Lattice Energy LLC

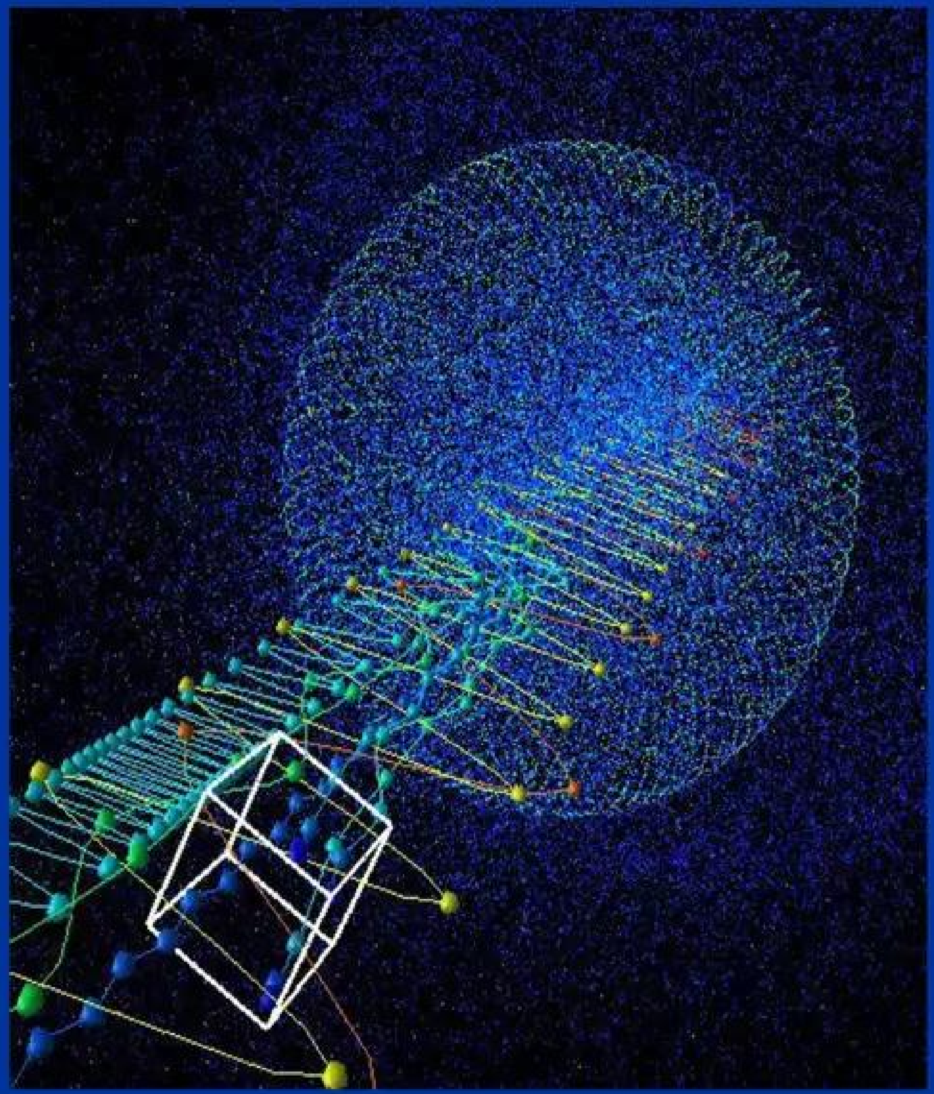
Commercializing a Next-Generation Source of Safe Nuclear Energy

Low Energy Nuclear Reactions (LENRs)

‘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 would be ideal to detect possible transmutation products



Electron Cloud Simulation
Credit: A. Adelman (PSI)

Lewis G. Larsen

President and CEO

March 13, 2012

“If you haven't found something strange during the day, it hasn't been much of a day.”

John Wheeler

Quoted in Charles Birch, *Biology and the Riddle of Life* (1999)

Prof. Wheeler first coined the term “black hole” in 1968

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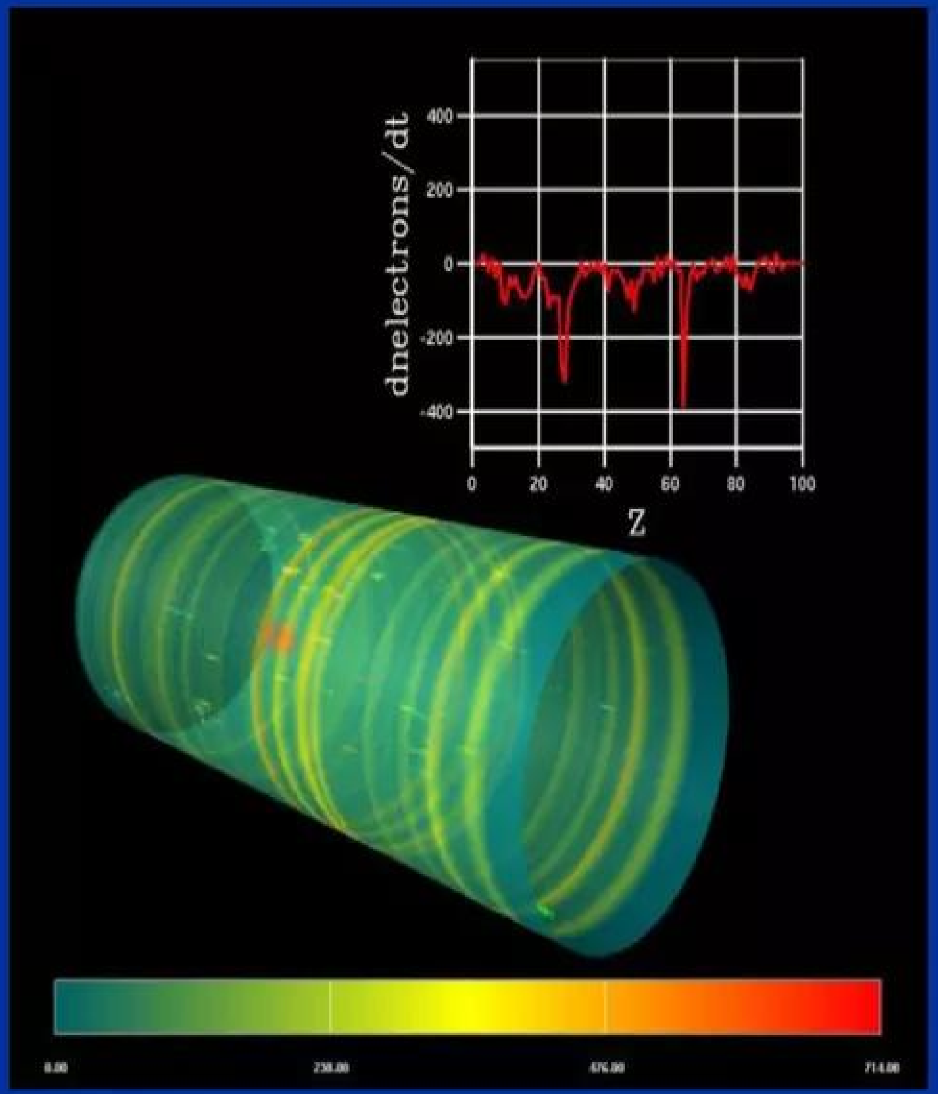


Proton Beam with Electron Cloud
Credit: A. Adelman (PSI)

Lattice Energy LLC

Isotopic analysis of 'UFOs' and exposed surfaces in the LHC

This is one part of a two-part Addendum to an earlier Lattice Energy LLC document dated December 7, 2011, as follows:

"Are Low Energy Nuclear Reactions (LENRs) producing troublesome Unidentified Falling Objects (UFOs - micron-scale 'dust' particles) observed in Large Hadron Collider (LHC)? Should somebody look?"

http://www.slideshare.net/lewisglarsen/lattice-energy-llccould-lenrs-be-producing-ufos-in-large-hadron-colliderdec-7-2011

In this two-part Addendum dated March 13, 2012, Lattice provides more details about its previous speculation that LENRs could potentially be occurring at scattered locations in the LHC and maybe producing some of the observed 'UFO' macroparticles; its preparation was prompted by interesting new presentation about UFOs in the LHC by Tobias Baer dated December 13, 2011, as follows:

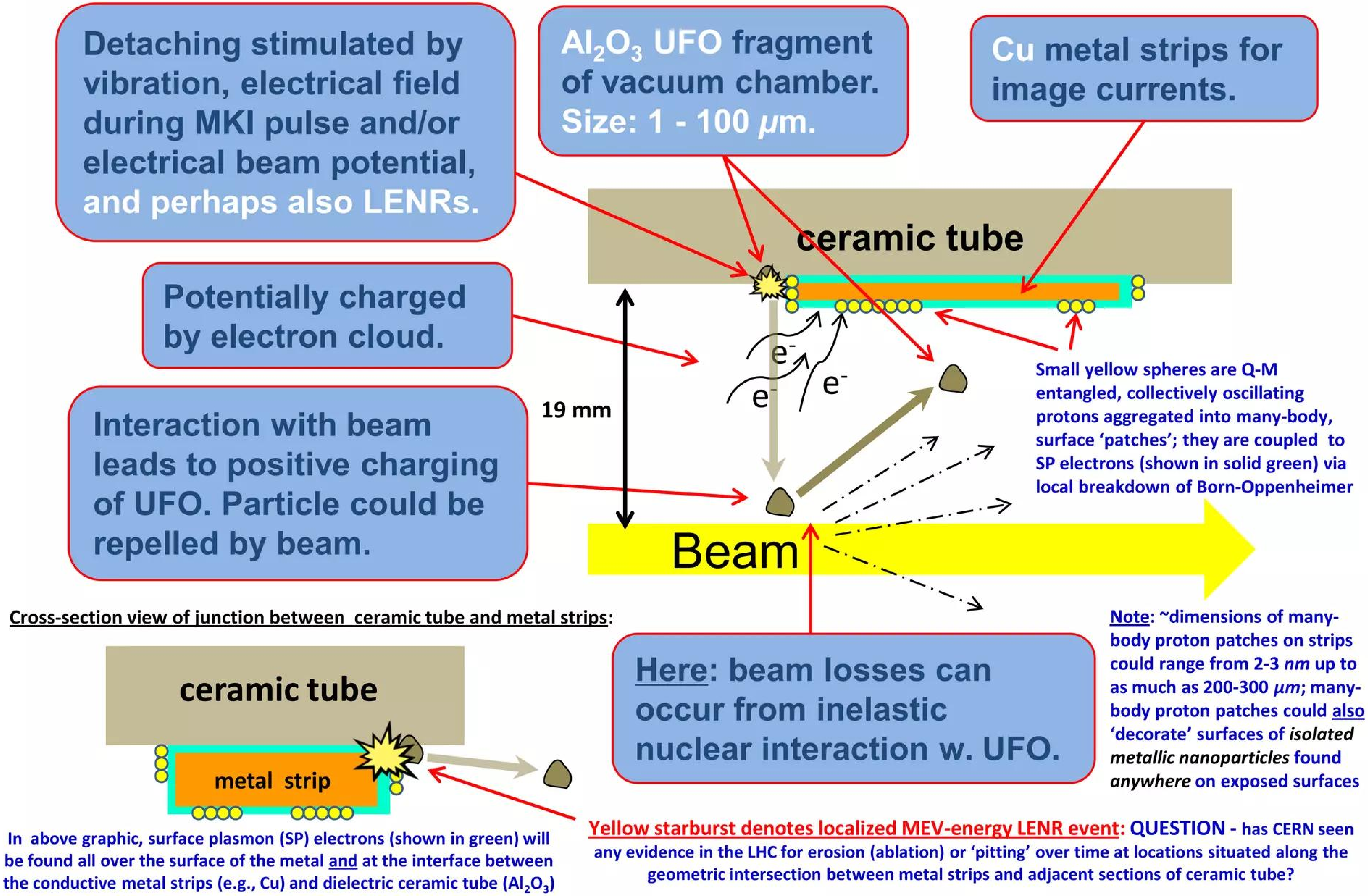
"UFOs in the LHC"
Tobias Baer (CERN) MS-PowerPoint presentation - 32 slides
Evian Workshop 2011 - December 13, 2011
http://indico.cern.ch/getFile.py/access?contribId=27&sessionId=5&resId=3&materialId=slides&confId=155520

This PowerPoint focuses mainly on why a Cameca NanoSIMS 50 would likely be an ideal instrument to look for LENR transmutation products inside the LHC; the companion Addendum document also dated March 13, 2012, is a textually-oriented Lattice technical report also available on SlideShare. Please note that selected slides from another Lattice document have been inserted into this PowerPoint for clarification of certain points and to make this presentation somewhat more self-contained; see:

"Nickel-seed LENR Networks"
Lewis Larsen - April 20, 2011 [61 slides]
http://www.slideshare.net/lewisglarsen/lattice-energy-llcnickelseed-lenr-networksapril-20-2011

Electron Cloud Simulation. - Credit: A. Adelman (PSI)

UFO Model – Adapted from T. Baer (Dec.13, 2011)



Extracted from T. Baer's Dec. 13, 2011 slide presentation and then adapted by Lewis Larsen - Lattice Energy LLC - March 13, 2012

Lattice Energy LLC

Isotopic analysis of 'UFOs' and exposed surfaces in the LHC

Comments regarding graph extracted from Slide#12 shown in T. Baer (Dec.13, 2011) Shows an EDX elemental surface analysis of a collected 'UFO' macroparticle

The unique isotopic spatial resolution capabilities of a NanoSIMS machine are needed in this particular situation because, being extremely energetic as a result of supporting local nuclear reactions, an LENR-active site with dimensions on the order of say ~1,000 *nm* (1 *μm*) or less occurring in close proximity to some alumina substrate could probably generate enough 'oomph' to locally damage the Al_2O_3 matrix and blow-out a much larger, multi-micron-sized chunk of local Al_2O_3 which then becomes a UFO macroparticle. Such a UFO produced by a LENR-active surface site might or might not show direct evidence in the form of observable LENR transmutation products, and if they really were produced thereon, *they might only be physically present on a small percentage of a given UFO's exterior surface.*

This is exactly why something like a NanoSIMS machine is ideal to properly study LHC's UFO macroparticles; same is true for any exposed interior surfaces inside the LHC whereupon one suspects that LENRs may have occurred in widely scattered, seemingly random locations.

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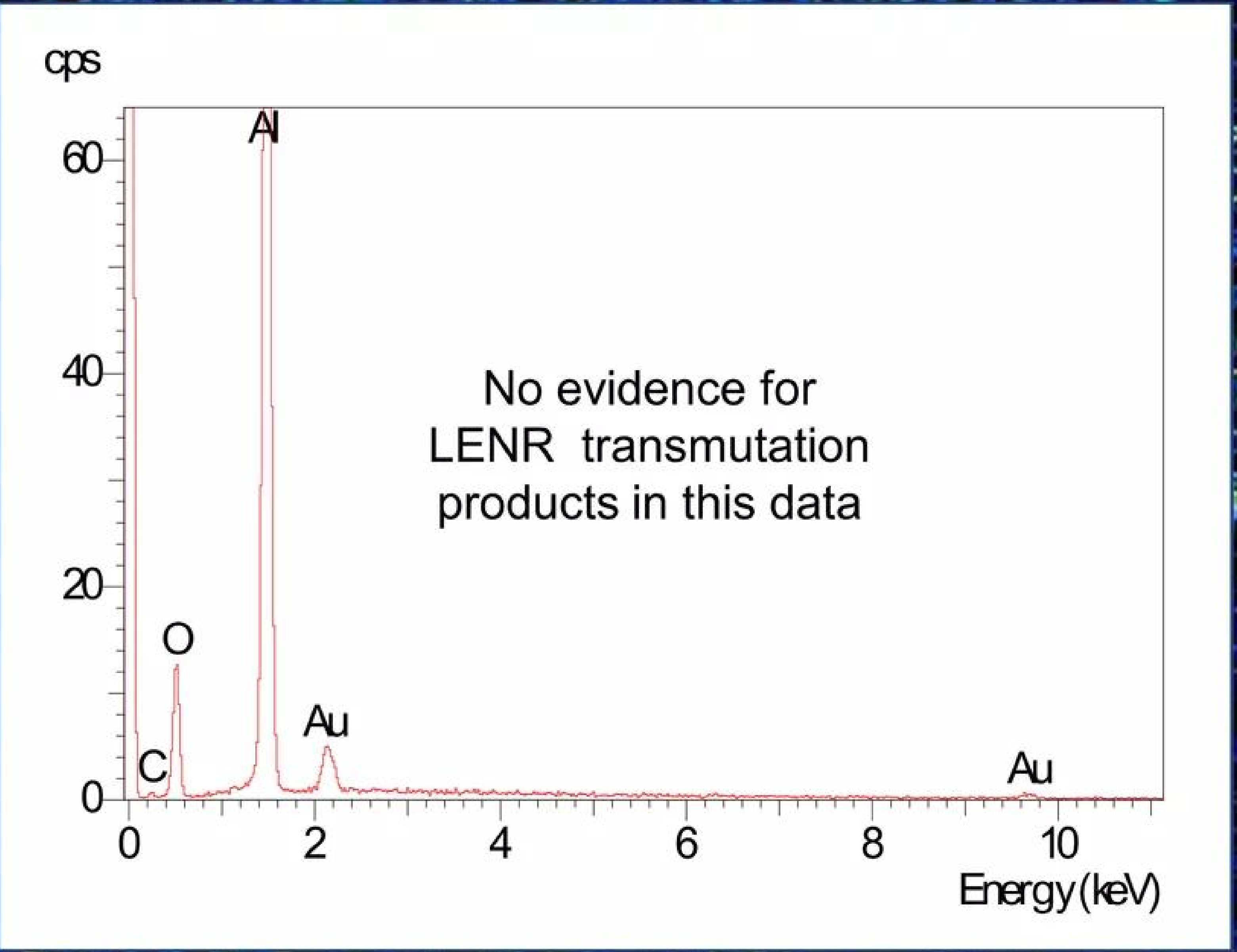
Electron Cloud Simulation - Credit: A. Adelman (PSI)



The above extracted graph shows an EDX elemental scan of the surface of a selected 'UFO' macroparticle; Oxygen (O) and Aluminum (Al) peaks shown therein are most likely derived from tubes' Al_2O_3 alumina ceramic found in beam tubes. However, where is the Carbon (C) peak coming from? Is it derived from some prosaic organic molecular contaminant present inside the LHC (e.g., stopcock grease)? Lastly, where is the small Gold (Au) peak coming from? The obvious Au source would be gold plating present on the 'fingers' of MKIs; that said, Au's presence on the surface of a UFO macroparticle may imply that at least some sort of an ablation process is occurring somewhere on MKI fingers' surfaces. If so, what exactly might be happening thereon? *There is no apparent evidence for the presence of potential LENR transmutation products in this set of analytical data.*

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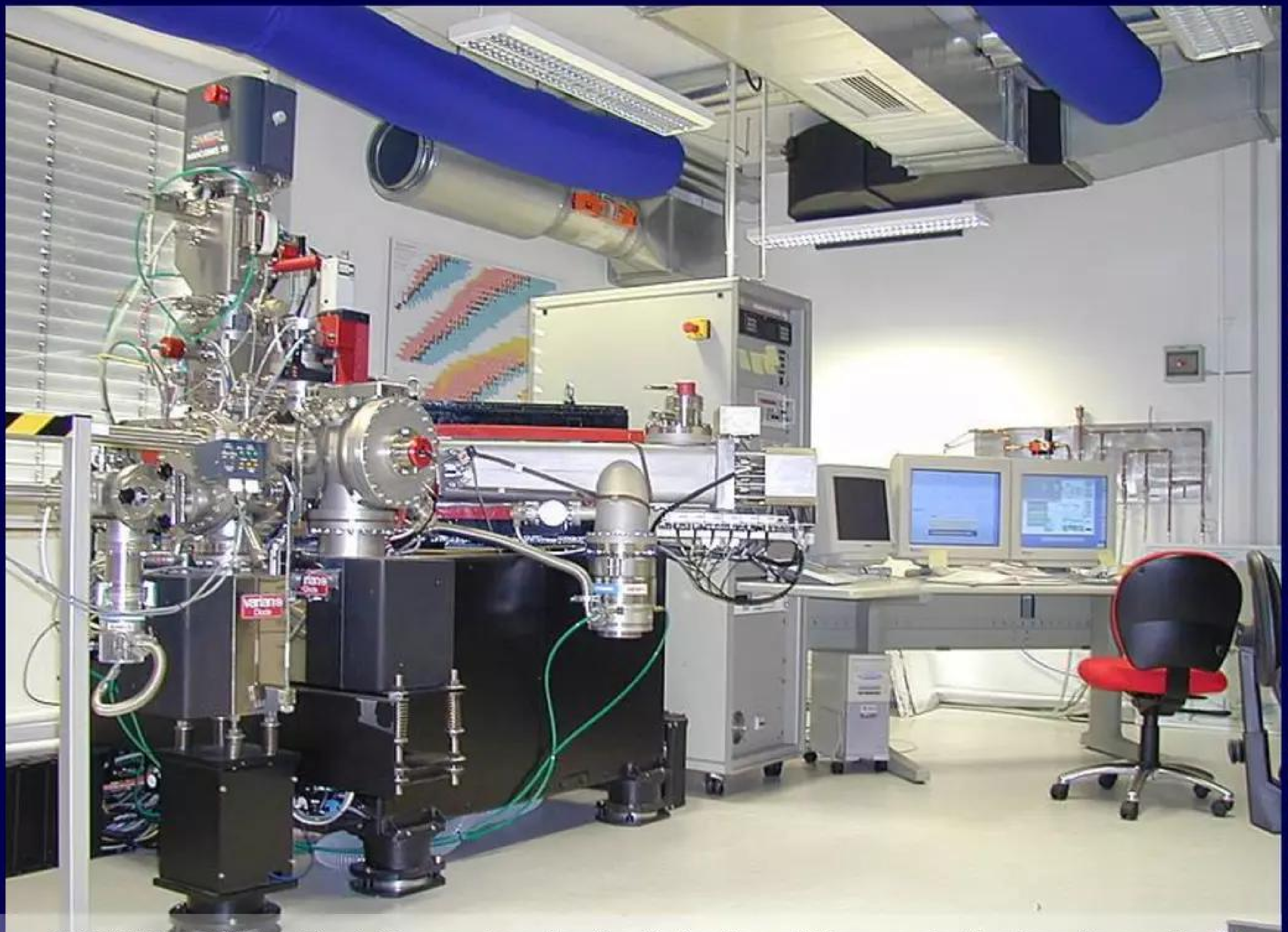
Isotopic analysis of 'UFOs' and exposed surfaces in the LHC

Cameca NanoSIMS 50


MADONNA (MAinz Dust Observatory for the Detection of Nanoscale Nuclear Anomalies)

As installed at the Max Planck Institute for Chemistry in Spring 2001

http://www.imago.com/instruments-for-research/nanosims.aspx
http://www.imago.com/applications/materials/ns-trace-element-yag.aspx

Electron Cloud Simulation. - Credit: A. Adelman (PSI)

W-L mechanism in condensed matter LENR systems

Weak interaction processes are very important in LENRs

1. E-M radiation on metallic hydride surface increases mass of surface plasmon electrons

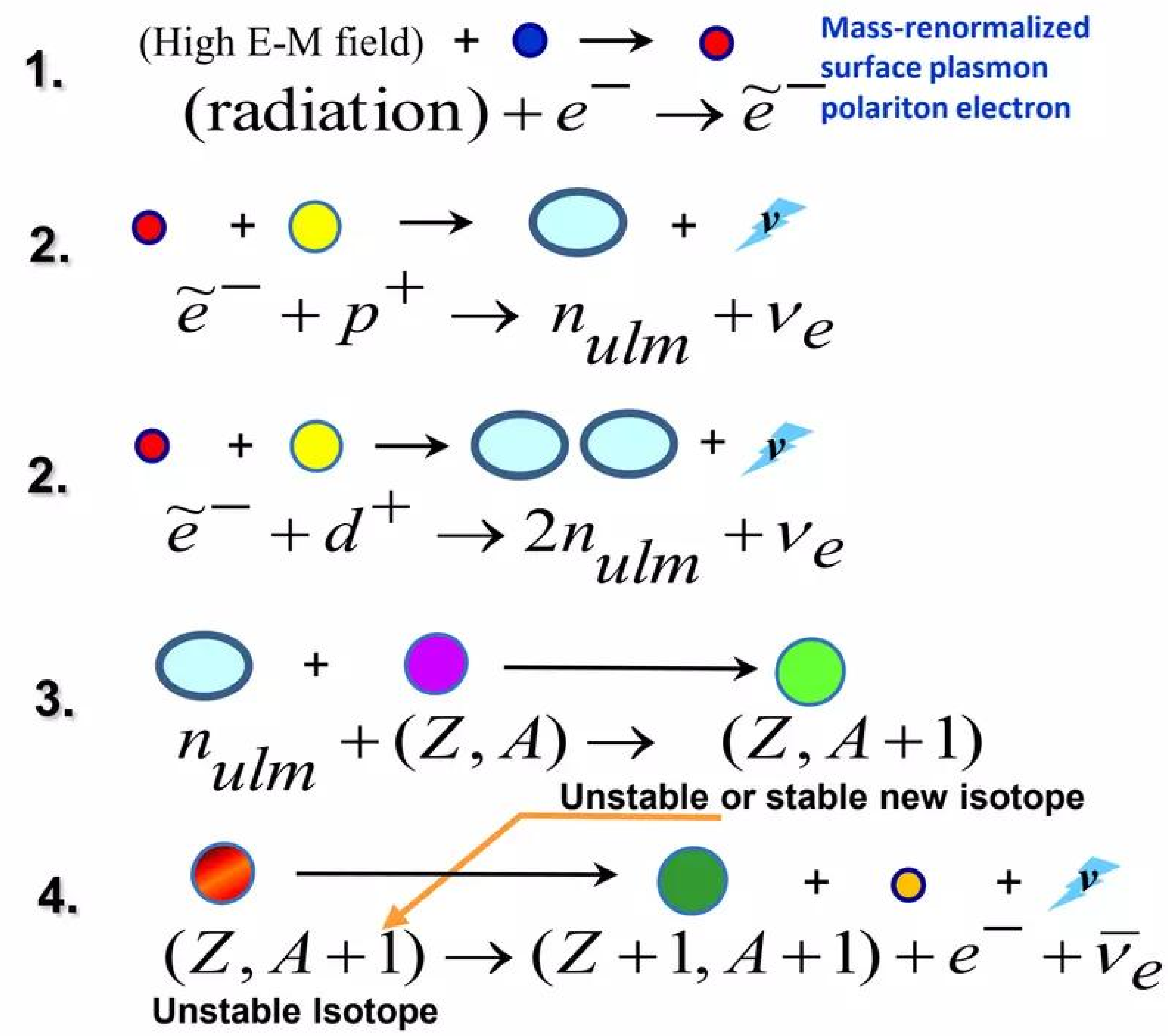
2. Heavy-mass surface plasmon polariton electrons react directly with surface protons (p^+) or deuterons (d^+) to produce ultra low momentum (ULM) neutrons (n_{ulm} or $2n_{ulm}$, respectively) and an electron neutrino (ν_e)

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^-); and an antineutrino

➡ Note: colored shapes associated with diagram on next Slide

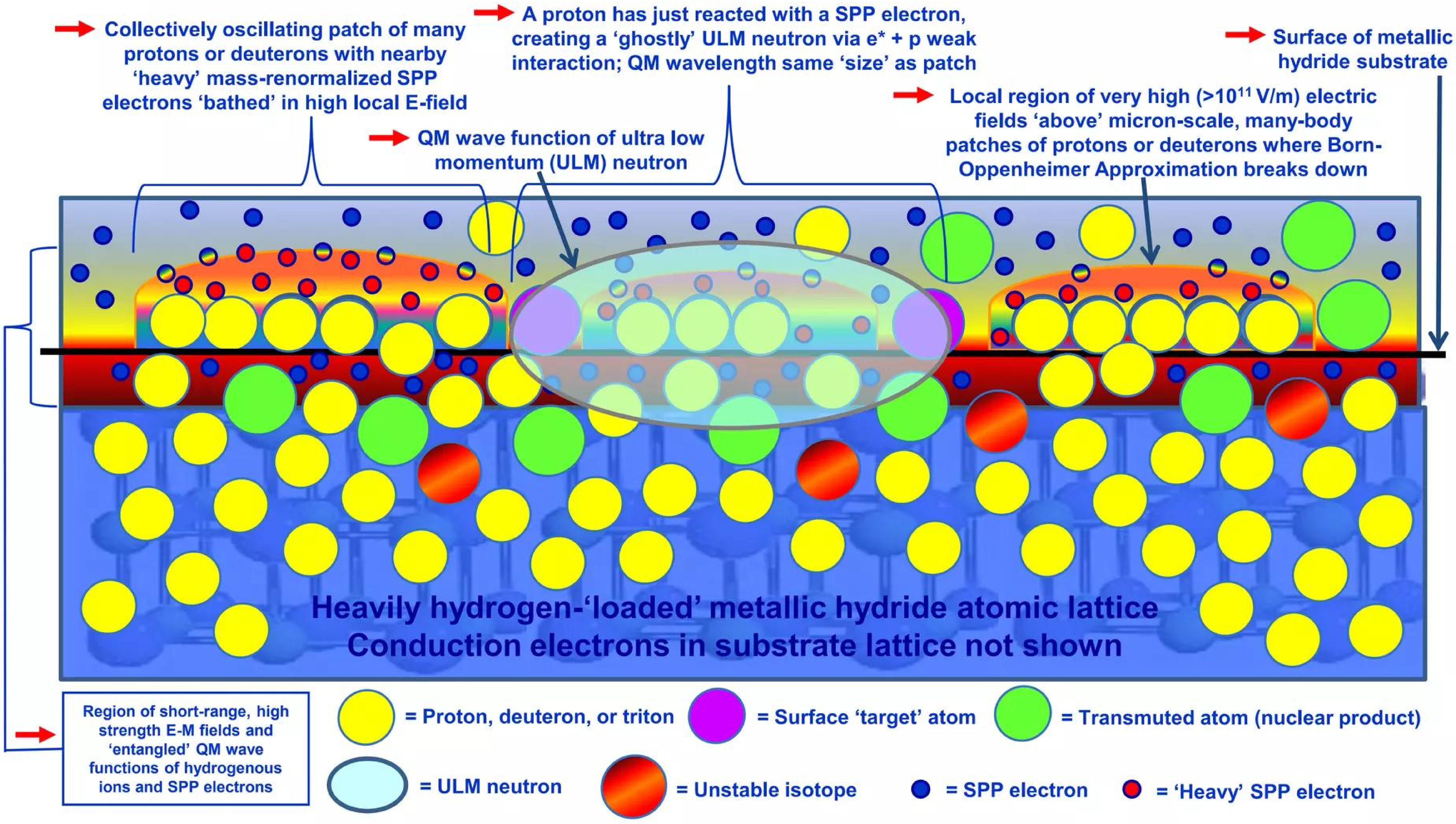
➡ **No strong interaction fusion or heavy element fission occurring below; weak interaction $e + p$ or $e + d$**



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

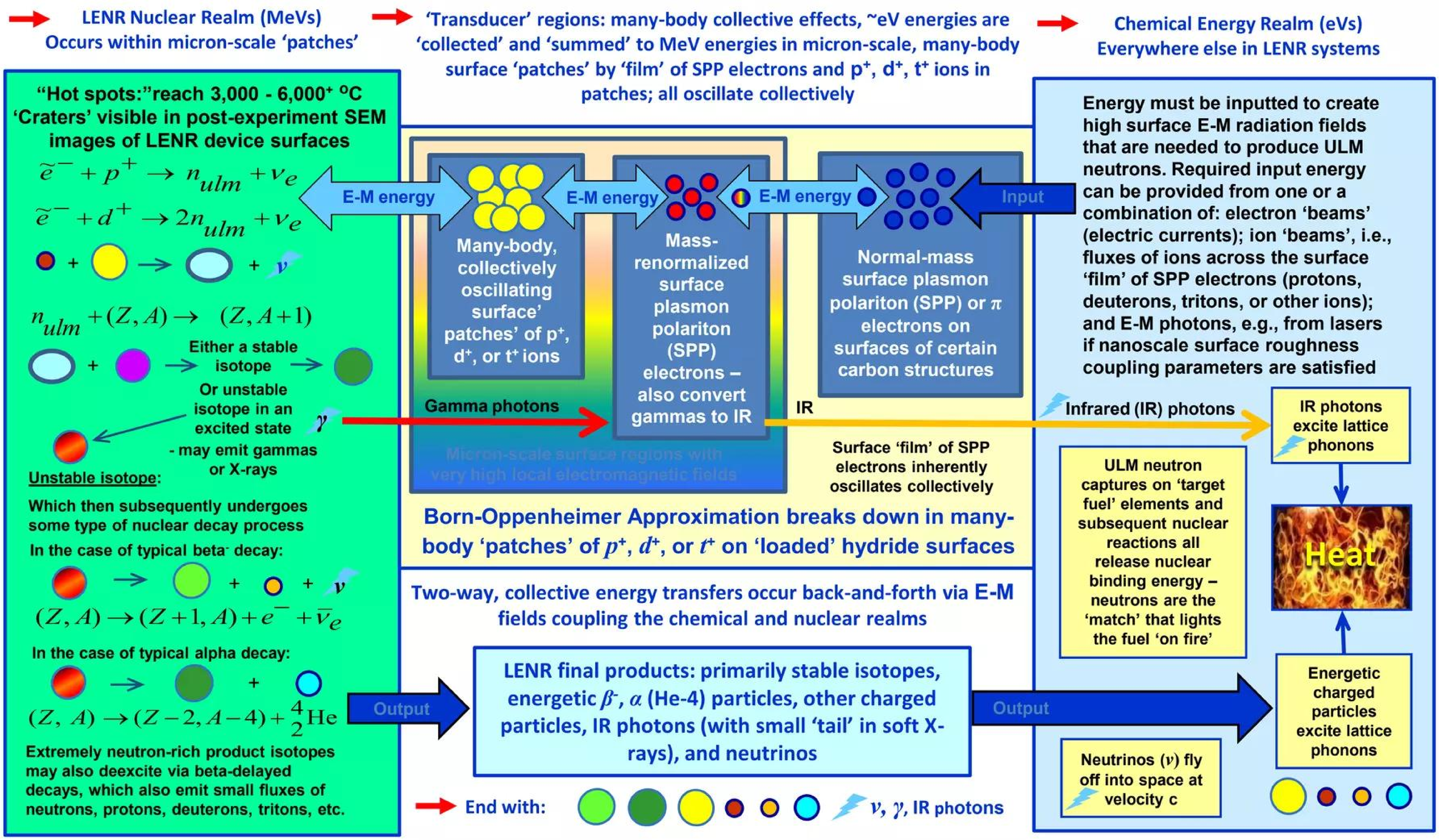
Conceptual details: W-L mechanism in metallic hydrides

Side view – not to scale – charge balances in diagram only approximate



High level overview: W-L mechanism in condensed matter

Chemical and nuclear energy realms can interconnect in small regions



What is required for LENRs to occur in condensed matter?

Key factors for initiation and operation

- ✓ Substantial quantities of Hydrogen isotopes must be brought into intimate contact with 'fully-loaded' metallic hydride-forming metals; e.g., Palladium, Platinum, Rhodium, Nickel, Titanium , Tungsten, etc.; please note that collectively oscillating, 2-D surface plasmon (SP) electrons are intrinsically present and cover the surfaces of such metals. At 'full loading' of H, many-body, collectively oscillating 'patches' of protons (p^+), deuterons (d^+), or tritons (t^+) will form spontaneously at random locations scattered across such surfaces
- ✓ Or, delocalized collectively oscillating π electrons that comprise the outer 'covering surfaces' of fullerenes, graphene, benzene, and polycyclic aromatic hydrocarbon (PAH) molecules behave very similarly to SPs; when such molecules are hydrogenated, they can create many-body, collectively oscillating, 'entangled' quantum systems that, within context of W-L theory, are functionally equivalent to loaded metallic hydrides
- ✓ Born-Oppenheimer approximation breaks down in tiny surface 'patches' of contiguous collections of collectively oscillating p^+, d^+, and/or t^+ ions; enables E-M coupling between nearby SP or π electrons and hydrogen ions at these locations --- *creates local nuclear-strength electric fields*; effective masses of coupled electrons are then increased to some multiple of an electron at rest ($e \rightarrow e^*$) determined by required simultaneous energy input(s)
- ✓ System <u>must</u> be subjected to external non-equilibrium fluxes of charged particles or E-M photons that are able to transfer input energy directly to many-body SP or π electron 'surface films.' Examples of such external energy sources include (they may be used in combination): electric currents (electron 'beams'); E-M photons (e.g., emitted from lasers, IR-resonant E-M cavity walls, etc.); pressure gradients of p^+, d^+, and/or t^+ ions imposed across 'surfaces'; currents of other ions crossing the 'electron surface' in either direction (ion 'beams'); etc. Such sources provide additional input energy that is required to surpass certain minimum H-isotope-specific electron-mass thresholds that allow production of ULM neutron fluxes via $e^* + p^+$, $e^* + d^+$, or $e^* + t^+$ weak interactions
- ✓ <u>N.B.</u>: please note again that surface plasmons are collective, many-body electronic phenomena closely associated with interfaces. For example, they can exist at gas/metal interfaces or metal/oxide interfaces. Thus, surface plasmon oscillations will almost certainly be present at contact points between purely metallic surfaces and adsorbed 'target' nanoparticles composed of metallic oxides, e.g., PdO, NiO, or TiO_2, etc., or vice-versa

Technical side note: ULM neutron capture cross-sections

- ✓ **Unlike energetic neutrons produced in most nuclear reactions, collectively produced LENR neutrons are effectively 'standing still' at the moment of their creation in condensed matter. Since they are vastly below thermal energies (ultra low momentum), ULM neutrons have huge DeBroglie wavelengths (from *nm* to ~100 *microns*) and accordingly large capture cross-sections on nearby nuclei; most or all will be locally absorbed; few will be detectable as 'free' neutrons**
- ✓ **For the vast majority of stable and unstable isotopes, their neutron capture cross-section (relative to measurements of cross-sections at thermal energies where *v* = 2,200 *m/sec* and neutron DeBroglie wavelength is ~2 *Angstroms*) is proportional to ~1/*v*, where *v* is velocity of a neutron in *m/sec*. Since *v* is extraordinarily small for ULM neutrons, their capture cross-sections on atomic nuclei will therefore be correspondingly larger. After being collectively created, an enormous percentage of the ULMNs produced will be locally absorbed before scattering on nearby atoms can elevate them to thermal kinetic energies; per Prof. S. Lamoreaux (Yale) thermalization would require ~0.1 to 0.2 *msec*, i.e. 10^{-4} *sec*., a very long time on typical 10^{-16} - 10^{-19} *sec*. time-scale of nuclear reactions**

***Please note*: ultra low momentum (ULM) neutrons have enormous absorption cross-sections on 1/v isotopes. For example, Lattice has estimated the ULMN fission capture cross-section on U-235 to be ~1 million barns (b) and on Pu-239 at 49,000 b, vs. ~586 b and ~752 b, respectively, for 'typical' neutrons at thermal energies**

A neutron capture expert recently estimated the ULMN capture cross-section on He-4 at ~20,000 b vs. a value of <1 b for thermal neutrons; this is a huge increase

By comparison, the highest known thermal n capture cross section for any stable isotope is Gadolinium-157 at ~49,000 b

The highest measured cross-section for any unstable isotope is Xenon-135 at ~2.7 million b

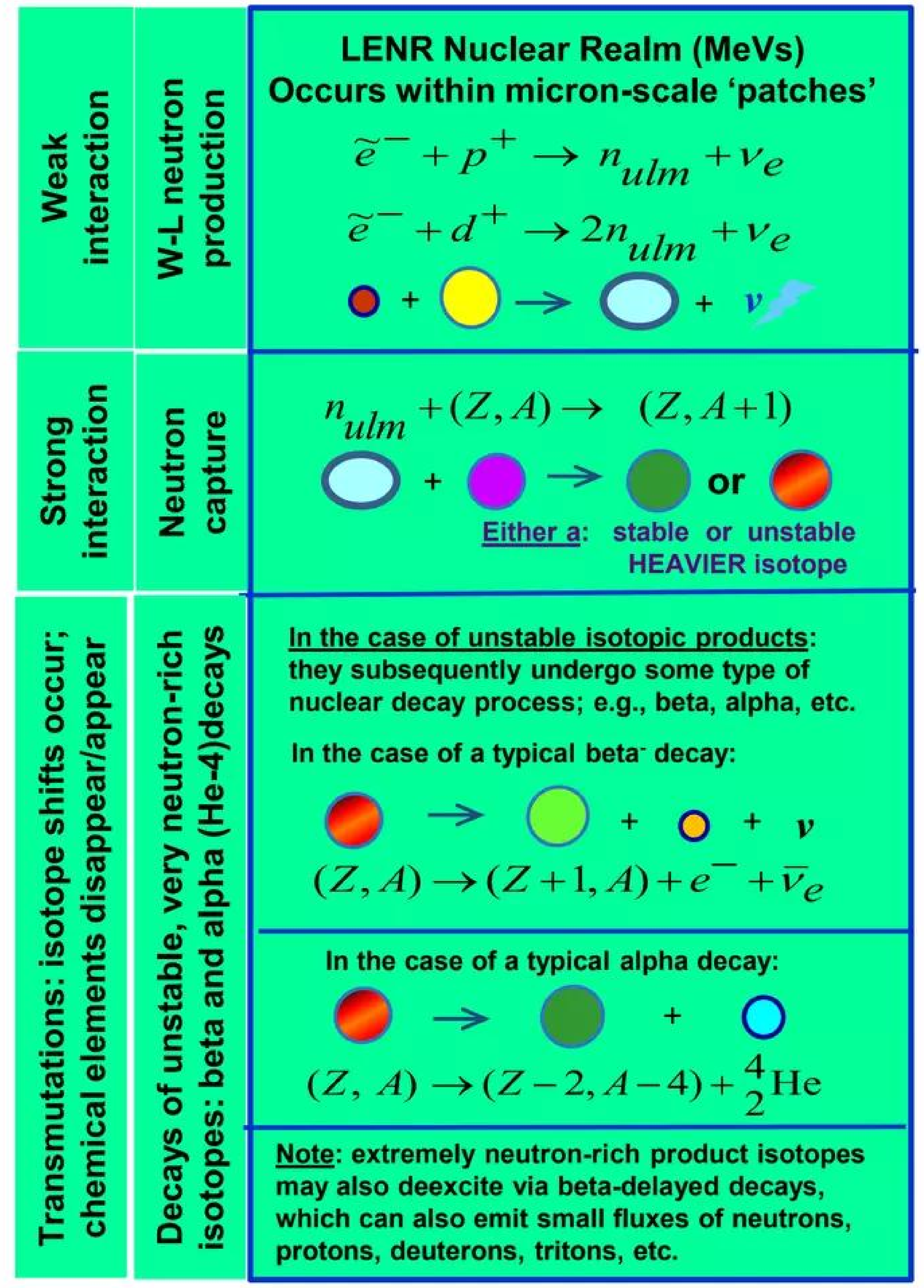
***Crucial technical point*: ULMNs have many-body scattering, NOT 2-3 body scattering as, for example, in stellar plasmas or thermalized neutrons traveling through condensed matter**

Decays of Neutron-rich Halo Nuclei: More Complicated

Can dynamically vary their decay ‘choices’ depending on their ‘environment’

Per W-L theory, once ULM neutron production begins at high rates, populations of unstable, very neutron-rich ‘halo’ isotopes build-up locally on 2-D surfaces. Such nuclei likely have substantially lengthened half-lives because they may have a difficult time emitting beta electrons or neutrons (both of which are fermions) into locally unoccupied Q-M states. By contrast, alpha (He-4) particle and gamma photon emissions are bosons and are unaffected by the exclusion principle. If fermionic decay channels are ‘blocked’, neutron-rich halo nuclei may emit bosons or continue capturing ULM neutrons as long as it is energetically favorable or until they finally get so neutron-rich and excited, or a previously occupied local state opens-up, that ‘something breaks’ and β^- decay cascades ending in stable isotopes can begin. This is one important reason why LENR systems typically do not end-up with large amounts of long-lived, radiologically ‘hot’ isotopes

Importantly, the neutron-capture phase of LENRs can release substantial amounts of nuclear binding energy, much of it in the form of prompt and delayed gammas (which are bosons). Unique to LENR systems and according to W-L theory, those gammas are converted directly to infrared photons by heavy SP electrons also present in nuclear-active ‘patches’ on surfaces in LENR systems. As explained elsewhere, beta-decay cascades of unstable isotopes with short half-lives can proceed very rapidly, release large amounts of binding energy, and produce complex arrays of different transmutation products that, if neutron fluxes are high enough, can rapidly traverse rows of the periodic table; in one spectacular experiment, Mizuno went from K to Fe in <2 minutes



LENR-active surfaces: very complex with many parallel processes

- **LENR 'hot spots' create intense local heating and variety of surface features such as 'craters'; over time, LENR-active surfaces experience major micron-scale changes in nanostructures/composition**

- **On LENR-active substrate surfaces, there are a myriad of different complex, nanometer- to micron-scale electromagnetic, chemical, and nuclear processes *operating in parallel.* LENRs involve interactions between surface plasmons, E-M fields, and many different types of nanostructures with varied geometries, surface locations relative to each other, and chemical/isotopic compositions**

- **To greater or lesser degrees, many of these very complex, time-varying surface interactions are electromagnetically coupled on many different physical length-scales: E-M resonances important!**

- **Surface plasmons and their interactions with nanostructures/nanoparticles enable physics regime that permits LENRs to occur in condensed matter systems under relatively mild *macroscopic* conditions (cores of stars, fission reactors, or supernovas are not required). In concert with many-body, collective Q-M effects, SPs also function as two-way 'transducers,' effectively interconnecting the otherwise rather distant realms of chemical and nuclear energies**

- ***Please be aware that a wide variety of complex, interrelated E-M phenomena may be occurring simultaneously in parallel in different nm to μ-scale local regions on a given surface*. For example, some regions may be absorbing E-M energy locally, while others nearby can be emitting energy (e.g., as energetic electrons, photons, other charged particles, etc.). At the same time, energy can be transferred from regions of resonant absorption or 'capture' to other regions in which emission or 'consumption' is taking place: e.g., photon or electron emission, and/or LENRs in which [E-M field energy] + $e \rightarrow e^* + p^+ \rightarrow n_{ulm} + \nu$ --- in LENRs, electrons and protons (particles) are truly consumed!**

Interactions: resonant E-M cavities, E-M fields, SPs, and nanostructures

Large E-field enhancements occur near nanoparticles:

Pucci et al.: "If metal structures are exposed to electromagnetic radiation, modes of collective charge carrier motion, called plasmons, can be excited … Surface plasmons can propagate along a distance of several tens of micrometers on the surface of a film."

"In the case of one nanoparticle, the surface plasmon is confined to the three dimensions of the nanostructure and it is then called localized surface plasmon (LSP). In this situation, the LSP resonance depends on the metallic nature (effect of the metal permittivity) and on the geometry (effect of the confinement of the electron cloud) of the nanostructure."

"If the smallest dimension of the particle is much larger than the skin depth of the electromagnetic radiation in the metal, also real metal wires can be estimated as perfect conductors. For ideal metal objects it is assumed that the light does not penetrate into the particle. This means an infinitely large negative dielectric function. Then, antenna-like resonances occur if the length L of an infinitely thin wire matches with multiples of the wavelength λ."

"Electromagnetic scattering of perfect conducting antennas with *D* smaller than the wavelength and L in the range of the wavelength is discussed in classical antenna scattering theory … It is a frequently used approximation to consider a metal nanowire as an ideal antenna. This approach has been proposed also for the modeling of nanowires in the visible spectral range …"

" … field is enhanced at the tip of the nanowire when the excitation wavelength corresponds to an antenna mode … the end of the nanowires in a relatively sharp and abrupt surface is a perfect candidate to host a lightning rod effect ..."

"… for metallic wires larger than several hundred nanometers. The increasing size of the nanoantennas makes the resonances to appear at wavelengths that present larger negative values of the dielectric function, i.e. for wavelengths well in the mid infrared portion of the spectrum in the case of micron-sized wires. It is actually this extension of the resonant behavior to micron-sized antennas what makes these structures optimal candidates for surface enhanced Raman spectroscopy (SERS) and surface-enhanced infrared absorption spectroscopy (SEIRA)."

Reference:

"*Electromagnetic nanowire resonances for field-enhanced spectroscopy*," Chapt. 8 in "*One-Dimensional Nanostructures*," Pucci et al., Series: Lecture Notes in Nanoscale Science and Technology, V. 3, Wang, Zhiming M. (Ed.), Springer 2008 178-181

Lattice Comments:

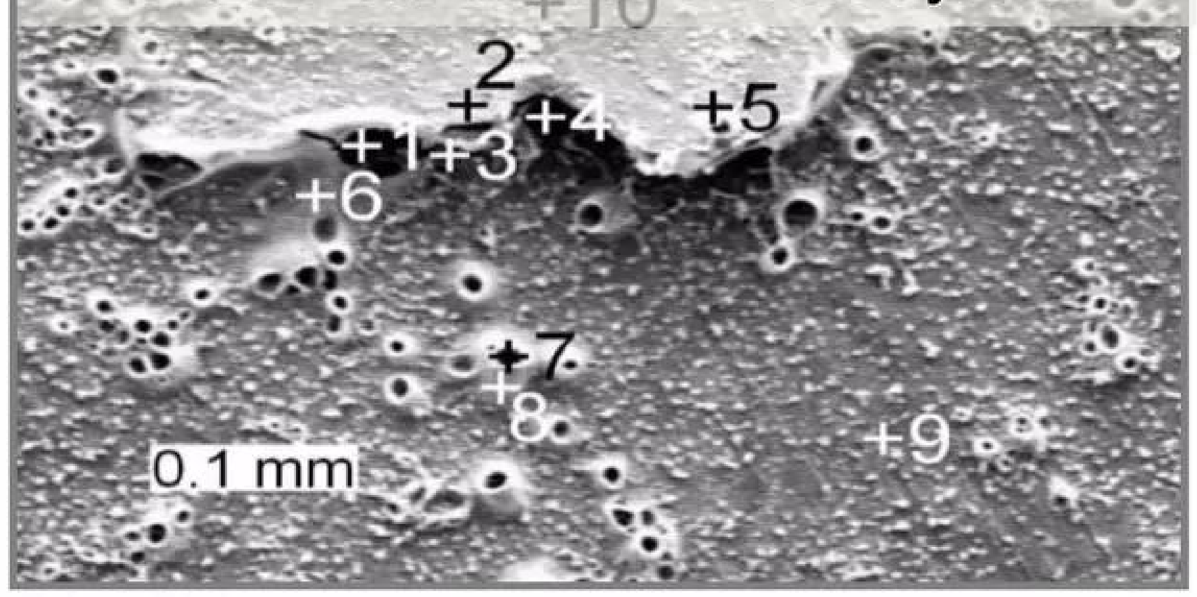
- **In addition to optical frequencies, surface plasmons (SPs) in condensed matter systems often have some of their absorption and emission bands located in the infrared (IR) portion of the E-M energy spectrum**
- **Walls of gas-phase metallic reaction vessels intrinsically have SPs present on their outer and inner surfaces; they can radiate IR electromagnetic energy into the interior space, i.e., open cavity**
- **Metallic surface nanostructures and various types of nanoparticles located inside such reaction vessels also have SPs present on their outer surfaces and interior interfaces, e.g. metal/oxide or metal/gas**
- **Nanostructures and nanoparticles found inside metallic reaction vessels can absorb IR radiated from vessel walls if their absorption bands fall into the same spectral range as IR radiation emitted from the walls**
- **When this occurs, volume of space enclosed in a reaction vessel effectively becomes a resonant E-M cavity: two-way energy transfers via E-M fields**
- **Think of nanostructures and nanoparticles inside reaction vessels as IR 'nanoantennas' with 'send' and 'receive' channels; walls also contain E-M antennas with complementary 'send' and 'receive' channels --- complex two-way interplay between all of them**

For experimental results to make sense, one must know starting points

- ✓ **When utilizing W-L theory and model LENR transmutation networks to help explain observed experimental data, please note that:**
  - **Literally ANY element or isotope present inside LENR experimental apparatus that has an opportunity to somehow move into very close physical proximity to surfaces or nanoparticles on which ULM neutrons are being produced can potentially 'compete' with other nuclei (located within the same nm-to-micron-scale domains of spatially extended ULM neutron Q-M wave functions) to capture locally produced ULMNs**
  - **Thus, some observations of transmutation products may appear oddly mystifying until one determines *exactly what elements/isotopes were initially present inside the apparatus when an experiment began*. In many cases, materials located inside such experiments are very poorly characterized; thus 'starting points' for ULMN captures on 'seed' nuclei may be quite unclear**

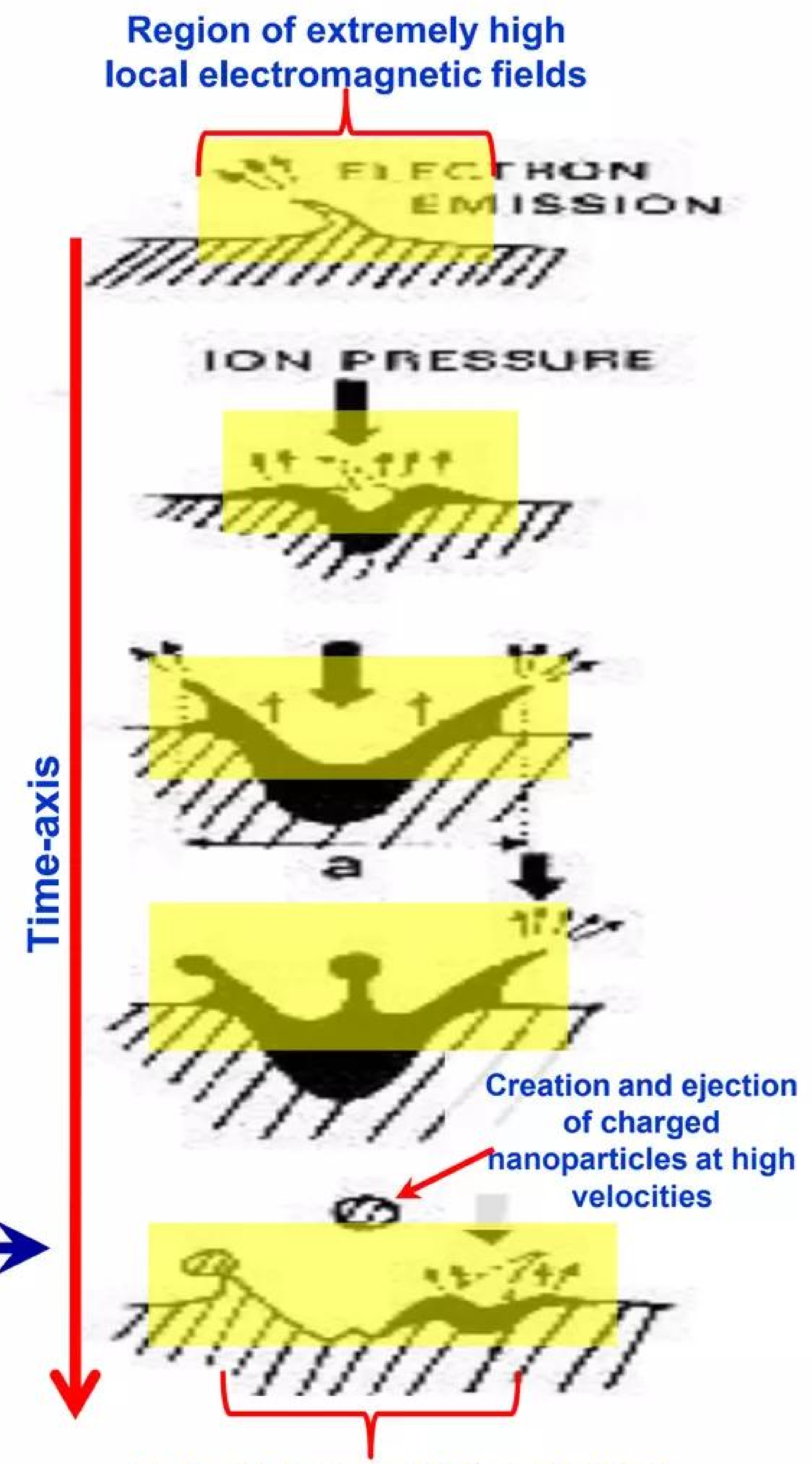
LENR-active surface sites ('hot spots') are not permanent entities. In experimental systems with sufficient input energy, they will form spontaneously, 'light-up' for 10 to several hundred nanoseconds, and then suddenly 'die.' Over time, endless cycles of 'birth', nuclear energy release, and 'death' are repeated over and over again at many thousands of different, randomly scattered nm-to micron-sized locations found on a given surface. When LENRs are occurring, these tiny patches become temporary 'hot spots' -- their temperatures may reach 4,000 - 6,000^{o} K or even higher. That value is roughly as hot as the surface temperature of the Sun and high enough to melt and/or even flash boil essentially all metals, including tungsten (b.p. = 5,666^{o}C). For a brief period, a tiny dense 'ball' of very hot, highly ionized plasma is created. Such intense local heating events commonly produce numerous explosive melting features and/or 'craters' that are often observed in post-experiment surface SEM images such as for example (credit: Zhang & Dash, 2007):

Post-experiment SEM image of Palladium (Pd) surface of cathode from an electrolytic cell



Gas-phase LENR systems: wall interactions can be very significant

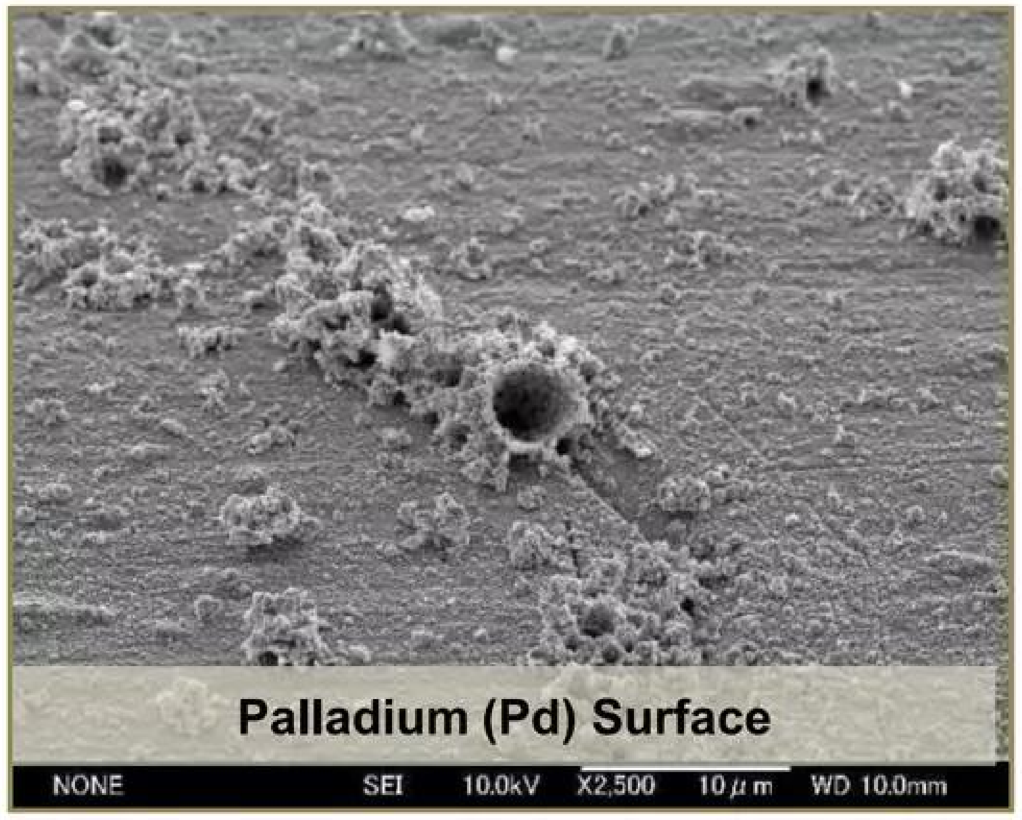
- **In gas-phase LENR systems, *especially if they contain tiny 'target fuel' nanoparticles or volatile aromatic compounds*, e.g., benzene or polycyclic aromatic hydrocarbons (PAHs, e.g., Phenanthrene), it is virtually a certainty that walls of reaction vessels will come into intimate physical contact with introduced nanoparticles and/or aromatic molecules**
- **Contact can occur via gravity or gaseous turbulence that swirls tiny nanoparticles around inside reaction vessels or by condensation of organic residues on walls. Once in close proximity, chemical reactions and/or LENRs can readily occur at points of interfacial contact between walls and introduced nanoparticles and/or organic molecules**
- **In the case of LENRs, atomic nuclei comprising wall materials at or near a mutual point of brief contact will have an opportunity to 'compete' with nuclei in nearby nanoparticles or aromatic molecules to capture produced ULM neutrons. If wall nuclei capture neutrons, LENRs will then occur in a local 'patch,' resulting in surface-altering 'cratering' processes; one of which is illustrated to right**
- **Therefore, in such systems wall nuclei atoms can potentially also become 'seeds' in LENR transmutation networks; LENRs occurring in or near walls can cause significant amounts of wall materials to ablate into the local gas in the form of newly created nanoparticles**



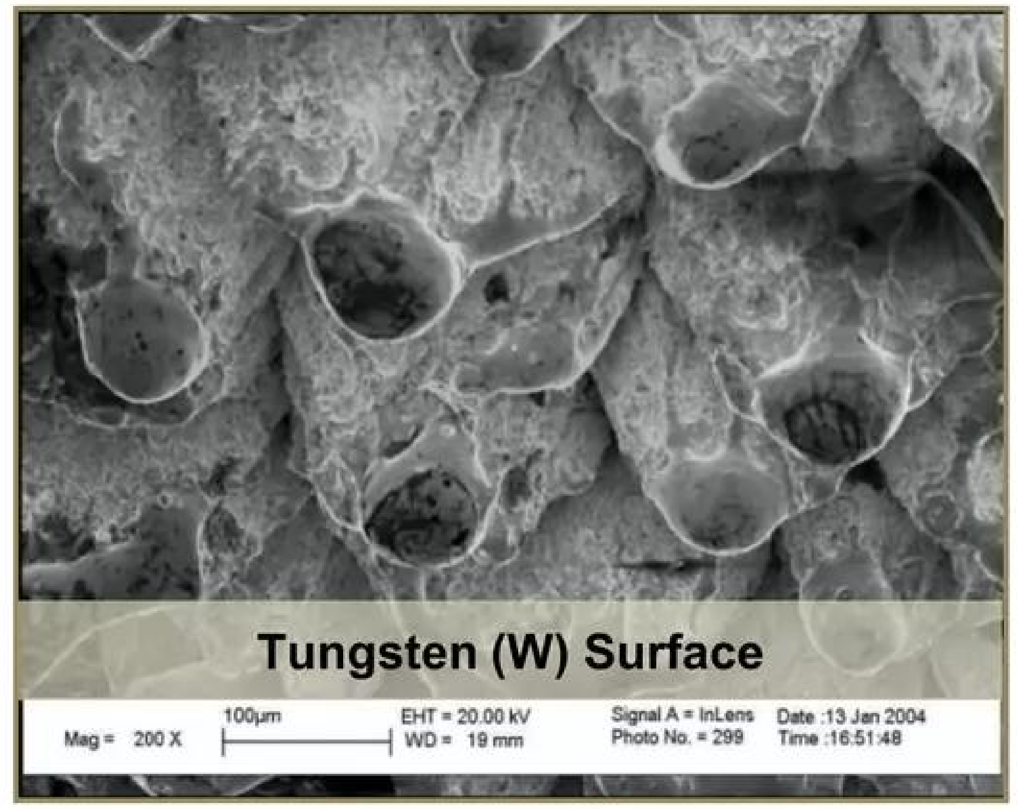
Idealized stages in ablative electrical breakdown of nm-to-micron-scale LENR surface sites that form 'craters' seen in many different SEM images

Figure courtesy of B. Jüttner, Berlin

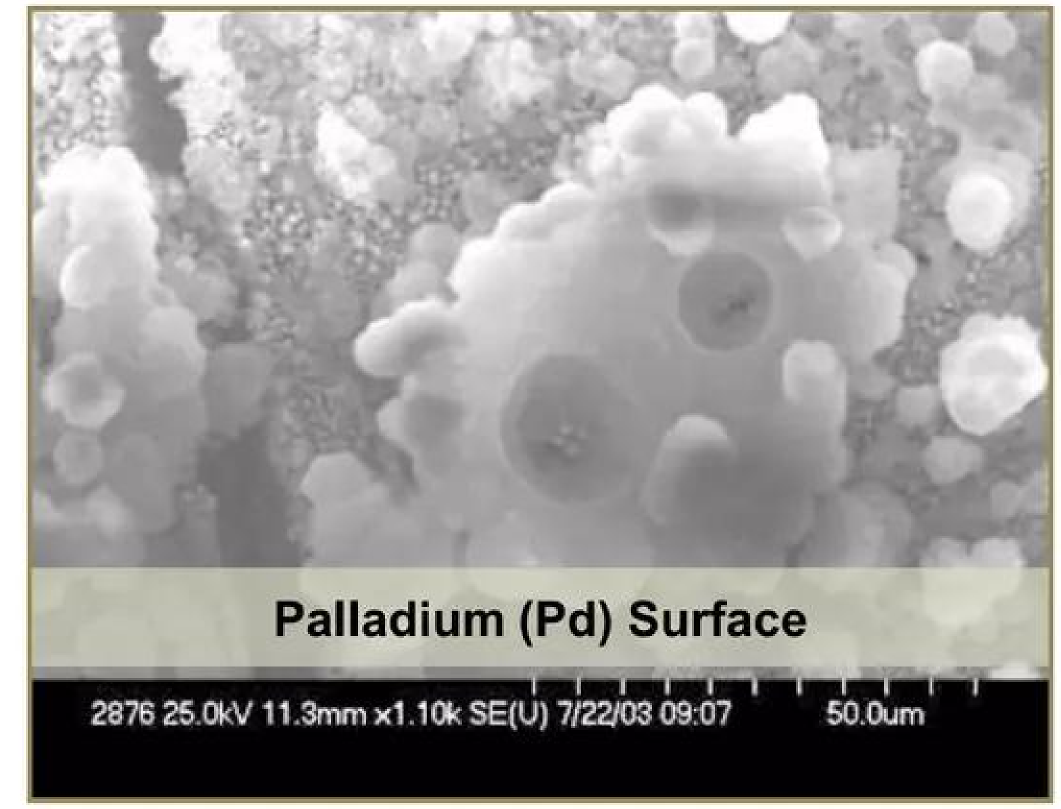
SEM images illustrate LENR 'flash melting' and cratering on surfaces



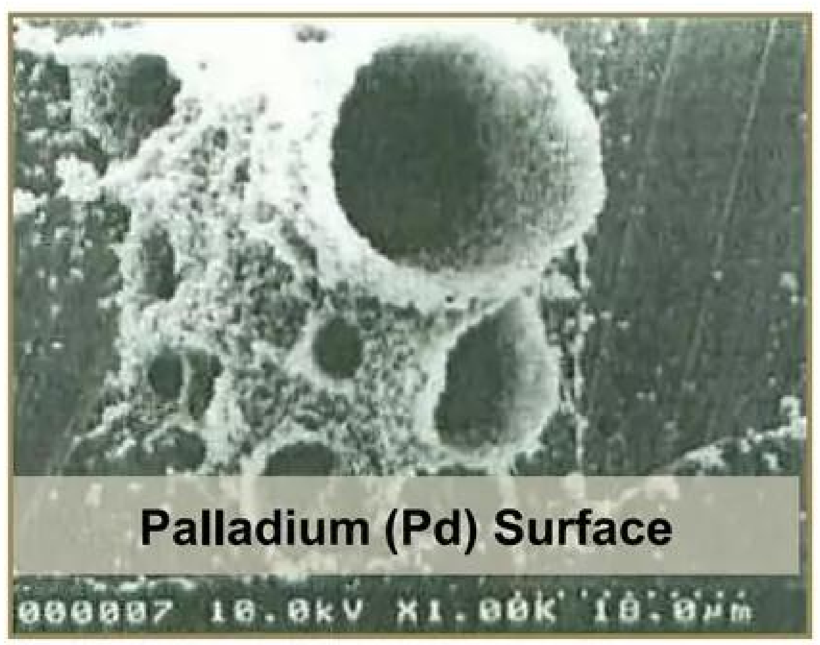
Credit: Y. Toriabe et al.



Credit: Cirillo & Iorio



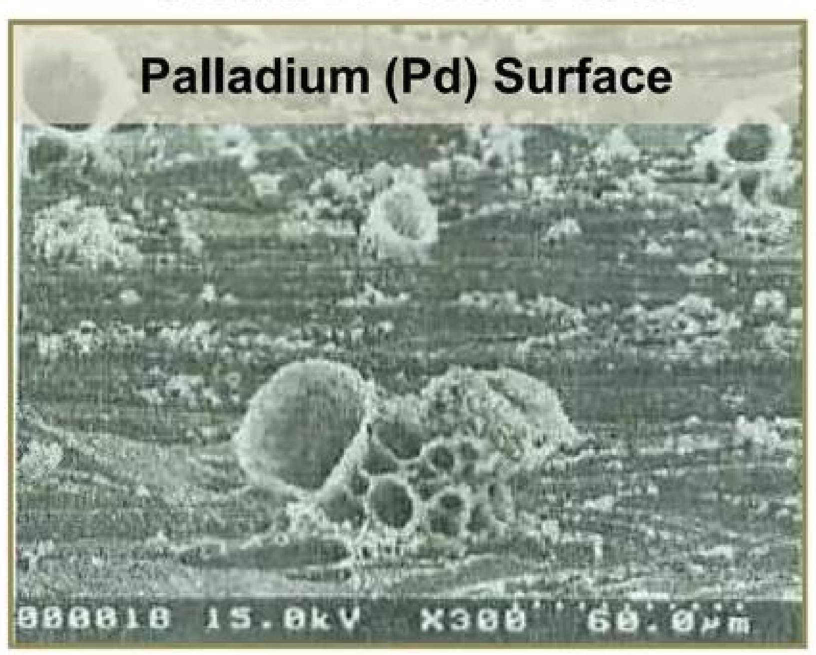
Credit: P. Boss et al.



Credit: Y. Toriabe et al.

Credit: P. Boss et al.

Credit: Energetics Technologies Ltd.



Credit: Y. Toriabe et al.

Credit: P. Boss et al.

Note: besides the examples shown here, nanostructures created by LENRs display an extremely varied array of different morphologies and can range in size from just several nanometers all the way up to ~100 microns or more

Discussion: results of earlier Italian gas-phase H_2/Ni experiments – VIII
Cu isotopes: results from Ni-seed aqueous LENR electrolytic experiment

Reference: **"Analysis of Ni-hydride thin film after surface plasmons generation by laser technique," V. Violante et al., Condensed Matter Nuclear Science – Proceedings of the 10th International Conference eon Cold Fusion (ICCF-10 2003), eds. P. Hagelstein and S. Chubb, pp. 421-434, World Scientific 2006 ISBN# 981-256-564-7 Source URL to free copy = http://www.lenr-canr.org/acrobat/ViolanteVanalysisof.pdf**

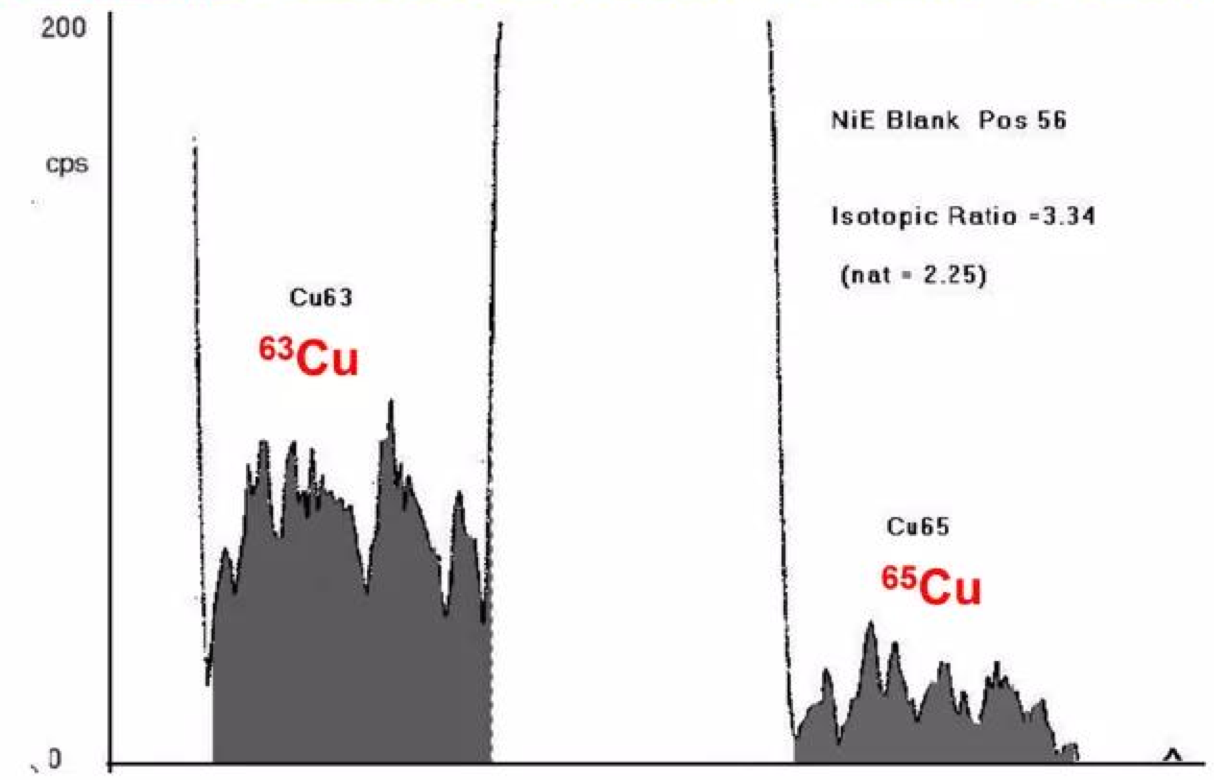
Key highlights of the experiment:

- **Fabricated two sputtered thin-film pure Nickel 'target' samples; "black" sample was loaded with hydrogen (made NiH) in electrolytic cell; "blank" sample was not put into the electrolytic cell (not loaded)**
- **Aqueous H_2O 1 M Li_2SO_4 P&F-type electrolytic cell; thin-film Nickel (Ni) cathode; [Platinum pt anode?]; loaded "black" Ni 'target' cathode with Hydrogen for 40 minutes at currents ranging from 10-30 mA and then removed it from the aqueous electrolyte bath**
- **Irradiated both samples with He-Ne laser (632 nm beam) for 3 hours**
- **After laser irradiation, analyzed Cu isotopes present on surface in "blank" and "black" Ni samples with SIMS; results shown in Figs. 12 and 13 to right: abundance of ^{63}Cu went down; ^{65}Cu went way up**
- **Suggested surface plasmons might have important role in LENRs**

Comments: **the observed dramatic isotopic shift (^{63}Cu goes down; ^{65}Cu goes up in an experiment) is readily explained by ULM neutron capture on ^{63}Cu 'seed' according to W-L theory of LENRs; if data is correct, only other possible explanation is magically efficient isotopic "fractionation" process**

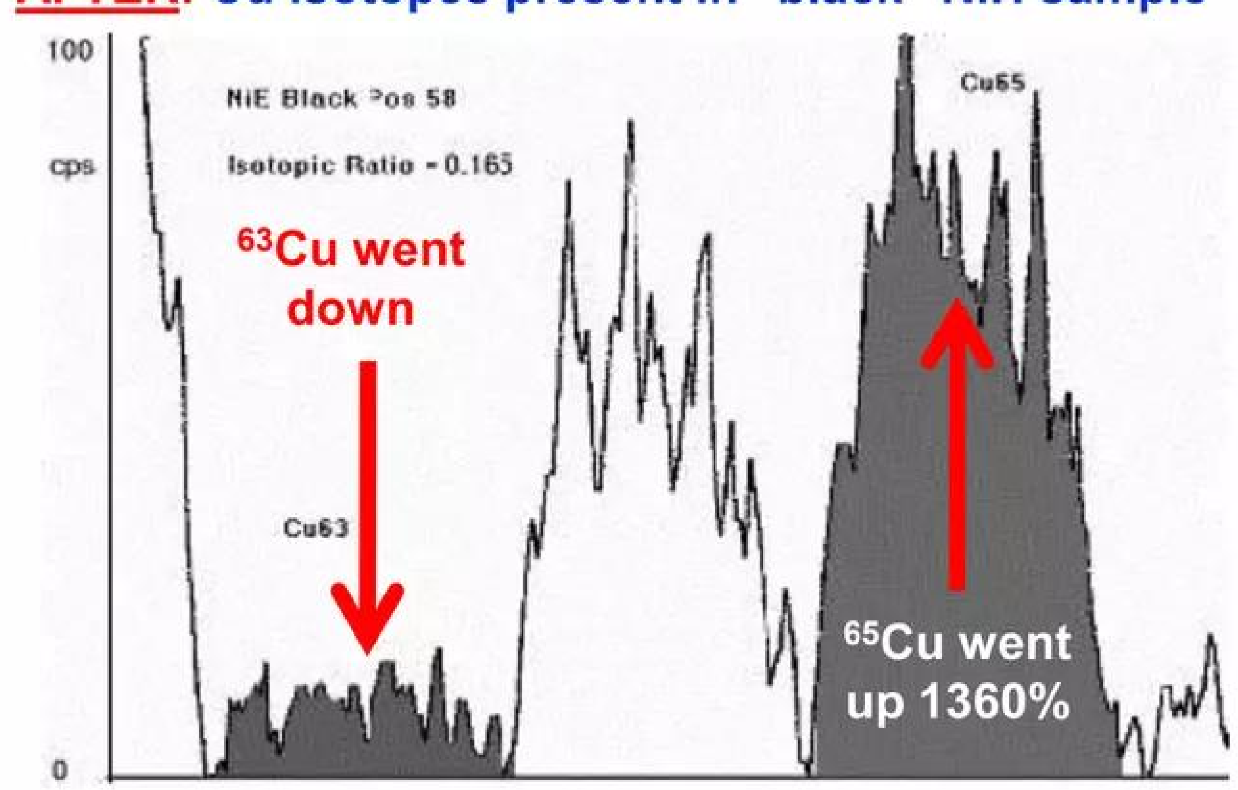
Note: **we have been informed that Violante et al. have openly questioned their own claims for reasons that we find dubious. Readers are urged to review the relevant publications and then judge whether such concerns are plausible**

BEFORE: Cu isotopes present in "blank" Ni sample



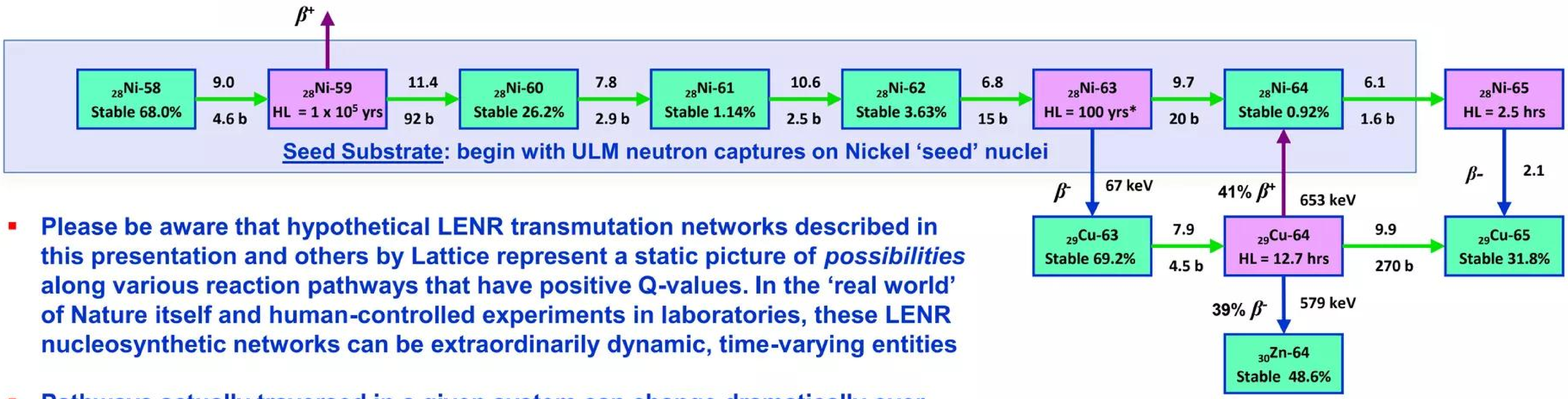
Quoting: "Figure 12. Blank of NiE, ^{63}Cu results to be more abundant of ^{65}Cu, the difference with the natural isotopic ratio is due to the small signal on mass 65. The sample was undergone to laser excitation of plasmons-polaritons for 3 hr"

AFTER: Cu isotopes present in "black" NiH sample



Quoting: "Figure 13. Black of NiE, after 40 min electrolysis + 3 hr of plasmons-polaritons excitation by laser. Isotopic ratio is changed of 1360%"

Comments about LENR transmutation network products and isotope ratios



- Please be aware that hypothetical LENR transmutation networks described in this presentation and others by Lattice represent a static picture of *possibilities* along various reaction pathways that have positive Q-values. In the 'real world' of Nature itself and human-controlled experiments in laboratories, these LENR nucleosynthetic networks can be extraordinarily dynamic, time-varying entities

- Pathways actually traversed in a given system can change dramatically over surprisingly short time-scales and on very small length-scales (nanometers to microns) in response to a myriad of different causative factors. Final product nucleosynthetic results observed in a given experiment run reflect a sum total across many parallel alternate reaction paths --- LENR network computer codes really need to be developed to better understand dynamics of such processes

- A frequent question in readers' minds is whether or not LENR networks typically produce final stable products with isotopic ratios that are roughly the *same* as the known natural abundances, or whether they would be more likely to differ? The straight answer to that question, as best we know today, is that sometimes they do, and sometimes they don't --- also, there is compelling evidence that some LENRs do occur outside laboratory settings in Nature

- For example, a series of aqueous electric arc experiments conducted at Texas A&M University and BARC (India) in the 1990s apparently transmuted Carbon into Iron (see Slides #46-56 in Lattice SlideShare technical overview dated Sept. 3, 2009, with file title, "Carbon-seed LENR networks"). In those experiments, measured isotopic ratios of the produced Iron did not differ significantly from natural abundances. On the other hand, there are many examples of LENR experiments in which product isotopic ratios differed greatly from natural ones

Let's take Copper (Cu) for example - see hypothetical W-L LENR network pathway above:

Given the long half-life and slow decay rate of Ni-63, one might reasonably expect that the network would produce Cu-65 at a much higher rate than Cu-63, hence the final elemental Copper isotopic ratio would probably shift in the direction of the heavier species. This is exactly what was observed by Violante et al. (ICCF-10, 2003, see Slide #45 herein)

On the other hand, it is well-known among astrophysicists that in certain very highly ionized states the half-life of Ni-63 can be *reduced* by >200x; i.e., it goes down from ~100 years to ~0.4 yrs. Could something like that ever happen in a condensed matter LENR system? Mostly likely not, but the little micron-scale LENR 'plasma balls' do get awfully hot, but not for a long enough period of time (~200 nanoseconds or less). That said, it would truly be extremely naïve to assume that LENR systems will not deal-out a few more big surprises along the way

Selected Technical Publications

"*Ultra Low Momentum Neutron Catalyzed Nuclear Reactions on Metallic Hydride Surfaces*" Eur. Phys. J. C **46**, pp. 107 (March 2006) Widom and Larsen – initially placed on arXiv in May 2005 at http://arxiv.org/PS_cache/cond-mat/pdf/0505/0505026v1.pdf; a copy of the final *EPJC* article can be found at: http://www.newenergytimes.com/v2/library/2006/2006Widom-UltraLowMomentumNeutronCatalyzed.pdf
"*Absorption of Nuclear Gamma Radiation by Heavy Electrons on Metallic Hydride Surfaces*" http://arxiv.org/PS_cache/cond-mat/pdf/0509/0509269v1.pdf (Sept 2005) Widom and Larsen
"*Nuclear Abundances in Metallic Hydride Electrodes of Electrolytic Chemical Cells*" http://arxiv.org/PS_cache/cond-mat/pdf/0602/0602472v1.pdf (Feb 2006) Widom and Larsen
"*Theoretical Standard Model Rates of Proton to Neutron Conversions Near Metallic Hydride Surfaces*" http://arxiv.org/PS_cache/nucl-th/pdf/0608/0608059v2.pdf (v2. Sep 2007) Widom and Larsen
"*Energetic Electrons and Nuclear Transmutations in Exploding Wires*" http://arxiv.org/PS_cache/arxiv/pdf/0709/0709.1222v1.pdf (Sept 2007) Widom, Srivastava, and Larsen
"*Errors in the Quantum Electrodynamic Mass Analysis of Hagelstein and Chaudhary*" http://arxiv.org/PS_cache/arxiv/pdf/0802/0802.0466v2.pdf (Feb 2008) Widom, Srivastava, and Larsen
"*High Energy Particles in the Solar Corona*" http://arxiv.org/PS_cache/arxiv/pdf/0804/0804.2647v1.pdf (April 2008) Widom, Srivastava, and Larsen
"*A Primer for Electro-Weak Induced Low Energy Nuclear Reactions*" Srivastava, Widom, and Larsen Pramana – Journal of Physics **75** pp. 617 (October 2010) http://www.ias.ac.in/pramana/v75/p617/fulltext.pdf

