A Basic Introduction to the Widom-Larsen Theory

Steven B. Krivit
Publisher, New Energy Times, USA
Email: steven3@newenergytimes.com S.B. Krivit

In March 1989, electrochemists Martin Fleischmann and Stanley Pons reported the results of their deuterium-palladium experiments, setting off a firestorm of controversy. [1] In October 1989, Edward Teller, a highly respected physicist, in a meeting sponsored by the U.S. National Science Foundation and the Electric Power Research Institute, applauded those organizations for their courage in objectively examining this new area of research.

Teller thought possible what others did not: "Perhaps a neutral particle of small mass and marginal stability is catalyzing the reaction. You will have not modified any strong nuclear reactions, but you may have opened up an interesting new field." The new field of LENR research had begun.

In 2006, Allan Widom and Lewis Larsen, two relative newcomers to the field, published a theory in a peer-reviewed, mainstream journal to explain many of the experimentally observed results seen in LENRs.[2] The proposed theory comprises four basic steps:

1. Creation of Heavy Electrons: Electromagnetic radiation in LENR cells creates localized regions of very high E-M fields on the surfaces of metallic hydrides or deuterides. Groups of surface plasmon polariton (SPP) electrons at the metallic interface, through a mass renormalization process, contribute some of their energy to an individual SPP electron. This collective effect increases the SPP electron mass by at least 0.78 MeV, becoming a heavy SPP electron.

2. Creation of ULM Neutrons: A heavy SPP electron and a proton combine through a neutronization process, producing a neutron that has ultra-low-momentum (ULM) and a neutrino.

3. Capture of ULM Neutrons: That ULM neutron is captured by a nearby nucleus, increasing its mass and producing either a new, stable isotope or an isotope unstable to decay.

4. Creation of New Elements: If unstable, the isotope may undergo alpha decay, producing helium-4 and a lower-Z residual atom. Alternatively, the unstable isotope may undergo beta decay, emitting an electron and producing a higher-Z residual atom.

Initially, the Widom-Larsen theory gained appreciable recognition, particularly from people outside the field. But by 2008, that recognition set off another firestorm of controversy, with objections coming mostly from inside the field. Many, if not all, of the objections stemmed from the fact that the Widom-Larsen theory looks at the (now) old problem of LENRs with an entirely different lens: not as fusion but as neutron-catalyzed reactions reliant on weak interactions and collective, many-body effects. But for many scientists, these areas of physics were unfamiliar ground compared with the more familiar two-body, strong-force fusion and fission interactions.

Scientists also considered it improbable that a free electron, outside of an atomic nucleus, could be captured by a proton at low energies. But decades earlier, none other than Albert Einstein thought it would be possible by using collective effects. In an Aug. 30, 1951, letter Einstein sent to Cornell graduate Ernest Sternglass about his successful neutron-producing low-energy experiments, Einstein wrote, "Perhaps reactions occur in which multiple electrons simultaneously transfer energy to one proton. According to quantum theory, this is somewhat conceivable, although not probable."

Decades later, other heavy-electron research at Princeton University showed how electrons moving in certain solids can behave as though they are 1,000 more massive than free electrons." [3,4]

For a decade, this author engaged in extensive discussion and correspondence with Lewis Larsen, the developer of the Widom-Larsen theory, who died in 2019. For the first time, this paper provides a concise, basic introduction to the main concepts of the theory as well as ideas on how the theory could be exploited for LENR experiments.

[1] M. Fleischmann and S. Pons, *Journal of Electroanalytical Chemistry*, **261**(2) (1989) pp. 301-308
[2] A. Widom and L. Larsen, *Eur. Phys. Journal C - Particles and Fields*, **46**(1) (2006) pp. 107-110
[3] C. Zandonella, Princeton University News, June 13, 2012
[4] A. Yazdani, *Nature*, 486 (2012), pp. 201-206