

# Lattice Energy LLC

*Commercializing a Next-Generation Source of Safe Nuclear Energy*

## Low Energy Nuclear Reactions (LENRs)

**Key 'Facts' Show that LENR Phenomena are Real**

*What are they and are they fully explained by W-L theory?*

**Lewis G. Larsen**

**President and CEO**

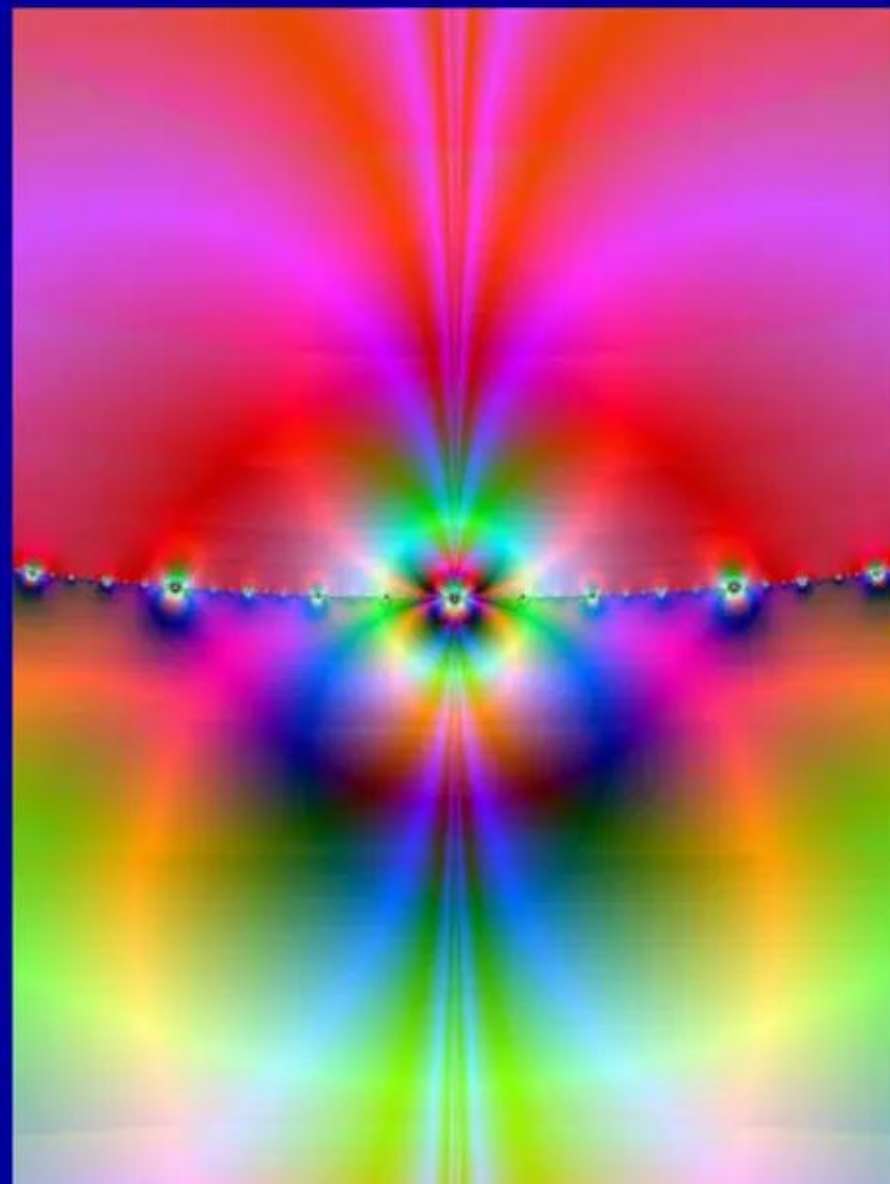
**October 20, 2011**

***"Facts do not cease to exist  
because they are ignored."***

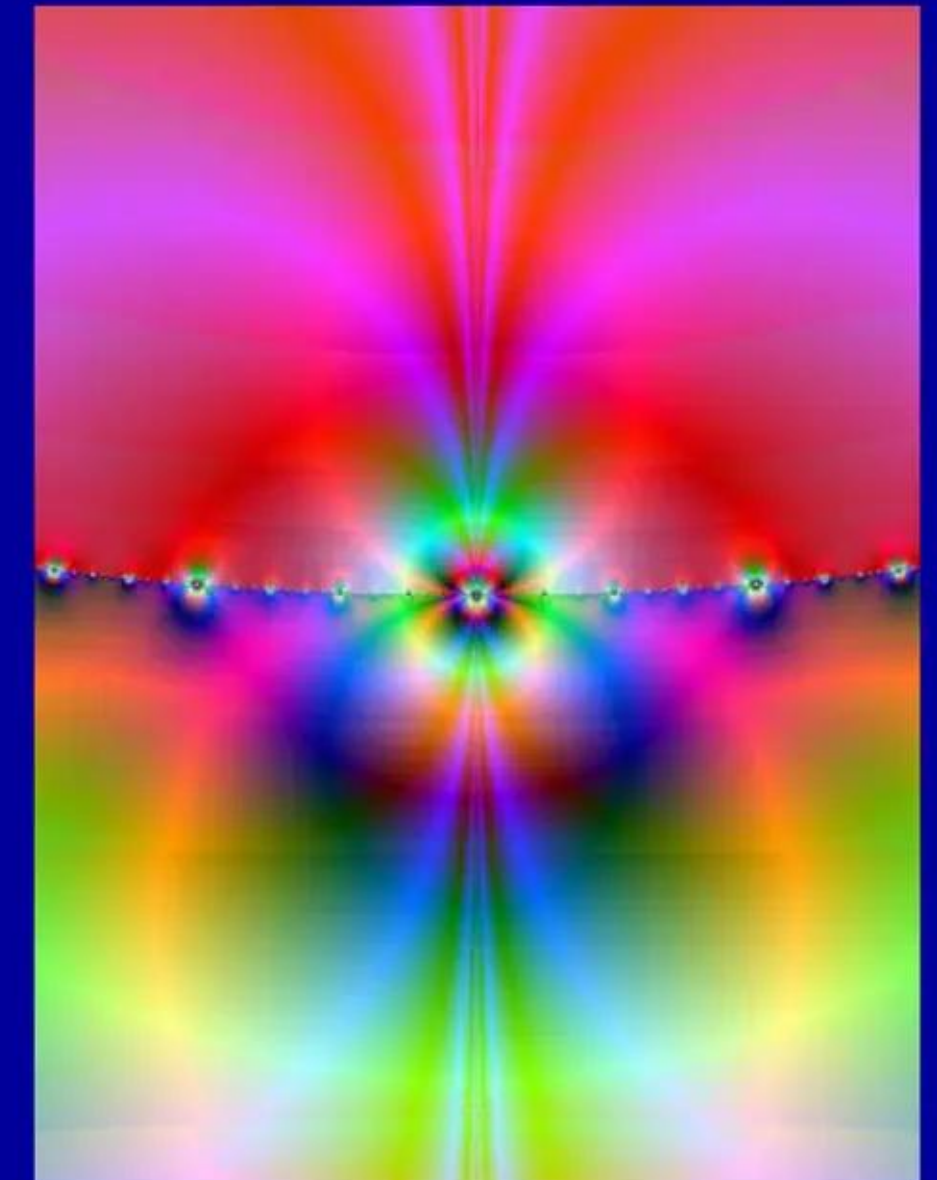
*Aldous Huxley  
"Proper Studies" 1927*

**Contact: (312) 861 – 0115  
lewisglarsen@gmail.com**

**<http://www.slideshare.net/lewisglarsen>**



Credit: J. Haas



Credit: J. Haas



# Lattice Energy LLC

*LENRs: large array of experimental data spanning 100 yrs*

**Summary of four major categories of 'facts' about LENRs**

**Are real phenomena: mastering excess heat needed to commercialize**

|    | Important LENR effect or directly related physical phenomena             | Overall type of experimental system producing observed data                            | Level of certitude; rate quality (1-10) of observations (FACT = 10; 1-9 )              | Example of <u>at least one</u> key reference or researcher, date                                   | Lattice commentary about information found in any of the previous 4 columns   | Is data fully explained by W-L theory? (Y/N) |
|----|--|--|--|--|---|--|
| #1 | Transmutations cannot possibly be from chemical processes                | Everything from aqueous (cell) electrolytic, gas-phase, electrical discharges, etc.    | FACT = 10  | Iwamura et al., <i>Japanese J. of Ap. Physics</i> 41 pp. 4642 (July 2002)                          | LENR transmutation products have been <i>unquestionably</i> observed in hundreds of different experiments                           | Yes  |
| #2 | MeV-energy charged particles cannot possibly be from chemical processes  | Observed in wide variety of different types of electrolytic LENR systems               | FACT = 10  | 2002 Prof. Andrei Lipson (Moscow), others, supported by Lattice, reported variety of MeV particles | Reliably observed small fluxes per day of very anomalous 14 - 17 MeV $\alpha$ particles; clearly <i>only</i> from a nuclear process | Yes  |
| #3 | Large, very controllable amounts of long-lived excess heat production    | Observed in many different LENR systems; <i>today, macroscopic very hard to repeat</i> | <u>Macroscopic</u> = 1-5 (now hit-or-miss)<br><u>Microscopic heat</u> is FACT = 9 - 10 | Lattice/others see $\mu$ -scale 'craters' w. transmutation products in and around them             | Technological challenge is to multiply, control large numbers of tiny LENR-active heat producing sites                              | Yes: W-L theory can help us achieve this     |
| #4 | Absence of high energy neutrons, gammas, long-lived radioactive isotopes | Consistently observed in scores of different experiments over past 20+ years           | FACT = 10  | Miley data 1996; saw no gammas, or neutrons, even w. huge amounts of transmutations                | Dangerous radiation, radioisotopes never observed, even when nuclear processes have obviously occurred                              | Yes  |



# Lattice Energy LLC

*LENRs: large array of experimental data spanning 100 yrs*

Key elements of Widom-Larsen theory are well-established

## Examples of additional selected 'facts' - 1

| Important LENR effect or directly related physical phenomena                                 | Overall type of experimental system producing observed data                   | Level of certitude; rate quality (1-10) of observations (FACT = 10; 1-9 ) | Example of <u>at least one</u> key reference or researcher, date                      | Lattice commentary about information found in any of the previous 4 columns  | Is data fully explained by W-L theory? (Y/N)      |
|--|---|---|---|--|---|
| <b>Born-Oppenheimer app. breakdown</b> at surfaces and at interfaces                         | Occurs at surfaces and at interfaces in thousands of different systems        | FACT = 10   | See Prof. John Tully's website at yale.edu  | Breakdown of B-O approximation and many-body collective Q-M effects enable huge local E-fields                         | Well-known 20+ yrs fact independent of W-L theory |
| <b>Involvement of surface plasmon electrons in LENR</b><br>$e + p$ or $e + d$ weak reactions | Observed in aqueous electrolytic and gas-phase experiments                    | FACT = 10   | Dr. Vittorio Violante, ENEA, Italy (2004); <b>CONFIRMED</b> w. laser polarization     | Laser triggering first observed by Letts & Cravens (2003); also seen by McKubre SRI, Lattice, and others               | Yes   |
| <b>MeV-energy particles</b> emanating from LENR reactions                                    | Observed in great many different electrolytic cells and gas-phase experiments | FACT = 10   | Prof. Andrei Lipson reported on Lattice's work at regional APS meeting (2002)         | In recent years, many LENR researchers have seen MeV particles; none used protocols as rigorous as Lipson <i>et al</i> | Yes   |
| Direct or indirect evidence for <b>production of ULM neutrons per W-L theory</b>             | Aqueous electrolytic systems ( $H_2O$ and $D_2O$ ) with various added salts   | Level = 8 - 9   | Prof. G. Miley US - Univ. Illinois (1996) and Dr. T. Mizuno Japan - Hokkaido U (1995) | <b>Very distinctive 5-peak transmutation product mass spectrum; unique 'signature' of ULM neutron production</b>       | Yes   |



# Lattice Energy LLC

**LENRs: large array of experimental data spanning 100 yrs**

**W-L theory explains wide-range of LENR-related phenomena**

## Examples of additional selected 'facts' - 2

| Important LENR effect or directly related physical phenomena                        | Overall type of experimental system producing observed data              | Level of certitude; rate quality (1-10) of observations (FACT = 10; 1-9 )   | Example of <u>at least one</u> key reference or researcher, date      | Lattice commentary about information found in any of the previous 4 columns   | Is data fully explained by W-L theory? (Y/N) |
|---|--|---|---|---|--|
| <b>GeV-energy particles</b> produced in very large solar flares and CMEs            | Spatially well-organized magnetic flux tubes on stars such as our Sun    | FACT = 10   | Measurements by many solar researchers published in refereed journals | <b>W-L-T many-body theory in collective magnetic regimes is the <i>only</i> theoretical model able to explain data</b>      | Yes  |
| W-L theory in magnetic regimes <b>predicts</b> nuclear reactions in stellar flares  | Quasi-stable and exploding magnetic flux tubes on stars such as our Sun  | Fact = 9 - 10   | Profs. Jenkins & Fischbach, <i>Astroparticle Physics</i> (2009)       | Observed changes in decay rate of <sup>54</sup> Mn during large solar flares; <b>CONFIRM</b> W-L-T mechanism in flares      | Yes  |
| <b>Larsen's theory of beta-decaying nuclei as simple types of quantum computers</b> | Q-M information interaction w. nuclei & local continuum via entanglement | Level = 5 - 6 hypothesis that needs further experimental testing            | Profs. Jenkins & Fischbach, <i>Astroparticle Physics</i> (2009)       | Explains certain features of complex delayed-beta decays of >> neutron-rich nuclei made in LENR systems                     | Yes  |
| <b>'Desktop' analogues of dusty solar flares</b> with organized magnetic fields     | Already developed by others for other R&D purposes                       | Level = 4 - 5 needs funding, more experimental testing, then apply to LENRs | <b>Proprietary</b>  | <b>If this engineering embodiment pans-out, have W-L-T B-field system that will readily scale up from desk to gigawatts</b> | Yes  |



# Lattice Energy LLC

**LENRs: large array of experimental data spanning 100 yrs**

**Seem to occur spontaneously on earth in variety of settings**

**Examples of additional selected 'facts' - 3**

| Important LENR effect or directly related physical phenomena                    | Overall type of experimental system producing observed data                       | Level of certitude; rate quality (1-10) of observations (FACT = 10; 1-9 )                       | Example of <u>at least one</u> key reference or researcher, date  | Lattice commentary about information found in any of the previous 4 columns   | Is data fully explained by W-L theory? (Y/N) |
|---|---|---|---|---|--|
| "Fractionated" heavy isotopes and anomalous elements in car & truck exhaust gas | Precious metals-based exhaust catalytic converters in cars and trucks             | Fact = 10 w.r.t. being isotopic "fractionation" –<br><b>Q: nuclear vs. chemical causes?</b>     | Kanitsar et al., <i>J. of Analytical Atomic Spectrometry</i> 18 pp. 239 -246 (2003)   | If it is conclusively proven that LENRs do really occur in catalytic converter; <b>strong proof that LENRs are biosafe!</b> | Yes  |
| Production of neutrons and energetic particles/photons during lightning         | Natural high-current lightning discharges occur in planetary atmospheres          | Fact = 10   | Shah et al., <i>Nature</i> 313 pp. 773 - 775 (28 February 1985)   | Theoretically speaking, lightning bolts are just very large W-L-T dusty plasma exploding wires up in the sky                | Yes  |
| Anomalously large amounts of 'heavy' Nitrogen-15 in local environment           | IAEA team studies coking ovens at Iscor integrated steel facility in South Africa | Fact = 10 w.r.t. to there being large isotopic shifts<br><b>Q: nuclear vs. chemical causes?</b> | Talma & Meyer, CSIR, S. Africa, 2002 <b>IAEA report</b> : <a href="http://www-pub.iaea.org/MTCD/publications/PDF/te_1298_web/t1298_part3.pdf">http://www-pub.iaea.org/MTCD/publications/PDF/te_1298_web/t1298_part3.pdf</a> | Data is consistent with ULM neutron capture on PAH carbon atoms – <b>explained: W-L resonant electromagnetic cavity</b>     | Yes  |
| 'Fractionation' of various isotopes, including Uranium, by soil bacteria        | Common soil microorganisms in natural environments & lab experiments              | Fact = 10 w.r.t. being isotopic "fractionation" –<br><b>Q: nuclear vs. chemical causes?</b>     | Rademacher et al. <i>Environ. Science &amp; Technology</i> 40 pp. 6943 - 6948 (2006)  | Earlier Russian work in 2003 on bacterial transmutation of Mn to Fe was <b>CONFIRMED</b> at IGCAR - India Feb 2011          | Yes  |



# Lattice Energy LLC

*LENRs: large array of experimental data spanning 100 yrs*

These phenomena have been observed for a very long time

## Examples of additional selected 'facts' - 4

| Important LENR effect or directly related physical phenomena                            | Overall type of experimental system producing observed data                                  | Level of certitude; rate quality (1-10) of observations (FACT = 10; 1-9 )     | Example of <u>at least one</u> key reference or researcher, date                                   | Lattice commentary about information found in any of the previous 4 columns   | Is data fully explained by W-L theory? (Y/N) |
|---|--|---|--|---|--|
| Observed fluxes of neutrons in hydrogen-filled X-ray tube @ only 20 kV - <b>bizarre</b> | In early 1950s, PhD candidate at Cornell <b>tests his ideas about e + p neutron creation</b> | Level = 5 - 7   | Ernest Sternglass drops inquiry and does thesis on something else, despite Einstein                | Profs. Hans Bethe & Albert Einstein tried to help explain – <b>Einstein said had to be electron collective effects</b>                | Yes  |
| Observed helium production during high-current exploding wire experiments               | Exploded tungsten wires inside sealed glass bulbs & saw He in spectrum                       | Level = 7 - 8   | Wendt & Irion, University of Chicago <i>Science</i> (1922) <b>see W-S-L arXiv preprint</b>         | Results 'trashed' by Rutherford in <i>Nature</i> - dropped research - we reanalyzed data: <b>Wendt &amp; Irion were truly right !</b> | Yes  |
| Transmutation of tungsten into gold and platinum during electric discharge              | High-current electric discharges in transformer oil w. <b>W</b> electrodes                   | Level = 6 - 8 his experiments need to be repeated w. today's modern equipment | <b>Prof. Hantaro Nagaoka, Japan</b> <i>Nature</i> (1924) <b>begged</b> people to repeat his expts. | Most famous physicist in Japan at time; very experienced, careful experimentalist unlikely to be wrong                                | Yes  |
| New elements observed spectroscopically during electric discharges                      | High-current electric discharges in various media  | Level = 4 - 5   | <b>Some of the most famous people in British science</b> from ca. 1900 to mid-1920s                | Published in all the top-tier refereed journals of that era; <b>area of inquiry died-out prior to 1932</b> (Chadwick - neutron)       | Yes  |



# Lattice Energy LLC

*LENRs: large array of experimental data spanning 100 yrs*

**Challenge: trigger, control, amplify what Nature does already**

- ✓ LENRs already occurring in Nature at varied rates in diverse array of physical environments: these range from biological and abiological processes operating quietly within earth's crust, to manmade industrial processes, to atmospheric lightning, all the way up to blazing hot magnetic flux tubes on surfaces of stars
- ✓ Lattice has identified mass-spectroscopy isotopic data in refereed publications which suggest that, for example, LENRs take place at very low rates in coking ovens, manganese separation plants, catalytic converters in vehicles, lightning, and, at times, high rates in electrolytic chemical cells (e.g., Miley, Mizuno data)
- ✓ Thanks to Widom-Larsen theory of LENRs, these data can now be understood
- ✓ Under exactly the right conditions, LENRs can and do spontaneously occur in Nature without Man's intervention; this has been happening for billions of years
- ✓ Reproducibility of device heat production has been major issue since 1989 because researchers didn't understand enough about LENRs other than to simply take whatever Nature 'decided' to give them at random in a given experiment
- ✓ W-L-T should enable us to do better: *our challenge is to control and amplify Nature*



# Lattice Energy LLC

*LENRs: large array of experimental data spanning 100 yrs*

## Can 'boil' refractory metallic nanostructures, but not tea yet

- ✓ In earlier lab work, Lattice was able to 'boil' metals only in limited numbers of random, tiny, localized LENR-active 'hot spots' on device surfaces
- ✓ That being the case, it is not a huge stretch to imagine that, given further device engineering and substantially funded R&D programs, it should be possible for Lattice to design and eventually mass-produce optimized, high-performance gas-phase  $H_2$  or  $D_2$  thermal sources that reliably produce large, long-lived, controllable fluxes of excess heat
- ✓ In principle, output of such heat sources could be scaled-up, either by fabricating larger area-densities of affixed nanostructures that enable formation of LENR 'hot spots' on device surfaces, or by injecting larger quantities of specially designed 'fuel' nanoparticles into volumetrically larger reaction chambers containing turbulent 'dusty' plasmas, with or without spatially organized magnetic fields present
- ✓ Lattice's LENR prototype R&D plan key step toward achieving these goals



# Lattice Energy LLC

## Commercializing a Next-Generation Source of Safe Nuclear Energy

Vast neutron-rich isotopic parameter space may be accessible to W-L LENRs

