Progress, in the Condensed Matter Nuclear Science, on excess energy production: towards practical applications?

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Vice-President of International Society of Condensed Matter Nuclear Science

World Sustainable Energy Conference 2012 –International Sustainable Energy Organization
Geneva, January 10-12, 2012
TRULY EXTRAORDINARY INTEREST
TFTR
Princeton University
A Major Problem with LENR

New Science

New Theory

Need More Experiments

Agreement with Theory?

Not Even Close!

Reproducibility Problems

Experiments Are Wrong!!

F & P & Other Reports

Old Science
Progress = Robust Results

Better Instrumentation, Calibration and Controls

Some Systematics Found & Verified for Heat Generation Experiments

Nuclear Ash Measured & Correlated with Heat Production

Many New Experiments Performed

More Attention to Materials

Improved Inter-Lab Reproducibility

Continuous Activity & International Conferences
Electrochemical Loading & Heat Measurements

Power x Time = Heat Energy

Temperature Increase
Experimental Summary

Each type of result individually indicates that nuclear reactions occur in diverse experiments at modest temperatures.

The database is robust & the observed effects must be due to nuclear reactions!!

Measurements of Large Excess Heat
Systematics Seen for Heat Production
Helium can be Produced
Heat-Helium can be Correlated
Tritium can be Produced
Neutrons Measured in Bursts
Observations of X-and γ-Rays
MeV-Energy Particles Measured
Observations of Sound Impulses
Craters in Cathodes Measured
Hot Spots Measured on Cathodes
New Elements Measured
Initially: The Situation was Very Uncertain

INCORRECT, UNCERTAIN & CORRECT SCIENCE

IT IS WRONG

FRAUD, ERROR

IT IS CORRECT

SCIENCE, TECHNOLOGY, COMMERCIAL
The ICCF Series of Conferences

<table>
<thead>
<tr>
<th>AMERICA</th>
<th>EUROPE</th>
<th>ASIA</th>
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</thead>
<tbody>
<tr>
<td>1. Salt Lake City</td>
<td>2. Como Italy</td>
<td>3. Nagoya Japan</td>
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<td>7. Vancouver</td>
<td>8. Lerici Italy</td>
<td>9. Beijing China</td>
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</table>

**Other Conferences**

12 in Russia, 6 in Japan, 5 in Italy and many sessions at various society conferences

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<tr>
<th>ASIA</th>
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<td>16. India</td>
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<td>17. Korea Aug 2012</td>
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Characteristics of Low Energy Nuclear Reactions

Experimentally, it is known that LENR offer:

- Little Dangerous Radiation          Safe
- Little Residual Radioactivity       Clean
- No Greenhouse Gases                 Green
- Small energy sources                Distributed

Individually, these attributes are important. Together, they might be historic.

Can LENR be commercialized?????
The Possible Evolution of LENR

**BASICS**
- Science
  - Technology
  - Engineering

**BUSINESS**
- Prototypes
  - Products
  - Profits

**IMPACTS**
- Economic
  - Social
  - Political
Two Major Parts of the Field Now

Electrochemical Loading of Deuterons into Palladium.

The initial Fleischmann-Pons approach
Most work in the field has been in this class

Gas Loading of Protons into Nickel

Work began by Piantelli in early 1990s
Approach used by Rossi in recent years
BIG Unresolved Questions about LENR

Are the reactions only nuclear, only atomic or both?

Is there one mechanism active or are there multiple processes?

Do the reactions occur only on the surface of materials or also in the bulk (volume) of the materials?

What, if anything, is common to electrochemical and gas loading experiments that have exhibited excess power and heat?

What is the root cause of experimental irreproducibility?

What external factors can be used to initiate and control LENR?
Investigation of Anomalous Heat Observed in Bulk Palladium

Gustave C. Fralick (Project Lead),
John D. Wrbanek, Susan Y. Wrbanek,
Janis M. Niedra (ASRC) and Marc G. Millis
with
David J. Spry, Roger Meredith
and Jim Mazor (TFOME/Sierra Lobo)

NASA Glenn Research Center
Cleveland, Ohio
RESULTS (Preliminary): Temperatures vs. Time

**Loading**

**Observed Temperature for H2 Load**

- Temperature (°C)
  - Range: 345 to 370
  - Time (s): 0 to 100

**Unloading**

**Observed Temperature for H2 Unload**

- Temperature (°C)
  - Range: 340 to 370
  - Time (s): 0 to 200

**Hydrogen**

**Deuterium**

- Temperature (°C)
  - Range: 340 to 370
  - Time (s): 0 to 80

Glenn Research Center
Short list, non exhaustive, of main experiments devoted to Excess Heat generation.

Only qualitative aspects, best results  (improvement/innovations in red colour)

<table>
<thead>
<tr>
<th>Authors</th>
<th>Year</th>
<th>Excess $P_W$</th>
<th>Temp. (°C)</th>
<th>Experiment type</th>
<th>Notes</th>
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<td>Fleisch.&amp;Pons</td>
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<td>.01-1W</td>
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<td>Rod Isoperibolic</td>
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<tr>
<td>Univ. SLC</td>
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<td>2-5%</td>
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<td>Pd/Pt</td>
<td>Calorimetry</td>
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<td>USA</td>
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<td>LiOD .1M</td>
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<tr>
<td>Mc. Kubre</td>
<td>1990</td>
<td>.1-3W</td>
<td>30°</td>
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<td>Rod</td>
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<tr>
<td>A. Takahashi</td>
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<td>Replication</td>
<td>Year</td>
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<td>Temperature (°C)</td>
<td>Method</td>
<td>Equipment</td>
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<td>Pd/Pt LiOD 1M</td>
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<td>Temperature</td>
<td>Electrolysis Method</td>
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<td><strong>ZrO$_2$-Pd</strong></td>
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<td><strong>McKubre</strong></td>
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<td>10-20W</td>
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<td><strong>Only 30minutes later self</strong></td>
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<td><strong>destructed.</strong></td>
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<td>10-30W</td>
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<td><strong>Nano-particl.</strong></td>
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<td>1-5.5W 5-10%</td>
<td>550°</td>
<td>Pd wire nano-coated D2, 6Bar</td>
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<td>2008</td>
<td>.1-1W infinite (no power input)</td>
<td>25°</td>
<td>D2, 60 bar</td>
<td>Confirmed, Industrial</td>
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<td></td>
<td>(Japan)</td>
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<td>Japan</td>
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<td>Arata method and improvements by Brian Ahern (USA), Takahashi &amp; Kitamura</td>
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<tr>
<td>Company</td>
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<td>Temperature</td>
<td>Pressure</td>
<td>Reactants</td>
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<td>2-26W</td>
<td>900°</td>
<td>H₂-Ar, (D₂), 6 bar Ni wire, nano-coated</td>
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<td>Rossi EFA-Italy</td>
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<td>10kW</td>
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<td>Ni nano-powders+X? H₂, 25bar</td>
<td>Flow calorim. NO ind. test &gt;6months??</td>
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<td>Defkalion Greece</td>
<td>2011</td>
<td>10kW, 2500%</td>
<td>&gt;200°C</td>
<td>Ni nano-powders+Y? H₂, 25bar</td>
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<td>Celani INFN-Italy</td>
<td>Nov. 2011</td>
<td>10W 15%</td>
<td>&gt;260°</td>
<td>Cu-Ni alloy Micro-Nano coated thin wires</td>
<td>Flow-calorim. Wire from PTC to NTC resistance, related to thermal anomalies</td>
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<td>Takahashi-Kitamura Toyota-Univ.Kobe</td>
<td>Dec. 2011 (JCF12 Congress, Japan)</td>
<td>In progress</td>
<td>In progress</td>
<td>Cu8%Ni32% -Zr60% Nano-powder H2, D2</td>
<td>Flow-calorim. EndoT&lt;100°C ExotT&gt;200°C</td>
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Conclusions

- After very turbulent beginning, due to poor reproducibility, the Researchers involved in the Science field of Condensed Matter Nuclear Science, step-by-step, improved the quality and reproducibility of the results obtained.

> Among other things, it is a pity that excellent experiments, like those performed by NASA, were not immediately made public, but after 15 years: the reality of LENR was reconfirmed, even in gaseous environment (D₂) and high temperature (350°C), after only 9 months from F&P first paper!

> The reconfirmation of the 1989 NASA experiment was performed on Dec 2009, perhaps to be concealed in the same way… but luckily it was found, by chance, in August 2011!

- The most innovative experiments were cross-controlled by other groups, with enough specific experience and not linked directly to the Scientists that claim extraordinary results.
• As time passed, it began evident, specially thanks to Yoshiaki Arata, the role of specific nano-materials (e.g. ZrO$_2$65%-Pd35%) able to absorb large amounts of Deuterium even under mild pressure (60bar).

• Thanks to gas environments, instead of initial electrolysis, the possibility to increase the temperature become evident and possible practical applications were planned.

• Under gaseous atmosphere, mixture of H$_2$-Ar, it was possible to detect anomalous excess heat even at wire (Ni, nano-coated at the surface) temperature as large as 900°C. The experiment lasted up to 6 days and other expert Scientist, external to the (Celani) group, made all kinds of tests they wished.
• The recent, extraordinary claims of Rossi and Defkalion group (gain 600% and 2500% respectively, at temperature larger than 100°C and 200°C), until they will not be verified by independent tests, must be regarded with attention and caution at the same time. In other words, when we consider the progress made in CMNS studies, we feel that the Rossi-Defkalion claims are not impossible in principle, but they must be proved in public under strict control, ASAP.

• Apart from the Rossi and/or Defkalion claims, the quality of experiments worldwide performed was so high and the results obtained so widespread, that an International Program, well funded and based on multidisciplinary approach, has the possibility to build a “device” producing even electricity with very low, overall, emissions.

• Regarding the theory, it is growing the interpretation that such phenomena arise because of the “Weak Force” (Larsen-Widom model) instead of the previously thought, conventional “Strong Force”. A well known Researcher (A.Takahashi) recently developed a model where both forces can be active.