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Is Cold Fusion becoming a new technology?

by Dr. Matti Pitkänen

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The progress in Cold Fusion research has been really fast during last years. The most recent news might well mean the final breakthrough concerning practical applications which would include not only wasteless energy production but maybe also production of elements such as metals. The popular article titled "Cold Fusion Real, Revolutionary, and Ready" says leading Scandinavian newspaper) tells about the work of Prof. Leif Holmlid and his student Sinder-Zeiner-Gundersen. For more details about the work of Holmlid et al, see this, this, this, and this.

The latter revealed the details of an operating cold fusion reactor in Norway reported to generate 20 times more energy than required to activate it. The estimate of Holmlid is that Norway would need 100 kg of deuterium per year to satisfy its energy needs (this would suggest that the amount of fusion products is rather small to be practical except in situations where the amounts needed are really small). The amusing co-incidence is that towards the end of the last year I constructed a detailed TGD-based model of cold fusion (see this). The findings of Leif Holmlid served as an important guideline although the proposed mechanism is different.

Histories are cruel. The cruel history of cold fusion begins in 1989 when Pons and Fleichmann reported anomalous heat production involving palladium target and electrolysis in heavy water (deuterium replacing hydrogen). The reaction is impossible in the world governed by textbook physics since the Coulomb barrier makes it impossible for positively charged nuclei to get close enough. If ordinary fusion is in question, reaction products should involve gamma rays and neutrons and these have not been observed.

The community preferred textbooks over observations and labelled Pons and Fleichman and their followers as crackpots. It became impossible to publish anything in so-called "respected" journals. The pioneers however have continued to work with cold fusion. A few years ago, the American Chemical Society had to admit that there might be something in it and cold fusion researchers got a status of respectable researcher. There have been several proposals for working reactors such as Rossi's E-Cat

and NASA is performing research in cold fusion. But in countries like Finland, cold fusion is still a cursed subject and will probably remain so until cold fusion becomes the main energy source in the heating of the Physics department.

The model of Holmlid for cold fusion

Leif Holmlid is a professor emeritus in chemistry at the University of Gothemburg. He has quite recently published a work on Rydberg matter in the prestigious journals of APS and is now invited to tell about his work on cold fusion to a meeting of American Physical Society.

1. Holmlid regards Rydberg matter as a probable precursor of cold fusion. Rydberg atoms have some electrons at very high orbitals with large radius. Therefore the nuclei plus core electrons look for them like a point nucleus, which charge equal to nuclear charge plus that of core electrons. Rydberg matter forms layer-like structures with hexagonal lattice structure.

2. Cold fusion would involve the formation of what Holmlid calls ultra-dense deuterium having Rydberg matter as precursor. If I have understood correctly, the laser pulse hitting Rydberg matter would induce the formation of the ultra-dense phase of deuterium by contracting it strongly in the direction of the pulse. The ultra-dense phase would then suffer Coulomb explosion. The compression seems to be assumed to happen in all directions. To me, the natural assumption would be that it occurs only in the direction of laser pulse defining the direction of force acting on the system.

3. The ultra-dense deuterium would have density about $.13\times 106$ kg/m^3 which is 1.3×10^3 times that of ordinary water. The nuclei would be so close to each other that only a small perturbation would make possible to overcome the Coulomb wall and cold fusion can proceed. Critical system would be in question. It would be hard to predict the outcome of individual experiment. This would explain why the cold fusion experiments have been so hard to replicate. The existence of ultra-dense deuterium has not been proven. But cold fusion seems takes place.

   Rydberg matter (which should not be confused with the ultra-dense phase) would be the precursor of the process. I am not sure whether Rydberg matter exists before the process or whether it would be created by the laser pulse. Cold fusion would occur in the observed microscopic fracture zones of solid metal substances.

Issues not so well-understood

The process has some poorly understood aspects.

1. Muons as also of mesons like pion and kaon are detected in the outgoing beam generated by the laser pulse. Muons with mass about 106 MeV could be decay products of pions with mass of 140 MeV and kaons. But how these particles with masses much larger than scale of nuclear binding energy per nucleon of about 7-8 MeV for ligher nuclei could be produced even if low energy nuclear reactions are involved? Pions appear as mediators of strong interaction in the old-fashioned model of nuclear interactions. But the production on mass shell pions seems very implausible in low energy nuclear collisions.

2. What is even stranger that muons produced even when laser pulse is not used to initiate the reaction. Holmlid suggests that there are 2 reaction pathways for cold fusion: (a) with and (b) without the laser pulse. This forces us to ask whether the creation of Rydberg matter (or something analogous to it) is alone enough to induce cold fusion and whether the laser beam actually provides the energy needed for this so that ultra-dense phase of deuterium would not be needed at all. The Coulomb wall problem would be solved in some other manner.

3. The amount of gamma radiation and neurons is small so that ordinary cold fusion does not seem to be in question as would be implied by the proposed mechanism of overcoming the Coulomb wall. Muon production would suggest muon catalyzed fusion as a mechanism of cold fusion. But this mechanism should also produce gammas and neutrons.

TGD-inspired model of Cold Fusion

It seems that Holmlid's experiments realize cold fusion and that cold fusion might be soon a well-established technology. A real theoretical understanding is however missing. New physics is definitely required and TGD could provide it.

1. TGD-based model of cold fusion relies on TGD-based view about **dark matter**. Dark matter would correspond to phases of ordinary matter with non-standard value of Planck constant $h_{eff} = n \times h$ implying that the Compton sizes of elementary particles and atomic nuclei are scaled up by n and can be rather large (of atomic size or even larger).

   Weak interactions can also become dark. This means that weak boson Compton lengths are scaled up so that they are effectively massless below Compton length and weak interactions become as strong as electromagnetic interactions. If this happens, then weak interactions can lead to rapid beta decay of dark protons transforming them to neutrons (or effectively neutrons as it turns out).

   For instance, one can imagine that proton or deuteron approaching nucleus transforms rapidly to neutral state by exchange of dark W bosons and can overcome the Coulomb wall in this manner. (This was my original proposal for the mechanism of cold fusion.)

2. The model assumes that electrolysis leads to a formation of so-called **4th phase of water** discovered by Pollack. For instance, irradiation by infrared light can induce the formation of negatively-charged exclusion zones (EZs) of Pollack. Maybe the laser beam used in the experiments of Holmlid could also do this so that compression to ultra-dense phase would not be needed. The 4th phase of water forms layered structures consisting of 2-D hexagonal lattices with stoichiometry $H_{1.5}O$ and therefore carrying a strong electric charge. Also, Rydberg matter forms this kind of lattices which suggests a connection with the experiments of Holmlid.

   Protons must go somewhere from the EZ. The interpretation is that one proton per hydrogen bonded pair of water molecules goes to a flux tube of the magnetic body of the system as dark proton with non-standard value of Planck constant $h_{eff} = n \times h$ and forms sequence of dark protons forming dark nucleus. If the binding energy of dark nucleus scales like $1/h_{eff}$ (1/size), the binding energy of dark nucleus is much smaller than that for ordinary nucleus. The liberated dark nuclear binding energy in the formation would generate further EZs and one would have a kind of chain reaction.

In fact, this picture leads to the proposal that even old and boring ordinary electrolysis involves new physics. Hard to confess, but I have had grave difficulties in understanding why ionization should occur at all in electrolysis! The external electric field between the electrodes is extremely weak in atomic scales and it is difficult to understand how it induce ionization needed to load the electric battery!

3. The dark proton sequences need not be stable (the TGD counterpart for the Coulomb barrier problem). More than half of the nucleons of ordinary nuclei are neutrons and similar situation is the first expectation now. Dark weak boson (W) emission could lead to dark beta decay transforming proton to neutron or what looks like neutron (what this cryptic statement means would requires explanation about nuclear string model). This would stabilize the dark nuclei.

   An important prediction is that dark nuclei are beta stable since dark weak interactions are so fast. This is one of the predictions of the theory. The second important prediction is that gamma rays and neutrons are not produced at this stage. The analogs of gamma rays would have energies of order dark nuclear binding energy which is ordinary nuclear energy scale scaled down by 1/n. Radiation at lower energies would be produced. I have a vague memory that X-rays in keV range have been detected in cold fusion experiments. This would correspond to atomic size scale for dark nuclei.

4. How the ordinary nuclei are then produced? The dark nuclei could return back to negatively-charged EZ (Coulomb attraction) or leave the system along magnetic flux tubes and collide with some target and transform to ordinary nuclei by phase transition reducing the value of h_{eff}. It would seem that metallic targets such as Pd are favorites in this respect. A possible reason is that metallic target can have negative surface charge densities (electron charge density waves are believed by some workers in the field to be important for cold fusion) and attract the positively-charged dark nuclei at magnetic flux tubes.

   Essentially **all** of the nuclear binding energy would be liberated (not only the difference of binding energies for the reacting nuclei as in hot fusion). At this stage, ultra-dense regions of deuterium might also be created since huge binding energy is liberated and could induce also ordinary fusion reactions. This process would create fractures in the metal target.

   This would also explain the claimed strange effects of so-called **Brown's gas** generated in electrolysis on metals. It is claimed that Brown's gas (one piece of Physics which serious academic physicists enjoying a monthly salary refuse to consider seriously) can melt metals although its temperature is not much more than 100 degrees Celsius.

5. This model would predict the formation of beta stable nuclei as dark proton sequences transform to ordinary nuclei. This process would be analogous to that believed to occur in supernova explosions and used to explain the synthesis of nuclei heavier than Iron. This process could also replace the hypothesis about super-nova nucleosynthesis. Indeed, SN1987A did not provide support for this hypothesis.

   The reactor of Rossi is reported to produce heavier isotopes of Nickel and of Copper. This would strongly suggest that protons also fuse with Ni nuclei. Also, heavier nuclei could enter to the magnetic flux tubes and form dark nuclei with dark protons transformed partially to neutral nucleons. Also the transformation of dark nuclei to ordinary nuclei could generate so high densities that ordinary nuclear reactions become possible.

6. What about the mysterious production of pions and mesons producing in turn muons?

A. Could the transformation of nuclei to ordinary nuclei generate so high a local temperature that hadron physics would provide an appropriate description of the situation? Pion mass corresponds to 140 MeV energy and huge temperature about 0.14 GeV. This is much higher than solar temperature and looks totally implausible.

B. The total binding energy of nucleus with 20 nucleons as single pion would generate energy of this order of magnitude. Dark nuclei are quantum coherent structures. Could this make possible this kind of "holistic" process in the transformation to ordinary nucleus. This might be part of the story.

C. Could the transformation to ordinary nucleus involve the emission of dark W boson with mass about 80 GeV decaying to dark quark pairs binding to dark mesons transforming eventually to ordinary mesons? Could dark W boson emission occur quantum coherently so that the amplitude would be sum over the emission amplitudes and one would have an amplification of the decay rate so that it would be proportional to the square of dark nuclear charge?

The effective masslessness below atomic scale would make the rate for this process high. The emission would lead directly to the final state nucleus by emission of on mass shell mesons.

For background, see the background see the chapter Cold fusion again of "Hyper-finite factors, p-adic length scale hypothesis, and dark matter hierarchy" or the article with the same title.

For a summary of earlier postings see Latest progress in TGD

Comments

1. At 3:12 PM, Anonymous Jerry L. Decker said...

Best chance for cold fusion seems to be electron capture by Deuterium assisted by Palladium catalyst in a region that is completely free of external magnetic fields.

The electron and nucleus acquire opposite magnetic polarity which provides the activation energy to make a neutron from electron and proton.

Deuterium converts to a pair of neutrons that repel by nuclear forces.

Result should be low quality heat, a pair of free fast neutrons and a pair of low energy neutrinos.

A similar reaction might occur with Hydrogen. But the result would be one slow neutron and one high energy neutrino.

2. At 8:08 PM, Matpitka6@gmail.com said...

Electron capture is not in question in the TGD-based model. Electron capture would be actually transformation of electron to neutrino emitting W boson absorbed by proton transforming to neutron. Also incoming proton could suffer this process.

In standard weak interaction physics, this is an extremely slow process. It has been however proposed that this migt work if the neutron going to nucleon moves extremely slowly so that collision cross section behaving like 1/velocity becomes large. I do not believe in this mechanism.

The fact that very few gammas and neutrons are created in the process means that standard nuclear reaction cannot be in question. I am not absolutely sure but I have vague remembrance that X rays in keV range are generated.

These observations could be one step leading to TGD-inspired model in which dark nuclei with much smaller binding energy are generated as larger h_{eff} particles first (dark proton sequences at magnetic flux tubes forming dark nuclear strings). They transform in metal larget to ordinary nuclei and liberate entier ordinary nuclear binding energy. This model satisfies all those constraints that I know of. It also explains the large variety of anomalous phenomena such as free energy phenomena and also biofusion and becomes essential part of Quantum-Bbiology.

We are dealing with **new Quantum Physics**. I would be grateful if someone would tell me how to help colleagues to finally wake up from their superstring dreams which have become nightmares. Young people able to apply advanced algorithms of Theoretical Physics would be needed to develop detailed models.

3. At 11:09 AM, Anonymous said...

Matti, did you know that Keksintösäätiö has sponsored a cold fusion company in Finland? The company is called Etiam Oy. Please take a look at www.etiam.fi . Their patent application can easily be found by search engine.

4. At 9:30 PM, Matpitka6@gmail.com said...

Never heard of them. Perhaps the decision makers are waking up also in Finland. Thank you.

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