

# Cold fusion, beyond spacetime and quantum fields

Sydney Ernest Grimm\*

*During the 20<sup>th</sup> century there were a couple of scientists who announced the observation of exceptional heat during the electrolysis of water with the help of Palladium electrodes. In spite of the opinion of the community of nuclear physicists that low energy generated nuclear fusion is a hoax there is a lot of research to understand and create the observed emission of exceptional electromagnetic radiation. This paper explains with the help of the concept of discrete space the simple mechanism that is responsible for the decrease of the Coulomb force of Hydrogen nuclei, established by Martin Fleischmann and Stanley Pons.*

## Introduction

A brief overview of the history of “cold fusion” can be found at page 3 (Background) of “A Synopsis of nuclear reactions in condensed matter”.<sup>[1]</sup> The document contains a comprehensive description of papers, patents and research during the last 3 decades. Including descriptions and links to the publications of other researchers.

The term “cold fusion” originates from all the fuss that was caused by the sensational publication of Martin Fleischmann and Stanley Pons in 1989.<sup>[2]</sup> Nevertheless, the experiments and the conclusions of Martin Fleischmann and Stanley Pons were not flawed. It is proved for example by the extensive description of the Pd/D co-deposition experiments of the DTRA.<sup>[3][5]</sup> Recently Elsevier has published the book “Cold Fusion” with contributions of different authors in the field of condensed matter nuclear reactions.<sup>[4]</sup>

At the moment there is no widely accepted hypothesis about the “mechanism” behind cold fusion. That’s problematic because modern problems like climate change and the destruction of natural habitats (e.g. by the construction of hydro-electric dams) are related to the production and use of (fossil) energy.

It is impossible to facilitate a big part of the energy demand with the help of nuclear fusion that is generated by Pd/D based “cold fusion”. Palladium is a precious metal and the heat of the fusion process is destroying Palladium atoms too (decay of nuclei). So if we want to establish the benefits of cold fusion – the nearly absence of harmful

high-energy radiation – we have to understand the mechanism that is responsible for the observed nuclear fusion of Deuterium atoms (<sup>2</sup>H). Although our present models in physics have no reliable explanation for the Pd/D generated nuclear fusion.

## References:

1. P.A. Boss, L.P. Forsley (2019): “A Synopsis of nuclear reactions in condensed matter”  
DOI: [10.13140/RG.2.2.21903.23204](https://doi.org/10.13140/RG.2.2.21903.23204)
  2. Fleischmann, Martin; Pons, Stanley (1989): “Electrochemically induced nuclear fusion of deuterium”, *Journal of Electroanalytical Chemistry*, 261 (2A): 301–308, DOI: [10.1016/0022-0728\(89\)80006-3](https://doi.org/10.1016/0022-0728(89)80006-3)
  3. DTRA final rapport (2016): “Investigation of nano-nuclear reactions in condensed matter”  
P.A. Mosier-Boss, L.P.G. Forsley, P.K. Mcdaniel  
DOI: [10.13140/RG.2.2.31859.53282](https://doi.org/10.13140/RG.2.2.31859.53282)
  4. “Cold Fusion” (Advances in condensed matter nuclear science), editor Jean-Paul Biberian  
Elsevier (2020), ISBN 978-0-12-815944-6  
DOI: [10.1016/C2017-0-02099-2](https://doi.org/10.1016/C2017-0-02099-2)
  5. “Cold Fusion”, chapter 2 (pages 17 - 36) –  
“Review of Pd/D co-deposition”  
Authors: P.A. Mosier-Boss, L.P. Forsley  
DOI: [10.1016/B978-0-12-815944-6.00002-6](https://doi.org/10.1016/B978-0-12-815944-6.00002-6)
- \* City of Amersfoort, the Netherlands  
email: [sydneynestgrimm@gmail.com](mailto:sydneynestgrimm@gmail.com)  
orcid: 0000-0002-2882-420X

## Palladium and Hydrogen

A lattice of Palladium atoms can adsorb Hydrogen atoms at room temperature. That seems awkward but Palladium and Hydrogen share the same electronegativity (Pauling scale 2.20). Electronegativity alone cannot explain the adsorption of Hydrogen atoms by the Palladium lattice. It is the combination of thermal vibrations and the respective radii of the Palladium atoms and the solitary Hydrogen atom that make the process of adsorption possible.

If the temperature of a Palladium lattice with adsorbed Hydrogen atoms is decreased far below 0 degrees Celsius the

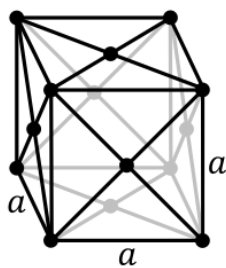


figure 1

surface area of the lattice of Palladium atoms starts to show cracks because of the decrease of the amplitudes of the thermal vibration. The lattice of Palladium atoms is categorised as a face centred cubic (see figure 1). Figure 2 shows the same lattice configuration. If I rotate the right image to the right I get the image at the left side. It shows the easy access by Hydrogen atoms in between the Palladium atoms of the lattice because the mutual distance between the atoms is  $2r$ .

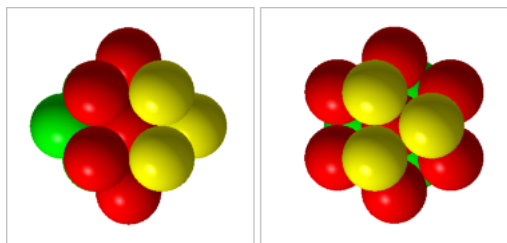


figure 2

“Cold fusion” is the result of the electrolyse of water with the help of a direct current and an electrolyte.<sup>[6]</sup> The process is well known. The electrons of the direct current move from the anode to the cathode and the surplus of electrons in the fluid influence the bond between the Hydrogen and Oxygen atoms of the water molecules.

As a result the involved molecules split up in Hydrogen and Oxygen atoms and the Hydrogen atoms are transferred to the Palladium cathode. The Hydrogen atoms “infiltrate” the empty Palladium lattice and at a certain moment the cathode starts to emit “exceptional heat”. In other words, the process of “cold fusion” is generated by a dense electromagnetic wave packet (electrons) and it influences the nuclei of Hydrogen atoms to decrease the Coulomb force.

#### References:

6. Martin Chaplin; “Water structure and science; electrolysis of water”  
<https://water.lsbu.ac.uk/water/electrolysis.html>

#### Newtonian mechanics

The standard atomic weight of Hydrogen is 1,008 and the standard atomic weight of Palladium is 106,42. That means that the mass of both atoms have a ratio of nearly 1 : 106 (1 : 53 for Deuterium). So if I supply an electromagnetic wave to a solitaire Hydrogen atom it will accelerate 106 times faster than a solitaire Palladium atom ( $F = m a$ ). The influence of the wave packet is the force ( $F$ ) and the standard atomic weight is the mass ( $m$ ).

The adsorbed Hydrogen atoms within the Palladium lattice cannot deform the shape of the Palladium atoms in an easy way because the Palladium atom has filled electron shells (2 | 8 | 18 | 18). However, decreasing the temperature of a Hydrogen saturated Palladium lattice will damage the symmetrical structure of the lattice. The result is visible cracks at the surface of the Palladium lattice.

The supply of a dense electromagnetic wave packet to the Pd/D lattice influences local Palladium atoms and solitary enclosed Hydrogen atoms. Because of the fixed acceleration the outcome for the local solitary Hydrogen atom is:

$$\uparrow F = \downarrow m a$$

The local Palladium atoms are part of the lattice and the energy of an electromagnetic wave packet cannot break up the metal bond structure of the lattice, therefore  $F$  is absorbed by the structure of the Palladium lattice (vibrational motion). The solitary Hydrogen atom cannot accelerate because it is enclosed by the Palladium atoms of the lattice.

In other words, if the acceleration of the solitary Hydrogen atom is obstructed by the Palladium atoms, the energy of the mass of the Hydrogen nucleus is forced to de-concentrate. The result shows to be nuclear fusion if there are 2 adjacent Hydrogen atoms. So we have to conclude that decreasing the energy concentration of the nucleus results in decreasing the Coulomb force of the involved Hydrogen atom. In other words: what kind of mechanism is responsible for the decrease the Coulomb force?

#### Quanta transfer

The mass of a nucleus represents an amount of concentrated energy ( $E = m c^2$ ). To transform mass into free energy again we have to de-concentrate the energy of the mass and redistribute the energy within the structure of the universal electric field (QFT).<sup>[7]</sup> Around matter the universal electric field is termed *vacuum space*.

Vacuum space is all the volume in the universe where the universal scalar field – the Higgs field – is flat. That means that every scalar has exactly the same magnitude (radius). The Higgs field is one of the basic quantum fields<sup>[8]</sup> and interferes with the universal electric field (the Higgs mechanism) and the magnetic field. The universal electric field and its corresponding magnetic field together are termed *electromagnetic field*. The consequence is that these 3 basic quantum fields must share a spatial structure.

The spatial structure was already described by the Greek philosopher/mathematician Parmenides of Elea (about 500 B.C.). In modern physics the spatial structure showed itself in the Planck-Einstein relation:

$$E = h \nu = h \frac{c}{\lambda} \longrightarrow h \frac{c}{n \ell_c}$$

The equation represents only universal constants except the wave length ( $\lambda$ ). The consequence is that the wave length of electromagnetic waves must be a multiple ( $n$ ) of a spatial metric, the minimal length scale ( $\ell_c$ ).<sup>[9]</sup>

If the universe represents a spatial structure of units that tessellate the mathematical volume of the universe, it is reasonable to conclude that the distinct properties of the basic quantum fields (QFT) represent the dynamical geometrical properties of these spatial units.

These geometrical properties<sup>[7]</sup> of the units are:

- an internal scalar (Higgs field);
- a 3D topological part (universal electric field);
- scalar mediated vectors (magnetic field)

All the units of the structure together are termed *discrete* (*quantised*) space and every unit of the structure has an invariant volume. Only the surface area of the unit is variable. That is in line with the experiments and in line with the equation  $E = m c^2$ . If the volume is variable the mass ( $m$ ) must be multiplied with  $c^3$  to transform the mass into free energy ( $E$ ) and experiments show that this cannot not be correct. In other words, energy represents the local differences in surface area and it is quantised too (Planck's constant). Actually the Planck constant is a fixed amount of topological deformation.

There exists only 1 geometrical scalar and it is the sphere, so every unit must be a deformed scalar. That means the “power” of every unit to transform its shape is an internal spherical shape forming mechanism (scalar mechanism).

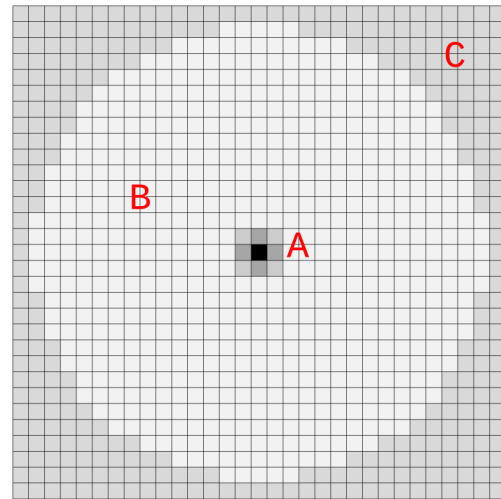


figure 3

The image above (3) shows in a *schematic* way the concentration of topological deformation within an amount of units of discrete space under influence of the scalar mechanism of the involved units. The result of the concentration is the division of local space into 3 “types” of units. In the centre a couple of highly deformed units (A), around the centre a large amount of units (B) that have transferred some quanta to the centre (A) and outside B the average deformation of all the other units in vacuum space (C).

Every unit has an invariant volume and the consequence is that every unit must deform its shape with the same fixed amount of topological deformation. If the topological deformation passes on in a linear way from adjacent unit to adjacent unit it has a constant velocity, the speed of light. Because every unit has exactly the same basic properties.

The consequence is that all the units in the universe deform synchronously and with exactly the same fixed amount of topological deformation. Moreover, the velocity of the pass on of a concentration of energy – e.g. a rest mass carrying particle – is determined by the amount of topological deformation of the particle.

The consequence is that a supply of energy to a rest mass carrying particle results in the acceleration of the particle. Because decreasing the topological deformation of the units around the particle decreases its amount of mass.

#### References:

7. S.E. Grimm (2023); “Dynamics in discrete space”  
DOI: 10.5281/zenodo.10443541  
<https://zenodo.org/record/10443541>

8. Art Hobson (2013); "*There are no particles, there are only fields*".  
American journal of physics 81, 211.  
DOI: 10.1119/1.4789885.  
<https://arxiv.org/ftp/arxiv/papers/1204/1204.4616.pdf>
9. Sabine Hossenfelder (2013); "*Minimal length scale scenarios for quantum gravity*."  
See page 5, A minimal history.  
Living Reviews in Relativity, January 2013.  
DOI: 10.12942/Irr-2013-2.  
<https://arxiv.org/pdf/1203.6191>

### The Coulomb force

If the concentration of energy (A) in figure 3 is a rest mass carrying particle – e.g. a proton – the particle and its direct surrounding (B) form a dynamical duality. Because the existence of A and B originates from the scalar mechanism of the involved units. Moreover, the surplus of energy of the particle (A) is equal to the deficit of energy of all the involved units in vacuum space around (B).

The consequence is that if the energy of the particle increases with 1 quantum of energy, the deficit of the energy of B must increase with 1 quantum too (and visa versa).

A proton is stable (no decay). Therefore it is possible to separate A and B under influence of e.g. high electromagnetic amplitudes. But under moderate conditions A and B are a dynamic duality. That is why A and B represent a mutual influence, a kind of force. The force is termed Coulomb force and its strength is equal to the amount of scalar mechanism – actually topological deformation – that keeps the duality intact.

In the first half of the 20<sup>th</sup> century Werner Heisenberg and other theorists estimated the metric of the minimal length scale at  $1,0 \times 10^{-15}$  m.<sup>[9]</sup> But now there is better data available<sup>[10]</sup> so  $\ell_c \approx 0,5 \times 10^{-15}$  m is more realistic. The consequence is that every unit of the structure changes its shape with  $\frac{1}{2}h$  some  $6 \times 10^{23}$  times during 1 second. Not  $1h$  because every topological deformation under invariant volume has an input deformation somewhere from around that is equal to the output deformation (the total local deformation is  $1h$ ). Of course the structure itself is the rest frame of the universe.

Every unit "inside" the volume of A and B still changes its shape synchronous with all the other units in the universe

( $\approx 6 \times 10^{23}$  during 1 second). But the direction of all the changes within the volume of A and B is circular under influence of the vectors of the strong force.<sup>[11]</sup> It questions the accuracy of our ideas about the Coulomb force. Because the energy of the resultant motion doesn't origin from the proton, it is generated by the units *inside* (A, B).

If the acceleration of the nucleus of a Hydrogen atom under influence of an energy supply is obstructed by the Palladium atoms around, all the involved units still have to deform in the same rate and energy quantity as all the other units in the universe. The only solution is a decrease of the energy density of the nucleus (figure 4). But that means that the Coulomb force decreases.

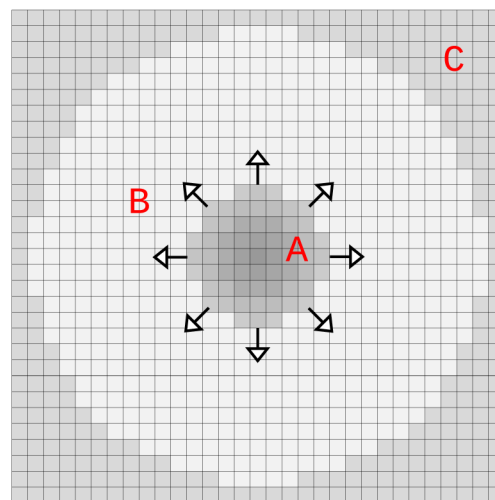


figure 4

The wave length of electromagnetic radiation is related to the size of the emitter. Figure 4 shows that an increase of the number of involved units that configure the nucleus will increase the wave length. The result is a low energy radiation during the fusion of 2 Hydrogen or Deuterium atoms in relation to the radiation that is created by the process of high energy fusion.

### References:

10. T. Cai et al. (2023), "*Measurement of the axial vector form factor from antineutrino-proton scattering*"  
Nature 614, 48-53 (2023)  
<https://doi.org/10.1038/s41586-022-05478-3>
11. S.E. Grimm (2024); "*On resultant motion in discrete space*"  
DOI: 10.5281/zenodo.11193931  
<https://zenodo.org/record/11193931>