# From Cold Fusion to Low Energy Nuclear Reactions: 2007 Update

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

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# Cold Fusion ???

- Mistake

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- Mistake
- Fraud

# Cold Fusion ???

- Mistake
- Fraud
- Incompetence, Delusion

# This Was Correct …

- Based on 1989 …
  - data
  - news
  - experts
- But things have changed …

  … Continuous research for 18 years

  … “Under the radar”

# Cold Fusion Research

"It is highly likely that your perceptions of the cold fusion field are (a) out of date and (b) wrong."

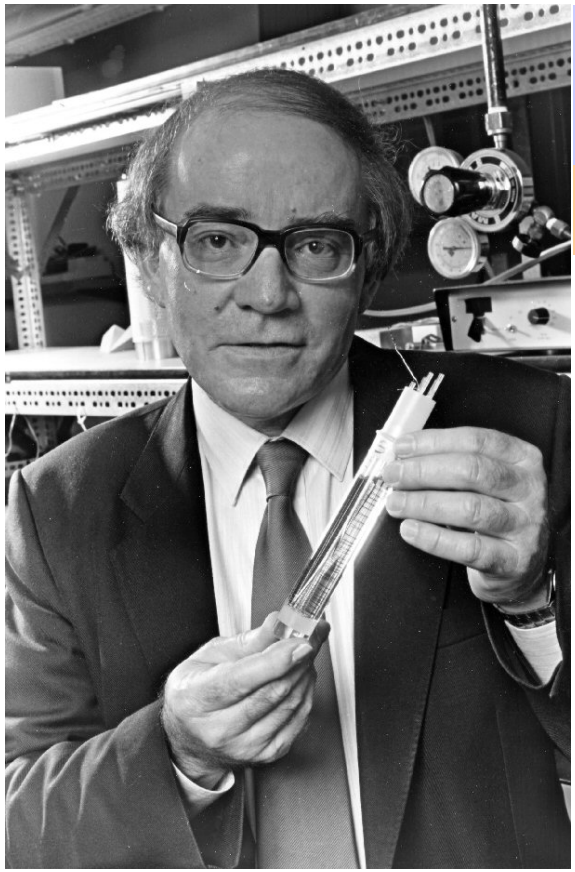
-- Dr. David J. Nagel, Research Professor, The George Washington University, and head of the Condensed Matter and Radiation Sciences Division, Naval Research Laboratory (ret.)

# Can I cover 18 Years in a 20 Minute Presentation?

No, however, this resource index will help newcomers to the subject:

http://newenergytimes.com/start

# Cold Fusion Is Announced

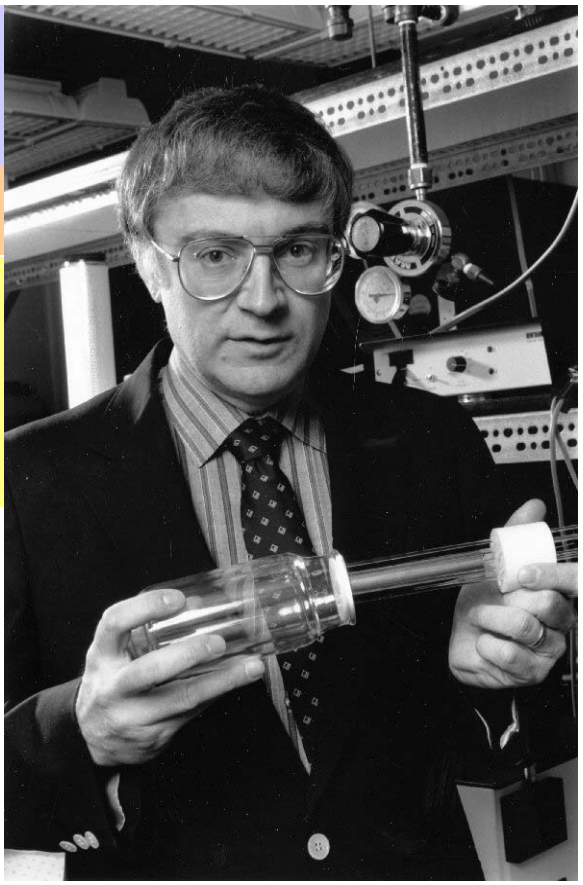


Martin Fleischmann
University of Southampton

University of Utah
Press Conference

March 23, 1989

"… established a sustained nuclear fusion reaction … "

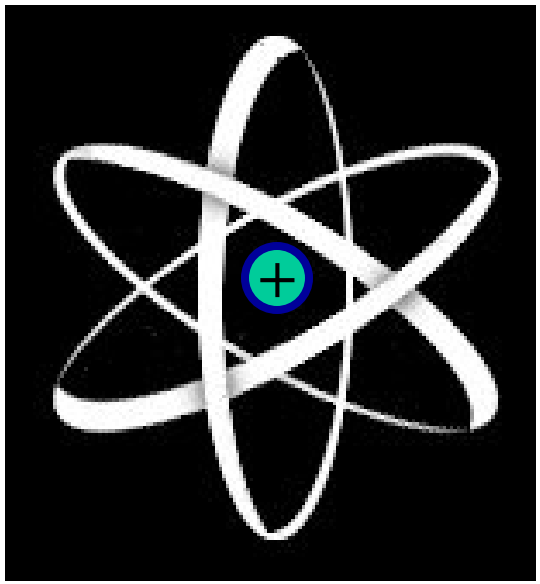


Stanley Pons
University of Utah

# Conventional Fusion

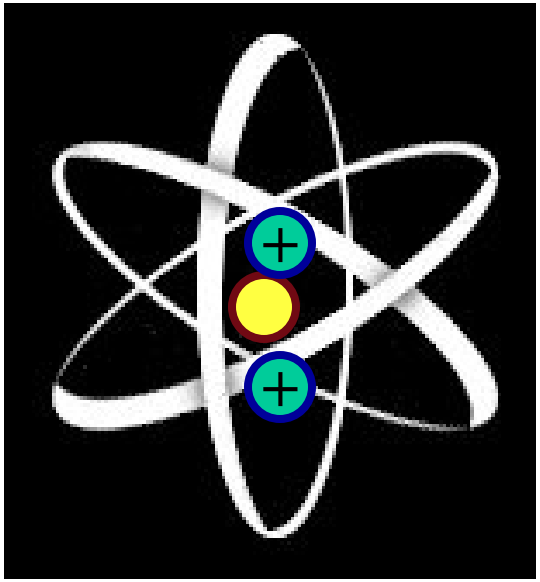
- Joining of atomic nuclei
- Energy research since 1951
- 0 Watts usable power
- Projection: 50 more years
- $20B spent so far

# Deuterium - Fusion's Fuel

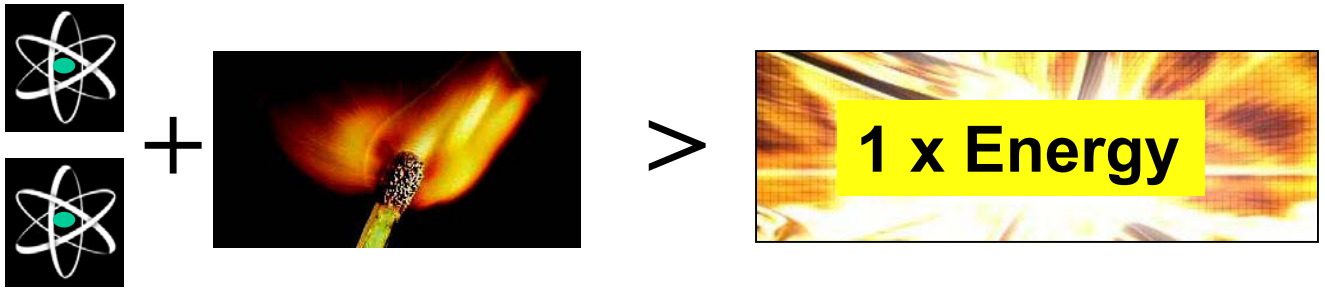


Normal Hydrogen
(one proton)

Deuterium (Hydrogen isotope)
(one proton, one neutron)

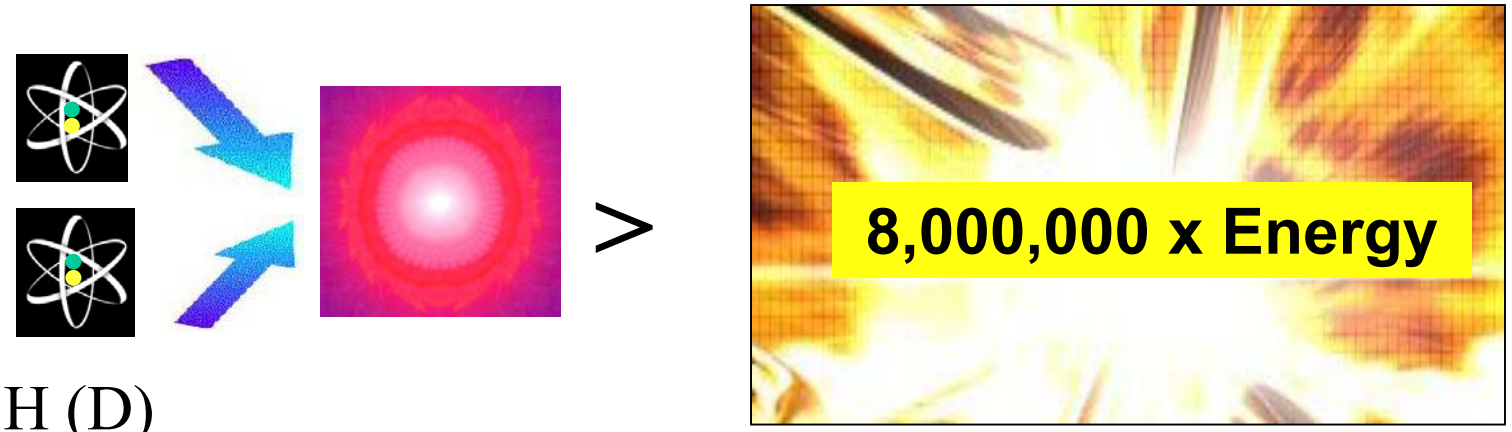


# Hydrogen Energy Release




H

Chemical Reaction




H (D)

Nuclear Fusion Reaction

# Cold Fusion – The Last 18 Years

- 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

# Cold Fusion: Yes, but …

Could be fusion …

Could be something else …

Either way – potentially significant

# Condensed Matter Nuclear Science

## Major Effects

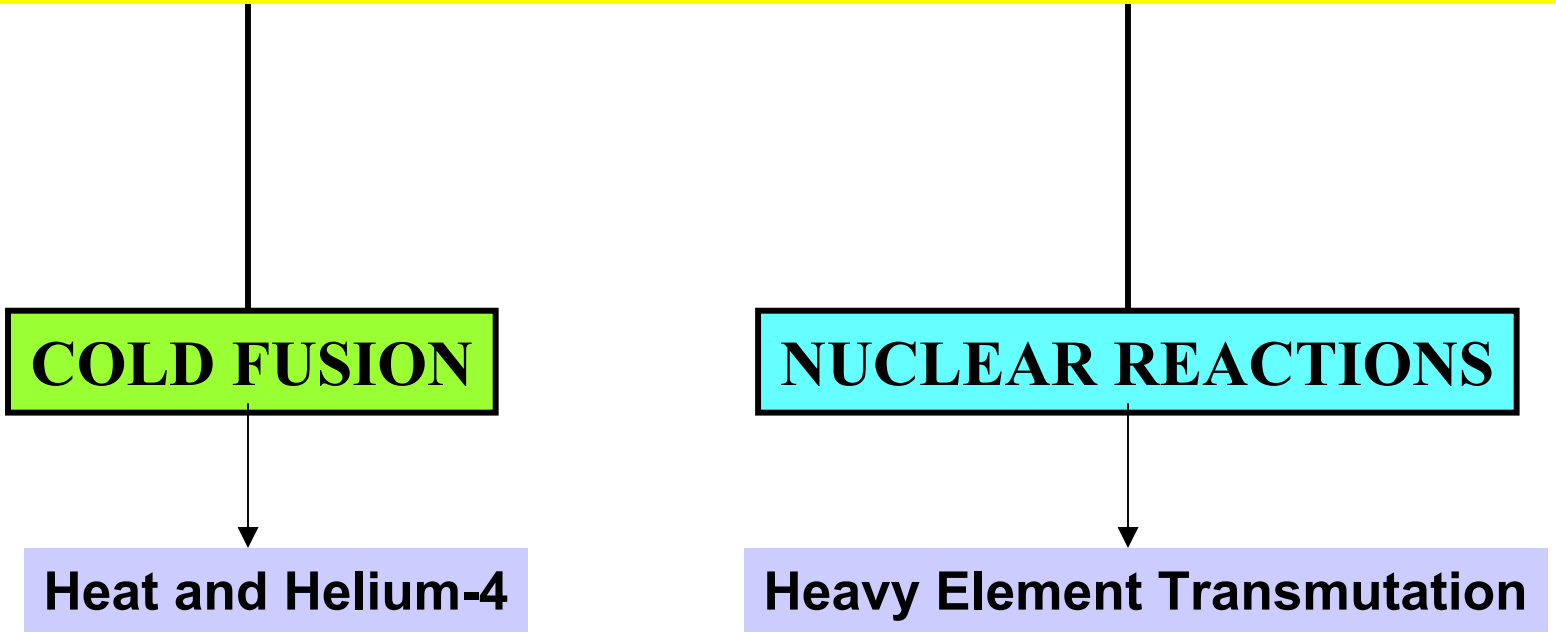
- Mossbauer Effect
- **Low Energy Nuclear Reactions**
- Nuclear Magnetic Resonance
- Magnetic Resonance Imaging

## Minor Effects

- Hyperfine Structure in Optical Spectra
- Isotope Shifts in X-Ray Spectra

Note: This listing is indicative and not complete

# Low Energy Nuclear Reactions (LENR)



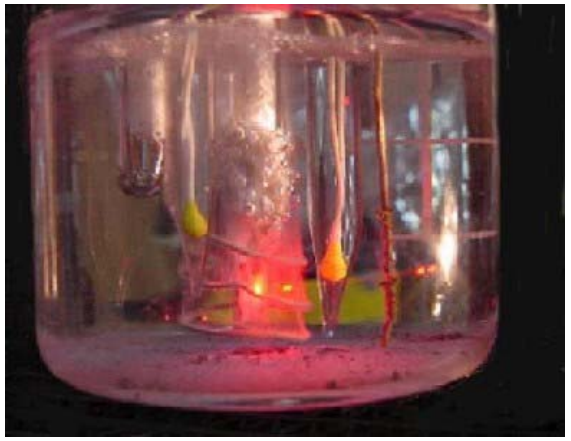

**"Low" Is A Relative Term.**
**DoE has a Low Energy Nuclear Physics Program**

# THE REACTIONS

# Threshold Parameters for the Excess Heat Reaction

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

It's a Materials Science Problem!



Letts-Cravens Laser Effect

# Many Methods Claimed

For example:

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

# Products / Effects Claimed

| | 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 | |
| Neutrons | 57/hr (Jones)<br>X/y (SPAWAR) | |
| X-Rays | Yes | |
| Gamma-Rays | Yes | |
| Craters in Cathodes | Yes | |
| Charged Particles | Yes | |
| Hot Spots on Cathodes | Yes | |
| Heavy Element Transmutation | Minor | Major |

# 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 |
| 2 | El-Boher #64a | 2004 | 34w | 2500% | 17h | 1.1Mj |
| 2 | El-Boher #64b | 2004 | 32w | 1500% | 80h | 4.6Mj |
| 3 | Stringham | 2004 | 40w | No Data | No Data | No Data |
| 4 | Takahashi | 1992 | 130w | 70% | 1440h | No Data |

See appendix E for references

# Q. So What is LENR, Anyway?

A1. Nobody really knows.

A2. “The experimental and theoretical study of reactions with hydrogen and deuterium in the presence of a metal.”

# SPAWAR San Diego Research

Szpak, Mosier-Boss, Gordon

***Simple, portable, highly repeatable, unambiguous, and permanent physical evidence of nuclear events using detectors that have a long track record of reliability and acceptance among nuclear physicists.***

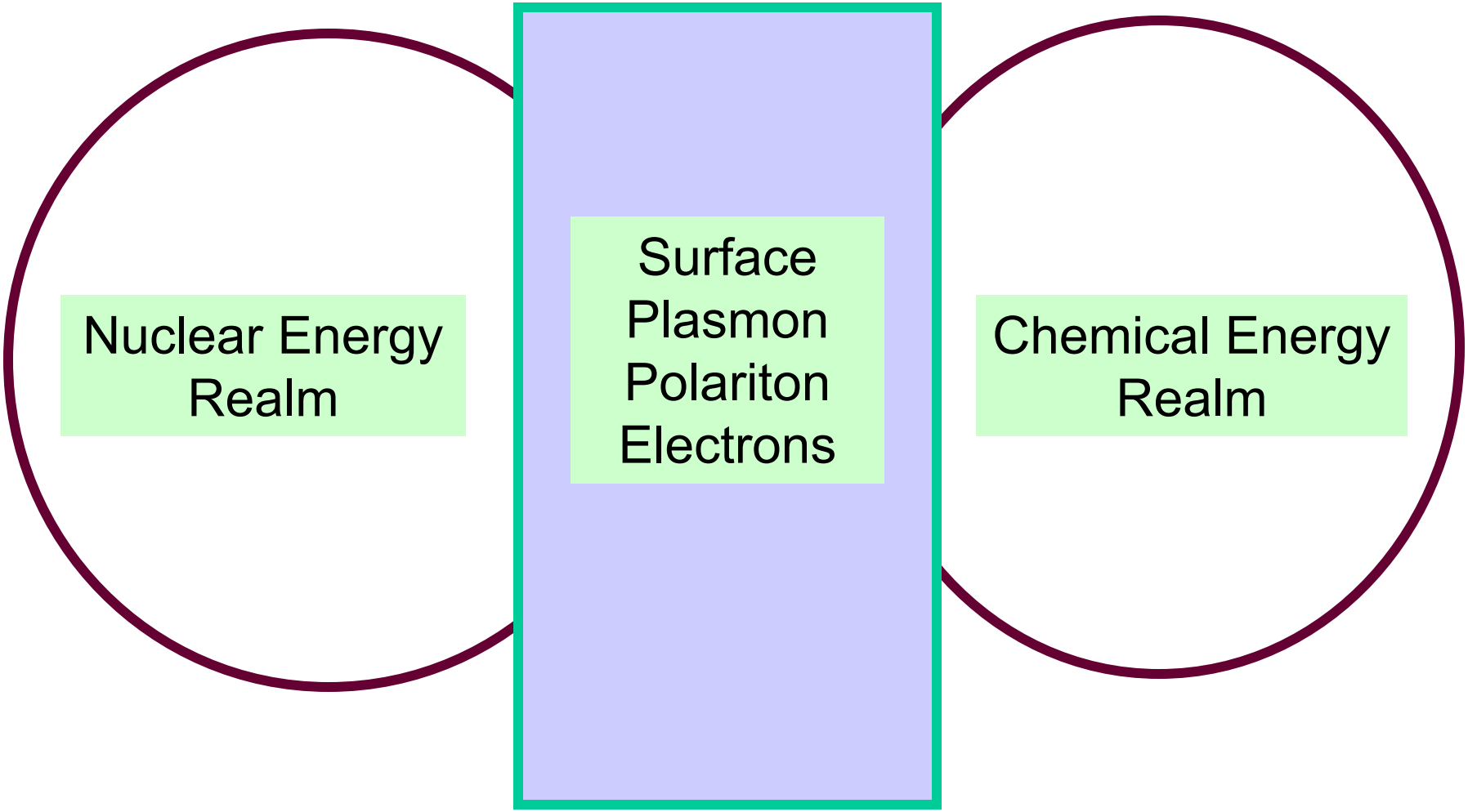

Visible with the naked eye

# 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.

# Widom-Larsen Theory



# Critical Path

No

Is It Nuclear?

Yes

No

Excess energy release?

Yes

No

Is the energy release cost-effective?

Science Curiosity

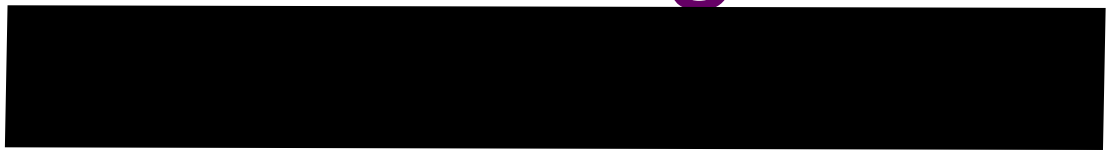
Yes

# Future Possibilities for Microelectronics

- “Batteries” that last 10-20 years
- Printed circuit boards with onboard energy sources
- Remote off-grid applications

http://newenergytimes.com/start

New Energy Times
Online Magazine



steven1@newenergytimes.com