Lattice Energy LLC

Commercializing a next-generation source of green nuclear energy

Index to documents

Explore underlying concepts, experimental evidence, and news coverage for Widom-Larsen theory of LENRs

Hyperlinked online information resource and user guide

Version #21 - Updated and revised through September 7, 2015

Lewis Larsen, President and CEO

LENRs in electric arc discharges

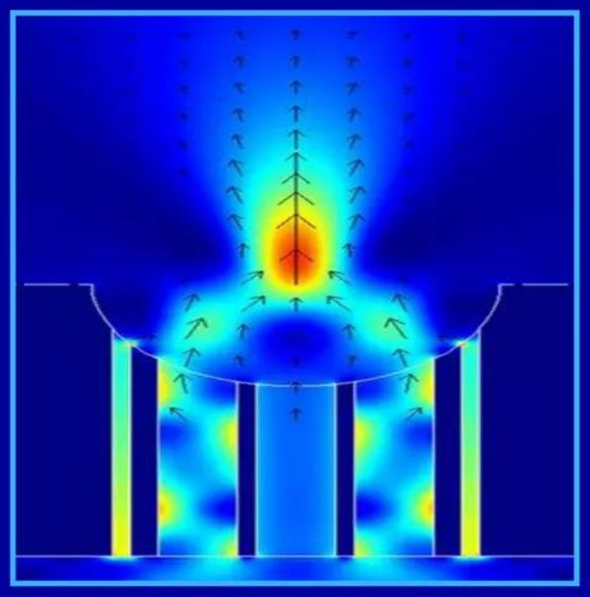
"For the truth of the conclusions of physical science, observation is the supreme Court of Appeal."

Sir Arthur Eddington
"The Philosophy of Physical Science" pp. 9 (1939)

Contact: 1-312-861-0115
lewisglarsen@gmail.com

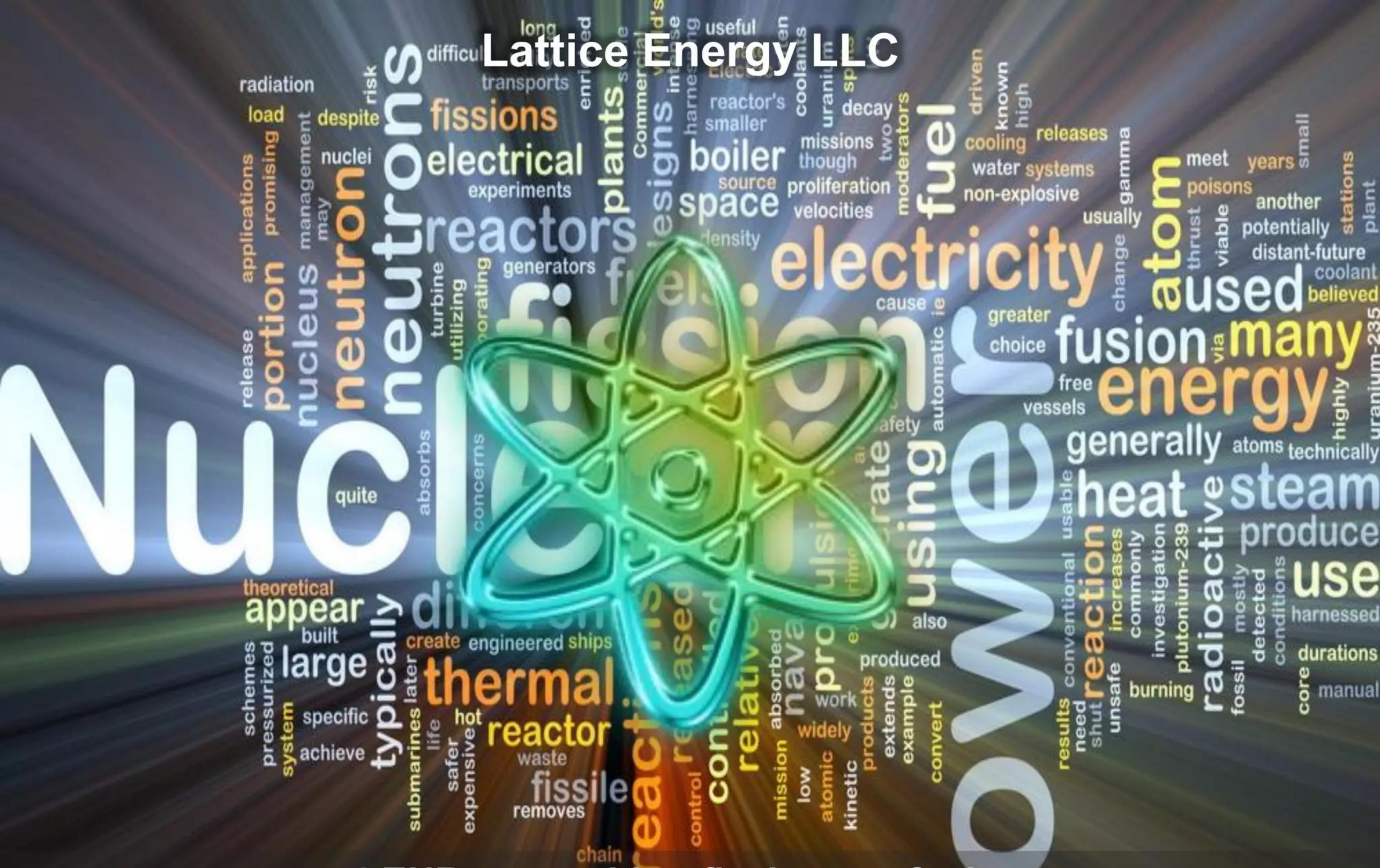
http://www.slideshare.net/lewisglarsen/presentations

pdf file download of document is enabled



LENRs in resonant E-M cavities

Lattice Energy LLC

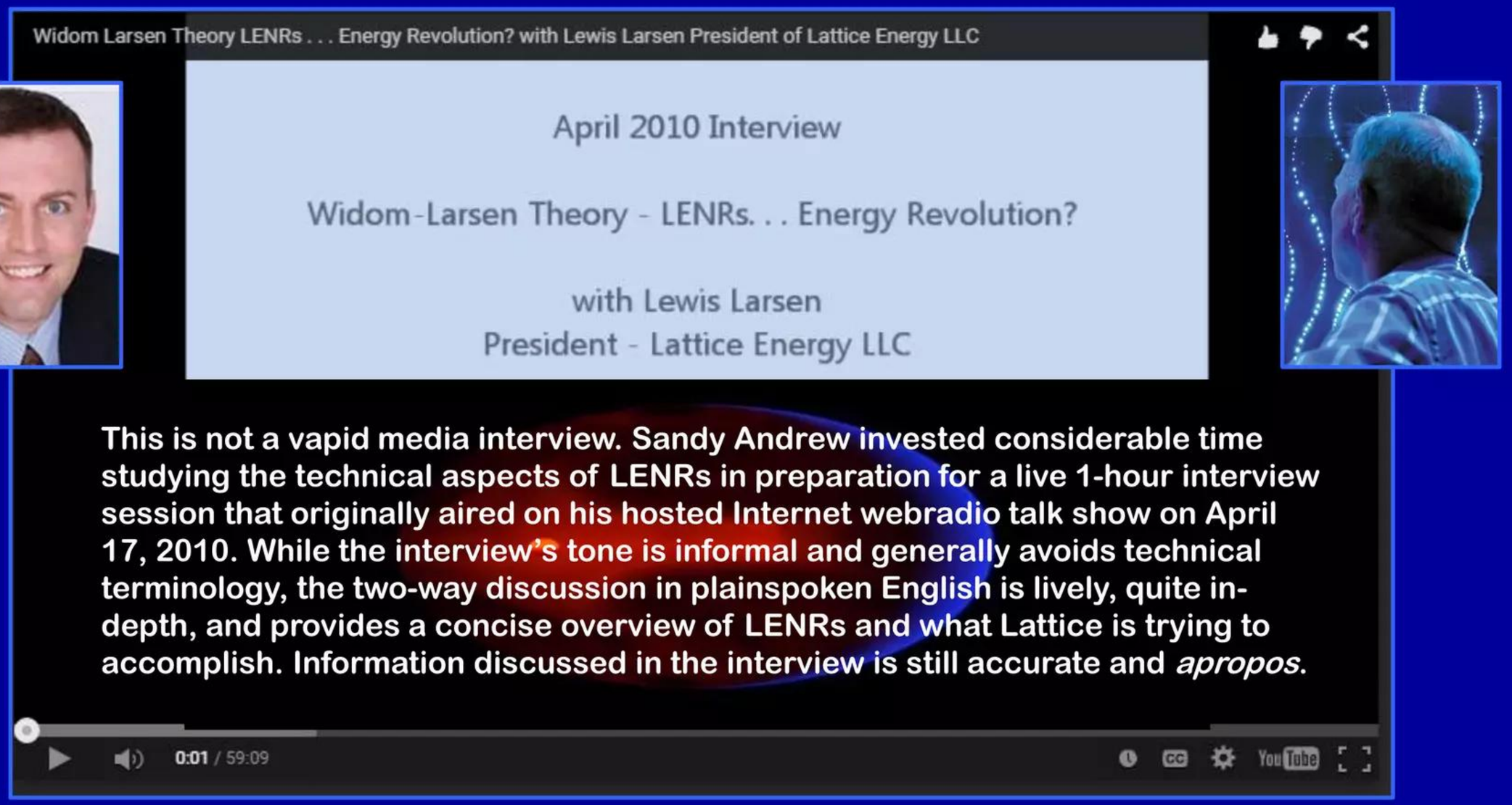


LENRs are neither fission nor fusion
but something rather different and better

Lattice Energy LLC

Online audio overview of LENRs and Lattice Energy LLC

https://www.youtube.com/watch?v=OVRLcC21F14



This is not a vapid media interview. Sandy Andrew invested considerable time studying the technical aspects of LENRs in preparation for a live 1-hour interview session that originally aired on his hosted Internet webradio talk show on April 17, 2010. While the interview's tone is informal and generally avoids technical terminology, the two-way discussion in plainspoken English is lively, quite in-depth, and provides a concise overview of LENRs and what Lattice is trying to accomplish. Information discussed in the interview is still accurate and *apropos*.

Lattice Energy LLC

Purpose of Index to documents

pdf file download of document is enabled

Explanations of the underlying concepts and selected examples of experimental evidence for the Widom-Larsen theory of Low Energy Neutron Reactions (LENRs) are provided in a number of different documents that have very different levels of technical difficulty --- some are extremely technical and highly mathematical, some are more-or-less plain English, and others fall in between the two polar extremes

Accordingly, this Index has been created to help interested parties navigate through W-L's theoretical concepts and relevant experimental data, contained in the above-noted documents, at a technical level with which they can feel comfortable. *In toto*, this collection of documents demonstrates that W-L theory successfully explains all of the key distinctive features of LENRs, e.g., absence of large fluxes of dangerous energetic neutrons and hard gamma radiation; little or no production of long-lived radioactive isotopes, and other notable features such as laser photon triggering. We do this without invoking any "new physics" beyond the Standard Model

This Index is an evolving document: it will be periodically updated and reposted to SlideShare as new documents become available and/or as concepts behind the W-L theory may expand further; a version number and date will appear on the lower left-hand corner of each page. You are invited to stop-by occasionally to see changes

Lattice Energy LLC

Organization of Index to documents

pdf file download of document is enabled

Beyond a brief historical introduction to LENRs and outline of W-L theory's genesis, the Index facilitates navigation amongst documents concerning:

- ✓ **Concepts** - scientific concepts utilized in W-L theory, e.g., many-body collective effects, mass-renormalized electrons in condensed matter LENR systems, breakdown of Born-Oppenheimer approximation, etc.; e.g., W-L *European Physical Journal - C* paper (2006)
- ✓ **Experimental data** - reported and/or published experimental results that either support and/or are explained by W-L theory. Such data may originate from inside or outside the field of LENRs, e.g., SRI Case replication (1999) or Wendt & Irion exploding wire data (1922)
- ✓ **Third party coverage of W-L theory and about Lattice** - news articles, commentaries, or interviews appearing in different venues; e.g., see *New Energy Times* W-L theory portal

Lists of presently available documents are provided in four Appendices:

- ✓ **Appendix 1** - Technical theoretical papers; contain rigorous physics and mathematics
- ✓ **Appendix 2** - Lattice's SlideShare presentations; varied technical levels; no math
- ✓ **Appendix 3** – 'Plain English' popular science articles written for a very broad audience
- ✓ **Appendix 4** - Selected media coverage re the Widom-Larsen theory, Lattice and LENRs

Lattice Energy LLC

Contents

All URL hyperlinks provided in this document are live and tested

Lattice Energy LLC

Previous notable new items and pending developments

- ✓ **December 27, 2009:** Srivastava, Widom, and Larsen, "A Primer for Electro-Weak Low Energy Nuclear Reactions," published online by the American Chemical Society (ACS) as a peer-reviewed chapter in a book-form *Symposium Series* titled, "Low-Energy Nuclear Reactions and New Energy Technologies Sourcebook (Vol. 2)." Please see source URL = http://pubs.acs.org/doi/pdf/10.1021/bk-2009-1029.ch014?cookieSet=1

  Online Document Purchase from the ACS for US$30.00 for a high-resolution Adobe Acrobat pdf document at source URL = http://pubs.acs.org/doi/pdf/10.1021/bk-2009-1029.ch014

- ✓ **April 12, 2010:** Lattice released 16-page excerpt from a White Paper, "Commercializing Low Energy Nuclear Reactions (LENRs): Cutting Energy's Gordian Knot --- A Grand Challenge for Science and Energy" 8SS

- ✓ **April 17, 2010:** Larsen has 1-hour live interview with Sandy Andrew on blogtalkradio.com (archived online) 7JC

- ✓ **May 24, 2010:** further-expanded version of "Primer" paper accepted by India's *Pramana - Journal of Physics*

- ✓ **June 25, 2010:** released, "LENRs in catalytic converters: are green LENRs occurring in common devices?" 9SS

- ✓ **July 16, 2010:** released, "Could LENRs be involved in some Li-ion battery fires? LENRs in advanced batteries" 10SS

- ✓ **July 29, 2010:** local newspaper, *The Chicago Reader,* publishes cover story on Larsen (print and online) 8JC

- ✓ **July 30, 2010:** Steven Krivit and *New Energy Times* publish 148-page, "Special Report: Cold Fusion is Neither" 9JC

- ✓ **October 2010:** Srivastava, Widom, and Larsen, "Primer" overview paper on W-L theory of LENRs finally published in *Pramana - Journal of Physics*, a peer-reviewed publication of the Indian Academy of Science in partnership with Springer; contains added new material not present in ACS version cited above 9TT, 70SS

Note: combinations of two capital letters plus number in red are unique IDs referring to documents listed in Index Appendices

Lattice Energy LLC

Previous notable new items and pending developments

- ✓ **February 22, 2011:** a fundamental technology patent on LENRs issues to Lattice as assignee 14SS
  US Patent #7,893,414 B2
  "Apparatus and Method for Absorption of Incident Gamma Radiation and its Conversion to Outgoing Radiation at Less Penetrating, Lower Energies and Frequencies"
  Inventors: L. Larsen and A. Widom

- ✓ **November 18, 2011:** a USPTO publication reveals that NASA had filed new LENR-related patent application 23SS

- ✓ **November 25, 2011:** first-ever measurements of W-L ultra low momentum (ULM) neutrons reported - Cirillo *et al.*: 26SS

- ✓ **March 22, 2012:** first-ever special colloquium on LENRs sponsored by CERN in Geneva, Switzerland - 12JC
  Organized by Prof. Ignatios Antoniadis (CNRS and CPHT Research Director as well as member of CERN's theoretical division), event was held in main auditorium at CERN. Importantly, a coauthor on many published Widom-Larsen theory papers, Prof. Yogendra Srivastava of the University of Perugia (Italy), gave the *only* invited talk on LENR theory at Colloquium; Dr. Francesco Celani, INFN and ENEA, Frascati, Italy, provided a review of experimental evidence for LENRs. Thus, arguably some of world's smartest physicists at CERN held well-advertized meeting about a very controversial subject (LENRs) that had previously been a scientific pariah for 20 years. Although this highly visible meeting was completely ignored and went unreported by prominent science journalists and technical journals, in Lattice's opinion the CERN Colloquium was a watershed event that would probably have been unthinkable 5 years ago. The tip-off that something portentous had happened is what *didn't* occur in aftermath of the CERN Colloquium: there were no howls of derision or caustic criticisms to be found anywhere on the Internet or in print media --- only silence --- formerly unspeakable LENRs finally became acceptable to certain mainstream physicists with little fanfare; for details including slides and videos please see URL = http://indico.cern.ch/conferenceDisplay.py?confId=177379

- ✓ **March 25, 2012:** Gurevich *et al.* report new data in *Phys. Rev. Lett.*; confirm WLT neutron production in lightning 43SS

Note: combinations of two capital letters plus number in red are unique IDs referring to documents listed in Index Appendices

Lattice Energy LLC

Previous notable new items and pending developments

- ✓ June 2012: Lattice hypothesis that surface plasmons exist on graphene surfaces experimentally confirmed 52SS
- ✓ July 2012: W-L theoretical mechanism for locally altering beta decay rates confirmed in nuclear fission reactors

  See: "Special Note" found on Slide #21 in this presentation
- ✓ August 2012: a publicly released official report unexpectedly reveals that NASA-Boeing are presently investigating LENRs for aircraft propulsion 54SS
- ✓ Sept. 2012: in a Cornell arXiv preprint, Ciuchi *et al.* (Univ. of Rome) questioned *e* + *p* reaction rate calculations of Widom-Larsen; claimed that our calculated estimates of such rates were way, way too high 10TT
- ✓ Oct. 2012: in an arXiv preprint, Widom, Srivastava, and Larsen answered Ciuchi *et al.* and decisively refuted their erroneous claim that our estimated *e* + *p* rates for condensed matter chemical cells were way too high 10TT, 58SS
- ✓ Nov. 2012: monthly *Discover* magazine published 2-page article about the Widom-Larsen theory 57SS, 14JC
- ✓ Nov. 2012: Lattice announced it recently developed a concept for an LENR rapid-pulse-detonation propulsion system that could in principle be suitable for green atmospheric aircraft, energy-density-limited UAVs, and key spacecraft applications. Such a system would be radiologically clean and could provide large thrust vs. weight performance improvements in comparison to combustion of fossil fuels or any conceivable chemical rocket propulsion technologies. Ratio of required mass of LENR fuel carried on-board divided by total aircraft/spacecraft system mass would likely be a minuscule number and thus revolutionary if it were successfully engineered 62SS
- ✓ Nov. 14, 2012: Larsen made presentation about W-L theory electroweak neutron production in lightning discharges during a session on LENRs at American Nuclear Society's (ANS) 2012 winter meeting in San Diego, CA; this was first such ANS-sponsored session on subject matter of LENRs in more than 14 years 60SS, 61SS

Note: combinations of two capital letters plus number in red are unique IDs referring to documents listed in Index Appendices

Lattice Energy LLC

Previous notable new items and pending developments

- ✓ **November 14, 2012 (continued):** 2012 Winter Meeting, San Diego, CA; Panel Session on LENRs held from 8:30 AM to 12:00 Noon on Wed Nov. 14; with respect to the Widom-Larsen theory, two key presentations were:
  - L. Larsen, Lattice Energy LLC (USA) – discussion of electroweak neutron production in lightning 61SS, 62SS, 64SS
  - Y. Iwamura, Mitsubishi Heavy Industries (MHI, Japan) – reported summaries of results from MHI's recent R&D work in LENRs; new experimental data that was reported at this ANS session included third independent confirmation of Widom-Larsen theory in production of Gold from ULM neutron capture on Tungsten metal targets 65SS
- ✓ **November 21, 2012:** monthly *New Scientist* magazine published article by Stuart Clark titled, "Half-life strife: Seasons change in the atom's heart." Lattice subsequently released a SlideShare presentation that discusses Clark's article in context of an extension of the Widom-Larsen theory of LENRs Lattice published on Jan. 10, 2012, in a 3-page MS-Word document titled, "New possibilities for developing minimal mass, extremely sensitive, collective many-body, quantum mechanical neutrino antennas," that successfully explains published experimental results of Jenkins & Fischbach concerning neutrino-induced perturbations in the nuclear decay rates of Manganese-54 (Mn-54) and other isotopes that are unstable to decay via a weak interaction (e.g., beta decays and inner-shell electron captures) 32SS, 63SS
- ✓ **January 2013:** on January 7, 2013, a GS Yuasa Lithium-based backup battery system overheated and experienced a thermal runway fire in an empty Japan Airlines (JAL) Boeing 787 Dreamliner that had just discharged its passengers and crew at Logan International Airport in Boston, MA. Similarly, on January 16, 2013, an All Nippon Airways (ANA) 787 made an emergency landing at Takamatsu Airport on Shikoku Island and evacuated passengers via emergency slides out on the runway after its GS Yuasa battery emitted extensive smoke and went into a thermal runaway. Importantly, back in July 2010 Lattice had publicly warned in a SlideShare presentation about the possibility of LENRs causing a subset of thermal runaways in Lithium-based battery systems (see 10SS). These two Dreamliner incidents triggered accident investigations by government regulatory bodies and spurred further interest in LENRs as one possible source of such problems; see related Lattice documents as follows: 66SS, 67SS, 79SS, 80SS, 81SS, 16JC

Note: combinations of two capital letters plus number in red are unique IDs referring to documents listed in Index Appendices

Lattice Energy LLC

Previous notable new items and pending developments

- ✓ **March 14, 2013: Jeff McMahon, *Forbes* magazine** contributor and blog columnist. published online story that was centered around Lattice's Slide Share presentation on possibility of LENRs occurring at low rates in household compact fluorescent lights; see, titled, "Tiny nuclear reactions inside compact fluorescent bulbs?" 15JC, 68SS

- ✓ **March 22, 2013:** Lattice released more technical details about the Widom-Larsen theory's concept of a built-in gamma shielding mechanism as discussed and taught in **Lattice's issued patent: US #7,893,414 B2** 72SS

- ✓ **April 11, 2013:** Lattice released SlideShare presentation, "Powering the world to a green LENR future: Truly green nuclear energy exists --- No deadly gammas … No energetic neutrons … No radioactive waste*"*; compared LENRs to fission and hoped-for fusion power generation technologies; in this document, **we show LENRs' relative achievable power density = ~3.6 x 10^{19} times the solar core's, an amazing number** 73SS

- ✓ **April 27, 2013:** Larsen and other experts on thermal runaways in Lithium-based batteries were interviewed by long-time *Barron's* magazine writer and investigative journalist **Jonathan Laing** and asked whether Boeing's "engineering fix" for the 787 Dreamliner's troubled GS Yuasa battery system would be adequate to successfully contain a worst-case battery failure scenario during flight operations; see , *"*Will Boeing's battery fix fly*?"* 16JC

- ✓ **May 7, 2013:** Lattice released SlideShare presentation, *"*NTSB reports indicate very high temperature*s,"* in which we show that presence of steel microspheres in SEM images of debris inside Boeing Dreamliner's failed GS Yuasa battery strongly suggests **peak temperatures in parts of battery exceeded 3,000º C during runaway** 81SS

- ✓ **May 22, 2013: Steven Krivit,** investigative science journalist of ***New Energy Times***, an online e-zine and blog, published an updated version of a very helpful, *"*Index of LENR experimental methodologies*,"* that uses simple graphic images and examples to concisely conceptualize and characterize ~20 types of LENR experiments 17JC

Note: combinations of two capital letters plus number in red are unique IDs referring to documents listed in Index Appendices

Lattice Energy LLC

Previous notable new items and pending developments

- ✓ May 29, 2013: Paul Chesser, Associate Fellow of non-profit organization called the NLPC (National Legal and Policy Center), published news story on NLPC website titled, "Dreamliner Flies, But Doubts Persist About Boeing's Batteries"; quotes extensively from Larsen about overlooked technical issues that might impact effectiveness of Boeing 787 Dreamliner's retrofitted battery fix in a worst-case thermal runaway event 18JC
- ✓ June 1, 2013: Lewis Larsen; copy of his 2-page c.v. uploaded to Lattice's public presence on SlideShare 83SS
- ✓ June 13, 2013: uploaded 66-slide Lattice PowerPoint presentation concerning new preprint published on June 3, 2013, by Barmina *et al.* arXiv:1306.0830v1, titled "Laser-induced synthesis and decay of Tritium under exposure of solid targets in heavy water." It is shown how their data are explained by Widom Larsen theory 84SS
- ✓ July 4, 2013: uploaded 60-slide Lattice PowerPoint presentation, "History, macroeconomics, LENRs, and the real price of Gold" 87SS
- ✓ July 20, 2013: aviation journalist Christine Negroni published news article, "Ethiopian 787 fire sparks a question: is Lithium-ion ready to fly?" 19JC
- ✓ July 22, 2013: uploaded 56-slide Lattice PowerPoint presentation, "LENRs vs. nuclear fission and natural gas for power generation" 88SS
- ✓ July 28, 2013: uploaded 51-slide Lattice PowerPoint presentation, "Widom-Larsen theory explains experimental data presented in new Mitsubishi patent application" 89SS
- ✓ August 6, 2013: uploaded 93-slide Lattice PowerPoint presentation, "Containing thermal runaways: a fool's paradise?" 90SS
- ✓ August 12, 2013: uploaded 34-slide Lattice PowerPoint presentation, "Minuscule cumulative investment in LENRs vs. nuclear weapons technology" 91SS

Note: combinations of two capital letters plus number in red are unique IDs referring to documents listed in Index Appendices

Lattice Energy LLC

Previous notable new items and pending developments

- ✓ **August 21, 2013:** uploaded 35-slide Lattice PowerPoint presentation, "$LiFePO_4$ immune to runaways: another fool's paradise?" 92SS
- ✓ **September 6, 2013:** uploaded 108-slide Lattice PowerPoint presentation, "Large increases in battery energy densities drive convergence between energetic materials, LENRs and batteries" 93SS
- ✓ **September 25, 2013:** uploaded 58-slide Lattice PowerPoint presentation, "Battery field-failures occur in electronic cigarettes: Lithium-based batteries that power them can and do explode" 94SS
- ✓ **October 3, 2013:** uploaded 23-slide Lattice PowerPoint presentation, "Tesla Motors Model S car catches fire on road --- Incident occurred on October 1, 2013 in Kent, WA" 95SS
- ✓ **October 3, 2013:** uploaded 8-slide Lattice PowerPoint presentation, "Hannah Elliott (Forbes) interviews Tesla spokesperson who ducks question re road debris that supposedly caused Oct 1 battery fire" 96SS
- ✓ **October 16, 2013:** uploaded 82-slide Lattice PowerPoint presentation, "What really caused the fiery October 1, 2013 Tesla Model S battery thermal runaway incident? Tesla's theory: event was caused by metallic debris on road impaling battery. Theory has some issues: could it instead have been an internal field-failure?" 97SS
- ✓ **October 20, 2013:** uploaded 35-slide Lattice PowerPoint presentation, "Thermite reactions are possible in Li-battery runaways; Mentioned in XXXXX's PowerPoint dated March 28, 2013 --- First time major battery manufacturer has publicly admitted possibility" Removed at request of third-party legal counsel – document is now just a single cover slide 98SS
- ✓ **October 31, 2013:** uploaded 100-slide Lattice PowerPoint presentation, "Toyota confirmed Mitsubishi's LENR transmutation results - Successfully transmuted stable Cesium into stable Praseodymium" 99SS

Note: combinations of two capital letters plus number in red are unique IDs referring to documents listed in Index Appendices

Lattice Energy LLC

Previous notable new items and pending developments

- ✓ **November 20, 2013:** uploaded 13-slide Lattice PowerPoint presentation, "Tesla Motors Model S vs. the Nissan Leaf: Why has Leaf had fewer thermal runaways vs. Model S? Answer potentially found in the frequency of battery field-failure events" 100SS
- ✓ **November 27, 2013:** uploaded 36-slide Lattice PowerPoint presentation, "LENRs and the future of energy" 101SS
- ✓ **November 28, 2013:** 8-page popular science article published, "Einstein's lost hypothesis --- Is a third-act twist to nuclear energy at hand?", by Mark Anderson, *Nautilus* magazine, Nov. 28, 2013 Winter 2013-14 issue pp. 21 – 29; Discusses Einstein's early 1950s-era connection to many-body collective effects utilized in Widom-Larsen theory of LENRs; in 1951 Sternglass had discovered anomalous neutron production in Hydrogen discharge tube experiments Subscription required to read entire article; however, key excerpts provided herein in later section under: 21JC
- ✓ **December 13, 2013:** uploaded 75-slide Lattice PowerPoint presentation, "LENR transmutation as source of scarce elements" 102SS
- ✓ **December 27, 2013:** uploaded 40 portrait-mode Lattice PowerPoint presentation, "World famous Japanese physicist Prof. Hantaro Nagaoka transmuted Tungsten into Gold in 1924 – why did he stop this work before 1930?" 103SS
- ✓ **January 3, 2014:** *New Energy Times* breaks news story that for first time ever, DOE willing to fund LENRs 22JC
- ✓ **January 4, 2014:** *Forbes* online contributor Jeff McMahon picked-up on the *New Energy Time*s story about ARPA-E and further amplified it; McMahon also received a written response from an ARPA-E spokesman which effectively confirmed that the radical shift in the DOE's willingness to fund LENRs that was first-reported by *New Energy Times* on Jan. 3 was in fact correct information 23JC

Note: combinations of two capital letters plus number in red are unique IDs referring to documents listed in Index Appendices

Lattice Energy LLC

Previous notable new items and pending developments

- ✓ **January 20, 2014:** uploaded 3-slide Lattice PowerPoint presentation, "NASA Project Document: Are Investigating LENRs for Powering Future Aircraft" 104SS
- ✓ **February 16, 2014:** uploaded 69-slide Lattice PowerPoint presentation, "Revolutionary green LENRs could potentially power future versions of advanced subsonic aircraft and UAVs --- What happens to aircraft, vehicles, and homes if LENRs achieve >10x chemical?" 105SS
- ✓ **April 8, 2014:** uploaded 32-slide Lattice PowerPoint presentation, "Converting aromatic fractions of heavy oils and coal into CLENR fuels: no CO_2 and 5 million x more thermal energy" 106SS
- ✓ **April 8, 2014:** *Nikkei* (the *Wall Street Journal* of Japan) ran favorable 5-page Japanese language story in the paper's electronic edition featuring ongoing LENR transmutation R&D work of Mitsubishi Heavy Industries 24JC
- ✓ **May 12, 2014:** uploaded 92-slide Lattice PowerPoint presentation, "Spreading LENR revolution: connecting the unconnected and empowering the powerless; delivering rural electrification and Internet to 1.4 billion energy-poor people around the world" 107SS
- ✓ **June 3, 2014:** uploaded 16-slide Lattice PowerPoint presentation, "In a surprising move both IBM and JCESR apparently slowed R&D to develop Lithium-air batteries" 108SS
- ✓ **June 13, 2014:** uploaded 98-slide Lattice PowerPoint presentation, "Revolutionary radiation-free nuclear propulsion for advanced hypersonic aircraft - Lattice's new concept for a LENR dusty plasma scramjet engine" 109SS
- ✓ **August 6, 2014:** uploaded 42-slide Lattice PowerPoint presentation, "Game-changing low energy neutron reactions - LENRs - What are they and the amazing things they could enable" 110SS

Note: combinations of two capital letters plus number in red are unique IDs referring to documents listed in Index Appendices

Lattice Energy LLC

Previous notable new items and pending developments

- ✓ **September 17, 2014:** Widom, Swain, and Srivastava publish arXiv preprint, "Electron capture in a fully ionized plasma" in which they demolish erroneous criticisms of our theoretical work in LENRs by Maiani *et al.* 111SS
- ✓ **October 6, 2014:** uploaded 49-slide Lattice PowerPoint presentation, "LENR transmutation of Carbon vs. combustion with Oxygen - Is this an extinction event for fossil fuels or a new pathway to the future for oil companies?" 112SS
- ✓ **November 12, 2014:** Bill Gates attended a private technical briefing on low energy neutron reactions (LENRs) at the Italian government's national agency for new technologies - ENEA (Frascati, Italy) --- see news story 25JC
- ✓ **November 19, 2014:** uploaded 95-slide Lattice PowerPoint presentation, "Green low energy neutron reactions (LENRs) could enable a Moore's Law for energy" 113SS
- ✓ **December 10, 2014**: uploaded copy of 36-slide PowerPoint that was prepared for an invited technical talk by Larsen at an IGRS meeting held at NASA-Ames in Mountain View, CA 114SS
- ✓ **December 22, 2014:** uploaded a 102-slide Lattice PowerPoint presentation, "Implications of LENRs and mobile + charge carriers in Earth's crust for seismicity, terrestrial nucleosynthesis, and the Deep Biosphere: paradigm shifts in geophysics, geochemistry, and biology" 115SS
- ✓ **January 14, 2015**: uploaded copy of 44-slide PowerPoint titled, "Compelling economics of transmutation vs. combustion of Carbonaceous energy sources" 116SS
- ✓ **March 20, 2015**: uploaded copy of 101-slide PowerPoint titled, "Surprising similarities between LENR-active sites and enzymatic catalysis" 117SS
- ✓ **April 30, 2015**: uploaded copy of 45-slide PowerPoint titled, "Beyond the Haber-Bosch process for ammonia production: Fixing Nitrogen at near-ambient temperatures and pressures" 118SS

Note: combinations of two capital letters plus number in red are unique IDs referring to documents listed in Index Appendices

Lattice Energy LLC

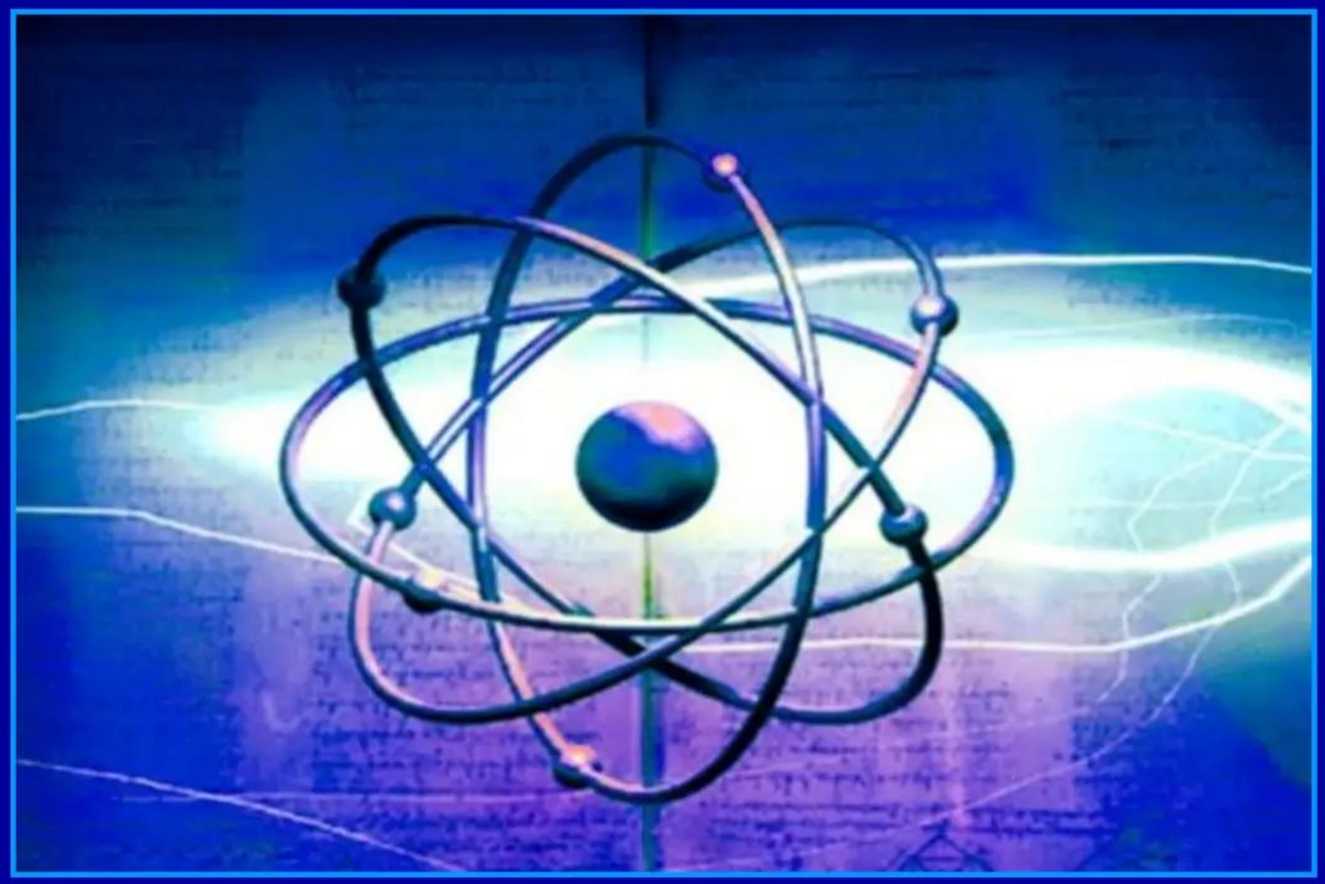
Previous notable new items and pending developments

- ✓ May 13, 2015: uploaded copy of 54-slide PowerPoint titled, "In 1989 some scientists knew neutrons were behind LENRs; experimental data from national labs clearly showed neutron captures" 119SS
- ✓ July 23, 2015: uploaded copy of 2-slide PowerPoint titled, "Greater awareness of risks of Lithium-ion battery fires and explosions: U.S. FAA recently made excellent presentation at industry meeting in Europe" 120SS
- ✓ July 23, 2015: uploaded copy of 31-slide PowerPoint titled, "Two facets of W-L theory's LENR-active sites supported by Daskalakis *et al.*'s experimental data just published in *Physical Review Letters*" 121SS
- ✓ August 2015: Reporter Angelica Buan discussed LENRs in an article titled "Asia's quest for clean energy" published on pp. 18 - 21 in a trade magazine, *Plastics and Rubber Asia* (August 2015 - online digital edition) 26JC
- ✓ August 3, 2015: uploaded copy of 32-slide PowerPoint titled, "LENR transmutation of Carbon better energy strategy than Obama clean power plan - Slashes CO_2 emissions for vehicles as well as electric power generation" 122SS
- ✓ August 25, 2015: uploaded copy of 20-slide PowerPoint titled, "Japanese government resumes funding LENR research after a 20-year hiatus" 123SS

Note: combinations of two capital letters plus number in red are unique IDs referring to documents listed in Index Appendices

Lattice Energy LLC

Overview of the Widom-Larsen theory



"It is a capital mistake to theorize before one has data. Insensibly one begins to twist facts to suit theories, instead of theories to suit facts."

Sherlock Holmes, "A Scandal in Bohemia" (1891)

Lattice Energy LLC

LENRs are a green paradigm-shifting nuclear technology

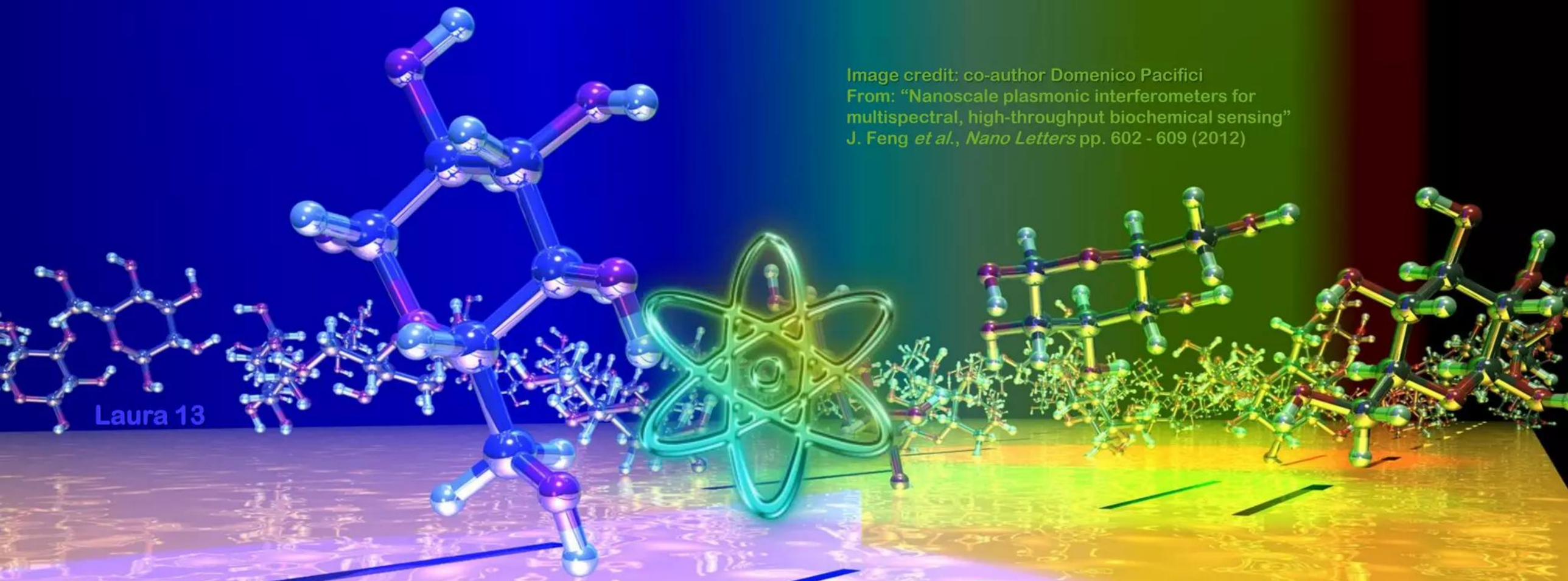


Image credit: co-author Domenico Pacifici
From: "Nanoscale plasmonic interferometers for multispectral, high-throughput biochemical sensing"
J. Feng *et al.*, *Nano Letters* pp. 602 - 609 (2012)

Laura 13

No deadly gamma radiation …
No dangerous energetic neutron fluxes and
Insignificant production of nasty radwastes

Truly revolutionary and environmentally safe

Lattice Energy LLC

Revolutionary safe green nuclear energy technology

- ✓ Exists and is correctly called low energy neutron reactions or LENRs
- ✓ LENRs are a truly eco-green next generation source of safe, low cost nuclear energy – no energetic gammas/neutrons, no long-lived wastes
- ✓ Controversial field of physical science – presently, there is still little current coverage in the mass-media, popular scientific press, and majority of so-called 'premier' mainstream scientific journals
- ✓ Pons & Fleischmann erroneously thought LENRs were D+D "cold fusion"
- ✓ Major 26-year worldwide scientific controversy began with P&F's now-notorious television news conference at the University of Utah in 1989
- ✓ And it ends here – Lattice believes that it has the answers to key theoretical and technical questions that will enable commercialization
- ✓ Using known physics, Widom-Larsen have developed a new theory of LENRs – shows how very energetic, non-fusion nuclear processes can occur in condensed matter systems under mild macrophysical conditions

Lattice Energy LLC

Historical Overview: LENRs and genesis of W-L theory

- ✓ **Work on W-L theory was begun by Larsen in 1998** with an exhaustive review of the entire available body of reported experimental results in LENRs; that has continued unabated to the present. **There is simply no substitute for good data**
- ✓ **Our theory evolved organically out of an attempt to discover underlying unifying physics that would be capable of explaining what might otherwise appear to be very disparate experimental results.** The W-L theory of LENRs was not created *ab initio* as a pure theoretical construct *a la* string theory. *Au contraire*, **it was created as a conceptual tool to help make sense out of what** was formerly a bewildering array of superficially different physical phenomena
- ✓ **For example, in late 1990s many "cold fusion" researchers mistakenly believed that heavy water electrolytic LENR systems involved a fundamentally different mechanism than light water systems:** they claimed heavy water produced only heat and He-4; light water supposedly produced little heat, transmutations, and no He-4. Circa 1996-98, this idea was contradicted when Mizuno observed essentially the same transmutation product mass spectrum in a heavy water electrolytic system that Miley had observed in light water systems. **Unburdened by then-popular "cold" D-D fusion paradigm, this data suggested to Larsen that the underlying microphysical process was exactly same in D and H systems**

Lattice Energy LLC

Historical Overview: LENRs and genesis of W-L theory

- ✓ Another example of a mistaken belief of "cold fusion" researchers was the notion that some sort of nuclear reactions were taking place throughout the bulk lattice of Palladium substrates. This notion was directly contradicted by post-experiment SIMS depth-profiling analyses of transmutation products reported by Miley *et al.* and Iwamura *et al.*, among others. All consistently showed that nuclear products were mostly confined to regions within ~1,000 - 1,500 Angstroms of device surfaces; LENRs are mainly a surface effect
- ✓ In 2004, Allan Widom joined the theoretical effort as an outside collaborator followed by Yogendra Srivastava in 2006. Importantly, while we are all clearly theoreticians both by inclination and by experience, philosophically we are and have always been strongly grounded in reported experimental data. Theory and careful experimentation are mutually synergistic; in good scientific practice they are inextricably and indissolubly linked
- ✓ At every step along the way during the development of the W-L theory, its predictions were carefully compared against the best available experimental data. Strangely, some have recently suggested that W-L's gamma suppression needs further experimentation because it supposedly has not been proven yet. Well, it depends on exactly what one means by the word "proven" in this context. For example, if one begins with isotope A, which then gets transmuted to isotope B (via ULM neutron capture according to W-L) and no gammas that would customarily be observed in non-LENR systems are detected, it provides *ipso facto* evidence for W-L's gamma-to-IR conversion mechanism. Since large fluxes of MeV-energy gammas have never been observed in over 20 years of LENR experiments, it would seem that little remains to be proven about the reality of gamma suppression in such systems

Lattice Energy LLC

Widom-Larsen theory explains $e + p$ in condensed matter

Enabled by many-body collective effects along with quantum mechanics

No new physics in W-L theory: combines well-established physics in novel ways

- ✓ Since 1989, most previously proposed theories of LENRs presumed that Coulomb barrier-penetrating D-D fusion was taking place in LENRs. However, these earlier theories incorporated many *ad hoc* assumptions, invoked questionable "new physics," and were readily dismissed by mainstream physicists and chemists

- ✓ Prior to work of Widom-Larsen, no comprehensive theory of LENRs existed that was consistent with known physics and could explain results of ordinary hydrogen as well as deuterium experiments, correctly identify the cause of complex transmutation products, and be able to calculate observed reaction rates from first principles; only theory able to explain Prof. John Huizenga's "three miracles" discussed in his highly critical 1993 book on the subject

- ✓ W-L theoretical work involves Standard Model interactions and many-body collective Q-M effects: explains all good experimental data on LENRs dating back to early 1900s, especially absence of 'hard' MeV-energy neutron or gamma radiation and negligible production of long-lived radioactive wastes; predicts new types of experimentally verifiable phenomena in condensed matter systems

If LENRs involved any fission or fusion, many researchers would have been killed by lethal doses of deadly hard radiation that would have invariably accompanied measurable excess heat

Frank Frazetta, "The Death Dealer" (1973)

Lattice Energy LLC

LENRs are an incredibly interdisciplinary technology

Resisted understanding until Widom-Larsen put all pieces together

Nanometer-to-micron scale many-body collective effects enable the 'impossible'

Quantum electrodynamics (QED)

Collective many-body effects

Modern quantum mechanics

Condensed matter physics

Classical electrodynamics

Modern nuclear physics

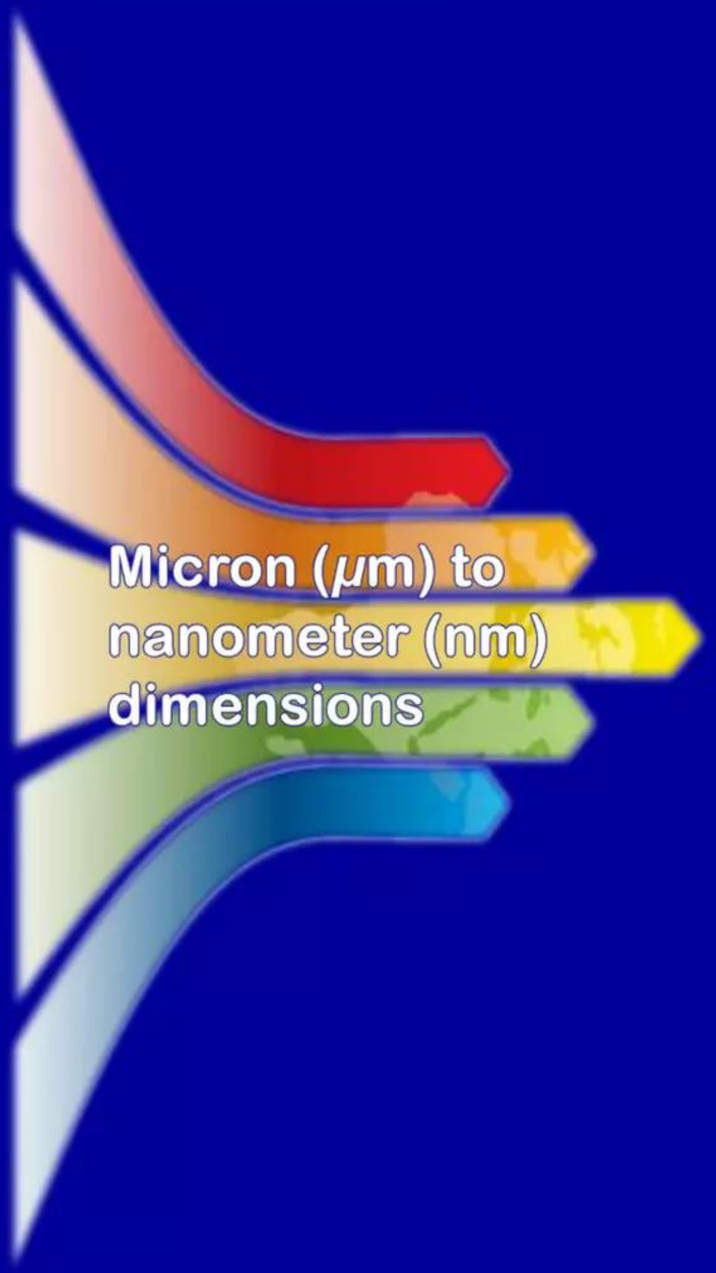
Surface chemistry (H)

All nanotechnology

Surface physics

Plasma physics

Plasmonics



Widom-Larsen theory of LENRS and related areas of science and technology in condensed matter systems utilize crucial knowledge derived from all of these varied disciplines

Lattice Energy LLC

Nanotechnology and LENRs are mutually joined at the hip

Guided by physics of the Widom-Larsen theory, an opportunity to commercialize LENRs as truly green CO_2-free nuclear energy source has been enabled by a unique juxtaposition of very recent parallel advances in certain very vibrant areas of nanotechnology (esp. plasmonics), quantum entanglement, new innovations in nanoparticle fabrication techniques, as well as an array of new discoveries in advanced materials science.

Lattice Energy LLC

Nanotechnology and LENRs are mutually joined at the hip

Large length scales

What was formerly thought impossible becomes possible by utilizing applied nanotechnology

Nuclear-strength electric fields in μ-sized LENR-active sites enable e + p reaction

Huge array of new technological possibilities and opportunities open-up at micron to nanometer length-scales

Lattice Energy LLC

Scientists observed LENRs in experiments for > 100 years

Not recognized as being nuclear because no hard radiation emitted

Periodically resurfaced as unexplained anomalies in different guises

Early 1900s: many researchers reported seeing transmutation of elements during electric discharges

1922: Wendt & Irion reported producing Helium in exploding wires; Rutherford trashed their results

1925: Nagaoka reported producing Gold during electric arc discharges; few believed paper's results

1927: one of Millikan's PhD students reported heavy element transmutations; not generally believed

Early 1930s to 1950: dark ages of LENR transmutation research; not pursued by anyone anywhere

1951: Sternglass saw neutron production in discharges; consulted Bethe & Einstein; dropped work

Mid-1960s: neutron production seen during RF excitation of Deuterium plasma; work was dropped

1989: Pons & Fleischmann claimed D+D "cold fusion" seen in electrolytic cell; trashed by scientists

2002: Mitsubishi Heavy Industries reported Cs to Pr transmutation in refereed journal; questioned

2006: Widom and Larsen published theory's key parts in peer-reviewed *European Physical Journal C*

2012: Mitsubishi Heavy Industries confirmed Nagaoka's LENR transmutation path to Gold at ANS

2013: Toyota finally confirmed Mitsubishi's LENR transmutation of stable Cesium → Praseodymium

Lattice Energy LLC

LENRs in context of historical events beginning in 1942

1942: Enrico Fermi activated Manhattan Project's first working fission reactor at Univ. of Chicago
1945: US first to use nuclear weapons in war; destroyed cities of Hiroshima and Nagasaki in Japan
1946: Prof. Fred Hoyle first published $e + p$ neutronization reaction theorized in cores of dying stars
1951: A. Einstein, H. Bethe & E. Sternglass reviewed apparent $e + p$ reaction in tabletop apparatus
1952: US detonated first fission-fusion thermonuclear weapon at Eniwetok Island, South Pacific
1955: First commercial fission-based nuclear power reactor in Shippingport, Pennsylvania, USA
1957: M. & G. Burbidge, W. Fowler & F. Hoyle published paper delineating modern astrophysics
1965: M. & G. Burbidge, W. Fowler & F. Hoyle published paper suggesting ex-core nucleosynthesis
1960s: S. Glashow, A. Salam & S. Weinberg published modern theory of electroweak interaction
1970 thru early 1980s: Glashow-Salam-Weinberg's electroweak theory confirmed experimentally
1985: ITER fusion power generation project first began at 1985 superpower summit in Geneva
1986: K. Erik Drexler published "Engines of Creation: The Coming Era of Nanotechnology"

1989: S. Pons & M. Fleischmann "cold fusion" debacle began with Univ. of Utah press conference
2001: Lattice Energy LLC commenced operation to commercialize LENRs for power generation
2005: A. Widom and L. Larsen release first theoretical preprint re LENRs on Cornell physics arXiv
2006: A. Widom and L. Larsen publish core of LENR theory in the *European Physical Journal C*
2010: ITER began 10-year construction phase with estimated completion costs of 13 billion Euros
2010: Y. Srivastava, A. Widom and L. Larsen publish theory paper in *Pramana - Journal of Physics*
2012: CERN sponsored first-ever colloquium on LENRs with Y. Srivastava discussing W-L theory
2012: American Nuclear Society sponsored first working session on LENRs to be held in 16 years
2013: LENR device physics now understood well enough to begin commercialization for power

Lattice Energy LLC

W-L theory extends beyond condensed matter systems

W-L theory and collective effects extended from LENRs in condensed matter to physical environments found in high-current exploding wires, e.g., large wire inductors, as well as to large-scale, magnetically dominated effects that occur in astrophysical systems

Green nuclear regime

Commercial opportunities

Length Scale	Type Of System	Electromagnetic Regime	Collective LENR Phenomena	Comment	Doc. ID
Submicron	Certain earthly bacteria and fungi	Very short-range electric or magnetic fields	Transmutations, high level gamma shielding	Obtain unavailable trace elements; survive deadly gamma/X-ray radiation	2TT and 6SS
Microns	Hydrogen isotopes on metallic surfaces	Very high, short-range electric fields on solid substrates	Transmutations, high level gamma shielding, heat, some energetic particles	This regime is useful for small-scale commercial power generation	1TT, 2TT, 3TT, 4TT, 8TT, 6PS
Microns to Many Meters	Exploding wires, planetary lightning	Dusty plasmas: mixed high-current and high local magnetic fields	Transmutations, 'leakier' gamma shielding, heat; X-rays up to 10 keV, larger energetic particle fluxes	This regime is useful for large-scale commercial power generation	5TT and 3PS
Many Meters to Kilometers	Outer layers and atmospheres of stars (flux tubes)	Dusty plasmas: high mega-currents and very large-scale, highly organized magnetic fields	Transmutations, large fluxes of energetic particles (to GeVs), limited gamma shielding, X-rays	Solves mysteries of heating of solar corona and radioactive isotopes in stellar atmospheres	7TT, 8TT, 17SS
Up to several AU (distance from earth to sun)	Active galactic nuclei in vicinity of compact, massive objects (black holes)		Energetic particles (GeVs), gamma-ray bursts (GRBs) and ultra-high energy cosmic rays (TeVs)	Solves several unexplained astronomical mysteries	

Note: mass renormalization of electrons by high local E-fields not a key factor in magnetically dominated regimes at large length scales

Lattice Energy LLC

W-L theory extends beyond condensed matter systems

Short-Range Collective Electric Field Effects Dominate

Longer-Range Collective Magnetic Field Effects Begin to Dominate

Long-Range Collective Magnetic Field Effects Dominate

Collective nuclear 'aikido'

Many-body collective magnetic 'taekwondo'

Regime of mostly ultralow energy neutron catalyzed reactions

Low to medium electric and/or ion currents

W-L: $e^* + p^+ \rightarrow$ 1 neutron + neutrino **or** $e^* + d^+ \rightarrow$ 2 neutrons + neutrino

Neutron production, capture, release energy, and transmutation products

- Microorganisms – biological transmutations by certain types of earthly bacteria & fungi
- Pressure gradients across membranes – e.g., Iwamura, Li, & Arata-Zhang - gas phase
- Current-driven P&F-type chemical cells - liquid phase; glow discharge cells - gas phase
- Laser-triggered chemical cells – e.g., Letts, Cravens, Violante, etc. - liquid or gas phase

High currents: electrons and/or ions

- RF-triggered dusty plasmas - gas phase
- Current-driven dusty plasmas - gas phase
- Vacuum diodes – e.g. Proton-21, Kiev, Ukraine, Sandia NL (US) in 1970s - gas phase
- Exploding wires – e.g., Wendt & Irion, Chicago 1922; Z-pinch, Sandia NL - gas phase
- Piezoelectric and pyroelectric processes in solid-state materials – Carpinteri, Naranjo
- Magnetic flux compression generators, e.g. US (LANL), Russia
- Lightning (terrestrial, planetary, nebular), especially in dusty environments – e.g., Dwyer
- ULMN-catalyzed subcritical fission reactors (<<< nuclear waste) - reprocess old wastes

Higher fluxes of neutrons

Scales-up to very large length scales

Wide range of magnetic field strengths

Mega-scale currents

W-L mixed regime: high energy particle reactions and/or LENRs on dust

Magnetic effects dominate large length-scale plasmas: $e^- + p^+ \rightarrow$ lepton + X

- Stars – additional nuclear reactions occur in photospheres, flares, and further out in coronas
- Dusty, hydrogen-rich nebular plasma clouds exposed to stellar photon and particle radiation
- Magnetars/active galactic nuclei: W-L mechanism can in theory create UHE TeV cosmic rays

>>>> fluxes

~0 eV Ultra low momentum neutrons ... MeV neutrons ...GeV neutrons ....TeVs

Increasing neutron and charged particle energies

Lattice Energy LLC

LENRs could be much better than fission or fusion

Ranking competing nuclear energy technologies by greenness

"Greener"

Reactants/Fuel	Reaction Type	Main End Products of Reactions
Very Heavy Uranium or Plutonium metal atoms + neutrons (chain reaction)	Conventional Fission in Nuclear Power Plants; Strong Interaction	Unstable long-lived radioactive isotopes, hard gamma/ X-ray radiation, energetic neutrons, heat
Starts With Lightest Atoms Hydrogen + Hydrogen	Fusion in Stars; Strong Interaction	Stable Helium-3/4 isotopes, Mainly fluxes of energetic neutrons, heat
Starts With Slightly Heavier Isotopes of Hydrogen Deuterium + Tritium	Fusion in Proposed Commercial Reactors; Strong Interaction	Stable Helium-3/4 isotopes, Mainly fluxes of energetic neutrons, heat
Lighter to Medium-Heavy Atoms + H or D + Electrons + ULMN Neutrons	$e + p \rightarrow n + \nu$ LENRs: Weak Interaction + n Captures then Decays	Primarily stable isotopes, no hard radiation, beta and alpha particles, no externally released neutrons, heat

Present nuclear

Lattice Energy LLC

Typical energy releases in power generation technologies

Some LENR processes release > energy than D-T fusion reaction

LENRs better than fission or fusion because no hard radiation emitted

Less Energy Per Reaction

Reaction Type	Typical "Average" Energy Release		Relative Index of Energy Release	
U-235 Conventional Fission (1938)	220 MeV	Nuclear: Strong Interaction	1000	Taekwondo
H+H Fusion in Stars (1939)	27 MeV		123	
D+T Fusion Reactors (1950s)	17. 6 MeV		80	
Hydrogen- and Deuterium-based LENRs (1989)	~ 22 MeV (high side)	Nuclear: Weak Interaction	91	Aikido
	~ 0.1 MeV (low side)		0.45	
Blacklight Power's "Hydrinos" (1991)	max 0.02 MeV	?	0.09	Chemical
Hydrogen Fuel Cells (1838)	0.0002 MeV	Chemical	0.0001	
Combustion of Gasoline (1876)	0.0001 MeV		0.00005	

Evolution of nuclear technology

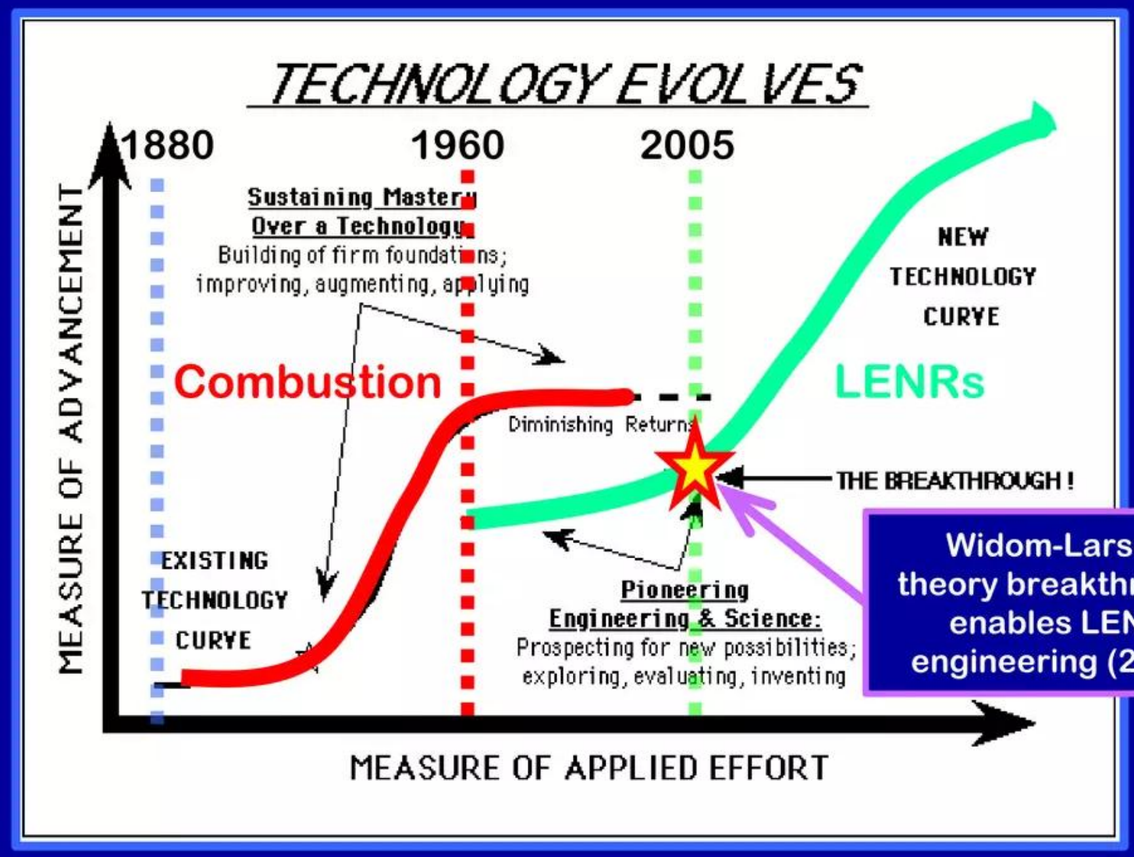
Lattice Energy LLC

Important commercial opportunities for LENRs

Enable a cleaner, less costly type of vastly denser energy source

Technology evolution S-curve timeline for combustion with Oxygen vs. LENRs

Opportunity: replace today's age-old combustion processes with CO_2-free transmutation



Lattice Energy LLC

Important commercial opportunities for LENRs

Fission and fusion emit hard radiation and produce radioactive wastes

LENRs do not emit any hard radiation or create environmentally harmful wastes

Fission, fusion, and LENRs all involve the controlled release of nuclear binding energy for power generation:

No CO_2 emissions; scale of energy release is MeVs (nuclear regime) > 1,000,000x energy density of chemical energy power sources

Heavy-element fission (involves shattering heavy nuclei to release stored nuclear binding energy):

Requires massive shielding and containment structures to handle radiation; major radioactive waste clean-up issues and costs

Alternate natural sources of fuel: today, almost entirely Uranium; Thorium-based fuel cycles now under development

Heavy element U-235 (fissile isotope fuel) + neutrons → (complex array of lower-mass fission products; some are very long-lived isotopes) + energetic gamma radiation + energetic neutron radiation + energy

Fusion of light nuclei: (involves smashing light nuclei together to release stored nuclear binding energy):

Present multi-billion $ development efforts (e.g., ITER, NIF, Tokamaks) focusing mainly on D+T fusion reaction; requires massive shielding/containment structures to handle 14 MeV neutron radiation; minor radioactive waste clean-up $ vs. fission

Natural sources of fuel: Deuterium and Tritium (two heavy isotopes of hydrogen)

Most likely commercial fusion reaction involves: D + T → He-4 (helium) + neutron + energy (total 17.6 MeV; ~14.1 MeV in neutron)

Low energy neutron reactions (LENRs - key distinguishing feature is neutron production via weak interaction; neutron capture + gamma conversion to IR + decays [α, β] release nuclear binding energy):

An early-stage technology; no emission of energetic neutron or gamma radiation; no long lived rad-waste products; LENR systems do not require massive and expensive radiation shielding and containment structures → much lower $ cost

Natural sources of fuel: any element/isotope that can capture LE neutrons and release >0.78 MeV in nuclear binding energy

Involves complex, branching LENR nucleosynthetic transmutation networks that begin with neutron captures on target nuclei then proceed from lower to higher values of atomic mass (A); very similar to what happens in stars, only at low temps/pressures

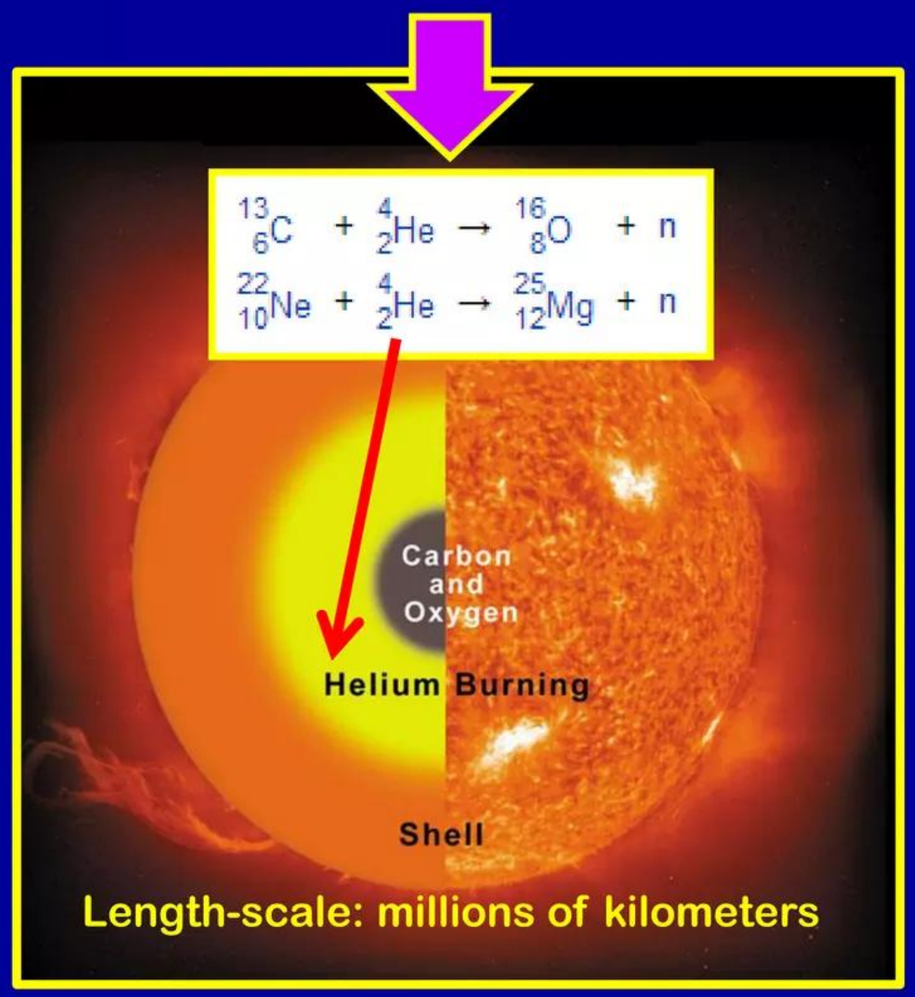
Lattice Energy LLC

Important commercial opportunities for LENRs

Fission and fusion neutrons are energetic, deadly and need shielding

All of the nuclear reactions shown below create neutrons: only LENRs are safe

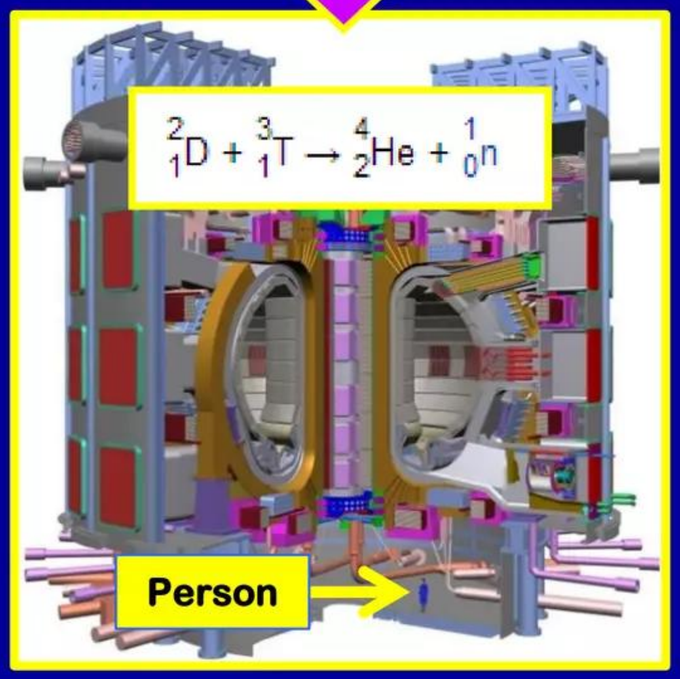
Stellar fusion reactions make MeV neutrons



Temperatures: many millions of degrees

ITER: D+T fusion reactor

Dangerous 14.1 MeV neutrons

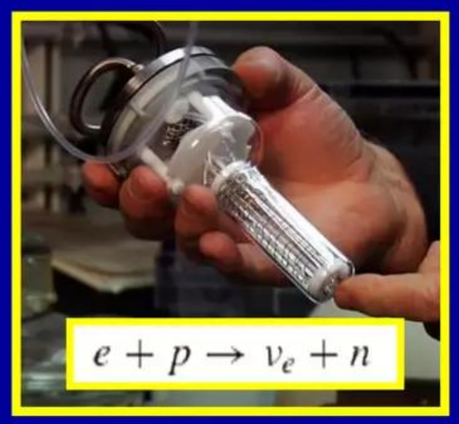


Temperatures: millions of degrees

Safe LENRs

Ultra low-energy

Hand-held device



Length-scale: inches

Temperatures: only thousands of degrees

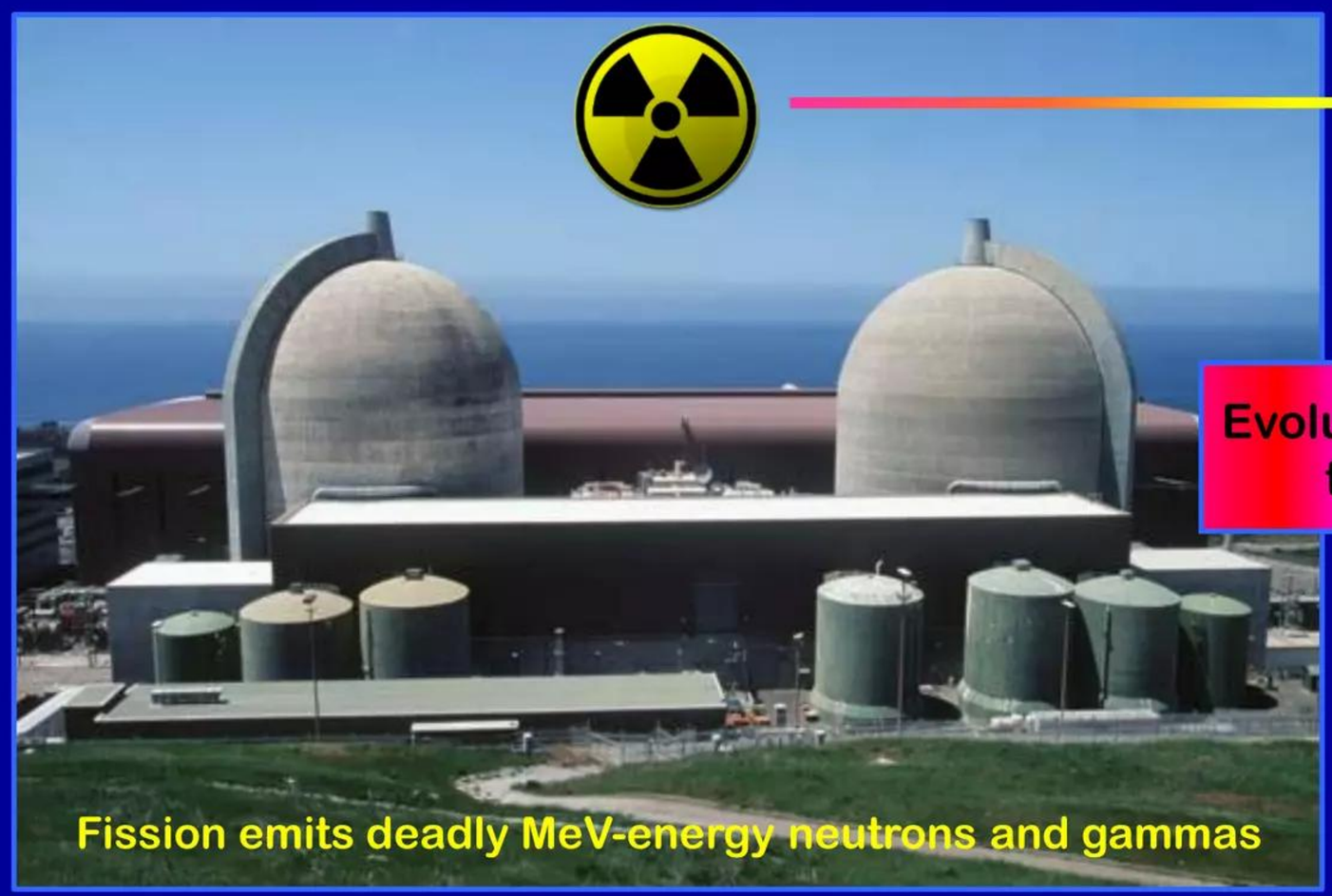
Lattice Energy LLC

Important commercial opportunities for LENRs

Lack of hard radiation eliminates heavy shielding and containment

Opportunity to develop revolutionary portable nuclear power sources

Fission reactors need 1 foot of steel and 3 feet of concrete to protect humans from hard radiation and wastes emitted by reactor; makes systems intrinsically large and heavy



Fission emits deadly MeV-energy neutrons and gammas

Evolution of nuclear technology

LENRs enable devices something like this: small, portable battery-like power sources that are safe and disposable

Much larger LENR devices based on dusty plasma embodiments can potentially scale-up to megawatts; akin to today's power plants

Lattice Energy LLC

Important commercial opportunities for LENRs

Applications	Description	Markets	Doc. ID
LENRs enable safe, radiation- and CO_2-free free nuclear energy production and power generation at substantially lower cost vs. competing nuclear (fission or fusion) and chemical technologies. Vastly greater energy densities and longevity at a lower price per kWh compared to chemical power sources for producing electricity	Integrate LENR heat sources w. different types of energy conversion technologies: e.g., develop battery-like devices using thermophotovoltaics that convert infrared heat directly into DC electricity; or use heat to rotate a shaft for direct motive propulsion and/or in power generation systems using steam turbines; scale-up by increasing area-density of LENR-active surface sites and/or volumetrically w. dusty plasmas	SAFE - no radiation shielding or waste issues. Could someday enter huge unit-volume portable power markets and be able to compete directly against advanced chemical batteries, small fuel cells, and fossil fuel microgenerators	8TT, 1PS, 2PS, 3PS, 5JC, and 6PS
Create large quantities of inexpensive raw process heat for bitumen extraction, heavy oil recovery, and/or oil shale processing. Could eliminate burning of natural gas used to make steam employed in SAGD process for underground bitumen extraction in oil sands regions of Canada (big decrease in CO_2 footprint and extraction costs)	Long-lived LENR thermal sources lowered down bore holes could be used to directly heat-up bitumen or heavy oil in underground reservoirs to reduce production costs and enhance % recovery. Use LENR heaters for *in-situ* underground upgrading. Can also produce clean, inexpensive process heat for many downstream petroleum operations such as refining	Major benefits to large oil and coal producers – can help increase long-term supplies of oil and reduce total production costs; shrink industry's global CO_2 emission footprint across all upstream and downstream operations	7SS
Develop much cleaner fission power technologies Use LENRs and ultra low momentum neutrons for triggering fission	Design new types of LENR-based subcritical fission reactors that can burn existing fissionable fuels down to stable isotopes – little or no long-lived radioactive wastes	Existing large-scale nuclear fission power generation systems – could engineer to retrofit existing facilities	5PS
Nuclear waste treatment Transmute dangerous radioactive nuclear waste using LENRs; generate additional power from waste burn-up	Develop turnkey systems for on-site clean-up of existing worldwide inventories of fission wastes from nuclear power plants	Nuclear waste remediation and clean-up – opportunities in many countries, e.g., US, France, Japan, China, etc.	4PS and 5PS
Transmutation of stable elements Produce almost any very valuable element or isotope in the periodic table at competitive costs compared to present mining and refining operations	Use LENRs to transmute less expensive elements into much more valuable ones – first do it abiologically; later migrate to methods using various species of genetically engineered bacteria	Mostly target precious and rare metals production, e.g., platinum, gold, rhodium, rare earth elements, etc	11SS and 6SS

Time

First targets

Long-term opportunities

Lattice Energy LLC

Important commercial opportunities for LENRs

Battery-like LENR devices energy density > chemical power sources

Lack of deadly radiation enables revolutionary portable nuclear power sources

LENRs Versus Chemical Energy Sources: Batteries, Fuel Cells, and Microgenerators	
Source of Energy	**Approximate Energy Density (Watt*hours/kg)**
Alkaline Battery	**164**
Lithium Battery	**329**
Zinc-Air Battery	**460**
Direct Methanol Fuel Cell (35% efficient)	**1,680**
Gas Burning Microgenerator (20% efficient)	**2,300**
100% Efficient Combustion of Pure Methanol	**5,930**
100% Efficient Combustion of Pure Gasoline	**11,500**
LENRs (based on an assumption of an average of 0.5 MeV per nuclear reaction in an LENR system)	**57,500,000** (maximum theoretical energy density – only a fraction would be achievable in practice)

Chemical energy sources

Lattice Energy LLC

Important commercial opportunities for LENRs

Heavy oil and coal could be processed to produce CO_2-free LENR fuels

Carbon atoms found on aromatic rings good fuel for radiation-free transmutation

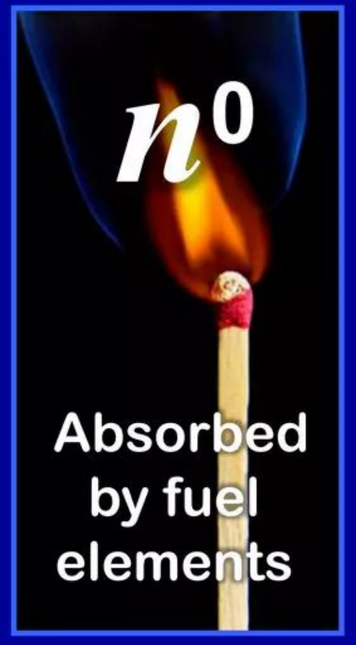
Radiation-free LENR transmutation

Neutrons + LENR fuel elements → heavier elements + decay products + heat

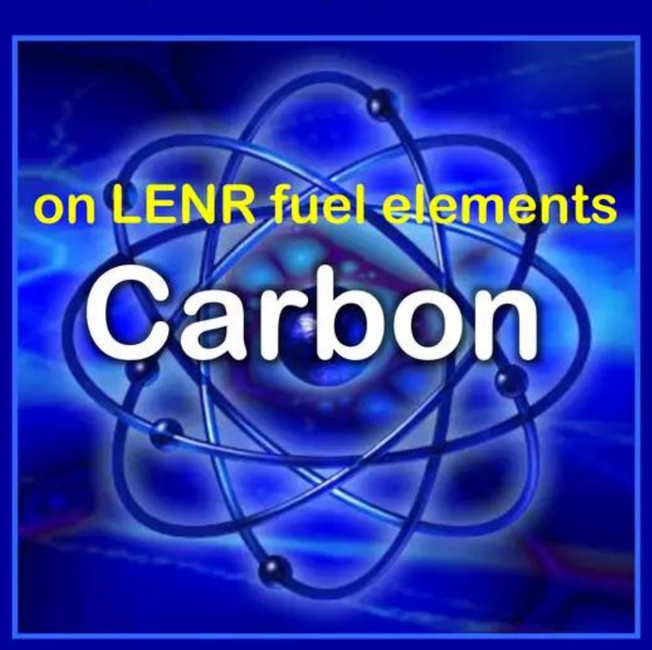
Catalytic neutron 'match'

Neutrons are readily absorbed by LENR fuels such as inexpensive Nickel, Titanium, Lithium, or Carbon atoms

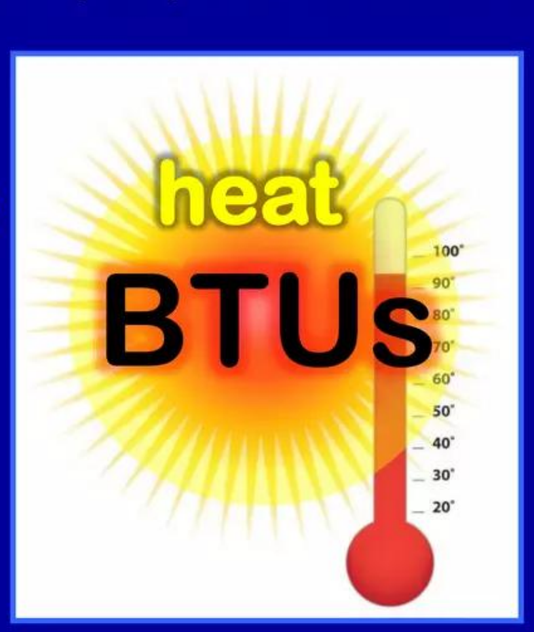
Direct conversion of neutron capture and decay-related gammas to IR and beta/alpha particles create heat



capture +



produces →



Process does not emit any deadly radiation or produce troublesome radwastes

Lattice Energy LLC

Important commercial opportunities for LENRs

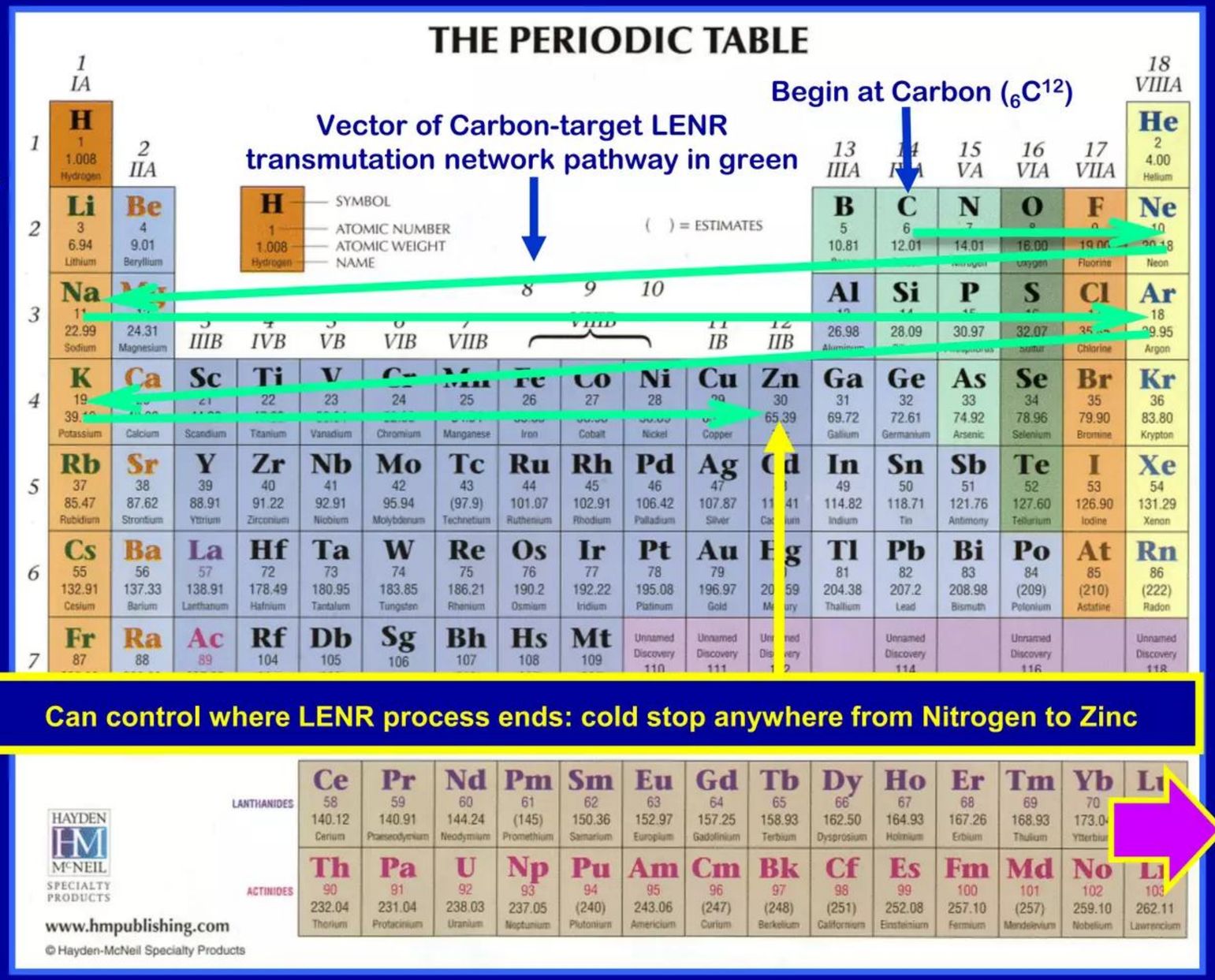
Heavy oil and coal could be processed to produce green LENR fuels

Carbon atoms found on aromatic rings are fuel for green transmutation process

Combustion of Carbon atoms in fossil fuels with Oxygen O_2 produces CO_2 and H_2O; CO_2 gas emissions are a problem, which has led to schemes like Carbon capture and sequestration (CCS)

Additional issues with coal's varied trace elements

Scale of energy release from chemical reaction combustion processes are on the order of eVs



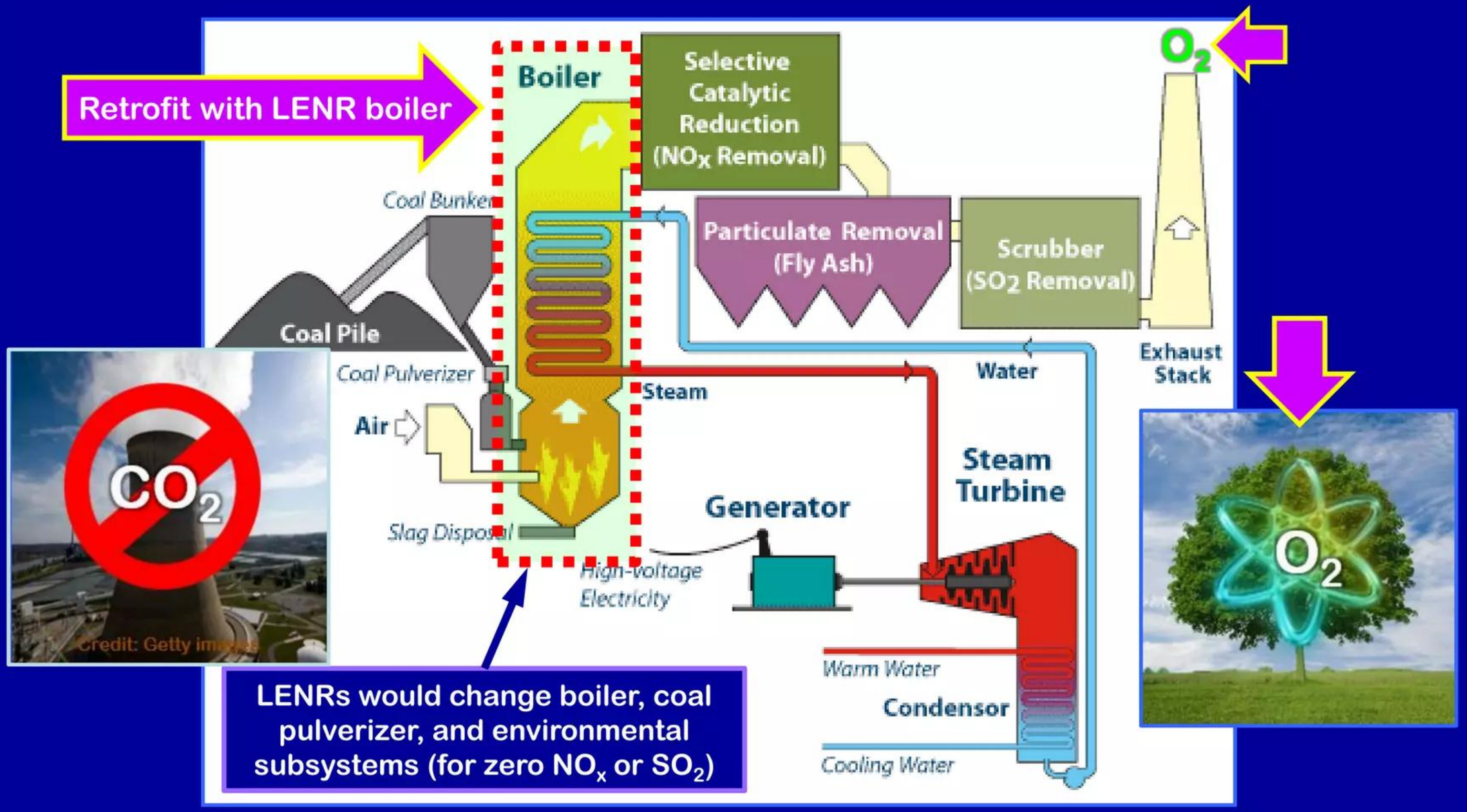
Depending on where nuclear process was stopped, LENR transmutation of Carbon atoms in oil and coal could produce a wide variety of stable elements up through Zinc; gaseous emissions might be limited to Neon, Argon, Nitrogen and/or preferably Oxygen

Scale of energy release is in MeV; or >10^6 larger than chemical reactions

Lattice Energy LLC

Could retrofit existing coal plants with C → N → O boilers

LENRs could end combustion of coal: $CH_4 + 2\ O_2 \longrightarrow CO_2 + 2\ H_2O$ + heat

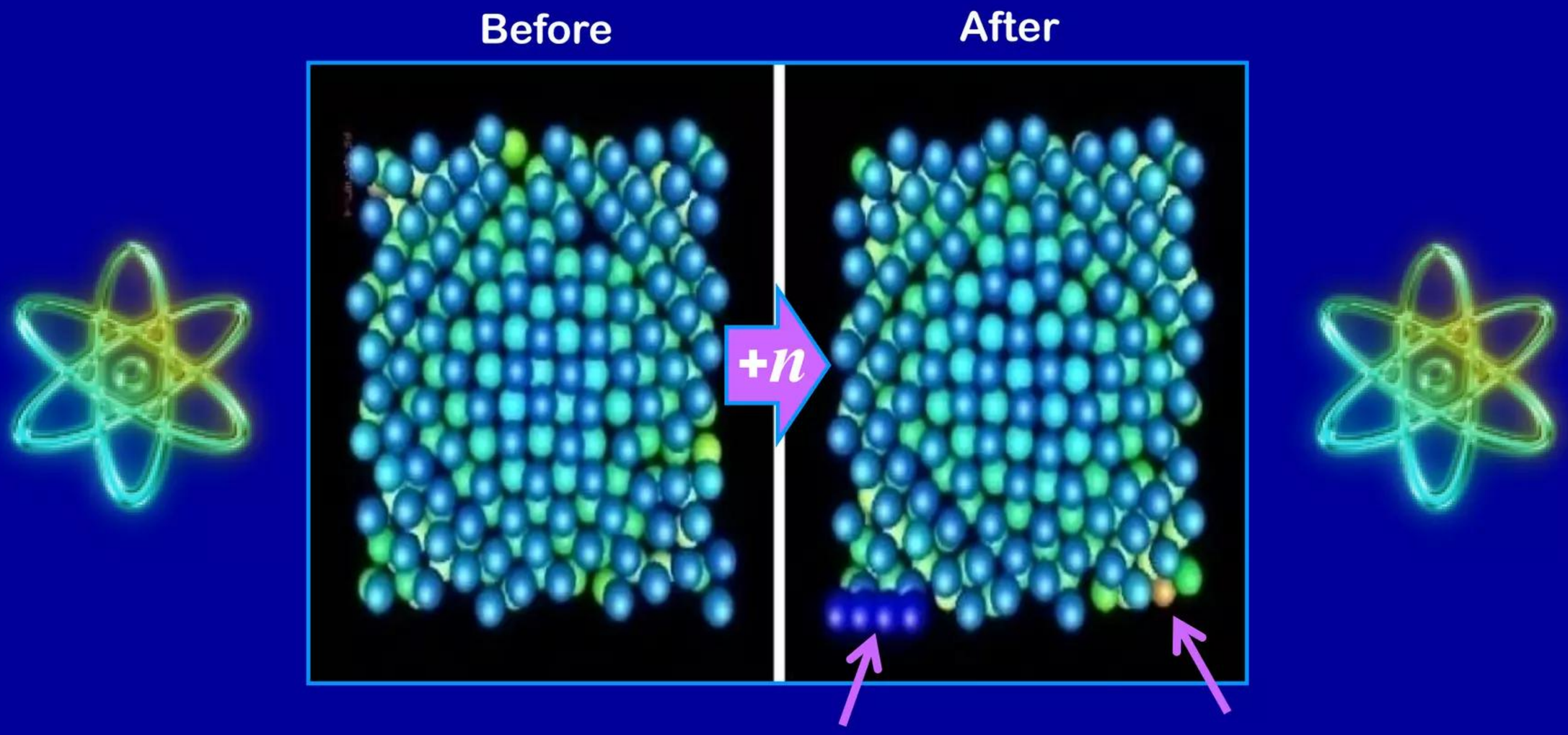


Retrofit strategy conserves capital; LENR plants would emit Oxygen O_2 like trees

Lattice Energy LLC

Details of Widom-Larsen LENR Theory

Some atoms are transmuted with collectively produced ULM neutrons



Dangerous energetic neutron and gamma radiation are absent

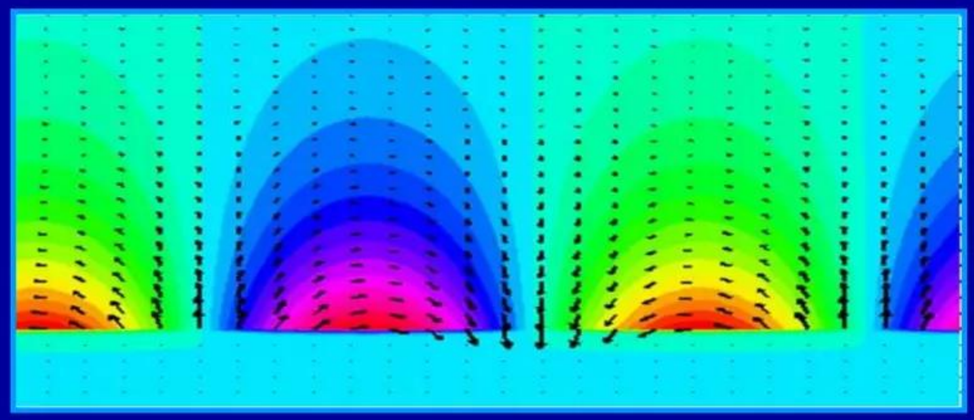
Lattice Energy LLC

Anomalies observed in LENR experiments since 1989

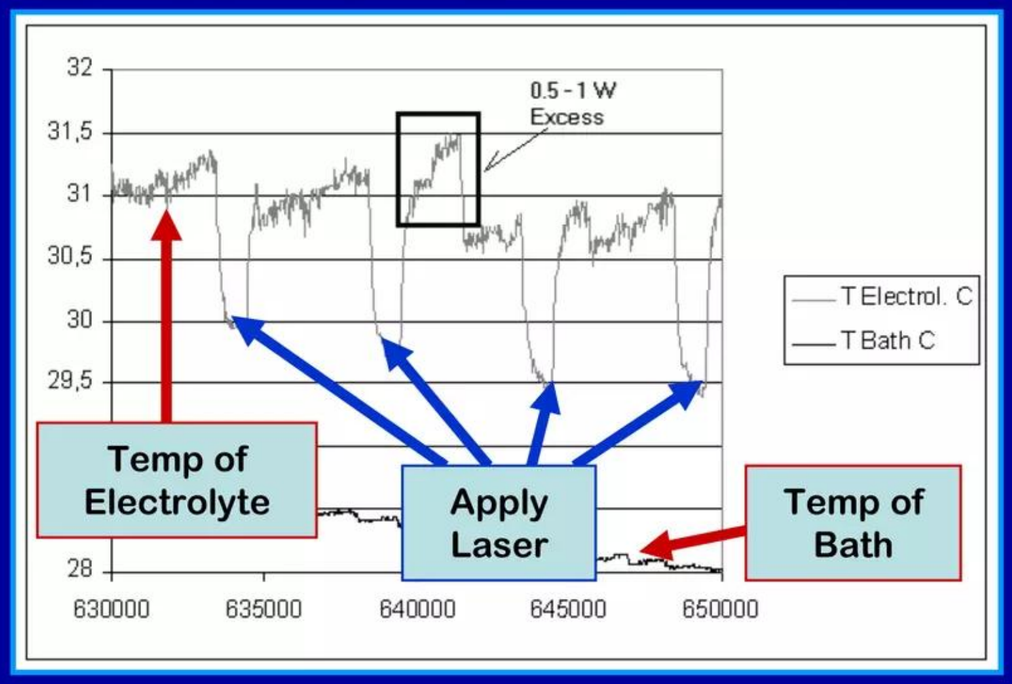
Since 1989, LENR researchers have reported a variety of anomalies in different types of heavy and light hydrogen (e.g., D_2O and H_2O) experimental systems, all involving heavily H-loaded metallic hydrides. Have observed electrical current-, laser-, RF-, and pressure-driven triggering of various types of anomalous, arguably nuclear effects as follows:

- ✓ **Calorimetrically measured excess heat effects** – wide range of values from just milliwatts to tens of Watts in some cases
- ✓ **Production of helium isotopes** (mostly He-4, rarely He-3); **rarely detect tritium**, H-3 unstable H isotope
- ✓ **Production of modest fluxes of MeV-energy alpha (α) particles and protons** as well as **minuscule emissions of low energy X- and gamma ray photons** (no large fluxes of MeV-energy gammas/neutrons) 14SS
- ✓ **Production of arrays of different stable isotopic transmutation products** (e.g., different elements)

Local variability: strength of surface plasmon electric fields



Experimental example - laser triggering of LENRs:
Sharp increase in excess power/temp after applying laser



Source: Violante *et al.* (ENEA, Italy), Asti Conference (2004)

Lattice Energy LLC

W-L theory successfully addresses longstanding issues

Widom-Larsen theory was developed after careful evaluation of a large body of experimental data; it addresses longstanding issues about LENRs that so-called "cold fusion" theorists have been unable to answer to satisfaction of mainstream physicists, e.g., Huizenga (1993):

- ✓ **Overcoming the Coulomb energy barrier:** weak interaction-based W-L theory posits that ultra low momentum neutrons and neutrinos are created from protons and heavy-mass surface electrons in very high electromagnetic fields found on surfaces of H-loaded metallic hydrides. **Unlike charged-particle D-D fusion, no Coulomb barrier to ultra low momentum (ULM) neutron capture by nuclei; neutrons have no charge** 1TT, 9TT

- ✓ **Absence of large emissions of dangerous high-energy neutrons:** ULM neutrons of the W-L theory have extraordinarily low energies and huge absorption cross sections --- are therefore very efficiently captured by nearby nuclei. **Thus, ULMNs are very difficult to detect directly** (ULM neutrons finally observed by Cirillo *et al.*, 2012) 1TT, 9TT, 26SS

- ✓ **Absence of large, dangerous emissions of gamma radiation:** in condensed matter LENR systems, heavy-mass surface plasmon (SP) electrons have a unique ability to absorb gamma rays and convert them directly to lower-energy infrared photons. **In LENR systems, gammas produced during neutron captures and beta decays are thus absorbed and converted to heat internally rather than being emitted externally** 1TT, 9TT

Note: 1TT, 69SS (2006) and 9TT, 70SS (2010) are both published in well respected, peer-reviewed physics journals

Lattice Energy LLC

Key features of the Widom-Larsen theory of LENRs

- ✓ W-L theory is based on very well-accepted physics; no microscopic "new physics" is postulated: 1TT, 8TT, 9TT
- ✓ Built upon well-established bedrock of electroweak theory and many-body collective effects; no *ad hoc* mechanisms are invoked: 1TT, 8TT, 9TT, 3SS, 1PS, 2PS
- ✓ Explains many-body collective neutron production in condensed matter with $e^* + p$, $e^* + d$, or $e^* + t$ weak interactions that occur in micron-scale H^+ or D^+ or T^+ ion patches having very high local electric fields that form on 'loaded' metal hydride surfaces: 1TT, 8TT, 9TT
- ✓ Shows how collectively produced neutrons have huge Q-M DeBroglie wavelengths and ultra low momentum (energy); have gigantic capture cross sections and are almost all absorbed locally. Very difficult to detect directly; minuscule or undetectable external releases of free neutron fluxes: 1TT, 8TT, 9TT, 5SS(21), 1PS, 2PS
- ✓ Explains unexpected absence of hard MeV-energy gamma radiation in such systems: 2TT, 8TT, 9TT, 14SS

Please note carefully:

Every document listed in the Appendices has a unique Document ID number: e.g., 1TT refers to the refereed W-L 2006 *EPJC* paper (copy 69SS), which is the first item in "Appendix 1 – Very Technical Theoretical Papers." If an optional parenthesis follows a document ID#, it is referring to specific page(s) or slide number(s) within that document. Some items may be associated with multiple Document ID#s: these may point to a mixture of technical and/or plain English documents, for example. ID #s are being provided to help readers control the level of technical details to which they are exposed and more efficiently examine documents about W-L theory and Lattice

Note: 1TT, 69SS (2006) and 9TT, 70SS (2010) are both published in well respected, peer-reviewed physics journals

Lattice Energy LLC

Electroweak reaction in Widom-Larsen theory is simple

Protons or deuterons react directly with electrons to make neutrons

electrons + protons (Hydrogen) → neutrons + neutrinos (benign photons, fly into space)

Require source(s) of input energy — Input energy creates electric fields > 2.5 x10^{11} V/m

Many-body collective electroweak neutron production — Heavy-mass e^{-*} electrons react directly with protons

Collective many-body quantum effects: many electrons each transfer little bits of energy to a much smaller number of electrons also bathed in the very same extremely high local electric field

Quantum electrodynamics (QED): smaller number of electrons that absorb energy directly from local electric field will increase their effective masses ($m = E/c^2$) above key thresholds β_0 where they can react directly with a proton (or deuteron) → neutron and neutrino

$$\text{Energy}_{\text{E-field}} + e^-_{sp} \rightarrow e^{-*}_{sp} + p^+ \rightarrow n^0 + \nu_e$$

ν_e neutrinos: ghostly unreactive photons that fly-off into space; n^0 neutrons capture on nearby atoms

Radiation-free LENR transmutation

Neutrons + fuel elements → heavier elements + decay products

Neutrons induce nuclear transmutations that release enormous amounts of clean, CO_2-free heat

Lattice Energy LLC

Electroweak reaction in Widom-Larsen theory is simple

Protons or deuterons react directly with electrons to make neutrons

In condensed matter systems, Steps 1. through 4. occur in nm- to μ-sized patch regions on surfaces; these are called LENR-active sites

Steps 1. thru 3. are very fast: can complete in 2 to 400 nanoseconds

1. Electromagnetic (E-M) radiation on a metallic hydride surface increases mass of surface plasmon (SP) electrons

2. Heavy-mass surface plasmon electrons react directly with (a) surface protons (p^+) or (b) deuterons (d^+) to produce ultra low momentum (ULM) neutrons (n_{ulm} or 2 n_{ulm}, respectively) and an electron neutrino (ν_e)

3. Ultra low momentum neutrons (n_{ulm}) are captured by nearby atomic nuclei (Z, A) representing some element with charge (Z) and atomic mass (A). ULM neutron absorption produces a heavier-mass isotope (Z, A+1) via transmutation. This new isotope (Z, A+1) may itself be a stable or unstable, which will perforce eventually decay

4. Many unstable isotopes β^- decay, producing: transmuted element with increased charge (Z+1), ~same mass (A+1) as parent nucleus; β^- particle (e_β^-); and an antineutrino ν_e

Ultra low momentum neutrons are almost all captured locally (very few have time to thermalize and be detected); any gammas produced get converted directly to infrared photons (heat) by heavy electrons

No strong interaction fusion or heavy element fission occurring below; weak interaction $e + p$ or $e + d$

High E-M field > 10^{11} V/m

Mass-renormalized surface plasmon electron

1. $h\nu_{field} + \bigcirc \longrightarrow \bullet$

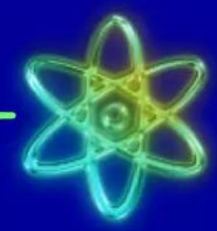
   (E-M energy) + $e^- \longrightarrow e^{-*}$

2a. $\bullet + \bullet \longrightarrow \text{⬭} + \text{⚡}$

   $e^{-*} + p^+ \longrightarrow n_{ulm} + \nu_e$

2b. $\bullet + \bullet \longrightarrow \text{⬭⬭} + \text{⚡}$

   $e^{-*} + d^+ \longrightarrow 2\,n_{ulm} + \nu_e$



3. $n_{ulm} + (Z, A) \longrightarrow (Z, A+1)$

   Unstable or stable new isotope

4. $(Z, A+1) \longrightarrow (Z+1, A+1) + e_\beta^- + \overline{\nu}_e$

   Unstable Isotope

Weak interaction β^- decays (shown just above), direct gamma conversion to infrared photons (not shown), and α decays (not shown) produce most of the excess heat that is calorimetrically observed in LENR systems

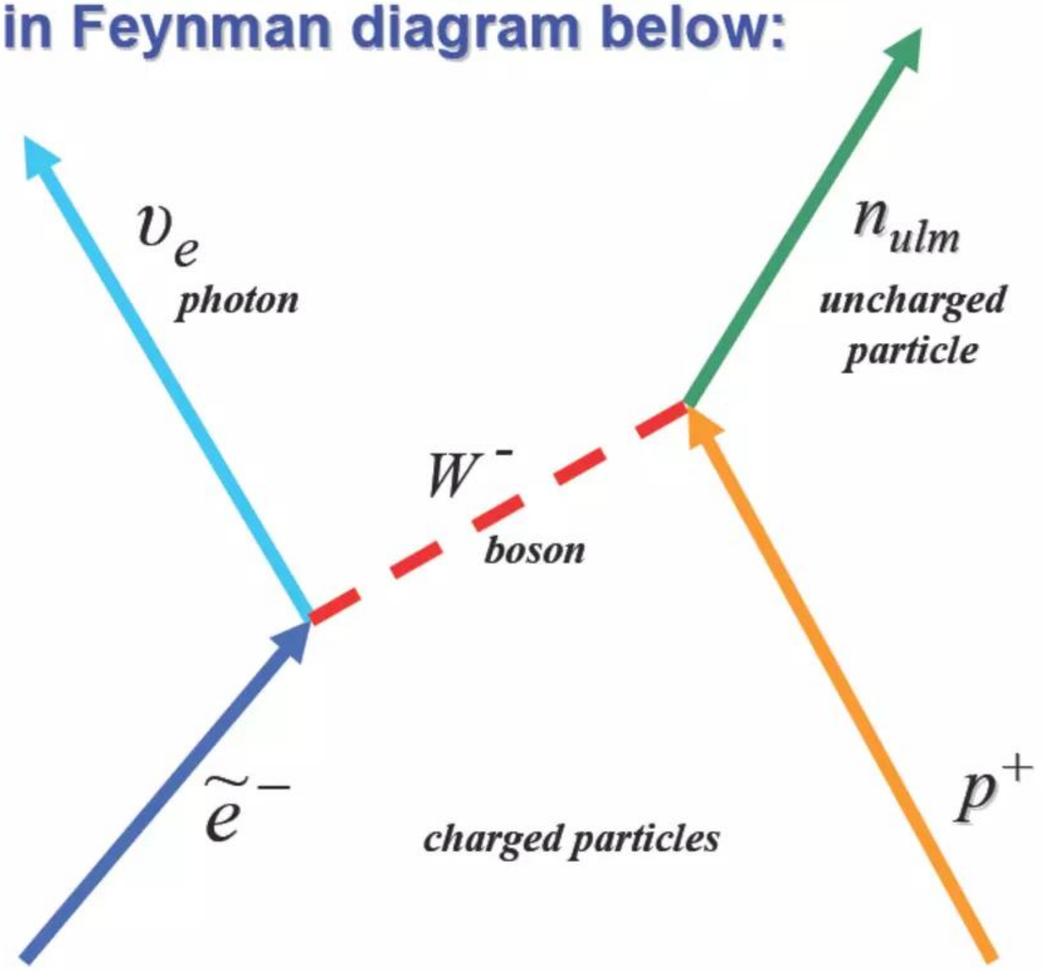
Lattice Energy LLC

Many-body collective quantum effects are key to LENRs

Written as a two-body reaction - what actually happens is many-body

LENR many-body collective effects also involve mutual quantum entanglement

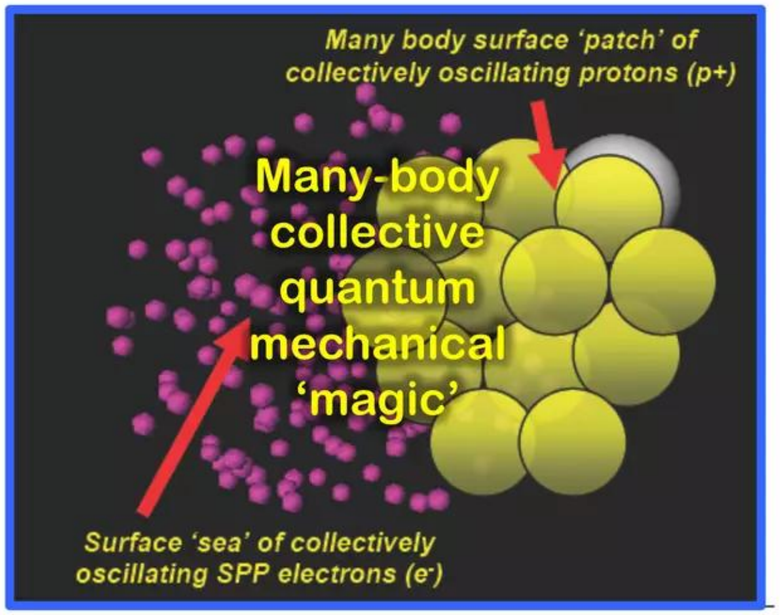
Simple two-body collision shown in Feynman diagram below:



$$\tilde{e}^- + p^+ \longrightarrow n_{ulm} + \nu_e$$

What happens is many-body

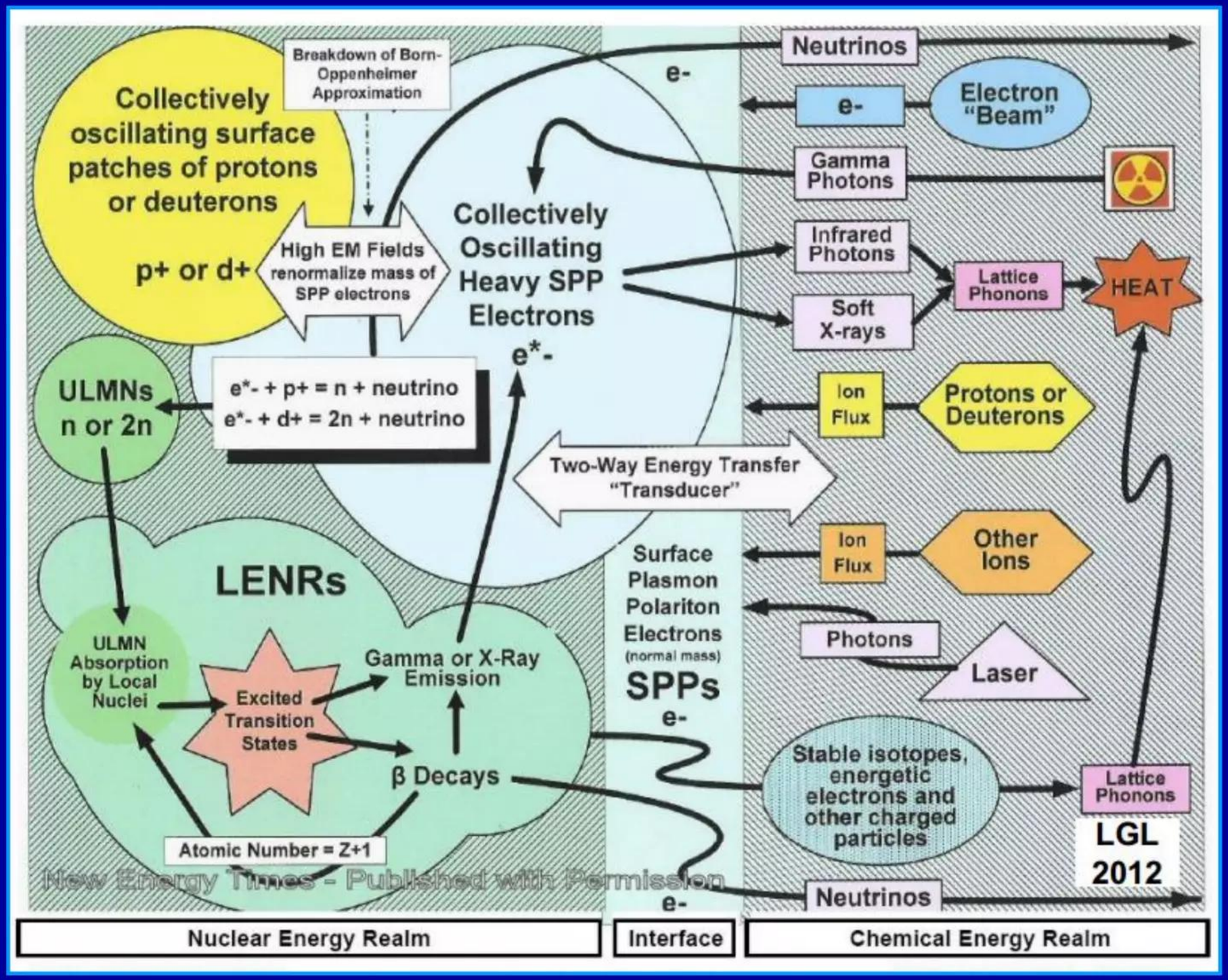
Now add collective rearrangements from condensed matter effects. It is not just a two body collision !!!



Above is what really occurs in condensed matter

Lattice Energy LLC

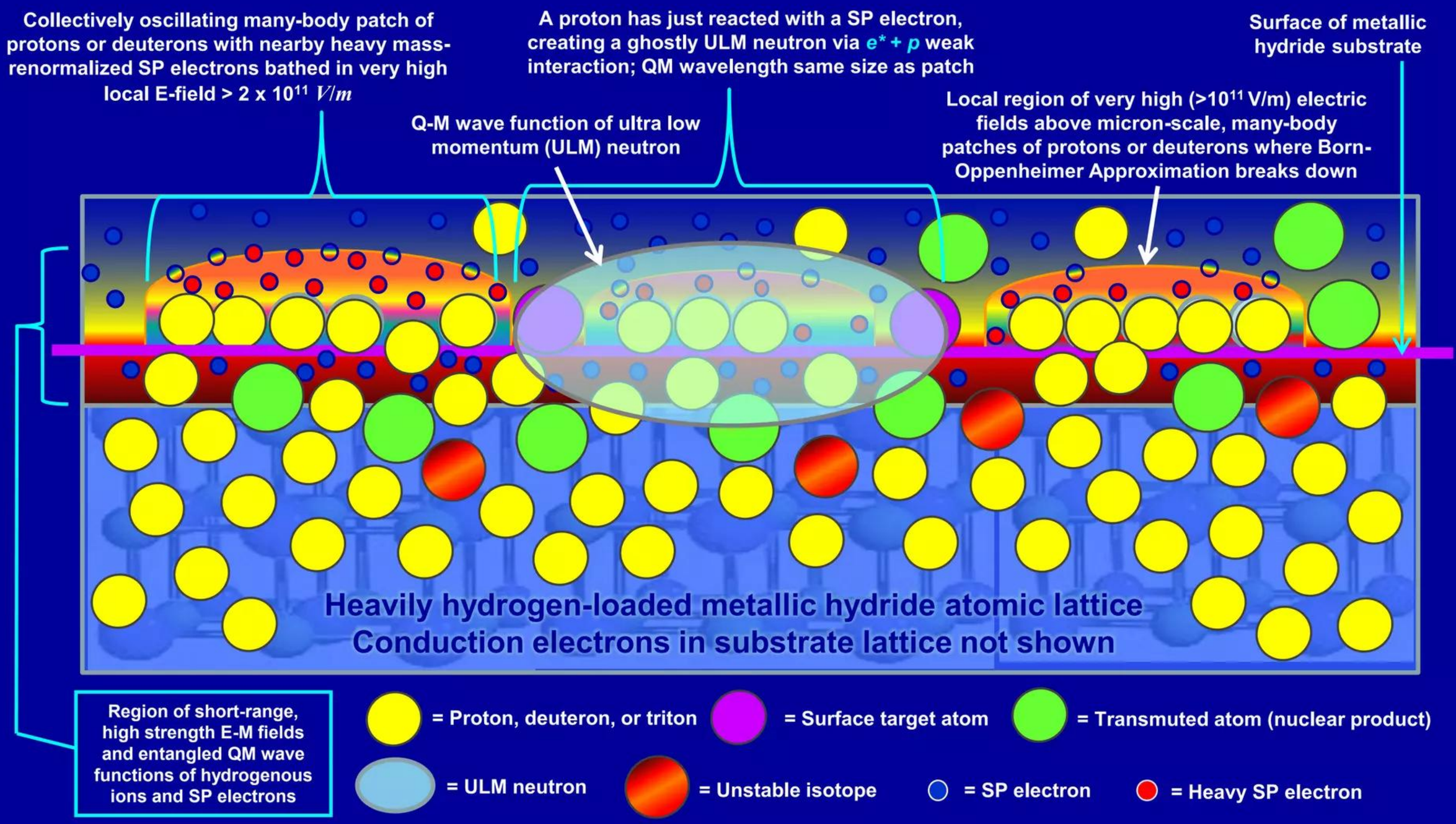
Conceptual summary: W-L theory in condensed matter



Lattice Energy LLC

Overview of Widom-Larsen theory of LENRs

Shows key details of W-L mechanism operating in condensed matter



Lattice Energy LLC

Overview of Widom-Larsen theory of LENRs

Shows key details of W-L mechanism operating in condensed matter

LENR nuclear realm (MeVs)
Occurs in tiny micron-scale patches

Transducer regions: many-body collective effects, ~eV energies are collected and summed to MeV energies in micron-scale, many-body surface patches by film of SP electrons and p^+, d^+, t^+ ions in patches; all oscillate collectively and are quantum mechanically entangled

Chemical energy realm (eVs)
Everywhere else in LENR systems

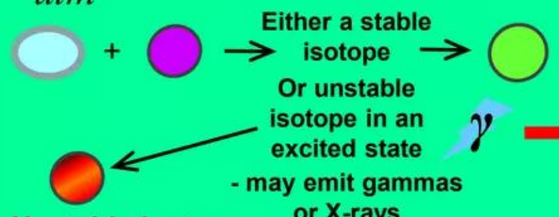
Nuclear chemistry

Hot spots: reach 4,000 - 6,000+ ° K
Craters visible in post-experiment SEM images of LENR device surfaces

$$\tilde{e}^- + p^+ \rightarrow n_{ulm} + \nu_e$$

$$\tilde{e}^- + d^+ \rightarrow 2n_{ulm} + \nu_e$$

$$n_{ulm} + (Z, A) \rightarrow (Z, A+1)$$



Unstable isotope:
Which then subsequently undergoes some type of nuclear decay process

In the case of typical beta⁻ decay:

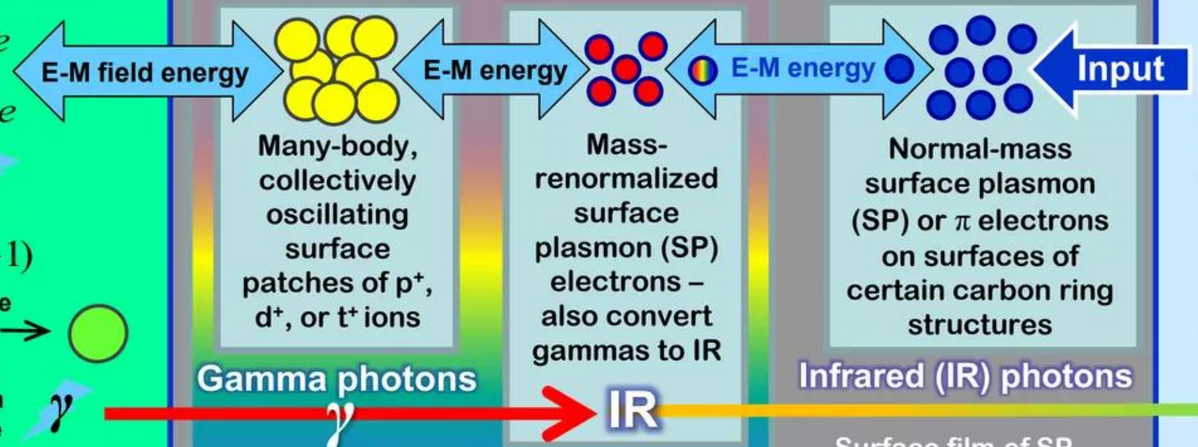
$$(Z, A) \rightarrow (Z+1, A) + e^- + \bar{\nu}_e$$

In the case of typical alpha decay:

$$(Z, A) \rightarrow (Z-2, A-4) + {}^4_2\mathrm{He}$$

Extremely neutron-rich product isotopes may also deexcite via beta-delayed decays, which also emit small fluxes of neutrons, protons, deuterons, tritons, etc.

Quantum effects are here: interconnect realms



Born-Oppenheimer Approximation breaks down in many-body patches of p^+, d^+, or t^+ on 'loaded' hydride surfaces

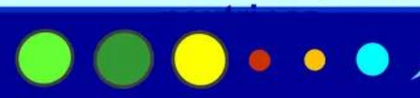
Two-way, collective energy transfers occur back-and-forth via E-M fields coupling the chemical and nuclear realms

Ordinary chemistry

Energy must be inputted to create high surface E-M radiation fields that are needed to produce ULM neutrons. Required input energy can be provided from one or a combination of: electron beams (electric currents); ion beams, i.e., fluxes of ions across the surface film of SP electrons (protons, deuterons, tritons, or other ions); and E-M photons, e.g., from lasers if nanoscale surface roughness coupling parameters are satisfied

Output

LENR final products: primarily stable isotopes, energetic β^-, α (He-4) particles, other charged particles, IR photons (with small tail in soft X-rays), and ghostly

End with:  ν, γ, IR photons

ULM neutron captures on target fuel elements and subsequent nuclear reactions all release nuclear binding energy – neutrons are the match that lights the fuel on fire

Output

Neutrinos (ν) fly off into space at velocity c

IR photons excite lattice phonons

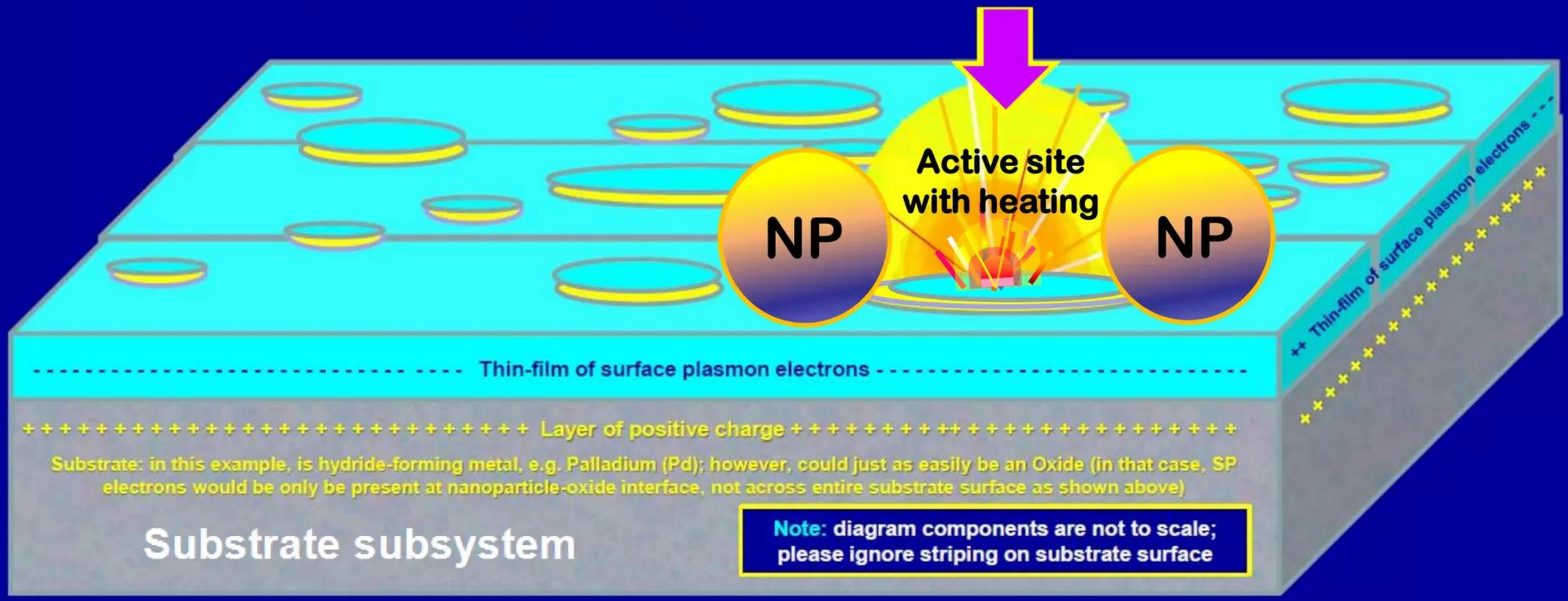
Energetic charged particles excite lattice phonons

Lattice Energy LLC

LENR-active sites only survive for ~200 - 400 nanoseconds

Intense heating destroys the local quantum coherence and site 'dies'

Releases nuclear binding energy stored in fuels and transmutes elements



NP = metallic nanoparticle

Neutron capture process operates extremely fast: occurs in just picoseconds

Lattice Energy LLC

Many varied features of LENRs explained by W-L theory

Our theory readily explains the:

- ✓ Anomalous absence of customarily expected nuclear products and abnormal proportions thereof compared to what is known about D-D fusion reactions (as reported in original work of Pons & Fleischmann and thousands of other experiments since 1989) - according to W-L, this is because LENRs simply do not involve any appreciable amounts of D-D or D-T fusion processes 1TT, 9TT
- ✓ Anomaly of insignificant production of dangerous long-lived radioactive isotopes (as reported in the original work of Pons & Fleischmann as well as thousands of other LENR experiments since 1989) 5SS, 6SS, 7SS
- ✓ Key details of physics mechanism for laser triggering of excess heat and LENR transmutations in H or D LENR systems, e.g., Letts & Cravens (2003), Violante *et al.* (2004), McKubre (*ca.* 2003 - 2004), and Barmina *et al.* (2013) 1TT, 8TT, 9TT, 84SS
- ✓ Method to calculate reaction rates in good agreement with range of rates (10^9 to 10^{16} cm^2/sec) that have been observed in different types of LENR experimental systems; reported in multiple papers by Miles, McKubre, Miley, etc. 4TT, 9TT

Note: 1TT, 69SS (2006) and 9TT, 70SS (2010) are both published in well respected, peer-reviewed physics journals

Many varied features of LENRs explained by W-L theory

Importantly, our theory also explains:

- ✓ **Source of calorimetric excess heat** seen in D_2O/H_2O (electrolytic) and D_2/H_2 (gas) systems (e.g. Pons & Fleischmann, McKubre, Piantelli) 1TT, 6SS, 5SS(25)
- ✓ **^{4}He production** measured in D_2 gas systems (McKubre et al. - Case expt.) 6SS
- ✓ **Anomalous 5-peak stable transmutation products** observed with varied mass spectroscopy in H_2O/D_2O electrolytic systems (e.g., Miley, Mizuno) 3TT, 5SS
- ✓ **Transmutation products** often seen in H and D LENR systems (e.g., electrolytic experiments of Miley, Mizuno, Iwamura, Violante, etc.) as well as in some types of high-current exploding wire/vacuum diode experiments in vacuums, liquids, gases (USA, UK, Russia, Japan - publications date back to 1905) 1TT, 3TT, 9TT
- ✓ **Variable fluxes of soft X-rays** that have been observed in some experiments (e.g., Violante, Karabut) 1TT
- ✓ **Very small fluxes of bursty low energy neutrons and high-energy alpha particles** observed in certain LENR experimental systems (e.g., Lipson, Karabut, Bhabha Atomic Research Center - India) 6SS (slides 7,9,11,15,62)

Note: 1TT, 69SS (2006) and 9TT, 70SS (2010) are both published in well respected, peer-reviewed physics journals

Lattice Energy LLC

Many varied features of LENRs explained by W-L theory

Importantly, our theory also explains (continued):

- ✓ Transmutation products (e.g., ^{13}C and ^{14}N) observed by Mizuno and Sawada (2008) during the hydrogenation of Phenanthrene under high temperatures and pressures in the presence of various metallic catalysts including Pt found on interior surfaces of Inconel 625 and SUS 316L reaction vessels 7SS
- ✓ Transmutation of Tungsten into Gold (Nagaoka, *Nature* 1924) 10SS, 65SS
- ✓ Possibility of LENR transmutation reactions occurring in biological systems and abiologically in the earth's crust 11SS, 44SS, 48SS
- ✓ Excess heat production, suppression of hard photon radiation, and nuclear transmutations in certain resonant electromagnetic cavities 15SS, 16SS, 72SS
- ✓ Alteration of measured rates of beta-decaying isotopes on earth as a direct result of neutrino bursts emitted from large solar flares 17SS, 32SS, 63SS
- ✓ Nuclear processes occurring in lightning discharges on earth, other planets, and brown dwarfs - maybe large gas giants are not "failed stars" 17SS, 61SS
- ✓ Isotopic shifts in Hg that develop over time in compact fluorescent lights 68SS

Lattice Energy LLC

Experimental data explained by W-L theory

Apparatus does not require radiation shielding and containment

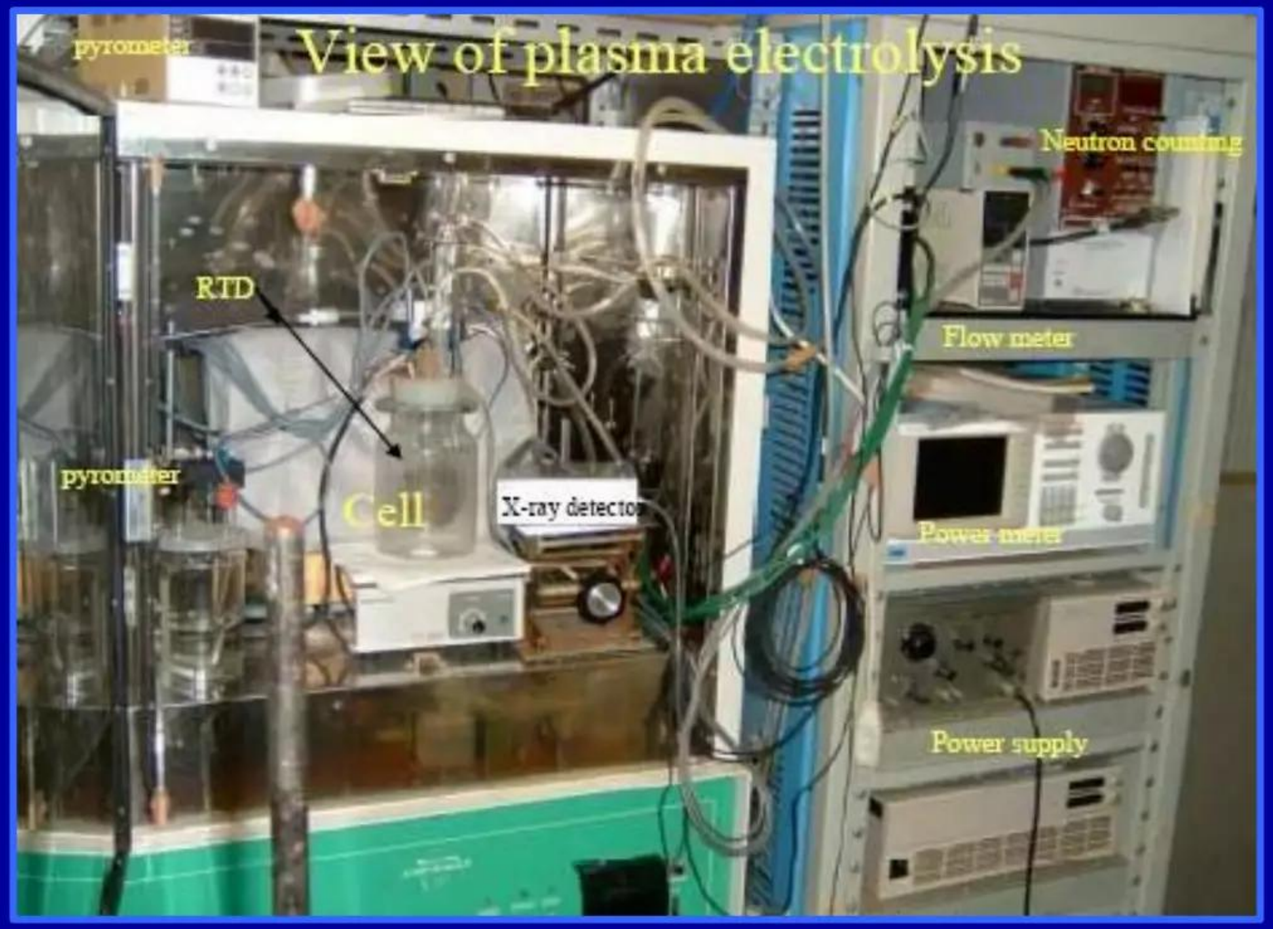


Fig. 1 in "Generation of heat and products during plasma electrolysis"
T. Mizuno, T. Ohmori, and T. Akimoto ICCF-10 (2003)

http://lenr-canr.org/acrobat/MizunoTgeneration.pdf

Lattice Energy LLC

All good experimental data explained by W-L theory

W-L explains a broad range of different LENR experimental results

New Energy Times created an index to ~20 experimental methods used in R&D

Source - html version: http://newenergytimes.com/v2/reports/Index-of-LENR-Experimental-Methodologies.shtml
pdf: http://www.slideshare.net/StevenKrivit/lenr-methodsdistributioncopyrightnewenergytimes20130522-21707257

- ✓ On May 22, 2013, *New Energy Times* published an updated version of a very helpful, "Index of LENR experimental methodologies," that uses simple graphic images and examples to concisely conceptualize and characterize ~20 different types of experiments conducted in LENR R&D
- ✓ While it is not necessarily totally perfect or all-encompassing, *NET's* index is extremely useful for gaining a rapid appreciation of very different types of LENR experiments that have been conducted and data that was subsequently collected and then published in one venue or another
- ✓ On next two Slides, we will examine four examples selected from the *NET* Index and map those examples into representative document ID #s that are provided in the Lattice document index herein

List of LENR Experimental Methods

Source: © New Energy Times

Category: Electrolytic Methods

- → Electrolysis in heavy water
- → Electrolysis in light water
- Electrolysis with low-power laser
- Electrodiffusion with double-structure cathode
- High-voltage plasma electrolysis in D_2O or H_2O
- Electrolytic co-deposition
- Thin-film electrolysis in packed bed
- Thin-film electrolysis on substrate

Category: Gas Methods

- Gas loading on bulk metal (rod or wire)
- Gas absorption into metal nano-powder
- Gas plasma - glow discharge
- → Gas permeation through thin-films
- Gas permeation through thin metals

Category: Unique Methods

- Exploding wires
- Electron beam impact
- Sonic implantation
- Biological processes
- Electromigration through solid-state proton conductors
- → Carbon arc experiments
- Hydrogen loading of Phenanthrene

Lattice Energy LLC

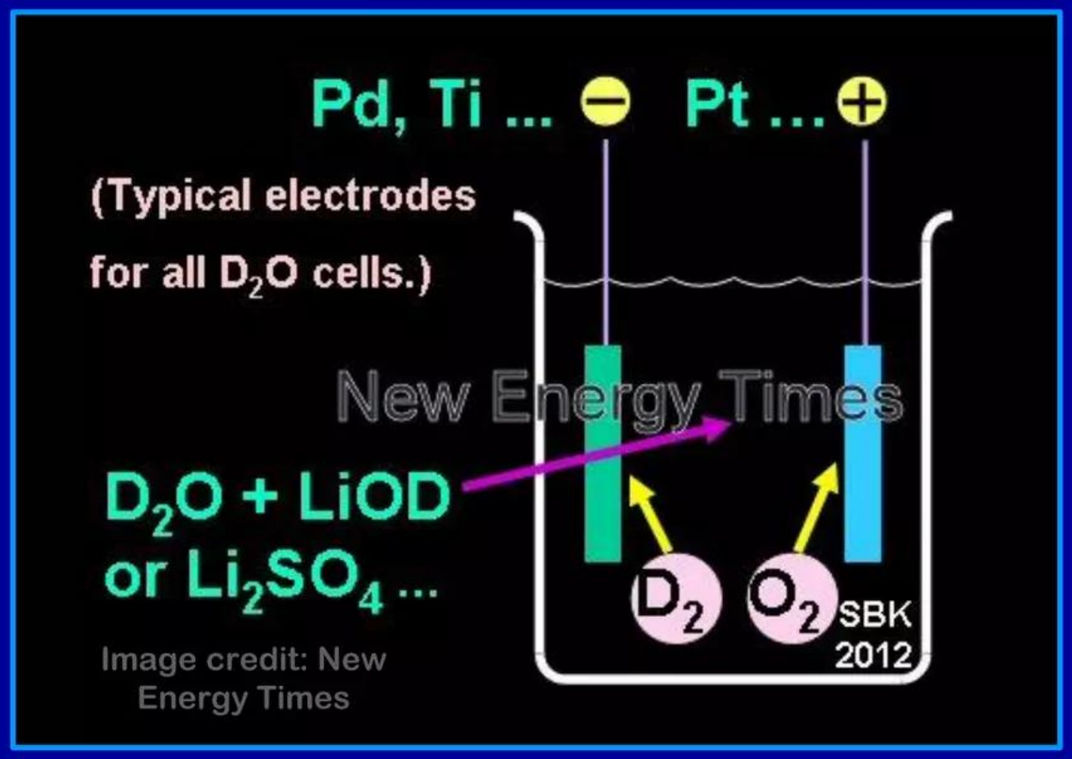
All good experimental data explained by W-L theory

W-L explains a broad range of different LENR experimental results

New Energy Times created an index to ~20 experimental methods used in R&D

Example 1: Heavy-water P&F-type electrolytic cell

Electric current provides necessary input energy

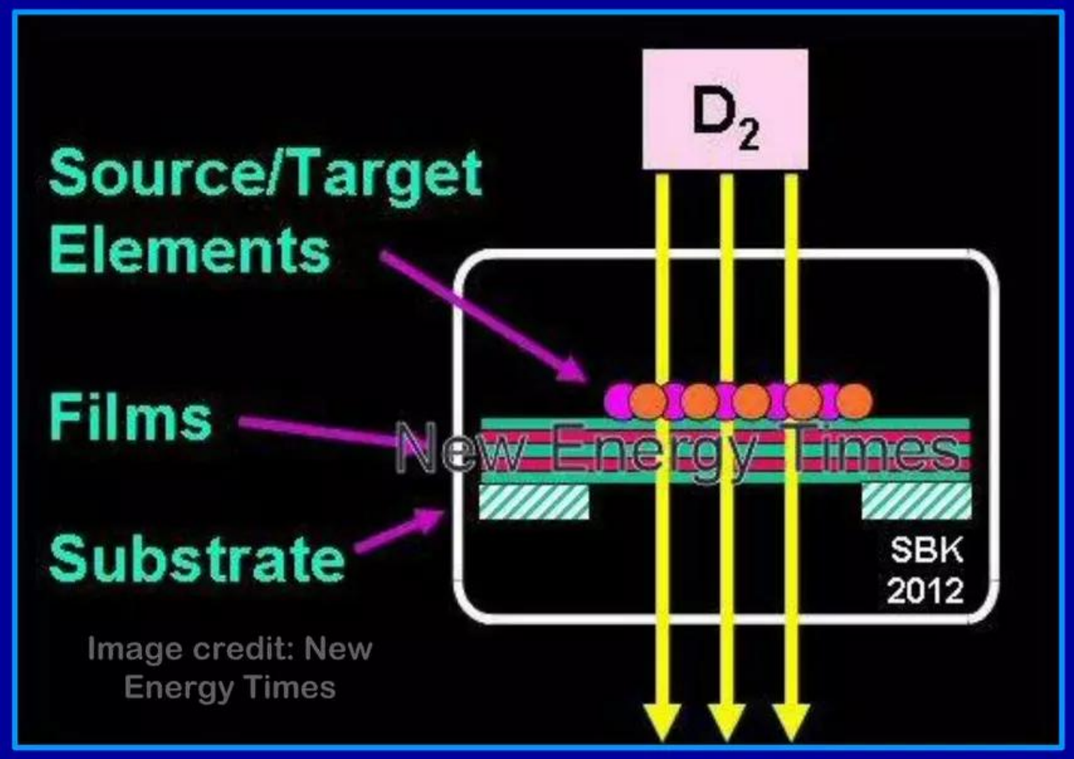


Selected examples of Lattice Index document ID #s that correspond to this specific type of experiment:

1TT, 5SS, 73SS(70 - 73)

Example 2: Deuterium gas permeation thru metal thin-film

Pressure and temperature provide necessary input energy



Selected examples of Lattice Index document ID #s that correspond to this specific type of experiment:

5SS, 65SS

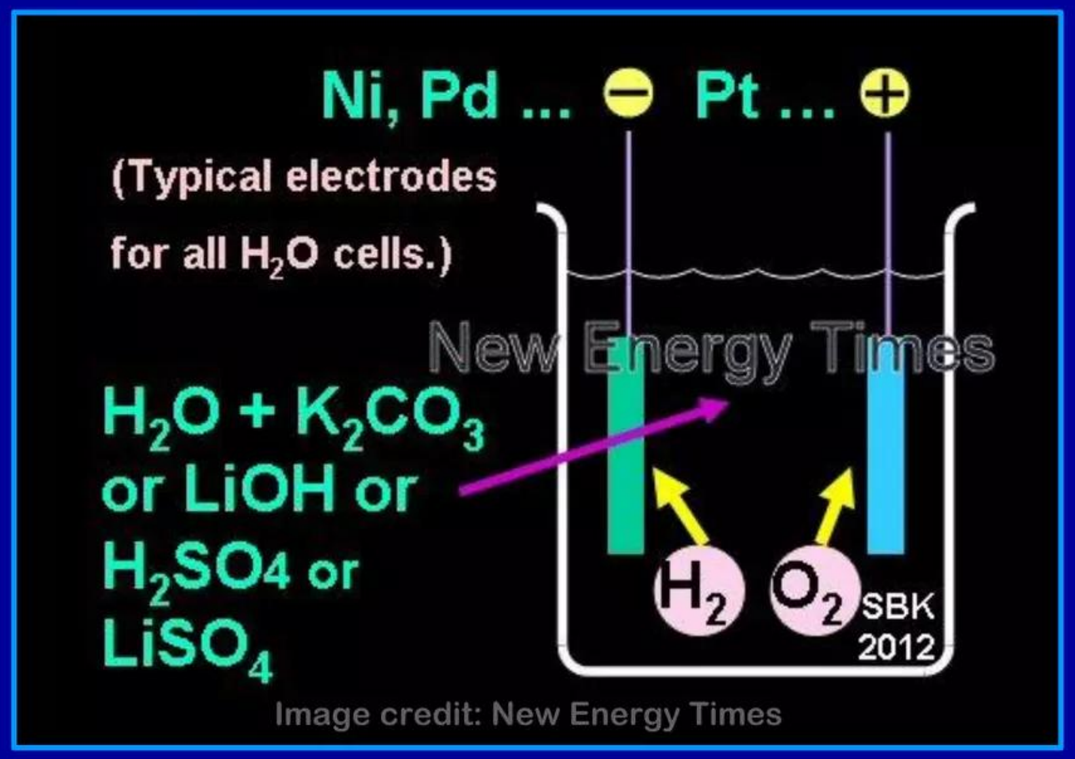
Lattice Energy LLC

All good experimental data explained by W-L theory

W-L explains a broad range of different LENR experimental results

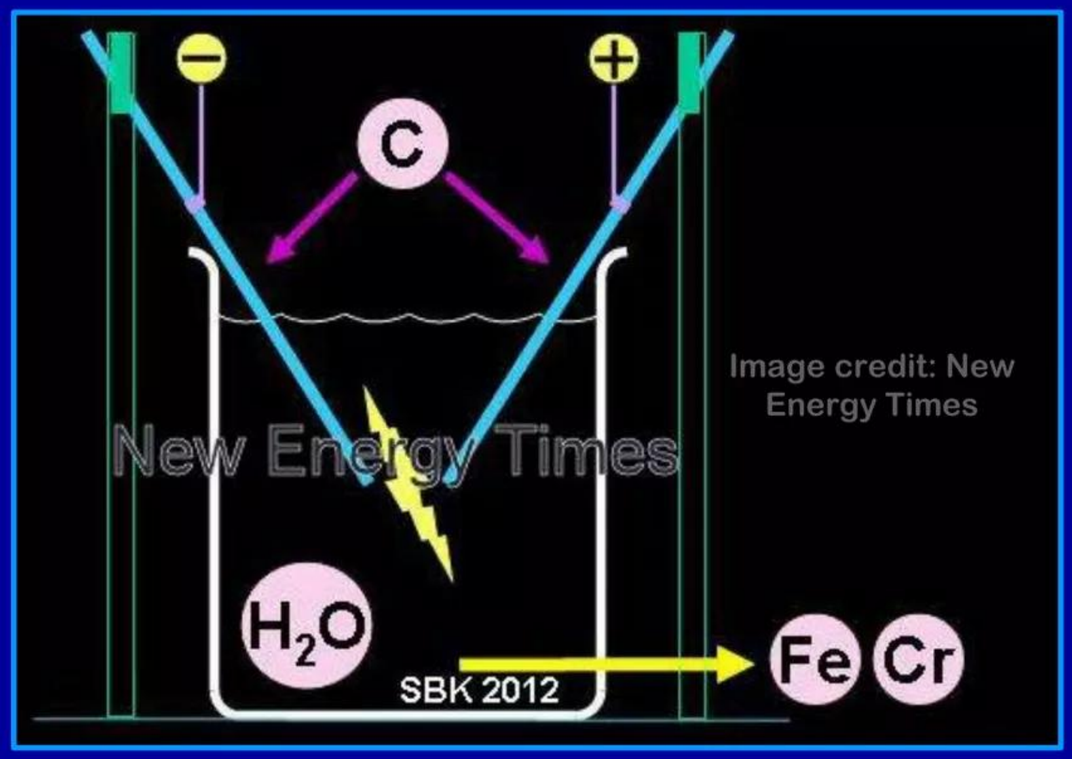
New Energy Times created an index to ~20 experimental methods used in R&D

Example 3: Light-water P&F-type electrolytic cell
Electric current provides necessary input energy



Selected examples of Lattice Index document ID #s that correspond to this specific type of experiment:
3TT, 5SS, 73SS(70 - 73)

Example 4: electric arcs between Carbon electrodes in H_2O
Electric current provides necessary input energy



Selected examples of Lattice Index document ID #s that correspond to this specific type of experiment:
6SS

Lattice Energy LLC

All good experimental data explained by W-L theory

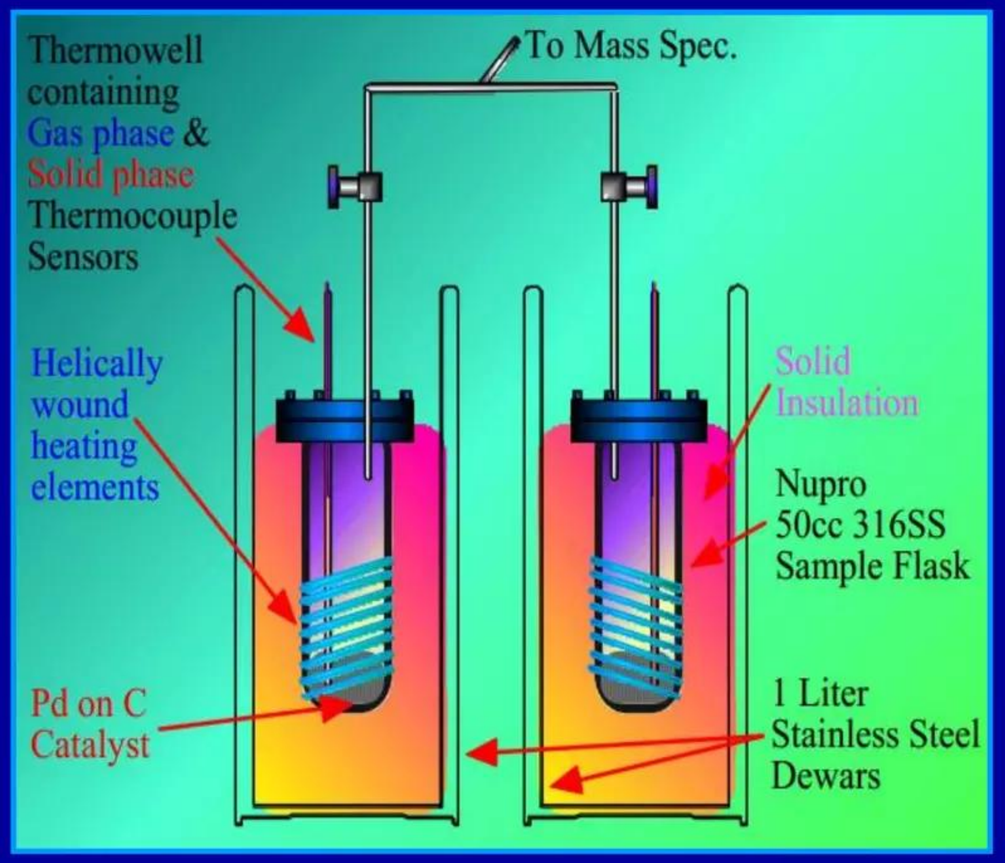
W-L explains a broad range of different LENR experimental results

Can use NET index to characterize and categorize experiments listed herein

- ✓ Readers are encouraged to familiarize themselves with NET's "Index of LENR experimental methodologies "and use it to help accelerate their ability to examine and evaluate experimental data from the field of LENRs. While the quality of such data can vary greatly, some of it is truly excellent and would merit publication in any number of respectable peer-reviewed journals if there had not been such widespread antipathy toward the field in the past. Examine LENR data with reasonable circumspection and then form your own judgments about quality
- ✓ Next group of slides maps selected LENR experiments and their data into Lattice document ID#s that point to specific documents that are listed and described somewhere within the four Appendices

D_2 gas permeates (Palladium + activated Carbon)

Elevated temperatures & pressures provide input energy



Source: M. McKubre (SRI presentation at ICCF-10 in 2003)
http://lenr-canr.org/acrobat/McKubreMCHreviewofex.pdf

Lattice Index Document ID #: 6SS

Lattice Energy LLC

Experimental data explained by W-L theory

Type of experimental system	Researchers and Year of Report	Hydrogen Isotope and substrate	Comments	Doc. ID
P&F-type Electrolytic Cells No calorimetry	Miley *et al.* (U. of Illinois -USA) 1996	Aqueous H_2O – Pd, Ni, and Ti cathodes	Conducted exhaustive search for LENR transmutation products; saw 5-peak product mass-spectrum that is a signature for ULM neutrons; results fully explained by W-L optical absorption model; Mizuno saw same spectrum	3TT
Gas-phase "Case" No Current Pressure/Temp only	McKubre *et al.* (SRI-USA) 1999	D_2 gas with Pd activated Carbon particulates	Made careful measurements of He-4 and heat production and reported 31-32 MeV/He-4. D-D "cold fusion" theory predicts 23.8 MeV; W-L low-energy carbon-seed ULMN network predicts 31.2 MeV, within 1%; much closer to data values	6SS
Gas-phase No current Pressure/Temp only	Iwamura *et al.* (MHI-Japan) 2003	D_2 gas forced thru "Pd complex" w. Barium target	W-L explains MHI's experimental data as the result of a ULM neutron-catalyzed LENR nucleosynthetic network that begins with neutron captures on Barium isotopes; network details in SlideShare presentation	5SS
Gas-phase No Current Pressure/Temp only	Iwamura *et al.* (MHI - Japan) 2002	D_2 gas forced thru "Pd complex" w. Sr & Cs targets	W-L explains MHI's experimental data as the result of a ULM neutron-catalyzed LENR nucleosynthetic network that begins with neutron captures on Sr & Cs isotopes; network details shown in SlideShare presentation	5SS
K_2CO_3 P&F-type electrolytic cell w. calorimeter	Mizuno & Toriabe (Hokkaido U - Japan) 2006	H in H_2O with Tungsten (W) wire cathode	Flash steam explosion: Mizuno was first researcher able to document a rare LENR thermal runaway event; these have occurred sporadically since 1989, but not documented except for this one; explained by W-L ULMN LENR network	5SS
High-current carbon-arc in aqueous H_2O	Singh *et al.* (BARC – India) 1994	H in H_2O w. two Carbon rods – no Pd or other such metals	Obtained essentially same experimental results as nearly identical experiments in 1994 at Texas A&M U. in USA - used very pure, well-characterized materials; observed Iron & Nickel transmutation products; results explained by W-L theory	6SS
High-current vacuum diode in steel vessel	Adamenko, Proton-21 (Kiev, Ukraine) 2003	H atoms in thin-film on a Copper target under a vacuum	Vacuum diodes are very closely related to exploding wires – to date, have conducted >10,000 experiments – observe many different transmutations on various types of metal targets nearly every time; results are fully explained by W-L theory	5TT
LiOD P&F-type electrolytic cell w. calorimeter & laser	Letts & Cravens (Texas – USA) 2003	Aqueous D_2O with Pd/Au cathode – Li in electrolyte	These experiments demonstrated that surface plasmon polariton (SPP) electrons were involved in neutron production; Violante (ENEA - Italy) clinched the role of SPPS in LENRs w. laser polarization experiment in 2004	1TT 8TT
High-current exploding wire inside glass bulbs	Wendt & Irion (U. of Chicago - USA) 1922	H atoms in thin-film on fine Tungsten wire under vacuum	Created worldwide scientific controversy in 1922 when they claimed in *Science* that observed Helium as a transmutation product in sealed glass bulbs – had technical dispute w. Rutherford who didn't believe; results explained by WLT	5TT

Lattice Energy LLC

Experimental data explained by W-L theory

Type of experimental system	Researchers and Year of Report	Hydrogen Isotope and substrate	Comments	Doc. ID
High temperature, high pressure, gas-phase metallic reaction vessels	Mizuno and Sawada (Hokkaido U., Japan) 2008	H_2 gas, phenanthrene, and metal catalysts	Reported that prosaic high P/T hydrogenation of phenanthrene with metal catalysts was accompanied by nuclear transmutations, anomalous excess heat, and low-level radiation. Their experimental results were broadly consistent with W-L and the LENR carbon-seed nucleosynthetic network	7SS
High-current electric arcs in transformer oil; Tungsten electrodes	Hantaro Nagaoka, *Nature*, 1924	H_2 in transformer oil and Tungsten	Plausible LENR nucleosynthetic pathway based on W-L is shown which suggests that Nagaoka's claimed observations of macroscopically visible particles of Gold in electric arc experiments could very well have been correct; he also believed that some sort of commercial transmutation technology would be developed at some point in the future. Thus, Nagaoka was not only a humble, brilliant scientist, but a bold visionary thinker --- a man far ahead of his own time	10SS
Gas-phase resonant electromagnetic cavities	Group of Italian LENR researchers dating back to early 1990s	H_2 – gas; no D_2 used	Results fully explained in detail by W-L theory in two SlideShare documents	15SS 16SS
Measured decay rates in sample consisting of beta-decaying isotope	Purdue University presently publishing more of this work	Not applicable	A derivative consequence of W-L theory suggests that many-body collective quantum mechanical neutrino antennas may well be possible, practical, reasonably compact, and highly scalable with regard to overall device sensitivity and determination of the directionality of ambient neutrino fluxes Special note: July 2012, received private e-mail communication that European team led by very experienced experimental neutrino physicist had just made new measurements involving a multi-GW commercial fission reactor in which depression of beta decay rates had been observed in vicinity of reactor for certain isotopes; if true, this report is consistent with and would confirm Lattice's theoretical predictions -- team has apparently submitted a paper for publication	17SS 32SS 63SS
Hydrous pyrolysis in stainless steel reaction vessel fully lined with pure Gold	*Organic Geochemistry* 18 pp. 745 - 756 (1992) J.A. Curiale (Unocal) *et al.*	Ordinary Hydrogen present in crude oil	Crude oil samples subjected to hydrous pyrolysis showed significant decreases in concentrations of trace metals Nickel and Vanadium over time. In one experiment, Iraq/300, decreases in Ni and V were accompanied by modest shift in Carbon isotopic ratios.	22SS

Lattice Energy LLC

Experimental data explained by W-L theory

Type of experimental system	Researchers and Year of Report	Hydrogen Isotope and substrate	Comments	Doc. ID
High current glow-discharge aqueous electrolytic cell	Cirillo *et al.* (2012)	Hydrogen present in H_2O (ordinary water)	First-ever experimental detection of Widom-Larsen ultra low momentum neutrons in, "Experimental evidence of a neutron flux generation in a plasma discharge electrolytic cell"	26SS
Lightning discharges occurring in terrestrial atmosphere	Gurevich *et al* (2012)	Hydrogen present in earth's atmosphere	New neutron flux data is consistent with predictions of W-L theory magnetic mechanism in lightning discharges; surprisingly large fluxes of low-energy neutrons well-correlated with thunderstorm EMF fluctuations were reported by a Russian-led team of experimental physicists in *Physical Review Letters*	43SS
Natural Uranium isotopes found in earth's crust	Hiess *et al.* (2012)	Hydrogen present in earth's crust	For 35 years it has been widely assumed that terrestrial $^{238}U/^{235}U$ ratio is invariant over time; new data reported by Hiess *et al.* clearly show otherwise. So if this longstanding assumption is truly erroneous, then what process(es) could cause such variance? LENRs proposed as possible cause of unexpected variability	44SS
High-current electric discharges between metallic electrodes	L. Thomassen Caltech PhD thesis (1927)	Hydrogen present within electric discharge chamber of experimental apparatus	In a WLT Tungsten-seed LENR neutron-catalyzed transmutation LENR network wherein Pb → Hg and Bi → Tl, unstable isotopes of Lead and Bismuth will spontaneously transmute into unstable isotopes of Mercury and Thallium, respectively, which can be detected. This was apparently observed by L. Thomassen in 1927; was advised by R. Millikan, who had just won Nobel prize	49SS
Metallic Palladium Hydrides (PdH_x) and Deuterides (PdD_x)	Selvaggi (2000) Tripodi *et al.* (2003 - 2004) Lipson *et al.* (2005)	Protons and Deuterons loaded into bulk lattice and onto Palladium surface	Data collected and published by Tripodi *et al.*, if correct, suggests that above-room-temperature (>RTSC) superconductivity might be possible, at least in PdHx systems. If high-temperature superconductivity (HTSC) or RTSC truly does occur in micron-scale W-L theory heavy-electron patches situated on metallic hydride surfaces, then although it shares some common characteristics with Type-2 superconductors, heavy-SP-electron SC differs from them in many key ways. W-L patch many-body proton subsystem's electromagnetic and Q-M interactions with patch's many-body SP electron subsystem may be able to provide a local environment conducive to electron pairing therein. Perhaps a patch's proton and SP electron subsystems form dynamic, mutually reinforcing mirror quantum condensates as conceptualized on Slide #81 in Aug. 23, 2012, Lattice document	55SS

Lattice Energy LLC

Experimental data explained by W-L theory

Type of experimental system	Researchers and Year of Report	Hydrogen Isotope and substrate	Comments	Doc. ID
Compact fluorescent lights (CFLs)	Mead *et al.* (2013)	Patchy Hydrogen monolayers exist on metallic components; these are introduced into CFLs during the product manufacturing process	When viewed through the conceptual lens of the Widom-Larsen theory, Mead *et al.*'s carefully collected Mercury (Hg) isotope data suggests that low energy nuclear reaction (LENR) transmutations may actually be occurring at extremely low rates in CFLs during normal operation. In other words, unbeknownst to the general public, dynamically active nuclear processes are presently occurring in tens of millions of households worldwide.	68SS
Laser irradiation of metallic targets immersed in aqueous D_2O with and without accompanying electric current-driven electrolysis	Barmina *et al.* (2013)	Deuterium (D_2O) Targets included Au, Ti, Pd, and Se (first ever for Selenium)	In series of different experiments with laser irradiation (sometimes combined with electrolysis) of hydride-forming metallic targets immersed in D_2O, Barmina *et al.* claim to have observed both production and so-called "accelerated decay" of Tritium. If correct, their claimed detection of significant amounts of radioactive Tritium production is a very interesting experimental result because over the past 24 years, out of the hundreds of thousands of LENR experiments conducted, literally only a handful have ever claimed to observe Tritium as a measurable nuclear product.	84SS
Natural processes that occur in the Earth's crust as well as in controlled laboratory experiments	Skelton *et al.* (2014) Salikhov *et al.* (2013) Antonova & Zhumabayev (2014) And other geochemists and grophysicists	Hydrogen and Deuterium In rocks, soils, and lake/ocean sediments	Freund *p*-holes provide a new electronic mechanism for transferring and dissipating energy in the upper crust besides well-known mechano-acoustic seismic P- and S-wave processes - this is a conceptual paradigm shift in geophysical thinking. Abiotic and biological LENR processes produce measurable products that are created at highly variable rates over periods of time ranging from just hours up to millions of years – a paradigm shift in geochemistry. Moreover, there is a significant body of published, peer-reviewed experimental evidence that strongly supports these conjectures and further suggests that *p*-holes and LENRs may well help facilitate earthquakes and other seismic phenomena. Lastly, geophysical processes on Earth may be modulated by neutrino fluxes coming from the Sun via $e + p$ neutrino interactions; this could successfully explain otherwise inexplicable Russian data on long-term changes in global seismicity	115SS

Lattice Energy LLC

Experimental data explained by W-L theory

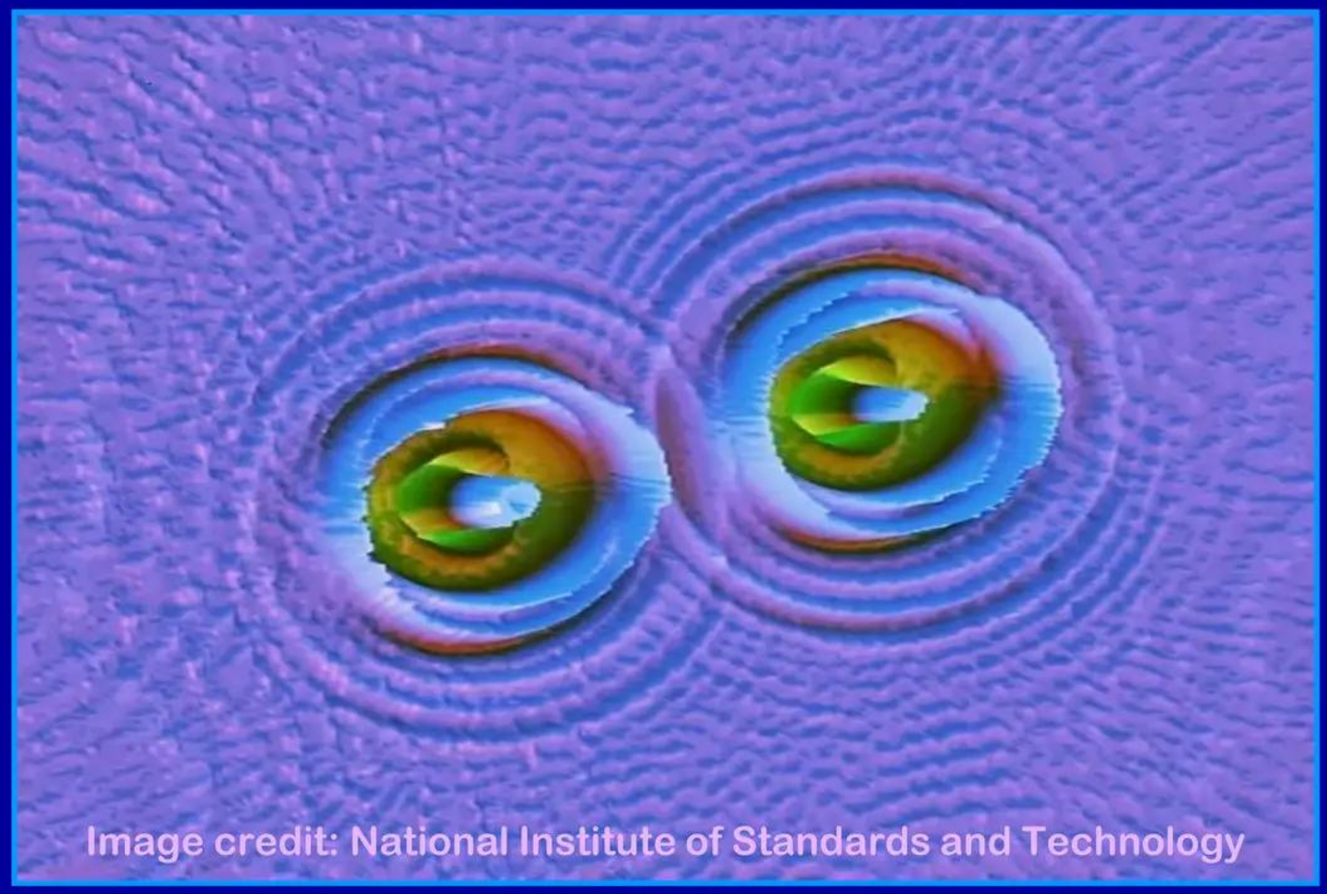
Type of experimental system	Researchers and Year of Report	Hydrogen Isotope and substrate	Comments	Doc. ID
Compact fluorescent light; effectively a gas discharge tube	Mead *et al.* (2013)	Patchy Hydrogen monolayers exist on metallic components; these are introduced into CFLs during the product manufacturing process	When viewed through the conceptual lens of the Widom-Larsen theory, Mead *et al.*'s carefully collected Mercury (Hg) isotope data suggests that low energy nuclear reaction (LENR) transmutations may actually be occurring at extremely low rates in CFLs during normal operation. In other words, unbeknownst to the general public, dynamically active nuclear processes are presently occurring in tens of millions of households worldwide.	68SS
Electrochemical cell	Rolison *et al.* (1989)	Deuterium and Palladium metal	Reported dramatic relative enrichment of Pd-106 and substantial parallel depletion of lighter Pd-105 isotope in same Pons-Fleischmann-type electrochemical cell experiment. Clearly observed production of normally absent, unstable isotopes of Palladium (e.g., Pd-103, Pd-107, Pd-109, and Pd-111) during experiment PdD#4 (note post-experiment appearance of these additional Pd mass-peaks back in Fig. 1 shown earlier) but made no special note of it. All this data is obviously well-explained by neutron captures on Palladium isotopes but Rolison et al. were reluctant to speculate because there was no clear evidence for substantial neutron fluxes during their experiments. Answers to this puzzling array of experimental data were finally provided by Widom & Larsen in arXiv preprint released in May 2005, 16 years later.	119SS
TBD	TBD	TBD	TBD	TBD

Lattice Energy LLC

Appendices

Note: live URLs to online documents are provided whenever possible

Coupled nano-oscillators on a surface



Simulation made with NIST micromagnetic software shows interaction of "spin waves" emitted by two nano-oscillators that generate microwave signals (*Nature* 2005)

Lattice Energy LLC

Appendix 1 - very technical theoretical papers

Document ID	Title, author, public release venue, and date	Document subject matter and comments thereon
1TT copy: 69SS	"Ultra Low Momentum Neutron Catalyzed Nuclear Reactions on Metallic Hydride Surfaces" A. Widom and L. Larsen *European Physical Journal C – Particles and Fields* **46** pp. 107 - 112 (2006) http://www.slideshare.net/lewisglarsen/widom-and-larsen-ulm-neutron-catalyzed-lenrs-on-metallic-hydride-surfacesepjc-march-2006	Except for gamma suppression, all core concepts of W-L theory and key details of its weak interaction physics found in this refereed paper; includes mass-renormalization of SPP electrons, B-O breakdown, etc.
2TT	"Absorption of Nuclear Gamma Radiation by Heavy Electrons on Metallic Hydride Surfaces" A. Widom and L. Larsen (Sept 2005) http://arxiv.org/PS_cache/cond-mat/pdf/0509/0509269v1.pdf	Covers W-L theory of hard gamma photon absorption and conversion to infrared in condensed matter LENRs
3TT	"Nuclear Abundances in Metallic Hydride Electrodes of Electrolytic Chemical Cells" A. Widom and L. Larsen (Feb 2006) http://arxiv.org/PS_cache/cond-mat/pdf/0602/0602472v1.pdf	Explains Miley transmutation data w. W-L optical model of ULM neutron absorption in condensed matter
4TT	"Theoretical Standard Model Rates of Proton to Neutron Conversions Near Metallic Hydride Surfaces" A. Widom and L. Larsen (v2. Sep 2007) http://arxiv.org/PS_cache/nucl-th/pdf/0608/0608059v2.pdf	Theoretical calculations of W-L ULM neutron production rates; agrees well with experimental measurements
5TT	"Energetic Electrons and Nuclear Transmutations in Exploding Wires" A. Widom, Y.N. Srivastava, and L. Larsen (Sept 2007) http://arxiv.org/PS_cache/arxiv/pdf/0709/0709.1222v1.pdf	W-L theory of weak interactions appl. to high-current exploding wires; explains Wendt-Irion expt. data (1922)
6TT	"Errors in the Quantum Electrodynamic Mass Analysis of Hagelstein and Chaudhary" A. Widom, Y.N. Srivastava, and L. Larsen (Feb 2008) http://arxiv.org/PS_cache/arxiv/pdf/0802/0802.0466v2.pdf	Hagelstein & Chaudhary published criticism of W-L theory; our response clearly refutes all of their arguments
7TT	"High Energy Particles in the Solar Corona" A. Widom, Y. N. Srivastava, and L. Larsen (April 2008) http://arxiv.org/PS_cache/arxiv/pdf/0804/0804.2647v1.pdf	Applies many-body collective, magnetically dominated W-L theory to explain heating of the solar corona
8TT	"A primer for electro-weak induced low energy nuclear reactions" Y. Srivastava, A. Widom, and L. Larsen *Pramana - Journal of Physics* **75** pp. 617 - 637 (2010) http://www.ias.ac.in/pramana/v75/p617/fulltext.pdf	Summarizes all of the W-L theoretical concepts found in previous 6 papers at lower-level of mathematical detail

Lattice Energy LLC

Appendix 1 - very technical theoretical papers

Document ID	Title, author, public release venue, and date	Document subject matter and comments thereon
9TT copy: **70SS**	"A Primer for Electro-Weak Induced Low Energy Nuclear Reactions" Y. N. Srivastava, A. Widom and L. Larsen *Pramana - Journal of Physics* 75 pp. 617 - 637 (2010) http://www.ias.ac.in/pramana/v75/p617/fulltext.pdf	*Pramana* version of *Primer* summarizes all of the W-L theoretical concepts found in our previous papers at a lower-level of mathematical detail; additional, never before disclosed, new material added in comparison to the version published by the American Chemical Society (ACS) in *LENR Sourcebook* in late 2009 Ciuchi *et al.* (Sept. 2012) questioned the accuracy of our estimates of electroweak neutron production rates in condensed matter. In this response (Oct. 2012), we have shown how their assertion that our calculated reaction rates were too high was incorrect and that their rate calculations were totally erroneous because Ciuchi *et al.* had assumed, incorrectly, that the *e* + *p* reaction in a condensed matter metallic hydride cell is a simple two-body process; it is not. Discussed in Document ID number: **111SS**
10TT	"Erroneous wave functions of Ciuchi et al. for collective modes in neutron production on metallic hydride cathodes" A. Widom, Y. N. Srivastava, and L. Larsen (Oct 2012) http://arxiv.org/pdf/1210.5212v1.pdf	
11TT	"Electron capture in a fully ionized plasma" A. Widom, J. Swain, and Y.N. Srivastava arXiv:1409.5344v1 [hep-ph] (Sept 2014) http://arxiv.org/pdf/1409.5344v1.pdf	

Lattice Energy LLC

Appendix 2 - Lattice's SlideShare presentations

Document ID	Title, author, public release venue, and date	Subject matter and comments
1SS	"Lattice Energy LLC – Public Overview" January 30, 2009 by Larsen at http://www.slideshare.net/lewisglarsen/lattice-energy-llc-public-overview-january-30-2009-986197 [19 slides]	Overview of Lattice as a company: its personnel, history, R&D plans, potential LENR-based commercial applications
2SS	"LENR Transmutations on Earth vs. Nucleosynthesis in Stars " January 2009 by Larsen at http://www.slideshare.net/lewisglarsen/lenr-transmutations-on-earth-vs-nucleosynthesis-in-stars [6 slides]	Similarities and differences between condensed matter LENR transmutations versus nucleosynthetic processes in stars
3SS	"High Level Historical and Technical Overview of LENRs" Feb 14, 2009 by Larsen at http://www.slideshare.net/lewisglarsen/lattice-energy-llchigh-level-historical-and-technical-overview-of-lenrsfeb-14-2009 [24 slides]	History of experimental anomalies in LENRs, 2004 DOE "cold fusion" review, overview of details of W-L weak interaction theory and how it explains all the important features of anomalous experimental data
4SS	"Google Insights and Selected Energy Topics" April 04, 2009 by Larsen at http://www.slideshare.net/lewisglarsen/lattice-energy-llc-google-insights-and-selected-energy-topics-april-04-2009 [14 slides]	Application and utilization of new Google analytical tool that examines historical search term data to assess changes in public interest on energy-related topics

Lattice Energy LLC

Appendix 2 - Lattice's SlideShare presentations

Document ID	Title, author, public release venue, and date	Subject matter and comments
5SS	"Lattice Energy LLC – Technical Overview" June 25, 2009 by Larsen at http://www.slideshare.net/lewisglarsen/lattice-energy-llctechnical-overviewjune-25-2009 [78 slides]	Detailed technical overview of W-L theory, explains 2 sets of transmutation results at Mitsubishi in Japan and Mizuno's steam explosion Reanalysis of SRI Case Pd/D/C experiments - W-L theory predicts MeV/He-4 results within ~1% - much more accurate than D-D "cold fusion" hypothesis of Hagelstein & McKubre
6SS	"Technical Overview – Carbon Seed LENR Networks " Sept 3, 2009 by Larsen at http://www.slideshare.net/lewisglarsen/lattice-energy-llctechnical-overviewcarbon-seed-lenr-networkssept-3-2009 [65 slides]	Explains carbon-arc H_2O data: while the heavy element "cold" fusion mechanism they conjectured to explain their data published in the 1990s was clearly erroneous, it appears that the carefully executed high-current ultrapure Carbon-arc in ultrapure H_2O experiments conducted in the Chemistry Dept. at Texas A&M University and at the Bhabha Atomic Research Center (BARC – India) that were reported in *Fusion Technology* (peer-reviewed journal published by the American Nuclear Society) in 1994 probably did indeed produce nuclear transmutation products in the form of anomalous Fe, Cr, and Ni.

Lattice Energy LLC

Appendix 2 - Lattice's SlideShare presentations

Document ID	Title, author, public release venue, and date	Subject matter and comments
7SS	"Technical Overview – PAHs and LENRs" November 25, 2009 by Larsen at http://www.slideshare.net/lewisglarsen/lattice-energy-llctechnical-overviewpahs-and-lenrsnov-25-2009 [61 slides]	Condensed matter nuclear science meets chemistry - Mizuno experiments with polycyclic aromatic hydrocarbons (PAHs) . Aromatic fractions found in oil sands' bitumen might someday be burned directly as green LENR nuclear fuels - worth vastly more that way
8SS	"Commercializing low energy nuclear reactions (LENRs): cutting energy's Gordian knot - a Grand Challenge for science and energy" April 12, 2010 by Larsen at http://www.slideshare.net/lewisglarsen/cfakepathlattice-energy-llc-white-paper-excerptapril-12-2010 [16-page excerpt from 60+ pages – MS-Word document format]	Lattice's strategic view of the overall global macroeconomic and geopolitical landscape of present energy dilemma; how LENRs fit into a societal portfolio of carbon-free green energy technologies (assuming that they can be commercialized); and what all this might mean
9SS	"LENRs in catalytic converters: are 'green' LENRs occurring in common devices?" June 25, 2010 by Larsen at http://www.slideshare.net/lewisglarsen/lattice-energy-llc-len-rs-in-catalytic-convertersjune-25-2010 [76 slides]	Widom-Larsen theory applied to explain data reported in peer-reviewed journals wherein various elements/isotopic transmutation products are observed in exhaust emissions coming from catalytic converters of cars and trucks powered by internal combustion engines
10SS	"Could LENRs be involved in some Li-ion battery fires? LENRs in advanced batteries" July 16, 2010 by Larsen at http://www.slideshare.net/lewisglarsen/cfakepathlattice-energy-llc-len-rs-in-liion-battery-firesjuly-16-2010 [68 slides]	Discusses possibility that LENRs may be occurring in some indeterminate subset of Li-ion battery fires; also, in Slide #55 and Slides #58-61 discuss 1924 LENR transmutation work of Prof. Hantaro Nagaoka (one of most famous physicists in the history of Japan and contemporary competitor of E. Rutherford) - Tungsten transmuted into Gold in high-current electric arcs in transformer oil

Lattice Energy LLC

Appendix 2 - Lattice's SlideShare presentations

Document ID	Title, author, public release venue, and date	Subject matter and comments
11SS	"Some bacteria appear capable of altering isotopic ratios of Uranium -- Is it the result of prosaic chemical fractionation processes and/or LENRs?" December 7, 2010 by Larsen at http://www.slideshare.net/lewisglarsen/bacteria-lenrsand-isotopic-shifts-in-uraniumlarsenlattice-energy-dec-7-2010-6177275 [50 pages – MS-Word 8.5 x 11 document format]	Description of theoretical W-L LENR Actinide nucleosynthetic network and selected examples of published mainstream, peer-reviewed experimental data which report anomalous isotopic shifts clearly associated with the metabolic activities of bacteria --- some or all of the hypothesized network pathways are potentially present in soils, ocean sediments, dusty chemical explosions, volcanic eruptions, and extraterrestrial impact events
12SS	Two key uncompressed, easier-to-read slides from above document http://www.slideshare.net/lewisglarsen/thoriumseed-lenr-networkfigslattice-energydec-7-2010-6177745 [4 slides]	Much more readable, uncompressed versions of Figs. 1 and 2 (found in the above-listed Document) that outline hypothesized LENR Actinide nucleosynthetic network are also available in this separate PowerPoint
13SS	Lattice is pleased to announce that a new Lattice patent concerning novel, high performance gamma shielding will issue on February 22, 2011, as US #7,893,414 B2; it is titled, "Apparatus and Method for Absorption of Incident Gamma Radiation and its Conversion to Outgoing Radiation at Less Penetrating, Lower Energies and Frequencies" February 22, 2011 by Larsen at http://www.slideshare.net/lewisglarsen/lattice-energy-llc-issuance-announcementus-patent-no-7893414-feb-22-2011 [8 slides]	February 2011: announces official issuance of Lattice's fundamental gamma shielding patent by the USPTO

Lattice Energy LLC

Appendix 2 - Lattice's SlideShare presentations

Document ID	Title, author, public release venue, and date	Subject matter and comments
14SS	US Patent #7,893,414 B2 issued by the USPTO on February 22, 2011 "Apparatus and Method for Absorption of Incident Gamma Radiation and its Conversion to Outgoing Radiation at Less Penetrating, Lower Energies and Frequencies" Assignee: Lattice Energy LLC Inventors: L. Larsen and A. Widom; clean copy available at http://www.slideshare.net/lewisglarsen/us-patent-7893414-b2 [43 pages – MS-Word 8.5 x 11 document format]	Abstract: "Gamma radiation (22) is shielded by producing a region of heavy electrons (4) and receiving incident gamma radiation in such region. The heavy electrons absorb energy from the gamma radiation and re-radiate it as photons (38, 40) at a lower energy and frequency. The heavy electrons may be produced in surface plasmon polaritons. Multiple regions (6) of collectively oscillating protons or deuterons with associated heavy electrons may be provided. Nanoparticles of a target material on a metallic surface capable of supporting surface plasmons may be provided. The region of heavy electrons is associated with that metallic surface. The method induces a breakdown in a Born-Oppenheimer approximation. Apparatus and method are described"
15SS	"Lattice Energy LLC-Nickel Seed W-L LENR Nucleosynthetic Network" March 24, 2011 by Larsen at http://www.slideshare.net/lewisglarsen/lattice-energy-llcnickel-seed-wl-lenr-nucleosynthetic-networkmarch-24-2011 [25 slides]	LENR nucleosynthetic networks beginning with Nickel seed nuclei --- Why cascades of fast beta-decays are important, and why end-products of LENR networks are mostly stable isotopes. Decays of neutron-rich halo nuclei more complicated; can dynamically vary their decay choices depending on their environment. Explains why LENR systems emit very little hard neutron or gamma photon radiation and are prone to producing ending arrays of stable isotopes/elements

Lattice Energy LLC

Appendix 2 - Lattice's SlideShare presentations

Document ID	Title, author, public release venue, and date	Subject matter and comments
16SS	"Lattice Energy LLC - Nickel-seed LENR Networks --- Experimental examples: gas-phase Nickel-seed Hydrogen systems and their measured transmutation products; hard radiation is absent --- What products might be found if Fe, Cr, Pd seeds were also present?" April 20, 2011 by Larsen at http://www.slideshare.net/lewisglarsen/lattice-energy-llcnickelseed-lenr-networksapril-20-2011 [61 slides]	Experimental examples: present selected segments of W-L model LENR nucleosynthetic networks starting with ULM neutron captures on stable Chromium (Cr), Iron (Fe), and Nickel (Ni) seed isotopes; discuss likely pathways and isotopic products that might be produced. Relate described W-L model networks and related concepts to specific experiments involving measurements of LENR transmutation products and photon radiation; how W-L theory can help to better understand such observations. Discuss implications of W-L Palladium (Pd) and Cr seed networks in context of selected examples of anomalous isotopic abundances observed in variety of physical environments, including catalytic converters
17SS	"Lattice Energy LLC – Claimed observations of variations in rates of nuclear β-decay; Evidence for dynamic behavior of nuclei responding to their immediate physical environment?" June 3, 2011 by Larsen at http://www.slideshare.net/lewisglarsen/lattice-energy-llc-changes-in-solar-neutrino-fluxes-alter-nuclear-betadecay-rates-on-earthjune-3-2011 [88 slides]	(1) Nucleosynthesis not limited to stellar cores, fission reactors, and supernovae; (2) illustrate astrophysical features of W-L; (3) outline many-body collective magnetic mechanism - explains very high temperatures in solar corona vs. photosphere; (4) show how this enables nucleosynthesis outside of stellar cores; (5) examples of experimental data that support W-L; (6) discuss new data which suggests beta-decaying isotopes (controlled by weak interaction) on Earth may be locally responding to changes in neutrino fluxes emanating from the Sun - this data provides direct evidence for our postulated mechanism noted above

Lattice Energy LLC

Appendix 2 - Lattice's SlideShare presentations

Document ID	Title, author, public release venue, and date	Subject matter and comments
18SS	"Lattice Energy LLC - Overview" August 15, 2011 by Larsen at http://www.slideshare.net/lewisglarsen/lattice-energy-llc-overview-august-15-2011 [1 slide]	Concise, non-technical one-page company and LENR technology overview
19SS	"Latest Data Suggests Global Population Growth is Slowing Unexpectedly Fast --- deceleration may have profound implications for economics, geopolitics, energy demand, and resource depletion --- First Fischer period of equilibrium for 600 years in which population growth is decelerating, instead of accelerating; future price stability and huge increases in global per capita income?" August 29, 2011 by Larsen at http://www.slideshare.net/lewisglarsen/population-growth-decelerating-faster-than-expected-consequences-for-next-50-yearslarsenexcerptaug-29-2011 [8 slides – consists of extract from a 38-page nonpublic document]	Given likely strength in global energy demand over the next 40 – 50 years (unless it is rationed-off and reduced by incredibly high energy prices) with continued growth in global per capita GDP, humanity broadly writ will need all the energy it can extract from any and every source that can possibly be found. Even with widespread deployment of an array of new carbon-free energy technologies, it will be a very long time before the world economy can afford to drastically reduce or stop using fossil fuels to help avert possibility of climate-related environmental catastrophes.
20SS	"Lattice Energy LLC Company Vision - What key milestones remain and why are we doing this?" September 11, 2011 by Larsen at http://www.slideshare.net/lewisglarsen/lattice-energy-llc-company-visionseptember-11-2011 [11 slides]	Lattice Energy articulates its vision for commercializing Low Energy Nuclear Reactions (LENRs): we explain what key technical and business milestones remain and why are we doing this. It is not just about money --- this task is important for many reasons --- it even transcends countries

Lattice Energy LLC

Appendix 2 - Lattice's SlideShare presentations

Document ID	Title, author, public release venue, and date	Subject matter and comments
21SS	"Lattice Energy LLC – Facts about W-L theory and LENRs" October 20, 2011 by Larsen at http://www.slideshare.net/lewisglarsen/lattice-energy-llc-facts-about-wl-theory-and-len-rsoct-20-2011 [9 slides]	Short synopsis of key facts about W-L theory and Low Energy Nuclear Reactions (LENRs) - the technological challenge is to amplify and control what Nature has already been doing for billions of years.
22SS	"Lattice Energy LLC – Mystery of the Missing Nickel and Vanadium" November 6, 2011 by Larsen at http://www.slideshare.net/lewisglarsen/lattice-energy-lcc-mystery-of-the-missing-nickel-and-vanadiumnov-6-2011 [28 slides]	Mystery of apparently missing Nickel and Vanadium: in the refereed paper "Hydrous pyrolysis of crude oil in gold-plated reactors," *Organic Geochemistry* 18 pp. 745 - 756 (1992) J.A. Curiale (Unocal) *et al.* reported results of experiments in which crude oil samples subjected to hydrous pyrolysis showed significant decreases in concentrations of trace metals Nickel and Vanadium over time. In one experiment, Iraq/300, decreases in Ni and V were accompanied by modest shift in Carbon isotopic ratios.
23SS	"NASA files USPTO patent application on LENRs" November 18, 2011 by Larsen at http://www.slideshare.net/lewisglarsen/nasa-zawodny-uspto-patent-application-on-lenrs-no-20110255645-published-oct-20-2011 [1 page – MS-Word 8.5 x 11 document format]	A NASA LENR-related patent application that lists Dr. Joseph Zawodny as Inventor, senior staff physicist at NASA-LaRC, was published by the USPTO on October 20, 2011. What is significant about this recently unveiled patent activity by a U.S. government agency is that NASA clearly believes that LENRs are real phenomena and that they are potentially commercially valuable for power generation applications, especially in aerospace.

Lattice Energy LLC

Appendix 2 - Lattice's SlideShare presentations

Document ID	Title, author, public release venue, and date	Subject matter and comments
24SS	"Lattice Energy LLC - LENRs ca. 1950s - Sternglass Experiments - Einstein & Bethe" November 25, 2011 by Larsen at http://www.slideshare.net/lewisglarsen/lattice-energy-llclenrs-ca-1950ssternglass-exptseinstein-bethenov-25-2011 [18 pages – MS-Word 8.5 x 11 document format]	Excerpted page scans from a chapter in Dr. Ernest Sternglass' 1997 book describe some enigmatic experiments conducted at Cornell Univ. physics dept. back in the early 1950s: recounts his work with old hydrogen-filled X-ray tube, as well as subsequent dialogue with Albert Einstein and Hans Bethe in trying to understand anomalous neutrons seen in observed results.
25SS	"Comments re Mr. Andrea Rossi & E-Cat Technology" November 26, 2011 by Larsen at http://www.slideshare.net/lewisglarsen/lewis-larsenlattice-energy-llccomments-re-mr-andrea-rossi-ecat-technologynov-26-2011 [1 page — MS-Word 8.5 x 11 document format]	Lattice Energy LLC comments publicly on Mr. Andrea Rossi and so-called "E-Cat" technology
26SS	"Two conference papers by Cirillo et al. involving Widom-Larsen Theory Published online Nov. 15 2011" November 30, 2011 by Larsen at http://www.slideshare.net/lewisglarsen/two-conference-papers-by-cirillo-et-al-involving-widomlarsen-theory-published-online-nov-15-2011 [3 pages — MS-Word 8.5 x 11 document format]	First time ever: Indirect experimental detection of Widom-Larsen ultra low momentum neutrons in, "Experimental evidence of a neutron flux generation in a plasma discharge electrolytic cell". Abstract: substantial neutron flux generated by plasma excitation at tungsten cathode of an electrolytic cell with alkaline solution is reported. Method based on CR-39 nuclear track detector coupled to boron converter was used to detect neutrons. This method is insensitive to strong plasma-generated electromagnetic noise that made inconclusive all previous attempts to identify neutrons in electrolytic plasma environment by means of electric detection techniques.

Lattice Energy LLC

Appendix 2 - Lattice's SlideShare presentations

Document ID	Title, author, public release venue, and date	Subject matter and comments
27SS	"Could LENRs be producing UFOs in Large Hadron Collider" December 7, 2011 by Larsen at http://www.slideshare.net/lewisglarsen/lattice-energy-llccould-lenrs-be-producing-ufos-in-large-hadron-colliderdec-7-2011 [6 pages – MS-Word 8.5 x 11 document format]	Are LENRs causing some of the UFO dust particles observed in the Large Hadron Collider? Maybe somebody should look?
28SS	"LENRs an cold fusion are different concepts" December 13, 2011 by Larsen at http://www.slideshare.net/lewisglarsen/lattice-energy-llclenrs-and-cold-fusion-are-different-conceptsdec-13-2011 [2 pages – MS-Word 8.5 x 11 document format]	"Cold fusion" and LENRs are not necessarily synonymous and isomorphous, as I will explain. First, LENRs are legitimate science. Second, "cold fusion" (i.e., D + D --> He-4 + heat; more generally, nuclear fusion of charged particles in the presence of high Coulomb barriers at high reaction rates at low temperatures) is not, and never was legitimate science. LENRs and "cold fusion" are different, readily distinguishable concepts. In the end, LENRs differ in that they are 'real' but "cold fusion" is not.
29SS	"Philosophical comment for 2012" December 13, 2011 by Larsen at http://www.slideshare.net/lewisglarsen/lattice-energy-llc-philosophical-comment-for-2012dec-21-2011 [1 page – MS-Word 8.5 x 11 document format]	LENRs versus "cold fusion" and the search for scientific 'truth' --- A philosophical comment for 2012. Remarks by Larsen interleaved with quotations from the Holy Bible, Holy Qur'an, Ibn Al-Haytham, Immanuel Kant, and Richard Millton's 1994 book, "Forbidden science: exposing the secrets of suppressed research" --quoting directly from it, "… only Nature is the [final] arbiter of what is and what is not."

Lattice Energy LLC

Appendix 2 - Lattice's SlideShare presentations

Document ID	Title, author, public release venue, and date	Subject matter and comments
30SS	"Cold fusioneers new ploy-ad hoc redefinition of technical term fusion" December 30, 2011 by Larsen at http://www.slideshare.net/lewisglarsen/cold-fusioneers-new-ploy-ad-hoc-redefinition-of-technical-term-fusiondec-30-2011 [2 pages – MS-Word 8.5 x 11 document format]	Cold fusion promoters are now saying that they always meant to include neutron-based processes as part of the concept of "cold fusion." Neutron-capture low energy nuclear reactions (LENRs) are NOT any form of fusion, hot, cold, warm, or otherwise. Distinction between these two concepts, LENRs versus "cold fusion" is *fundamental*, not merely malleable semantics as cold fusioneers might have people believe
31SS	December 30, 2011 Note: since third-party website providing documentation has been removed , this document has been deleted from SlideShare collection [1 page – MS-Word 8.5 x 11 document format]	Please see note to left
32SS	"Collective many-body Q-M neutrino antennas" January 10, 2012 by Larsen at http://www.slideshare.net/lewisglarsen/lattice-energy-llc-collective-manybody-qm-neutrino-antennasjan-10-2012 [3 pages – MS-Word 8.5 x 11 document format]	New possibilities for developing minimal mass, extremely sensitive, collective many-body, quantum mechanical neutrino 'antennas'. Widom-Larsen theory and Jenkins & Fischbach's experimental data suggest that weak-interaction-based detection devices could potentially be designed and built to function as passive, many-body, collective quantum mechanical neutrino antennae with very high neutrino interaction efficiencies, as well as high directional sensitivity and energetic specificity to neutrino fluxes emitted from distant point sources

Lattice Energy LLC

Appendix 2 - Lattice's SlideShare presentations

Document ID	Title, author, public release venue, and date	Subject matter and comments
33SS	"LENR Theory - Fleischmann et al. - Nuovo Cimento 1994" January 17, 2012 by Larsen at http://www.slideshare.net/lewisglarsen/lenr-theoryfleischmann-et-alnuovo-cimento-1994 [15 pages – MS-Word 8.5 x 11 document format]	Prescient theoretical insights in an annotated copy of very interesting, 14-page theoretical paper, "Possible theories of cold fusion" (1994) by Fleischmann, Pons, and Preparata that was published in *Il Nuovo Cimento*, then a peer-reviewed journal of Italian Physical Society
34SS	"Tin whisker shorting problems analogous to Li-ion batteries" January 24, 2012 by Larsen at http://www.slideshare.net/lewisglarsen/lattice-energy-llc-tin-whisker-shorting-problems-analogous-to-liion-batteriesjan-24-2012 [2 pages – MS-Word 8.5 x 11 document format]	Growth of conductive metallic tin whiskers and random electrical shorting events implicated in Toyota's uncontrollable vehicle acceleration safety problems. Whisker shorting issue analogous to metallic dendrite shorting events that can cause LENRs which can then trigger super-hot, fast-burning metal oxidation fires in Li-ion batteries.
35SS	"Synopses of selected WLT technical papers" January 30, 2012 by Larsen at http://www.slideshare.net/lewisglarsen/lattice-energy-llcsynopses-of-selected-wlt-technical-papersjan-30-2012 [4 pages – MS-Word 8.5 x 11 document format]	Contains concise, more-or-less plain English synopses of key Lattice technical papers for a broader, non-specialist scientific audience.
36SS	"Guide to concepts - experimental evidence for W-L theory of LENRs" February 17, 2012 by Larsen at http://www.slideshare.net/lewisglarsen/guide-to-conceptsexperimental-evidence-for-wl-theory-of-lenrsfeb-17-2012 [4 pages – MS-Word 8.5 x 11 document format]	Very brief, condensed guide to key Ideas and illustrative examples of experimental evidence for the Widom-Larsen theory of low energy nuclear reactions; broad-brush technical level.

Lattice Energy LLC

Appendix 2 - Lattice's SlideShare presentations

Document ID	Title, author, public release venue, and date	Subject matter and comments
37SS	"LENRs from 1900s to 1989 to today and beyond" February 21, 2012 by Larsen at http://www.slideshare.net/lewisglarsen/lattice-energy-llclenrs-from-1900s-to-1989-to-today-and-beyondfeb-21-2012 [2 pages – MS-Word 8.5 x 11 document format]	Researchers have been observing different types of LENR effects for at least 100 years; this short, semi-technical essay gives an overview of the history of such phenomena from the past to the present and on into the near-term future.
38SS	"300 nanoseconds in life of an LENR-active patch" February 29, 2012 by Larsen at http://www.slideshare.net/lewisglarsen/lattice-energy-llc300-nanoseconds-in-life-of-an-lenractive-patchfeb-29-2012 [8 pages – MS-Word 8.5 x 11 document format]	A much more physically detailed look at Widom-Larsen theory of LENRs in condensed matter; 300 nanoseconds in the brief lifetime of a μ-scale LENR-active surface patch initially comprised of protons/deuterons, SP electrons.
39SS	"Many LENR paths may produce He-4" March 3, 2012 by Larsen at http://www.slideshare.net/lewisglarsen/lattice-energy-llcmany-lenr-paths-may-produce-he4march-03-2012 [1 slide]	Slide shows examples of a number of selected LENR reaction pathways than can produce Helium-4 (He-4 or alpha particles); just detecting He-4 production in an experiment does not say exactly which pathway(s) might have caused it.
40SS	"Addendum Part 2 to UFOs in LHC" March 13, 2012 by Larsen at http://www.slideshare.net/lewisglarsen/lattice-energy-llcaddendum-part2-to-ufos-in-lhcmarch-13-2012 [19 slides]	Re UFO dust macroparticles in Large Hadron Collider: could nm- to μm-scale LENR events be causing some of them? Analysis with a Cameca NanoSIMS 50L mass spectroscopy instrument would be ideal to detect possible transmutation products.
41SS	"Addendum Part 1 to UFOs in LHC" March 13, 2012 by Larsen at http://www.slideshare.net/lewisglarsen/lattice-energy-llcaddendum-part1-to-ufos-in-lhcmarch-13-2012 [10 pages – MS-Word 8.5 x 11 document format]	Briefly reviews other processes *besides* LENRs that could potentially be causing production of troublesome "UFOs" in Large Hadron Collider.

Lattice Energy LLC

Appendix 2 - Lattice's SlideShare presentations

Document ID	Title, author, public release venue, and date	Subject matter and comments
42SS	"Coal as a CLENR CO_2 emissionless fuel" March 21, 2012 by Larsen at http://www.slideshare.net/lewisglarsen/lattice-energy-llccoal-as-a-clenr-co2-emissionless-fuelmarch-15-2012-12109180 [60 slides]	Polycyclic aromatic hydrocarbons (PAHs), LENRs, and coal: dirty coal as a future source of CLENR fuels with zero CO_2 emissions? Discusses speculative possibilities about the potential future of coal and CLENR energy. New neutron data consistent with W-L theory mechanism in lightning: surprisingly large fluxes of low-energy neutrons well-correlated with thunderstorm EMF fluctuations. A plausible W-L mechanism is discussed whereby LENR nucleosynthetic processes could potentially occur in high-current atmospheric lightning discharges happening on Earth, as well as on other planets, moons (e.g., Io?), and large hydrogen-rich regions of dusty nebulae subjected to large fluxes of energetic photon and particle radiation emitted by nearby stars. Non-stellar nucleosynthesis could thus be occurring at widely varying rates in many more places around the Universe than any of us could have ever before imagined. This paradigm shift in thinking about nucleosynthesis opens-up huge new vistas for future research and promises further exciting insights into the long, rich pageant of planetary and galactic chemical evolution.
43SS	"New Russian data supports WLT neutron production in lightning" April 4, 2012 by Larsen at http://www.slideshare.net/lewisglarsen/lattice-energy-llcnew-russian-data-supports-wlt-neutron-production-in-lightningapril-4-2012 [73 slides]	

Lattice Energy LLC

Appendix 2 - Lattice's SlideShare presentations

Document ID	Title, author, public release venue, and date	Subject matter and comments
44SS	"New data on terrestrial Uranium ^{238}U - ^{235}U ratios confirm not invariant" April 12, 2012 by Larsen at http://www.slideshare.net/lewisglarsen/lattice-energy-llcnew-ata-on-terrestrial-uranium-238-u235u-ratios-confirm-not-invariantapril-12-2012 [35 slides]	For 35 years it has been widely assumed that terrestrial $^{238}U/^{235}U$ ratio is invariant over time; new data reported by Hiess *et al.* clearly show otherwise. So if this longstanding assumption is truly erroneous, then what processes could cause such variance? Discusses paper by Hiess *et al.* and its consequences for geochemistry; also explores issues with chemical fractionation theories and suggests that LENRs may better explain certain anomalous isotopic data. Provides an overview of LENR Actinide transmutation network; discusses experimental data on bacterial isotopic shifts and outlines a speculative conjecture about LENRs and so-called electric bacteria
45SS	"Macroeconomics, technology and the long sweep of history" April 14, 2012 by Larsen at http://www.slideshare.net/lewisglarsen/lattice-energy-llc-macroeconomics-technology-and-long-sweep-of-historyapril-14-2012 [19 pages – MS-Word 8.5 x 11 document format]	Potential strategic implications of decelerating world population growth during a Fischer "period of equilibrium" could be profound: if this scenario describes what is actually underway today, and if runaway global warming and/or other types of mega-environmental disasters do not somehow befall us, it would mean that during the next 30 - 50 years there could potentially be incredibly large worldwide increases in per capita income accompanied by mostly stable to declining long term interest and inflation rates. As Mark Twain remarked, "... history does not really repeat itself, but it does rhyme."

Lattice Energy LLC

Appendix 2 - Lattice's SlideShare presentations

Document ID	Title, author, public release venue, and date	Subject matter and comments
46SS	"Lewis Larsen - Forecasting track record re 1980s Barron's articles by Jon Laing" April 15, 2012 by Larsen at http://www.slideshare.net/lewisglarsen/lewis-larsenforecasting-track-record-re-1980s-barrons-articles-by-jon-laingapril-15-2012 [26 pages - heavily oriented toward graphical analysis of time-series economic and financial data – MS-Word 8.5 x 11 document format]	In the 1980s, Larsen made a series of future conjectures about international competitiveness, future direction of stock markets, interest rates, and likely rates of inflation (among other things) that were reported in *Barron's* by Laing. This document analyzes Larsen's forecasting track record of those 10 – 20 year future prognostications.
47SS	"New data support idea of decelerating population growth" April 24, 2012 by Larsen at http://www.slideshare.net/lewisglarsen/lattice-energy-llcnew-data-support-idea-of-decelerating-population-growthapril-24-2012 [14 slides]	Important update: new data in recent articles supports Lattice's conjecture of unexpectedly rapid deceleration in population growth; very important macroeconomic, geopolitical, and long-term energy demand implications if correct.
48SS	"LENR transmutation networks can produce Gold" May 19, 2012 by Larsen at http://www.slideshare.net/lewisglarsen/lattice-energy-llc-lenr-transmutation-networks-can-produce-goldmay-19-2012 [66 slides]	In theory, neutron-catalyzed LENR transmutations can produce Gold; already observed experimentally and reported in peer-reviewed journals in the 1920s. This process may also occur naturally in the earth. Might LENR process be scalable and economic; if so, what are long-term implications for Gold price? Prof. H. Nagaoka, *Nature* July 18, 1925: created powerful electric arc discharge between two metallic, Thorium-oxide-free Tungsten (W) electrodes bathed in transformer oil laced with liquid Mercury (Hg). Depending on experiment, arcing continued for 4-15 hours. After periods of arcing, many small flecks of Gold were sometimes quite visible to naked eye in "black masses" at the end of experiment.

Lattice Energy LLC

Appendix 2 - Lattice's SlideShare presentations

Document ID	Title, author, public release venue, and date	Subject matter and comments
49SS	"Addendum to May 19, 2012 Technical Overview - 1927 Caltech experiments" May 26, 2012 by Larsen at http://www.slideshare.net/lewisglarsen/lattice-energy-llcaddendum-to-may-19-2012-technical-overview1927-caltech-experimentsmay-26-2012 [34 pages – MS-Word 8.5 x 11 document format]	In a WLT Tungsten-seed LENR neutron-catalyzed transmutation LENR network wherein Pb → Hg and Bi → Tl, unstable isotopes of Lead and Bismuth will spontaneously transmute into unstable isotopes of Mercury and Thallium, respectively, which can be detected. This was apparently observed by L. Thomassen in experimental work for his PhD at Caltech in 1927 (copy of his PhD thesis is embedded within this document). Shorter version of Thomassen's results was subsequently published in peer-reviewed *Physical Review* in 1929; he was advised in this work by Prof. R. Millikan, who was then on the faculty at Caltech and who had received the Nobel Prize in Physics in 1923 and was intrigued with subject of nuclear transmutation.
50SS	"Comment re 1927 Caltech electric arc transmutation experiments" May 29, 2012 by Larsen at http://www.slideshare.net/lewisglarsen/lattice-energy-llccomment-re-1927-caltech-electric-arc-transmutation-experimentsmay-29-2012 [1 page – MS-Word 8.5 x 11 document format]	
51SS	"Electroweak neutron production and capture during lightning discharges" June 11, 2012 by Larsen at http://www.slideshare.net/lewisglarsen/lattice-energy-llc-electroweak-neutron-production-and-capture-during-lightning-dischargesjune-7-2012 [4 pages – MS-Word 8.5 x 11 document format]	Electroweak production of low-energy neutrons in terrestrial lightning discharges predicted by Widom-Larsen theory of LENRs; recently confirmed by new Russian data. Contrary to longstanding belief, this implies that neutron-capture-driven, non-stellar nucleosynthetic processes have likely been occurring in the environs of earth for *at least* ~4.5 billion years. Altogether, geochemists' present widely-accepted thinking about types of nuclear processes affecting the chemical evolution of the earth and solar system may require significant revision.

Lattice Energy LLC

Appendix 2 - Lattice's SlideShare presentations

Document ID	Title, author, public release venue, and date	Subject matter and comments
52SS	"LENRs on Hydrogenated Fullerenes and Graphene" July 6, 2012 by Larsen at http://www.slideshare.net/lewisglarsen/lattice-energy-llclenrs-on-hydrogenated-fullerenes-and-graphenejuly-6-2012 [64 slides]	Along with a number of other plasmonics researchers, Lattice had also hypothesized that surface plasmon electrons existed on the surface of Graphene Carbon sheets and said so publicly in SlideShare document dated Sept. 3, 2009. New papers by two teams published in *Nature* (2012) have confirmed that speculative conjecture. In conjunction with confirmation of breakdown of Born-Oppenheimer approximation on surfaces of Graphene (2007) and Carbon nanotubes (CNTs - 2009), this development is significant because it implies that Widom-Larsen theory in condensed matter applies to such materials and that under the proper conditions LENRs can be triggered on hydrogenated CNTs and Graphene surfaces decorated with engineered target nanoparticles in manner similar to cases of proton-loaded metallic hydrides and catalytic hydrogenation of polycyclic aromatic hydrocarbons (e.g. Phenanthrene - Mizuno, 2008).
53SS	"Larsen webradio interview with Sandy Andrew" July 11, 2012 by Larsen at http://www.slideshare.net/lewisglarsen/lattice-energy-lllarsen-webradio-interview-with-sandy-andrewjuly-11-2012 [15 slides --- that are provided to informationally enhance a 1-hour live audio interview with Sandy Andrew that he recently cross-posted on YouTube along with accompanying graphics and URLs]	In-depth Q&A audio interview with graphics is available on YouTube, "Widom-Larsen Theory of LENRs . . . Energy Revolution?" on webradio program, *The Universal Learning Series* with Sandy Andrew. This is very definitely not a typical thin gruel, brain-dead media interview; Sandy invested considerable time studying the technical aspects of this subject matter in preparation for the professional Q&A session that originally aired on Sandy's Internet webradio talk show April 17, 2010.

Lattice Energy LLC

Appendix 2 - Lattice's SlideShare presentations

Document ID	Title, author, public release venue, and date	Subject matter and comments
54SS	"Report reveals Boeing and NASA investigating LENR-powered aircraft" August 3, 2012 by Larsen at http://www.slideshare.net/lewisglarsen/lattice-energy-llc-report-reveals-boeing-and-nasa-investigating-lenrpowered-aircraftaug-3-2012 [149 pages + NASA rept. – MS-Word document format]	NASA Report: NASA/CR-2012-217556 Subsonic Ultra Green Aircraft Research Phase II: N+4 Advanced Concept Development; this NASA report document reveals NASA and Boeing are Investigating possibility of future LENR-powered "green aircraft." Annotated copy of 148-page NASA/CR-2012-217556 is appended to a 1-page Lattice cover note. Quite technical: certain experimental data suggests that some form of HTSC may be occurring in W-L many-body patches found in LENR systems. While not widely known or accepted, controversial experimental data collected and published by Tripodi *et al.*, if correct, suggests that >RTSC might be possible, at least in PdHx superconducting systems. If HTSC or RTSC truly does occur in W-L heavy-electron patches, although it shares some common characteristics with Type-2 superconductors, it differs in many key ways. For example, normal lattice electron-phonon interactions seem unlikely to be involved in facilitating formation of Cooper pairing in a W-L patch's SP electron subsystem. Instead, it seems like, during brief attoseconds of collective proton coherence, the many-body collective proton subsystem somehow functions as a local lattice (*a la* a dynamic Coulomb crystal???). Viewed in that manner, a many-body proton subsystem's electromagnetic and Q-M interactions with a patch's many-body SP electron subsystem might then be able to provide a local environment conducive to electron pairing therein. Perhaps a patch's two subsystems form dynamic, mutually reinforcing mirror quantum condensates as conceptualized on Slide #81 therein.
55SS	"High-temperature superconductivity in patches" August 23, 2012 by Larsen at http://www.slideshare.net/lewisglarsen/lattice-energy-llc-hightemperature-superconductivity-in-patchesaug-23-2012 [92 slides]	

Lattice Energy LLC

Appendix 2 - Lattice's SlideShare presentations

Document ID	Title, author, public release venue, and date	Subject matter and comments
56SS	"High-temperature Superconductivity in Patches - Addendum" Sep 11, 2012 by Larsen at http://www.slideshare.net/lewisglarsen/lattice-energy-llchightemperature-superconductivity-in-patchesaddendumsep-11-2012 [25 slides]	September 5, 2012: Shukla & Eliasson posted an excellent new paper on arXiv: "Clustering of ions at atomic dimensions in quantum plasmas" Supports our speculative conjecture about Cooper pairing of protons in Widom-Larsen patches. Quoting directly from their conclusions: "Specifically, we stress that the Cooper pairing of ions at atomic dimensions shall provide possibility of novel superconducting plasma based nanotechnology, since the electron transport in nanostructures would be rapid due to shortened distances between ions in the presence of the novel SE attractive force."
57SS	"Article re Widom-Larsen LENR Theory in Nov 2012 Discover Magazine" Oct 6, 2012 by Larsen at http://www.slideshare.net/lewisglarsen/lattice-energy-llc-article-re-widomlarsen-lenr-theory-in-nov-2012-discover-magazineoct-6-2012 [1 slide]	Two-page article about Widom-Larsen theory of LENRs published in *Discover* magazine's monthly "Big Idea" section as follows: "Bring back the cold fusion dream – A new theory may explain the notorious cold fusion experiment from two decades ago, reigniting hopes of a clean-energy breakthrough" by Mark Anderson *Discover*, pp. 10 - 11 (November 2012)
58SS	"Response to Sept 2012 Univ. of Rome arXiv Preprint" Oct 30, 2012 by Larsen at http://www.slideshare.net/lewisglarsen/lattice-energy-llc-response-to-sept-2012-univ-of-rome-arxiv-preprintoct-30-2012-14956399 [52 slides]	Ciuchi *et al.* (arXiv preprint - Sept. 2012) questioned the accuracy of Widom-Larsen estimates of electroweak neutron production rates in electrical current-driven, condensed matter metallic hydride electrolytic cells. In our response to their claims (arXiv preprint - Oct. 2012), we showed how their assertion that our calculated reaction rates were way too high was erroneous and that their overly simplistic reaction rate model calculations were in error because Ciuchi *et al.* had assumed, quite incorrectly, that the $e + p$ reaction in a condensed matter metallic hydride cell is a simple two-body process; it is not --- it is many-body collective.

Lattice Energy LLC

Appendix 2 - Lattice's SlideShare presentations

Document ID	Title, author, public release venue, and date	Subject matter and comments
59SS	"Song for those who believe collective many body effects can be ignored in LENR systems" Nov 10, 2012 by Larsen at http://www.slideshare.net/lewisglarsen/lattice-energy-llc-song-for-those-who-believe-collective-many-body-effects-can-be-ignored-in-lenr-systemsnov-10-2012 [1 slide - which includes URL to YouTube music video]	The apropos lyrics of a circa 1983 song by the Australian group, *Men At Work*, titled "It's a mistake" are dedicated to those scientists who happen to erroneously believe that many-body collective effects can safely be ignored for LENRs occurring in condensed matter systems. A link is provided to a URL on YouTube where the audio soundtrack from the "Cargo" album is integrated with a synchronized video that is iconoclastic and quite entertaining to watch - video could easily be subtitled, "The war of two paradigms." Please note that this document is intended to make a point by injecting a little light-hearted levity into an otherwise deadly-serious discussion about an ongoing multi-year struggle between old and new paradigms in science *a la* Thomas Kuhn.
60SS	"Larsen Electroweak Neutron Production and Capture in Lightning Discharges-ANS Meeting San Diego Nov 2012" Nov 11, 2012 by Larsen at http://www.slideshare.net/lewisglarsen/larsen-electroweak-neutron-production-and-capture-in-lightning-dischargesans-meeting-san-diego-nov-2012 [15 slides]	This presentation is part of a November 13, 2012, panel session "Discussion of Low-Energy Nuclear Reactions" at the American Nuclear Society 2012 Winter Meeting in San Diego, CA. Enabled by many-body, collective effects and appropriate forms of required input energy (e.g., electric currents and/or organized magnetic fields with cylindrical geometries can be used to produce catalytic neutrons via an electroweak reaction: e + p --> n + ν), LENRs involve elemental nucleosynthetic transmutation reactions very much like stars, only at vastly lower temperatures and pressures that are found in laboratory apparatus such as electrolytic chemical cells and many natural processes such as lightning discharges. Note: audio-narrated version of this presentation is also available on SlideShare exactly as presented live Nov 14

Lattice Energy LLC

Appendix 2 - Lattice's SlideShare presentations

Document ID	Title, author, public release venue, and date	Subject matter and comments
61SS	"AUDIO - Larsen-Electroweak Neutron Production and Capture in Lightning Discharges-ANS San Diego Nov 14 2012" Nov 13, 2012 by Larsen at http://www.slideshare.net/lewisglarsen/audio-larsenelectroweak-neutron-production-and-capture-in-lightning-dischargesans-san-diego-nov-14-2012 [15 slides – includes fully synchronized mpg audio track]	Please note that this SlideShare SlideCast document is exactly the same as other 15-slide 'plain vanilla' version other than the accompanying audio narration track. Also note that as of Saturday, Nov. 17, 2012, at 9:55 AM CST (Chicago time), we improved the synchronization between the slide transitions and the audio track. This SlideCast presentation should run automatically from start-to-finish with the slides being advanced at the correct point in the audio narrative dialogue about each of the slides.
62SS	"One Page Overview-ANS-LENR Neutrons in Lightning" Nov 20, 2012 by Larsen at http://www.slideshare.net/lewisglarsen/lattice-energy-llcone-page-overviewanslenr-neutrons-in-lightningnov-20-2012 [1-page – MS-Word 8.5 x 11 document format]	Provides URL links to audio version of Nov 14, 2012, ANS meeting presentation and two additional Lattice summary documents. Also announces that Lattice recently developed a concept for an LENR rapid-pulse-detonation propulsion system that could in principle be suitable for 'green' atmospheric aircraft, energy-density-limited UAVs, and key spacecraft applications. Such a system would be radiologically clean and could provide large thrust vs. weight performance improvements in comparison to combustion of fossil fuels or any conceivable chemical rocket propulsion technologies. Ratio of required mass of LENR fuel carried on-board divided by total aircraft/spacecraft system mass would likely be a minuscule number and thus revolutionary if it were successfully engineered

Lattice Energy LLC

Appendix 2 - Lattice's SlideShare presentations

Document ID	Title, author, public release venue, and date	Subject matter and comments
63SS	"Nov 21 New Scientist article re variations in rates of nuclear decay - Extension of Widom-Larsen theory of LENRs can explain this data" Nov 23, 2012 by Larsen at http://www.slideshare.net/lewisglarsen/lattice-energy-llcobserved-variations-in-rates-of-nuclear-decaynov-23-2012 [65 slides]	Lattice's technical comments regarding: "Half-life strife: Seasons change in the atom's heart," by Stuart Clark published in *New Scientist* magazine issue #2891 on November 21, 2012. An extension of the Widom-Larsen theory of LENRs published on Jan. 10, 2012, in a 3-page MS-Word document titled, "New possibilities for developing minimal mass, extremely sensitive, collective many-body, quantum mechanical neutrino antennas," successfully explains the published experimental results of Jenkins and Fischbach with regard to Manganese-54 (Mn-54) and other isotopic decays involving the weak interaction (e.g., beta decays and inner-shell electron captures). This theoretical explanation for the phenomenon involves a rather straightforward application of the Pauli Exclusion Principle to all types of neutrinos, which are fermions (NOT bosons).
64SS	"Electroweak Neutron Production via e + p → n + ν and Capture during Lightning Discharges" Nov 27, 2012 by Larsen at http://www.slideshare.net/lewisglarsen/larsen-lans-winter-meeting-san-diego-ca-04150417-nov-2012 [3-pages – MS-Word 8.5 x 11 document format]	This official paper is part of the American Nuclear Society November 2012 panel session "Discussion of Low-Energy Nuclear Reaction*s.*" Enabled by many-body, collective effects and appropriate forms of required input energy (e.g., electric currents and/or organized magnetic fields with tubular geometries can be used to produce an electroweak reaction: e + p --> n + ν), LENRs involve elemental nucleosynthetic transmutation reactions very much like stars, only at vastly lower temperatures and pressures that are found in laboratory apparatus such as electrolytic chemical cells and many natural processes such as lightning discharges..

Lattice Energy LLC

Appendix 2 - Lattice's SlideShare presentations

Document ID	Title, author, public release venue, and date	Subject matter and comments
65SS	Neutron-catalyzed LENR transmutations produce Gold from Tungsten; Mitsubishi Heavy Industries presents new data at Winter ANS meeting - Comparable results: three sets of different experiments separated by as much as 88 years" December 7, 2012 by Larsen at http://www.slideshare.net/lewisglarsen/lattice-energy-llc-lenr-transmutation-networks-can-produce-golddec-7-2012 [29 slides]	Widom-Larsen theory of LENRs predicts that Gold can be created via nucleosynthetic transmutation process that involves e + p electroweak neutron production followed by captures of ultra-low momentum (ULM) neutrons on stable isotopes of Tungsten. This theoretical prediction has been effectively confirmed in data from at least three sets of published laboratory experiments that differ significantly in experimental techniques but nonetheless involve exactly the same underlying Widom-Larsen nucleosynthetic process and LENR network pathway: W → Re → Os → Ir → Pt → Au. These measured data provide effectively comparable experimental confirmations of our theoretical prediction that are separated in time by as much as ~88 years; namely, Nagaoka *et al.* (Japan, 1925); Cirillo *et al.* (Italy, *circa* 2004), and just recently at the American Nuclear Society 2012 Winter Meeting session on LENRs in San Diego, CA, Dr. Yasuhiro Iwamura *et al.* (Mitsubishi Heavy Industries, Japan, 2012)
66SS	"LENRs are potentially another mechanism for producing so-called field failures that can trigger catastrophic thermal runaway fires in Lithium-based batteries" January 23, 2013 by Larsen at http://www.slideshare.net/lewisglarsen/lattice-energy-llc-field-failures-and-lenrs-in-lithiumbased-batteriesjan-23-2013 [28-pages – MS-Word 8.5 x 11 document format]	Is a subset of Lithium-based battery problems called a "field failure" mode that, while rarer than plain vanilla safety issues such as punctures and other types mechanical damage, seems to be highly correlated with catastrophic thermal runaway events. It is known that if just a single cell in multi-cell battery pack fails in this manner, it can potentially trigger a catastrophic large-scale thermal runaway event that rapidly propagates through an entire battery pack. Lattice has applied the Widom-Larsen theory of LENRs on a practical level to help better understand possible role of nanoscale metal dendrites/nanoparticles in field failures that can occur in Lithium-based batteries.

Lattice Energy LLC

Appendix 2 - Lattice's SlideShare presentations

Document ID	Title, author, public release venue, and date	Subject matter and comments
67SS	Lattice makes comments on, "Microscopic Dendrites Focus in Boeing Dreamliner Probe" – a *Wall Street Journal* article that published on February 11, 2013 February 11, 2013 by Larsen at http://www.slideshare.net/lewisglarsen/microscopic-dendrites-focus-in-boeing-dreamliner-probe-wall-street-journalfeb-11-2013 [4-pages – MS-Word 8.5 x 11 document format]	"Microscopic Dendrites a Focus in Boeing Dreamliner Probe," in *The Wall Street Journal*, updated February 11, 2013, 10:45 p.m. ET, by Jon Ostrower and Andy Pasztor. Quoting from their article, "Aviation safety investigators are examining whether the formation of microscopic structures known as dendrites inside the Boeing Co 787's lithium-ion batteries played a role in twin incidents that prompted the fleet to be grounded nearly a month ago … The new information from the National Transportation Safety Board offers a glimpse into what could become an important line of inquiry for the investigation into a Jan. 7 battery fire aboard a Japan Airlines Co. 787 Dreamliner parked in Boston."
68SS	"Are LENRs occurring in compact fluorescent lights?" March 7, 2013 by Larsen at http://www.slideshare.net/lewisglarsen/lattice-energy-llcare-lenrs-occurring-in-compact-fluorescent-lightsmarch-7-2013 [102 slides]	Peer-reviewed paper by Mead *et al.* published in February 2013, *Environmental Science & Technology,* contains amazing new experimental data on anomalous shifts in abundances of Mercury isotopes found in compact fluorescent lights (CFL) used in homes and businesses. When viewed through conceptual lens of the Widom-Larsen theory, their carefully collected Hg isotope data suggests that low energy nuclear reaction (LENR) transmutations may actually be occurring at extremely low rates in CFLs during normal operation. We discuss their experimental data and its implications in this PowerPoint. We conclude that if the intriguing possibility about LENRs in CFLs seemingly revealed in this data is substantiated by further experimentation, it provides more proof that LENRs are likely to be a truly 'green' nuclear technology that has great promise for use in CO_2-free power generation.

Lattice Energy LLC

Appendix 2 - Lattice's SlideShare presentations

Document ID	Title, author, public release venue, and date	Subject matter and comments
69SS	"Ultra Low Momentum Neutron Catalyzed Nuclear Reactions on Metallic Hydride Surfaces" A. Widom and L. Larsen *European Physical Journal C* 46 pp. 107 - 112 (2006) Uploaded to SlideShare by Larsen in March 2013 at http://www.slideshare.net/lewisglarsen/widom-and-larsen-ulm-neutron-catalyzed-lenrs-on-metallic-hydride-surfacesepjc-march-2006 [5 pages: as-published copy of our *EPJC* theory paper]	Abstract: Ultra low momentum neutron catalyzed nuclear reactions in metallic hydride system surfaces are discussed. Weak interaction catalysis initially occurs when neutrons (along with neutrinos) are produced from the protons that capture heavy electrons. Surface electron masses are shifted upwards by localized condensed matter electromagnetic fields. Condensed matter quantum electrodynamic processes may also shift the densities of final states, allowing an appreciable production of extremely low momentum neutrons, which are thereby efficiently absorbed by nearby nuclei. No Coulomb barriers exist for the weak interaction neutron production or other resulting catalytic processes.
70SS	"A Primer for Electro-Weak Induced Low Energy Nuclear Reactions" Y. N. Srivastava, A. Widom, and L. Larsen *Pramana – Journal of Physics* 75 pp. 617 - 637 (2010) Uploaded to SlideShare by Larsen in March 2013 at http://www.slideshare.net/lewisglarsen/srivastava-widom-and-larsenprimer-for-electroweak-induced-low-energy-nuclear-reactionspramana-oct-2010 [21 pages: as-published copy of our *Pramana* review paper] Note: it is strongly recommended that the "Primer" paper be read first, as it is higher-level and more conceptually oriented than the terser, much more mathematically intensive *EPJC* publication.	Abstract: Under special circumstances, electromagnetic and weak interactions can induce low-energy nuclear reactions to occur with observable rates for a variety of processes. A common element in all these applications is that the electromagnetic energy stored in many relatively slow-moving electrons can (under appropriate circumstances) be collectively transferred into fewer, much faster electrons with energies sufficient for the latter to combine with protons (or deuterons, if present) to produce neutrons via weak interactions. The produced neutrons can then initiate low-energy nuclear reactions through further nuclear transmutations. The aim of this paper is to extend and enlarge upon various examples analyzed previously, present order of magnitude estimates for each and to illuminate a common unifying theme amongst all of them.

Lattice Energy LLC

Appendix 2 - Lattice's SlideShare presentations

Document ID	Title, author, public release venue, and date	Subject matter and comments
71SS	"Further technical details about W-L gamma shielding mechanism in condensed matter LENRs" March 17, 2013 by Larsen at http://www.slideshare.net/lewisglarsen/lattice-energy-llcfurther-technical-details-re-gamma-shielding-mechanism-in-condensed-matter-lenrsmarch-17-2013 [2 pages – MS-Word 8.5 x 11 document format]	More details are provided about the Widom-Larsen theory's concept of a built-in gamma shielding mechanism that we believe occurs at LENR-active sites in condensed matter systems. What is referred to as shielding in this context is really a process of absorption and direct conversion of locally emitted gammas into many more less energetic infrared photons (with a tiny, highly variable 'tail' in soft X-rays) at high efficiency while, of course, obeying the law of conservation of energy.
72SS	"US #7,893,414 B2 – Patent Discussion" March 22, 2013 by Larsen at http://www.slideshare.net/lewisglarsen/overviewlattice-energy-llc-gamma-shielding-patent-us-7893414-b2-issued-feb-22-2011 [35 slides]	Yet more technical details are provided about the Widom-Larsen theory's concept of a built-in gamma shielding mechanism that we believe occurs at LENR-active sites in condensed matter systems.
73SS	"Powering the world to a green LENR future: Truly green nuclear energy exists --- No deadly gammas … No energetic neutrons … No radioactive waste" April 11, 2013 by Larsen at http://www.slideshare.net/lewisglarsen/powering-the-world-to-a-green-lenr-future-lattice-energy-llcapril-11-2013 [104 slides]	A not unduly technical Lattice overview: truly green hard-radiation-free nuclear energy exists: no gammas, no energetic neutrons, nor any radioactive wastes. During their brief existence, peak power densities in LENR-active sites in condensed matter are enormous. Dividing 1.0×10^{21} (power density of LENRs) by 2.765×10^{2} (fusion power density at the Sun's core) we calculate LENRs' relative power density = ~3.6×10^{19} times the solar core's. One could quibble re details in these simplistic estimates; however, conclusion of this calculation is that LENR-active sites briefly have energy power densities that can be substantially higher than the Sun's inner core

Lattice Energy LLC

Appendix 2 - Lattice's SlideShare presentations

Document ID	Title, author, public release venue, and date	Subject matter and comments
74SS	"Search for scientific truth and greener sources of nuclear energy: The Rainbow Connection" April 20, 2013 by Larsen at http://www.slideshare.net/lewisglarsen/lattice-energy-llc-search-for-scientific-truth-and-greener-sources-of-nuclear-energyapril-20-2013 [1 slide + URL to YouTube audio + lyrics]	Comment: sometimes contemporary pop music is much intellectually deeper than you might think … listen.
75SS	"Make no mistake: rising powers/shrinking planet is a dangerous formula …" April 21, 2013 by Larsen at http://www.slideshare.net/lewisglarsen/lattice-energy-llcquote-from-new-geopolitics-of-energya-book-by-prof-michael-klareaapril-21-2013 [1 slide]	Notable quote: extracted from Prof. Michael T. Klare's very insightful book, "Rising Powers, Shrinking Planet: The New Geopolitics of Energy" pp. 261 (2009)
76SS	"On oft-observed slowness of major technical paradigm shifts" April 21, 2013 by Larsen at http://www.slideshare.net/lewisglarsen/lattice-energy-llc-quote-from-prof-brian-arthur-re-slowness-of-technical-paradigm-shiftsapril-21-2013 [1 slide]	Notable quote: extracted from pp. 139 in Prof. W. Brian Arthur's fascinating book, "The Nature of Technology - What it is and how it evolves," Free Press (2009)
77SS	"On the never-ending search for scientific truth" April 21, 2013 by Larsen at http://www.slideshare.net/lewisglarsen/lattice-energy-llc-quoteimmanuel-kantcritique-of-pure-reason-re-search-for-scientific-truthapril-21-2013 [1 slide]	Notable quote: extracted from Immanuel Kant's famous book, "The Critique of Pure Reason" (1781)

Lattice Energy LLC

Appendix 2 - Lattice's SlideShare presentations

Document ID	Title, author, public release venue, and date	Subject matter and comments
78SS	"By following this method … (we can find) a road to the truth" April 21, 2013 by Larsen at http://www.slideshare.net/lewisglarsen/lattice-energy-llc-ibn-alhaythamca-1016quote-from-kitab-almanadhir-re-search-for-scientific-truthapril-21-2013 [1 slide]	Notable quote: from renowned Arab mathematician and brilliant polymath, Ibn Al-Haytham (Arabic: أب و ع لي، ال ح سن ب ن ال ح سن ب ن ال ه ي ثم) who is considered by many historians of science to be the father of the modern scientific method; this statement appears in his famous 7-volume treatise on optics, *Kitab Al-Manadhir* (written *ca.* 1011-1021 while being held under house arrest in Egypt).
79SS	"Will Boeing's battery fix fly?" *Barron's* magazine, Jonathan Laing (national financial weekly) April 27, 2013; reference for article + older articles re Larsen http://www.slideshare.net/lewisglarsen/lewis-larsenbarrons-magazine-articles-by-jon-laingpublished-2013-1999-1988-1986-april-27-2013 [12 pages; URL to article - MS-Word 8.5 x 11 document format]	Quoting from text: "Boeing has FAA clearance to restart its Dreamliner rollout. Some experts aren't convinced the big plane maker has cut the risks in its lithium-ion batteries far enough." Article appears on pp. 16-17 in the print edition; also published electronically online with a paid subscription. Copies of prior *Barron's* articles involving Larsen by Jon Laing that were published in 1986, 1988, and 1999, are appended to the cover page in this document. Free copy of the April 27, 2013, article is available on *Aviation Week* magazine's public website as follows: http://www.aviationweek.com/Portals/AWeek/TWW/Laing%20Jonathan%20R-Barrons%20Magazine-Will%20Boeings%20Battery%20Fix%20Fly-April%2027%202013.pdf
80SS	"Steel microspheres in NTSB Dreamliner battery SEM images suggest high local temps" April 30, 2013 by Larsen at http://www.slideshare.net/lewisglarsen/lattice-energy-llc-steel-microsopheres-in-ntsb-dreamliner-battery-sem-images-suggest-high-local-tempsapril-30-2013 [33 slides]	Presence of perfect stainless steel microspheres in Dreamliner's post-thermal-runaway battery debris from Logan Airport incident suggests that local temperatures inside Cell #5 were >3,000° C because microspheres are most commonly created by rapid condensation of solid droplets from a gaseous metal vapor phase. The process of microsphere formation during some battery runaways also occurs during laser ablation of metallic surfaces.

Lattice Energy LLC

Appendix 2 - Lattice's SlideShare presentations

Document ID	Title, author, public release venue, and date	Subject matter and comments
81SS	"NTSB reports indicate very high temperatures" Technical Discussion May 7, 2013 by Larsen at http://www.slideshare.net/lewisglarsen/lattice-energy-llc-technical-discussionntsb-logan-dreamliner-runaway-data-suggest-high-local-tempsmay-7-2013 [51 slides]	NTSB's investigative data implies that the local temperature of the battery casing's Type 304 stainless steel hotspots directly exposed to the internal short's arc plasma didn't just get to the melting point of such steel (~1,482 degrees C) --- instead these local areas got all the way up to the explosive boiling point of stainless (> 3,000 degrees Centigrade), were turned into a gaseous vapor (expanding in volume by >50,000 x in the process of vaporizing); solid steel then recondensed from hot metallic vapor in the form of perfect nanoscale steel spheres as portions of the super-hot metallic Fe-alloy vapor quench-cooled. Damage observed to materials inside Logan GS Yuasa battery enclosure was consistent with primary destructive processes being venting and *partial* combustion of flammable electrolyte liquids; measured weight loss of ~6 lbs. vs. exemplar battery is consistent with this hypothesis. There is no large-scale, definitive evidence for widespread occurrence of thermite-like pyrotechnic reactions.
82SS	"Electric arc discharges inside batteries are hot and energetic" May 15, 2013 by Larsen at http://www.slideshare.net/lewisglarsen/lattice-energy-llc-electric-arcs-or-internal-shorts-inside-batteries-are-hot-and-energeticmay-15-2013 [1 slide + URL hyperlink to 76SS listed above]	Electric arcs or internal shorts that can potentially occur inside Lithium-based batteries are extremely hot and very energetic – inner cores of arc plasmas can reach peak temperatures as high as 35,000 degrees F or ~19,427 C. Such arcs can be triggered by massive separator failures and are very damaging --- physical effects can extend well beyond the battery cells in which they begin and may be instrumental in causing some worst-case catastrophic thermal runaway events. Some of these energetic collateral effects of internal shorts are called "arc flashes" and "arc blasts."

Lattice Energy LLC

Appendix 2 - Lattice's SlideShare presentations

Document ID	Title, author, public release venue, and date	Subject matter and comments
83SS	Lewis Larsen personal curriculum vitae as of June 1, 2013 http://www.slideshare.net/lewisglarsen/lewis-g-larsen-cv-june-2013 [2-pages]	Lewis G. Larsen, c.v.
84SS	"Russian experiments further confirm Widom-Larsen New results are fully explained and predicted by our theory Used laser irradiation of metallic targets in D_2O to produce detectable Tritium" Technical Discussion June 13, 2013 by Larsen at http://www.slideshare.net/lewisglarsen/lattice-energy-llc-new-russian-experiments-further-confirm-widomlarsen-theory-of-lenrsjune-13-2013 [66 slides]	In series of different experiments with laser irradiation (sometimes combined with electrolysis) of hydride-forming metallic targets of Au, Ti, Pd, and Se, immersed in D_2O (isotopically heavy water), Barmina *et al.* claim to have observed both production and so-called "accelerated decay" of Tritium. If correct, their claimed detection of significant amounts of radioactive Tritium production is an extremely interesting experimental result because over the past 24 years, out of the hundreds of thousands of LENR experiments conducted, literally only a handful have ever claimed to observe Tritium as a measurable nuclear product. While it needs to be independently replicated, this data does appears that it may well be correct.
85SS	Notice of revised version of "Powering the World …" http://www.slideshare.net/lewisglarsen/lattice-energy-notice-of-revised-version-of-len-rs-powering-world-to-green-futurejune-22-2013 [1 slide]	Alerts readers to revisions in previously posted document
86SS	Copy of Larsen memo published privately back in 2011, "S&P/Gold and Dow/Gold ratios look way out of whack; IMO prospect of substantially accelerating inflation isn't causing this relative pricing anomaly" August 10, 2011 [13 pages] https://www.slideshare.net/secret/1ZKIb7TOg6XkXH	Not publicly visible; go to URL provided to left and then enter password (all lower case): paradigmshift1 Note that download is disabled on this document. This document was password-protected to insure that key background was read prior to trying to peruse this tersely worded memo about gold vs. stock prices

Lattice Energy LLC

Appendix 2 - Lattice's SlideShare presentations

Document ID	Title, author, public release venue, and date	Subject matter and comments
87SS	"History, macroeconomics, LENRs, and real price of Gold" July 4, 2013 by Larsen at: http://www.slideshare.net/lewisglarsen/lattice-energy-llc-historymacroeconomicslenrsand-real-price-of-goldjuly-4-2013 [60 slides]	Examine recent events and large price movements in world gold market, especially concerning likely nadir in the DJIA/Gold ratio; review long term trends in real DJIA and S&P 500 indices. Conclusion: the real price of gold is very likely to substantially under-perform the real price appreciation in equities markets during most of the next 5 - 15 years and perhaps even longer.
88SS	"LENRs vs. nuclear fission and natural gas for power generation" July 22, 2013 by Larsen at [56 slides]: http://www.slideshare.net/lewisglarsen/lattice-energy-llc-lenrs-vs-nuclear-fission-and-natural-gas-for-power-generationjuly-22-2013	Future grid-scale LENR-based power generation plants could potentially be ~54 - 74% less costly than natural gas. **Number of large Japanese companies now involved in LENR R&D --- Mitsubishi Heavy Industries, Toyota Central Research, and Toyota Motors, among others --- somebody, somewhere will eventually succeed**
89SS	"Widom-Larsen theory explains experimental data presented in new Mitsubishi U.S. patent application" July 28, 2013 by Larsen at: http://www.slideshare.net/lewisglarsen/lattice-energy-llcwidomlarsen-theory-explains-data-presented-in-new-mitsubishi-us-patent-applicationjuly-28-2013 [51 slides]	Conclusions: the Widom-Larsen theory of LENRs can successfully explain the various experimental data that was presented and discussed in the recently published, LENR-related US patent application filed June 8, 2012, by Mitsubishi Heavy Industries, Ltd. (Japan), US 2012/0269309 A2.
90SS	"Containing [battery] thermal runaways: a fool's paradise?" August 6, 2013 by Larsen at: http://www.slideshare.net/lewisglarsen/lattice-energy-llc-containment-of-lithiumbased-battery-firesa-fools-paradiseaug-6-2013 [93 slides]	Focus ion thermal runaways in primary and secondary lithium-based batteries; includes: Peak temperatures reached during thermal runaways; scaling-up electrical storage capacities can cause increases in safety-related risks; causes of thermal runaways, including electric arcs (internal shorts) and LENRs; examples of runaways involving portable devices/mobile platforms; Boeing 787 Dreamliner's battery containment system falls short of mark on its likely ability to safely handle the effects of battery thermal runaway events that are significantly worse than what occurred during the JAL and ANA incidents

Lattice Energy LLC

Appendix 2 - Lattice's SlideShare presentations

Document ID	Title, author, public release venue, and date	Subject matter and comments
91SS	"Minuscule cumulative investment in LENRs vs. nuclear weapons technology" August 12, 2013 by Larsen at: http://www.slideshare.net/lewisglarsen/lattice-energy-llc-minuscule-cumulative-investment-in-lenrs-vs-nuclear-weapons-technologyaug-12-2013 [34 slides]	R&D investment in LENRs to-date is minuscule compared to >US$8 trillion spent on U.S. nuclear weapons programs since 1942 Factoid: Fareed Zakaria, CNN – journalist and host of GPS show that aired on August 11, 2013, he stated that, "Between 1945 and the 1990s, we produced more than 70,000 total warheads and spent at least $8 trillion in present-day terms on nuclear weapons development."
92SS	"$LiFePO_4$ immune to runaways: another fool's paradise?" August 21, 2013 by Larsen at: http://www.slideshare.net/lewisglarsen/lattice-energy-llclithium-iron-phosphate-batteries-are-not-immune-to-thermal-runawaysaug-21-2013 [35 slides]	Thermal runaways and field-failures can occur in ALL lithium battery chemistries. In recent years, a myth has been propagated by certain industry participants and battery scientists that the lithium iron phosphate chemistry is effectively immune to catastrophic thermal runaway events. When one examines the available facts, it is obvious that this myth or widely-held belief is simply not true --- it is a fool's paradise. Importantly, well-documented thermal runaways have been reported involving $LiFePO_4$ battery cells and multi-cell arrays
93SS	"Large increases in battery energy densities drive convergence between energetic materials, LENRs and batteries" September 6, 2013 by Larsen at: http://www.slideshare.net/lewisglarsen/lattice-energy-llc-increased-energy-densities-drive-convergence-of-batteries-and-lenrssept-6-2013 [108 slides]	Large increases in battery energy densities drive convergence between energetic materials, LENRs and batteries. Today LENRs create problems in high-energy-density advanced batteries; battery manufacturers can potentially turn today's LENR issues into tomorrow's opportunities. Importantly, Japanese companies understand the convergence: Mitsubishi Heavy industries, Toyota Central Research, Toyota Motor Corp., and other unnamed large Japanese companies all now have LENR R&D programs; Lattice believes their ultimate goal is to eventually be able to replace the internal combustion engine using CO_2-free LENRs

Lattice Energy LLC

Appendix 2 - Lattice's SlideShare presentations

Document ID	Title, author, public release venue, and date	Subject matter and comments
94SS	"Electronic cigarette explodes - burns child sitting in car seat -LENRs in Batteries" September 25, 2013 by Larsen at: http://www.slideshare.net/lewisglarsen/lattice-energy-llc-electronic-cigarette-explodes-burns-child-sitting-in-car-seatlenrs-in-batteriessep-25-2013 [58 slides]	Battery field-failures occur in electronic cigarettes; reported frequency of such events per year roughly agrees with what large Japanese company's Lithium-based battery data would predict. Now seeing increasing numbers of statistically rare but serious incidents occurring with electronic cigarettes in which their Lithium-based batteries have had thermal runaways and even explosions; some have caused human injuries. Incidents occurred inside buildings and in motor vehicles. Unknown % of such events may have been caused by LENRs. In July 2010, Lattice began to issue public warnings about thermal runaway risks with large, scaled-up Lithium-based battery packs; on Slide #54 in an August 6, 2013 Lattice presentation subtitled "A Fool's Paradise" we questioned whether Tesla's engineering had solved problematic runaway issues, or whether they had just been lucky - so far. October 1, 2013 fire incident (really a form of battery runaway) with Tesla Model S that occurred near Seattle, WA suggests that they had merely been lucky to date --- battery thermal runaway issues have not yet been truly solved by Tesla Motors or anyone else.
95SS	"On Oct 1 Tesla Model S caught fire on highway - has company's luck run out" October 3, 2013 by Larsen at: http://www.slideshare.net/lewisglarsen/lattice-energy-llcon-oct-1-tesla-model-s-caught-fire-on-highwayhas-companys-luck-run-outoct-3-2013 [23 slides]	
96SS	"Forbes - Hannah Elliott interviews Tesla spokesman - no answer to debris question" October 3, 2013 by Larsen at: http://www.slideshare.net/lewisglarsen/lattice-energy-llc-forbeshannah-elliott-interviews-tesla-spokesmanno-answer-to-debris-questionoct-3-2013 [8 slides]	Non-answer to Hannah Elliott's key question about the precise nature of the so-called "large metallic object" that was supposedly struck by the car at highway speeds; Tesla claims that this purported object on the road was the proximate triggering cause for the ensuing thermal runaway conflagration that destroyed the front portion of the vehicle.

Lattice Energy LLC

Appendix 2 - Lattice's SlideShare presentations

Document ID	Title, author, public release venue, and date	Subject matter and comments
97SS	" Technical discussion - October 1 Tesla Motors Model S battery thermal runaway" October 16, 2013 by Larsen at: http://www.slideshare.net/lewisglarsen/lattice-energy-llc-technical-discussionoct-1-tesla-motors-model-s-battery-thermal-runawayoctober-16-2013 [82 slides]	To explain why its much-heralded battery safety systems were unable to prevent the occurrence of a potentially dangerous battery thermal runaway and fire that disabled and destroyed key parts of a full-sized vehicle within a span of several minutes, Tesla proposed a theory for the event. It explains the runaway as having been caused by the car's driver accidentally running over piece of road debris - "large metallic object" - that had been lying on the highway surface. In Tesla's theory, this hypothetical metal object somehow rotated upwards, slammed into the car's armored underbody with 25 tons of force, and then pierced a module in the car's battery pack, which triggered a thermal runaway and fire. Lattice's alternative theory for the October 1 model S runaway incident posits that: field-failure internal electrical short (whatever its proximate cause might truly be) occurred in a single 18650 cell that was located somewhere in first front module of vehicle's battery pack. This field-failure-triggered event caused catastrophic overheating of the affected cell, creating huge local temperature increase within a few seconds that eventually wreaked havoc within the immediate module.
98SS	"XXXX admits thermite reactions possible in Li-ion battery runaways" October 20, 2013 by Larsen at: http://www.slideshare.net/lewisglarsen/lattice-energy-llc-xxxx-admits-thermite-reactions-possible-in-liion-battery-runawaysoct-20-2013 [1 slide]	While the content of this document was verified and 100% factually correct, the original document was removed at the request of a third party's US law firm

Lattice Energy LLC

Appendix 2 - Lattice's SlideShare presentations

Document ID	Title, author, public release venue, and date	Subject matter and comments
99SS	"Toyota confirms Mitsubishi transmutation of stable Cesium to Praseodymium" October 31, 2013 by Larsen at: http://www.slideshare.net/lewisglarsen/lattice-energy-llc-toyota-confirms-mitsubishi-transmutation-of-cs-to-proct-31-2013 [100 slides]	In Oct. 2013, Toyota published a paper in the peer-reviewed *Japanese Journal of Applied Physics* which confirmed important experimental results that Mitsubishi Heavy Industries had first published in 2002. MHI had claimed transmutation of Cesium into Praseodymium via the forced diffusion of Deuterium gas through a thin-film heterostructure containing elemental Palladium using a permeation method pioneered by Mitsubishi; it is capable of triggering nuclear reactions in condensed matter systems under modest temperatures and pressures. Importantly, all of this published experimental data is both predicted and fully explained by the peer-reviewed Widom-Larsen theory of LENRs.
100SS	"Why has Tesla Model S had more thermal runaways than Nissan Leaf" November 20, 2013 by Larsen at: http://www.slideshare.net/lewisglarsen/lattice-energy-llcwhy-has-tesla-model-s-had-more-thermal-runaways-than-nissan-leafnov-20-2013 [13 slides]	Many have wondered why the Tesla Model S has experienced three catastrophic battery thermal runaway fires to date whereas the Nissan Leaf has apparently not experienced any such runaway incidents, at least so far. Answer to this question can potentially be found with simple calculations that utilize manufacturers' estimated frequencies of battery field-failure events. By employing a limited number of key simplifying basic assumptions and manufacturers' statistical data on estimated rates of field-failures, we can predict that the Nissan Leaf would be likely to experience a substantially lower frequency of major thermal runaway fire events compared to the Tesla Model S, which is exactly what has been observed so far to date. Predicted number of observed macro-scale thermal runaway events appears to be accurate to within roughly one order of magnitude, i.e., a factor of ~10.

Lattice Energy LLC

Appendix 2 - Lattice's SlideShare presentations

Document ID	Title, author, public release venue, and date	Subject matter and comments
101SS	"LENRs and the future of energy" November 27, 2013 by Larsen at: http://www.slideshare.net/lewisglarsen/lattice-energy-llc-lenrs-and-the-future-of-energy-nov-27-2013 [36 slides]	LENRs represent new type of paradigm-shifting nuclear technology. Differ greatly from present-day fission and fusion power generation technologies; LENRs are potentially much safer from environmental and biosafety perspectives. Embody a truly 'green' type of nuclear process: neither deadly hard neutron or gamma radiation emissions nor any measurable production of dangerous, long-lived radioactive wastes. Phenomena were hidden in plain sight for 100 years because hard radiation signatures and radioactive wastes are absent from LENR processes. With the benefit of today's knowledge, examination of a large body of available published, peer-reviewed experimental literature shows that reliable reports of LENR effects, e.g. transmutation, date all the way back to the early 1900s. Lack of hard radiation emissions and long-lived radioactive wastes obviates need for shielding and containment subsystems; eliminates enormous amounts of weight and could reduce costs dramatically. Phenomena resisted understanding until Widom-Larsen theory integrated all the necessary conceptual pieces together into one coherent whole; W-L successfully explains all of the relevant experimental data. LENR device physics are now sufficiently well-understood to begin device engineering that is crucial for advancing commercialization process.
102SS	"LENR transmutation as source of scarce elements" December 13, 2013 by Larsen at: http://www.slideshare.net/lewisglarsen/lattice-energy-llc-lenr-transmutation-as-source-of-key-scarce-elements-dec-13-2013 [75 slides]	New studies warn that future shortages may occur in key scarce elements used in high-tech devices/processes; could LENR transmutations someday provide yet another source to help fill gaps in supplies? Recent studies, especially those by Graedel *et al.* (Yale University, Center for Industrial Ecology - 2013, 2012), warn that costly and disruptive supply shortages could potentially occur in the near-term future for an array of key elements

Lattice Energy LLC

Appendix 2 - Lattice's SlideShare presentations

Document ID	Title, author, public release venue, and date	Subject matter and comments
103SS	"World famous Japanese physicist Prof. Hantaro Nagaoka transmuted Tungsten into Gold in 1924 – why did he stop this work before 1930?" December 27, 2013 by Larsen at: http://www.slideshare.net/lewisglarsen/lattice-energy-llc-mystery-of-nagaokas-1920s-gold-experiments-why-did-work-stop-by-1930-dec-27-2013 [40 portrait-mode slides]	Between September 1924 and June 1925, Nagaoka and his co-workers at RIKEN in Japan conducted some 200 experiments with high-current electric arc discharges between Tungsten electrodes immersed in liquid hydrocarbon transformer oil in which they detected successful transmutation of Tungsten into macroscopic, visible flecks of Gold and Platinum. In June 1925, Nagaoka went a world tour in which he spoke to scientific and lay audiences about their transmutation experiments in Japan and handed-out samples comprising small pieces of porcelain reactor vessels with tiny bits of adhering Gold that had been created therein. In July 1925, *Nature* published his Letter to the Editors in which he reported on their results and encouraged other scientists to try to repeat their provocative experiments. Amazingly, as far as we can tell no one ever tried to repeat Nagaoka et al.'s landmark experiments. Even more incredibly, the entire area of inquiry involving electric discharge-triggered transmutations of elements essentially died-out worldwide by 1930 (Chadwick discovered the neutron in 1932 and transmutation via neutron-capture was first elucidated by Taylor in 1935). In this document, we explore some of the possible underlying reasons that may have caused this totally unexpected historical twist.
104SS	"NASA Project Document: Are Investigating LENRs for Powering Future Aircraft" January 20, 2014 by Larsen at: http://www.slideshare.net/lewisglarsen/lattice-energy-llc-nasa-project-documentare-investigating-lenrs-for-powering-future-aircraftjan-20-2014 [3 slides]	NASA document reveals they are studying possible use of LENRs to power future advanced 'green' subsonic aircraft

Lattice Energy LLC

Appendix 2 - Lattice's SlideShare presentations

Document ID	Title, author, public release venue, and date	Subject matter and comments
105SS	"Revolutionary green LENRs could potentially power future versions of advanced subsonic aircraft and UAVs --- What happens to aircraft, vehicles, and homes if LENRs achieve >10x chemical?" February 16, 2014 by Larsen at: http://www.slideshare.net/lewisglarsen/lattice-energy-llc-revolutionary-lenrs-could-power-future-aircraft-and-other-systems-feb-16-2014 [95 slides]	Technologists at NASA, Boeing, and California Polytechnic have been investigating alluring possibility of using 'green' low energy nuclear reactions (LENRs) to power future aircraft. Also, large Japanese companies such as Mitsubishi Heavy Industries and Toyota, among others, have active R&D programs and patent filings in LENRs and are publishing some of their experimental results in peer-reviewed science and engineering journals. It appears likely that the Japanese companies' ultimate goal is to replace the internal combustion engine. Clean low energy neutron reactions (CLENRs) transmute Carbon atoms into other stable elements without emitting deadly radiation or creating radwastes. Could provide new bridge to the future for the global oil and coal industries. On an energy-equivalent BTU basis, PAHs and related aromatics might easily be worth a million times more $$$ as CLENR fuels, as opposed to their being used to produce chemical feedstocks or to undergo cracking of the aromatic rings to create types of hydrocarbon chains suitable for vehicles, or in case of coal, simply burning pulverized coal with Oxygen to create process heat, H2O, as well as gases and dirty particulates. If CLENRs' technological potentialities were realized, global oil and coal industries' even more profitable bridge to the future could include their traditional extraction and processing of hydrocarbons and coal for use in today's fossil fuels and chemical feedstocks, as well as a new business: producing revolutionary CLENR fuels.
106SS	"Converting aromatic fractions of heavy oils and coal into CLENR fuels: no CO_2 and 5 million x more thermal energy" April 8, 2014 by Larsen at: http://www.slideshare.net/lewisglarsen/lattice-energy-llc-converting-oil-and-coal-into-more-energetic-green-co2free-clenr-fuels-april-8-2014 [32 slides]	

Lattice Energy LLC

Appendix 2 - Lattice's SlideShare presentations

Document ID	Title, author, public release venue, and date	Subject matter and comments
107SS	"Spreading LENR revolution: connecting the unconnected and empowering the powerless; delivering rural electrification and Internet to 1.4 billion energy-poor people around the world" May 12, 2014 by Larsen at: http://www.slideshare.net/lewisglarsen/lattice-energy-llc-connecting-the-unconnected-and-empowering-the-powerless-may-12-2014 [92 slides]	Opportunity to develop low-cost, LENR-powered base stations to serve as modular local infrastructure backbones that can provide adequate amounts of combined electrical power and heat (CHP) for people and Internet-capable communications systems that can be delivered to sites in form of field-upgradeable packages of integrated components that then can be deployed in remote rural areas not presently being served by any wide-area electrical grids.
108SS	"In a surprising move both IBM and JCESR apparently slowed R&D to develop Lithium-air batteries" June 3, 2014 by Larsen at: http://www.slideshare.net/lewisglarsen/lattice-energy-llc-ibm-and-jcesr-tap-the-brakes-on-lithiumair-battery-research-june-3-2014 [16 slides]	In a development that was surprising to many battery industry players, it became apparent by May that IBM and the Joint Center for Energy Storage Research (JCESR) had both tapped the brakes on further development of Lithium-air batteries. Perhaps some parties do not regard Li-air as a panacea anymore
109SS	"Revolutionary radiation-free nuclear propulsion for advanced hypersonic aircraft - Lattice's new concept for a LENR dusty plasma scramjet engine" June 13, 2014 by Larsen at: http://www.slideshare.net/lewisglarsen/lattice-energy-llc-radiationfree-nuclear-propulsion-for-advanced-hypersonic-aircraft-june-13-2014 [98 slides]	Document outlines our speculative concepts about propulsion of hypersonic aircraft by the controlled triggering LENRs on nanoparticles in dusty plasmas. Could utilize optimized combinations of LENR nuclear and very energetic chemical reactions simultaneously inside very same reaction chamber. Engine thrust control is achieved by tightly regulating amounts of DC input current into dusty plasma and dynamic injection rates of LENR target fuels. Incredibly high energy densities and low weight of LENR nanoparticulate target fuels might allow an LENR dusty plasma scramjet the flexibility of carrying multiple fuel types optimized for very different flight envelopes from ground-level to low-earth orbit.

Lattice Energy LLC

Appendix 2 - Lattice's SlideShare presentations

Document ID	Title, author, public release venue, and date	Subject matter and comments
110SS	"Game-changing low energy neutron reactions - LENRs - What are they and the amazing things they could enable" August 6, 2014 by Larsen at: http://www.slideshare.net/lewisglarsen/lattice-energy-llcgame-changing-lenrs-what-are-they-and-amazing-things-they-could-enable-aug-6-2014 [42 slides]	Lacking production of deadly radiation or hazardous long-lived radioactive wastes, LENR power systems would not require any expensive and massive shielding, containment, or waste clean-up. Coupled with intrinsic multiway scalability, these unique attributes could enable development of highly competitive commercial products with outputs ranging from milliwatts to megawatts suitable for portable, stationary, vehicular, and aerospace power markets. End-user price per BTU or kWh for LENR-based power systems could be substantially lower than prices for competing batteries or fuel cells, combustion, and present fission and fusion technologies.
111SS	"Masterful riposte by Widom-Larsen theory coauthors (Widom & Srivastava) and Swain Invalidates the erroneous criticisms of Maiani *et al.* and reaffirms correctness of our 2006 *EPJC* estimates for neutron production rates" "Electron capture in a fully ionized plasma" A. Widom, J. Swain, and Y.N. Srivastava arXiv:1409.5344v1 [hep-ph] September 17, 2014 http://arxiv.org/pdf/1409.5344v1.pdf September 17, 2014 by Larsen at: http://www.slideshare.net/lewisglarsen/electron-capture-in-a-fully-ionized-plasma-sept-17-2014-39429338 [1-page MS-Word format]	Excerpt from Abstract: " We have applied this theory to electron capture in a water plasma to explain observed nuclear transmutations on the cathode surface of a chemical cell. The theoretical kinetic model gives rise to electron capture rates per unit time per unit cathode surface area in a water plasma in agreement with the quantum field theoretical model and is in agreement with experiments … The Maiani computation fails theoretically because (i) The Debye screening length is applied in regimes wherein it is clearly invalid and (ii) the WKB approximation is applied in the long De Broglie wave length regime but in reality the WKB approximation is valid only in the short De Broglie wave length regime. One of our purposes is to correct the errors made by Maiani. When the properly rigorous mathematics is applied we recover our previous and correct results."

Lattice Energy LLC

Appendix 2 - Lattice's SlideShare presentations

Document ID	Title, author, public release venue, and date	Subject matter and comments
112SS	"LENR transmutation of Carbon vs. combustion with Oxygen - Is this an extinction event for fossil fuels or a new pathway to the future for oil companies?" October 6, 2014 by Larsen at: http://www.slideshare.net/lewisglarsen/lattice-energy-llc-transmutation-vs-combustion-are-lenrs-chicxulub-for-fossil-fuel-dinosaurs-oct-6-2014 [49 slides]	By the world very gradually switching power generation technologies from presently dominant chemical combustion processes to instead using transmutation of LENR Carbon-based fuels derived directly from petroleum and coal, oil companies have an opportunity to dramatically extend the effective longevity of today's remaining in-ground supplies of fossil fuels. Achieving this goal could postpone mankind's day of reckoning on energy for thousands of years, enable high rates of sustainable global economic growth, and allow future consumers to enjoy abundant supplies of nonpolluting, CO_2-free energy.
113SS	"Green low energy neutron reactions (LENRs) could enable a Moore's Law for energy" November 19, 2014 by Larsen at: http://www.slideshare.net/lewisglarsen/lattice-energy-llc-lenrs-could-enable-a-moores-law-for-energy-nov-19-2014 [95 slides]	Underneath all of today's ferment, world economic activity is still gradually crawling out of the aftermath of the Great Recession in fits and starts with GDP now decelerating in China and Europe; U.S. economy finally starting to reaccelerate smoothly - that has sent USA's stock market indices to new all-time highs. Persistent long-term energy usage trends suggest to Lattice that it's not just about renewables vs. fossil fuels; in ensuing years the world will need ALL of the energy that can possibly be gotten from all available sources; the key trick is to be able to slash global CO_2 emissions in parallel. By transforming oil and coal into 'green' CO_2-free LENR fuels, commercialization of LENRs offers an opportunity to cut the Gordian Knot of sustainable economic growth.

Lattice Energy LLC

Appendix 2 - Lattice's SlideShare presentations

Document ID	Title, author, public release venue, and date	Subject matter and comments
114SS	"Positive holes and low energy neutron reactions (LENRs): energy transfer within Earth's crust, terrestrial nucleosynthesis, and energy supply for bacterial colonies in the Deep Biosphere" Invited technical talk for IGRS meeting held at NASA-Ames, Mountain View, CA December 10, 2014 by Larsen at: http://www.slideshare.net/lewisglarsen/lewis-larsen-igrs-presentation-nasaames-dec-10-2014 [36 slides]	Freund p-holes provide a new electronic mechanism for transferring and dissipating energy in Earth's upper crust besides well-accepted mechano-acoustic seismic P- and S-wave processes --- this entails a paradigm shift in geophysical thinking. Electric fields associated with dissipation of p-holes in micron-scale regions at interfaces where appropriate metals and hydrogenous moieties are present can provide enough electrical input energy to drive abiotic LENRs via the Widom-Larsen mechanism. P-holes may also provide a new and previously unappreciated mechanism for explaining otherwise inexplicable induced seismicity associated with fracking.
115SS	"Implications of LENRs and mobile + charge carriers in Earth's crust for seismicity, terrestrial nucleosynthesis, and the Deep Biosphere: paradigm shifts in geophysics, geochemistry, and biology" December, 22 2014 by Larsen at: http://www.slideshare.net/lewisglarsen/lattice-energy-llc-lenrs-pholes-crustal-nucleosynthesis-seismicity-and-deep-biosphere-dec-22-2014 [102 slides]	Freund *p*-holes provide a new electronic mechanism for transferring and dissipating energy in the upper crust besides well-known mechano-acoustic seismic P- and S-wave processes - this is a conceptual paradigm shift in geophysical thinking. Quasiparticle *p*-holes can also power remarkable, recently discovered "electric bacteria" living in the Earth's soils, sediments, and crust that could potentially be engaging in LENR neutron-catalyzed nucleosynthesis (transmutation of elements). Abiotic and biological LENR processes produce measurable products that are created at highly variable rates over periods of time ranging from just hours up to millions of years – a paradigm shift in geochemistry. Moreover, there is a significant body of published, peer-reviewed experimental evidence that strongly supports these conjectures and further suggests that *p*-holes and LENRs may well help facilitate earthquakes and other seismic phenomena

Lattice Energy LLC

Appendix 2 - Lattice's SlideShare presentations

Document ID	Title, author, public release venue, and date	Subject matter and comments
116SS	"Compelling economics of transmutation vs. combustion of Carbonaceous energy sources" January 14, 2015 by Larsen at: http://www.slideshare.net/lewisglarsen/lattice-energy-llc-compelling-economics-of-transmutation-vs-combustion-of-carbonaceous-energy-sources-jan-14-2015 [44 slides]	LENRs increase economic/BTU value of fossil Carbon by at least 500x Achieved without emitting CO_2 while releasing vastly greater thermal energy. Can potentially transform oil and coal into 'green' CO_2-free LENR fuels that have >5,000x the energy density (Watt*hours/kg) of gasoline. In LENR fuels derived from extraction and processing of aromatic fractions found in oil and coal, generation of usable heat (i.e. BTUs) occurs via clean radiation-free, neutron-catalyzed transmutation of Carbon into Nitrogen and Oxygen rather than chemical combustion with Oxygen. Application of LENR technology can potentially increase BTUs and economic $$$ values of natural fossil Carbonaceous energy sources by at least 500x. Commercialization of LENRs on aromatic molecules would extend useful economic lifetime of fossil Carbon resources out to at least 25,000 years; eliminate "Carbon Bubble" and "stranded assets" problems.
117SS	"Surprising similarities between LENR active sites and enzymatic catalysis" March 20, 2015 by Larsen at: http://www.slideshare.net/lewisglarsen/lattice-energy-llc-surprising-similarities-between-lenr-active-sites-and-enzymatic-catalysis-march-20-2015 [101 slides]	Nuclear and chemical catalysis are deeply connected: radiation-free LENR electroweak nuclear catalysis and enzymatic chemical catalysis are not as distant from each other as one might naively assume; they can sometimes even interoperate on nanometer length-scales. Fried *et al.*'s stunning experimental results revealed that complex Carbon-based isomerase enzyme protein employs very high local electric fields and quantum entanglement of particles in active sites to achieve enormous increases in chemical reaction rates. Abiotic LENR many-body active sites comprising Q-M entangled protons and electrons achieve even larger catalytic increases in rates of neutron-producing electroweak reactions using exactly same effects. Deep knowledge about LENR electroweak catalysis provide insights into operation of both enzymatic and abiotic chemical catalysis; opportunity to use new types of insights to help greatly increase performance and reduce costs for a broad range of important industrial catalysts.

Lattice Energy LLC

Appendix 2 - Lattice's SlideShare presentations

Document ID	Title, author, public release venue, and date	Subject matter and comments
118SS	"Beyond the Haber-Bosch process for ammonia production: Fixing Nitrogen at near-ambient temperatures and pressures" April 30, 2015 by Larsen at: http://www.slideshare.net/lewisglarsen/lattice-energy-llc-beyond-the-haberbosch-process-for-ammonia-production-april-30-2015 [45 slides]	Opportunity to develop competitive small-scale production of low cost ammonia. High-temp, high-pressure Haber-Bosch process has dominated the commercial production of anhydrous ammonia for >100 years; its cost closely tied to economics of available supplies of input natural gas that are slowly dwindling. Haber-Bosch arguably the most important industrial chemical process on Earth; 40% of world's people are alive today thanks to low cost and wide availability of ammonia-based fertilizers; production facilities typically large. Recent advances in materials science, nanotechnology, chemistry, enzymology, and many-body collective condensed matter physics created opportunity to develop commercial Nitrogen fixation processes that operate at near-ambient temperatures and pressures and utilize natural gas, or alternatively water, as source of Hydrogen to react with gaseous Nitrogen.
119SS	"In 1989 some scientists knew neutrons were behind LENRs; experimental data from national labs clearly showed neutron captures" May 13, 2015 by Larsen at: http://www.slideshare.net/lewisglarsen/lattice-energy-llc-us-government-labs-reported-clearcut-neutron-capture-data-from-pf-cells-in-oct-1989-may-13-2015 [54 slides]	Data indicating neutron capture processes in LENRs were totally ignored by U.S. government and most scientists because it violated paradigms and existing theory couldn't explain it. Pons & Fleischmann's nuclear paradigm challenge created furor; participants in intense debate fixated on D+D fusion. Physicists at 1989 meeting in Erice, Italy agreed with theoretical calculations by Koonin & Nauenberg which concluded that increasing electron masses by factors of 5 - 10 could increase D+D fusion rates enough to explain observed heat production; however, "... we know of no plausible mechanism for achieving such enhancements." Rolison *et al.* of the Naval Research Laboratory reported dramatic relative enrichment of Pd-106 and substantial parallel depletion of Pd-105 isotope in experiments. All this data is very well-explained by neutron captures on Palladium but Rolison *et al.* reluctant to suggest it. Explanation finally provided by Widom & Larsen in 2005.

Lattice Energy LLC

Appendix 2 - Lattice's SlideShare presentations

Document ID	Title, author, public release venue, and date	Subject matter and comments
120SS	"Greater awareness of risks of Lithium-ion battery fires and explosions: U.S. FAA recently made excellent presentation at industry meeting in Europe" July 23, 2015 by Larsen at: http://www.slideshare.net/lewisglarsen/lattice-energy-llcgreater-awareness-of-risks-of-lithiumion-battery-fires-and-explosionsjuly-23-2015 [2 slides]	U.S. FAA recently made an excellent presentation at meeting in Europe; Boeing also recently warned airlines re risks with Li-ion batteries shipped in cargo. Exactly 5 years ago, Lattice begin to publicize risks with Li-ion batteries carried inside commercial aircraft because LENRs can potentially trigger catastrophic field-failures; back then, some labeled us as "fear mongers."
121SS	"Two facets of W-L theory's LENR-active sites supported by Daskalakis *et al.*'s experimental data just published in *Physical Review Letters*" July 23, 2015 by Larsen at: http://www.slideshare.net/lewisglarsen/lattice-energy-llc-two-facets-of-wl-theorys-lenractive-sites-supported-by-paper-in-phys-rev-lettjuly-23-2015 [31 slides]	According to Widom-Larsen, many-body collective quantum and electromagnetic effects are enabling to operation of electroweak nuclear catalysis at ambient temperatures; quantum entanglement amongst protons and plasmons at LENR sites is inferred; 1 ps lifetime of plasmon condensate is ample time for LENRs. In 2006 *EPJC* paper (Widom & Larsen) first estimated size of many-body coherence domains in LENR sites on metallic hydride surfaces as ~1 - 10 μ. As discussed in this document, in 2009 Larsen extended Widom-Larsen theory to cover occurrence of LENRs on organic aromatic molecules; at that time, maximum size of W-L coherence domains re-estimated and increased up to ~ 100 μ. W-L active site functions like a microcavity; seems reasonable to speculate that the surface plasmons in LENR-active sites form condensates similar to what Daskalakis *et a*l. have observed and reported.
122SS	"LENR transmutation of Carbon better energy strategy than Obama clean power plan - Slashes CO_2 emissions for vehicles as well as electric power generation" August 3, 2015 by Larsen at: http://www.slideshare.net/lewisglarsen/lattice-energy-llc-lenr-transmutation-of-carbon-better-energy-strategy-than-obama-clean-power-plan-aug-3-2015 [32 slides]	Lattice's strategy for replacing today's combustion with LENR transmutation of Carbon saves the global fossil fuel industry yet is highly synergistic with renewables, enables sustainable economic growth, and helps to ameliorate climate change.

Lattice Energy LLC

Appendix 2 - Lattice's SlideShare presentations

Document ID	Title, author, public release venue, and date	Subject matter and comments
123SS	"Japanese government resumes funding LENR research after a 20-year hiatus" August 25, 2015 by Larsen at: http://www.slideshare.net/lewisglarsen/lattice-energy-llc-japanese-government-resumes-funding-lenr-research-after-20-year-hiatus-august-25-2015 [20 slides]	*New Energy Times* has reported that Japan's government has resumed funding R&D in LENRs after a 20-year hiatus. In July, the New Energy and Industrial Technology Development Association (NEDO) issued a public request for proposals (RFP) that included LENRs as being eligible for funding. Key details of the NEDO RFP reveal an important strategic shift in program R&D goals. Research to be funded instead emphasizes generation of excess heat as implied in description of the program goal (quoting from English translation of key description found in the RFP): "… technology of heat reactions between metals and hydrogen." This particular language in the RFP signals a shift from pursuit of basic science to engineering-oriented programs that aim to develop revolutionary new power generation technologies.
124SS	TBD	TBD

Lattice Energy LLC

Appendix 2 - Lattice's SlideShare presentations

Document ID	Title, author, public release venue, and date	Subject matter and comments
125SS	TBD	TBD
126SS	TBD	TBD

Lattice Energy LLC

Appendix 3 - Plain English general articles

Document ID	Title, author, public release venue, and date	Subject matter and comments
1PS	"Low energy nuclear reactions for green energy – how weak interactions can provide sustainable nuclear energy and revolutionize the energy industry," *Institute of Science in Society* London, UK, Larsen (November 13, 2008) at http://www.i-sis.org.uk/LENRGE.php	Overview of weak interaction LENRs vs. fission, fusion and "cold fusion," and what it might mean for world energy markets
2PS	"Widom-Larsen theory explains low energy nuclear reactions & why they are safe and green – all down to collective effects and weak interactions," *Institute of Science in Society* London, UK, Larsen (December 4, 2008) at http://www.i-sis.org.uk/Widom-Larsen.php	Layman's explanation of the physics in Widom-Larsen theory of LENRs; comparisons with various chemical energy sources
3PS	"Portable and distributed power generation from LENRs – power output of LENR-based systems could be scaled up to address many different commercial applications," *Institute of Science in Society*, London, UK, Larsen (December 10, 2008) at http://www.i-sis.org.uk/PortableDistributedPowerFromLENRs.php	Explains how future LENR heat sources might be scaled-up from small portable systems up to much larger power outputs
4PS	"LENRs for nuclear waste disposal – how weak interactions can transform radioactive isotopes into more benign elements," *Institute of Science in Society* London, UK, Larsen (December 11, 2008) at http://www.i-sis.org.uk/LENR_Nuclear_Waste_Disposal.php	Explains how LENRs might be used to transmute dangerous 'hot' nuclear waste → benign
5PS	"Safe, less costly nuclear reactor decommissioning and more – how weak interaction LENRs can take us out of the nuclear safety and economic black hole," *Institute of Science in Society* London, UK, Larsen (January 26, 2009) at http://www.i-sis.org.uk/safeNuclearDecommissioning.php	Decommissioning old reactors; also possibility to design LENR-based subcritical fission reactors with no nuclear waste
6PS	"LENRs replacing coal for distributed democratized power – low energy nuclear reactions have the potential to provide distributed power generation with zero carbon emission and cheaper than coal, " *Institute of Science in Society* in London, UK, Larsen (January 27, 2009) at http://www.i-sis.org.uk/LENRsReplacingCoal.php	How small-scale, future LENR-based distributed power generation systems might eventually displace 'king coal'

Note: free versions of all these papers *sans* references and some Figures are available online on the I-SiS website

Lattice Energy LLC

Appendix 4 - Media coverage of WLT, Lattice, and LENRs

Document ID	Title, author, publication venue, and date	Subject matter and comments
1JC	"Widom-Larsen Theory Portal," on the *New Energy Times* website at: http://www.newenergytimes.com/v2/sr/WL/WLTheory.shtml	Collection of papers, commentaries, and other documents relating to W-L theory
2JC	"Nuclear reactions may produce phones' power," Jon Van, originally published in the *Chicago Tribune* on April 16, 2007; now archived on the *Energy Bulletin* website at http://www.energybulletin.net/node/28783	Short technology news story about Lattice; potential future applications for energy-dense battery-like LENR devices
3JC	"Transmutation – the alchemist dream come true," Dr. Mae-wan Ho, Founder and Director, *Institute of Science in Society* London, UK, (October 24, 2007) at http://www.i-sis.org.uk/alchemistsDream.php	Good discussions of LENR transmutation experiments of Miley and Iwamura *et al.*, and W-L ULMN optical absorption model
4JC	"Coast to Coast" nationally syndicated AM radio talk show hosted by George Noory - on the evening of Wednesday, August 12, 2009, Dr. Robert Piccioni was an invited guest on Noory's show to discuss and promote his new book as well as answer impromptu questions from the *Coast to Coast* listening audience. During the course of the 3 hour live interview, Noory brought up the subject of "cold fusion." Dr. Piccioni's answers to Noory's questions about LENRs are contained in a ~9-minute extracted audio clip that can be found at http://www.4shared.com/u/pvrvtmtm/8a2eb529/Lattice_Energy_LLC.html	Dr. Robert Piccioni, a high-energy particle physicist and author of a well-regarded educational book, "Atoms, Einstein, and the Universe, " made a series of very favorable remarks about Lattice and its theoretical work on LENRs. URL to the web page for Dr. Piccioni's book is http://www.guidetothecosmos.com/book.html; his website is at http://www.guidetothecosmos.com
5JC	"Low Energy Nuclear Reactions: An Energetics Revolution for ALL of NASA's Missions and a Solution to Climate Change and the Economic Meltdown," Dr. Joseph W. Zawodny, a senior scientist at NASA-LaRC, in a 21-slide MS-PowerPoint presentation dated August 12, 2009, that can be found on the Hampton Roads Partnership's (a public-private nonprofit organization) website in its "Resource Library" section under NASA at http://www.hrp.org/Site/docs/ResourceLibrary/NASA_LowEnergyNuclearReaction_8-12-09.pdf	Dr. Zawodny, a longtime NASA veteran, is a physicist by training. His August 2009 presentation is very interesting, fact-filled, and provocative. He believes that the W-L theory is the correct explanation for LENRs and that NASA understands the theory. For example, in the document he also states that LENRs may provide, " … total replacement of fossil fuels for everything but synthetic organic chemistry."

Lattice Energy LLC

Appendix 4 - Media coverage of WLT, Lattice, and LENRs

Document ID	Title, author, publication venue, and date	Subject matter and comments
6JC	"Guide to the Cosmos" on-demand web radio science talk show hosted by Robert Piccioni – Lewis Larsen was interviewed to discuss LENRs. The ~31 minute Q&A interview first aired on WebTalkRadio.net on Sunday, November 8, 2009; available as an archived online mp3 audio clip at: http://www.webtalkradio.net/index.php/show-podcasts/142-guide-to-the-cosmos/4370-week0946	Dr. Robert Piccioni, high-energy particle physicist and author of the book, "Atoms, Einstein, and the Universe, " interviewed Lewis Larsen on his educational Internet on-demand radio show, "Guide to the Cosmos" hosted by Dr. Piccioni
7JC	"Universal Learning Series" live on-demand web radio talk show hosted by Sandy Andrew – in a segment titled, "Widom-Larsen Theory: Energy Revolution?," Lewis Larsen was interviewed to discuss LENRs. The 1-hour Q&A interview first aired on blogtalkradio.net on Saturday, April 17, 2010; it is available in its entirety as an archived online mp3 audio clip at: http://blogtalk.vo.llnwd.net/o23/shows/show_1009147.mp3	Lively, in-depth interview suitable for a general audience; Mr. Andrew had carefully researched the topics of LENRs and "cold fusion" prior to the show --- asked a number of probing questions that explored the scientific, economic, geopolitical, and social implications of the W-L theory of LENRs
8JC	Local print and online newspaper, *The Chicago Reader*, published a cover story by a freelance arts & entertainment writer, Mr. Edward Koziarski, that was titled, "A nuclear reactor in every home?," at source URL = http://www.chicagoreader.com/gyrobase/personal-cold-fusion-reactor-invention-lenr/Content?oid=2165464&show=comments&display=&sort=desc	Lattice only partially cooperated on this story. There were several major factual errors in it that were corrected in an online comment by Larsen that was subsequently published one week later as a Letter to the Editors in the print edition of the *Reader*; that included a written apology from editors for the errors about military service record
9JC	Steven Krivit and *New Energy Times* published 148-page, "Special Report: Cold Fusion is Neither," on July 30, 2010; the "Report" and a very concise 4-page "Overview" outline of it can be downloaded from following URLS: http://www.newenergytimes.com/v2/news/2010/35/ColdFusionisNeither.pdf http://www.newenergytimes.com/v2/news/2010/35/NET35.pdf	"Special Report " is a culmination of Krivit's decade of involvement as a science journalist covering the field of LENRs: each of its 20 sections has a different blend of scholarly technical information and readily understandable plain English text

Lattice Energy LLC

Appendix 4 - Media coverage of WLT, Lattice, and LENRs

Document ID	Title, author, publication venue, and date	Subject matter and comments
10JC	"Energetics" was presented on October 19, 2010 Meeting PowerPoint prepared by Dr. Joseph Zawodny, NASA-LaRC Abstract: "In 1989, Pons and Fleischman made their infamous 'Cold Fusion' announcement promptly ending their careers. Despite this the study of the Pons-Fleischmann Effect continues to this day. This talk will cover some selected historical highlights from the past 20+ years that gave rise to the emerging field called Low Energy Nuclear Reactions (LENR). The body of evidence strongly suggest that the LENR effect is real, increasingly understood, and most recently, may actually be useful. The experimental approaches and evidence along with several theories will be presented. One theory, Widom-Larsen Theory (WLT), will be discussed in detail. The practical application of LENR to aerospace will transform virtually every aspect of system design." Venue: 3-day NASA-NIA conference, "Aviation Unleashed," that was held in Hampton, VA, at which Dr. Zawodny, a NASA senior staff physicist, spoke about the potentially revolutionary impact of LENR technology on aviation Copy of Dr. Zawodny's presentation available at: http://nia-webdev.nianet.org/aviation-unleashed/assets/PRESENTATIONS/zawodny.pdf [23 slides]	Among many comments about LENRs that appear in his presentation, Dr. Zawodny stated that (quoting directly): On Slide #11: "Potential Impact - 10*6 x chemical, very scalable, clean, perhaps the most disruptive technology - a magnitude 10 TechnoQuake!" On Slide#19: "Ramifications: Revolutionizes Aviation and Access to Space [and could result in the] - Total replacement of fossil fuels for everything but synthetic organic chemistry"

Lattice Energy LLC

Appendix 4 - Media coverage of WLT, Lattice, and LENRs

Document ID	Title, author, publication venue, and date	Subject matter and comments
11JC	Background: USPTO publication reveals that NASA filed patent application based directly on Widom-Larsen theory and Lattice's extant patent work "LENR Gold rush begins --- at NASA" By Steven Krivit *New Energy Times* blog, January 13, 2012 http://blog.newenergytimes.com/2012/01/13/lenr-gold-rush-begins-at-nasa/ Quoting selected excerpts directly from *New Energy Times* article: "Several years ago, NASA scientists identified one theory that appears to explain low-energy nuclear reactions. Since then, in their public communications, they have given credit to the inventor of the theory. Not anymore." "After filing a patent application in 2011 based on this theory, one of these scientists, in his public communications, stopped giving credit to the inventor." "On March 9, 2006, Allan Widom, a condensed matter physicist with Northeastern University, and Lewis Larsen, chief executive officer of Lattice Energy LLC, published a landmark theory that offers a promising explanation for low-energy nuclear reactions." "Two scientists at NASA's Langley Research Center, Dennis Bushnell and Joseph Zawodny, saw the promise of the Widom-Larsen ultra-low-momentum neutron theory of LENRs. For several years, Bushnell and Zawodny spoke favorably and enthusiastically about the Widom-Larsen theory as well as LENR in general." "Thursday, Larsen told New Energy Times that he spoke with both NASA employees by phone to help them learn about LENR and his theory. "I spent six months tutoring Zawodny so he had the basics of the theory," Larsen said. 'In January 2009, after an internal NASA meeting, Bushnell and Zawodny informed Lattice that they would not be funding us but they would welcome any free advice we wanted to offer NASA. We declined'."	See document: 23SS A NASA LENR-related patent application that lists Dr. Joseph Zawodny as Inventor, senior staff physicist at NASA-LaRC, was published by the USPTO on October 20, 2011. What is significant about this recently unveiled patent activity by a U.S. government agency is that NASA clearly believes that LENRs are real phenomena and that they are potentially commercially valuable for power generation applications, especially in aerospace. See details in Lattice SlideShare document dated November 18, 2011.

Appendix 4 - Media coverage of WLT, Lattice, and LENRs

Document ID	Title, author, publication venue, and date	Subject matter and comments
12JC	URL: http://indico.cern.ch/conferenceDisplay.py?confId=177379 "Overview of Theoretical and Experimental Progress in Low Energy Nuclear Reactions (LENR)" chaired by Francesco Celani, Yogendra Srivastava Thursday, March 22, 2012 from 16:30 to 18:00 (Europe/Zurich) at CERN in Geneva, Switzerland (500-1-001 - Main Auditorium) Description (quoting directly from CERN announcement): "An overview will be given on the main progress made –since March 1989- through experimental/theoretical studies on thermal/nuclear anomalies observed in forced interactions of Hydrogen isotopes (H, D), in non-equilibrium conditions, with pure or alloyed materials (mainly Palladium, Nickel). Most of the experiments used electrolytic environments at moderate temperatures (20-50°C). More recently, gas environments have been used at higher temperatures (between 200-400°C and even temperatures between 500-900°C have been employed). Specific nanostructures have begun to play a crucial role both in basic studies as well as in, recently claimed, technological/industrial applications. A plethora of theoretical models have been proposed to explain several experimental anomalies in LENR. A brief description of a weak interaction model shall be presented that claims to explain almost ALL of the anomalous effects found so far." Venue: special late-afternoon subject-matter colloquium with two invited speakers Copy of Prof. Srivastava's presentation slides on W-L theory is available at: File name: cern_colloquium6.pdf [warning: CERN website can be very slow] at URL: http://indico.cern.ch/getFile.py/access?resId=1&materialId=slides&confId=177379 Video of Prof. Srivastava's presentation at CERN on W-L theory available at: http://cdsweb.cern.ch/record/1433865	Organized mainly by Prof. Ignatios Antoniadis (CNRS and CPHT Research Director as well as member of CERN's theoretical division). Importantly, a coauthors on many published Widom-Larsen theory papers, Prof. Yogendra Srivastava of the Univ. of Perugia (Italy), gave the only invited talk on LENR theory at Colloquium; Dr. Francesco Celani, INFN and ENEA, Frascati, Italy, provided review of experimental evidence for LENRs. Arguably some of smartest physicists in the world held well-advertized meeting about a very controversial subject (LENRs) that had previously been a scientific pariah for 20 years. Although this publicly announced event was completely ignored and went unreported by prominent science journalists and journals, in Lattice's opinion CERN's Colloquium was watershed event that would have been unthinkable 5 years ago.

Lattice Energy LLC

Appendix 4 - Media coverage of WLT, Lattice, and LENRs

Document ID	Title, author, publication venue, and date	Subject matter and comments
	Background: copy of official document unexpectedly appears on public NASA website which reveals that NASA and The Boeing Corporation are actively investigating the technological possibility of using LENRs for propulsion systems in advanced types of 'green' aircraft "Boeing and NASA Look at LENRs for Green-Powered Aircraft" By Steven Krivit *New Energy Times* blog, August 3, 2012 http://blog.newenergytimes.com/2012/08/03/boeing-and-nasa-look-at-lenrs-for-green-powered-aircraft/ Quoting selected excerpts directly from *New Energy Times* article:	See document: 54SS
13JC	*"New Energy Times* has obtained a May 2012 document that reveals that Boeing Research and Technology, in association with NASA, is looking at low-energy nuclear reactions for future green-powered aircraft. The interest in LENRs by Boeing is an indicator of the field's growing recognition as a serious area of research that may help bring about carbon-free and waste-free energy. The document, 'Subsonic Ultra Green Aircraft Research Phase-II: N+4 Advanced Concept Development,' was written by Marty K. Bradley and Christopher K. Droney of Boeing Research and Technology and prepared for NASA Langley Research Center." "The document is the result of a team effort by Boeing Research and Technology, Boeing Commercial Airplanes, General Electric and Georgia Institute of Technology's Aerospace Systems Design Laboratory to identify and analyze advanced concepts and technologies for aircraft that may fly in the 2030-2035 timeframe." "Members of the team met in person and virtually, on June 22 and 23, 2011, in a workshop. Attendees of the workshop included representatives of the Federal Aviation Authority and Virginia Tech. The team recognized well-known features of LENR: high power density, reduced emissions and low environmental impact. The report speculates that the heat-engine power versus weight from LENR-based engines could offer a significant cost savings — 33 percent less than a conventionally powered aircraft."	An annotated copy of this 148-page Adobe Acrobat NASA document is appended to a one-page cover note in a Lattice SlideShare document dated August 3, 2012

Lattice Energy LLC

Appendix 4 - Media coverage of WLT, Lattice, and LENRs

Document ID	Title, author, publication venue, and date	Subject matter and comments
14JC	"Bring Back the Cold Fusion Dream - A new theory may explain the notorious cold fusion experiment from two decades ago, reigniting hopes of a clean-energy breakthrough" *Discover* magazine, "Big Idea" section in the November 2012 issue By Mark Anderson, physicist and independent science journalist, at http://discovermagazine.com/2012/nov/27-big-idea-bring-back-the-cold-fusion-dream [2 pages in print version – published online on October 23, 2012]	Quoting directly from the article: "The man most responsible for the change of thinking is a technology and energy consultant with a background in physics named Lewis Larsen. In 1989 he was paying attention when Pons and Fleischmann described how a set of palladium rods, connected to an electric current and immersed in lithium-enriched water, churned out more energy in the form of heat than it received in electricity. He followed along as subsequent experiments achieved mixed results. Some seemed to produce a lot of heat, others little or none. Yet a nagging question persisted: If the contraptions really were putting out more energy than they took in, what could be responsible?" "Pons and Fleischmann's infamous explanation was that hydrogen nuclei were fusing inside the metal rods. Larsen, along with virtually every physicist on the planet, knew that was implausible: Fusion requires enormous temperatures and pressures, which is why it occurs only in stars and bombs. But the heat seemed real, at least in some cases. So in 1997 … he decided to investigate the cold fusion mystery using only established physics."

Lattice Energy LLC

Appendix 4 - Media coverage of WLT, Lattice, and LENRs

Document ID	Title, author, publication venue, and date	Subject matter and comments
15JC	"Tiny nuclear reactions inside compact fluorescent bulbs?" By Jeff McMahon, *Forbes* contributor and blogger *Forbes* online (national biweekly financial magazine) March 14, 2013 http://www.forbes.com/sites/jeffmcmahon/2013/03/14/tiny-nuclear-reactions-inside-compact-fluorescent-bulbs/?utm_source=followingimmediate&utm_medium=email&utm_campaign=20130314 [online only]	Quoting: "Harmless low-energy nuclear reactions may be taking place routinely inside of compact fluorescent light bulbs … Nuclear reactions may be responsible for an unusual fingerprint of mercury isotopes in used fluorescents that can identify environmental pollution from the bulbs …Larsen has suspected low energy nuclear reactions occur in CFLs."
16JC	"Will Boeing's battery fix fly?" By Jonathan Laing *Barron's* magazine (national weekly financial industry newspaper) April 27, 2013 http://www.aviationweek.com/Portals/AWeek/TWW/Laing%20Jonathan%20R-Barrons%20Magazine-Will%20Boeings%20Battery%20Fix%20Fly-April%2027%202013.pdf [2 pages in hardcopy print version]	Larsen and other experts on thermal runaways in Lithium-based batteries were interviewed by long-time *Barron's* writer and investigative journalist Jon Laing and asked whether Boeing's engineering fix for the 787 Dreamliner's troubled GS Yuasa battery system would be adequate to successfully contain worst-case battery failure scenarios that might occur during flight operations.
17JC	"Index of LENR experimental methodologies" By Steven Krivit, Publisher *New Energy Times (*online e-zine) Updated May 22, 2013 http://newenergytimes.com/v2/reports/Index-of-LENR-Experimental-Methodologies.shtml [SlideShare version consists of 23 MS-PowerPoint slides] http://www.slideshare.net/StevenKrivit/lenr-methodsdistributioncopyrightnewenergytimes20130522-21707257	Quoting: *'*Low-energy nuclear reaction researchers have used at least two dozen methods to perform LENR experiments. This index describes the more common [ones] …The comprehensive Widom-Larsen theory of LENRs enables the following varied experimental methods and their results to be understood within a common conceptual framework."

Lattice Energy LLC

Appendix 4 - Media coverage of WLT, Lattice, and LENRs

Document ID	Title, author, publication venue, and date	Subject matter and comments
18JC	"Dreamliner Flies, But Doubts Persist About Boeing's Batteries" By Paul Chesser, Associate Fellow of NLPC National Legal and Policy Center website (NLPC promotes ethics in public life through research, investigation, education and legal action) May 29, 2013 http://nlpc.org/stories/2013/05/29/dreamliner-flies-doubts-persist-about-boeings-batteries [online only]	Quoting directly from Chesser's article: "Another scientist, physicist Lewis Larsen of Chicago-based Lattice Energy has studied investigative data of the NTSB report on the Japan Air Lines incident at Logan Airport in Boston … the essence of Larsen's review is that debris from the 'thermal runaway' event included 'perfect nanoscale steel spheres.' Larsen explained that the presence of those spheres are evidence that stainless steel 'hotspots' in the battery casing, which were exposed to the internal shorts that created arc discharges, reached temperatures far higher than Boeing engineers likely contemplated."
19JC	"Ethiopian 787 Fire Sparks Question: Is Lithium Ion Ready to Fly?" Christine Negroni *Flying Lessons* blog, July 20, 2013 http://christinenegroni.blogspot.com/2013/07/ethiopian-787-fire-sparks-question-is.html	"Advanced batteries with very different chemistries seem to have a marked propensity to misbehave when installed in Boeing 787 Dreamliners," Larsen told me when I called to get his take on the latest installment in the ongoing Dreamliner saga. Larsen was one of many people I interviewed while working on previous stories about the two fire events on Japanese-operated planes."

Lattice Energy LLC

Appendix 4 - Media coverage of WLT, Lattice, and LENRs

Document ID	Title, author, publication venue, and date	Subject matter and comments
20JC	"Technical Glitches and Payments for Down Time Still Nag Boeing's Dreamliner" By Paul Chesser, Associate Fellow of NLPC, August 8, 2013 National Legal and Policy Center website (NLPC promotes ethics in public life through research, investigation, education and legal action) "Another fire, another mysterious technical glitch, and happy-go-lucky Boeing skips along enjoying strong sales, revenues and profits, despite the shadow of uncertainty that hangs over the lithium battery-charged Dreamliner." http://nlpc.org/stories/2013/08/07/technical-glitches-and-payments-down-time-still-nag-boeings-dreamliner	"But whether Boeing should remain comfortable about measures it has taken to alleviate concern about new battery technology on the Dreamliner is another question. NLPC has reported about the challenges both before and after the Chicago-based manufacturer announced it had rectified the problems caused by its lithium ion batteries, despite the company not knowing what caused the fires last winter. The current "solution" is to make sure any "thermal runaway" event is contained within a stainless steel box and vented outside the airliner so as to not endanger passengers and crew. The only problem, as at least one scientist has explained, is that fires caused by the batteries often burn so hot as to melt stainless steel." "That scientist, Lewis Larsen of Chicago-based Lattice Energy, is particularly fascinated by the behavior of electric arcs. His analysis of the original fires in January appeared to be dead-on, with the explanation that nanoscale steel orbs that were discovered afterward were evidence that stainless steel "hotspots" were created in the battery casing, which caused melting and then reformed as spheres when they cooled."

Lattice Energy LLC

Appendix 4 - Media coverage of WLT, Lattice, and LENRs

Document ID	Title, author, publication venue, and date	Subject matter and comments
21JC	"Einstein's lost hypothesis --- Is a third-act twist to nuclear energy at hand?" Mark Anderson, *Nautilus* magazine, Nov. 28, 2013 Winter 2013-14 issue pp. 21 – 29 [8-pages including illustrations] Subscription required to view it in its entirety Source URL to excerpt: http://nautil.us/issue/7/waste/einsteins-lost-hypothesis ********* Quoting selected excerpts directly from the article ********** "What Sternglass didn't know is that his visit to Einstein would set off a chain of correspondence, involving both an unpublished experiment (his) and an unpublished hypothesis (Einstein's) that together may constitute one of the century's most important disregarded pieces of science. The reason why the science was overlooked is plain enough: It was at least a generation ahead of its time. Now, more than half a century later, the work is being re-examined, with potentially profound implications for sustainable energy production. For Sternglass was to discover how to create free neutrons with household wall socket energy levels — and Einstein was to explain why." ********** "Einstein had made a characteristically brilliant leap. But neither he nor Sternglass nor indeed any contemporaries had either the technology or the theoretical framework to make sense of Sternglass' data. Neither his data, nor Einstein's supposition [about many-body collective effects with electrons] were published." ********** "In a letter to Einstein dated Aug. 26, 1951, Sternglass wrote, "You may be interested to learn that in the course of the past two months, I have been able to obtain experimental evidence for the formation of neutrons from protons and electrons in high-voltage hydrogen discharge." Sternglass' neutron experiment consisted of an evacuated glass tube less than a foot long filled with hydrogen gas. He fired an electron gun, not unlike the type found in old tube TV sets, through the gas and at thin foils of silver and indium at the end of the tube. There was no known way that an electron beam of the energies he was studying (about 35,000 electron Volts) could have induced any radioactivity in the foils. Nevertheless, time and again, that is what he observed. When he ran a control experiment with the beam passing through regular air, the foils did not become radioactive."	Discusses Einstein's early 1950s-era connection to many-body collective effects utilized in Widom-Larsen theory of LENRs ****** Quoting excerpt directly ****** "It was only in 2006, with the publication of a landmark [Widom & Larsen] paper in the *European Journal of Physics* C that neutron-induced transmutations, as something distinct from cold fusion, began to emerge as a viable theory. The paper predicts that electrons on a metal surface coated with hydrogen, deuterium, or tritium atoms can behave collectively (as Einstein had predicted) when driven by an oscillating electromagnetic field at a particular frequency. This collective behavior can give them enough energy to combine with the hydrogen, deuterium, or tritium to make neutrons."

Lattice Energy LLC

Appendix 4 - Media coverage of WLT, Lattice, and LENRs

Document ID	Title, author, publication venue, and date	Subject matter and comments
22JC	"U.S. Department of Energy Invites Submission of LENR Proposals" By Steven B. Krivit, January 3, 2014 http://news.newenergytimes.net/2014/01/03/u-s-department-of-energy-invites-submission-of-lenr-proposals/#more-9492 Quoting directly from this story: "This first-ever direct invitation from the Department of Energy for submission of proposals to fund this research marks a significant point in the field's history. This is one of three recent shifts in the scientific establishment's attitude toward this new field of science … ARPA-E made its announcement in its 'Funding Opportunity No. DE-FOA-0001002, CFDA Number 81.135'."	*New Energy Times* reporting of the previously unheralded existence of this heretofore unpublicized, still-open ARPA-E LENR "Funding Opportunity" was a totally unexpected development. Any open Broad Agency Announcement (BAA) such as this concerning potential DOE funding of R&D proposals involving low energy nuclear reactions (LENRs) is something that the DOE has bureaucratically resisted doing for 25 years. By the simple act of issuing this BAA, DOE's ARPA-E program has signaled officially that LENRs are finally recognized by that particular arm of the U.S. government as a legitimate area of scientific inquiry. This shift in policy has been exceedingly long in coming.
23JC	"DOE Mentions Technology Behind The Home Nuclear Reactor In Funding Opportunity" By Jeff McMahon, Contributor, published in *Forbes* online, January 4, 2014 http://www.forbes.com/sites/jeffmcmahon/2014/01/04/doe-mentions-technology-behind-the-home-nuclear-reactor-in-funding-opportunity/	*Forbes* picked-up on *New Energy Times* news story about ARPA-E's marked shift in policy with regard to DOE funding of LENR-related R&D proposals and further amplified it. In response to a question from *Forbes*, McMahon received written confirmation from ARPA-E spokesman effectively acknowledging that information about the funding shift reflected in ARPA-E BAA supplemental document was correct and LENR proposals could be submitted for potential funding under the program.

Lattice Energy LLC

Appendix 4 - Media coverage of WLT, Lattice, and LENRs

Document ID	Title, author, publication venue, and date	Subject matter and comments
24JC	*Nikkei* (*Nihon Keizai Shimbun* - Japan) published favorable 5-page news about Mitsubishi Heavy Industries LENR transmutation research "The road to the detoxification of radioactive waste - Mitsubishi Heavy Industries' practical research" Yoshikazu Miura, April 8, 2014, *Nihon Keizai Shimbun* – Japanese language electronic version (Japan) Filed under: Technology > Environment and Energy > Green Biz > article http://www.nikkei.com/article/DGXNASDZ040JJ_X00C14A4000000/	Today, a number of major Japanese companies that include Mitsubishi Heavy Industries and the Toyota Group (among others) are working quietly without fanfare to commercialize LENRs, ostensibly for use in nuclear waste remediation but in fact intended to create a new primary energy source that can someday replace burning petrol in internal combustion engines and chemical batteries in portable power applications.
25JC	"Gates looks at LENRs as future energy source" By Steven B. Krivit, *New Energy Times*, November 14, 2014 http://news.newenergytimes.net/2014/11/14/gates-looks-at-lenrs-as-future-energy-source/	Nov 12, 2014: Bill Gates attended a private technical briefing on low energy neutron reactions (LENRs) by scientists at Italian government's national agency for new technologies ENEA (located near Rome in Frascati, Italy)
26JC	"Asia's quest for clean energy" By Angelica Buan, *Plastics and Rubber Asia*, pp. 18 - 21 in the August 2015 digital edition http://issuu.com/plasticsrubberasia/docs/aug2015-elec-issue-reduced?e=2769350/14748715	In her informative 4-page article, at the very end she notes that ultralow energy neutron reactions (LENRs) are potentially a "fresh option" for Asia in a long-term effort to decarbonize its rapidly growing power generation infrastructure. In the article she states that LENRs are "synergistic" with today's fossil fuel sources, incl. coal.

Lattice Energy LLC

Appendix 4 - Media coverage of WLT, Lattice, and LENRs

Document ID	Title, author, publication venue, and date	Subject matter and comments
26JC	TBD	TBD
27JC	TBD	TBD

Working with Lattice

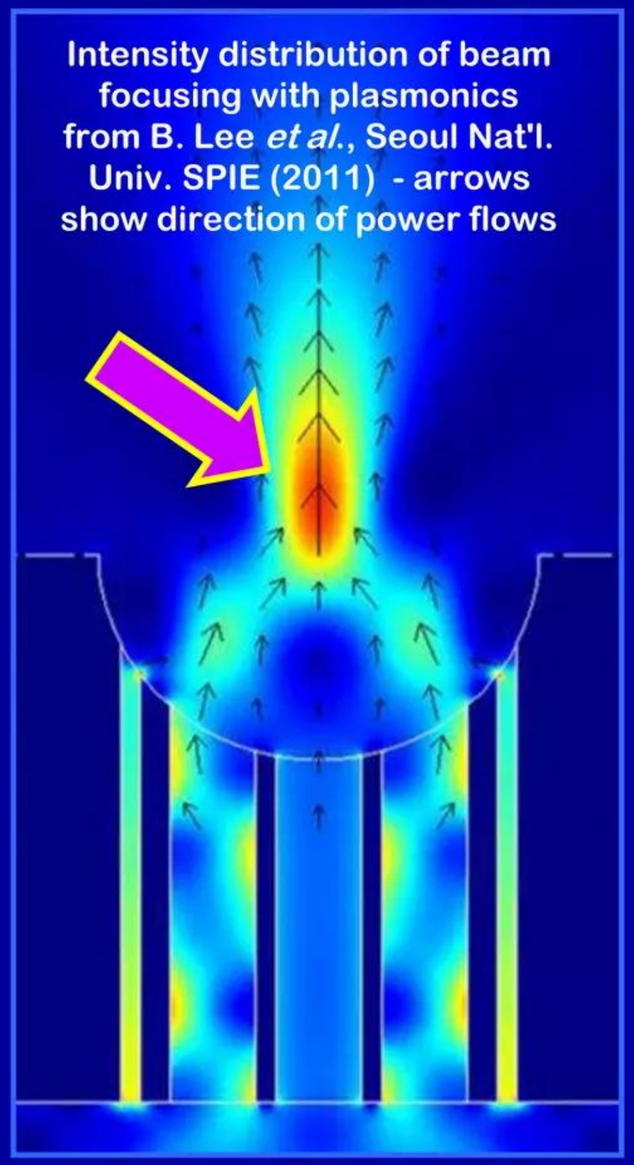
Partnering on commercialization and consulting on certain topics

Larsen cv: http://www.slideshare.net/lewisglarsen/lewis-g-larsen-cv-june-2013

1-312-861-0115 lewisglarsen@gmail.com

- ✓ **Lattice welcomes serious inquiries from large, established organizations** that have an interest in discussing the possibility of becoming a strategic capital and/or technology development partner
- ✓ **Lewis Larsen also selectively engages in fee-based third-party consulting that does not compromise Lattice's proprietary intellectual property relating to LENR power sources.** Such expertise includes many areas such as thermal runaways in Li-ion batteries; LENRs as they relate to petroleum geochemistry and fracking-induced seismicity; long-term strategic implications of LENRs on high cap-ex long term investments in power generation and petroleum-related assets; as well as long-term outlooks for real prices of energy, precious metals, and other commodities

Concentrating E-M energy in resonant electromagnetic cavity



http://spie.org/documents/Newsroom/Imported/003435/003435_10.pdf

Powering the world to a green future

"No single solution will defuse more of the Energy-Climate Era's problems at once than the invention of a source of single solution abundant, clean, reliable, and cheap electrons. Give me abundant clean, reliable, and cheap electrons, and I will give you a world that can continue to grow without triggering unmanageable climate change. Give me abundant clean, reliable, and cheap electrons, and I will give you water in the desert from a deep generator-powered well. Give me abundant clean, reliable, and cheap electrons, and I will put every petrodictator out of business. Give me abundant clean, reliable, and cheap electrons, and I will end deforestation from communities desperate for fuel and I will eliminate any reason to drill in Mother Nature's environmental cathedrals. Give me abundant clean, reliable, and cheap electrons, and I will enable millions of the earth's poor to get connected, to refrigerate their medicines, to educate their women, and to light up their nights."

Thomas Friedman, "Hot, Flat, and Crowded" pp. 186 (2008)