Addendum - Part 1of 2

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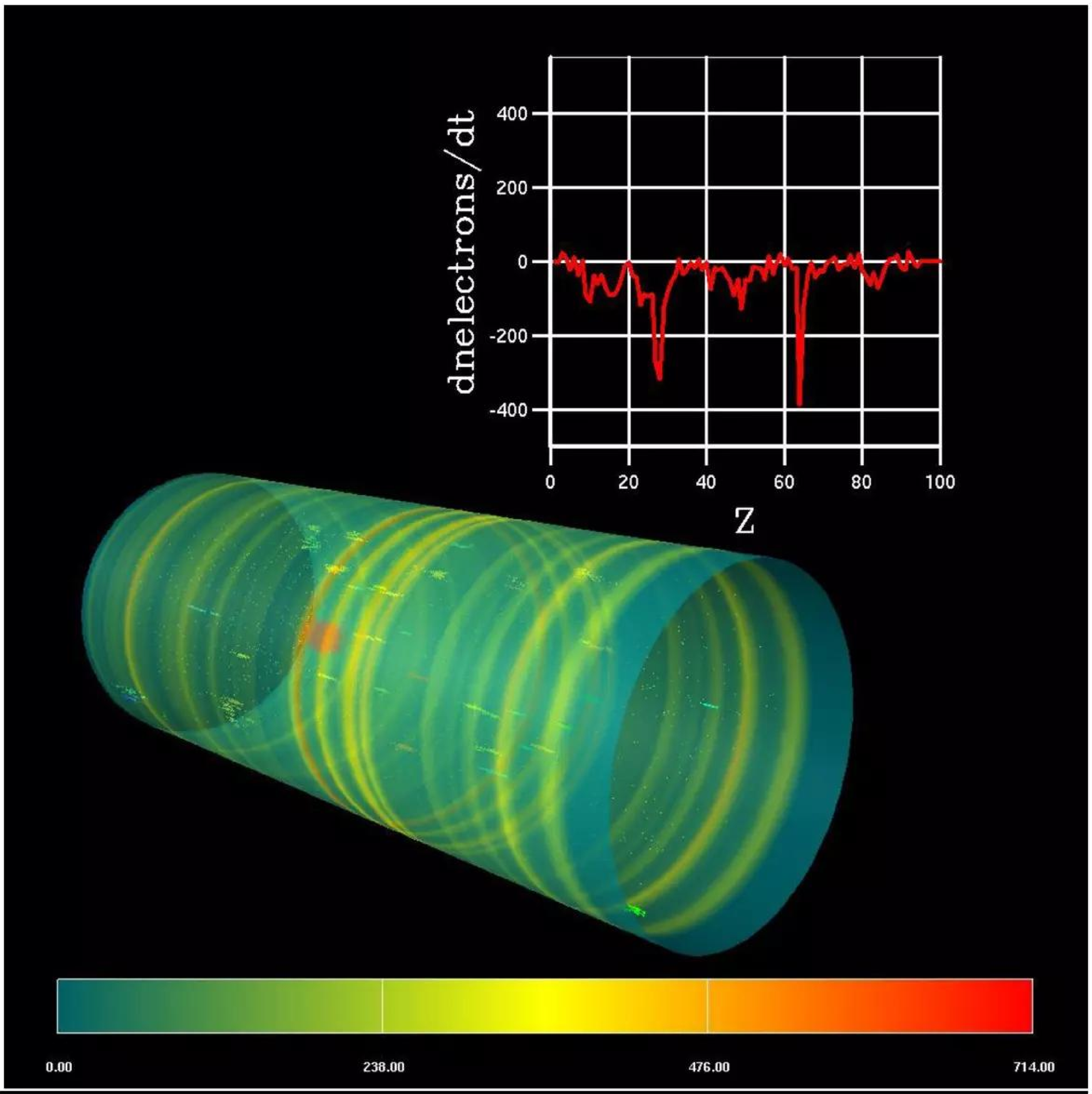


Proton Beam with Electron Cloud - Credit: A. Adelman (PSI)

This is Part 1 of a two document Addendum to an earlier Lattice Energy LLC document dated December 7, 2011, titled ***"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

Part 2 is a 19-slide PowerPoint format; it focuses mainly on why a Cameca NanoSIMS 50 would likely be an ideal instrument to look for LENR transmutation products inside the LHC; selected slides from another Lattice document were inserted into this PowerPoint for clarification of certain points and to make this presentation somewhat more self-contained than otherwise:

http://www.slideshare.net/lewisglarsen/lattice-energy-llcaddendum-part2-to-ufos-in-lhcmarch-13-2012

Preface: let me preface the remarks to follow by noting that, according to a theory developed by Prof. Dave Seidman of Northwestern University (Director, Center for Atom-Probe Tomography, Evanston, IL), prosaic, small-length-scale electron field emission processes on surfaces are almost invariably accompanied by some degree of surface breakdown and production of ejected charged/uncharged nanoparticles, i.e. 'dust.' In addition, Dr. Andre Anders of Lawrence Berkeley National Laboratory (who has done very interesting work on cathodic arcs) has gone one step further and proposed an even more energetic type of "*arc spot ignition*" event which he describes as a (quoting him directly), **"*Local thermal run-away process [that] leads to micro-explosion and formation of extremely dense plasma*."**

Electric field strengths and effective power densities can get surprisingly large on nanometer to micron length-scales on and around nanostructures located on surfaces; quoting Dave Seidman, *"Another interesting feature of this [electrical breakdown] mechanism is that the power densities involved are enormous. The numbers can be obtained from the values we measured for field emitted currents, electric field, the emitter dimensions, and volume for transferring electromagnetic field energy into electron kinetic energy. Combining these gives, (10 GV/m)(10^{-7} m)(1 mA)/(10^{-7} m)^3 = 10^{21}W/m^3, a value that seems to be greater than all other natural effects, except perhaps Gamma Ray Bursters (GRB"s). The power density is comparable to nuclear weapons."* **Length-scale matters!**

Details about all of the above items are explained in **Slides #11 – 31** (as well as SEM-image-based morphological comparisons between 'prosaic' cathodic arc surface 'craters' and LENRs) in the following online Lattice PowerPoint presentation dated July 16, 2010 (can be viewed online in 'full-screen' mode or downloaded after a perfunctory free registration):

"Low Energy Neutron Reactions (LENRs) in Advanced Batteries and Other Condensed Matter Environments --- Could LENRs be involved in some Li-ion battery fires?"

http://www.slideshare.net/lewisglarsen/cfakepathlattice-energy-llc-len-rs-in-liion-battery-firesjuly-16-2010

Widom-Larsen Theory (WLT) of LENRs - brief recap: beyond Anders' plausible runaway mechanism, under exactly the right conditions (contiguous many-body monolayer 'patch' of entangled, collectively oscillating protons on a surface + entangled collectively oscillating surface plasmon electrons + local breakdown of Born-Oppenheimer approximation + nonequilibrium energy input in form of charged particles and/or photons) and when local *nanoscale* E-fields in a 'patch' exceed ~2 x 10^{11} V/m, then some number of the surface plasmon electrons located in such a "patch' will have high-enough renormalized masses to react directly with 'nearby' protons in a weak reaction: *e + p → neutron + electron neutrino*. Collectively produced neutrons will have extremely large DeBroglie wavelengths (depend on dimensions of a given 'patch; from ~2 *nm* to perhaps ~100 *microns*) and will be captured locally within picoseconds (they generally don't have enough time to thermalize which requires a few tenths of a millisecond); prompt and delayed gammas between ~0.5 – 1.0 MeV up through 10 - 11 MeV resulting from captures or subsequent decay processes are locally converted directly into infrared photons by the population of unreacted, entangled heavy electrons present in a 'patch' ('tail' in soft X-rays; again, please see: ***"Absorption of Nuclear Gamma Radiation by Heavy Electrons on Metallic Hydride Surfaces"*** (Sept 2005), A. Widom and L. Larsen at http://arxiv.org/PS_cache/cond-mat/pdf/0509/0509269v1.pdf).

Under most 'normal' circumstances, LENRs would probably be *rare* dust-producing processes: prosaic electron field emission and electric arcing processes as well as more exotic LENRs can trigger surface breakdown and production of 'dust' particles that are ejected away from a given surface; that particular feature would presumably be common to all such mechanisms. Importantly, under 'normal' circumstances in Nature and in the vast majority of typical laboratory experiments LENRs clearly do not occur very often --- maybe only rarely in a minuscule percentage of even favorable microenvironments and at relatively low rates therein. Otherwise, for example, our earth would probably be a hostile, much different, hotter place --- perhaps a molten ball of incandescent lava in a perpetual state of LENR-driven chemical element chaos (as opposed to the temperate, water-rich world teeming with life in which we presently exist that is comprised of predominantly long-lived isotopes having relatively stable planetary abundances, at least over non-geological time horizons).

Rates of LENRs can be increased substantially in non-natural environments: fortunately, using conceptual insights provided by the WLT, experimental conditions in condensed matter systems and 'dusty' plasmas can be technologically 'tweaked' to increase rates of weak reaction neutron production far above whatever levels might ever be attainable in analogous systems found at random out in Nature or in the vast majority of LENR laboratory experiments conducted to date.

Technologically, many-body collective electroweak neutron production rates can be manipulated by: (1) controlling total numbers and density of e^-p^+ pairs on a given surface (which is ~equivalent to controlling the area-density and dimensions of many-body, collectively oscillating surface 'patches' of protons or deuterons); and (2) controlling the rate and total quantity of appropriate form(s) of nonequilibrium energy input into LENR-active 'patches'; appropriate forms of transferable input energy (charged particles and/or properly coupled photons) that can go directly into increasing the strength of local electric fields that 'bathe' SP electrons in a 'patch' --- it determines the number and effective masses of e^* electrons present in a given 'patch' whose increased masses are at values somewhere above the minimum mass-renormalization threshold ratio, β_0 that is required for initiating $e^* + p$ or $e^* + d$ weak reactions. The term $(\beta - \beta_0)^2$ in our published rate equation reflects the degree to which mass renormalized e^* electrons in a given 'patch' *exceed* the minimum threshold ratio for neutron production β_0. Details of this are explained in our first principles ULM neutron production rates calculation paper, ***"Theoretical Standard Model Rates of Proton to Neutron Conversions Near Metallic Hydride Surfaces,"*** that can be found at:

http://arxiv.org/PS_cache/nucl-th/pdf/0608/0608059v2.pdf

Simply put, all other things being equal, the higher the density of e^-p^+ reactants and the greater the rate and quantity of nonequilibrium input of appropriate forms of energy, the higher the rate of ULM neutron production in μ-scale LENR-active 'patches' in an appropriately pre-configured condensed matter system.

Preparation of the Addendum was prompted by T. Baer's interesting new presentation 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

Comments/questions by Slide #: I will now comment and pose questions about specific slides in Baer's December 13th presentation. Please note that, not being a particle beam experimentalist, I confess to having only a very hazy, incomplete knowledge of key working details of the LHC's interior construction, relative placement geometry and physical dimensions, beam physics, and surface composition of materials exposed to the unique physical environment that exists inside the LHC during beam operation.

That said, of special interest from the standpoint of the possibility of LENRs occurring in the LHC would be the area-density and spatial distribution of any contiguous, monolayer, many-body surface 'patches' of protons (their ~dimensions might range from several nm up to perhaps as large as 300 microns) that could potentially exist on interior surfaces within the LHC that are effectively exposed to electron currents created during beam operation.

Interestingly and importantly, such tiny 'patches' of protons can form spontaneously, oscillate collectively, and are effectively quantum mechanically entangled (this had been experimentally measured and verified by Chatzidimitriou-Dreismann at the Technical University of Berlin in published work dating back to 1995).

Question: could any such surface 'patches' of contiguous protons be present inside the LHC? If so, where might they potentially be located and what might area-densities be at various locations?

Such surface monolayers of protons and related prolonged 'outgassing' issues are well-known to people working with UHV systems; they were also a problem some years ago (before the invention of magnetic bottles for temporarily trapping ultracold neutrons) when researchers at Los Alamos National Laboratory and Grenoble were trying to make improved measurements of the neutron lifetime.

Although not widely appreciated, it is also known that protons are almost invariably present on just about every metallic surface that has been exposed to the earth's atmosphere; they adhere strongly enough to persist in surprisingly high vacuums for long periods. If one is trying to prepare ultraclean metallic surfaces *sans* hydrogen (protons) with materials that have previously been exposed to the atmosphere, it takes ion milling techniques to insure complete removal of unwanted hydrogen from such surfaces.

In the case of the LHC, surface proton 'patches' might simply have been present on interior materials to begin with and/or have originated from protons that somehow 'leaked' out of the LHC's beam and then migrated away from the beam onto exposed interior surfaces.

Question: is such beam leakage a plausible mechanism for creating a source of 'free' protons that can then migrate and aggregate into localized 'patches' adhering to exposed surfaces?

If a large-enough electron current (high-current, short rise-time works best) and/or photon flux (at a resonant absorption frequency in the case of LENR-active metallic nanostructures) interacts with such a 'patch' located on a 'flat' exposed interior surface or on a 'host' surface nanostructure, local electric fields in the vicinity of the 'patch' can potentially exceed ~2 x 10^{11} V/m (thanks to local breakdown of the Born-Oppenheimer approximation). When certain field-strength thresholds are exceeded, 'patch' SP electron masses are then renormalized, and ultra-long-wavelength ULM neutron production via the weak $e + p$ reaction can begin. The rest of what occurs locally is more-or-less prosaic neutron-capture-driven nucleosynthetic network processes that create extreme 'hotspots' which may break-up a local surface and then eject UFOs from *nm*-sized up to perhaps max of ~100 μm.

T. Baer slide #6 – Spatial UFO Distribution: ***"UFOs occur all around the machine; many UFOs around MKI's"*** In theory, LENRs could potentially occur on exposed metallic surfaces or at exposed interfaces/junctions between metallic structures and Al_2O_3 ceramics anywhere in the LHC's open interior cavities that enclose the beam. LENRs could be expected to occur more frequently on or spatially near the MKIs because: (1) macroscopic E-M fields are very high and rapidly changing (dI/dt is large) in the vicinity of the MKI 'fingers'; and/or (2) MKI 'fingers' are plated with Gold (Au) on which surface plasmon (SP) electrons are easily excited by impinging energetic charged particles such as other electrons. If small monolayer 'patches' of protons were present on such Au surfaces, IMO they would have a good chance to sometimes trigger LENRs.

Question: is there any evidence that micron-scale, localized 'pitting' or ablation of the gold surface is occurring anywhere on MKI 'fingers' over time? If so, what are the morphologies of any distinctive pits or 'craters' under SEM imaging and has CERN looked for any localized transmutation products nearby such features (if in fact present) with SIMS or equivalent?

T. Baer slide #10 – MKI UFOs: ***"Most events within 30 min after the last injection. Many events within a few hundred ms after MKI pulse"*** Some LENR-related, μ-scale heating and subsequent surface break-up UFO production events could conceivably be temporally delayed, depending on the half-lives of neutron-rich products of ULMN captures on atoms near LENR-active patches. A typical 'lifetime' of an LENR-active site probably ranges from < 20 *nsec* up to perhaps as long as 300 nanoseconds (an educated guesstimate based on some things known in plasmonics and field emission).

The likely temporal duration of typical LENR-active sites would be consistent with the observation that many UFO events occur within several hundred ms after an MKI pulse.

T. Baer slide #11 – FLUKA Simulations: ***"UFO location must be in MKIs (or nearby upstream of MKIs) ... Minimum particle radius of 40 µm ..."***

Based on what Lattice knows about LENRs, the first place I would also attempt to closely examine as a potential location for localized LENR production of UFOs would be either nearby upstream or in the immediate vicinity of the MKIs. Interestingly, a UFO particle radius of > 40 μm would fall within what are believed to be the ~spatial dimensions of an LENR-active surface site.

<u>T. Baer slide #12 – Macroparticles in MKIs</u>: ***"5,000,000 particles on filter found in MKI #5 inspection ... Typical macroparticle diameter: 1 - 100 μm ... Most particles are Al_2O_3 (material of ceramic tube)"***
The number of UFO particles found in the MKI #5's filter does seem to suggest that there probably are at least several thousands of sites producing UFOs that are located at scattered locations somewhere on interior surfaces inside the LHC. The observed range of sizes ranging up to ~100 μm span approximately the same expected range as what are believed to be 'typical' dimensions for LENR-active sites.

<u>Question</u>: to narrow down the number of different types of potential locations on exposed interior surfaces where LENRs might be expected to occur, can one make a simplifying assumption that LENRs are strictly limited to metallic surfaces and should not be present on what appear to be visually 'bare' (to the naked eye) Al_2O_3 surfaces? The answer to this important question is yes and no --- I will explain: first please refer to the the Addendum Part 2 at:

http://www.slideshare.net/lewisglarsen/lattice-energy-llcaddendum-part2-to-ufos-in-lhcmarch-13-2012

If one is referring to a pure, perfectly pristine, totally uncontaminated Al_2O_3 surface *<u>at a microscopic level</u>*, this simplifying assumption is correct: LENRs will not occur on such an alumina surface because surface plasmon electrons will not be present thereupon. *However, the devil is in the details*. To wit, up until now we have been blithely assuming that *decidedly macroscopic* Copper-coated metallic strips and other cm-length-scale exposed metallic objects found inside the LHC are the most likely locations for 'hosting' LENRs. However, recalling that per WLT LENRs in condensed matter systems are inherently *nm*- to *μm*-scale surface phenomena*, we should be aware that very tiny conductive metallic particles (that are most likely <u>invisible</u> to the naked eye) resting directly on top of an Al_2O_3 substrate on exposed surfaces inside the LHV (whatever such metallic nano particles origin or elemental composition might be), can, if their outer surfaces also happen to be 'decorated' with protons, potentially function as LENR-active sites if they were to receive proper types and amounts of input energy from whatever source inside the LHC.*

<u>Question</u>: do we know whether or not alumina surfaces inside the LHC are perfectly clean and always totally free of any conductive metallic nanoparticles? Has anyone ever examined those surfaces for the possible presence of strongly adhering nanoparticulates after a lengthy period of beam operation? If such metallic particles have already been detected, how common are they and exactly where have they been seen inside the LHC? Is their composition known? Per the WLT, LENRs in condensed matter systems inherently occur on small nm to μm length-scales.

That being the case, to qualitatively assess various types of locations at which LENRs might potentially occur inside the physically huge LHC machine and to determine what kinds of analytical techniques would be best suited to detect their presence therein, one must necessarily approach isotopic analytical issues from a microscopic conceptual perspective; that is, on *nm*- to *μm*-length-scales .

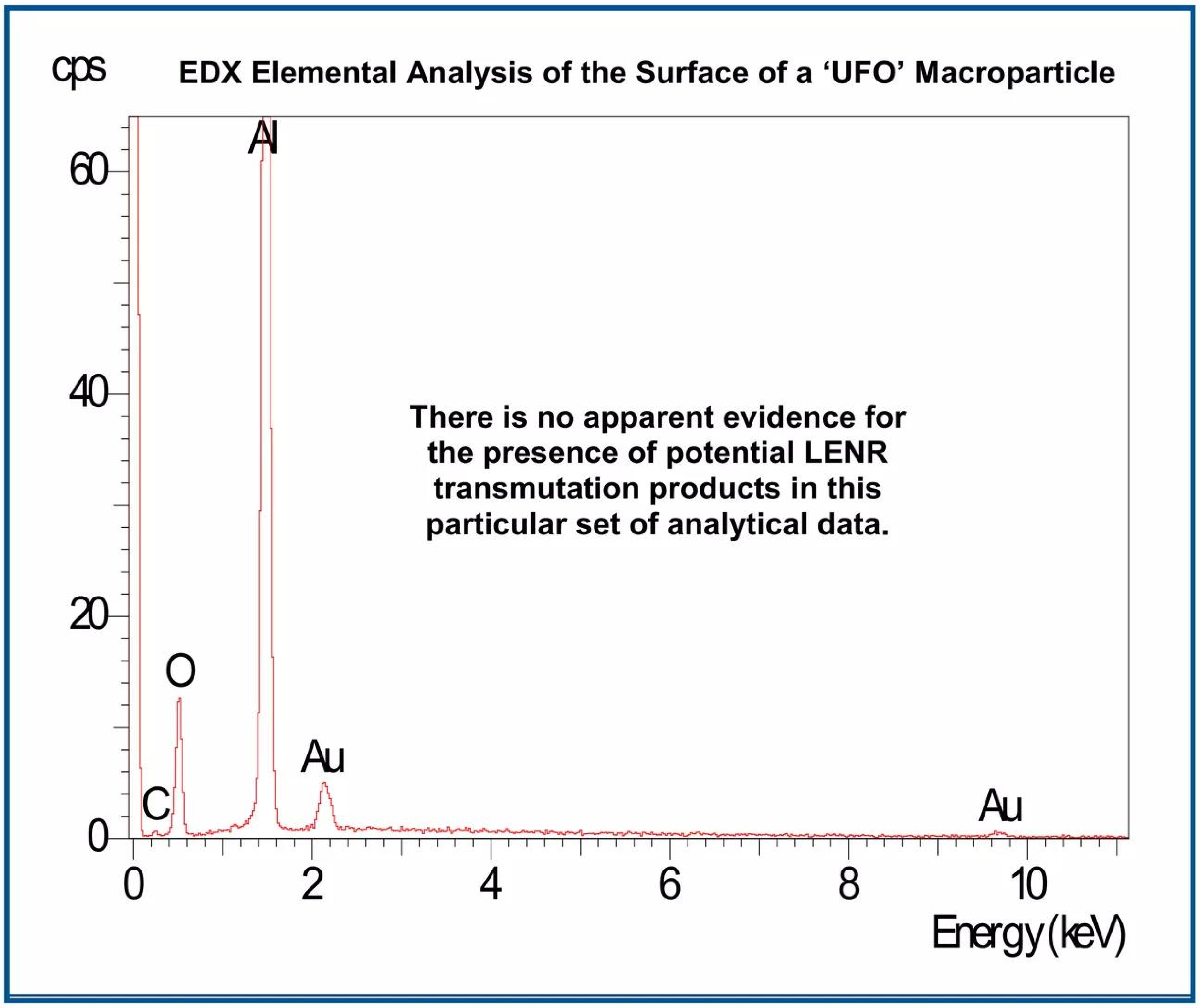
Furthermore, if sophisticated 'spatially aware' mass spectroscopy instruments utilizing SIMS or NanoSIMS have not yet been used to analyze isotopes present on surfaces of UFO macroparticles and/or on selected, morphologically 'suspicious' nanostructures found on exposed surfaces inside the LHC, then important questions about the possible presence of anomalous, unexpected elemental 'contaminants' and/or isotopic shifts in stable isotopes (either in collected UFO macroparticles and/or at random, isolated locations on surfaces of various exposed materials inside the LHC) *<u>remain unanswered</u>*.

Post-experiment mass spectroscopy analysis of possibly LENR-active materials on small length-scales can effectively answer many of these questions; thus, a Cameca NanoSIMS 50L would be an ideal instrument to perform such analyses and collect necessary isotopic data because it can effectively resolve a wide range of isotopes on length-scales down to as small as 50 nm (.05 μm).

The unique isotopic spatial resolution capabilities of a Cameca 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 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.

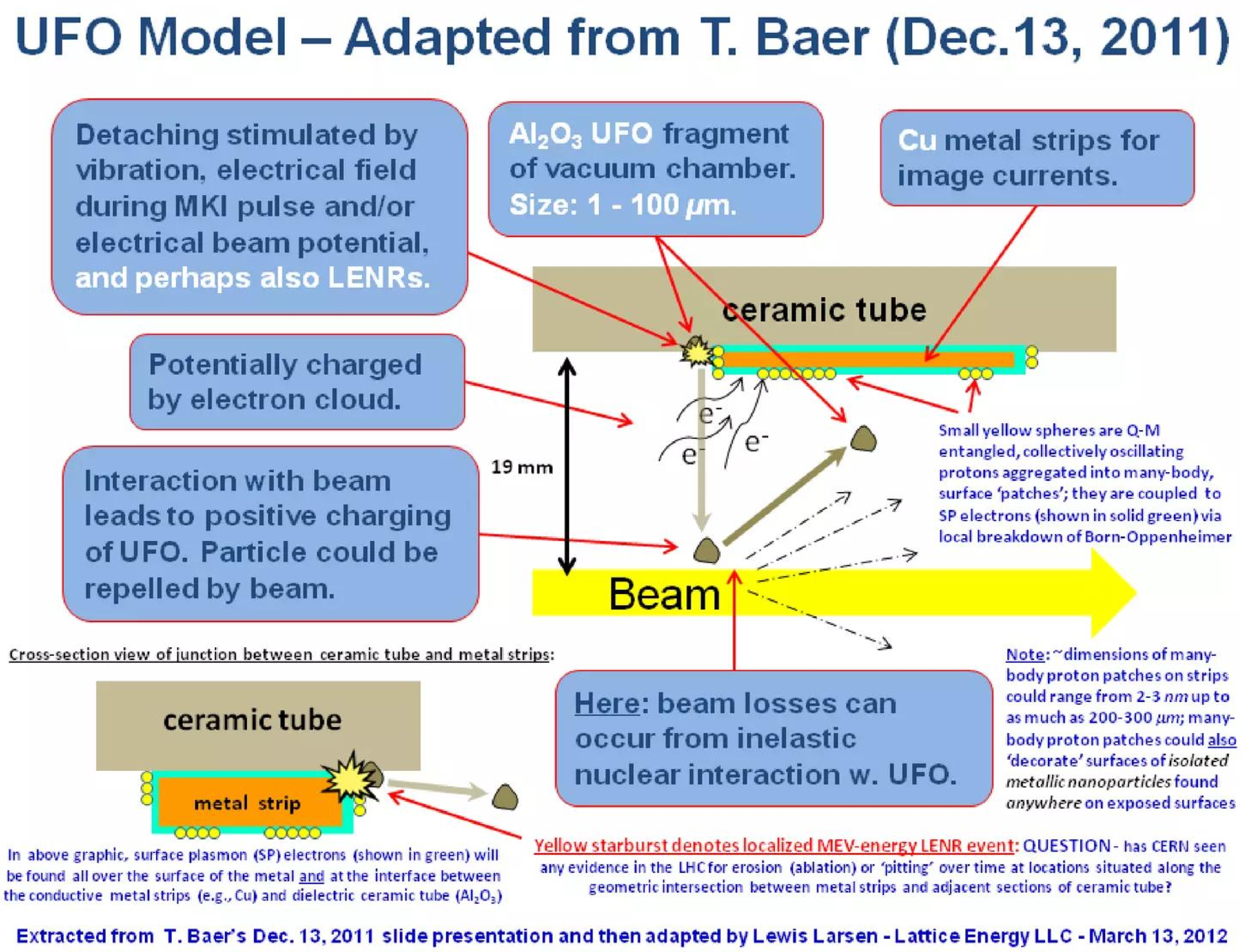
Questions/comments regarding the following graph on Slide#12 shown in T. Baer (Dec.13, 2011):



The above extracted graph appears to be an EDX elemental scan of the surface of a 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 particular set of analytical data.

<u>T. Baer slide #13 – UFO Model</u>: [please again refer to the Addendum Part 2, Slide #3 for a much larger, full-slide version of the graphic of T. Baer’s UFO Model slide shown below] – please note that I have taken the liberty of modifying T. Baer’s Slide #13 to graphically illustrate how LENRs could potentially be occurring at one particular type of exposed surface location; namely, right where conductive metallic structures (e.g., copper-coated strips resting in contact with and on top of the beam-facing interior surface of the ceramic tube) geometrically intersect the Al_2O_3 tube surface.



For example, if a very fast LENR thermal event (‘nano-explosion’) occurred <u>in very close proximity</u> to the contact intersection between a macroscopic conductive metallic strip (or even a minuscule nanostructure, for that matter) and the Al_2O_3 tube substrate, it could readily blow-out chunks of nearby, non-ductile, much more brittle alumina material (which may then become UFOs, once they are ejected from the surface).

Interestingly, the coefficients of thermal expansion (CTE) are very different for Copper versus alumina (**Cu** = **17.6**; $\mathbf{Al_2O_3}$ = **8.1** 10^{-6}/°C); all other things being equal, this large difference in adjacent materials’ CTEs would create strong local thermal stresses (please recall that local temperature ‘spikes’ in tiny LENR-active sites can potentially reach peak values 4,000 - 6,000° K prior to quenching) which would also help to mechanically fracture and break-up nearby alumina matrix material into multiple pieces.

In addition, let’s suppose that an ULM neutron’s greatly extended DeBroglie wave function happened to reach into nearby alumina and that it is instead captured by an Aluminum atom in nearby Al_2O_3 substrate (trigonal hR30; space group R3c). Well, Aluminum only has one stable isotope, Al-27. If an Aluminum atom embedded in a chemical compound (Al_2O_3) were to capture only one ULM neutron, it would be transmuted to Al-28, which is unstable to β^- decay, has a half-life of ~2.2 minutes, and then transmutes (decays) into Silicon (Si-28), which happens to be stable with a natural abundance of ~92%. One now suddenly has a different chemical compound, $AlSiO_3$ that has a different crystalline structure and lattice constant which create internal structural stresses. If enough such transmutations of Al-28 were to occur in a small region of alumina, there will be spontaneous atomic rearrangements into the compound Al_2SiO_5 (which comprises the structurally distinct mineral species Andalusite, Kyanite, or Sillimanite --- again, the devil is in the details) which has yet a different crystalline structure. ***The bottom line is the all these types of forced atomic rearrangements could locally weaken alumina matrix, making it more vulnerable to mechanical fracturing and break-up into macroparticles that then become UFOs.***

Alternatively, let us assume an ULM neutron was instead captured by a nearby Copper atom (Cu only has two stable isotopes with natural abundances: **Cu-63** = **~69.2%** and **Cu-65** = **~30.6%**); let's suppose it was Cu-63 for the sake of discussion (neutron capture cross-section at thermal energies = ~4.5 barns).

In this case, Cu-63 gets transmuted into Cu-64 which is unstable to β^- decay, has a half-life of ~12.7 hours, and transmutes into Zinc (Zn-64) which is stable and has a natural abundance of ~48.8%. In the case of stable Zn-64, it readily alloys with Copper so mechanically destabilizing structural stresses would be minimal. In such a situation, ductile metals that alloy with each other will hold-up better structurally under transmutations than relatively brittle materials like alumina. On the other hand, if a 2nd ULM neutron is captured onto Cu-64 before it can decay, it then transmutes into Cu-65 (stable); in this case isotopic ratios of Copper will shift, which can be detected and measured with appropriate mass spectroscopy.

For more details on the above issues, please see Slide #17 (marked pp. 45 on slide) and Slide #18 (marked pp. 49 on slide) in Addendum Part 2; Slide #18 shows part of a Ni-seed LENR network.

What is apparent from the above discussion is that all other things being equal, when subjected to the effects of LENR processes, ductile metals that readily alloy with other metals located nearby in the periodic table would probably fare better from a structural integrity standpoint compared to brittle microcrystalline materials like alumina. Thus, exposed metallic materials inside the LHC would appear to be much less prone to fracturing and break-up and thus would likely produce vastly smaller numbers of significant-sized metallic UFOs. This expectation is consistent with what CERN appears to be observing in the LHC; namely, collected and analyzed macroparticles appear to be predominantly composed of what is presently assumed to be 'pristine' alumina.

<u>T. Baer slide #15 - 25 ns Operation</u>: ***"Heavy UFO activity during 25 ns MDs.... UFO cascade observed in 30L3 B2 (450 GeV) --- 2 UFOs at same location within 20 seconds"*** With rapid energy input into already collectively oscillating monolayer 'patches' of protons situated on a metallic surface (which may or may not form bulk hydrides; such hydride formation by underlying substrates is not a hard-and-fast requirement for triggering LENRs, but collective many-body oscillation and mutual entanglement of protons and electrons are a fundamental pre-condition per WLT) the process of increasing local *E*-field strengths to surpass the key WLT threshold ratio β_0, for triggering an *e* + *p* reaction, producing and then locally capturing ULM neutrons can all occur very fast start-to-finish --- in fact, within a time-period as short as 20 ns in some types of pulsed high-current experimental systems.

This particular time parameter for the pace of LENR processes happens to be known because of certain high-current, fast rise-time, short pulse-duration experiments (extremely high values of *dI/dt*) that were conducted over more than a decade by an R&D company named Proton-21 located in Kiev, Ukraine; for details, please see the following excerpt from page 737 in Adamenko *et al*.'s 2007 book, **"*Controlled nucleosynthesis: breakthroughs in experiment and theory,*"** at:

http://books.google.com/books?id=rGmK-fuZWMcC&pg=PA737&lpg=PA737&dq=Proton-21+20+ns&source=bl&ots=4kb99g5nUF&sig=LAaojTxQxyaiLE3QkOS4yNyO08w&hl=en&sa=X&ei=0ohaT5DNOoGFgweBsYWiCw&ved=0CC4Q6AEwAA#v=onepage&q=Proton-21%2020%20ns&f=false

Local many-body, collectively oscillating 'patches' of protons (effectively micron-scale, spatially isolated, local ~monolayers of hydrogen) situated on a pure copper surface, if struck by high-intensity electron currents and other charged-particle 'beams', can engage in e + p weak reactions and potentially produce copious fluxes of ULM neutrons and neutrinos.

If one doubts this possibility, please examine Proton-21's voluminous body of collected experimental data; see their company website at http://www.proton21.com.ua/. Also please examine their summary of experiments published in 2004 at http://www.proton21.com.ua/publ/Booklet_en.pdf). In a large number of successful experiments (perhaps maybe as many as 10,000 by now), Proton-21 essentially struck a pure copper target having a particular geometry with a huge, short rise-time electron current arc in a vacuum (unbeknownst to them, a monolayer of hydrogen is present on their Cu targets' surface when the current strikes it). What they detect post-experiment are amazing arrays of different nuclear transmutation products in and around the original copper target. I believe their results are explained by the Widom-Larsen theory (their experimental system is more akin to the exploding wire case that we have analyzed and published); I also think they are probably really triggering copious LENR transmutations.

That said, Adamenko *et al*. have published their own alternative theory about what they think is occurring in their experimental system. I don't happen to agree with their theoretical ideas; readers may wish to examine their theory to judge whether it better explains fascinating processes that create their data.

It appears that WLT LENR neutron production and capture processes can readily take place during the course of 25 ns MDs and are thus capable of creating UFOs during such time intervals.

"*Experimental demonstration and visual observation of dust trapping in an electron storage ring"*
Y. Tanimoto, T. Honda, and S. Sakanaka [with thanks to Tobias Baer]
Physical Review Special Topics – Accelerators and Beams **12**, 110702 (2009)

http://prst-ab.aps.org/pdf/PRSTAB/v12/i11/e110702

Comment: per the results of the paper cited above (Tanimoto et *al.*, 2009: pp. 110702-6 ***"...These observations suggested that dust was generated by the mechanical movement of the electrodes without any electric discharge ..."***), Seidman's theory (*ca.* 2005), and experimental data from the field of LENRs (including certain experiments supported by Lattice), one should be cautious about assuming that outright sparking and visible arcing effects are required to produce UFOs. While it is certainly true that *macroscopically visible* electrical breakdown phenomena will almost always produce some amount of dust particles, it is also true in the case of LENRs that breakdown of an LENR-active surface (and hence dust production) can occur just as readily in the *absence* of macroscopic or even microscopic electrical sparking or arcing effects. There is abundant experimental evidence which supports that statement.

If LENRs are really occurring somewhere inside the LHC, IMO their locations wouldn't necessarily be closely associated with visible macroscopic or essentially invisible microscopic arcs/sparks.

Relevant Lattice technical document is available online (not peer-reviewed):

An 8-page Lattice report, ***"A closer look at low energy nuclear reactions (LENRs) in condensed matter systems --- 300 nanoseconds in the life of a micron-scale LENR-active surface 'patch' in condensed matter,"*** dated February 29, 2012, is available at:

http://www.slideshare.net/lewisglarsen/lattice-energy-llc300-nanoseconds-in-life-of-an-lenractive-patchfeb-29-2012

Information contained in the above document offers insight into 100-year 'checkered' history of LENRs as well as providing much more detailed working knowledge about exactly how LENR-active 'patches' operate on condensed matter surfaces where Born-Oppenheimer breaks down and the otherwise distant chemical and nuclear energy realms can, under exactly the right conditions, occasionally come together.

Conclusions and final comments:

If I had to make an educated guess with what we know today, it would be that several different types of processes are likely to be responsible producing various-sized UFOs within the LHC.

'Prosaic' localized field emission 'spots' *a la* Seidman's theory, full-blown electric arcs between spatially separated conductive structures, and Anders' "*arc spot ignitions*" concept would certainly be plausible candidates; all are certainly capable of producing UFOs. *So are LENRs*, although *a priori* I would expect that somewhat exotic, spontaneously formed LENR-active sites would be much rarer than sites involving more prosaic UFO-creating processes noted above, simply because several things must happen together at a particular surface location in order for LENRs to occur (i.e., one needs many-body surface 'patch" of entangled protons + sufficient input energy within time-frame required to surpass minimum field-strength thresholds needed for ULM neutron production + subsequent local capture of produced ULM neutrons).

So if several different types of processes could potentially produce UFOs inside the LHC, how can one discriminate between them to determine their relative contributions to observed UFO fluxes and thus perhaps illuminate where attention should be focused on developing technical strategies for mitigation?

Reiterating: the most conclusive (in fact, unequivocal) discriminator between LENRs and other candidate UFO-producing processes would involve using mass-spectroscopy to look for the presence of anomalous transmutation products (ideally with a Cameca NanoSIMS 50 machine).

If unexpected, otherwise inexplicable 'contaminant' elements were to be detected and/or significant shifts of stable isotope ratios in otherwise expected-to-be-present elements were observed in localized *nm*- to *µ*m-scale regions either somewhere on interior exposed surfaces inside the LHC and/or in collected UFO macroparticles, it would seem reasonable to conclude that LENRs are probably occurring more-or-less randomly at various locations inside the LHC (although perhaps in significantly higher area-densities in the vicinity of MKIs for reasons we have already discussed).

If no such elemental or isotopic anomalies can be detected anywhere with mass spectroscopy, then it would seem very unlikely that LENRs are occurring at significant rates inside the LHC.

FWIW – other, vastly less definitive distinguishing features of LENRs versus alternative plausible UFO-producing mechanisms are as follows: (1) all other things being equal, since tiny LENR-active sites involve MeV-level energy releases, being even more energetic, LENRs would probably tend to produce significantly larger-sized 'chunks' of UFO macroparticles compared to other plausible processes (if I understand Baer's materials correctly, physically larger-sized UFOs cause greater beam problems); and (2) all other things being equal, the heat-load produced by LENR-active sites would undoubtedly be substantially larger as compared to same-sized surface sites in which other candidate mechanisms for UFO production were operating (corollary: by comparison, LENR-active sites would probably make larger relative contributions to increasing vacuum pressures within the LHC).

Hopefully, CERN will at some point utilize a mass spectroscopy instrument like the Cameca NanoSIMS 50 machine to more closely analyze small length-scale elemental/isotopic compositions of collected UFO macroparticles and/or investigate suspicious-looking nanostructures that might be found on exposed interior LHC surfaces per this discussion. Although LENRs may not end-up not being a major producer of troublesome UFOs inside the LHC, it would still be truly fascinating to discover that LENRs were occurring therein, even at small rates at locations scattered across the entire inside of the huge machine.

"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