***"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 (2006 – released on arXiv in May 2005)
http://www.newenergytimes.com/v2/library/2006/2006Widom-UltraLowMomentumNeutronCatalyzed.pdf

Synopsis: rigorously explains physics of how of collectively oscillating, quantum mechanically entangled, many-body surface ‘patches’ of protons or deuterons ($p^+$ or $d^+$) on loaded metallic hydride surfaces become locally coupled to nearby entangled, collectively oscillating surface plasmon electrons ($e^-$) via local breakdown of the Born-Oppenheimer approximation. This creates short-range, nuclear-strength local electric fields above $2 \times 10^{11}$ Volts/meter in the vicinity of such ‘patches.’ Per well-accepted quantum electrodynamics principles outlined in Landau & Lifshitz, local surface plasmon electrons bathed in such high E-fields can experience substantial increases in their effective masses, which after key local E-field strength thresholds are exceeded, in turn enables significant numbers of such ‘heavy’ electrons to react directly with protons or deuterons to produce neutrons via a weak interaction ($p + e \rightarrow 1n + \textit{neutrino}$ or $d + e \rightarrow 2n + \textit{neutrino}$). Neutrons produced collectively in such many-body weak reactions in condensed matter (in discrete nanoscale LENR-active surface sites) have huge quantum mechanical DeBroglie wavelengths that must perforce span the physical dimensions of many-body ‘patches’ in which they were created (from a nanometer up to perhaps 100 microns in diameter). Such neutrons will necessarily have “*ultra low momentum*” (i.e., extraordinarily low kinetic energy) and thus enormous capture cross-sections on any nearby nuclei located within the ~spherical envelope of ULM neutrons’ spatially extended DeBroglie wave functions. Collectively produced ULM neutrons will thus be captured locally. Therefore, large, externally detectable fluxes of energetic neutrons will not typically be observed. This strong prediction of W-L theory is consistent with 20+ years of experimentation in LENRs; explains exactly why lethal fluxes of energetic neutrons are never produced. This paper also clearly explains why the Coulomb barrier is a non-issue in LENRs; being uncharged neutral particles there is no such barrier to local capture of ULM neutrons by ‘target’ nuclei. Lastly, there is no “*new physics*” used anywhere in this paper.

***"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

Synopsis: rigorously explains physics details of exactly how heavy-mass surface plasmon electrons found in high-E-field LENR-active ‘patches’ located on metallic hydride surfaces have a unique ability to absorb outgoing or incoming gamma photons, convert them directly to larger numbers of much lower-energy infrared E-M photons (conservation of energy applies) at high efficiencies, and then emit down-shifted infrared radiation effectively as thermal ‘heat’ into the local environment. ‘Automatic’ local conversion of gamma photons occurs in the energy range from ~0.5 - 1.0 MeV all the way up to ~10.0 - 11.0 MeV; gamma radiation outside of that range of energies is unaffected and is not converted. The heavy electron down-conversion emission spectrum also includes a small, highly variable ‘tail’ consisting of ’soft ’X-rays that has only occasionally been observed and measured experimentally; at present it is incompletely understood. This paper explains exactly why lethal fluxes of gamma radiation are essentially never produced in condensed matter LENR systems; this strong theoretical prediction is also consistent with 20+ years of experimentation in LENRs. Similarly, there is no “*new physics*” used anywhere in this paper.

***“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
US Patent #7,893,414 filed in 2005 and issued by the USPTO on February 22, 2011
http://www.slideshare.net/lewisglarsen/us-patent-7893414-b2

Synopsis: USPTO examined, granted, and issued a method and apparatus patent assigned to Lattice Energy LLC concerning a novel, revolutionary low-mass gamma shielding invention that was based upon the physics and theoretical principles explained in the September 2005 Widom & Larsen arXiv preprint.

***"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

Synopsis: in the mid-1990s, both George Miley (Ni-H aqueous electrolytic experiments, University of Illinois, USA) and Takahiko Mizuno (Pd-D aqueous electrolytic experiments, Hokkaido University, Japan) published singularly comprehensive analyses of LENR transmutation products observed post-experiment that were exhaustively detected and systematically analyzed with a suite of well-recognized techniques used for measuring isotopes (e.g., neutron activation analysis - NAA, secondary-ion mass spectrometry - SIMS, etc.). From those transmutation product measurements, they were able to calculate implicit rates of isotope/element production for particular values of *amu* (atomic mass unit, collectively referred to as A) in the range of hydrogen (A = 1) all the way out past the *amu* value of elemental Lead (Pb, A ~ 208). When these experimentally observed rates were then plotted as graphs of apparent isotope/element production rate (y-axis) versus A (x-axis, with amu value going from 1 out to past 200), they showed a remarkable series of five (5) particularly spaced product 'peaks' and 'valleys' (essentially equivalent to experimental abundances of measured isotopes/elements) that were extraordinarily similar in both the Miley and the Mizuno datasets, even though Miley used a Nickel (Ni) cathode light-Hydrogen $H_2O$ system and Mizuno used a Palladium (Pd) heavy hydrogen (Deuterium – $D_2O$) system. This important result strongly suggested that the underlying mechanism which created the observed LENR transmutation products was exactly the same process in both types of systems. Miley & Mizuno's LENR experimental 'abundance' data also exhibited striking similarities to charts of solar system elemental abundances already published by astrophysicists. Since the astrophysical community believes that elements above the mass of Iron (Fe) are produced by neutron-capture processes occurring in stars and supernova explosions, it is not illogical to think that ULM neutron capture transmutation processes might potentially produce somewhat similar isotope/element production patterns in LENR condensed matter systems here on earth. In fact, this paper uses a simple, two-parameter theoretical 'optical' neutron absorption model (no data-fitting whatsoever) to show exactly how Miley & Mizuno's distinct 5-peak pattern of observed LENR product abundances were produced. It shows quantitatively why the 5-peak abundance pattern represents a unique signature ('fingerprint') of ULM neutron capture processes occurring in condensed matter LENR systems.

***"Theoretical Standard Model Rates of Proton to Neutron Conversions near Metallic Hydride Surfaces"***
A. Widom and L. Larsen (Sep 2007)
http://arxiv.org/PS_cache/nucl-th/pdf/0608/0608059v2.pdf

Synopsis: since the 1940s, it was widely assumed in the nuclear physics community that $e + p$ or $e + d$ weak reactions were totally impractical as a method for producing neutrons that could be used to catalyze energy-releasing nuclear transmutation reactions. This belief was widely-held among physicists because they thought (not unreasonably) that the physical conditions which would allow such reactions to occur at substantial (versus thought-to-be minuscule) rates were probably unattainable in terrestrial real-world laboratory systems. For example, astrophysicists have long accepted the idea that such weak reactions occur at very high rates (in a process is called "*neutronization*") during non-equilibrium gravitational collapse of a stellar core. However, the maelstrom of vast energies found in highly ionized plasmas located inside a huge collapsing star is a far cry from a comparatively tiny, aqueous LENR chemical cell resting placidly on a laboratory bench here on earth. Therefore, to be believable, a key question that any weak-interaction based theory of LENRs must necessarily answer is exactly why and how $e + p$ or $e + d$ weak reactions can potentially occur at high rates in condensed matter systems under modest conditions of temperature and pressure. Accordingly, using rigorous, very difficult and lengthy first-principles calculations for a model current-driven electrolytic cell, this paper explains physics details of exactly how and why LENR ULM neutron production can occur at surprisingly large rates in laboratory systems under such 'mild' physical conditions. Contrary to longstanding beliefs, this paper concludes that such ULM neutron production rates are in fact theoretically achievable in condensed matter and that our calculated results for such rates in a model electrolytic chemical cell (on the order of $10^{12}$ to $10^{14}$ neutrons $cm^2$/second) are in good agreement with the best available published experimental data.

  

***"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

Synopsis: in this paper, the many-body collective features of the Widom-Larsen theory of LENRs are further extended to cover cases of LENRs that can occur in exploding wires, prosaic electrical arcs, and natural atmospheric lightning; systems that comprise vastly lower density, gaseous ionized plasmas. Conceptually, such systems are treated as magnetically organized, plasma-filled structures having tubular geometries. The paper explains exactly how longer range many-body collective *magnetic* field effects can induce substantial production of neutrons via weak *e* + *p* reactions in such organized structures, both in the laboratory and in Nature. In such magnetically dominated LENR regimes, energy required to drive weak interaction neutron production is transferred and delivered to embedded charged particles (e.g., electrons) through much longer-range collective *magnetic* field effects. Thus, the physics of this regime differs somewhat from W-L physics that applies to micron-scale LENR-active regions found on condensed matter surfaces whereon nuclear-strength, very localized *electric* fields provide energy needed to drive ULM neutron production via weak interactions. Also note especially that: (a) neutrons produced via weak interactions in ionized plasmas away from condensed matter surfaces will not necessarily be ultra low momentum --- those neutrons can have very substantial kinetic energies; (b) in exploding wires, lightning, and solar flux tubes, high local electric fields may also occur simultaneously on surfaces of any condensed matter metallic nanoparticles that happen to be embedded in the confines of such organized tubular structures --- when that is the case, the LENR physics occurring on surfaces of condensed matter particles located inside such 'dusty' plasmas would be essentially the same as what happens with WLT on cathode surfaces in chemical cells; and (c) as the proportion of LENRs occurring in gaseous portions of a 'dusty' plasma versus the proportion occurring on surfaces of embedded nanoparticles increases (where the W-L heavy surface plasmon electron gamma to infrared conversion mechanism is most effective), observed energetic gamma radiation emanating from a dusty plasma will increase accordingly.

***"Errors in the quantum electrodynamic mass analysis of Hagelstein and Chaudhary"***
A. Widom, Y. N. Srivastava, and L. Larsen (Feb 2008)
http://arxiv.org/pdf/0802.0466v2.pdf

Synopsis: this paper identifies and discusses serious errors in Hagelstein & Chaudhary's deeply flawed criticism of the Widom-Larsen mechanism for increasing effective masses of surface plasmon electrons. In Widom, Srivastava & Larsen's view, their claimed 'problems' with W-L theory were decisively refuted in this paper. Readers are strongly urged to read Hagelstein & Chaudhary's paper, study the rebuttal, and then decide for themselves whether the asserted 'issues' were satisfactorily addressed by W-L authors.

***"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

Synopsis: in this paper the Widom-Larsen theory's many-body collective magnetic mechanism on very large length scales with high-proton-and-electron-current plasmas with tubular geometries is extended to include organized magnetic structures called "flux tubes" that frequently occur on and around the 'surface' of the sun and are also involved in spectacular astronomical events like solar flares and coronal mass ejections. Application of the W-L collective many-body theoretical paradigm to this magnetically dominated system is used to explain the longstanding mystery of anomalous heating of the solar corona, which at millions of degrees is vastly hotter than the 4,000 - 6,000 K 'surface' temperature of the sun.

The paper's proposed mechanism for coronal heating involves a rather simple 'betatron-like' theoretical model; it utilizes a many-body collective magnetic process akin to what happens in an ordinary step-up electrical transformer. In this new model, magnetic fields that spatially organize solar flux tube structures operate to transfer magnetic energy from the comparatively dense plasma in the vicinity of the sun's 'surface' up to the region above the sun's surface where the vastly less dense solar corona is found. When solar magnetic energy is thus transferred from surface regions up to much smaller numbers of charged particles found in the corona (e.g., electrons) it increases their 'average' kinetic energy. In this manner, the process effectively causes local coronal heating which substantially increases the measured temperature of the solar corona relative to that of the sun's surface. The model also predicts that significant production of neutrons via weak interactions and substantial acceleration of charged particles can occur in solar flux tubes and violent events such as solar flares (essentially flux tubes that become dynamically unstable and 'explode' their magnetic fields, which rapidly 'dumps' magnetic energy into embedded charged particles which increases their kinetic energy) and coronal mass ejections (CME) that 'launch' huge balls of hot plasma outward into space, away from the sun's surface.

*A further implication of this paper is that significant amounts of nucleosynthesis can occur in flux tubes and flares well outside the boundaries of the sun's super-dense, super-hot core. This new idea is contrary to the longstanding belief that fusion processes occurring inside the stellar core are the only nuclear processes of any significance going on in the sun.*

There is experimental evidence for the new idea: it explains anomalous presence of short-lived radioactive isotopes and other unexpected heavy elements spectroscopically observed in atmospheres of "*chemically peculiar*" (CP) stars that have unusually high 'average' magnetic fields.

***"A primer for electroweak induced low-energy nuclear reactions"***
Y. N. Srivastava, A. Widom, and L. Larsen
*Pramana - Journal of Physics* **75** (4) pp. 617 - 637 (October 2010)
http://www.ias.ac.in/pramana/v75/p617/fulltext.pdf

Synopsis: this paper summarizes and explains the results of all previous technical publications about the W-L theory at a lower level of mathematical detail; unlike many earlier papers it is much more conceptually oriented.

Summarizing: "*Three seemingly diverse physical phenomena, viz., metallic hydride cells, exploding wires and the solar corona, do have a unifying theme. Under appropriate conditions which we have now well delineated, in all these processes electromagnetic energy gets collectively harnessed to provide enough kinetic energy to a certain fraction of the electrons to combine with protons (or any other ions present) and produce neutrons through weak interactions. The produced neutrons then combine with other nuclei to induce low-energy nuclear reactions and transmutations*."

Since the WLT impinges many areas of study, readers are urged to start with the "*Primer*" and then examine details in other papers as dictated by specific interests. Note again that in magnetically organized astrophysical plasmas (which typically occur on relatively large length-scales, as opposed to nanometers to microns for LENR processes in condensed matter) W-L theory involves many-body collective magnetic effects.

Also note that in large length-scale, magnetically dominated regimes, neutrons produced via weak interactions per W-L theory are not necessarily ultra low momentum (ULM). In stars' magnetic flux tubes and more violent events like solar flare 'explosions', neutrons and a varying array of other particles (e.g., protons, positrons) may be created at energies that range all the way up to 500 GeV and even beyond.

In the case of dusty astrophysical plasmas in regions where average temperatures are such that intact embedded dust grains and nanoparticles (which may be strongly charged) can exist for a time therein, W-L condensed matter LENRs producing ~ULM neutrons may also occur on the surfaces of such particles.

Also published in this paper for the first time are detailed calculations and a discussion about how the authors' collective many-body magnetic mechanism can accelerate particles to multi-GeV energies in solar flares. This acceleration mechanism is not only capable of accelerating protons in a solar flare to hundreds of GeVs but it also yields a high-energy positron flux which is a substantial fraction of the overall cosmic ray positron flux; at the time of publication, the authors were unaware of any similar theoretical estimate published in the literature.