

Roadmap to Fusion Battery

A Novel Type of Nuclear Battery and Potential Outcomes and Applications

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Abstract – *The Fusion battery was the object of many science fiction novels and movies; the most recent one being “Star Trek,” but now it is poised to come to life. These batteries rely on a process that converts the fusion energy into electricity. They are more compact and state-of-the-art and resemble an aluminum air battery, but up to about 10 million times more powerful.*

In my developments I have learned that is possible that in a specific particle arrangement, sometimes met by nano-structures, with a specific excitation creating what now is considered exceptional conditions it is possible to generate nuclear reactions, like transmutation, fusion or fission [1]. All the parameters from mass distribution and state and field excitation are contributing to the process, that involves more than two bodies as the actual nuclear knowledge shows, the fading of the requirement of being smashed under the Coulombian barrier, that means a nonlocality, and potential formation of nuclear molecules. This is an entanglement of several nuclear or sub-nuclear entities that are in various positions but with the nuclear mass in a special communion, that may end in totally different structures than previously entered in communion. The stress to vacuum by something we call energy, brings out nothing balanced mass, as for example electron positron creation by a gamma with energy greater than 1.022 MeV. This process, in the absence of radiation, but specific kinetic energy like in material fracture or cavitations may make the most stable nucleus to fission, and occupy the hole in the “vacuum”, effect that enters in direct contradiction with nuclear binding energy, and we may say that that process remained valid until something with the “space” or “vacuum” happens, that reverses the process.

This is new physics, not in contradiction to the quantum mechanics predictions, that have to be added to our knowledge and understanding of the universe.

Even if, with the accumulated knowledge, will be possible to deliver a current source in few years with appropriate funding, equipment and support, the present road map to fission battery is proposing a more rigorous approach, in order to study and understand all the aspects involved in the process as well the domain of good-operation versus domains of hazardous behavior.

*In the last 20 years of experiments, there have been seen all the nuclear aspects, from reactions producing **heat only** to reactions having strong bursts of neutrons, gamma and X, to some sort of explosions and the community registered over 40 accidents.*

That is why a serious national, or international research program is recommended, which to convey the interests of inventors with those of the business and the nation to create the necessary synergy that to drive towards a fast progress.

Key words: *Fusion, LENR, Direct Energy Conversion, Entanglement, Quantum Nonlocality, Battery, R&D, Power Source, Transmutation*

I. INTRODUCTION

The novel nano-structures under certain conditions might facilitate non-local nuclear reactions, as fusion, transmutation of fission that follows all the laws of physics known today [2]. The non-local fusion is a novel process that appears in very particular conditions [3], being put in

evidence today due to technological advancements. The materials, their local structures and conditions are out of the ordinary, but with modern technology they may be successfully reproduced to make the process repeatable, delivering power at demand, running at command, and under control [4].

While these nuclear reactions in condensed matter processes have long been a part of nature, first reported as anomalies in the 1920s [5]. In 1933, J. Frank [6] first observed them, and then one year later Herzfeld and Gopert-Mayer [7] studied them. However, outside of these scientists, little attention was given. Then, in 1989, electrochemists Martin Fleischman and Stanley Pons, released a report [8, 9] on the anomalous behavior of hydrogen isotopes during electrolyzes. This report received a much wider media attention than in 1930s, creating a turmoil followed by competence assassination, disputes but acted as a catalyst, focusing the energy of many people, all over the planet who put in light more anomalies and developed successful tests showing much more aspects of less understood anomalous behavior. It was an aha-moment, showing that there is something that may be used to obtain power and the race started at a global scale.

My opinion, based on personal experience, is that the reported phenomenon is real, is not common and not so well understood and if more attention will be given to this subject, we may reach a better understanding of the universe surrounding us, where different types of matter and energy may well coexist and which may have more dimensions than we know today.

We might better understand the correlation in a multi-dimensional space-time, the matter-energy, and other fundamental parameters [10]. As an example, a proton and a neutron seems to be two facets or manifestations of the same entity, a neutron being 3 electrons heavier, than a hydrogen atom when it is "floating" on the "vacuum" with a single quark "up." However, if the "vacuum", or "space" that seems to be deformed is shaken it may flip the p to n and vice-versa being bound or unbound to a certain state as shown in Fig. 1.

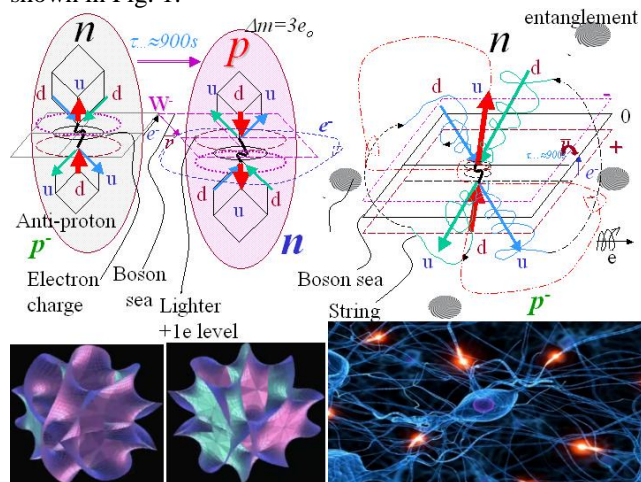


Fig. 1 – a 10-D representation of a neutron and proton manifestation, based on string theory concepts

The entanglement and tunneling are already accepted notions, with many applications, but inside a deformed space these notions may get special meanings and the

particles involved may get different properties. In a multi-dimensional space it is possible that the known elements in our 3D space could be consistent in other invisible dimensions, but may not span over all dimensions. They may also exist in subspaces that might intersect and influence each other. For example, a particle from another dimension, that does not have a body – a mass effect – in our 3D space may exist as a force or potential field, or may not be felt at all. Rather, it could occupy space and limit movements ($v < c$) or freedom degrees. This is what now we call dark mass, dark energy, antimatter, that will become a little bit more visible to our knowledge if we will start managing the effort to understand in depth these anomalies, not only making functional objects as power sources, but eventually understanding other transportation means.

In my developments and previous research I have learned that there is possible that in a specific particle arrangement, sometimes met by nano-structures, with a specific excitation to create what now is considered exceptional conditions, and to facilitate nuclear reactions, like transmutation, fusion or fission and even more. In these quantum assemblies, all parameters, from mass distribution and state of excitation fields are contributing to the process, no matter their energy. These processes involves more than two bodies, as the actual nuclear knowledge shows, driving to the fading of the requirement of being smashed to penetrate the Coulombian barrier, and that means a nonlocality, and potential formation of quantum assemblies resembling nuclear molecules. This is similar to an entanglement of several nuclear or sub-nuclear entities that are in various positions but with the nuclear mass in a special communion, possibly in a sub-space or other dimension, that may end in totally different structures than previously entered in communion as a function of a more complex selection rules. The stress to vacuum by something we call energy, brings out of nothing balanced mass, as for example the electron-positron creation by a gamma quanta with energy greater than 1.022 MeV when is interacting on a space-energy structure. Strange effects as Casimir's [11], or Aharonov-Bohm [12] may be mentioned, and why not the string theory and the recent discovery of a little bit of a Higgs boson [13, 14], or the old 1982 etherons theory [15].

This process, in the absence of radiation, but specific kinetic energy like in material fracture or cavitations may make the most stable nucleus fission, and occupy the hole in the "vacuum" [16], effect that enters in direct contradiction with nuclear binding energy, and we may say that that process remained valid until something with the "space" or "vacuum" happens, that reverses the process.

In fact, in the technologic approach towards the pragmatic application of these effects, with or without understanding to create a power source there are two main effects that have to happened concurrently in order to successfully operate:

- the nano structure to be possible to be operated in such a controllable manner that always to drive towards the same, stable nuclear reaction, for example to fusion two Deuterium atoms into a Helium 4 atom and release the fusion energy of about 22 MeV – also called miracle No. 1.

- The particle's kinetic energy has to be harvested immediately it was produced by the same structure, organized as a super-capacitor, and evacuated as electricity, and that is – miracle No. 2, and an adjuvant

- In order that this structure to operate long time have to self-recover from the structural damage inflicted by the previous interaction with the energetic reaction [17].

I have learned long time ago, and we now know that these are not miracles any more, but technical objects possible to be manufactured inside the actual technology, and put to work no matter if we really understand or not the fundamentals of the processes behind.

The fusion battery is posed to have exceptional performances, maximal power density may reach 1 MW/cc, one academic 20-liter D₂ bottle may deliver 25 MWDay, enough energy for a car to be driven 1 Million miles, or a small plane to fly twice around the Earth, but it may rise safety and reliability concerns too, that have to be well understood and mastered.

There are many other byproducts that may be obtained in the same manner as we aim to obtain energy or heat now, from transmutation or fission, or we may get new isotopic species by transmutation in these solid-state matter exceptional conditions.

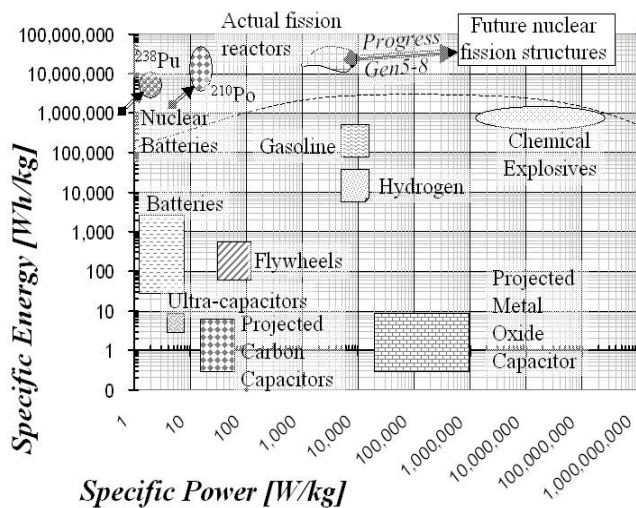


Fig. 2 – The actual map of energetic materials [18]

As is shown in Fig.1 the performances of the novel nuclear structures using fission, fusion or transmutation processes are well above the most energetic chemical fuels known today, being better by a factor of 3 than the fission based structures.

This fusion power source uses engineered nano-structures made of selected isotopic combinations to facilitate the nuclear reactions between light isotopes and

the nano-structured lattice material. It does not uses radioactive material and critical nuclear structures, being safe to operate and store the fuel and the nano-structure, having no critical mass constraints, and it doesn't generate radioactivity, but, some constructive versions may generate radioactive byproducts.

The construction and safe use of this fusion battery requires a new understanding of quantum and nuclear physics, and a new understanding of matter – may be is the beginning of a new revolution in physics.

The support for this statement is given by many anomalies observed up to now, that trend to have a different explanation than the actual physics mat provide.

II. NEW PHYSICS

A new view on nature

In the actual view on nature we conceive the substances surrounding us made of molecules, and these are made of atoms bound by various connections between electrons orbital. The quantum effects between atomic electrons in fact drive the actual chemistry's progress.

Fig. 3 shows in center the iron atom, having the dimensions of about 1 Angstrom (0.1 nm), one of the most used elements in the actual technology, having the most stable nucleus.

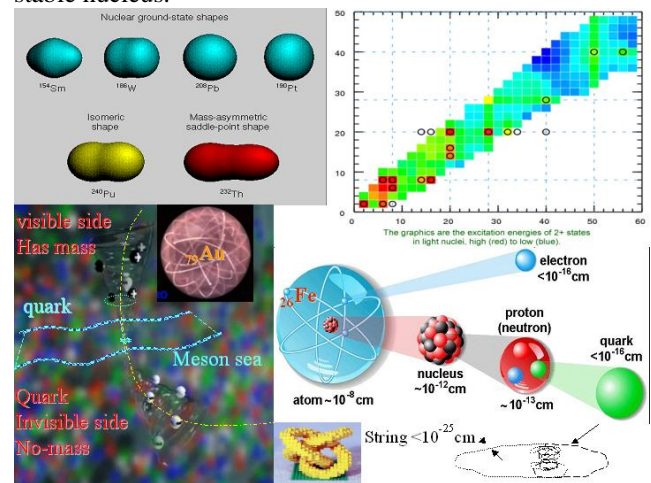


Fig. 3 – Brief representation of the actual knowledge and understanding of matter

Its nucleus is even smaller; all its mass being concentrated in few fm (femtometers), and in traditional nuclear physics models is seen as a mixture of nucleons, protons and neutrons, each having the mass concentrated in less than 1 fm. It is understood now that each nucleon is formed by the combination of 3 quarks with dimension of few atometers (am). In cutting edge nuclear theories, the nucleus is often seen as a soup of quarks, where each quark is formed of strings, an entity with dimensions of 10^{-27} m.

The string may be open or closed, as the modern string theories show, and may have various manifestations in our space, being an entity that resides in a higher dimension space. There are three main types of interactions between nuclear entities: gravitational, electro-weak and strong, those determine the type of manifestation we see in our space-time domain [19, 20].

In the lower-left side of the picture is an artistic view of a quark floating on a meson sea, a part visible and having mass, mass visible for us, and a part beyond the “vacuum wall”, in other dimensions having no (visible) mass, what we now call “dark-mass” that interacts gravitational but undetectable with other fields [21].

The visible mass, nuclear isotopes formation and stability is given by the nuclear binding force and the rule of selection and combinations of quarks, that makes an average of 1.3 neutrons to be added at each proton to form a stable combination, as is shown in upper-right chart of Fig.3. The nuclei having more or less neutrons per proton are deformed, unstable and prone to transformation.

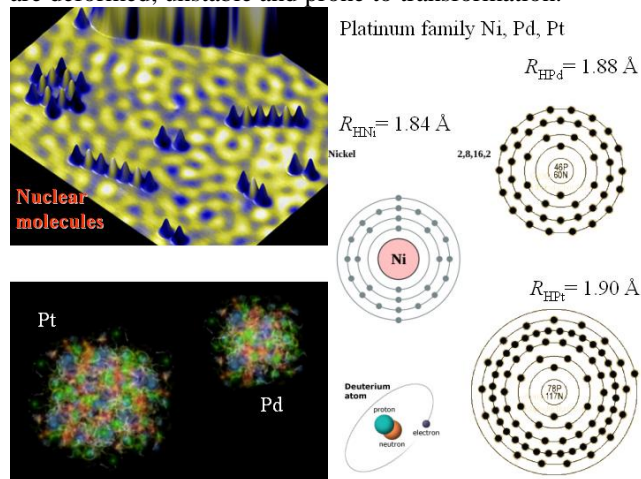


Fig. 4 – D, Ni, Pd, Pt atoms and their possible nuclear combinations

In the recent developments since 1920 have been shown anomalies in the interaction between hydrogen isotopes and Palladium, Nickel and Platinum, presented in Fig.4 with the dimension of the hydrides cells that are about 2 Angstrom. In the right side is shown the nuclei of Pt and Pd as soups of quarks, and above there are presented some novel combinations called “nuclear molecules”[22]. Without entering in fundamental details, of these new quantum species I will mention only that they are the product a strange anomalous manifestation of a kind of strong force, mentioned in modern theory as quantum non-local effect [23], entanglement (or spooky action at distance as Einstein used to call it in 1930s [24]), and is used in the actual teleportation experiments [25].

This is an exceptional condition, where several nuclei become entangled, due to a synergistic participation of all the quantum states around them, and is what Ed

Storms uses to call NAE (Nuclear Active Environment) [26] as a very special manifestation of the nature, that as a paradox opens the access of high energetic quantum states via low energy states, but whose role is amplified by the inter-quark interaction rules.

There were theories that predicted inside the classical quantum mechanics these manifestations, and the capability of creating the NAE by using electromagnetic waves – low energy photons or the lattice movements as low energy phonons to reach the needed synergy. By 1985 a paper [27] was published by Ioan Iovitz Popescu showing the quantum effects of the electromagnetic waves, as part of a more complex work at gamma ray laser like devices, where with optical photons [28] is possible to trigger nuclear transitions in meta-stable elements as ^{178}Hf , ending with coherent stimulated gamma ray decays [29]. This is a very interesting tool for many applications.

As wikipedia shows, [30] “quantum tunneling falls under the domain of quantum mechanics: the study of what happens at the quantum scale. This process cannot be directly perceived, but much of its understanding is shaped by the macroscopic world, which classical mechanics can adequately explain. To understand the phenomenon, particles attempting to travel between potential barriers can be compared to a ball trying to roll over a hill; quantum mechanics and classical mechanics differ in their treatment of this scenario. Classical mechanics predicts that particles that do not have enough energy to classically surmount a barrier will not be able to reach the other side. Thus, a ball without sufficient energy to surmount the hill would roll back down. Or, lacking the energy to penetrate a wall, it would bounce back (reflection) or in the extreme case, bury itself inside the wall (absorption). In quantum mechanics, these particles can, with a very small probability, tunnel to the other side, thus crossing the barrier. Here, the ball could, in a sense, borrow energy from its surroundings to tunnel through the wall or roll over the hill, paying it back by making the reflected electrons more energetic than they otherwise would have been.

The reason for this difference comes from the treatment of matter in quantum mechanics as having properties of waves and particles. One interpretation of this duality involves the [31] Heisenberg uncertainty principle, which defines a limit on how precisely the position and the momentum of a particle can be known at the same time. This implies that there are no solutions with a probability of exactly zero (or one), though a solution may approach infinity. [32] Hence, the probability of a given particle's existence on the opposite side of an intervening barrier is non-zero, and such particles will appear—with no indication of physically transiting the barrier—on the 'other' (a semantically difficult word in this instance) side with a frequency proportional to this probability.

Tunneling occurs with barriers of thickness around 1-3 nm and smaller, but is the cause of some important

macroscopic physical phenomena. For instance, tunneling is a source of current leakage in very-large-scale integration (VLSI) electronics and results in the substantial power drain and heating effects that plague high-speed and mobile technology; it is considered the lower limit on how small computer chips can be made."

The phenomenon of tunneling has many important applications. For example, it describes a type of radioactive decay in which a nucleus emits an alpha particle (a helium nucleus). According to the quantum explanation given independently by George Gamow and by Ronald W. Gurney and Edward Condon in 1928, the alpha particle is confined before the decay by a potential [33]. For a given nuclear species, it is possible to measure the energy E of the emitted alpha particle and the average lifetime of the nucleus before decay. The lifetime of the nucleus is a measure of the probability of tunneling through the barrier-the shorter the lifetime, the higher the probability [34].

In present tunneling has many applications and nobody thinks that is a miracle because it has applications in electronics [35] and nano-materials measurement [36], in chemistry [37, 38] and bio-chemistry [39], in nuclear phenomena as nano-structure stimulated tunneling, [40] vibration modes and tunneling stimulation [41], etc.

Applying the tunneling to the Hydrogen induced anomalies one gets extremely small probabilities, that means – never. But another recent discoveries show that these anomalies may be possible and real [42, 43].

The recent entanglement and quantum-bits teleportation experiments, teleporting independent qubits through a 97 km free-space channel, announced by a Sanhai, China research group, doubled by many other experiments in US and Europe, prove the 1930s quantum mechanics prediction and so the "spooky action at distance", becomes reality of our days communication [44].

It was also plausible, that entanglement appears not only artificially stimulated but in natural environments that meet all the necessary conditions, also decaying in time, therefore there is a dynamic balance between entanglement creation and entanglement disappearance .

This process applied to multi-body systems as the nano-clustered hydrides is susceptible of bringing significant new knowledge. It still remains to learn in what conditions the speed of light is a space-time limit or the speed of entanglement transmission of q-bits information is another limit of the dark matter by only few orders of magnitude higher than the speed of light, a kind of a speed of another sub-space.

Using the last information about the universe, shown in Fig. 5, we concluded that the mass of visible matter should be about 1/6 from the total mass in universe. The rest mass is called "dark mass" due to historical reasons but this in fact is invisible inheriting form of matter that does not interact with electromagnetic fields.

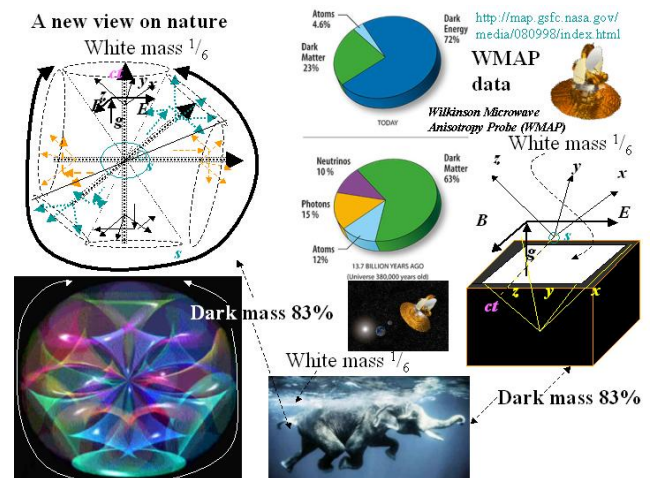


Fig. 5 – A new view of universe and dark matter

The Wilkinson Microwave Anisotropy Probe (WMAP) shown in upper right side, [45] is a NASA Explorer mission that launched June 2001 to make fundamental measurements of cosmology -- the study of the properties of our universe as a whole. WMAP has been stunningly successful, producing our new Standard Model of Cosmology. WMAP's data stream has ended.

WMAP data reveals that its contents include 4.6% atoms, the building blocks of stars and planets. Dark matter comprises 23% of the universe. This matter, different from atoms, does not emit or absorb light. It has only been detected indirectly by its gravity. 72% of the universe is composed of "dark energy" that acts as a sort of anti-gravity. This energy, distinct from dark matter, is responsible for the present-day acceleration of the universal expansion. WMAP data is accurate to two digits, so the total of these numbers is not 100%. This reflects the current limits of WMAP's ability to define Dark Matter and Dark Energy.

In a classical Hindu view of the universe, see the bottom center picture, [46] the white matter is equivalent with the bubbles left behind by a swimming elephant, and is just a fraction of the total water involved in the process.

The WMAP data, that is shown in the pies in the center shows a preliminary estimation on the unseen content of the universe. In a generic view it may be a set of 3 orthogonal Minkowsky universe, each containing all the 4 dimensions embedded, having each two directions and from which one is our cone of realm, and that is the only one visible to us. That does not mean that it has only 4 directions, and not more like 8 or 10, and here is an open field to be studied by integrating the results in nano-materials with the results in galactic observations.

There is also made a distinction between mass and energy, and one have to understand that mass is an energy in rest, or stored which in our universe follows the Einstein's famous formula $E=mc^2$ where c is the propagation speed of the EM field, in vacuum [47]...in the

absence of visible mass [48]...It's validity beyond vacuum remains to be verified.

Beyond all the knowledge, it is clear that the systematic study of these processes will drive to a superior understanding of the universe with potential game changing applications in many domains.

III. THE FUSION BATTERY OPERATION MODE

Fig. 6 shows a ternary nuclear reaction where two ^2H (Deuterium) nuclei generically called "fuel" and a nucleus belonging to the "burner's" nano-structure makes via entanglement a unitary compound nucleus entangled in the lattices positions.

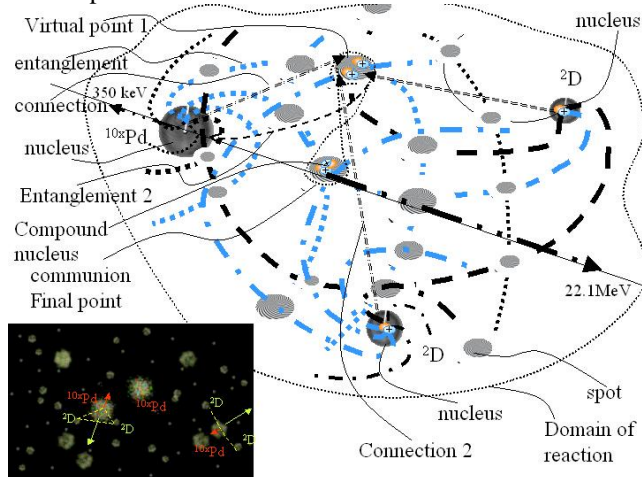


Fig. 6 – A possible explanation on the multi-body quantum reaction among Pd and D atoms in synergistically stimulated lattices.

For explanation purposes there are shown 3 nuclei that are interacting in a compound nucleus without "touching" each other in the classical sense of ion beam interactions that requires energy to penetrate through the Coulombian barrier in what we believed are the boundaries of the nucleus. There is also important to understand that a compound nucleus is not a sum over protons and neutrons present there but a wrap or loom of quarks, floating in the "meson sea", with all quantum states surrounding it, in other words having more than 3 dimensions, where as was previously shown a neutron and a proton is the same entity, showing us 1 quark for each dimension of our 3D space, having a possibility to flip showing like a set of 3 magnets, a side $uud=p$ or $ddu=n$, that has a lower stability, and a halving life time $T_{1/2} = 900s$ until flips back via a virtual boson w^- and an anti-neutrino $\bar{\nu}_e$, what is also called neutron's beta decay [49].

The nuclear exchange is made at this level or at strong interaction units that operates in the case of fusion, transmutation, as well for fission, being no difference

between them from this point of view of the nuclear reaction.

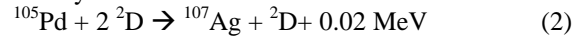
This neutron decay is a process inverse to the e-capture, and in our universe the proton-electron coupling in H atom is more stable than a neutron. That is why the proton does not capture its electron to become a neutron in normal conditions [50].

This loom of quarks once entered in entanglement the exchange starts in order to recombine in a more advantageous manner from the point of view of nuclear stability and exhausting the surplus of energy as kinetic energy of the newly resulted particles. It is very probable that the initial ternary entanglement to produce new binary entanglement, following the conservation laws in new entanglement positions, based on center of mass, from where the surplus energy or defect of mass, is released, conserving the energy, impulse, spin, parity, etc., as kinetic energy of the particles and excitation energy of the particles, that is released at later times by various nuclear decay modes.

In this respect:



or may drive to:



In the first reaction (1) that releases 22.4 MeV, Pd gets about 0.3 MeV recoil kinetic energy producing about 200,000 dislocations (dpa-s) in the lattice while He gets about 22.1 MeV traveling about 50 microns in the lattice.

This high energy, 22.1 MeV makes the particle travel a long distance of about 50 microns making possible the direct conversion of particle's energy into electricity. The structure used resembles a super-capacitor because it relies of the difference of the ionization energy deposited by radiation in different materials that drives to knock-on electrons induced electron showers that may be collected on electrodes and driven outside to the plots.

Up to this point, it was described the molecular excitation to nuclear reaction process, and remains to clarify how we can control the reaction rate in order to deliver power at will with ultra-high efficiency.

Under this aspect it is important to highlight that the fusion reaction delivers 22.4 MeV from which about 22 MeV, about 3 pJ (pico-Joules) are carried by the He nucleus, and may be converted into electricity, the rest of 0.4 MeV, about 2% are carried by Pd on short range and ends up in thermal energy, if another structure matching Pd recoil is not embedded.

To deliver a power of 1 W, $3 \cdot 10^{11}$ reactions are needed, while for 1 MW a factor of 1 million more is needed.

In order to estimate the limits of this method and power source, we may consider a total conversion efficiency of 95%, and we know that up to about $1\ \text{kW}/\text{cm}^3$ may be removed from the actual nuclear structures operating at 900K that will drive to a maximum power density of about $20\ \text{kW}/\text{cm}^3$.

A further estimation of the power density may be made considering that for each 10 microns of Pd structure; 100 microns of direct conversion structures have to be added. That makes 80 structures to be packed in 1 cm thick power source.

If 1 fusion act takes place at each cubic-micron, about 1 at 343 trillion atoms with a probability of $3 \cdot 10^{-12}$, about 10^{10} fusion acts are produced in 1cm^3 delivering about 30 mW/cm^3 power. To have an acceptable technologic power supply one may need 30 W/cm^3 , for which 1 fusion is required at every 100 nm apart, at about 7,000 atoms lateral cube cell ($343 \cdot 10^9$ atoms pairs (pd-D)) has to deliver 1 fusion per second, and that seems to be a reasonable value.

The process and the NEW PHYSICS beyond

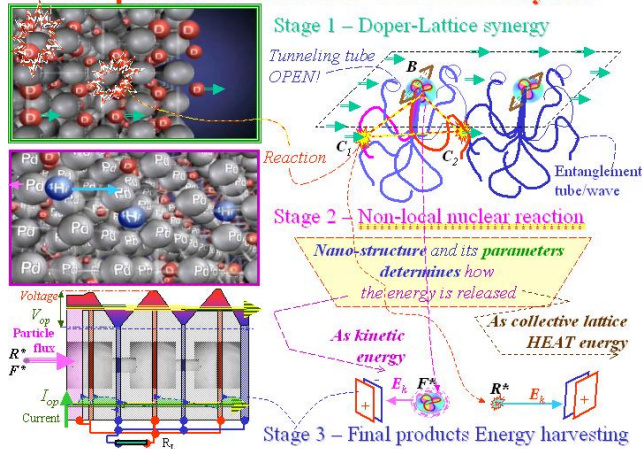


Fig. 7 – The operation principia of the battery nano-element

To simplify the explanations for Fig. 7 we will pretend that there are 2 POSTULATES or MIRACLES that have to be simultaneously accomplished in order to make the device work.

The fusion reaction does not consist in crushing one nucleus into another through Coulombian barrier but in a non-local reaction through the opening of a tunneling wave-tube (worm-hole) in which a nucleus falls into, also called entanglement or sub-space teleportation.

The nano-structure engineering and its parameters determines the nuclear reaction channel and how energy is released as kinetic energy of charged particles, or involving neutrons or is split into multiple quanta – heat without radiation.

The nuclear process relies on recent advances in quantum mechanics and previous experiments.

The main statement is that the nucleus hyperfine structure is resembling as a soup of quarks, that may have another layer of detail – strings of space.

Another statement refers to multidimensionality of the space – having few layers observable to us like the 3D space, its time component and the electromagnetic components, and other indirectly visible, like dark matter, etc.

Another statement says that at the quark level the space is not uniform, and has singularity points connected in sub-space layers that make the nuclear entity to be present simultaneously in several separated locations in our 3D space. That is what is called by quantum mechanics that the particle takes a stand in response to a measurement, that is a strong perturbation, and we have some incertitude covered by Heisenberg.

The recent entanglement experiments proved this sub-space interconnection mechanism exists and is accessible in some conditions.

One may use imagination and analogy and see the nuclei as “octopuses” or some plant roots in water, where the tentacles are fibers of space immersed in sub-space not directly visible to us, and those do not follow exactly the movement of the visible nucleus (that soup of quarks with sub-structure previously discussed) so there is possible that tunnels of entanglement to open at long range – occurred during oscillations of the nuclei...- when such a “tentacle” or tunnel or call it “worm hole” touches another tentacle, or nuclei – a spontaneous “communion” occurs and the previously separated nuclear entities are now entangled, and able to change quarks via subspace, in order to come out with an improved more stable nuclear structure in our space, following almost all the present laws.

Another postulate says that the nano-structures are able to generate such entanglements, during specific quantum excitation and by controlling the nano-structure macroscopic parameters there is possible to control the entanglement rate and finally the reaction rate and the reaction channel, or final quantum states.

Of course this does not occur with acceptable rates in any nano-structure and in whatever conditions, and a knowledge-based selection is required.

The figure also shows that after the nuclear reaction took place, the reaction products fly apart following all the well known rules, delivering the excess of energy as kinetic energy of the final product F (usually a product of transmutation) and to the residual product R (that may be a product of fusion or spallation). The kinetic energies above add to the lattice threshold energy, that energy that synergistically contributed to entanglement and was trapped in the process, but what matters most is the sequence of quantum states.

The reaction product may carry inside an internal excitation energy, marked by “*” that will be released later.

The reaction products deliver the energy to the lattice by stopping inside a several microns range, and there is recommended to harvest their energy immediately before it becomes heat. This is done by a super-capacitor design built inside the structure. One have to know also that the thermodynamics as we know it comes into play nano-seconds later, after the nuclear reaction ended.

There is possible to obtain binary or multiple nuclear reactions – in the figure was shown the ternary nuclear

reaction that may lead to the release of fusion products, while the binary nuclear reactions may drive to transmutation products.

Electrons are participating to these nuclear reactions too, bringing an important contribution to entanglement rate, but have been omitted for simplicity reasons.

Following preliminary calculations shows possible reaction rates up to 1 reaction/nm³, driving to power of several MW/cc, power that might make that cc evaporate in few microseconds or less, if not appropriately harvested.

From the point of view of nuclear reaction mechanism there is NO difference between Fusion, Transmutation or Fission; these names have only historical importance for us and denotes more a superficial aspect of the nuclear reaction, related to the mass ratio before and after reaction than an intrinsic aspect of the nuclear reaction mechanism.

It is now accepted that long-range entanglement is possible, that entanglement is created and decays in time, that can be wiped out during a hard measurement but this is transmitted at distance in a complementary or not manner.

It was observed the tunneling, measured and visualized on high-resolution electron microscopes, and there are lots of practical applications and headaches from tunneling in modern electronics, in nm domain.

What is still not yet accepted and understood is that entanglement and tunneling seems to be about the same process with slightly different outcomes.

It is not yet clearly specified that entanglement is not only artificially created, but it randomly creates itself, and when happens among nuclear quantum entities, new final product appears in the class of nuclear reactions triggered with extremely low energies as photons, or phonons. That is odd, spooky Einstein would say, but was already proven that with lasers or electron beams, soft X rays is possible to excite nuclear decay, a step forward towards GRASER, or modifying the e-capture decay time by offering more electrons in the near vicinity of the nucleus.

Collins-Iovitzu experiments prove that there is possible to make gamma levels excitations using laser beams or synchrotron radiation. Other experiments prove that using THz rays is possible to excite nuclear states driving to fusion and transmutation.

Fig. 8 in upper left shows an example of the moving particle energy deposition when crossing a sandwich of various electron availability layers. In this example Layer 1 is Gold (79Au), second layer is PTFE (¹C₂F₂), third is Aluminum, and so on: (PTFE, Au, PTFE, SiO₂).

The left-down figure shows the knock-on electron trajectories after they have been generated in gold layer.

The chart in lower-right side shows a synthetic view over the material electronic power deposition for 5 MeV alpha particles in a normalized view.

The stopping ranges are different and so the layers thickness and they are balanced in order to generate about same current and voltage drop all along the structure.

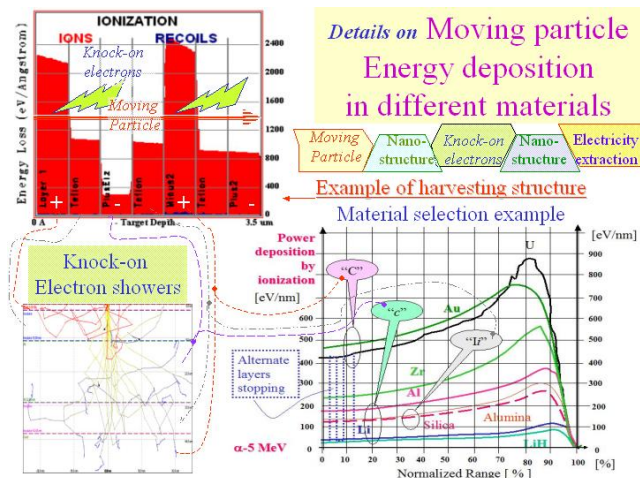


Fig.8 – The operation principle of the super-capacitor.

The most important thing is the sequence of interaction and the harmony created between various materials apparently sitting passive in the structure with the active elements participating in the process, similar to the processes in an organization. The creation of the harmony at all levels makes the process efficiency.

The direct nuclear energy conversion into electricity process has two main stages:

- The particles released by the nuclear reaction are stopped in the nano-hetero structure –like a planar capacitor - made of an alternating structure generating electron showers
- The next plate that becomes negatively polarized collects the electron showers generated on previous conductive plate.

To amplify the process the capacitor plates are made of different materials, that maximizes the efficiency.

The Direct energy conversion ideas are about 99 years old, starting with Henry Moseley's 1913 beta-cell and ending with the super-capacitor structure presented in the Fig.8 in didactical view.

A history of direct energy conversion device I have presented [4] in the SPIESTIF meeting in 2011 in Maryland University covering all the period, and many other types of direct conversion devices [51-53].

Fig. 9 is an exemplification of an elementary "CICI" cell as previously discussed, where the delta-layers making the interfaces between main elements of the harvesting cells are visible, and some dimensions are provided.

The alpha source, also called particle source, because may be any radioisotope or particle generator as fusion or fission materials, is placed in direct contact with the conversion structure. It can be a fusion system, or a isotopic source or a fission particle generator, or an accelerator beam. The alpha particle appears in the source and crosses all the layers of the energy converter slowing down to rest.

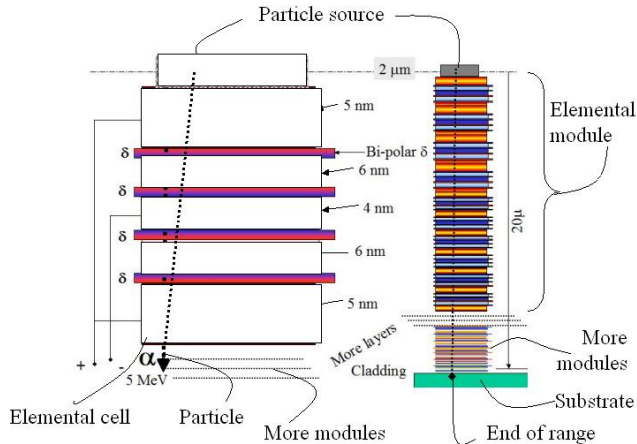


Fig. 9 – The structure of a direct energy conversion module

The "C" layer is electrically connected to the rest of the cells by cables starting from the plots of the armature. In this type of material the particle is dropping most of its energy.

The particles generated in “C” layer are adjusted in the delta layer separating from the insulator “I”, and redirected by the next delta-layer between the insulator “I” and the “c” layer. Further the electrons generated in the “c” layer are returned in “c” layer by the combined action of the delta layer and the insulator “i” .

The backscattered multipactor electrons emitted by the next “C” layer are driven by the delta-layer straight into the conductive layer “c”.

A plurality of elemental conversion cells have to be used in order to achieve the optimal energy conversion into electricity, that has to span over the entire stopping range of the particle of interest.

The right side picture shows the structure of a conversion pack, using the source of nuclear particles, that are passing through an elemental module made of a plurality of conversion elementary “CIci” cells. There are several such modules, customized on energy, that are stabilized in the support, that has the role of stopping light radiations and give the necessary mechanical rigidity.

IV. THE FUSION BATTERY DEVICE

The final goal is to build a functional power source that to have the burner in the middle, surrounded by direct energy conversion structures (DNECE modules) as shown in Fig. 10 in a block diagram.

It is coated in cooling devices that uses helium to take the heat from the structure and release it in a heat exchanger.

In order to have a smooth operation it have to be fueled with the combustible gas – the nuclear burning is envisioned.

In the constructive solutions where the transmutation released energy is harvested the burner, consumes out too, and have to be periodically replaced, while in structures generating transmutation less fusion, the burner has longer life.

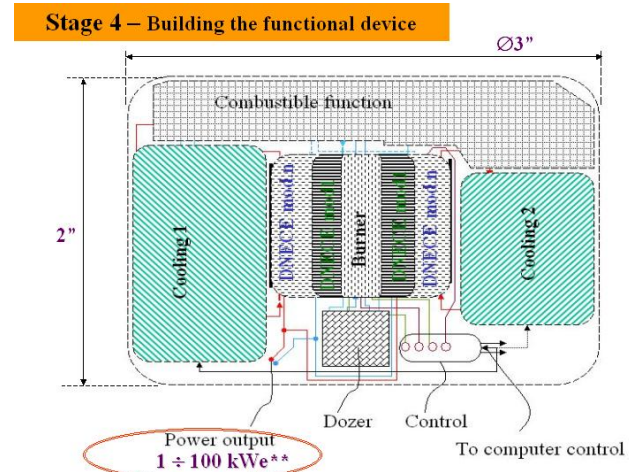


Fig. 10 – The block diagram of a fusion battery

The system is assisted by computer and has fuel recovery systems from the cooling agent.

The maximum temperature depends on the acceptance of the burner and harvesting structure, and if it is high enough may carry supplementary thermal to electric conversion systems.

In Fig. 10 is given a schematic diagram of the power source that relies on nano-cluster controlled nuclear reaction.

The power source is made of an external enclosure, containing the following modules:

- The central burner that contains a “Clci” nano-structure that harvests the recoil energy of the atoms involved in nuclear reaction. In the central burner the combustible fluid that can contain Deuterium, Hydrogen or Tritium is introduced and reacts with the Palladium, Platinum or Nickel atoms in nano-clusters. In this area there are means to control the reaction rate by controlling the input parameters as pressure, temperature, electric field, input and output flows. The central burner is built on a “Clci” structure that converts in electricity the energy of the recoiled nuclei. An important fraction of this will be heat that will be removed from the structure by same liquid flow, carrying the heat outside in a heat exchanger.

- The conversion module that converts the energy of the resulted fusion product in electricity. This module contains the high-energy customized “Clci” structure that converts the energy of alpha particles into electricity. It also uses Helium for its cooling purposes. It may also use actinides in the structure to convert the energy of emitted neutrons by fission and fission energy harvesting.

As a general use the first charged particle energy conversion module may not contain actinides being very thin compared with what is needed to harvest the neutron's energy and amplify it in fission processes.

The second stage of the direct energy converter, that contains "Clci" structures customized for lower energy and terminal structures robust to the end of range damage. These structures will be cooled down by a Helium flow.

To prevent the end of range excessive damage the end structures will have higher porosity and liquid or viscous material trapped in the pores that recover after the end of the range dislocation process. Another alternative solution is to use special cells that fail-safe and may be easily replaced when damaged.

The third energy conversion stage is placed outside the box, because it has high volume, being about 1 ft thick of nano-structure fulfilled with actinides exhibiting high cross section, and driving to a sub-critical nuclear fission structure.

The burner converter stage is using a special unit that to inject the fluid and re-circulate them for cooling. It uses for cooling the same combustible fluid because there is not too much room to separate the circuits. The pressure is dynamically established by the differential pumping method.

- The main fuel system that provides the fuel to the burner system and re-circulates it, cooling and purifying it and preparing for being reused. The system supposes no leaks of any material all being content inside the system.

- The helium cooling system and helium recovery is a closed system attached to each energy converter structure. It cools the harvesting structure in the zone where it has the maximum conversion efficiency and prevents overheating. It also recovers the reaction-generated helium and prevents its agglomeration in the structure where it may trigger damaging effects.

- The control system and power extraction combines the power extraction systems and power adjustment for delivery with control system, integrating the feedback signals coming from all the modules, with those from the external control unit.

Fig. 11 shows a more detailed view of all the subassemblies that are integrated in the functional modules that are easy plug-ins having standardized connection arrays made with the purpose that everything to be interchangeable and allow an easy maintenance.

The outer case 00 is integrating in the same box the modules needed that the harvesting unit to operate for transmutation and aneutronic fusion processes. It allows the connection on exterior side of the special harvesting modules 04 used for neutronic fusion that is coming with their own shield, and structure.

This structure is bulky and heavy and it comes as a modular nuclear fission reactor sub-critical structure that integrates in its core the entire fusion box 00 or only its

active part 03, leaving the rest of equipment out of the radiation field.

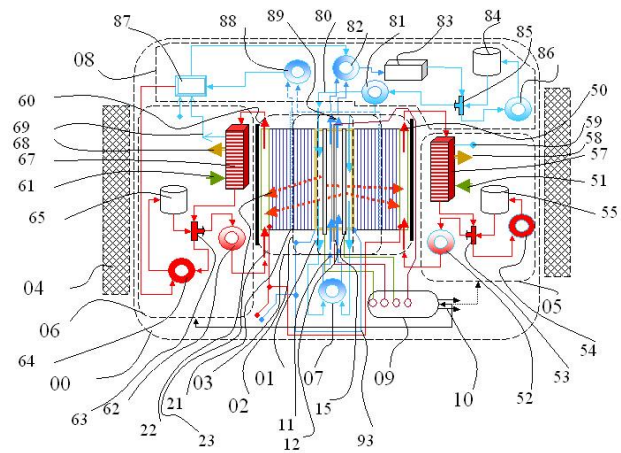


Fig. 11 – More detailed block diagram of the battery

The central part of the structure is the active element box 03 that contains inside the burner 01 where the nuclear reaction takes place blanketed on its lateral sides by the energy harvesting modules 02. The structure may have a cylindrical or rectangular geometry. In case of cylindrical geometry the harvesting modules will be built and add as sectors. In fact all the dimensions we are talking about for the inner structure 03 are about 1 mm diameter and up to 100 mm long, while for planar structures they are up to 50 mm lateral and 100 microns thick. A bigger interlaced structure being the most preferred.

The present figure shows the simplest configuration for the power source.

The central module also called burner 01 is made of a very thin containment structure that is mainly a frame. It contains the fittings 11 that assure the fuel re-circulation from inside to the re-circulation module 07 and back into the burner. The arrows show the flow of fluid through the system. The central armature 12 is used for electric polarization, applying an electric field with role of ion implanter in the burner structure 15 that is made of a foil or a micromesh supporting the active material plated structure.

The foil has the capability of warming up electrically as a resistor and also operates as a grid in connection with the central armature 12. The fuel fluid is washing the structure inside on all directions and is caring out the heat, while is taking part in the reaction. From the burner structure also a set of electric wires are connected to the control unit 09. The structure 07 is basically showing a MEMS fluid multi-stage pump.

The main wires coming from the burner are related to resistor 15 power warm-up and its temperature control, central armature 12 to active mesh 15 voltage, central

armature temperature, burner harvesting structure current output, and flow detection.

The burner modularity and interchangeability is important because it is the most stressed structure from all the system.

The fluid coming into the burner is accelerated between armatures and penetrates the microstructure deposited on a lateral grid in the "C" elements of the associated "CIci" nano-beaded structure. The electron avalanches that creates an electric current and voltage is further transmitted outside the structure to the control module 09 where it gets a multiple use, as information about the reaction rate and output energy.

The complementary particle associated with the ternary nuclear reaction 22 is crossing the burner structure and stops in the "CIci" harvesting structure 21.

The structure is also modular, having various modules stacked together but being customized for different zones of the particle's stopping range where it exhibits different energies. A helium flow 23 cools the structure and maintains it inside the operational domain that exits the structure collecting and the nuclear reaction produced atoms.

A very important part that assures the operation of the harvesting structure is the cooling system that relies on the use of Helium gas (other fluids may be used too) that is pumped inside by the MEMS pump 62. The gas flows in the structure channels mainly between modules and collects the heat and all the residual gases formed inside, maintaining the operation pressure inside.

The exhausted gas 50,60 is driven into a heat exchanger 57, 67 that took outside air 51, 61 to cool down, and exhausts it 58, 68. The heat exchanger unit also separates and collects the fuel fluid 59, 69 and sends it back to feed unit.

The cooling gas that leaves the heat exchanger is going into a multistage two way flow switch 53, 63 that can resend it back into the recirculation pump 52, 62 or may direct it into a compressor pump 54, 64 that pushes it back into the tank 55, 65. All these are micro-fluidics devices controlled from the control unit 09. For good operation there are needed two cooling system for a lamellar structure, one for each harvesting module.

The units 05 and 06 are identical but serving different energy conversion "CIci" units.

The fuel control circuit uses a storage tank, 84 that can be placed outside the structure or inside, because the consumption is very small connected through a multi-stage, multi-way flow micro-switch to the recirculation pump 81 that introduces the fuel into the burner 80 on the active structure side 15.

From here it passes in the opposite recirculation pump 07 that reintroduces the flow in the center of the cell, from where it exits the structure 89 and is taken by a multi-stage pump 82 that passes through the heat exchanger 83 and

further in the flow micro-switch 85 that may direct it back in the circuit or into the compressor micro-pump 86 and store in the tank 84.

Some of the fuel may diffuse through the harvesting structure 21 from where is directed collected by the vacuum pump 88 that sends it into a purifier structure 87, together with the fuel recovered from the cooling circuit 05 and 06, respectively 69. From the purifier 87 the fuel is redirected back to the circuit 82, while the coolant is sent to coolant re-circulation pump 64.

The control unit 09 collects the signals from all the units and bring them into a computer data acquisition system, interprets them in real time and sends commands to all the elements of the systems as micro-pumps drivers, micro-switches, voltage and current controllers. The harvested energy collected on the wires 93 from the energy converter modules and that collected from the burner's embedded direct energy collection structure is processed by the controller specialized unit in order to be delivered outside the structure with the appropriate voltage and current.

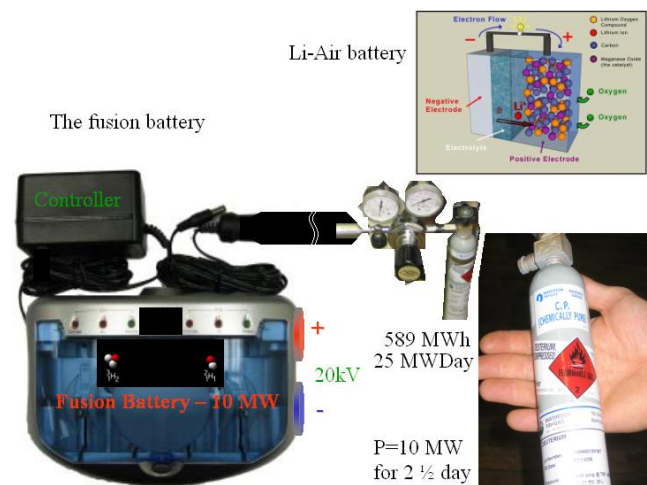


Fig. 12 – The fusion battery compared to an Li-air battery

The final product, at maturity will look like that presented in Fig. 12, where is placed in an case, having all cooling system in place, and ready to be connected at its plots.

In a size of about 1 cubic feet it may deliver up to 20 MW, by a factor of few millions more than a Li-Air battery. In general lines, the batteries are similar, they are fed with a gas (air or deuterium) and based on specific internal processes they deliver electric energy at their plots.

One bottle of 20 liter of Deuterium is all it needs for an electric vehicle to run over 1 million miles. There are many other applications in space, air ground, underground and underwater, which will not be mentioned here.

In spite all the knowledge accumulated I have to state that the domain is very broad, and even if a demonstrative battery may be build in a relatively short period of time with the appropriate funding and infrastructure, a more ample research program is needed.

V. THE PROPOSED FUSION BATTERY R&D PROGRAM

As was shown before this subject requires more ample research performed inside a program able to incorporate all the aspects.

In the introduction we have learned that this hydrogen induced anomalous behavior was periodically reported since 1920s, and the 1990s Fleischman and Pons retaliation was a manifestation of the mental inertia of scientific communities, prone to resist to novelties. Since that moment, up to now, more than 23 years of experiments have been accumulated, and this anomaly becomes more visible, being proven and shown in many experiments.

To the many theories about this process, this paper brings a new explanation based on space entanglement and multi-dimensionality of the universe.

It raises a question mark, over rigid perpetual-mobile definitions, because the postulate says the following:

In an insulated physical system many fundamental parameters are conserving as energy, impulse, spin, moments, etc. The problem is that if we are going to admit that the universe have more dimensions and there is "dark" mass and energy, how can we be assured that the systems we define in various experiments are insulated, and not transferring energy from a dimension into another?

This answer is difficult to be given now, and requires more research.

Research proposal goals and phases

My research proposal is not dealing with fundamental aspects of the universe, but with practical technological ones, able to produce quantitative accumulations and when a critical mass will be reached to drive to a novel understanding quality and spectacular progress.

Its goal is to build a safe, compact, reliable fusion battery is bold enough to drive to a game-changing product, because with enough energy all the other resources may be obtained.

The program has to have a theoretical component, because, up to now more than 20 models and theories have been developed and I will cite the Marian Apostol's 1989 heavy electrons theory [54], published in a less accessible magazine in East Europe [55], or the modern theories of Peter Hagelsting, Larsen-Windom's bound neutrons, or Miley-Hora swimming electrons and many more. All of them are good, are describing several aspects of the manifestation, and are more like predictions tables, but, and they are still missing, the high quality understanding of the process they are modeling. My model presented above is just an opinion.

The research program will have a direct experimental component aimed to identify the main material structures prone to facilitate the process, with simple basic experimental devices as that shown in Fig. 13 that relies on simple setups and a large variation of parameters searching for the right conditions that facilitate these quantum reactions, in close correlation with Molecular Dynamics and other models predictions.

General description of my The research effort proposal

Stage 1

- Proof the fundamentals of many other nano-lattices that facilitates nuclear reaction (NSFNR) and
- Measure the Nuclear Reaction rate as function of nano-structure parameters:

Simple Experimental assembly

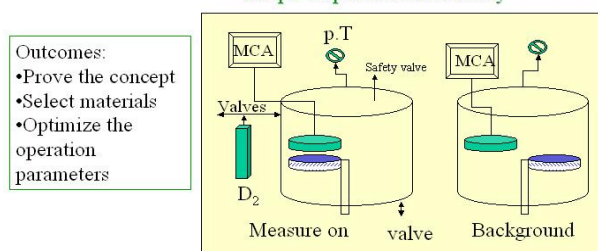


Fig. 13 – Simple experimental setup

The research effort has to analyze in all details, all the statements and solutions presented before, in order to make a sound, reliable device and learn more about the properties of matter. In Fig. 13 it is presented a simple device that to test the nano-structure properties and analyzed the nuclear reaction, based on several computer based instruments. It is a gaseous phase analysis device.

The figure shows the experimental setup to measure the nuclear reaction yield of the nano-structures. It is made of a sealed chamber that contains a moving support or sample holder that may have adjustable positions. The sample to be measured in blue, right side disc is set on the holder table, that have capabilities of thermostat and electric field control being insulated from the ground.

The chamber is equipped with electric signal passes through, and fittings for ambient atmosphere control.

A set of input valves is used to introduce the desired isotopic gas inside, or flush the chamber.

Another set of valves is used to control the "combustible" gas input. In this case we used Deuterium stored in a bottle. A safety valve that is meant to mitigate the avalanche burning danger that can drive to step pressure increase and at least a set of atmosphere measurement devices as pressure, temperature, composition are recommended.

The system also is equipped with a charged particle detector and a specific multi-channel analyzer (MCA) that detects the nuclear particles produced in the sample as a function of sample control parameters.

The figure shows the same setup with the experimental chamber containing the sample holder in a remote position with the sample on.

The charged particle detector is connected to the MCA and is measuring the background radiation effect, as function of the inner gas parameters controlled and measured by the system.

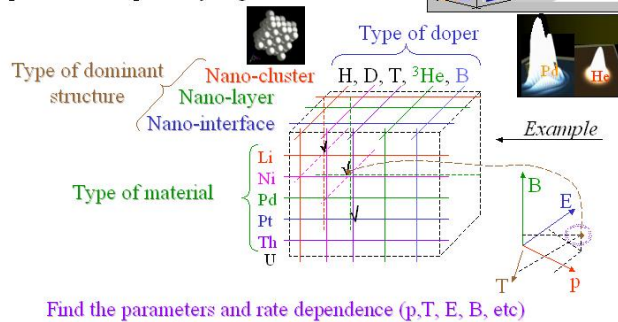
The experiment is making a background calibration and detection system test using the position in the figure and after that the sample is brought in the measurement position shown in the near by left figure, and the test program is run.

The result will give the dependence of the reaction rate on the control parameters.

It is important to make the correlation between the nano-structures, the excitation signal, and operating parameters in order to find the exact domain of operation and the variation laws of the control parameters.

Stage 2 – Advanced research

Find the best engineered nano-structures that produces the optimal synergistic effects



Find the parameters and rate dependence (p, T, E, B, etc)

Outcome – technologic, constructive parameters for dedicated systems

Fig. 14 – The complexity of the problem

In Fig. 14 it is shown in the upper right corner the Pd-D-D nuclear entanglement reaction in the active environment as a particular case that driven to this application, but as it was stated in the physics details, there are many materials and combinations that may be used in order to produce the structure, and that is what the cube is showing. Adding the alloys the problem gets another order of magnitude in complexity.

The upper right ideogram shows a lattice atom of Palladium, (Base or Burner =B) entered into entanglement with two deuterium atoms of the (Combustible=C) that generates an excited Paladium (Final product = F) and a recoiled alpha particle (He) (Recoiled=R), both carrying the kinetic energy of the mass defect and conserving the energy, impulse, etc.

The cube, shows the multi-dimensionality or the research and certification activity, where a large number of substances may be used, each being possible of having isotopic enrichment.

From each of these materials several structures may be fabricated and the reaction rate dependence of certain parameters may be measured.

The arrows near by the cube shows the large range of variation of the main operation parameters that have to be searched in detail in order to be able to know the response of the system.

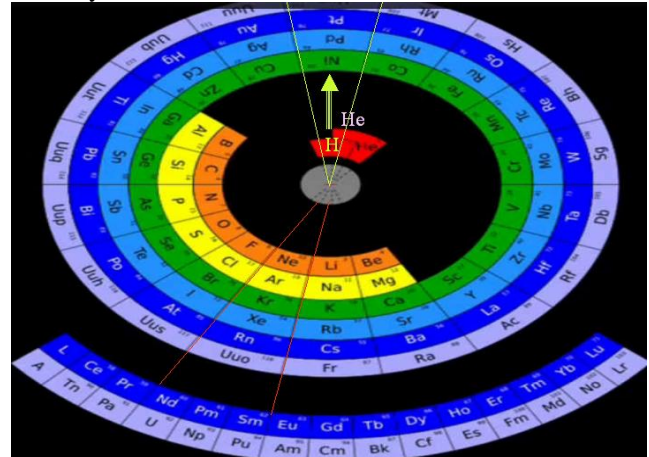


Fig. 15 – The radar map of elements

From the radar map of elements shown in Fig. 15 we simply observe that the cube of materials in Fig. 14 have been largely underestimated.

The radar map shows that we are exploring the direction 0 (North) as one may see the green arrow pointing towards the only 3 elements Ni, Pd, Pt previously discussed, but that represent less than 3% from the available elements and less than 10% from the potential use elements.

Even in this direction the complexity is high, when consider specific isotopes, and their combinations.

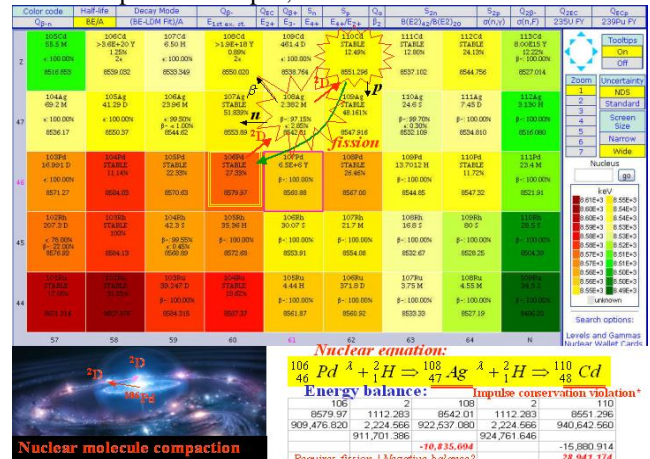


Fig. 16 – Transmutation of Pd in Ag and Cd [56]

The supposed as known, reaction (1) presented before, may have a large diversity of manifestation due to isotopic variations that may influence the reaction conditions. In Fig. 16 is shown the energy calculation for the transmutation of ^{106}Pd in ^{110}Cd , via ^{108}Ag by successive

absorption of 2 deuterons that requires that two synergistic conditions to be successively met, that seems to be much difficult than a triplet nuclear entanglement reaction.

From here considering the nuclear binding energy at both isotopes and Fig. 17 shows the Hydrogen zone.

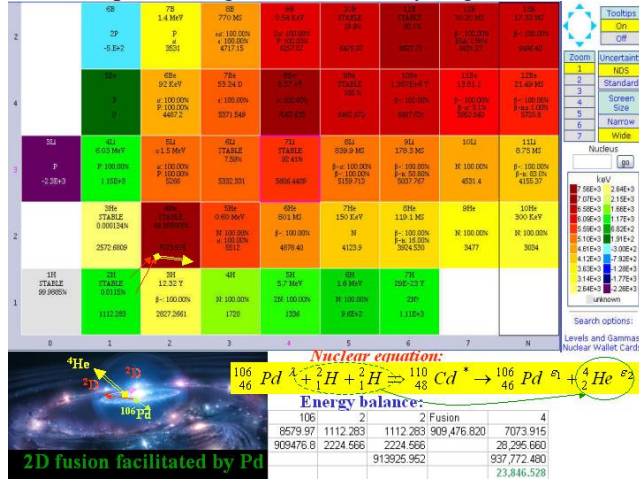


Fig. 17 – Nuclear binding energy in H zone [56]

The figure shows that the most advantageous transformation may be the combination of the two deuterons into a Helium nucleus with return to 106Pd initial position taking the recoil energy and helping to the parameter conservation.

Another opportunity or nuclear reaction channel is the fission of ^{110}Cd as shown in Fig. 18.



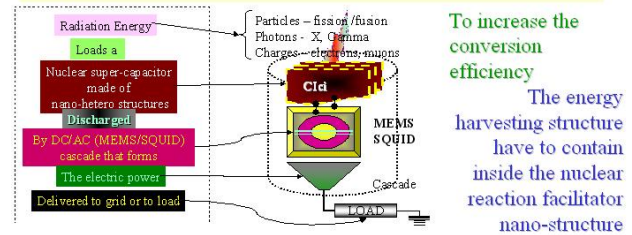
Fig. 18 – ^{110}Cd Fission Nuclear Reaction Channel [56]

The fission reaction channel may drive to a symmetric or asymmetric decay of two or more particles. Here there is a statistical distribution. The big question posed to this research is to find the right response function for the available control parameters.

As shown before the best harvesting structures have to be embedded in the burner – because the moving particles are produced there and stopped in few microns around, their energy becoming heat.

Stage 3 – Test the harvesting structures embedded in the burner

The operation : a moving charged particles stops in matter by creating electron showers, that can polarize a nano-size electrodes of a nano-structure that resembles a super capacitor, that becomes loaded directly by particle's kinetic energy and is discharged as electricity.



Output: high efficiency operational structures = fabrication technology

Fig. 19 – The research related to direct energy conversion

The super capacitor structure as seen in center-right picture of Fig. 19 that shows the stage 3 of modular research and development projects, is embedded in burner structures. The moving particles produced in the burner are immediately harvested and their kinetic energy is converted in electric energy.

The project of developing a prototype ends in stage 4 already presented in Fig. 10, above.

A R&D project is necessary to be developed for each materials structure, ending with a prototype. After this phase the prototype specific application tests have to be performed, followed by certification and homologation phases, that are terribly time consuming and a procedure to accelerate these tests will be required.

Addressing the safety and reliability issues

As resulted from the previous introduction in the fundamentals of the process, some structures are producing nuclear particles and other structures are free of radiation, producing heat directly. There is possible to expect that during the operation structural self damage a structure designed for heat only to start to irradiate, and that is a safety issue.

Another important safety issue we need to address is related to potential explosions. Fusion process is 3 times more energetic than fission, and in Hiroshima little Boy case there have been burned 200 g of ^{235}U to generate about 15 ktTNT (1 ktTNT = 12^{12} cal= 1Tcal) [57]. Same mass by fusion would deliver 3 times more energy or explosive power, but under transmutation by 10-100 times less.

In order to have an explosion main three elements are needed: confinement; fuel and trigger.

In the fusion and transmutation case we have the fuel, in amounts in grams range, and that makes us to have upper limit estimation on the best possible explosion power and that is about 245 tTNT/g for fusion generating He from

deuterium, and 3 tTNT for Ni transmutation to Copper, considering that a regular truck can carry about 10tTNT.

We have to consider that 1 g of H has a volume of about 22.4 liters, or 11 liters for Deuterium, and that is huge for the actual devices that usually have active about 1 cm³ of gas. This correction to our calculation makes brings the explosive power in the range of 24 kgTNT for Deuterium and less than 2 kgTNT for Ni-H systems, in the range of artillery shells.

As a measure of precaution, is needed that the design to be made in such a manner as not to assure a good confinement, and the reaction to have negative amplification with temperature or pressure similar to the negative worth of criticality in nuclear reactors, and that will dim by a factor of 100 or more the explosion power.

In this conditions an accident will be equivalent to the explosion of a steam boiler or a criticality minor accident in nuclear fuel industry, but both requires special attention, and that is why the homologation and certification tests are required, and unfortunately will delay the market availability.

Coordinated research at national and international level

Presently private persons mainly outside US have performed this research, and there is a tremendous need to bring this exploratory and applicative research at the right standards.



Fig. 20 – The schematic diagram of a national Quantum Reactions for Energy Research Center

In Fig. 20 is shown a structure of integration of the all active forces in the domain, starting with private persons that performed this research with passion for the sake of science and world's welfare or for the sake of profit inside small business companies, universities that are education and for business and profit large entities, national laboratories, private investors and benefactors.

This is a large diversity of interests and Intellectual Property constrains, and contradictions that have to be accommodated, in order that everybody to be happy with the participation in the program and have a fair share from the profits and get the right credit and rewards for the work and ideas. A very delicate and complicated issue not solved in present by the US obsolete IP laws, favoring the big and rich, who do not have many valuable ideas and the rules of engagement of National laboratories, that pretend non competition with the small business, but prefer to grab their ideas without giving any credit and/or compensation, discouraging the small inventors from inventing and feeling safe. The new organization has to openly tackle these issues, creating the necessary synergy atmosphere.

Advanced Energy Research Virtual Network Proposal

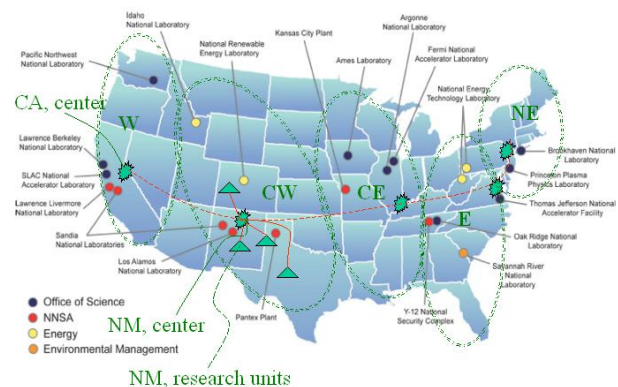


Fig. 21 – US territorial virtual research centers

There may be created more than 5 US territorial virtual research centers, using the regions criteria, that will work together with the universities and even developing redundant research, in order to be able to compare data and better check the results, as is shown in Fig. 21.

Expected collateral research results and applications

The present research is directed in a very basic and pragmatic approach –clean, abundant, cheap and externality-free energy in its most compact and portable form – electricity. It is right that most of the actual energy consumption is thermal, but that is an historic fact, because the first energy we were able to extract was thermal. The new technology we know and can use to make few prototypes, will inverse this fact, and electricity will be extracted first followed by thermal.

The pragmatism is given by the fact that we propose the use of the present knowledge and know-how to produce a “Pd-D” electric power supply based on quantum reactions and direct energy conversion, as part of a more ample research program meant to assure the quality of the research and of the product and deliver a safe reliable

product, accident free and fail safely, being used in the market exempt from other regulations like NRC, because will be out of any nuclear and chemical hazardous contamination.

The statement: with enough energy all the other resources may be had, is true, because the main problems of the actual world as drinking water, food, rare earths, etc. would be solved, and new perspectives might open with respect to global partnership and cooperation, and expansion in outer space.

The research actually proposed will be meant to study entanglement, nuclear molecules, quantum modes in large assemblies, selection rules, dark and white matter and energy, that will drive not only for safe power sources but for new and many outstanding discoveries that are now in the realm of the science-fiction.

For example, understanding how the nuclear reaction takes place by quantum entanglement we may develop teleportation systems where adding a set of molecules in one place they may appear in space time in one or several places simultaneously. New concepts in manipulation the space-time for transportation and resources purposes, and understanding the wrap of space will create astounding applications.

VI. CONCLUSIONS

The power sources we may produce using this process will place the mankind in a new more friendly relationship with nature, and we may become a cosmic civilization, having solved the problem of energy and resources, because with enough energy all other resources may be had.

With-in a serious approach, the first reliable products may be delivered in less than 10 years.

The estimated performances might be:

Device's Specific Energy density:

- 3 GWDay/kg for D-D, D-6Li, H-7Li

- 1 GWDay/kg for H-11B, 3He,

- 50 MWDay/Kg – H-Ni, D-Ni, H-V

With no storage limitation (no criticality constraints).

The possible structures used first may be:

Power source: **Fuel : H,D,T,3He, B

**Burner materials: Ni, V, Pd, Pt, Th, etc.

Conversion efficiency may be as high as 95% depending of constructive solution.

The power density depends of conversion efficiency, and heat extraction, because the energy not converted in electricity and extracted becomes heat and have to be extracted as heat flow, and for 95% and extracted Heat flow =200 W/cc maximum power $P_d^{Max} = 4 \text{ kW/cc}$, by a factor of 10 over the actual power sources.

Novel Fusion Transmutation power source will replace the chemical power source reducing the size by >100,000 times from 1 m^3 to 1 cc . and will replace the actinide based

nuclear fuel, eliminating criticality accident hazard, radio-chemical contamination hazard, irradiation hazard and maneuver restrictions.

Converting directly the quantum reaction energy into electricity it is possible to obtain high power density that needs cooling and allows a supplementary thermo-electro conversion to make the energy efficiency even higher, and have safe , reliable operation.

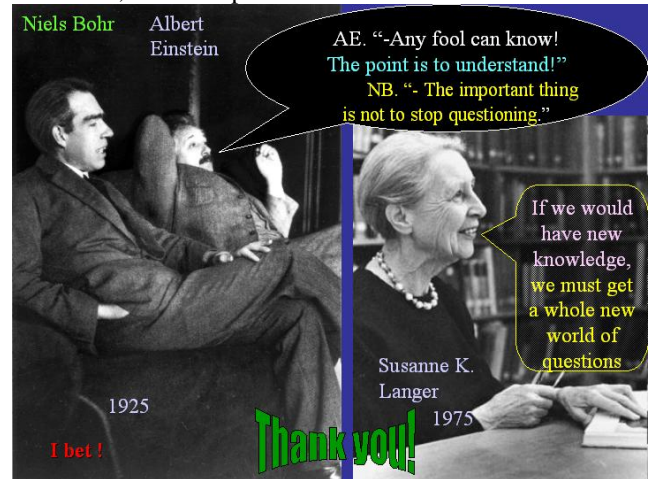


Fig. 22 – Some of the great personalities thoughts [58]

The knowledge journey effort is just at the very beginning, and much more have to be done in order to understand the fundamentals of this process, as the Fig. 22 exemplifies. New physics will emerge from the study of this new reactions like:

- Space, entanglement, teleportation
- Space and matter correlation
- Matter's synergy and energy
- Conservation principles – that requires an “insulated physical system”, but “how insulated are our common systems”, and what do we have to consider to keep the principles valid?
- Exotic nuclear reactions and applications, and many more.

In fact it has to be understood that no form of compact energy is risk free, and “there is no-free lunch”, and in order to harvest the benefits of one technology we have to master all its aspects and manifestations, and understand its fundamentals, in such a manner as “to pay the right price at the right time”, deliver risk free, profitable products to the market. That is the main purpose of the entire research and development infrastructure proposed: to provide us with the necessary knowledge and understanding of a new world of applications of these phenomena we discovered grace to Hydrogen anomalous behavior.

All these relies in our capacity to organize in a research and development structure that to allow us to prosper doing these researches and developments and deliver one by one all foreseen applications and know-how.

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Roadmap to Fusion Battery

*A Novel Type of Nuclear Battery
And
Potential Outcomes and Applications*

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Abstract

A new view on nature

Supporting details

The process

The research

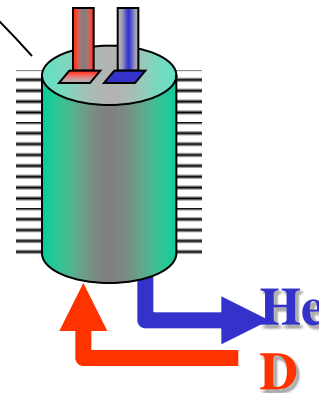
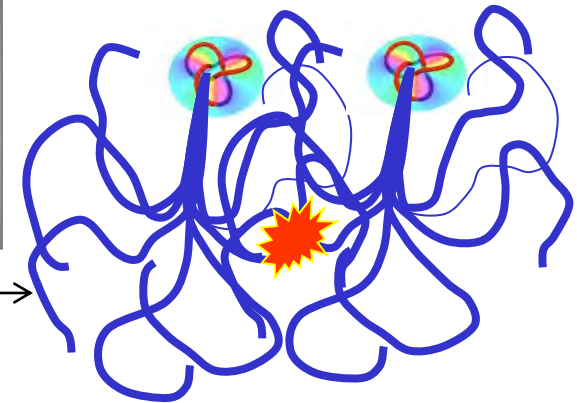
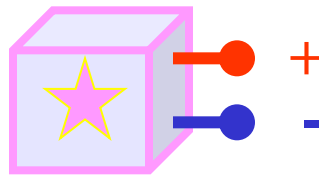
The collateral outcomes

The fusion battery

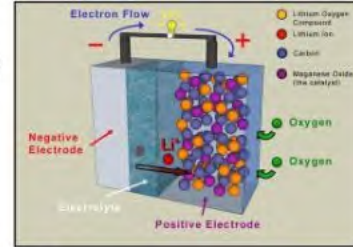
Performances and safety

Applications

Conclusions



Li-Air battery

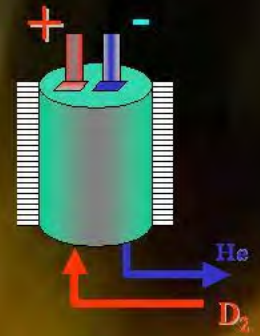
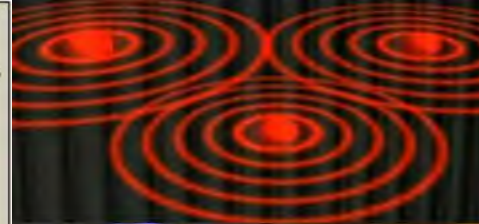


The fusion battery



589 MWh
25 MWDay

P=10 MW
for 2 1/2 day



The Fusion Battery

*A Novel Type of Nuclear
Battery*

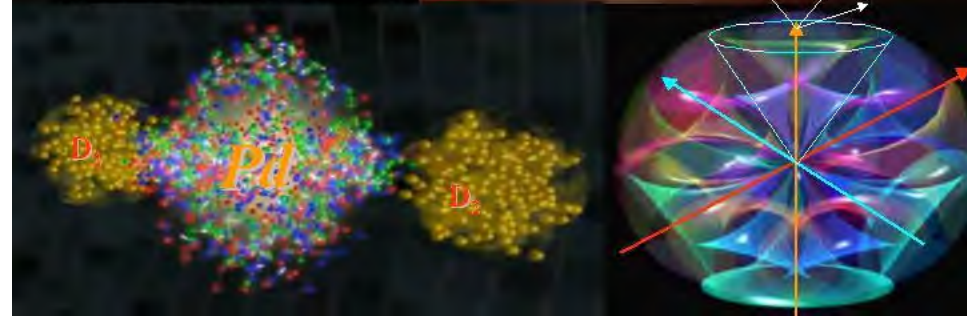
and

*Potential Outcomes and
Applications*

Liviu Popa-Simil

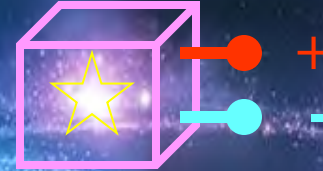
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Abstract

What is a fusion battery ?



A star in a box with \pm plots?

How realistic is it ?

What does one need to know and understand to make it ?

Do we need new physics or just a better understanding of what we already have?

When will it be available ?

What about safety, performances and costs ?

Is it too abstract?

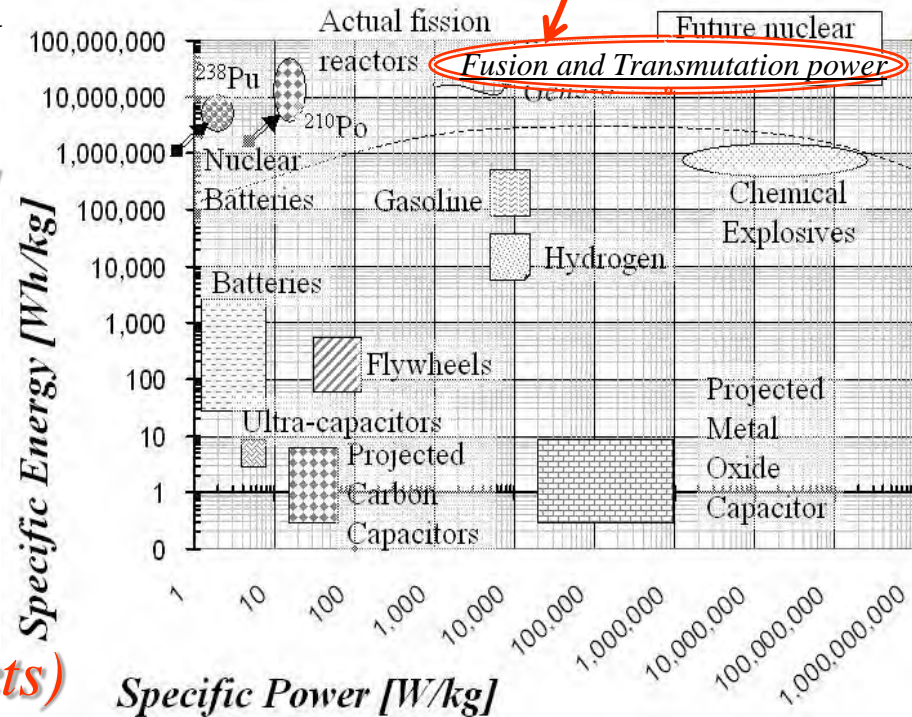
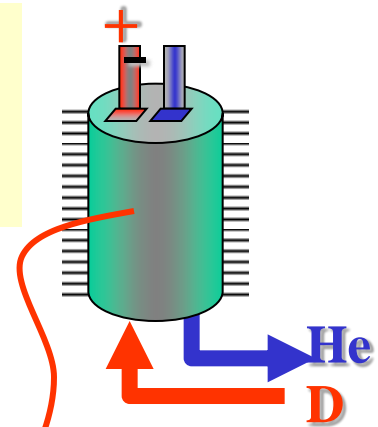
Nuclear – Electric Compact Power Source based on Fusion or Transmutation

It uses **engineered nano-structures** made of **selected isotopic combinations** to **facilitate the nuclear reactions** between **light isotopes** and the **nano-structure lattice material**.

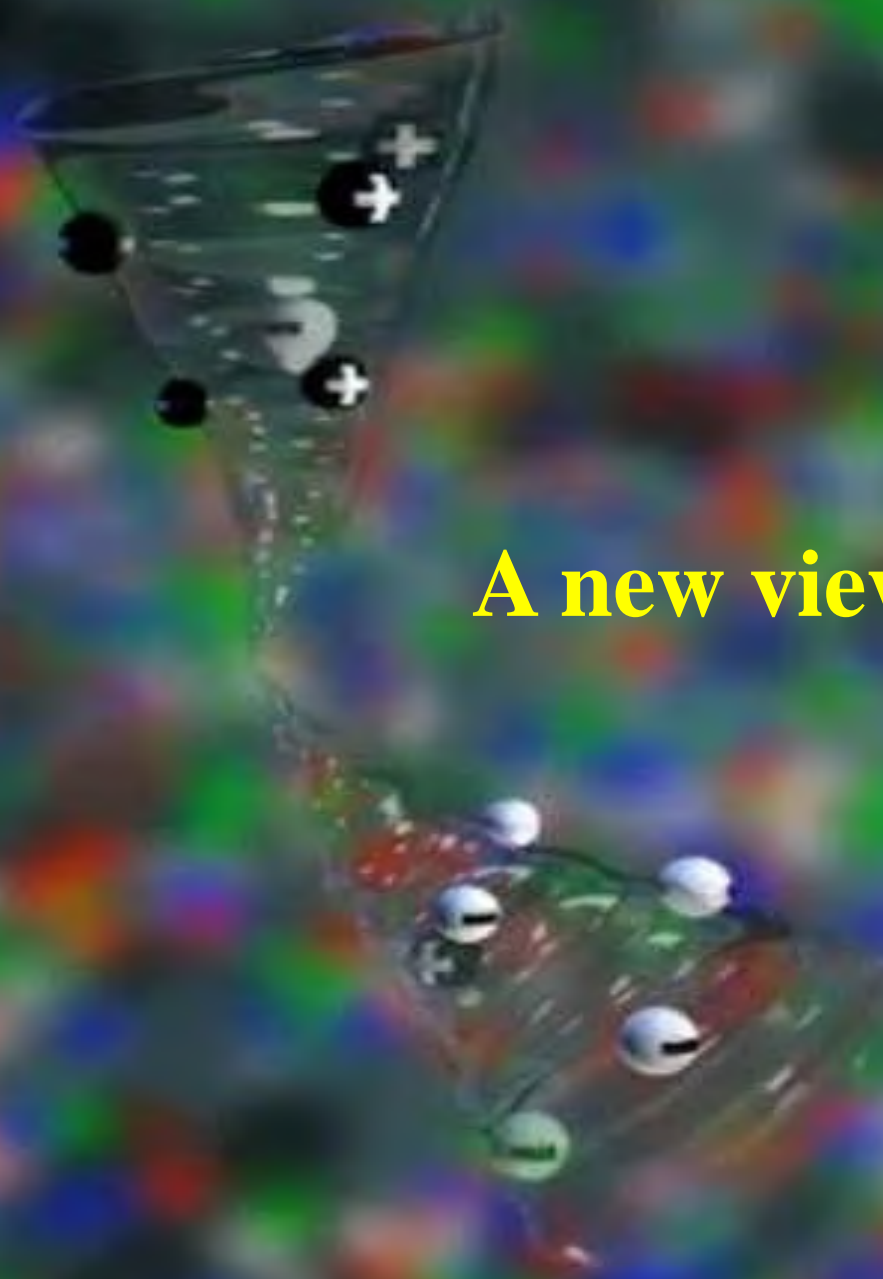
It does not uses radioactive material and critical nuclear structures

It is safe to operate and store the fuel and the nano-structure

It does not generate radioactivity
(but, some constructive versions may produce radioactive byproducts)

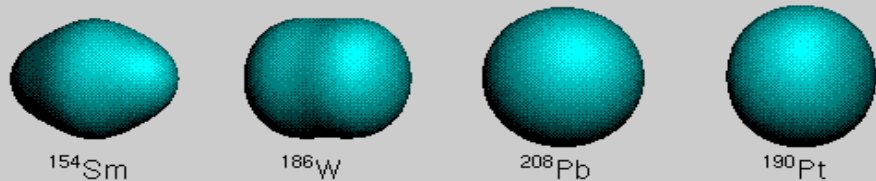


It may deliver up to **3 GWD/Day/Kg**; Conversion efficiency: **20%-95%**
Power density may be higher than **1Kw/cc** The upper limit is **1MW/cc**



A new view on nature

Nuclear ground-state shapes



^{154}Sm

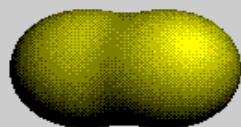
^{186}W

^{208}Pb

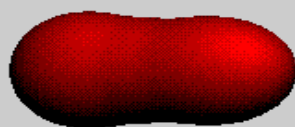
^{190}Pt

Isomeric shape

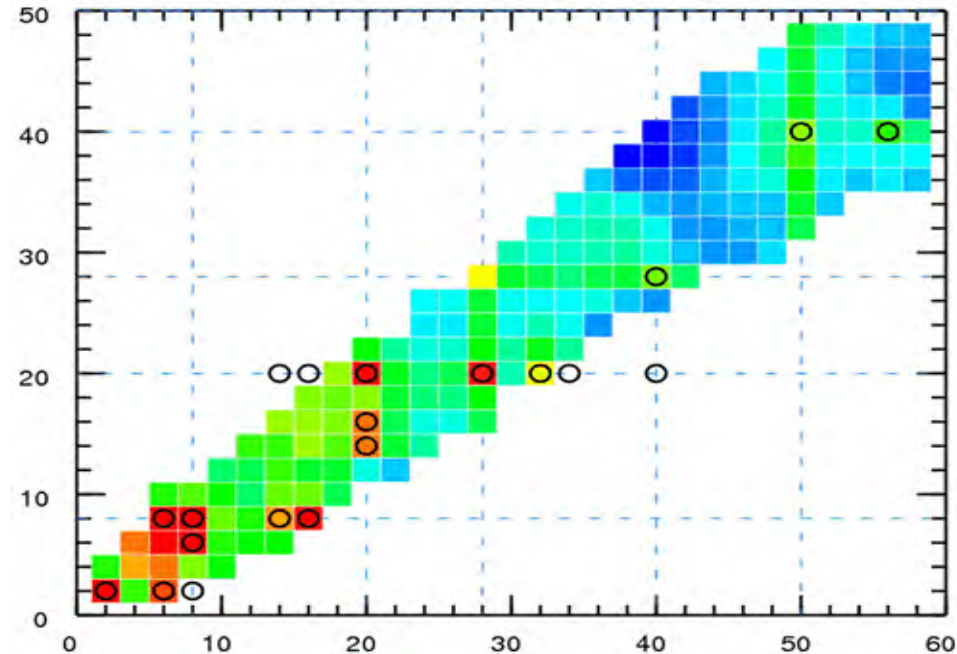
Mass-asymmetric saddle-point shape



^{240}Pu



^{232}Th



The graphics are the excitation energies of 2+ states in light nuclei, high (red) to low (blue).

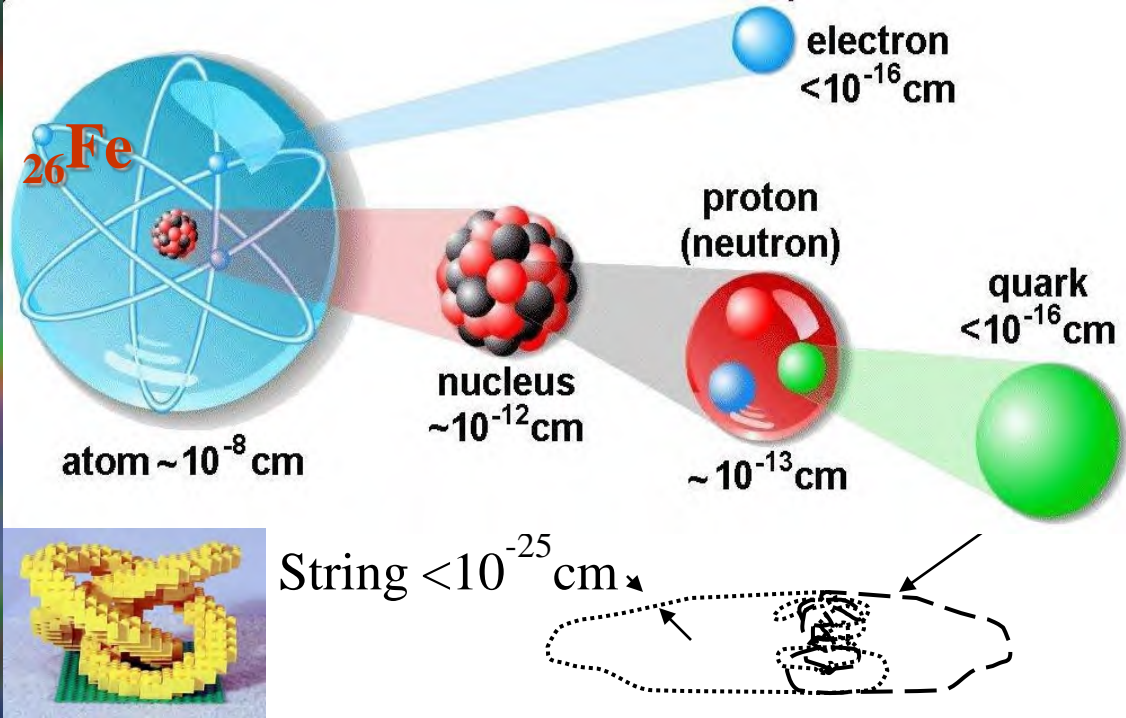
visible side
Has mass

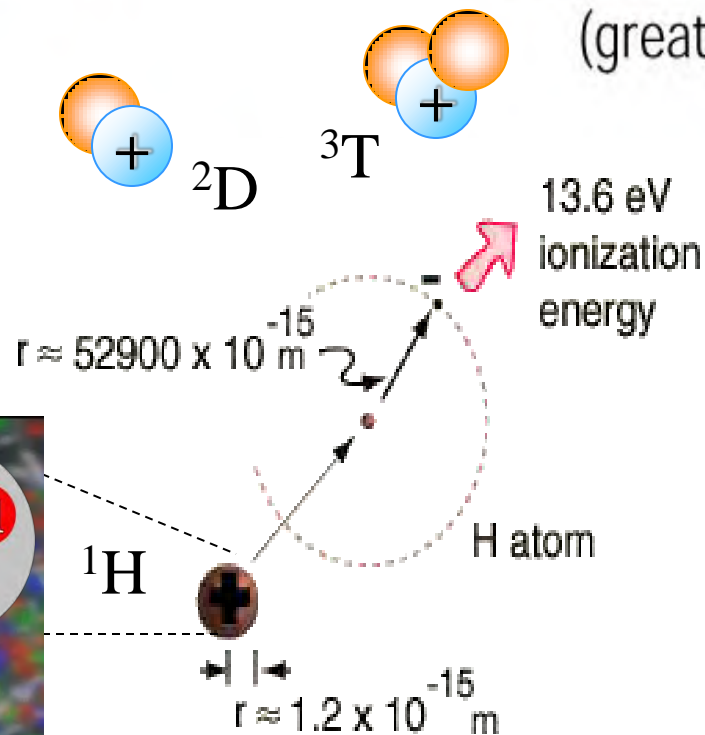
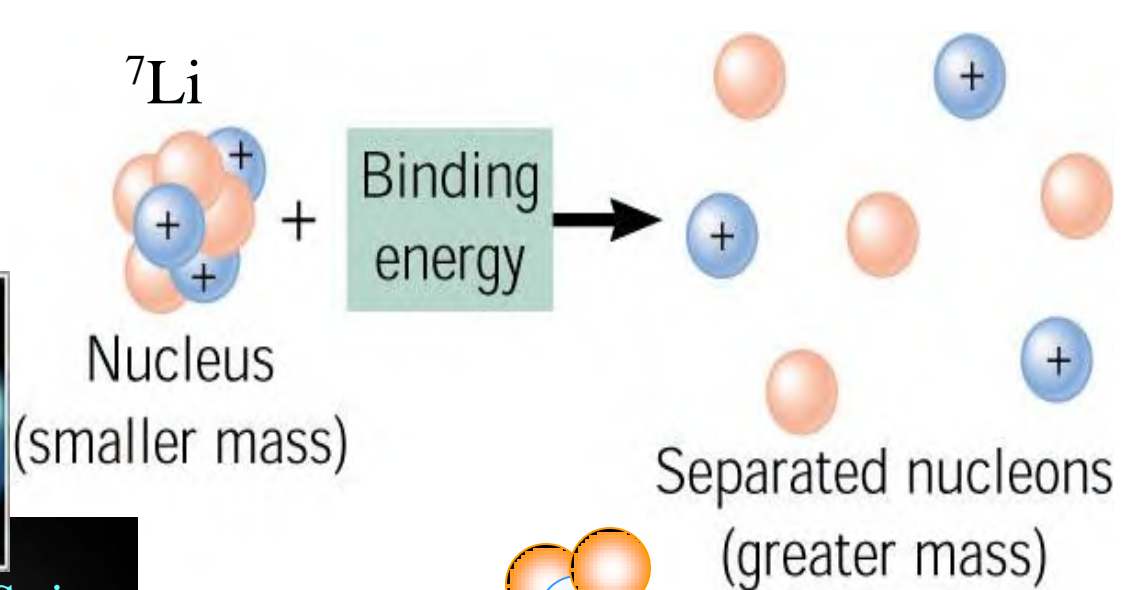
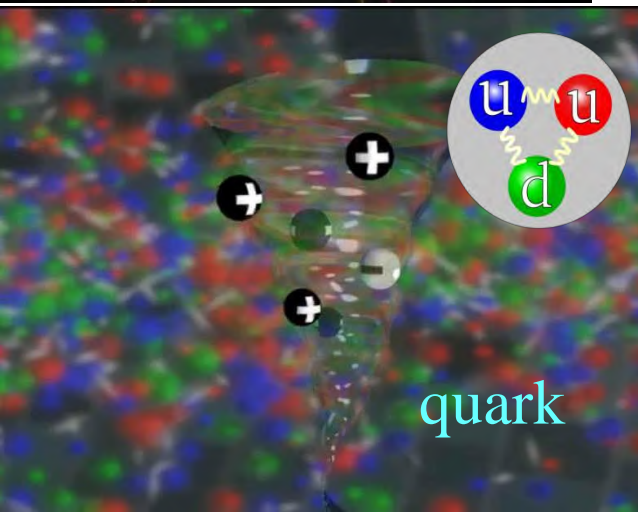
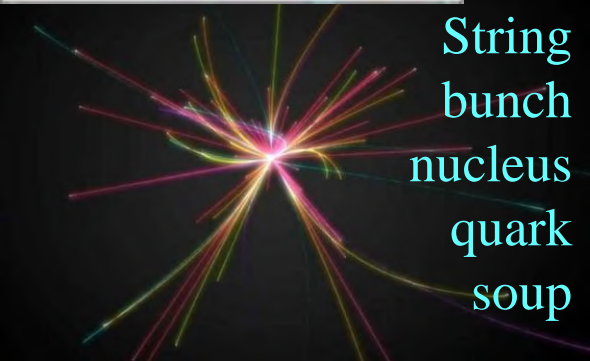
quark



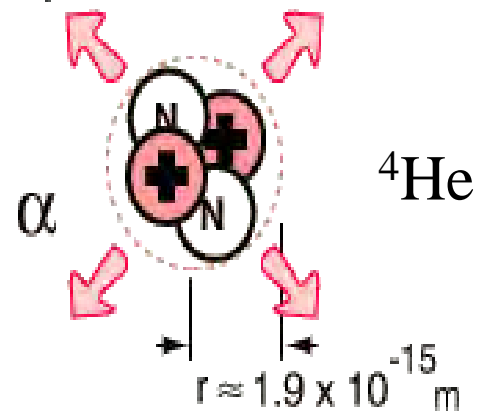
Meson sea

Quark
Invisible side
No-mass

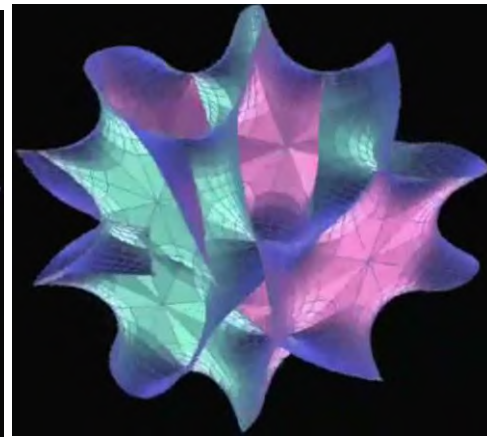
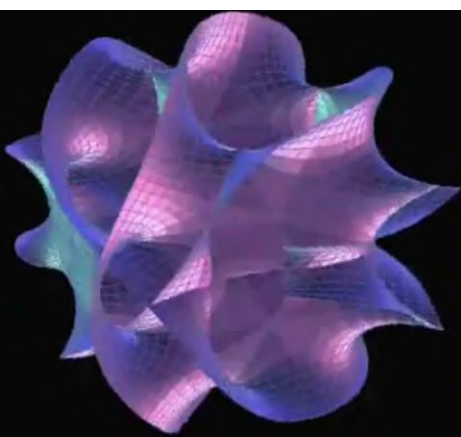
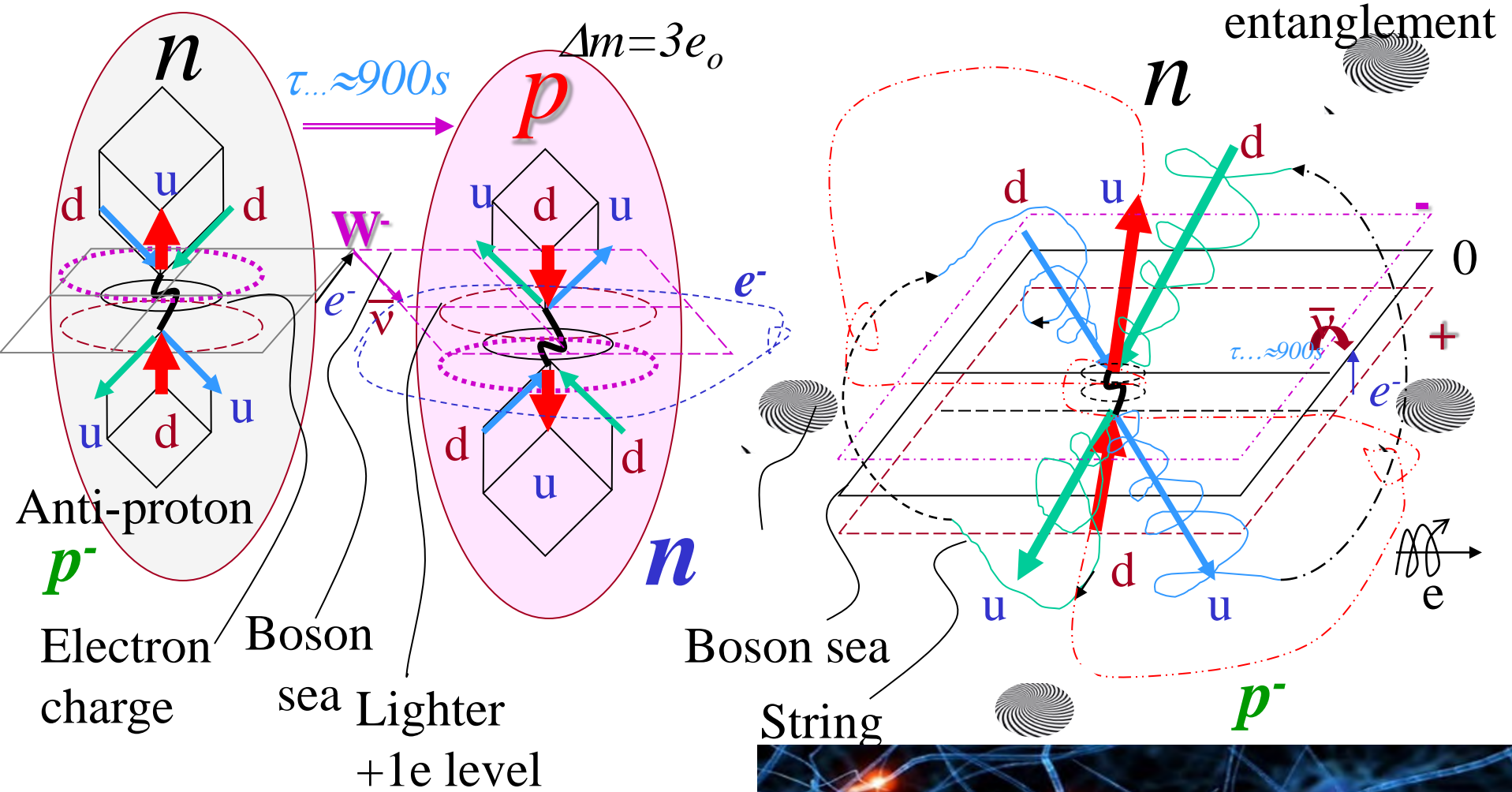


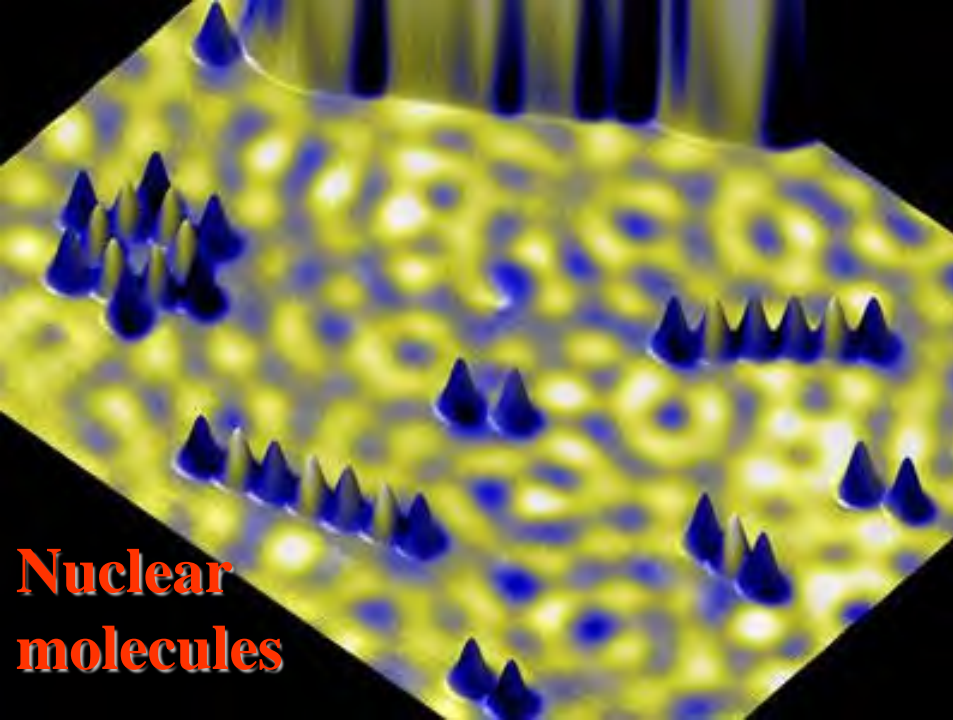


28,300,000 eV to break apart protons and neutrons.



Comparison of atomic and nuclear scales and binding energy





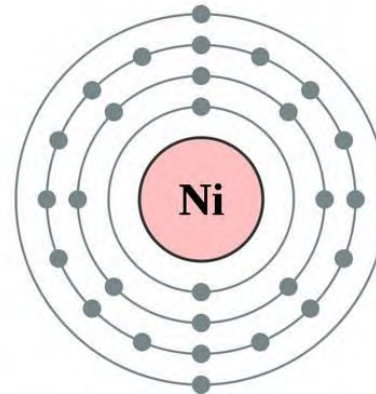
Platinum family Ni, Pd, Pt

$$R_{\text{HPd}} = 1.88 \text{ \AA}$$

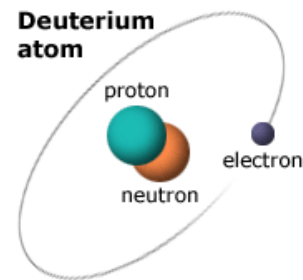
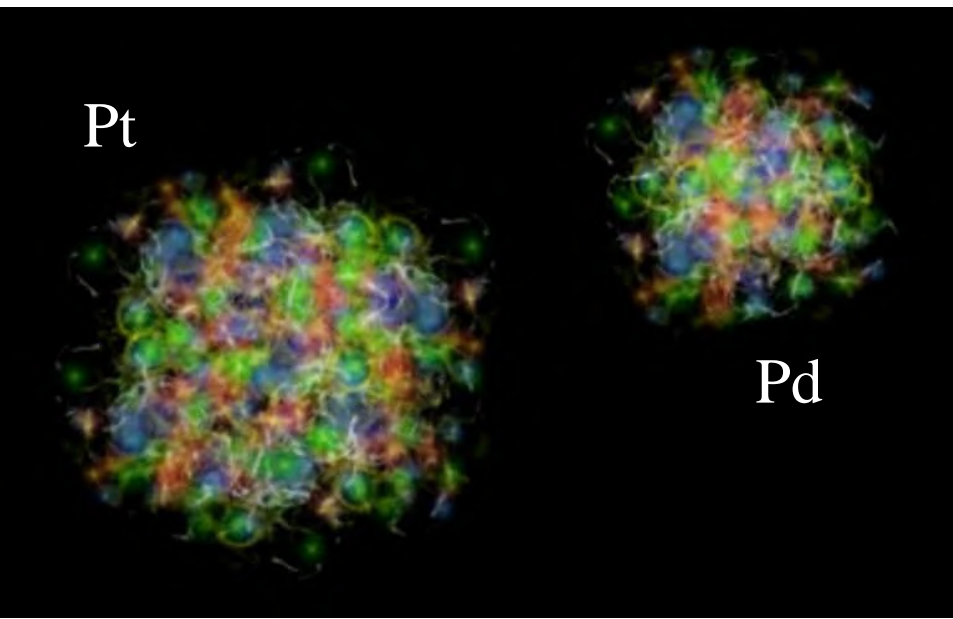
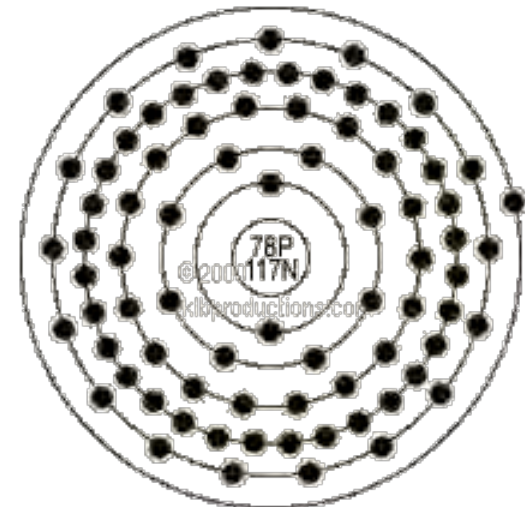
$$R_{\text{HNi}} = 1.84 \text{ \AA}$$

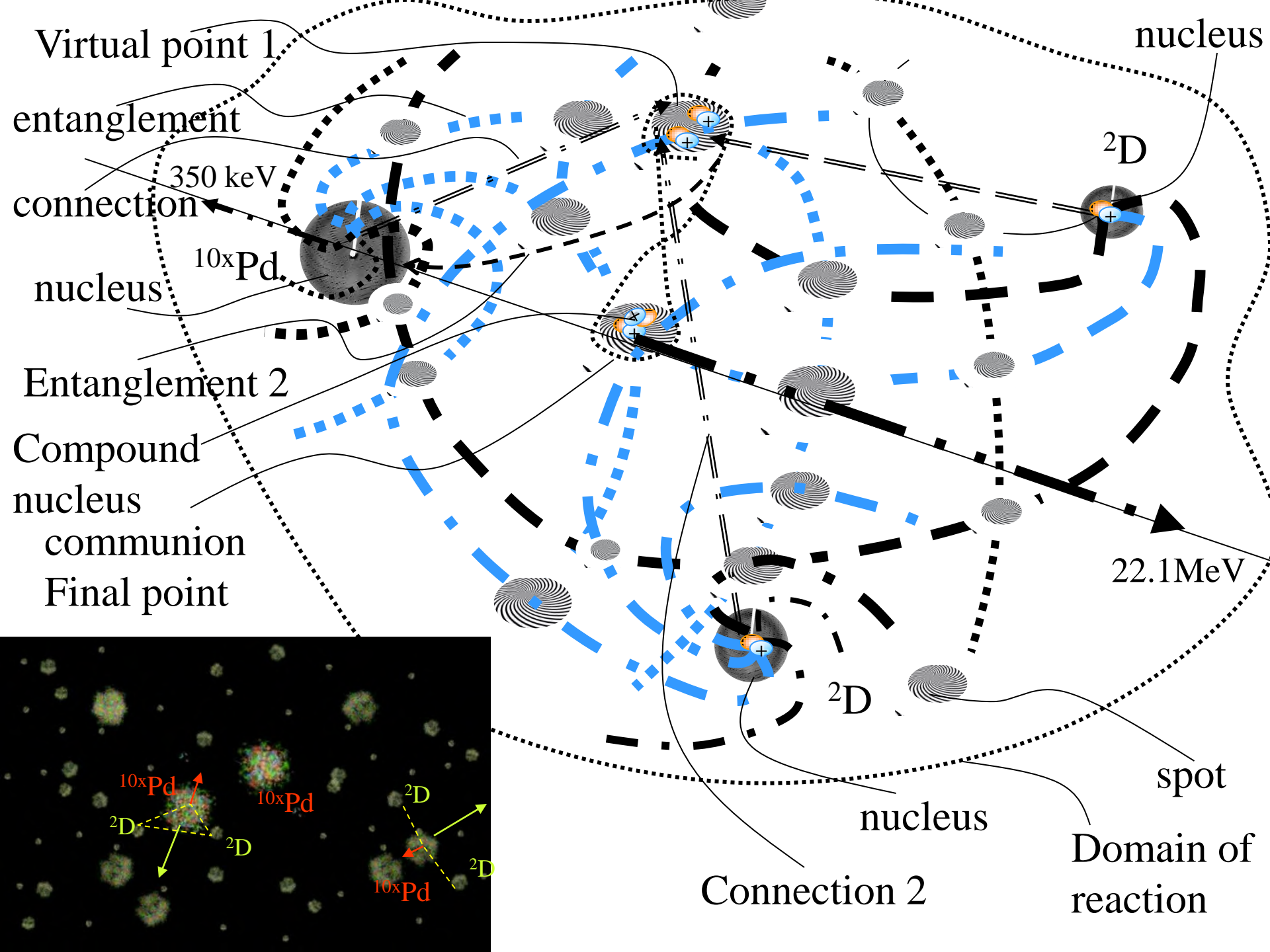
Nickel

2,8,16,2

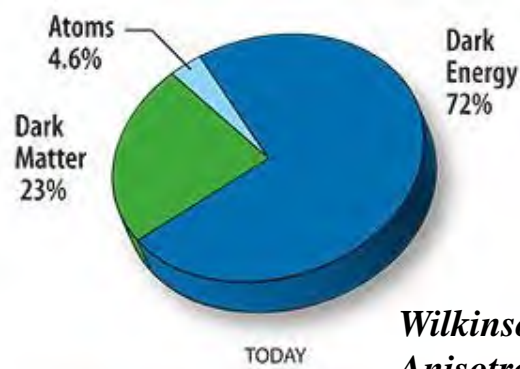
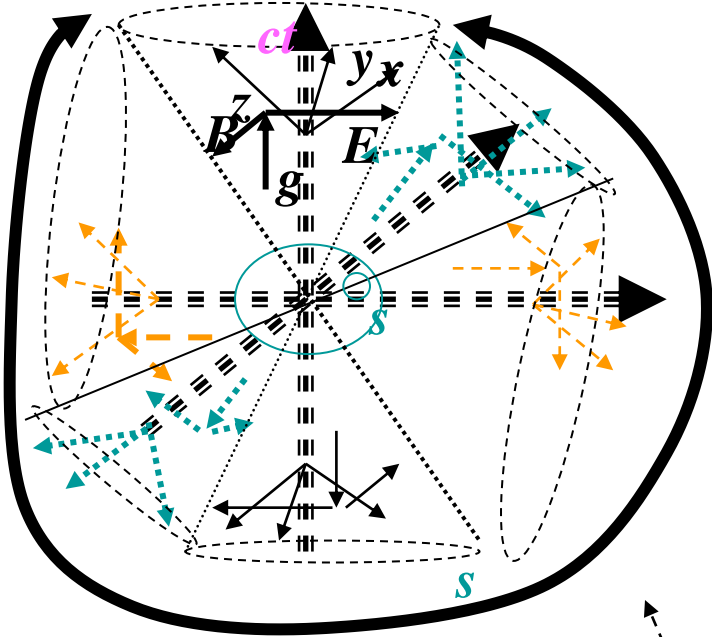


$$R_{\text{HPt}} = 1.90 \text{ \AA}$$





A new view on nature

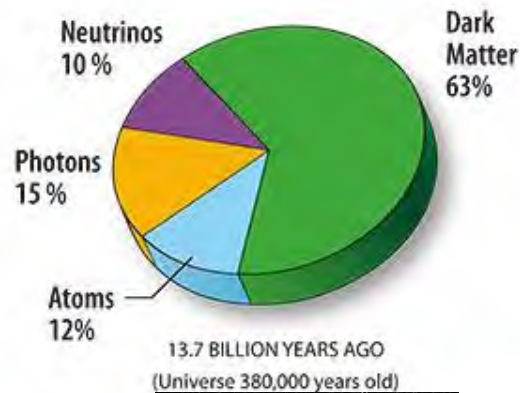
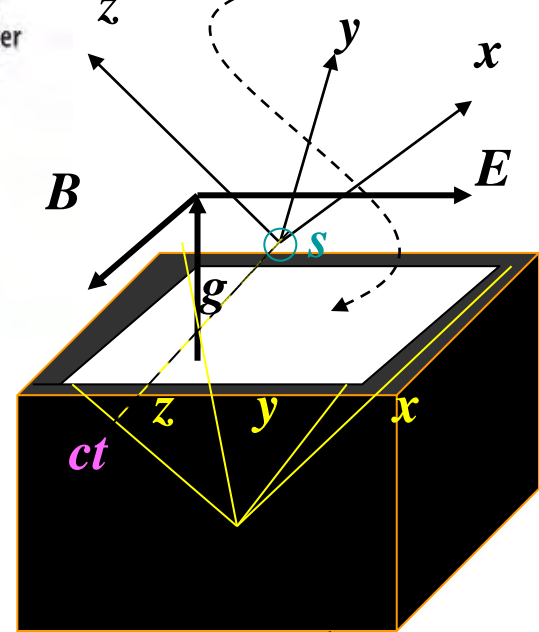
White mass $^{1/6}$ 

[http://map.gsfc.nasa.gov/
media/080998/index.html](http://map.gsfc.nasa.gov/media/080998/index.html)

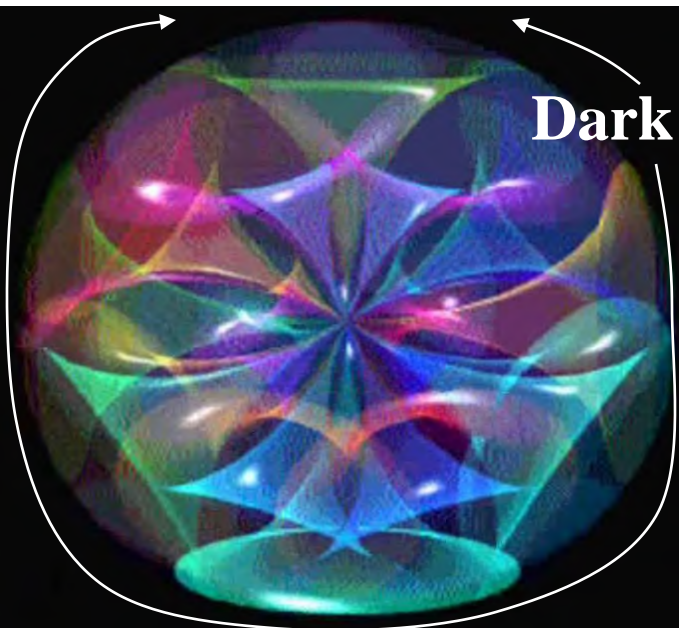
WMAP data



Wilkinson Microwave Anisotropy Probe (WMAP)

White mass $^{1/6}$ 

Dark mass 83%

White mass $^{1/6}$ 

Dark mass 83%



Supporting details



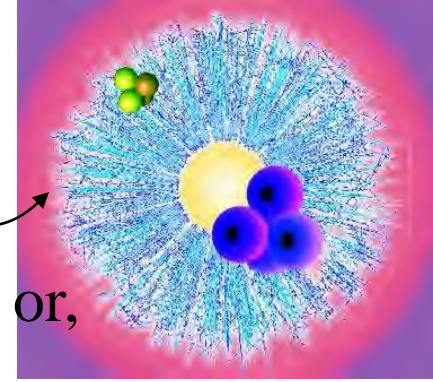
State of the art



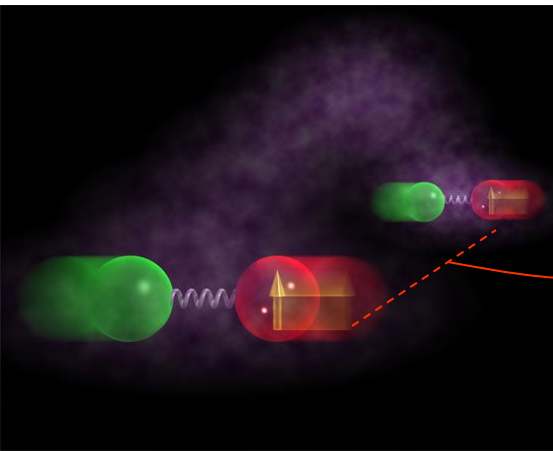
A nuclear reaction may be accomplished by:

→ smashing one nucleus into another through the Coulombian barrier (accelerated particles or neutrons) or,

→ by **tunneling** (non-local nuclear reaction)



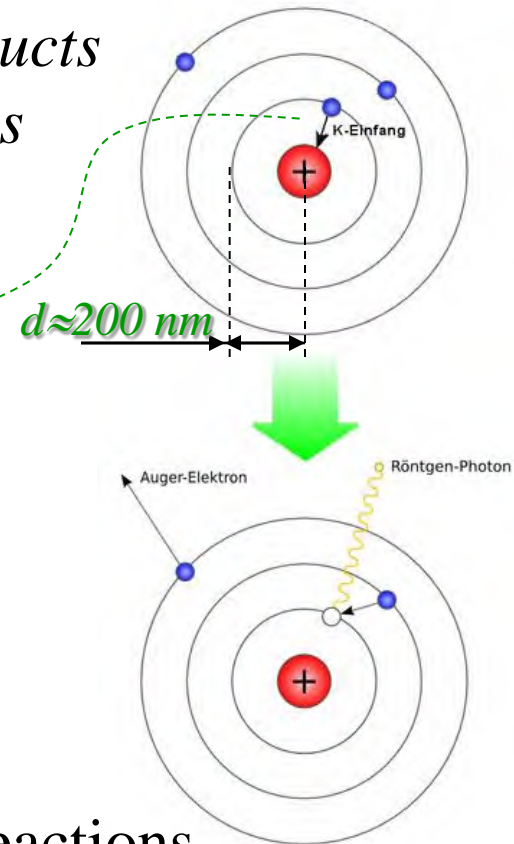
The selection rules for nuclear reactions apply, and the nuclear reaction channels opened and the final products depend on the entry parameters of the initial particles



Examples :

- **electron capture**

- **entanglement** /teleportation



Observations - Isotopic anomalies (transmutation)
- Excess heat in chemical dominated reactions

Supporting details for quantum tunneling

Applications in electronics and measurement

Measurement of tunneling

Many references

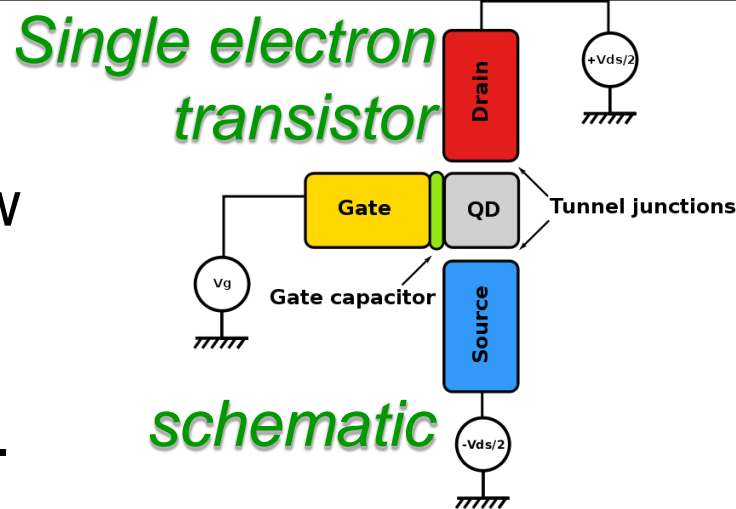
Tunneling in chemistry and bio-chemistry

Tunneling in nuclear phenomena

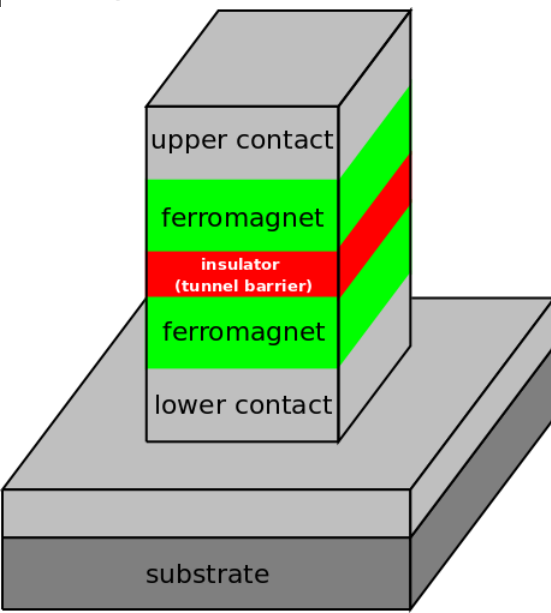
Nano-structure stimulated tunneling

Vibration modes and tunneling stimulation

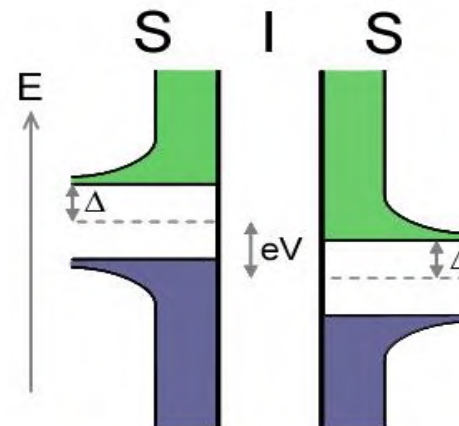
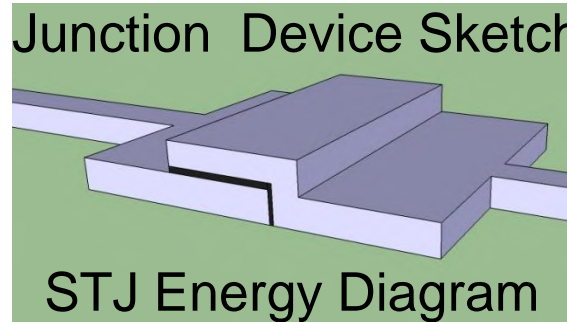
Applications of the phenomenon:
electrons can flow through an insulating barrier, by means of quantum tunneling.



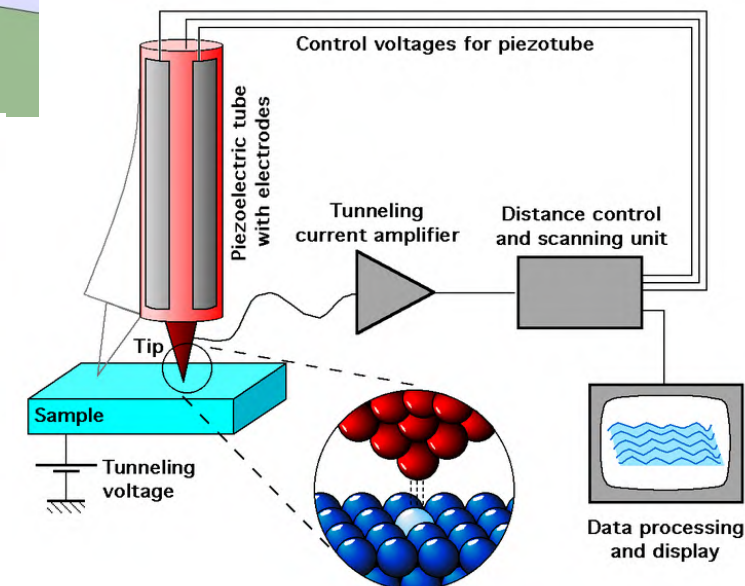
Magnetic Tunnel Junction



Superconducting Tunnel Junction Device Sketch

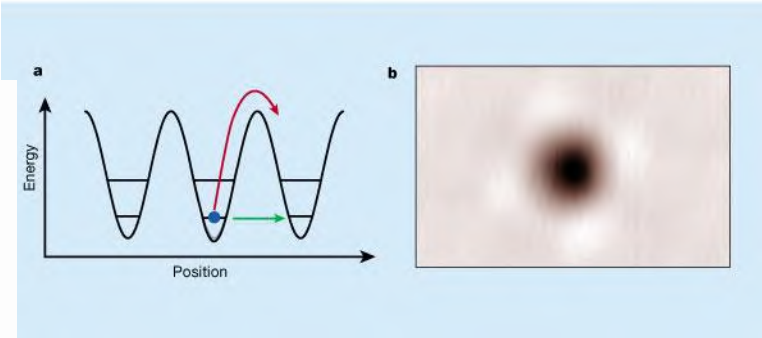


Scanning Tunneling Microscope schematic



A. Yazdani, *Nature* **409**, 471 (2001) H surface tunneling

a- hydrogen atom in an energy well created by the copper surface. The red path shows the energy needed for the atom to diffuse into the next energy well under classical physics. The green path indicates that the atom needs little or no energy to tunnel by quantum mechanical means into the adjacent well.



b- An image of a hydrogen atom (dark feature in the center) on a copper surface taken by scanning tunneling microscopy

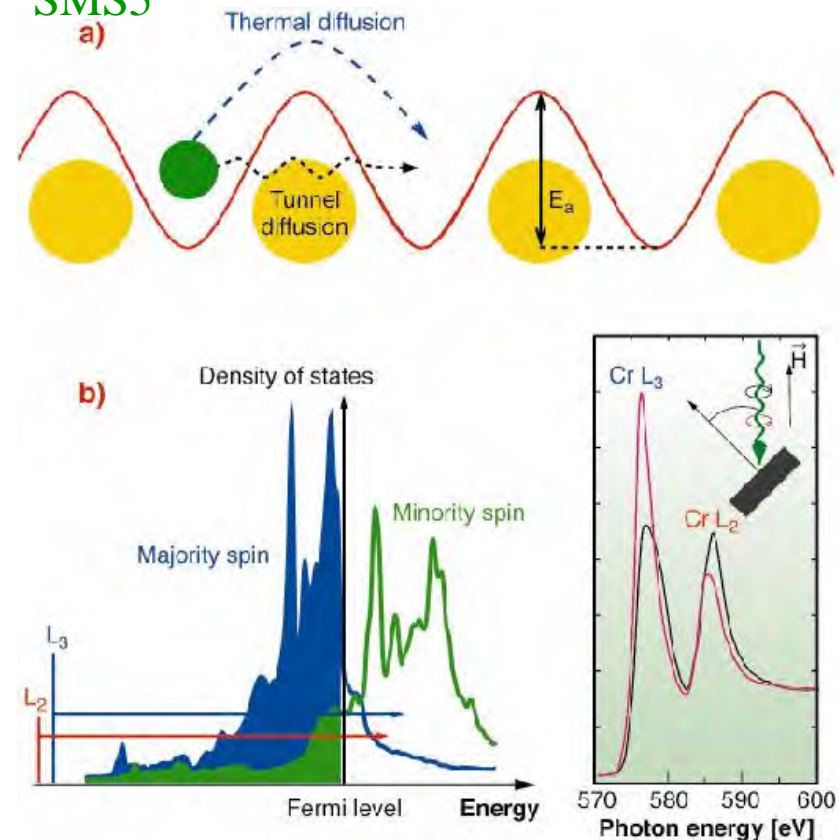
Below 40 K, the tunnel jump rate is orders of magnitude larger than the one expected from an Arrhenius law for thermal diffusion and it is nearly temperature independent.

This extremely fast diffusion, nearly temperature independent, is attributed

(a) to quantum tunneling. The particle may overcome the energy barrier either by thermal activation or by quantum tunneling. E_a is the energy barrier.

(b) Electronic calculations of the density of states for a Cr monolayer on Au(111); Cr $L_{2,3}$ core-level transitions are represented (arrows) and the XAS absorption spectra are displayed for left and right circularly polarized light. A magnetic field parallel to the photon beam is applied. The XMCD signal is the

<http://www.esrf.eu/UsersAndScience/Publications/Highlights/2005/XASMS/XASMS5>



References on Tunneling:

- Tunneling of molecules and atoms

Lauhon, Ho, PRL 85, 4566 (2000) (H-atom tunnels a copper surface)

Yazdani, Nature 409, 471 (2001)

- Tunneling of Cooper pairs

Zelevinsky, Flambaum, JPG 34, 355 (2005)

- Tunneling of excitons

Saito, Kayanuma, Phys. Rev. B 51, 5453 (1995)

Jin et al., Acta Phys. Sin. 53 3211 (2004)

Effective potential and fusion enhancement

CB, Flambaum, Zelevinsky, JPG 34, 1 (2007)

□ **Tunneling is a direct consequence of quantum mechanics and its effects can be found throughout the physical sciences**

Particle physics: explains phenomena such as α -particle emission and can be exploited for practical use (STM)

Material Science: superconductors, semiconductors and dielectric materials all make use of charge transfer via tunneling

Biology: the main mechanism of charge transfer in cellular respiration and other biological processes

Chemistry: electron, hydrogen and heavy atom tunneling is found throughout a number of chemical transformations

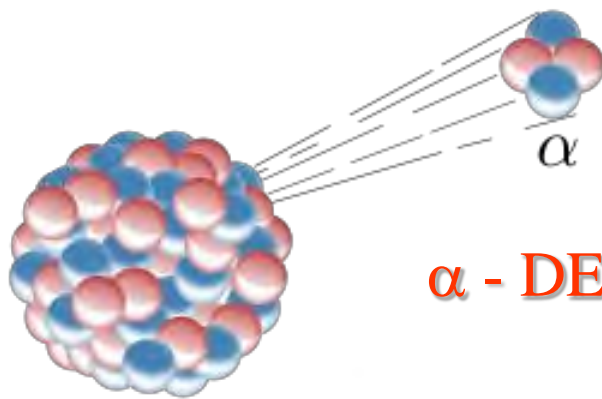
□ **Though less common than electron tunneling, heavy particle tunneling does play an important role in chemistry**

explains : spectroscopic splitting patterns as well as reactivity at extremely low temperatures

□ **Chemists habitually speak of individual particles tunneling but it's important to keep in mind that according to QM the entire system is tunneling**

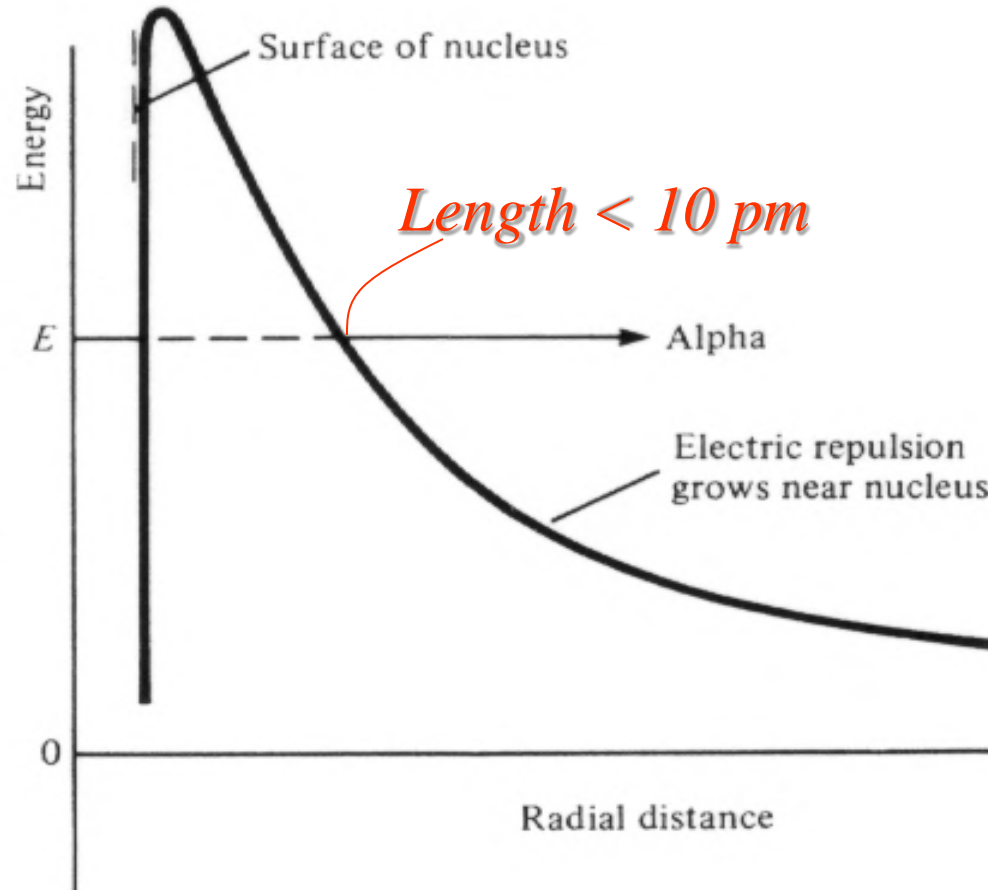
ammonia inversion,
diketopiperazine puckering,
formaldehyde polymerization

Nuclear tunneling



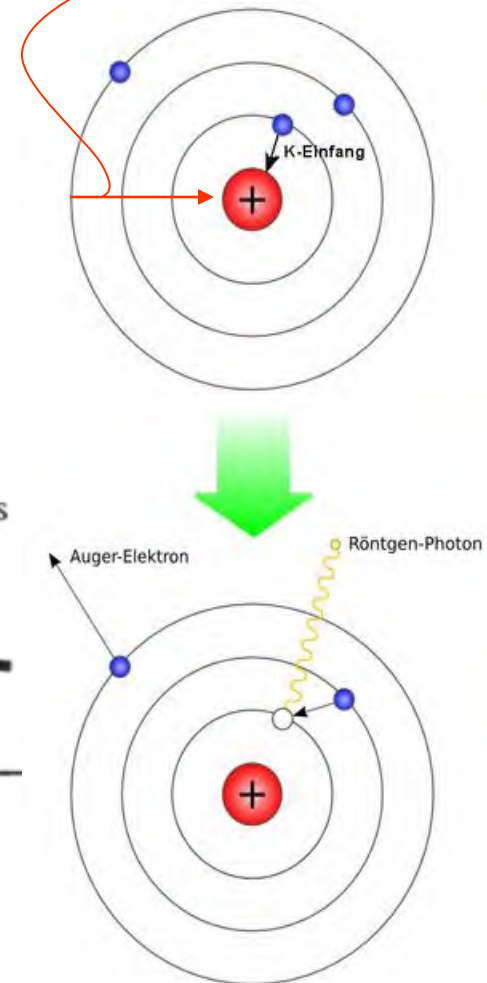
α - DECAY

Potential barrier around a uranium nucleus presented to an alpha particle. The central well is due to the average nuclear attraction of all the nucleons and the hill is due to the electric repulsion of the protons. Alpha particles with energy E trapped inside the nuclear well may still escape to become alpha rays, by quantum mechanically tunnelling through the barrier.



Electron Capture
DECAY

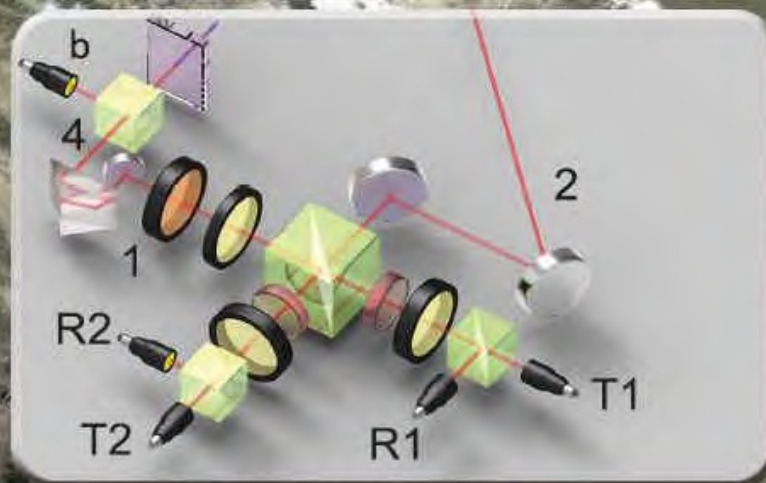
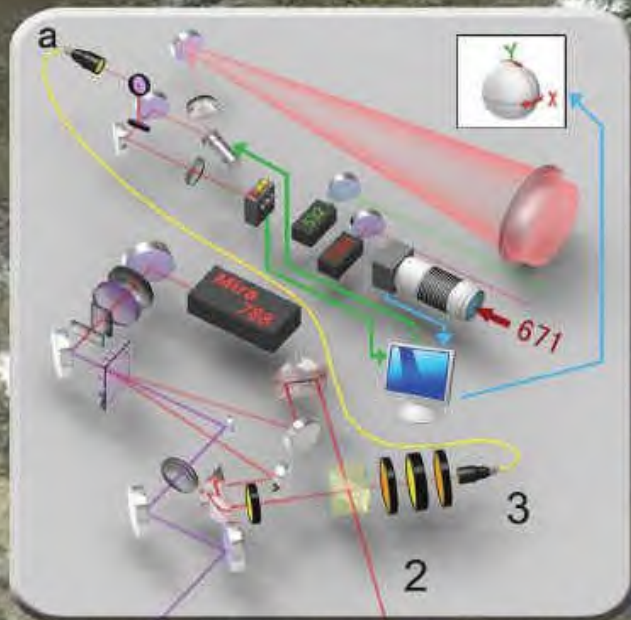
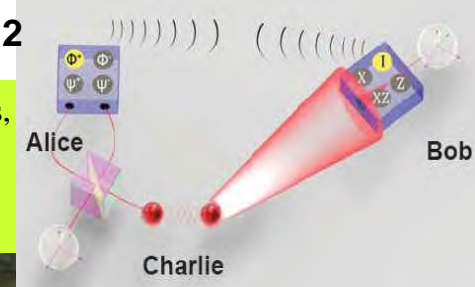
$\text{Length} < 500 \text{ pm}$



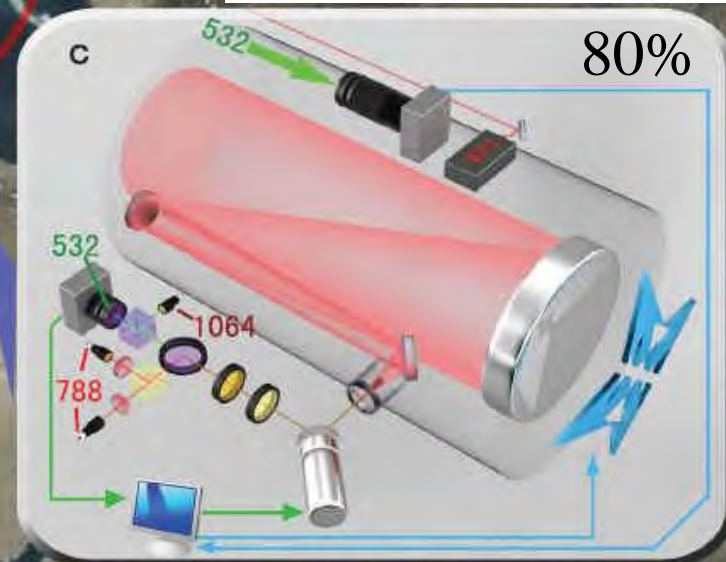
Entanglement experiments and applications May 10, 2012

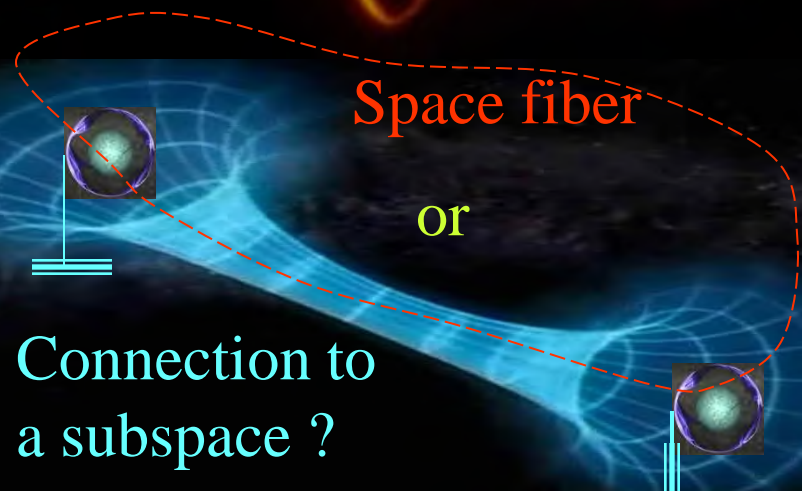
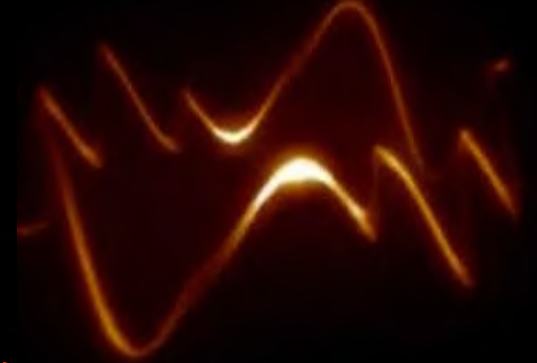
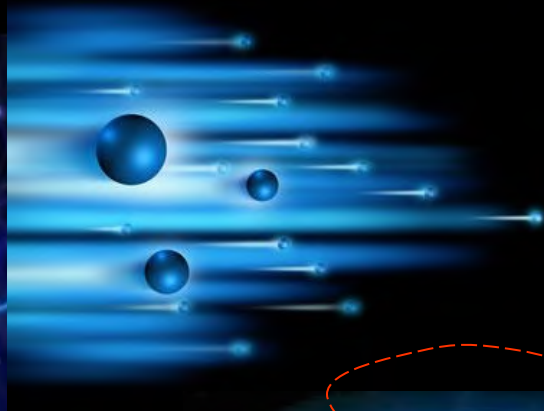
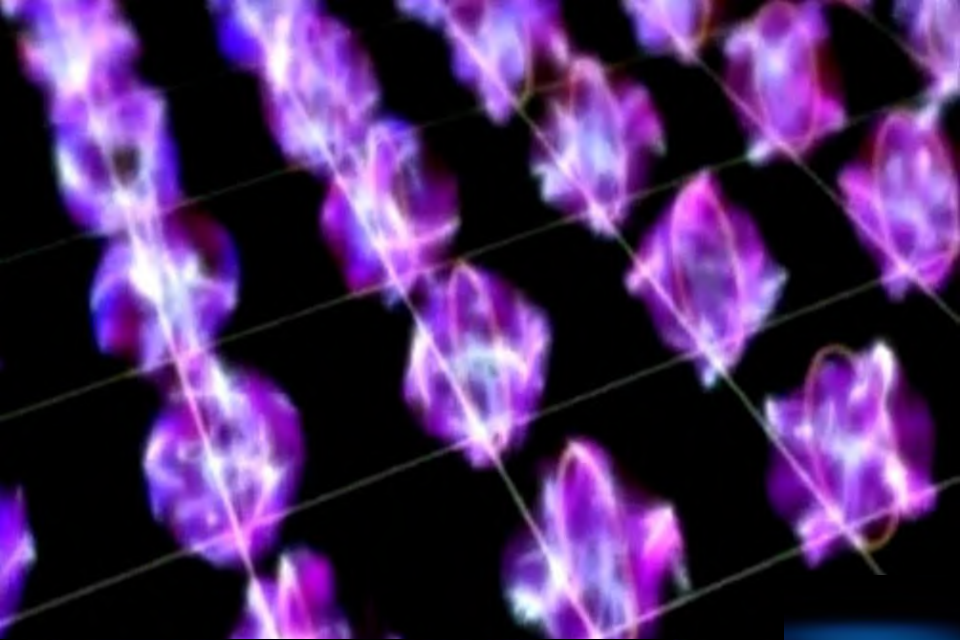
Shanghai Branch, National Laboratory for Physical Sciences at Microscale and Department of Modern Physics,
University of Science and Technology of China, Shanghai 201315, China

Shanghai Institute of Technical Physics, Chinese Academy of Sciences, Shanghai 200083 China



$$|\chi\rangle_1 \otimes |\Phi^+\rangle_{23} = \frac{1}{2} (|\Phi^+\rangle_{12}|\chi\rangle_3 + |\Phi^-\rangle_{12}(Z|\chi\rangle_3) + |\Psi^+\rangle_{12}(X|\chi\rangle_3) + |\Psi^-\rangle_{12}(XZ|\chi\rangle_3) ,$$



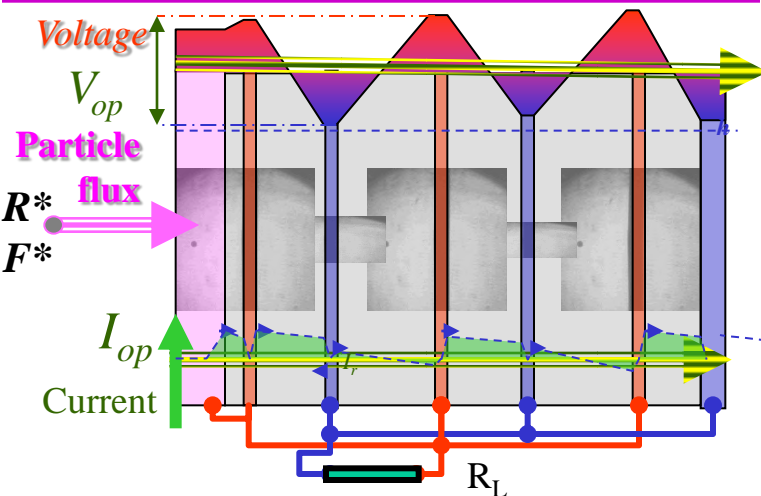
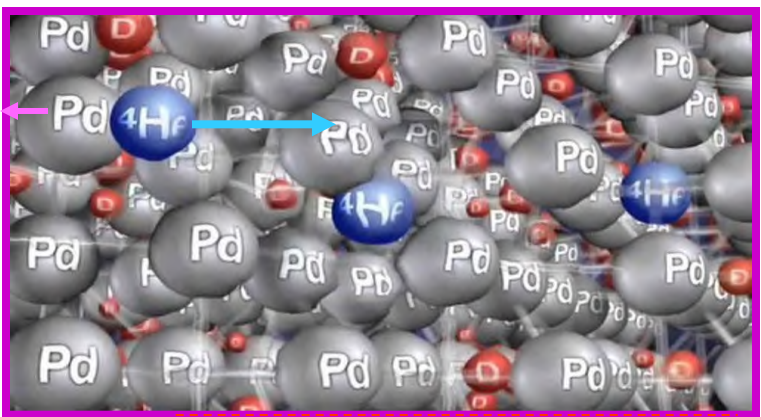
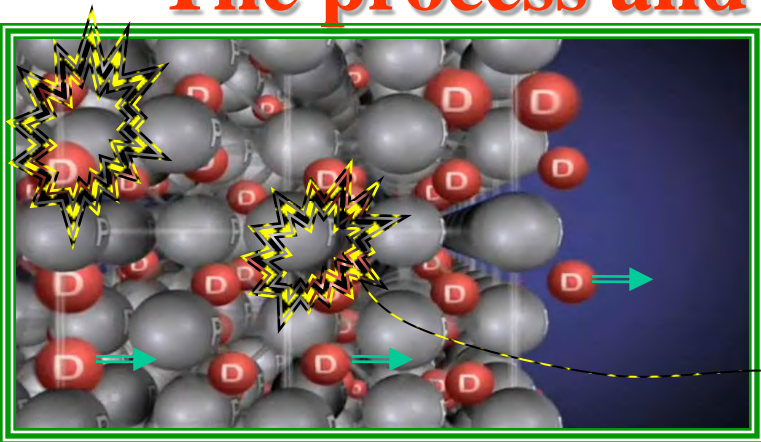




The process

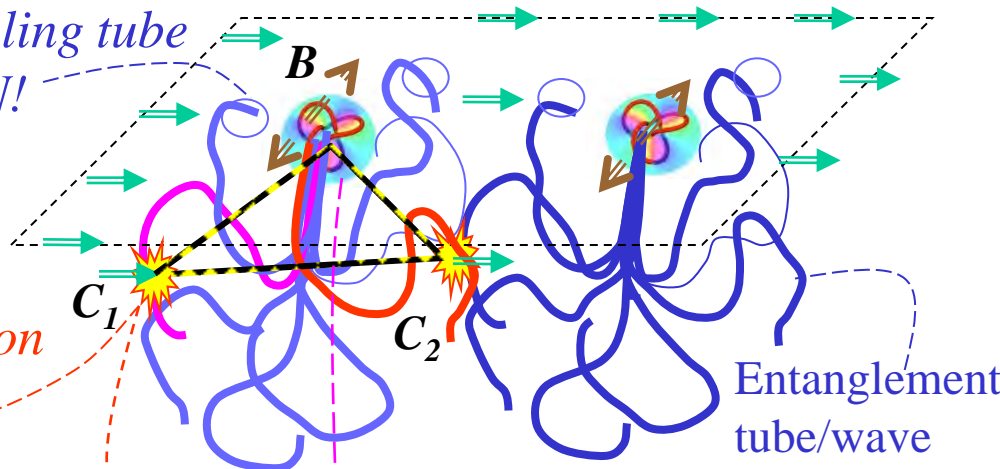
Inside a fusion battery

The process and the *NEW PHYSICS* beyond



Stage 1 – Doper-Lattice synergy

*Tunneling tube
OPEN!*

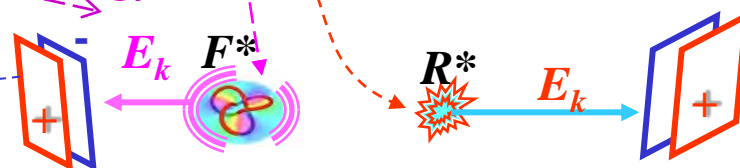


Stage 2 – Non-local nuclear reaction

*Nano-structure and its parameters
determines how
the energy is released*

*As collective lattice
HEAT energy*

*As kinetic
energy*



Stage 3 – Final products Energy harvesting

The NEW PHYSICS contains TWO POSTULATES :

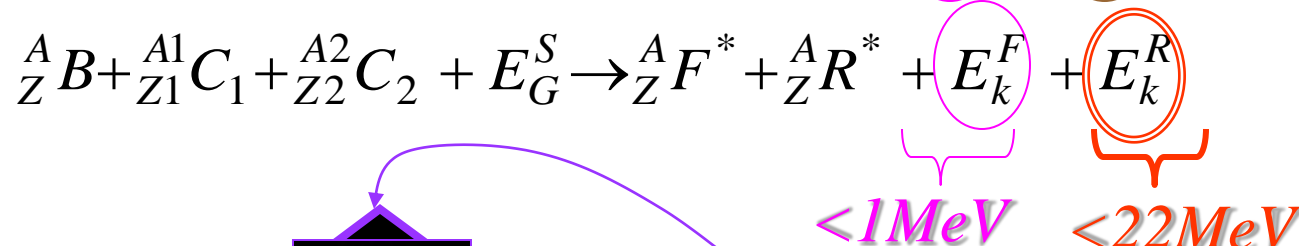
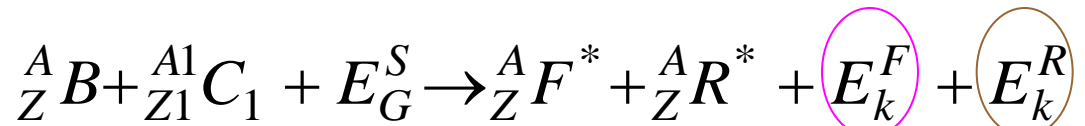
1. The reaction does not consists in crushing one nucleus into another through Coulombian barrier but in a **non-local reaction** through the opening of a tunneling wave-tube (worm-hole) through which the nuclei exchange quarks.
2. **The nano-structure engineering and its parameters** determines the nuclear reaction channel and how energy is released as kinetic energy of charged particles, or involving neutrons or is split into multiple quanta – heat without radiation.//*Safety hazard for radiation free structures !/*

Nuclear reactions and physics laws remain the same!

Quarks-exchange

Transmutation

*Transmutation
and Fusion*

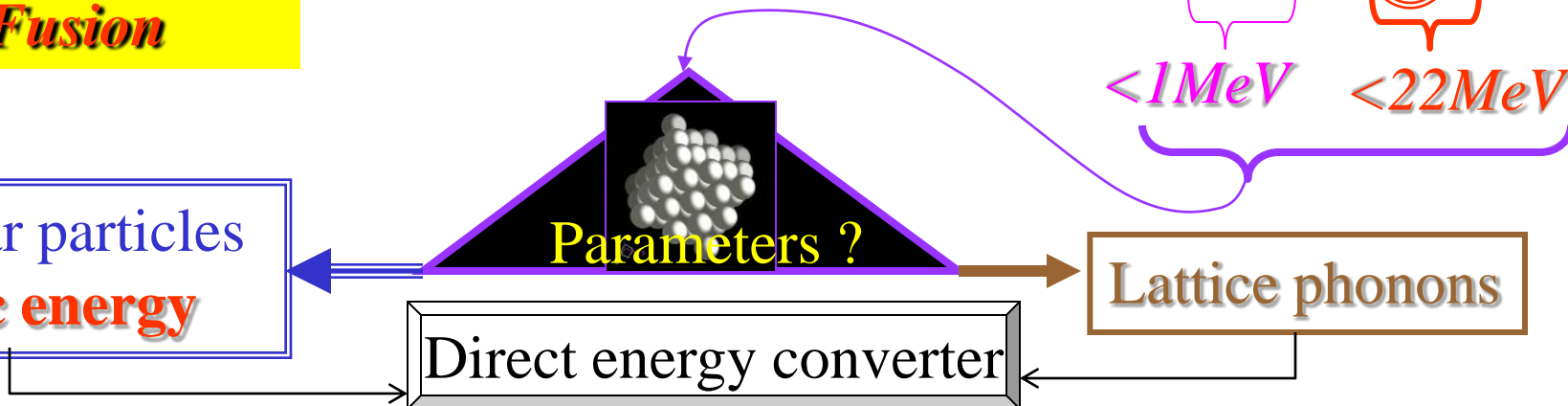


Nuclear particles
kinetic energy

Parameters ?

Lattice phonons

Direct energy converter



Details on Moving particle Energy deposition in different materials

Moving
Particle

Nano-
structure

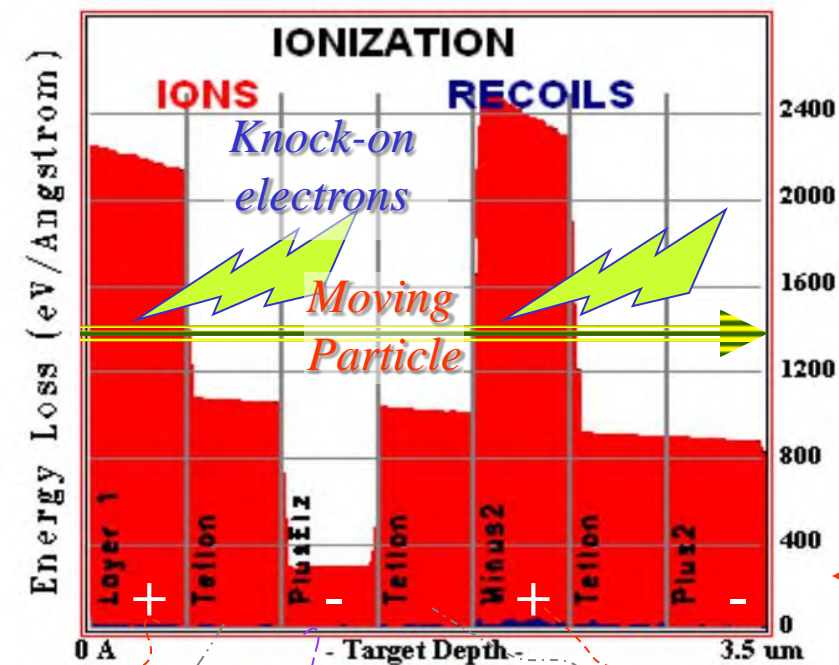
Knock-on
electrons

Nano-
structure

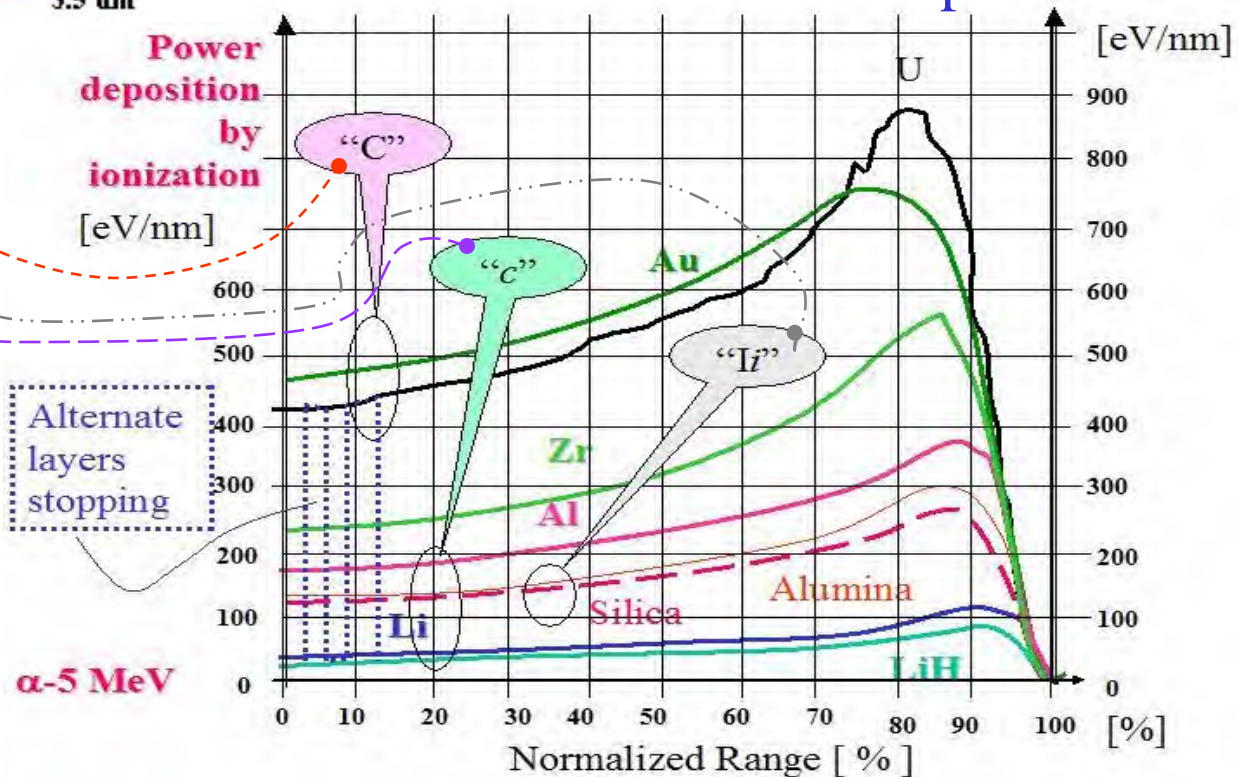
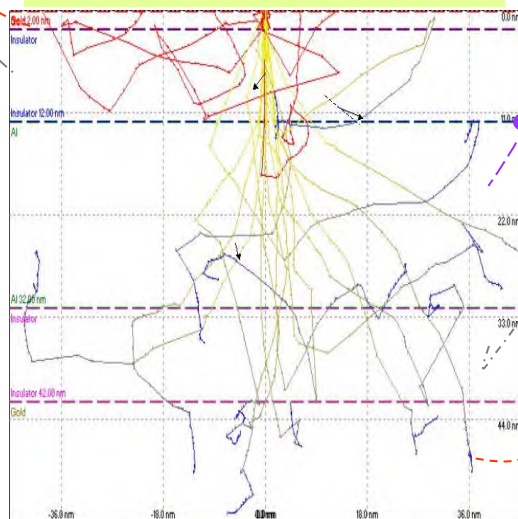
Electricity
extraction

Example of harvesting structure

Material selection example



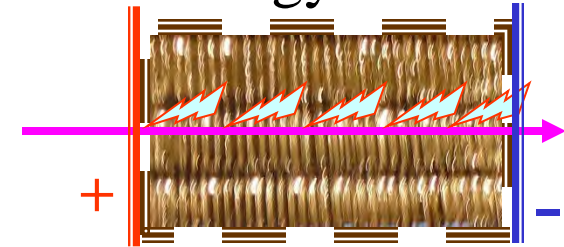
Knock-on
Electron showers



The nano-structure may also harvest the energy released by the nuclear reaction, when and where it was released!

The direct nuclear energy conversion into electricity resembles a super-capacitor

- charged directly from the nuclear reactions released energy
- discharged directly as electric current

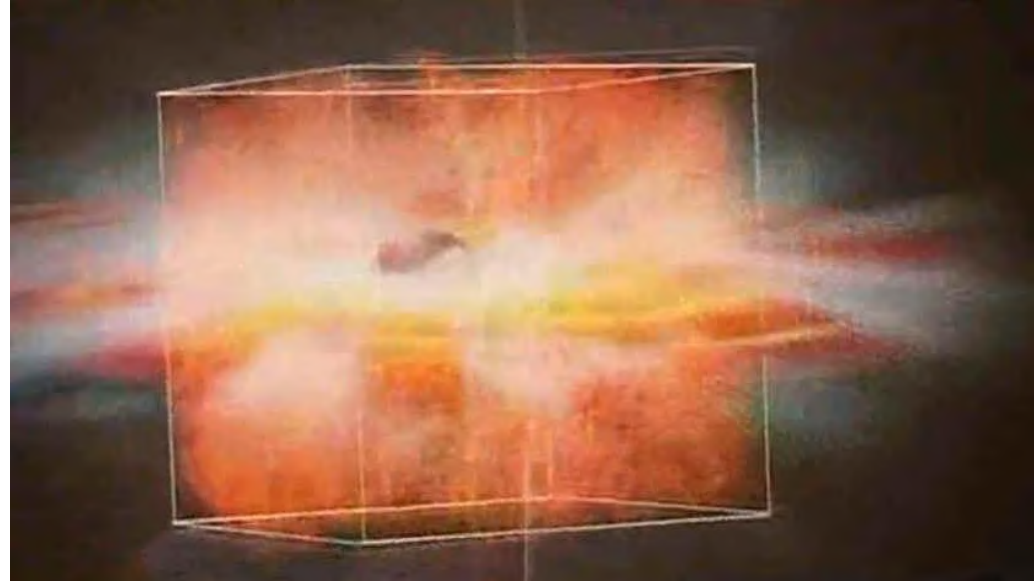


The process has 2 main stages:

1. – The particles released by the nuclear reaction are stopped in the nano-hetero structure –like a planar capacitor - made of an alternating structure generating electron showers
2. - The electron showers generated on one plate are collected by the next plate that becomes negatively polarized

- To amplify the process the capacitor plates are made of different materials, that maximizes the efficiency
- The device will be a single solid-state unit

Supporting details for direct energy conversion in nano-structures



Physics of ion interaction with matter

Direct conversion structures studies at MIT

Direct nuclear conversion studies at Missouri-Columbia

DOE funded projects

DOD-DARPA funded projects

SWRI patent for a direct conversion device

*A history of direct energy conversion device I presented in
the SPIESTIF meeting in 2011 in Maryland University
covering all the period from 1913 to 2010.*

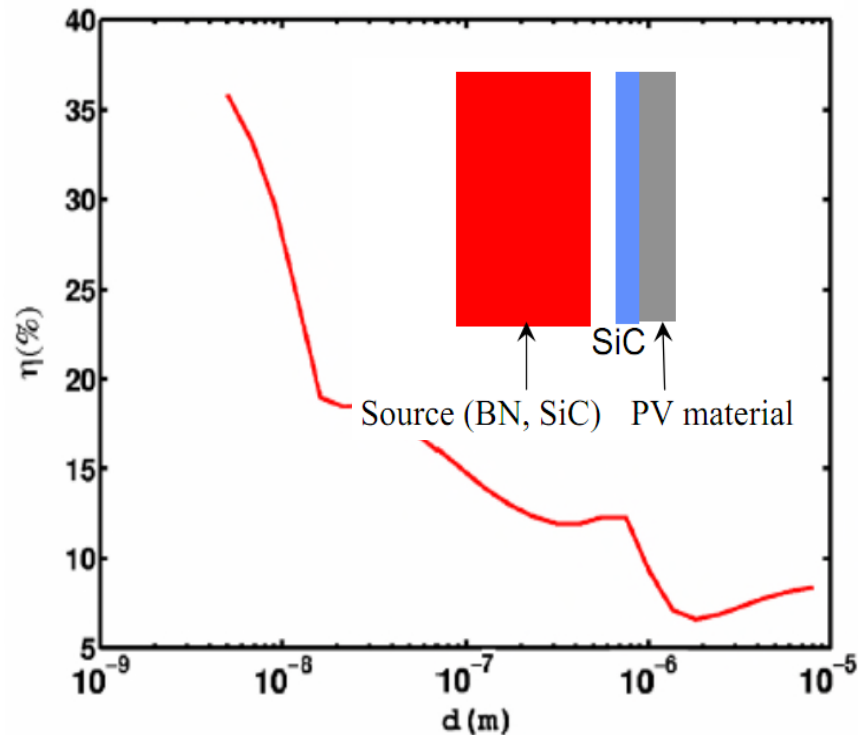
Direct Energy Conversion

Gang Chen

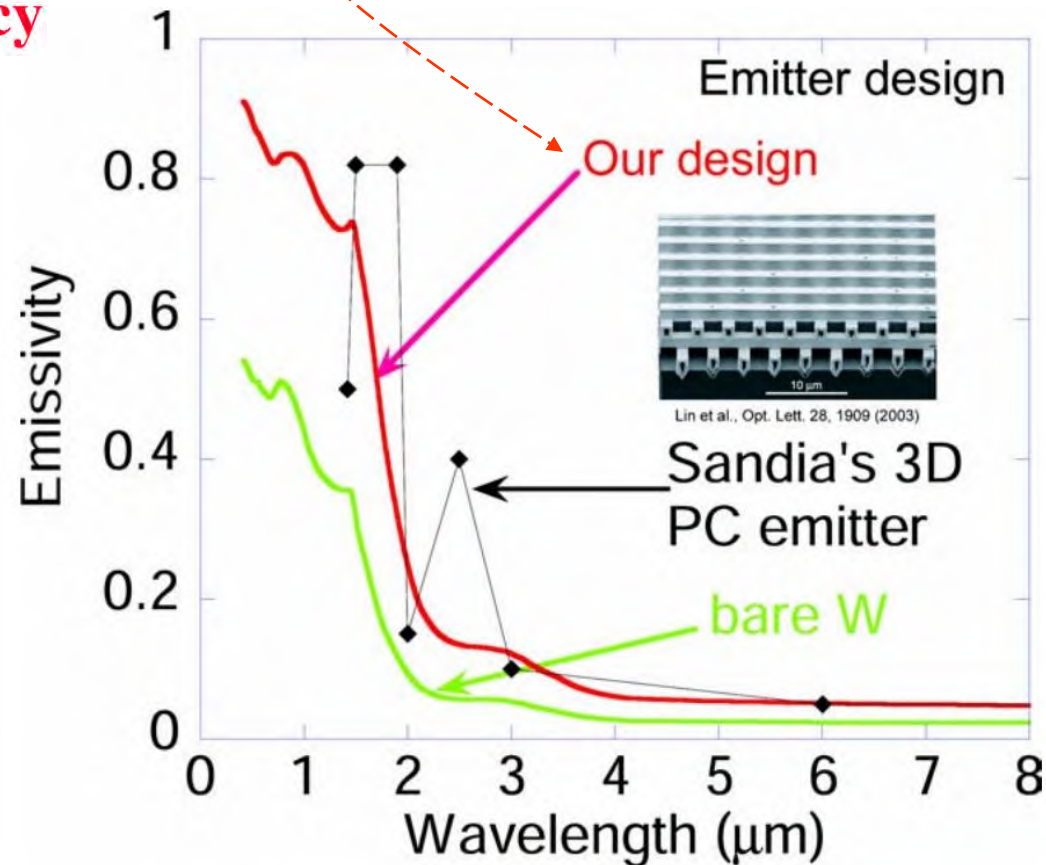
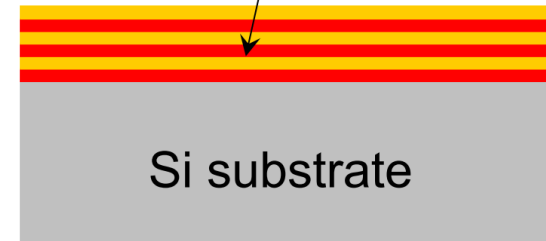
**Mechanical Engineering Department
Massachusetts Institute of Technology**

Near-Field Effect on Efficiency

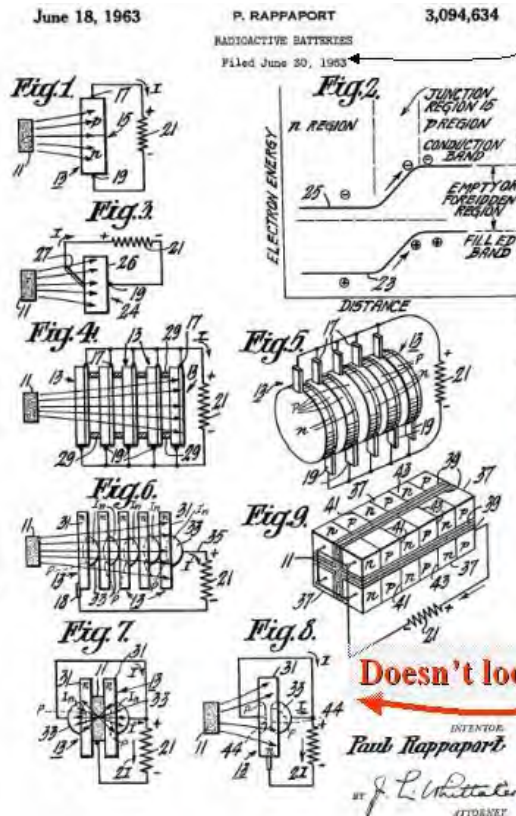
Laroche et al., JAP, 100, 063704 (2006)



Alternating layers of tungsten and alumina



DARPA 2004 - \$25M funding for GTI –Idaho and ASU



Semiconductor based batteries 1953

Molten Semiconductor Idea appears ! In 2004

Diodes manufactured at ASU are used by GTI researchers at Idaho State University in fission fragment studies



Doesn't look similar?

Liquid electronics Effect accidentally observed by my team in 1987 when accidentally melted the solid capacitor structure - drastic drop in efficiency

Liquid Electronics Power Source

Not a new idea – patent protection expired 30 years ago, so it can be used for free..

Result = Negative;

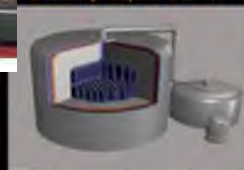
Issues – low efficiency
- low stability

LEAPS-2006

<http://www.gtiusa.net/LEAPSDARPA.htm>

Liquid Electronics Nuclear Sources (LENS):

Develop Liquid Semiconductors for Direct Nuclear to Electric Conversion at 50+% Efficiency



Of course the electronics is liquid because at low efficiencies and high temperatures most of the electronics melts...

The Liquid Electronics Advanced Power Systems (LEAPS)

GTI has recently been awarded its third contract through the United States Defense Advanced Research Projects Agency (DARPA) for research and development of a new technology for directly converting radiation energy to electricity.

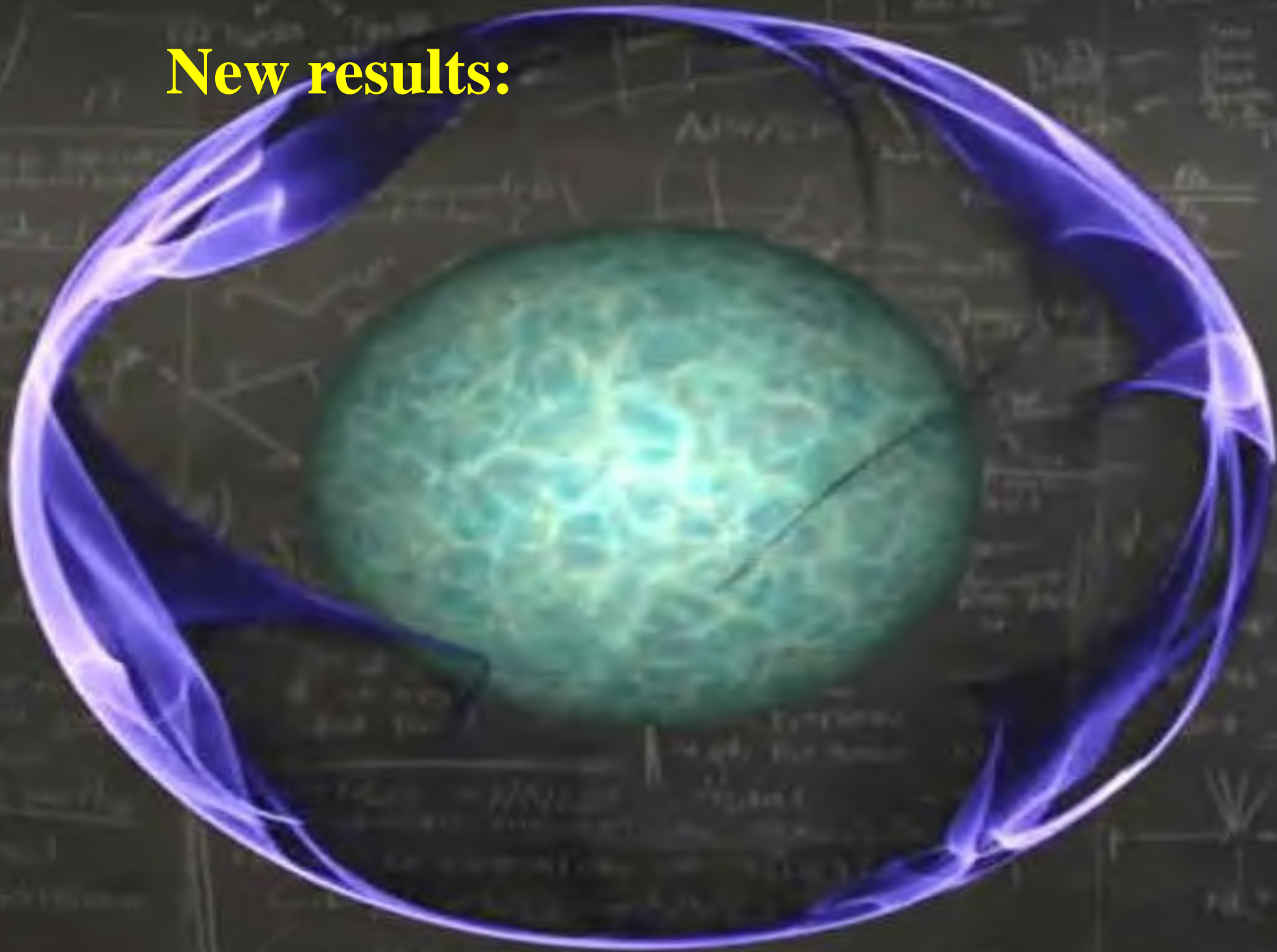


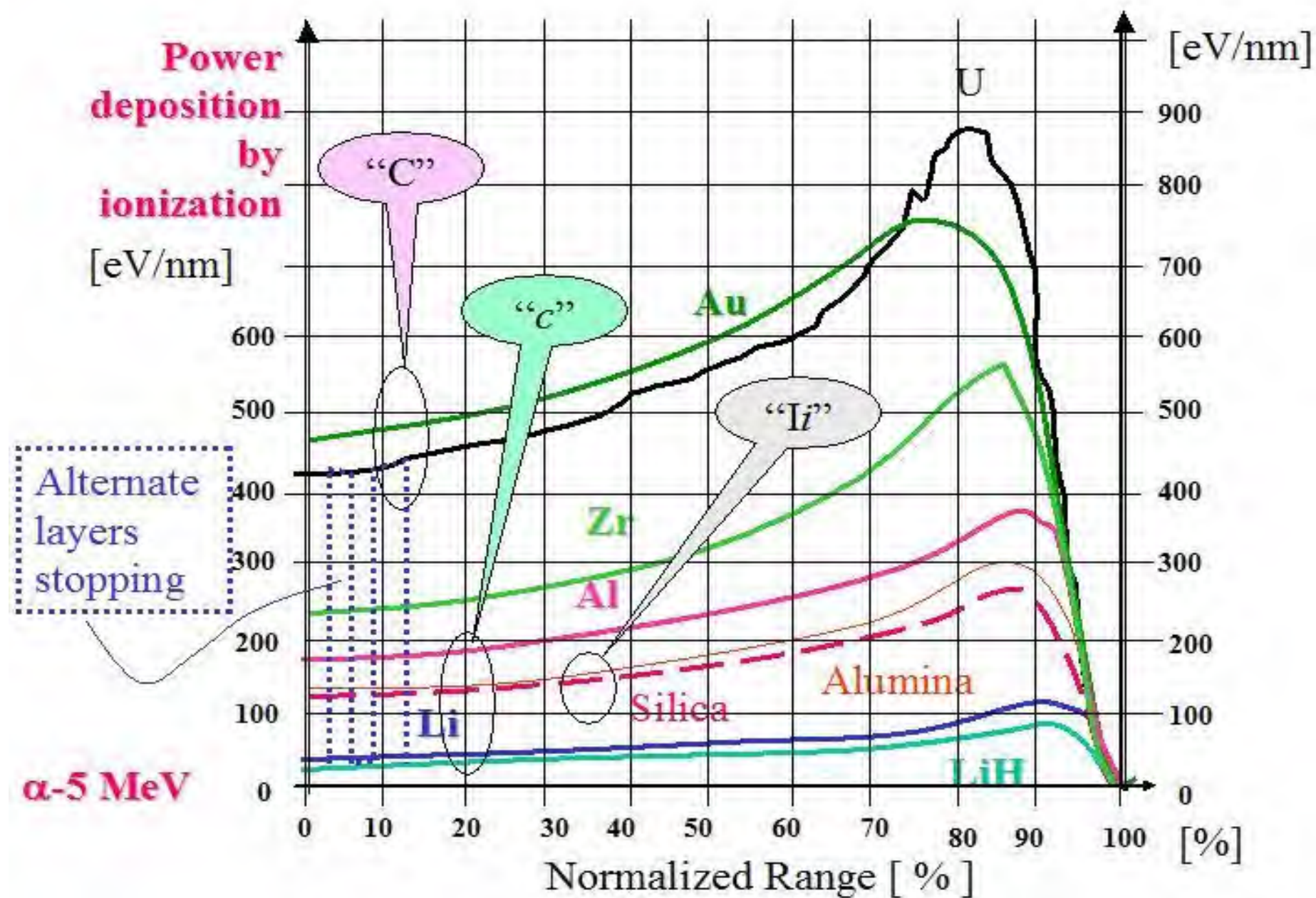
That is DoD nice pictures project !

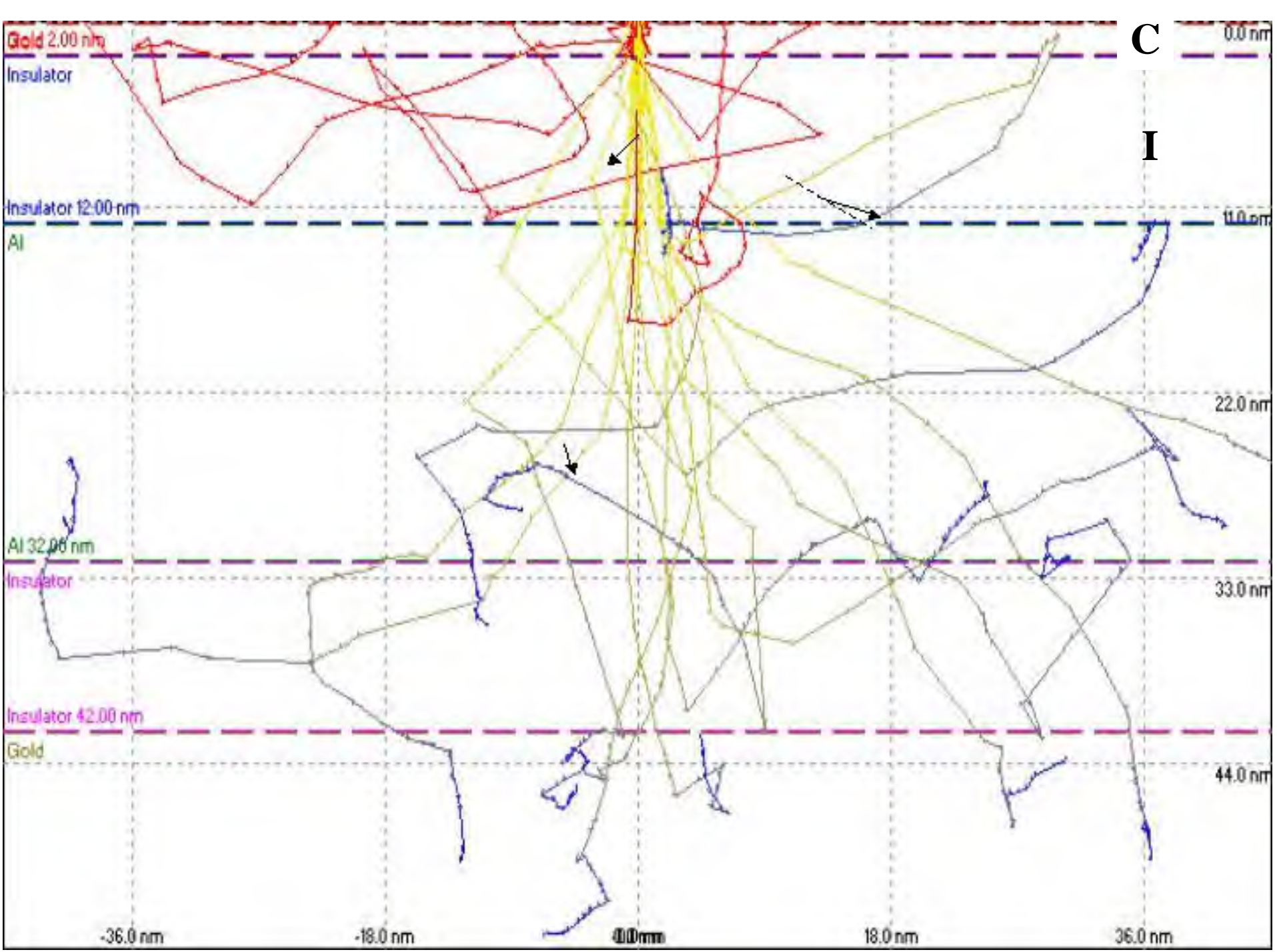
Power for the Future: Generator Scalable to No Moving Parts, No Acoustic Signature, in

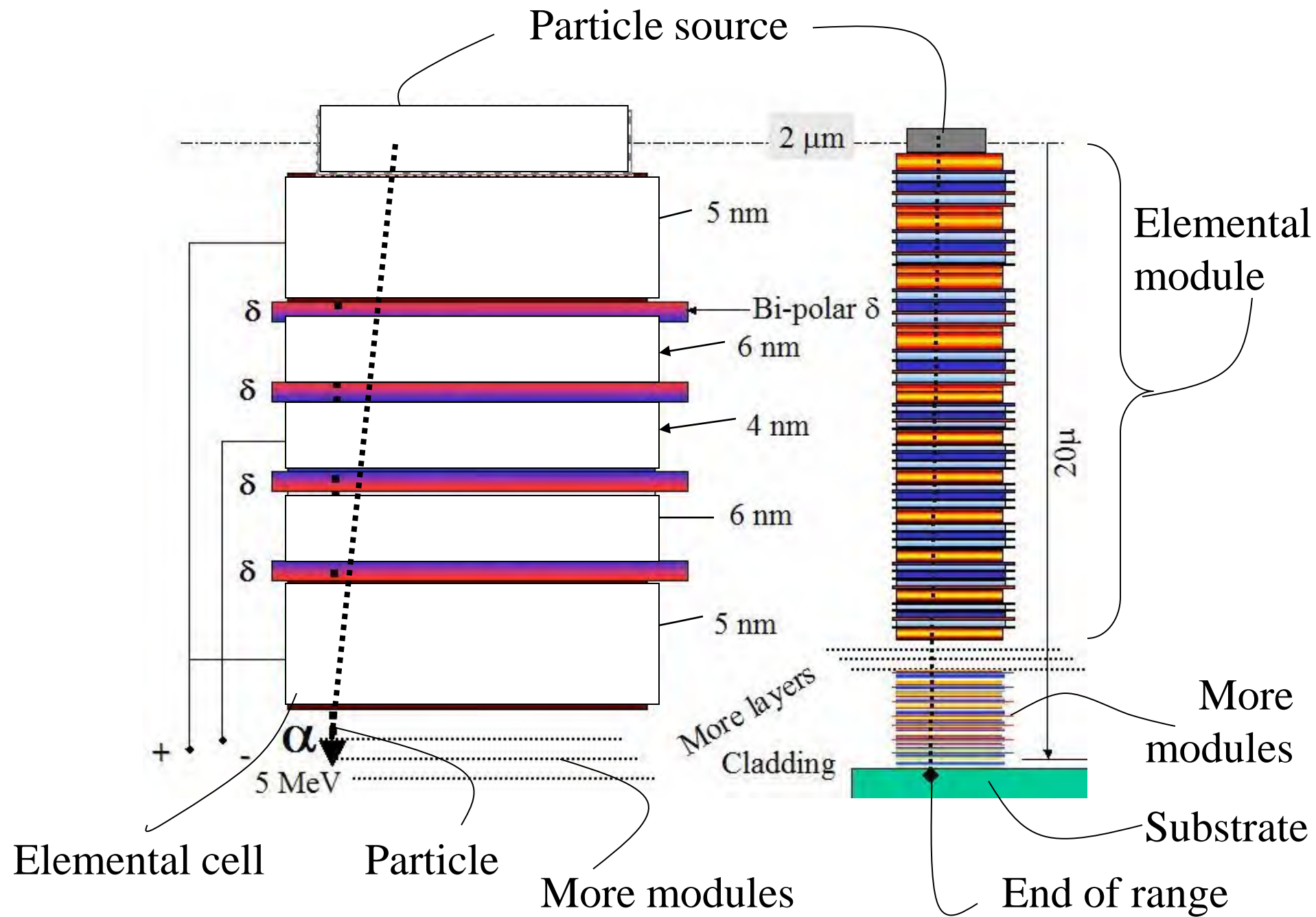


New results:









The research



A national R&D program is needed which to integrate:

- Government agencies
- Private investors
- National Laboratories, Universities, Private companies and Individuals, respecting their proprietary information and shortening the time from idea to application by joint work.

General description of my The research effort proposal

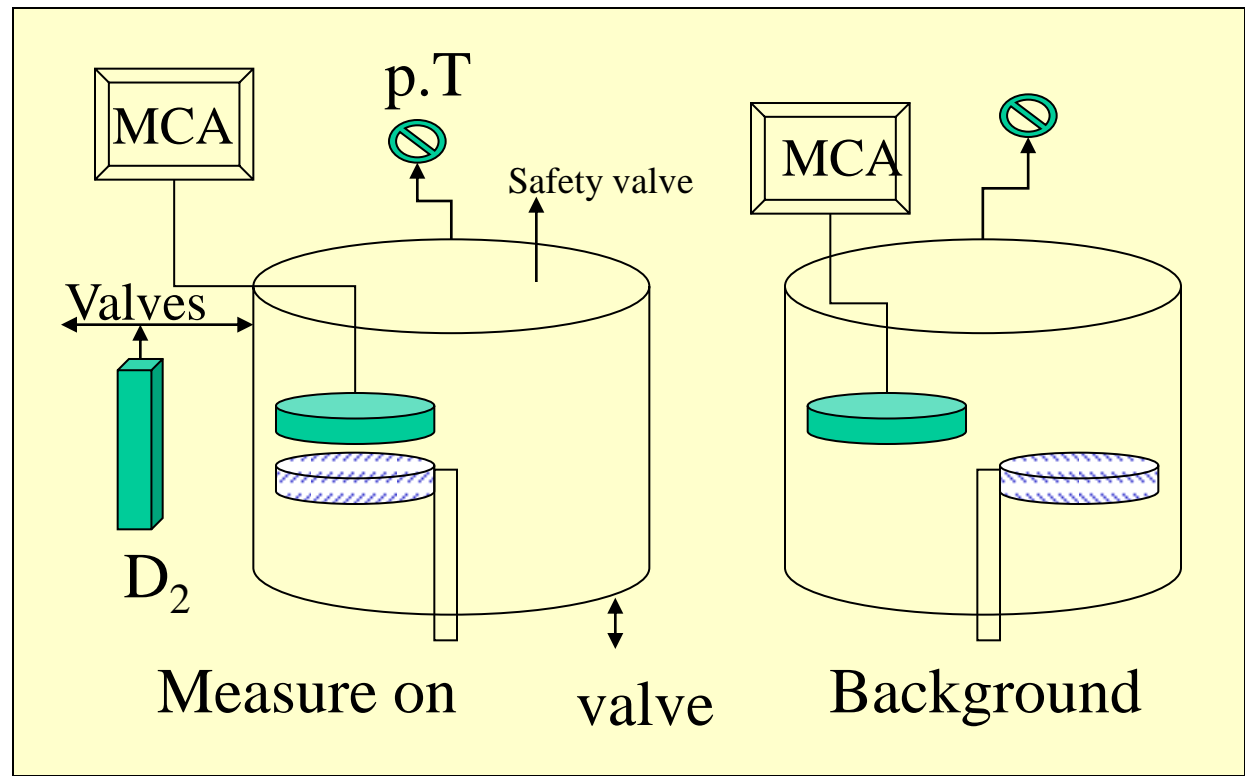
Stage 1

- Proof the fundamentals of many other nano-lattices that facilitates nuclear reaction (NSFNR) and
- Measure the Nuclear Reaction rate as function of nano-structure parameters:

Simple Experimental assembly

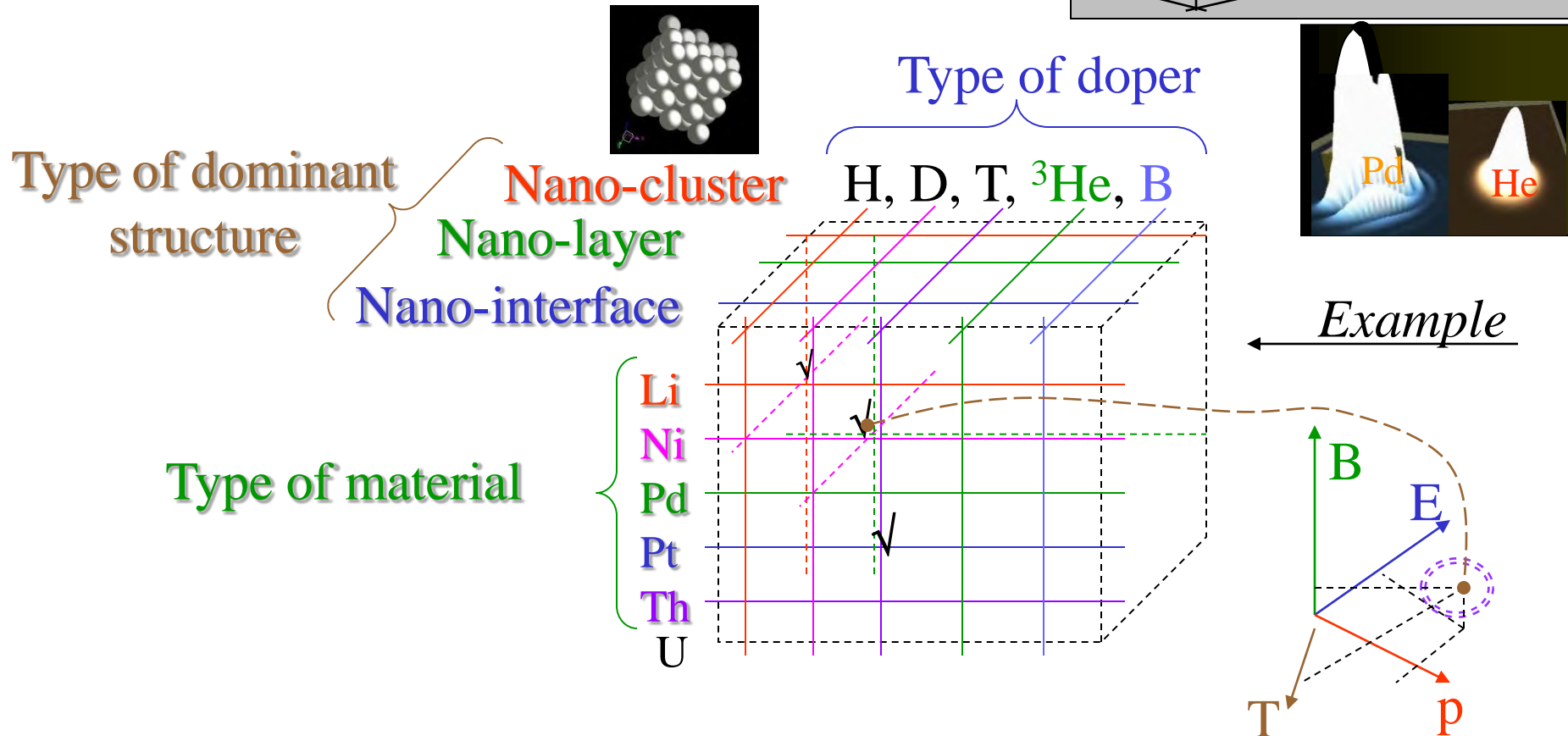
Outcomes:

- Prove the concept
- Select materials
- Optimize the operation parameters



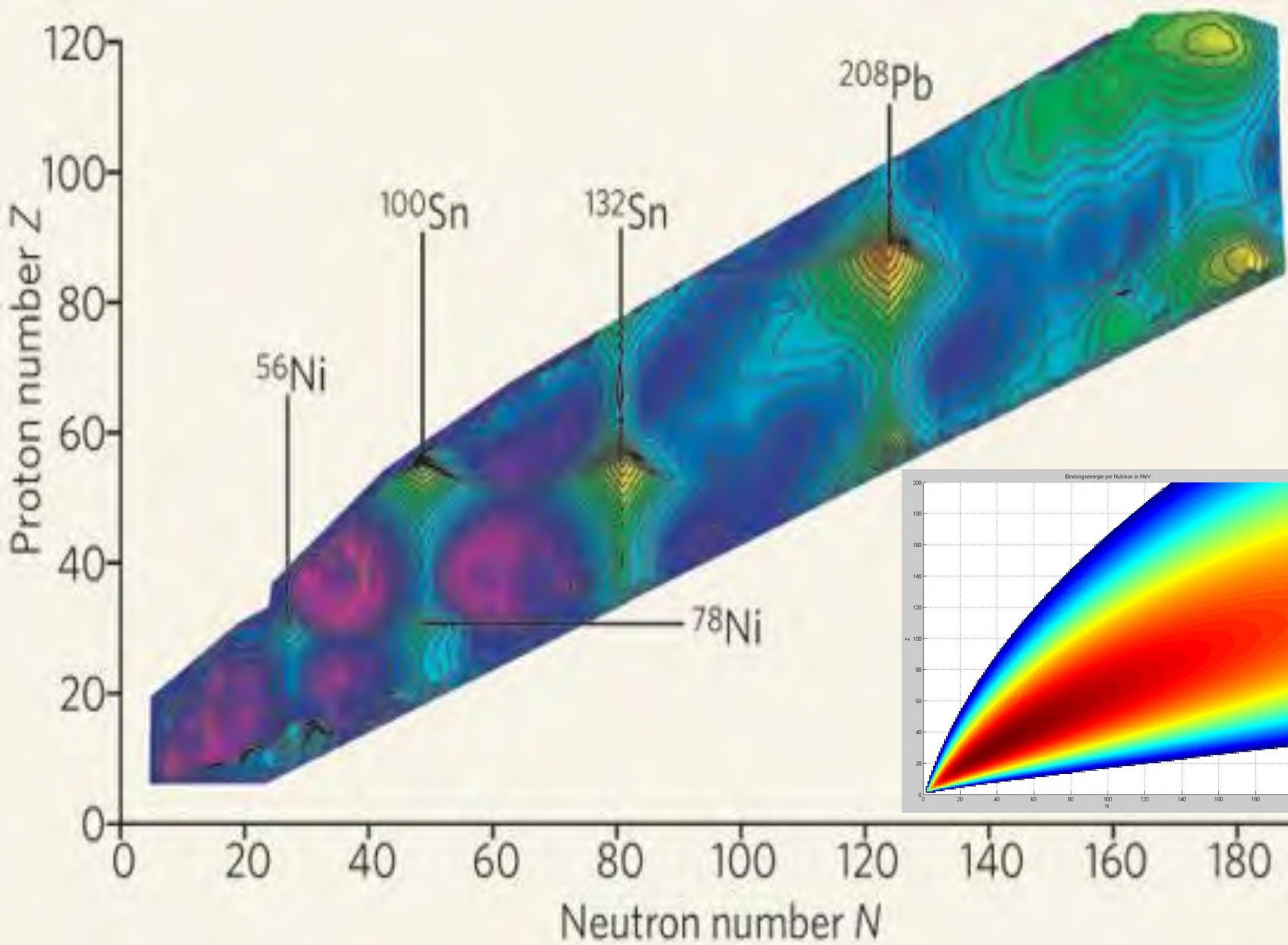
Stage 2 – Advanced research

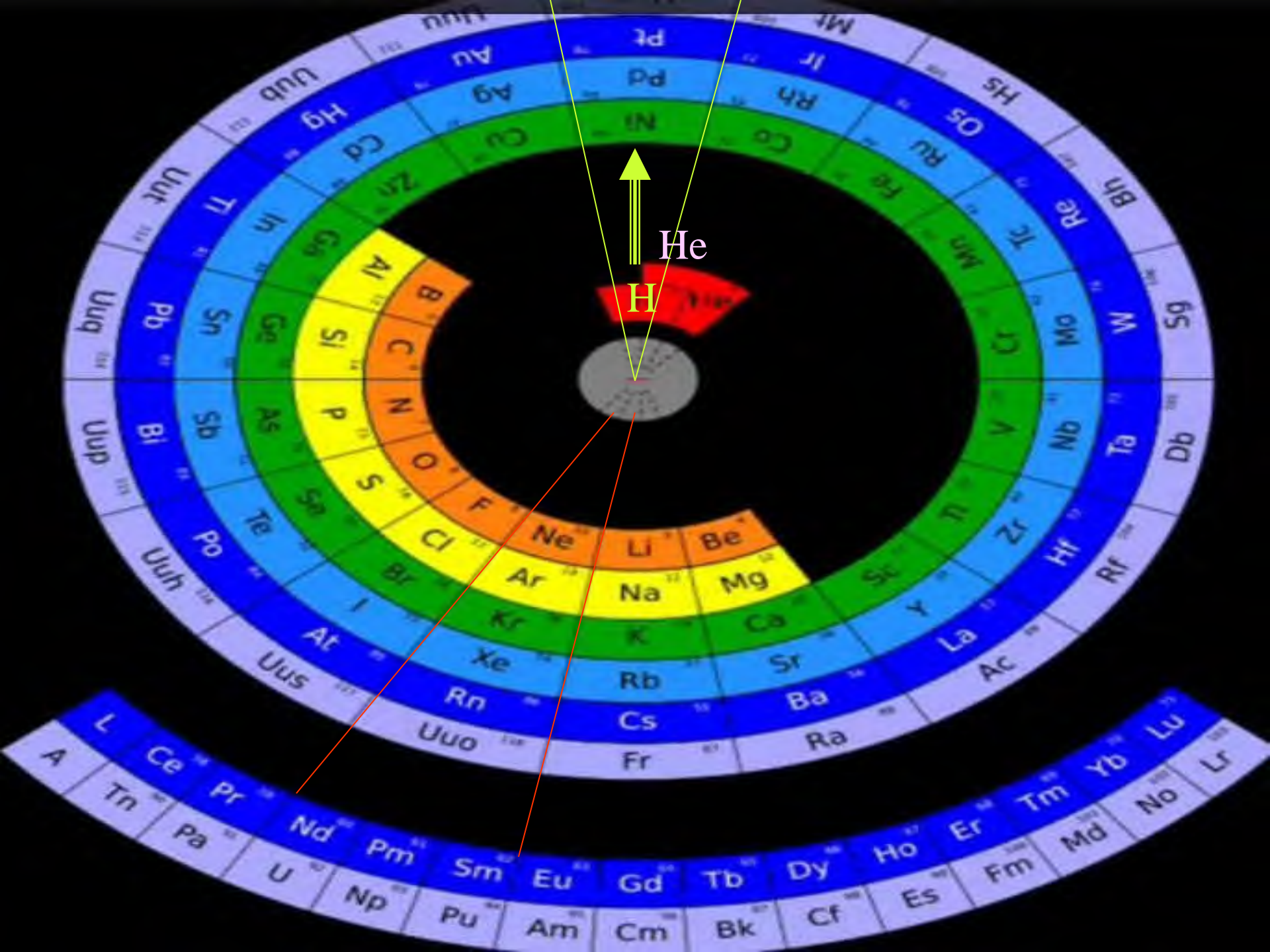
Find the best engineered nano-structures that produces the optimal synergistic effects

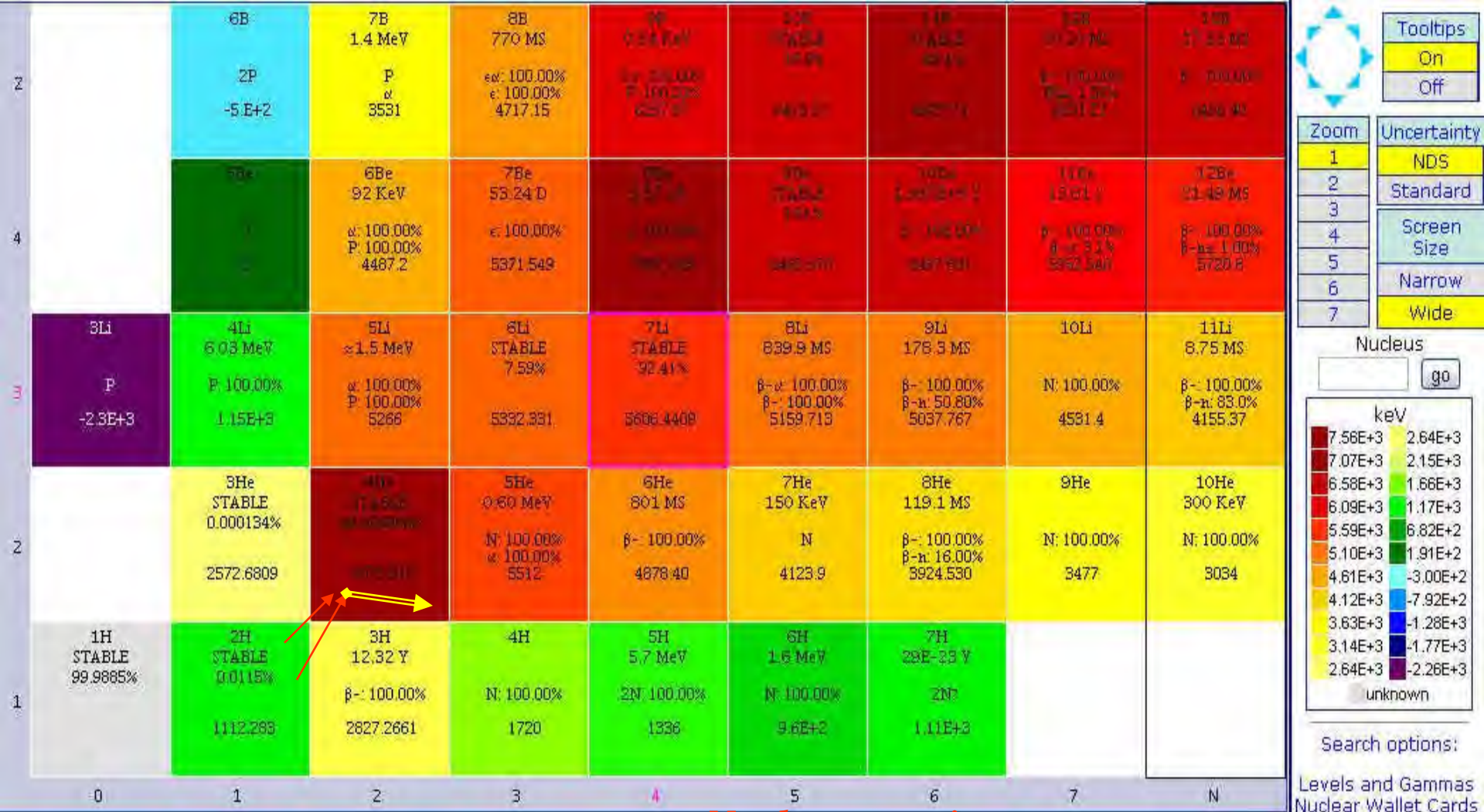


Find the parameters and rate dependence (p, T, E, B, etc)

Outcome – technologic, constructive parameters for dedicated systems







Z	55Ni 204.7 MS	56Ni 6.075 D	57Ni 35.60 H	58Ni STABLE 68.077%	59Ni 7.6E+4 Y	60Ni STABLE 26.223%	61Ni STABLE 1.1399%	62Ni STABLE 3.6346%	63Ni 101.2 Y
	ε: 100.00%	ε: 100.00%	ε: 100.00%		ε: 100.00%				β-: 100.00%
	8497.308	8642.767	8670.922	8732.049	8736.578	8780.764	8765.015	8794.545	8763.485
27	54Co 193.28 MS	55Co 17.53 H	56Co 77.236 D	57Co 271.74 D	58Co 70.86 D	59Co STABLE 100%	60Co 1925.28 D	61Co 1.650 H	62Co 1.50 M
	ε: 100.00%	ε: 100.00%	ε: 100.00%	ε: 100.00%	ε: 100.00%		β-: 100.00%	β-: 100.00%	β-: 100.00%
	8569.205	8669.606	8694.825	8741.871	8738.958	8768.025	8746.756	8756.141	8721.4
Z	53Fe 8.51 M	54Fe STABLE 5.845%	55Fe 2.744 Y	56Fe STABLE 91.754%	57Fe STABLE 2.119%	58Fe STABLE 0.282%	59Fe 44.495 D	60Fe 2.62E+6 Y	61Fe 5.98 M
	ε: 100.00%		ε: 100.00%				β-: 100.00%	β-: 100.00%	β-: 100.00%
	8648.78	8736.370	8746.583	8790.342	8770.267	8792.238	8754.760	8755.85	8703.77
25	52Mn 5.591 D	53Mn 3.74E+6 Y	54Mn 312.12 D	55Mn STABLE 100%	56Mn 2.5789 H	57Mn 85.4 S	58Mn 3.0 S	59Mn 4.59 S	60Mn 0.28 S
	ε: 100.00%	ε: 100.00%	ε: 100.00% β- < 2.9E-4%		β-: 100.00%	β-: 100.00%	β-: 100.00%	β-: 100.00%	β-: 100.00%
	8670.32	8734.154	8737.944	8765.009	8738.320	8736.71	8696.64	8680.92	8628.14
24	51Cr 27.7025 D	52Cr STABLE 83.789%	53Cr STABLE 9.501%	54Cr STABLE 2.365%	55Cr 3.497 M	56Cr 5.94 M	57Cr 21.1 S	58Cr 7.0 S	59Cr 1.05 S
	ε: 100.00%				β-: 100.00%	β-: 100.00%	β-: 100.00%	β-: 100.00%	β-: 100.00%
	8712.003	8775.966	8760.177	8777.935	8731.905	8723.19	8663.38	8641	8565
23	50V >2.1E+17 Y 0.250% ε > 92.90% β- < 7.10%	51V STABLE 99.750%	52V 3.743 M	53V 1.543 M	54V 1.51E+17 Y	55V 1.61E+17 Y	56V 1.24E+17 Y	57V 1.24E+17 Y	58V 1.24E+17 Y
	8695.919	8742.100	8714.584	8710.11	8551.296	8731.905	8755.699	8755.85	8755.85
					940,642.560	480,254.775	437,784.950	525,351.000	525,351.000
22	49Ti STABLE 5.41%	50Ti STABLE 5.18%	51Ti 5.76 M	52Ti 1.7 M	53Ti 2.76E+17 Y	54Ti 2.76E+17 Y	55Ti 2.76E+17 Y	56Ti 2.76E+17 Y	57Ti 2.76E+17 Y
			β-: 100.00%	β-: 100.00%					
	8711.138	8755.699	8708.970	8691.65	-15,880.914 28,941.174 -2,870.080	8596.9	8516	8459	8358
	27	28	29	30	31	32	33	34	N

New physics emerging from the study of this new reactions

Space, entanglement, teleportation

Space and matter correlation

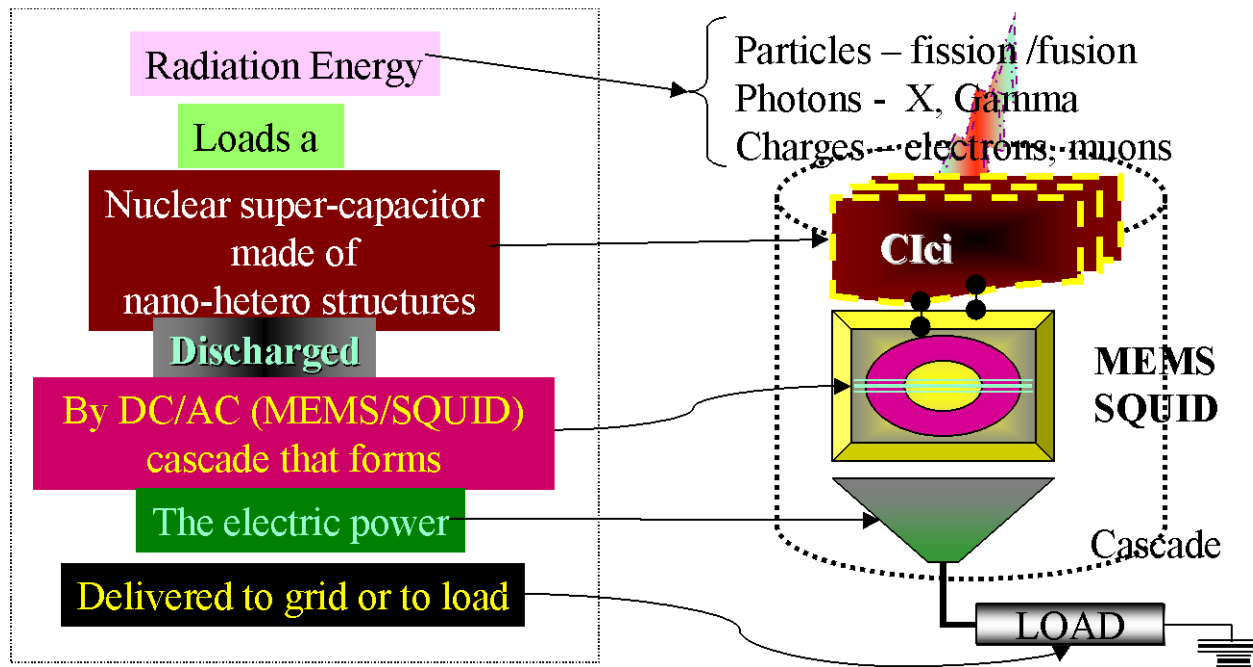
Matter's synergy and energy

Conservation principles – that requires
an “insulated physical system”, but
“how insulated are our common systems”, and
what do we have to consider to keep the principles valid?

Exotic nuclear reactions and applications

Stage 3 – Test the harvesting structures embedded in the burner

The operation : a moving charged particles stops in matter by creating electron showers, that can polarize a nano-size electrodes of a nano-structure that resembles a super capacitor, that becomes loaded directly by particle's kinetic energy and is discharged as electricity.

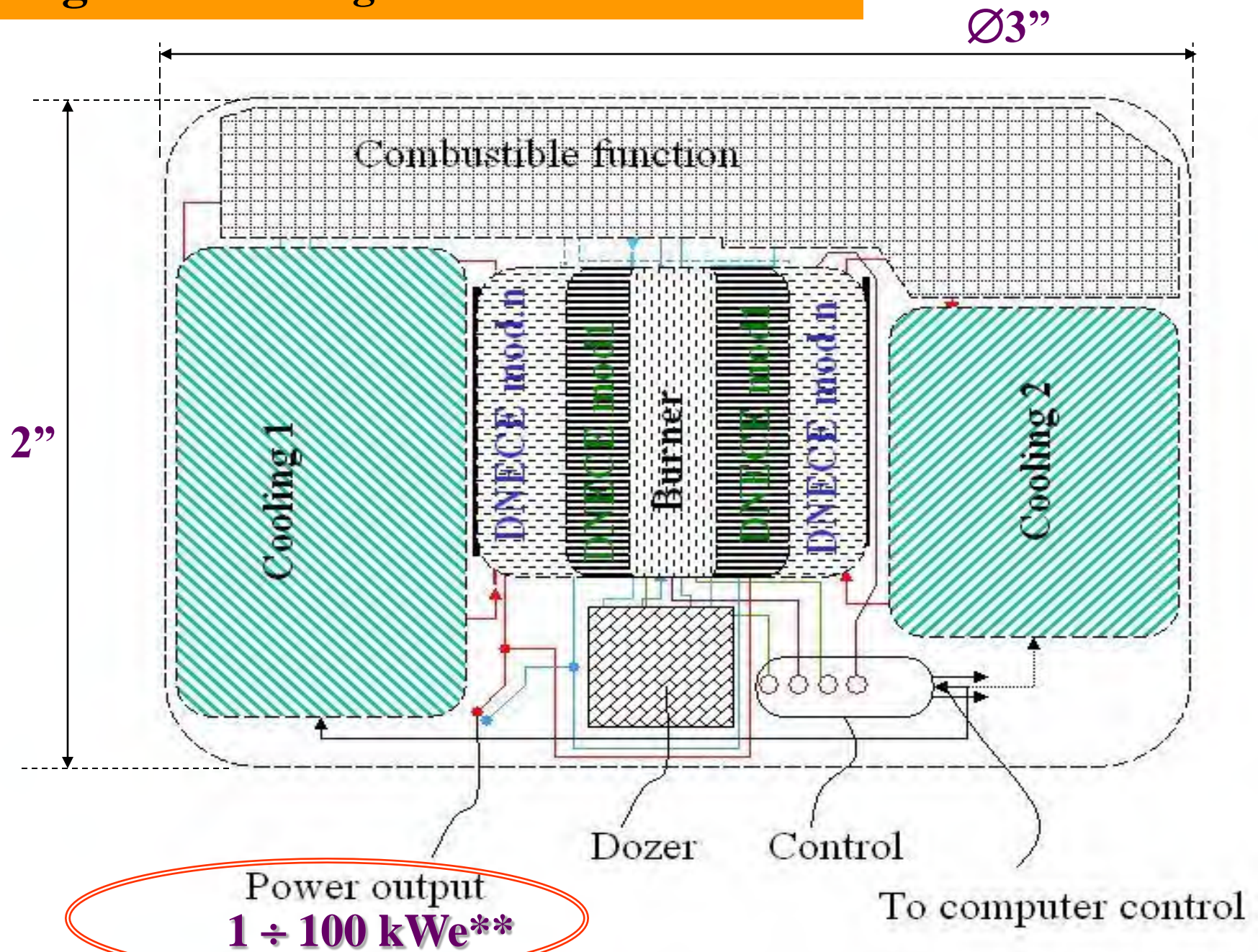


To increase the conversion efficiency

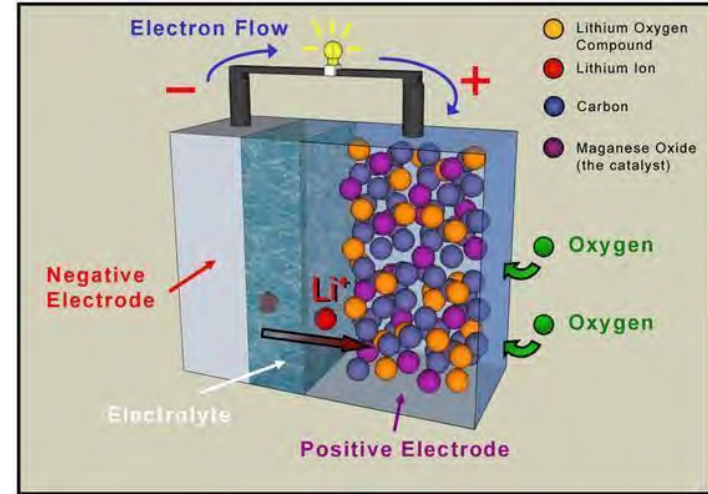
The energy harvesting structure have to contain inside the nuclear reaction facilitator nano-structure

Output: high efficiency operational structures = fabrication technology

Stage 4 – Building the functional device



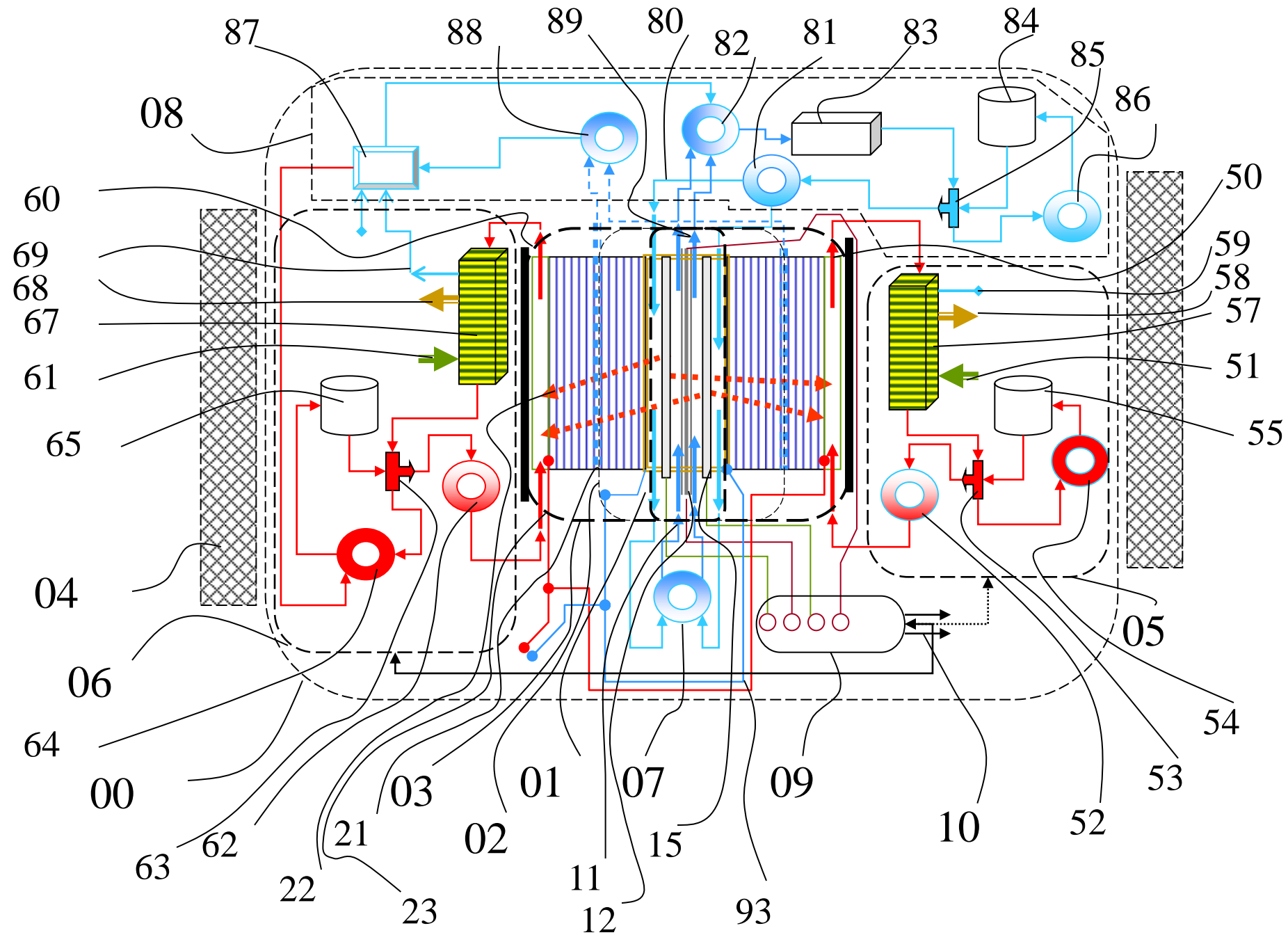
Li-Air battery



The fusion battery



P=10 MW
for 2 ½ day





Estimated performances:

Storage Specific Energy density:

- 3 GWDay/kg for D-D, D-⁶Li, H-⁷Li
 - 1 GWDay/kg for H-¹¹B, ³He,
 - 50 MWDay/Kg – H-Ni, D-Ni, H-V
- No storage limitation

Possible structure

Power source:

**Fuel : H,D,T,³He, B

**Burner materials:

Ni, V, Pd, Pt, Th, etc.

Conversion efficiency:

Up to 95% depending of constructive solution

Power density:

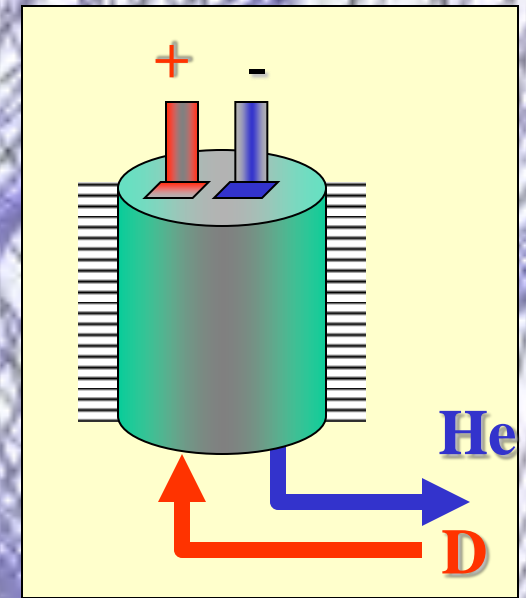
Dependent of conversion efficiency, and heat extraction
For 95% and Heat=200 W/cc

$Pd_{Max} = 4 \text{ kW/cc}$

Novel Fusion Transmutation power source

Replaces the chemical power source
reducing the size by $>100,000$ times
($1 \text{ m}^3 \rightarrow 1 \text{ cc}$)

Replaces the actinide based nuclear fuel,
eliminating criticality accident hazard,
radio-chemical contamination hazard,
irradiation hazard and maneuver restrictions



Converting directly the nuclear reaction energy into electricity

High conversion efficiency – between 20 and 95%
the power source runs cold or with moderate heat

At high power density needs cooling and allows a supplementary
thermo-electro conversion to make the energy efficiency even
higher.

Safe , reliable operation,

A little bit of History

James Franck

(26 August 1882 – 21 May 1964)

German physicist and Nobel laureate.

1.) J. Franck, Goettinger. Ber. II,
44, 203 (1933)



2.) KF Herzfeld, M Goeppert-Mayer,
Z. Phys. Chem. 26B 203 (1934)

Karl Ferdinand Herzfeld

Maria Goeppert-Mayer



My experience and expertise

I have never published because of lack of coherent data.

Stage 1- 1980-2000 – Growing awareness

Phase a) 81-90-

- 1981 – D-Pd strange surface processing with low power laser in D₂ flowing after glow discharge plasma (Geavidt Musa's exp.)
- 1982- Learned about Oil V anomaly search for explanation (Aldescu Stelu)
- 1982 - ICP_Ploiesti, RO signaled that V in some lubricating oil modifies in time
- 1985 – Strange isotopes in bio-experiment Pitesti Pyramids (Glodeanu)
- 1987 - Request for investigation from–Teleajen – V, Ni [%] was decreasing in time, faster at high temperature
- 1988 - Pd catalyst structural modification in G Heavy water plant was added on list (Musa)

Phase b) 90-2000-

1985-1995 – Cyclotron electrolyze electrode anomaly
Cyclotron W filament material modification during D sessions, some bursts of radiation in electrolyzer room observed, before cathode failure

Stage 2- 2001-2012 – Doing something

2000 - 2010 – developing direct nuclear energy conversion concepts

2008-⬆ MD studies for clusters on the feasibility of fusion

2011 – Patent application for a fusion battery US 13/297,243



Liviu Popa-Simil

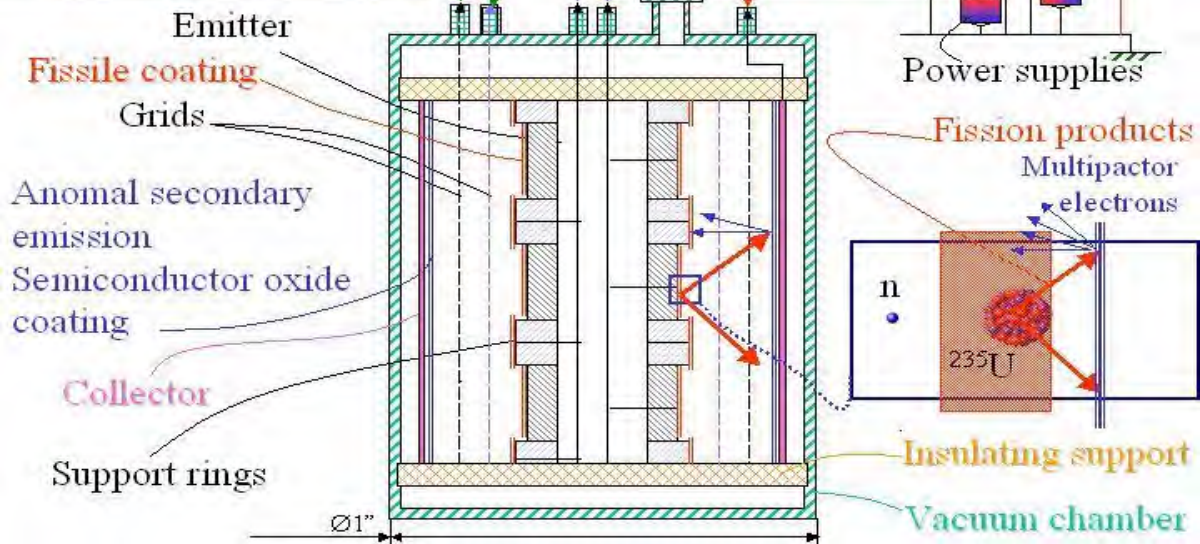


30 years ago

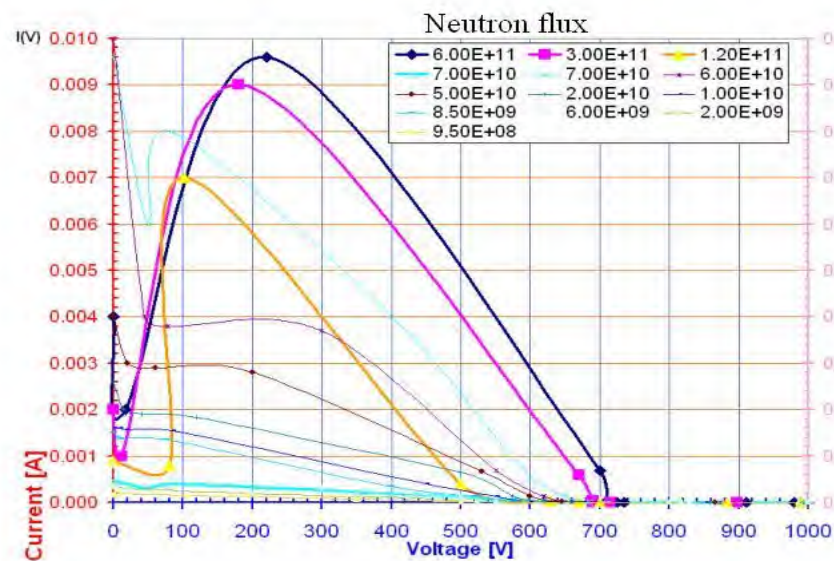
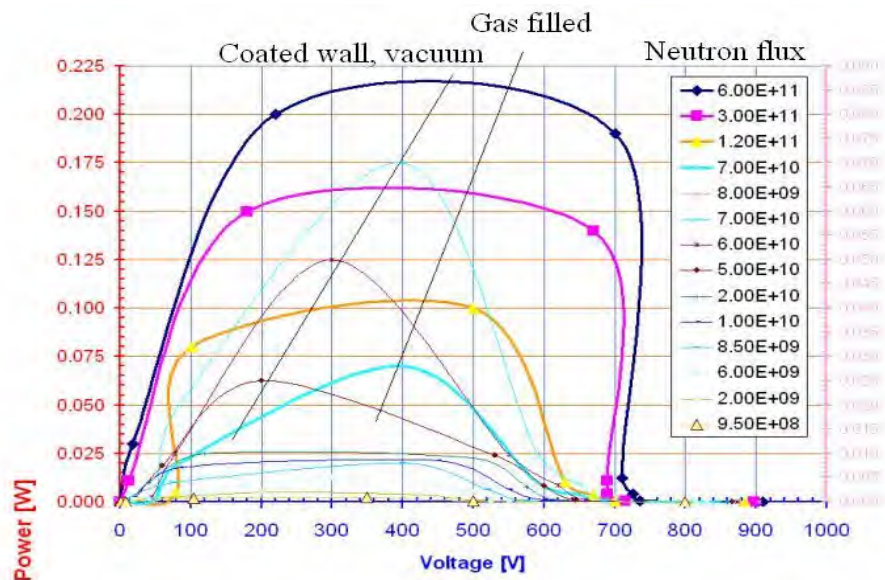


Transversal section in a fission cell

Ursu-Purica fission cell



Accelerator, Nuclear reactor
applications division
1984-1995 worked in direct
nuclear energy conversion
special program –
Coated Capacitor structures
(gas, Vacuum filled)
Solid structures (Se, Al, Au, U)
Semiconductors upset
Positron annihilation
Tritium accelerator /applications



Romania's efforts in nuclear anomalies research

Before 89 Fleischmann Pons Announcement

APS » Journals »

Rev. Mod. Phys. 57, 2, 339–436 (1985)

The quantum effects of electromagnetic fluxes

S. Olariu

Central Institute of Physics, Bucharest/Magurele,

I. Iovitzu Popescu

Department of Physics, University of Bucharest,



Ioan- Iovitz-Popescu

Bucharest, Romania

Ether and Etherons; Etheronics – A Possible Reappraisal of the Ether Concept

Roumanian Academy journal of physics; Stud. Cercet. Fiz., vol. 34, 451-468 (1982)

PHYSICAL REVIEW C, VOLUME 61, 054305 sent April 1999

γ emission from the 31-yr isomer of ^{178}Hf induced by x-ray irradiation

Radiation Physics and Chemistry 71 (2004) 619–625

Accelerated gamma-emission from isomeric nuclei

C.B. Collins, N.C. Zoita, F. Davanloo, S. Emura, Y. Yoda, T. Uruga, B. Patterson, B.

Schmitt, J.M. Pouvesle, I.I. Popescu, V.I. Kirischuk, N.V. Strilchu

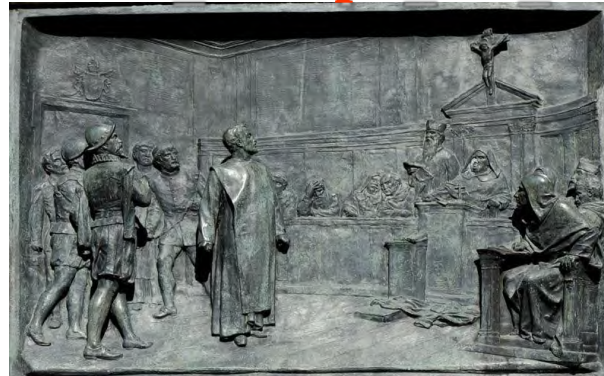
3.) **F.A. Lewis**, The Palladium/Hydrogen System, Academic Press, New York, 1967

4.) University of Utah. "'Simple experiment' results in sustained n-fusion at room temperature for first time".



Now, this statement was heard after 60 years and shocked the world, but the world was unprepared and with bad IP customs.

Bruno_Campo_dei_Fiori



After 89 Fleischmann-Pons Announcement

On a competition between solid state and nuclear scale energies. A possible theoretical approach to cold fusion in palladium and other transitional elements.

M. Apostol and I. A. Dorobantu

Rev. Roum. Phys. 34 233 (1989)

On the hydrogen ionization in simple metals

L. Vasiliu-Doloc and M. Apostol

Conf. Nat. "Progrese in Fizica", Oradea, 1989, p.259 and Rev. Roum. Phys. 37 61 (1992)

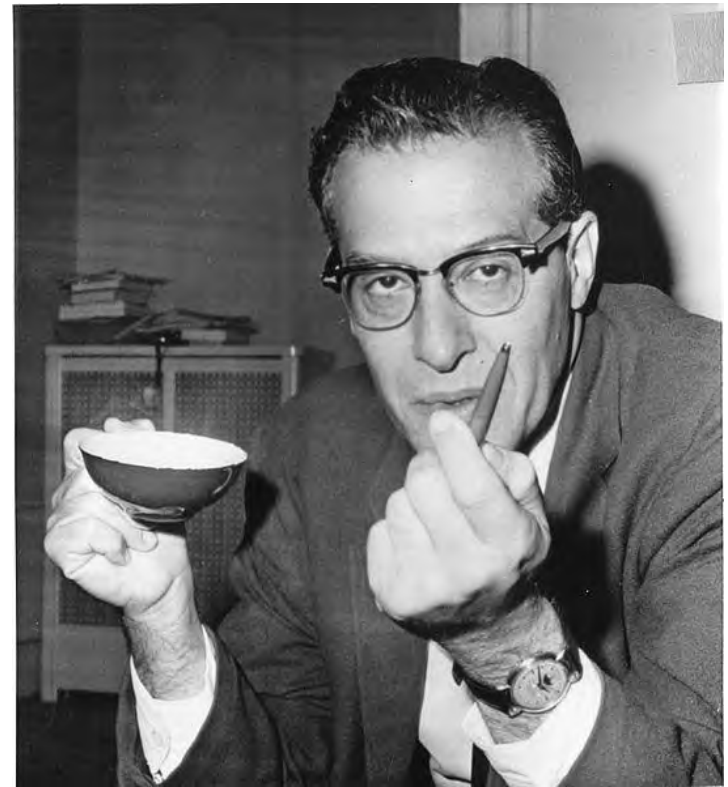
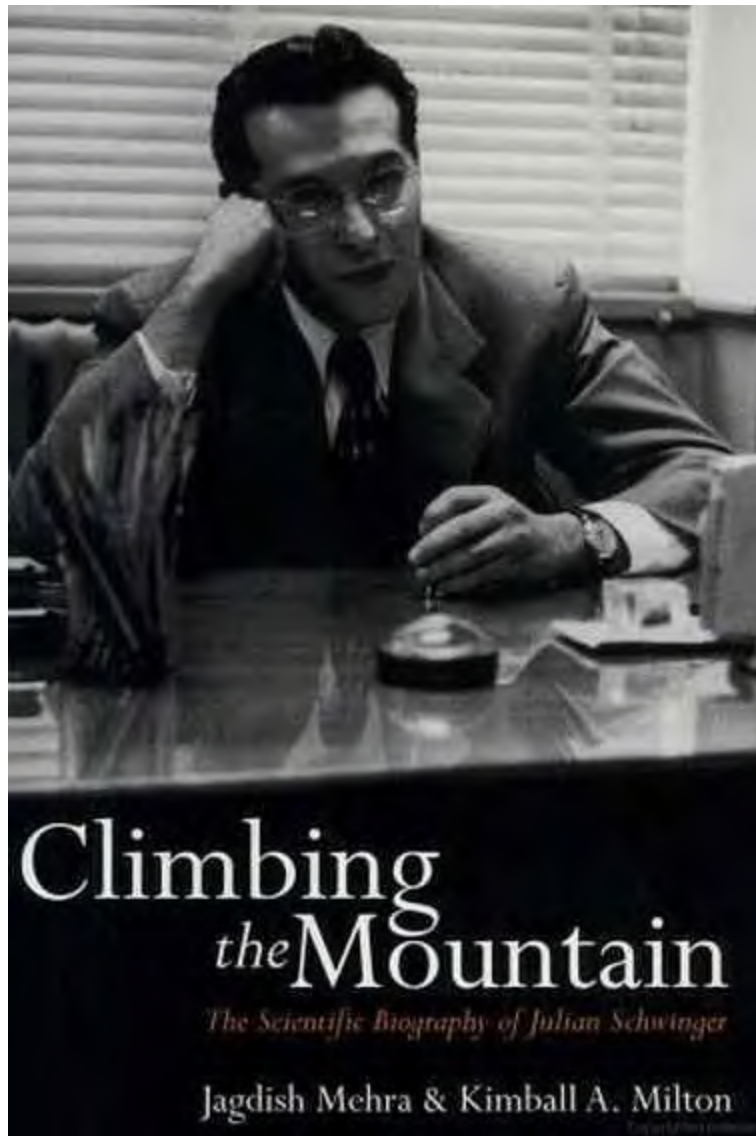


Other Romanian researchers active in the field:

A. Dorobantu, N.Mandache, N.C.Zoita, M. Atanasiu,

D.Dorcioman, M. Ganciu, I. Tiseanu, M.Ivascu, I.Ursu

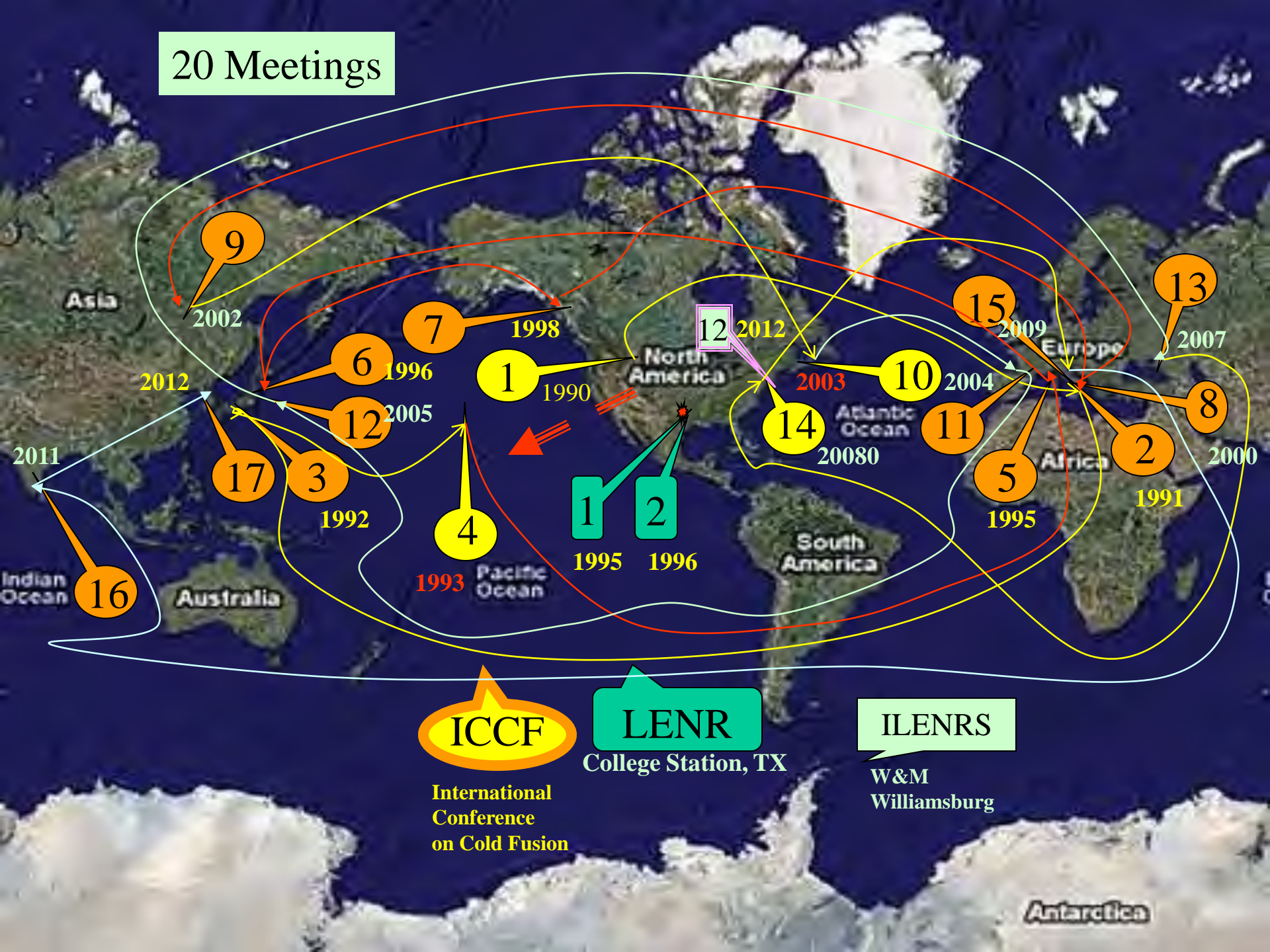
After 1990 the enlightenment disappeared, by high order and research was carried on on individual basis



Julian Schwinger, winner of the 1965 Nobel Prize in Physics.
Original caption: "His laboratory is his ballpoint pen."

He resigned from the American Physical Society due to their dogmatically anonymous peer review censorship –practice in force

20 Meetings



Conclusions

With-in a serious approach, the first reliable products may be delivered in less than 10 years

The knowledge journey effort is just at the very beginning, and much more have to be done in order to understand the fundamentals of this process

This is the gate towards new fascinating discoveries and applications

The power sources we may produce using this process will place the mankind in a new more friendly relationship with nature, and we may become a cosmic civilization, having solved the problem of energy and resources, because with enough energy all other resources may be had.



National
Laboratories

Universities

Center for Advanced Energy Researches

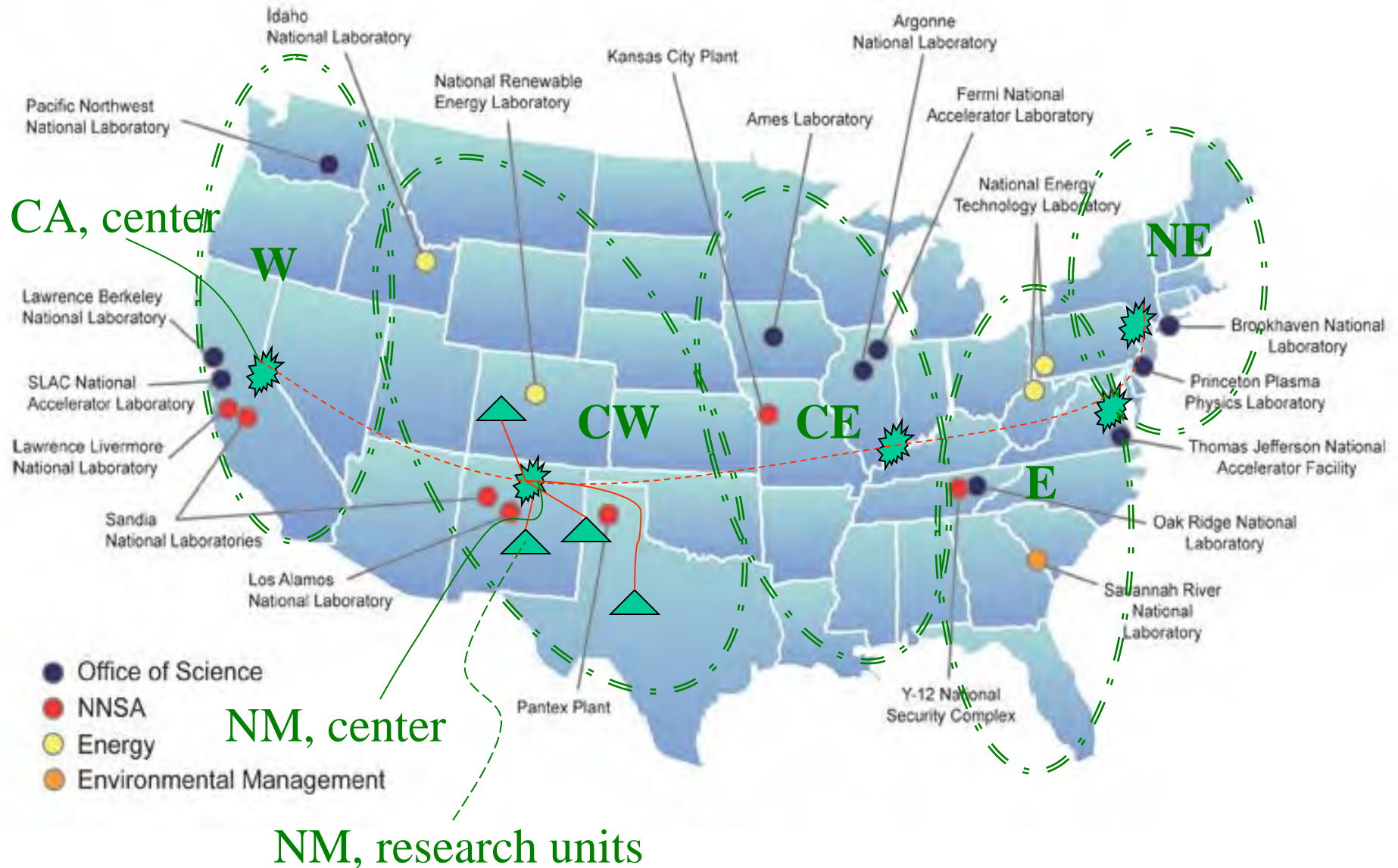
Private organizations

For Profit
Research
Non Profit

Individuals

Investors

Advanced Energy Research Virtual Network Proposal



A matter of nomenclature or a matter of knowledge

Cold Fusion $\left\{ \begin{array}{l} = \text{the opposite of} \\ = \text{different of} \end{array} \right.$ hot fusion $\left\{ \begin{array}{l} = \text{partially wrong} \\ = \text{partially right} \end{array} \right.$

Process	Multi-body Communion	Head on collision	$\left\{ \begin{array}{l} \text{Tokamack} \\ \text{Laser ign.} \\ \text{Colliders} \end{array} \right.$
Environment	Special materials	Special equipments	
Issue	Conditions	Process parameters (n,t)	

Other names for Cold Fusion (CF):

Low-Energy Nuclear Reactions (LENR)

Chemically Assisted Nuclear Reactions (CANR),

Lattice Assisted Nuclear Reactions (LANR),

Condensed Matter Nuclear Science (CMNS),

Lattice Enabled Nuclear Reactions (LENR),

Suggested names:

Condensed Structures Initiated/Facilitated Nuclear Reactions (CSIFNR)

Space Entanglement Nuclear Reactions facilitated in Special

Condensed Matter States (SENRFSCMS)

Niels Bohr

Albert
Einstein

AE. “-Any fool can know!
The point is to understand!”

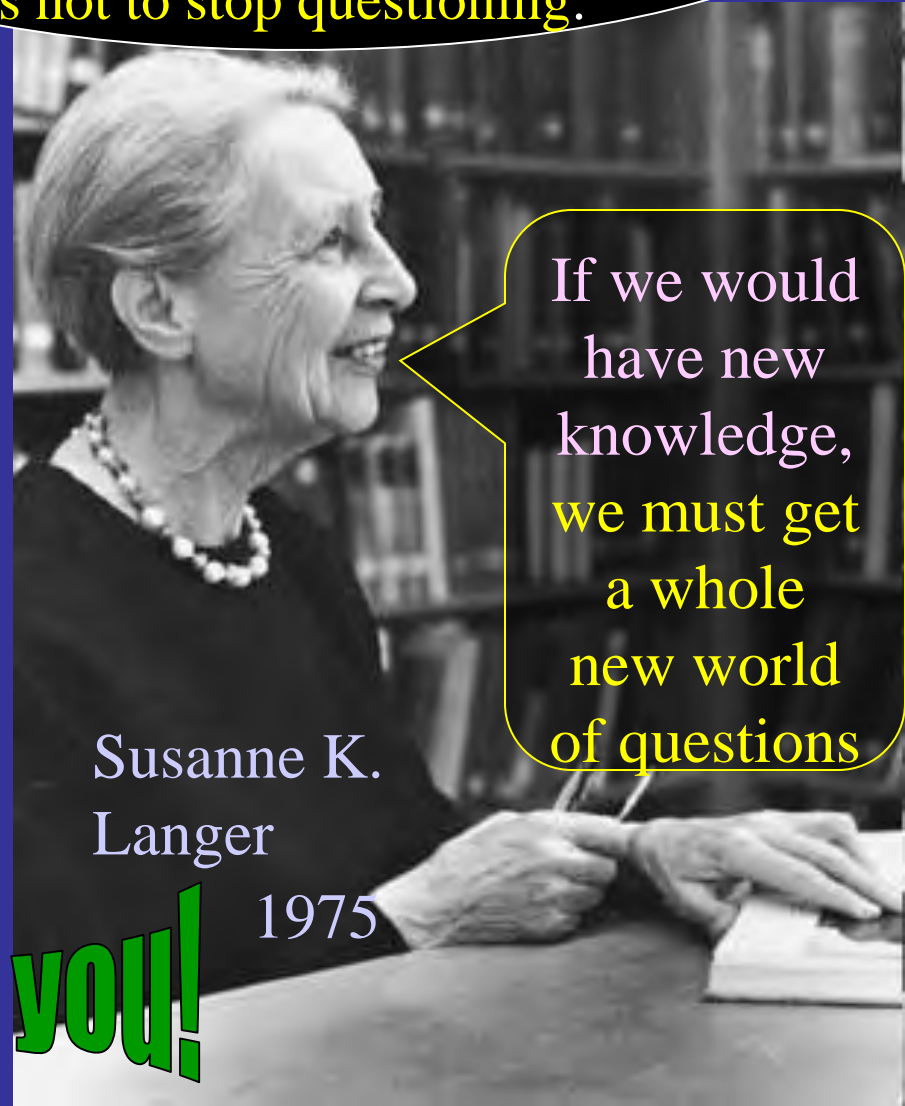
NB. “- The important thing
is not to stop questioning.”



1925

I bet !

Thank you!



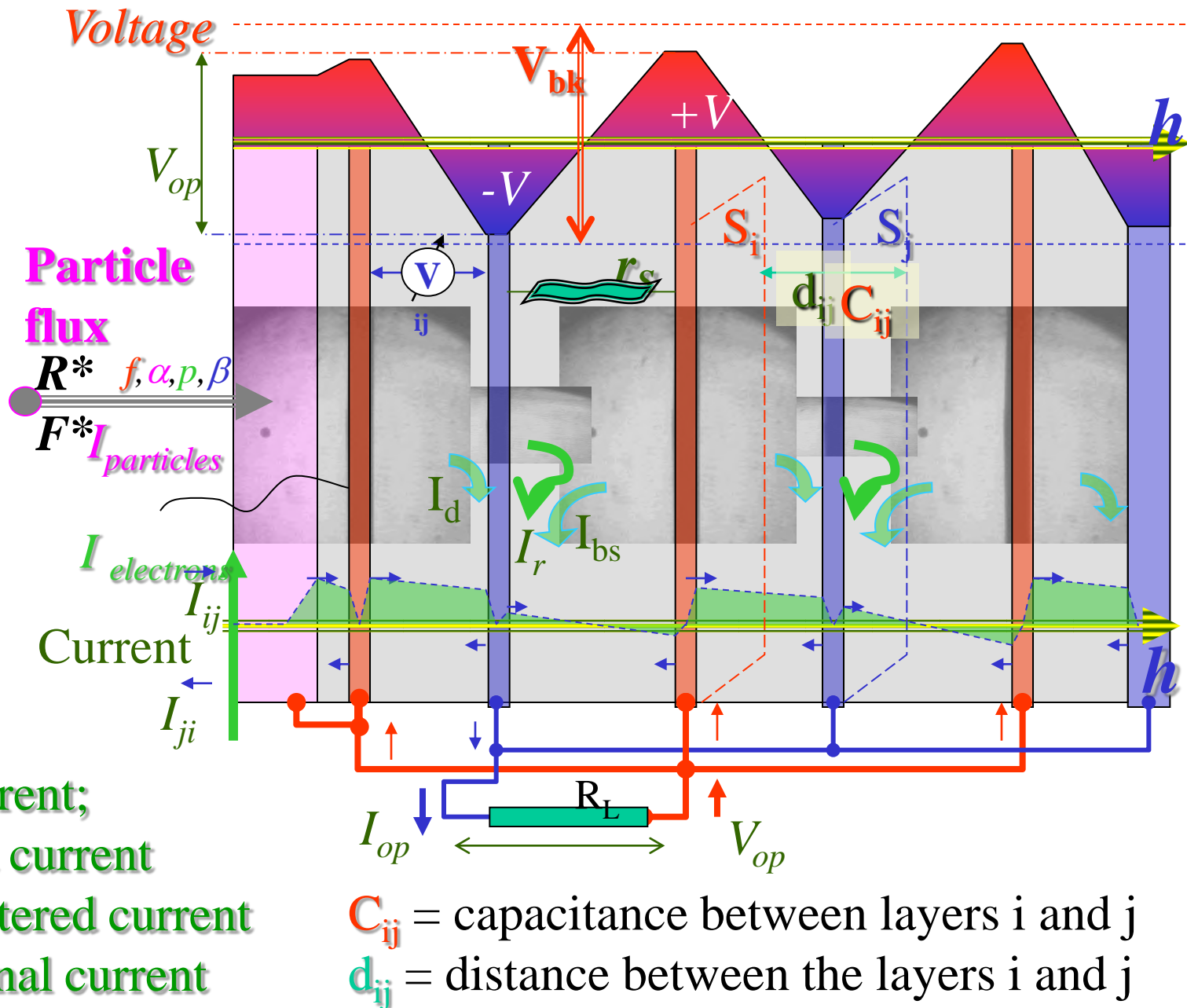
Susanne K.
Langer

1975

If we would
have new
knowledge,
we must get
a whole
new world
of questions

The energy harvesting in nano-hetero structures

This structure incorporates the previous nuclear reaction facilitator nano-structure



I_d = Drift current;
 I_r = returned current
 I_{bs} = backscattered current
 I_{op} = operational current