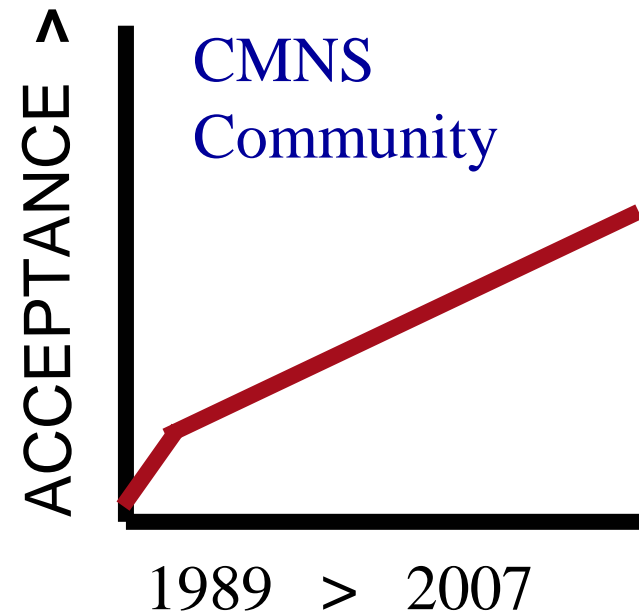
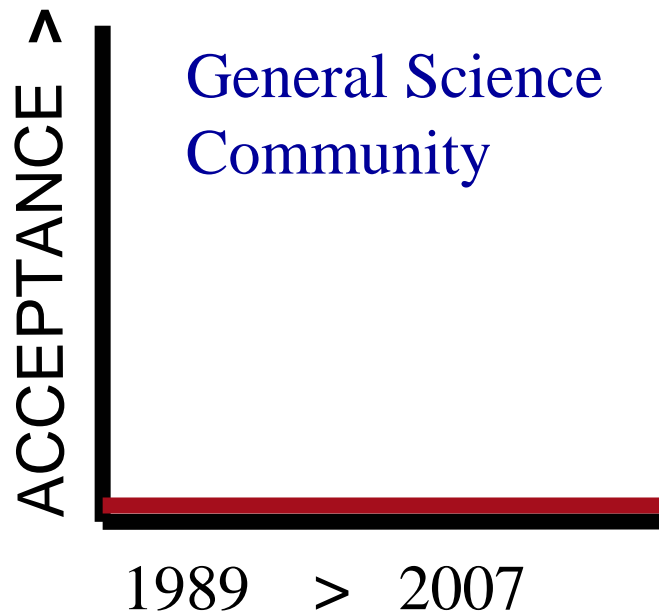


SPAWAR, 8/2/2006



SPAWAR, 8/2/2006

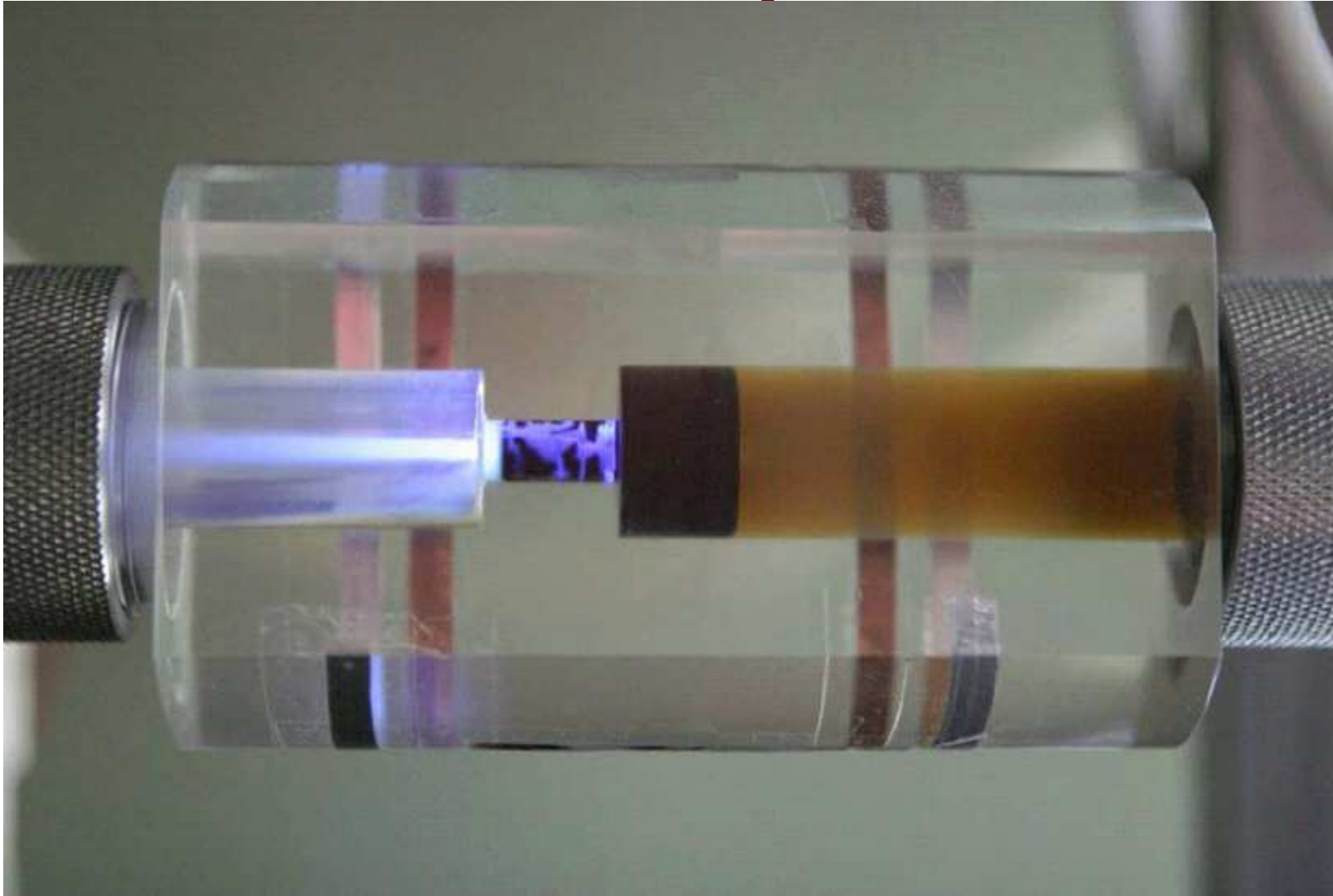
# Acceptance of Excess Heat Claim



# ADDITIONAL DATA

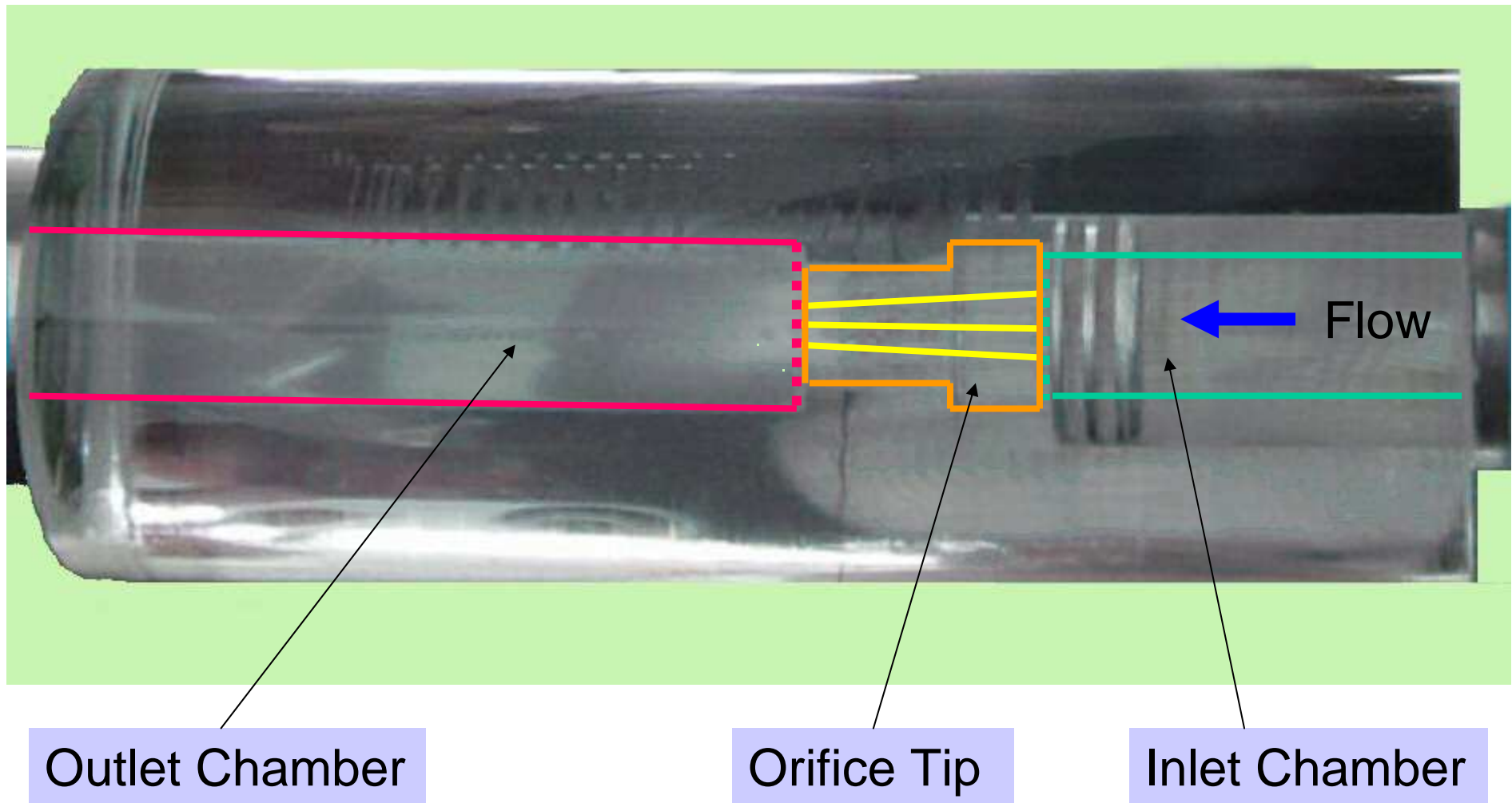
# Hydraulic-Electrostatic Method

Koldamasov-Yang et al.



# Hydraulic-Electrostatic Method

Koldamasov-Yang et al.



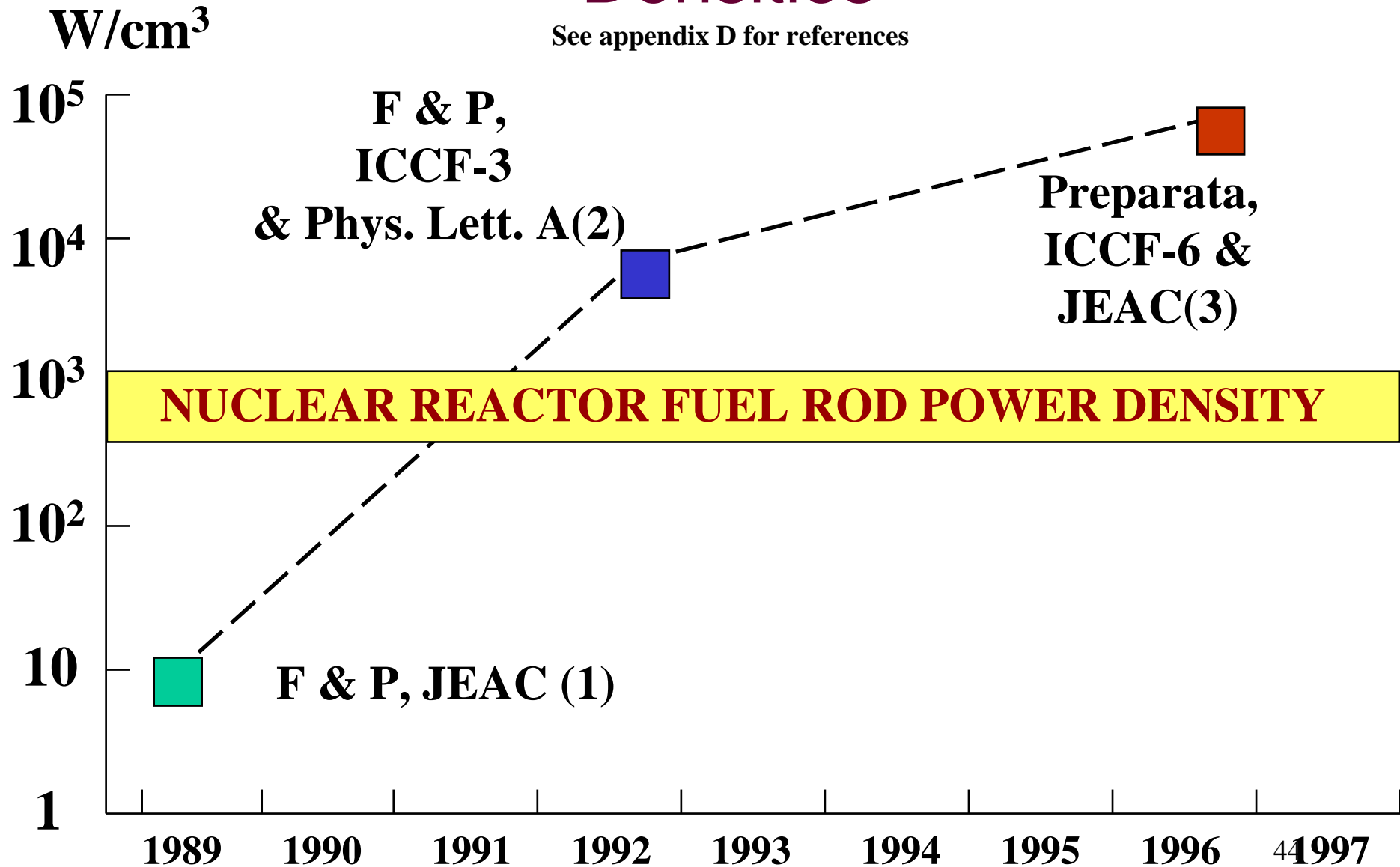
# Widom-Larsen Theory

The Widom-Larsen theory seeks to understand and predict LENR phenomena by postulating the creation of extremely cold neutrons that facilitate low energy nuclear reactions. This theory does not need to explain how to overcome the Coulomb barrier repulsion problem because neutrons have no charge.

In contrast to other fusion- or fission-based theories that involve Coulomb barrier penetration and the strong interaction, this approach primarily involves the weak interaction. It extends electroweak theory within the context of the Standard Model to include collective effects in condensed matter systems.

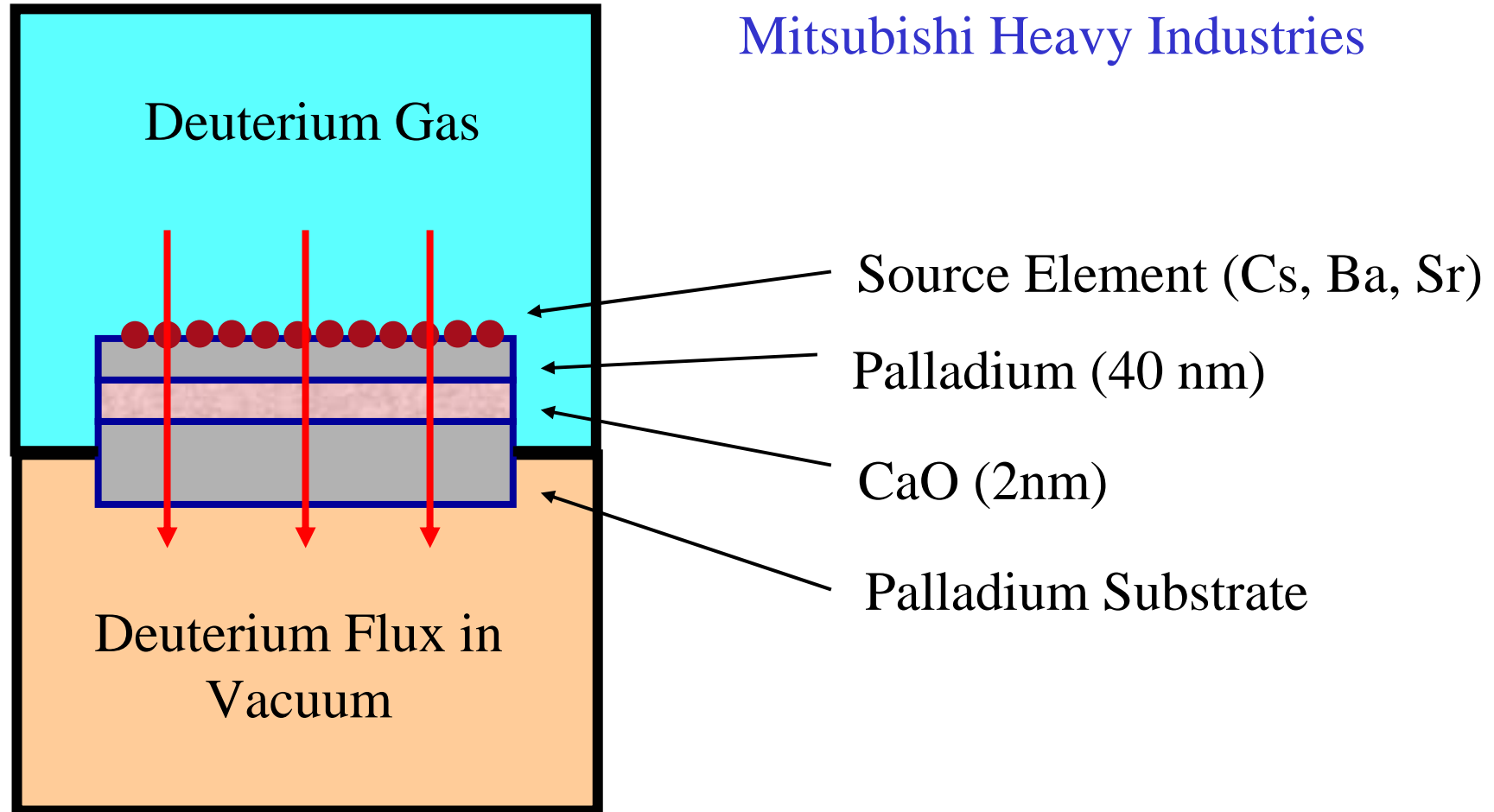
# Cold Fusion Volumetric Power Densities

See appendix D for references



# Nuclear Transmutation at Low Energies Using Gas Permeation

Iwamura et al.,  
Mitsubishi Heavy Industries



# Selected Transmutation Studies

Iwamura, Y., et al., "Elemental Analysis of Pd Complexes: Effects of D<sub>2</sub> Gas Permeation,"  
Jpn. J. Appl. Phys. Vol. 41 (2002) pp. 4642–4650

<http://lenr-canr.org/acrobat/IwamuraYelementalaa.pdf>

Higashiyama, T., "Replication Of MHI Transmutation Experiment..."

<http://lenr-canr.org/acrobat/Higashiyamreplificatio.pdf>

## **Iwamura's Presentation at ICCF-11 Short Course October 31, 2004**

“Nuclear transmutation induced by deuterium permeation through the Pd complexes detected by surface and bulk analysis methods.”

<http://newenergytimes.com/Library/2004IwamuraY-ICCF11Class-NuclearTransmutation.pdf>

<http://newenergytimes.com/Library/2004IwamuraY-ICCF11Class-PdComplex.pdf>

<http://newenergytimes.com/Library/2004IwamuraY-ICCF11-TheRoleOfCaO.pdf>



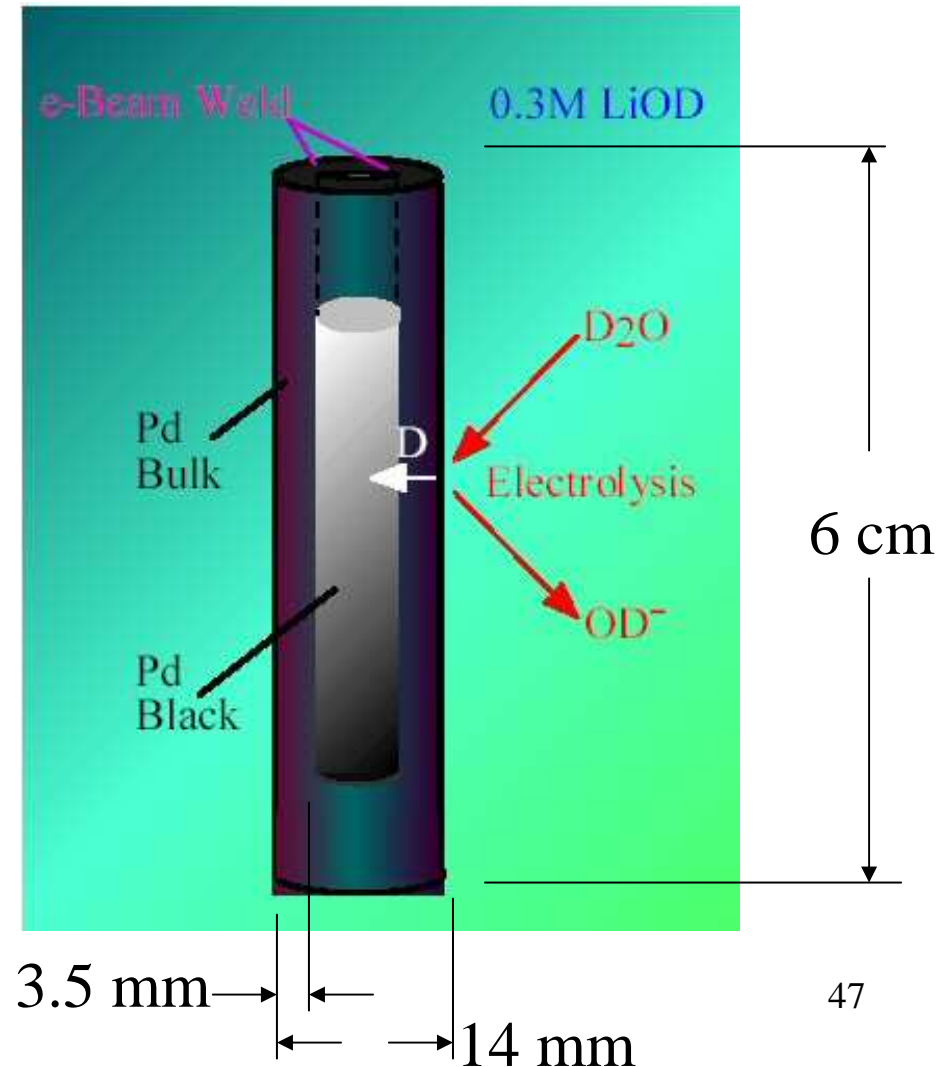
Yasuhiro Iwamura,  
Mitsubishi Heavy  
Industries 46

# Excess Energy and Helium from Double-Structure Cathode

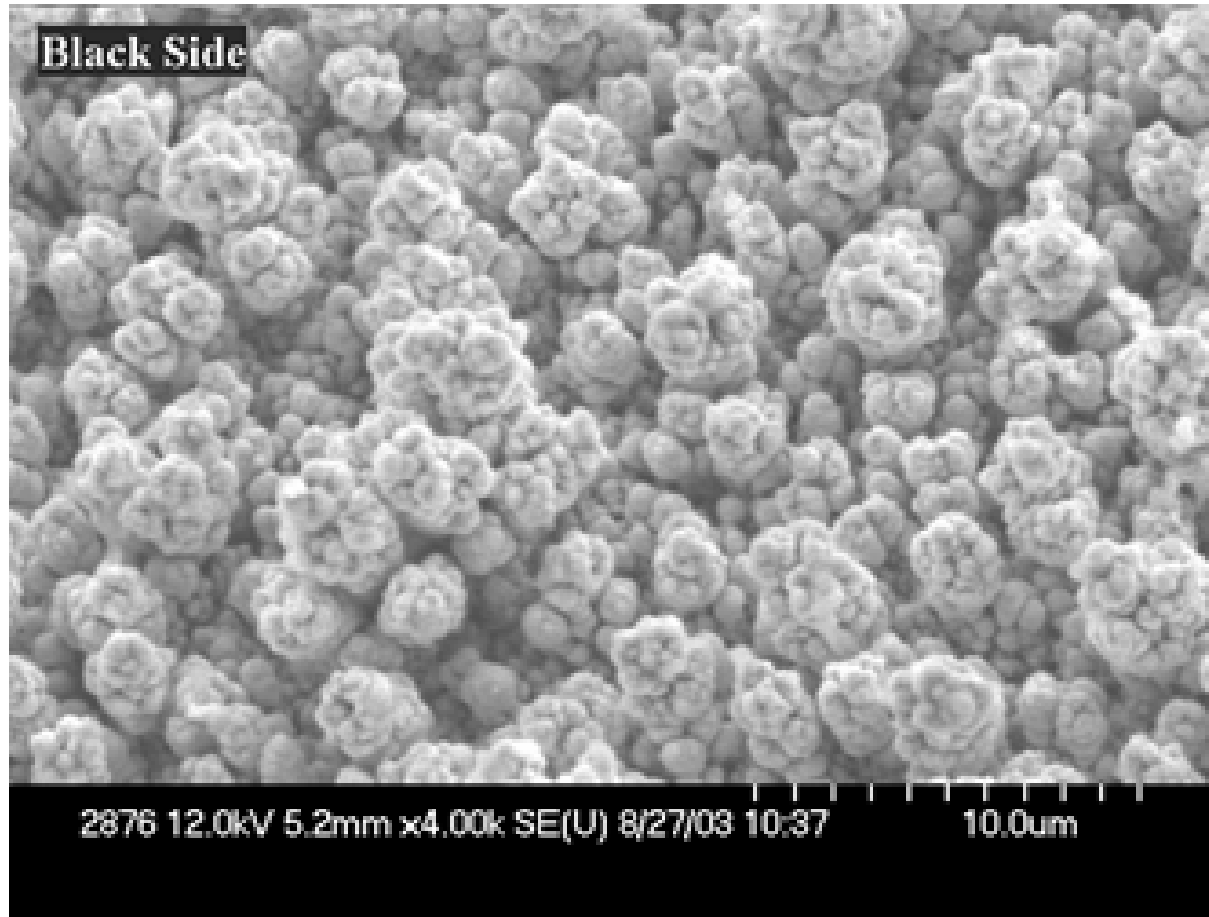
Arata/Zhang, Osaka University

McKubre et al.  
SRI International

“Pd-Black,” fine nano-powders of about 20nm diameter, are placed into void inside Pd bulk.

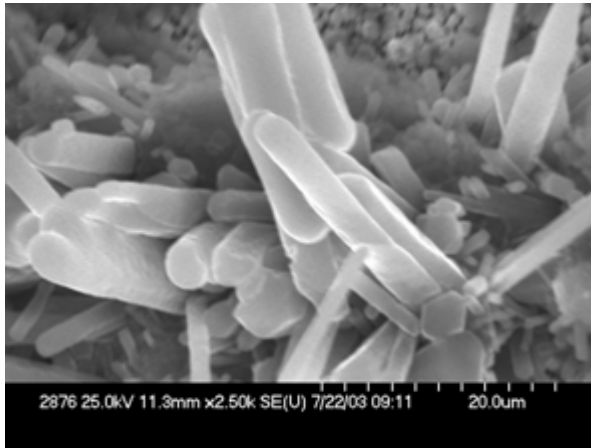


# Morphological Changes – (Before)(Szpak et al).

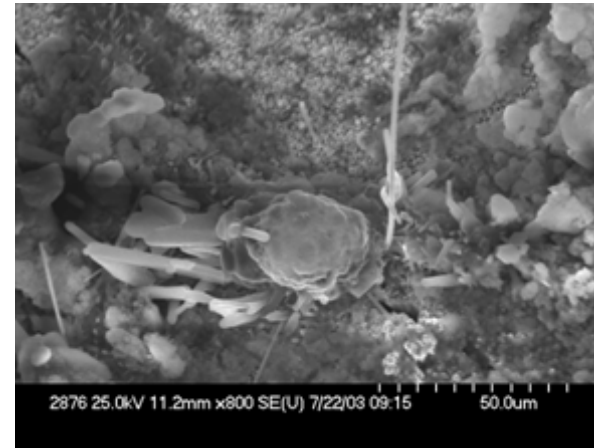


**Pd/D structure before application of external Electric field.  
Shows uniform, 'cauliflower-like' morphology of globules**

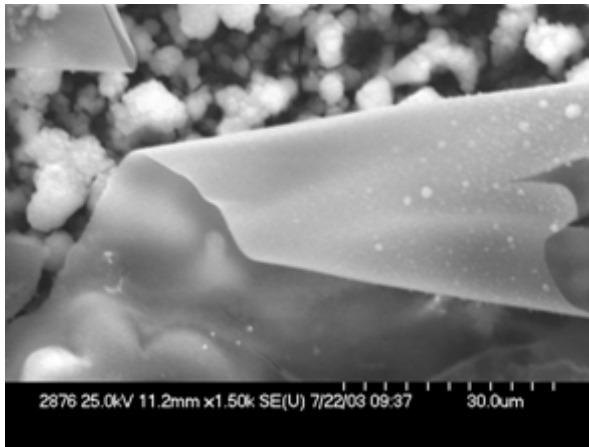
# Morphological Changes – (After)(Szpak et al).



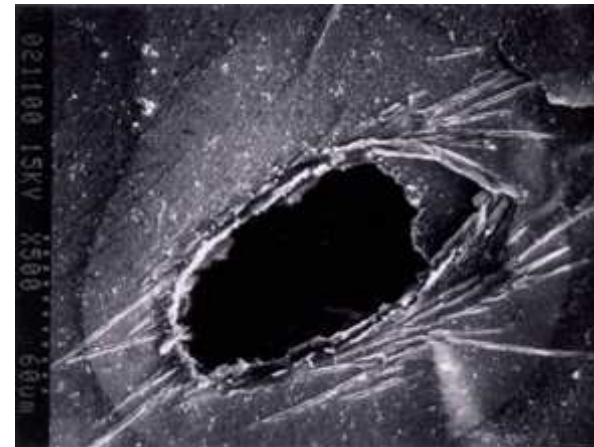
**Rods (circular and square)**



**Long wires**



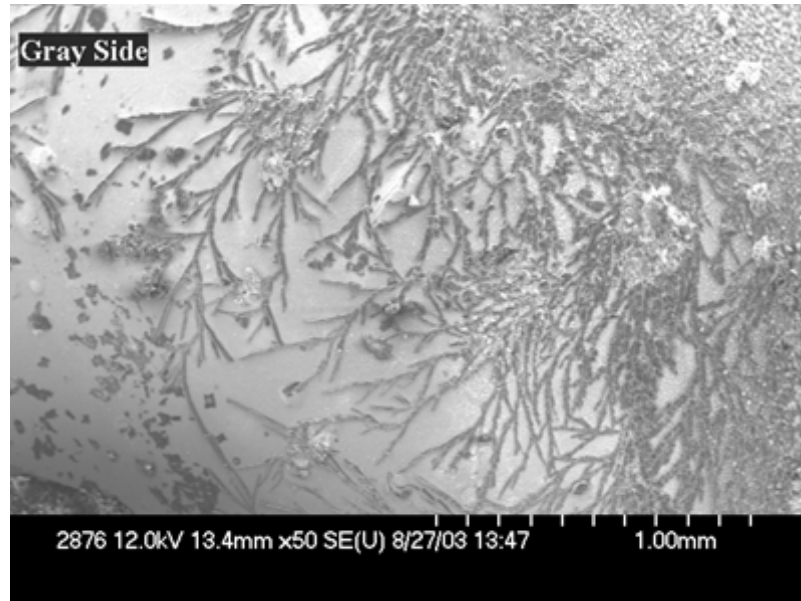
**Folded thin film**



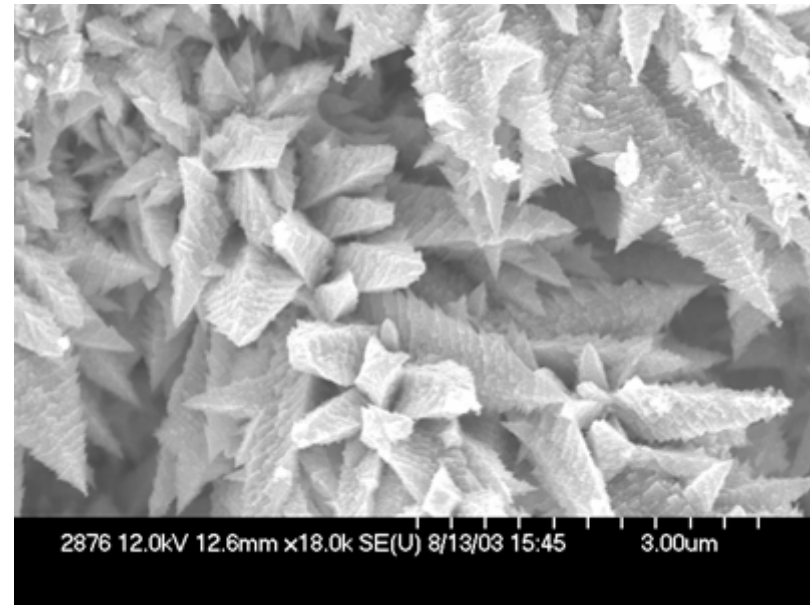
**Crater**

# Morphological Changes – (After)(Szpak et al).

**Formation of fractals  
(branches)**



**Production of dendritic growth**



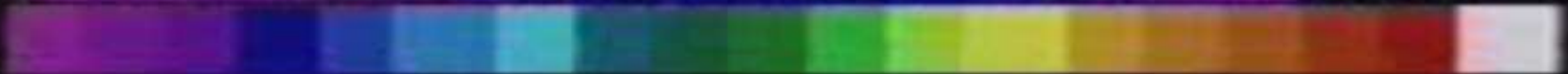
**These features are the result of the combined action of:**

- (1) Current flow through a porous structure**
- (2) Evolving deuterium**
- (3) The electric field on the separated micro-globules suspended in the electrolyte and restricted by the porous structure**

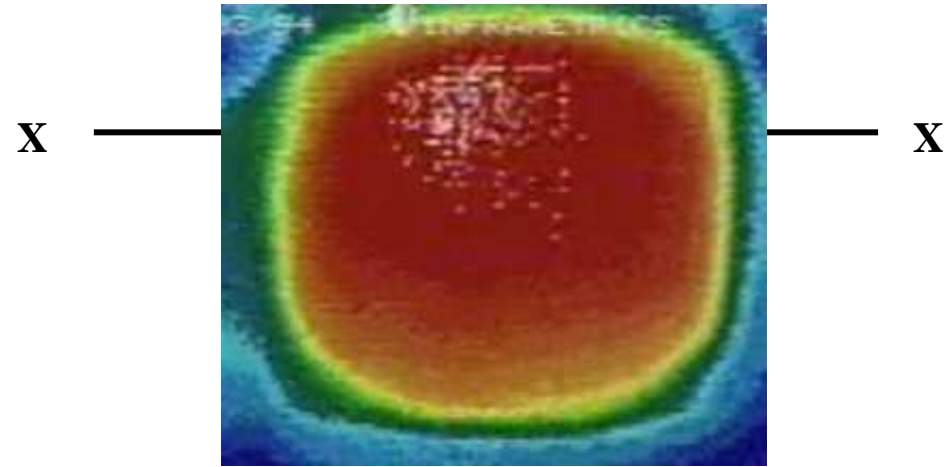
# Hot Spots on Cathode

< Cathode: 2.5cm >

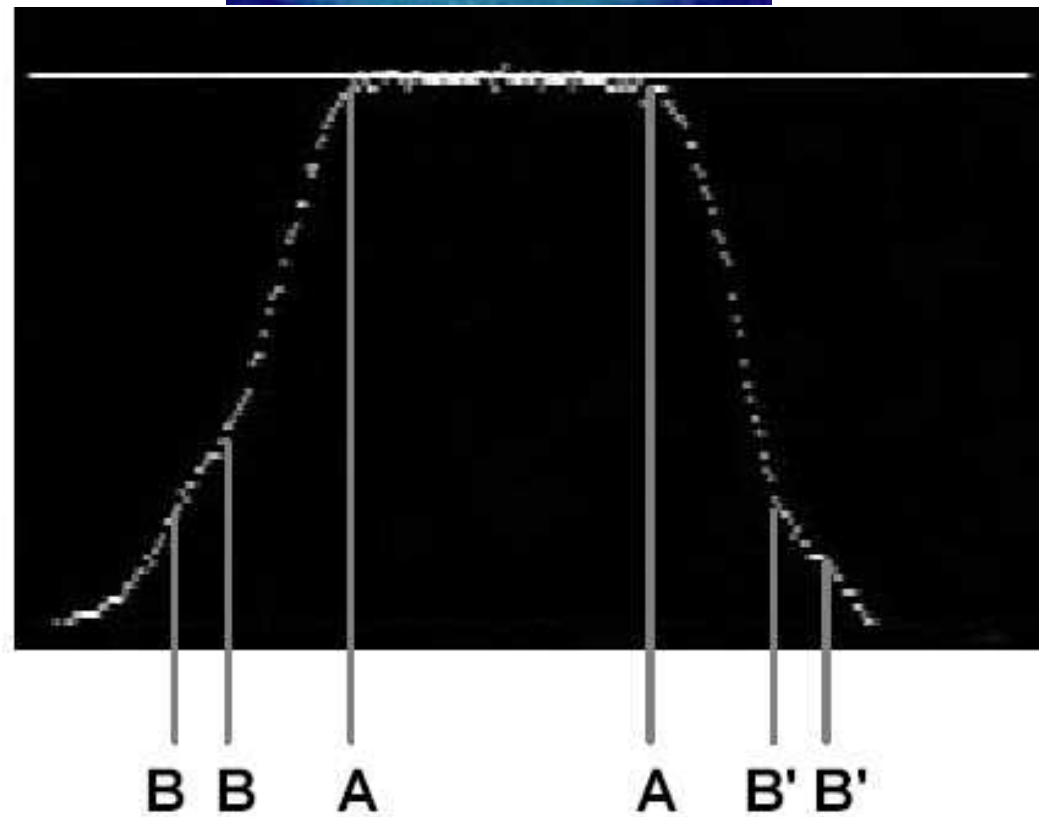
+29.8°C IMAGE MODE OPEN NORM +49.8°C



# Plot of Electrode Surface and Solution Temperatures



**Electrode > 60 C**  
**Solution ~ 30 C**



**A = Electrode Surface T; B = Solution T**

# Appendix E

## Energy Production

1. Arata, Yoshiaki, Zhang, Yue-Chang, "Anomalous production of gaseous  $4\text{He}$  at the inside of 'DS cathode' during  $\text{D}_2\text{O}$ -electrolysis," Proc. Jpn. Acad., Ser. B, 75: p. 281 (1999)  
<http://newenergytimes.com/Library/1999ArataY-AnomalousProduction.pdf>
2. El Boher et al., "Excess Heat In Electrolysis Experiments At Energetics Technologies," (to be published Proceedings of 11th International Conference on Cold Fusion, Marseilles, France, 2004)  
<http://newenergytimes.com/Library/2004ElBoher-ExcessHeatInElectrolysis.pdf>
3. Stringham, R., "1.6 MHz Sonofusion Device," (to be published Proceedings of 11th International Conference on Cold Fusion, Marseilles, France, 2004)  
<http://newenergytimes.com/Library/2004StringhamR-1.6MHzSonofusion.pdf>
4. Takahashi, A., et al., "Anomalous Excess Heat by  $\text{D}_2\text{O}/\text{Pd}$  Cell Under L-H Mode Electrolysis," Third International Conference on Cold Fusion, Nagoya, Japan: Universal Academy Press, Inc., Tokyo, Japan. (1992)  
<http://newenergytimes.com/Library/1992TakahashiAAnomalousExcessHeat.pdf>

# Appendix D

## Cold Fusion Volumetric Power Densities

1. Fleischmann, M., S. Pons, and M. Hawkins, "Electrochemically induced nuclear fusion of deuterium," *Journal of Electroanalytical Chemistry*, Vol. 261, p. 301 and errata in Vol. 263 (1989)
2. Fleischmann, M. and S. Pons, "Calorimetry of the Pd-D<sub>2</sub>O system: from simplicity via complications to simplicity," *Physics Letters A*, Vol. 176, (1993), p. 118
3. Preparata, Giuliano, et al., "Isoperibolic calorimetry on modified Fleischmann-Pons cells," *Journal of Electroanalytical Chemistry*, 411, 9 (1996)