Nuclear & Particle Physics version 2.0

< SO(4) physics >

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Main achievements

Unification of all 4 forces
Explanation of the gravitation mechanism
Detailed wave structure of particles
includes charge radius, inner forces
Calculation of nuclear masses, magnetic moments
Wave structure explains fusion (LENR)
Wave structure explains gamma levels

Mile stones:

- June 2017 : Work started: – data analysis
- 06.08.2017 : **Strong force factor (3FC) found**
- 11.09.2017 : First gamma spectra decoded ^{6}Li,^{9}Be
- 28.10.2017 : Strong coupling of gamma spectrum decoded
- 09.11.2017 : **First Neutron radius**.
- 15.01.2018 : Magnetic moment of ^{6}Li,^{7}Li
- 12.02.2018 : Magnetic moment of proton Nj proton charge radius
- 24.02.2018 : Neutron 4-He details
- 07.03.2018 : **^{28}Si proof for 2FC/3FC mass factors**, neutron “energy hole” wave
- 30.03.2018 : Pion,Kaon,Muon modeling
- 03.04.2018 : 3FC quantum structure of stable Isotopes with mass <= 32. ^{9}Be magnetic moment.
- 30.04.2018 : **Proton mass formula and proton & 4D radius** from neutron radius
- 14.06.2018 : Neutron energy hole Nj ^{10}B mass & magnetic moment, exact ^{4}He mass.
- 02.09.2018 : Alpha particle mass defect anomaly that leads to gravitation constant
- 10.09.2018 : **First exact Hydrogen model with all 10 digits matching**
- 09.11.2018 : First ionization energy of ^{4}He
- 13.01.2019 : proton-electron mass equivalence relation
- 30.01.2019 : Orbit formula for exact neutron, deuterium, 4-He mass, Hydrogen ionization
- 18.02.2019 : **Derivation of gravitation constant**
- 24.05.2019 : **Proton inner force equation** that explains charge generation
- 12.07.2019 : Orbit formula for dense hydrogen (H*-H* / D*-D*)

Introduction

It is well known that the so called standard model of physics (SM) is incomplete and only works for so called open space with 3 space dimensions and one time dimension.
The Standard Model In Physics was created for descriptions of ultra-thin plasma environments, while thin plasma environments are interesting for high energy physics, that's not the universe we humans inhabit..
SM has some merits in describing the outcome of particle collisions. But any attempt to model dense matter by SM fails and it is easy to show that the mathematical space used by SM (SO(3)xSU(2)xU(1)) has the wrong symmetry to successfully describe dense matter.
Dense matter, respectively the energy that forms dense matter is expressed by magnetic flux. Magnetic flux is coupling indirectly by induced (or virtual) currents that finally interact (attract, repel) according the Biot Savart law. Thus the magnetic coupling needs the mathematical combination of two (4D) rotations, which does not conform with (3D,t) SM potentials.
Furthermore it can be mathematically and physically shown that time on nuclear level no longer is a free (open) dimension and only occurs as a frequency or wave number. A uniform time axis is a mathematical trick that allows us to model events that change the relation between an old and a new state in a regular fashion. But from the more fundamental information theory we know that there is no global time and we can only model phenomena, that are based on a partial order of events.
Previously R.Mills [2] found 30 years ago the first metric that allows us to convert mass at rest into a mass in a rotating relativistic frame. Because in mass aggregation (fusion) the average radius shrinks, the inward radial dimension must be included into the relativistic metric, which does not work with Einstein's general relativity model as it cannot handle the center of mass being a pole. Thus the inward (to pole) length contraction is given by **α** and the finite! mass increase by 2π (Mills). The combination of these two factors is the well known and here renamed constant is called 2FC.
The simplest geometric object that fulfills the requirements of a SO(4) 2 X 2 rotations coupled space is the so called Clifford torus. This is the center symmetry space of SO(4). It has been shown [8] that the Maxwell equations fundamental for dense matter calculations can be transformed to S^3, (3 independent acting rotation dimensions!) which is a valid projection of the SO(4) Clifford torus that has 4 independent acting rotation dimensions. Thus from a mathematical point of view using Maxwell laws in higher dimensional space is valid. The Biot-Savart coupling of masses in SO(4) is of a circular nature.
Because almost all states of dense matter are stable, and of course invariant over time, the basic relations between orbits and mass distribution can be given by Eigenvalues. Surprisingly there exist three constants that define almost all relations between physical quantities (mass=energy,force,orbits) in dense space. We named these constants after their primary function (**F**lux **C**ompression) in fusion - 1FC, 2FC, 3FC. The leading number is the starting number of rotations. Flux compression/expansion is one way to express the fact, that the volume of dense mass can slightly shrink/expand due to fusion/aggregation.

This described NPP2 model or a more improved version of it, will certainly replace the SM part for dense matter. Thus we warn people who have spent a large part of their life in learning/teaching SM that they have to forget or put aside old knowledge. Even worse things could happen as soon as we come to understand, that a large part of SM is fringe science, that vastly ignores the reality of experimental data. Just one simple example: ^{56}Fe should be magic nucleus and fusion should stop at ^{56}Fe. The first, ^{56}Fe being a magic nucleus, is completely wrong and the second only holds if we try to fuse ^{56}Fe with ^{56}Fe. But this is not the way that fusion happens in the universe as the general path is LENR, which is adding H/D to a nucleus. Thus fusion in a star does not stop at ^{56}Fe, it stops, when all Hydrogen is consumed. ^{56}Fe as singular endpoint that can (could!) only happen under a gravitational collapse.

What we here do not show:

- Gamma spectrum analysis and gamma state calculations with various couplings.
- SO(4) Quantum structure of periodic table.
- The relation between proton & muon, pion, kaon and the two CERN fake Higgs masses.
- More detailed magnetic moment calculations.
- Alternative mass formulas based on magnetic moments only.
- Low Z nuclei orbital electron couplings.

Special thanks go to R. Bryant for proof reading the poster.

1 Short overview of NPP2.0 (nuclear & particle physics 2.0)

The following base assumption are made:

- Dense space is homogenous and has at least 6 dimensions
- Almost all energy is stored in rotations = magnetic flux
- Magnetic flux can be compressed/removed to **release** energy/mass
- Magnetic flux can be expanded/added to **increase** the energy/mass
- Stable particles have a base magnetic mass and carry (a minor part of) additional excess-energy
- The mathematical (base)space for the description of NPP2.0 is SO(4)
- In SO(4) space & time are homogeneous and time is of periodic nature with a maximal duration of 2*π, 4*π, 8*π depending on the number of coupled rotations.
- To increase a relativistic magnetic mass = adding one more flux-rotation, we must multiply the base magnetic mass by 1/***α*** To convert (v Nj c) a non relativistic mass to a relativistic one, we must multiply it by 2*π or 4*π
- To find a non relativistic rest-mass you must divide a relativistic mass by 2*π
- 1/***α*** corresponds to the classic length contraction, 2*π to the maximal relativistic mass increase.

These rules are not complete as yet e.g. a relativistic mass is only once affected by the time parameter (2*π) and further mass increases only involve length contraction by 1/***α*** *or the 1,2,3FC factors or the SO(4) metric factor.*

1.1 Flux compression/expansion constants

Energy conversion constants:

		For mass reduction		for fraction/amount
3D/4D - 4D Flux capture	**3FC**	= 0.99711307593398	**3FC' =**	0.00288692406602
3D-3D/4D Flux capture	**2FC** = $1 - (\alpha/2\pi)$	= 0.99883859026758	**2FC' =**	0.00116140973242
2D-3D/4D Flux capture	**1FC** = $1 - 16*(\alpha/2\pi)^2$	= 0.99997841803894	**1FC' =**	0.00002158196106

Excess-energy is flowing(rotating) around the core mass with different number (1,2,3,4,5) of rotations. But the number of Eigenvalues for the excess energy is smaller than the rotations of the core – relativistic – mass. The numbers (1,2,3) prefixing FC denote the base number of rotation the "flux compression" works on. E.g. 1FC converts a one dimension flux/potential in a two dimensional rotation. **2FC** converts flux from 2 Nj 3 rotations. The virtual charge is able to do 5 rotations.

A special case is the 1D/2D-/3D relativistic photon flux capture (Mills [4]-) $\gamma^* = 1/(1+\pi\alpha^2)$ = 0.9998327339.. It is used e.g. for the conversion of a 2D bound gamma quantum mass to a free gamma quantum mass.

In NPP2.0 only the above constants are used to relate the Eigenvalues for flux-capture/expansion or to express the space like perturbations.

1.1.1 Short explanation of constants

2FC is the Coulomb potential folding factor that defines the mass loss if a proton binds over one dimension.

m_p*2FC' = Coulomb potential at de Broglie radius - r= 1.32141..fm of the proton. (this is a mathematical identity!)

1FC is the second torus radius "coulomb potential" folding factor. (structurally corresponds to the "electro weak" force)

1FC is the total two radius potential for all wave 8 rotations/16 Hyper quadrants $(16*(\alpha/2\pi)^2) = 16*2FC'^2$

3FC is the metric factor that maps 5 rotations into 2x2 rotating magnetic flux. (Structurally corresponds to the “strong force”.)

Construction of 3FC:

Eccentricity of 4D space (golden ratio excess)

Ex4D = (0.6180339887 – 0.6)/2π = 0.00287019845321 (deviation from integer ratio = 3/5)

Z = $2FC^5 = (1 - \alpha/2\pi)^5$= 0.9942064244067

Z = Ex4D/(1 - 3FC) = 0.9942064244067= $(1- \alpha/2\pi)^5$

(1 – 3FC) = 3FC' = 0.00288692406602

According to Mills relativistic treatment, we know, if a mass is accelerated in two more dimensions/ + 1 rotation, then we have to increase the energy by the factor 2*π/ ***α*** . Because magnetic flux already is at light speed, we only have length contraction by alpha. The formula 2*π/ ***α*** *,* for mass increase has recently also been re-found by N.Chiatti [3] using QM-related reasoning but assuming a “complex” time. Another method to derive 2FC is by just comparing the classic 3D,t magnetic mass formula [4; 1.160] with the electron magnetic mass formula (0) given below.

1.2 Energy

Classically particle energy is modeled by waves and the associated spherical harmonics. Because nuclear flux is confined in a very narrow range, we can also use mechanical analogues of (force free) rigid rotating masses. In the symmetric case the mass is given by the sum of the eigenvalues of each independently rotating dimension. This can be irritating as the waves may cover e.g. 4 dimension but the independent energy Eigenvalues only cover 3. In a wave (rotation) coupling formula like (1x1) “x” means magnetic/ vector product coupling.

2 Why is all mass electro magnetic mass?

The answer is simple and has been known for about 90 years. The Planck quantum “h” has been defined by the electron mass/ light speed relation that finally has been used to define the Bohr magneton & electron de Broglie radius together with charge (e) “α” has been defined: A simple change of the connected parameters (e,c,m_e,h,α)shows:

Electron magnetic mass :

(0) $$m_{eeV} := \frac{\mu_0 \cdot \mu B^2}{e \cdot \pi \cdot \alpha \cdot r_{edbr}^3} = 510'998.946\text{eV}$$

- r_{edbr} electron de Broglie radius!

Thus our framework of physics is based on the electron magnetic mass. (See also magnetic mass formula from Mills [4]32.32b. Mass equivalence.) This too explains why SM/QED fails to calculate anything relevant for dense (=nuclear/particle) mass as usually the Coulomb-gauge (=charge potential) is used.

2.1 Why is EM mass rotating in SO(4)?

See Fig. 1a,b. A single current loop produces a field that in the center is perpendicular to the loop. If a second loop is 2D orthogonal to the first loop then the magnetic field is co-linear with **one** current direction of the second loop. This condition is symmetric. As we have 3 sets of independent currents in SO(4) we may have 2x2 combinations. In “reality” the current loops are just projections of the charge surface and the currents span the whole rotation surface.

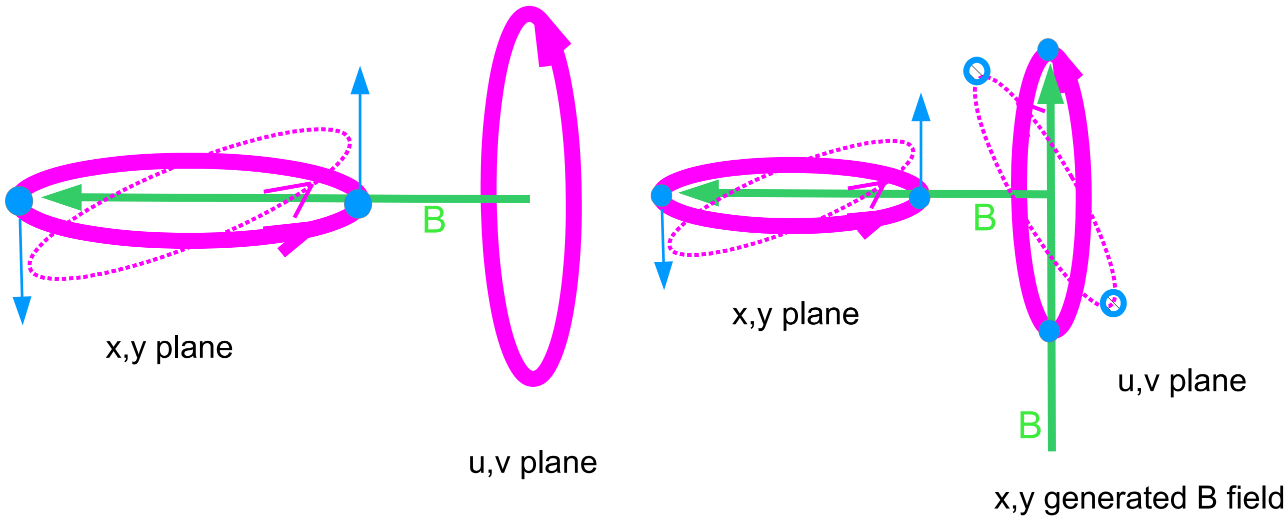


Fig.1a) 2 current loop induced forces in SO(4) Fig.1b symmetric forces

If we unfold the coupled SO(4) current-loop field structure it looks like the magnet field is strictly unidirectional and enclosed by the current loop, that itself gets induced by the magnetic flux. This explains why at the end the magnetic force and the electric forces are equal. This equality also follows from the energy conversion law.

What we will see is that 1x1,2x2 (1x1)x(1x1) , 4x4 ((2x2)x (2x2)) rotations are symmetric and only the 3 rotation flux at the end is responsible for external behavior like the magnetic moment or the gamma spectrum. On the other side, external visible charge is given by a 1x1 rotation structure that works in the electron too. As we will see later charge is not a basic quantity. Charge square is proportional to mass moving on a radius. This can already be understood from figure 1a,b). The current loops are not independent. In “reality” there is one source current that flows, at a constant distance, along the whole Clifford torus surface. But in the projection 2 charges are needed for the attractive force.

For a basic treatment of Maxwell equations – Biot-Savart coupling in 4D space see [8].

To get to the real understanding we will see that the charge effectively does one more (maximal total 5) rotation than the coupled magnetic fields – which obviously is needed if the magnetic flux should be contained. The only consequence is that the radius of the current loop is a bit smaller than the average distance of two current loops.

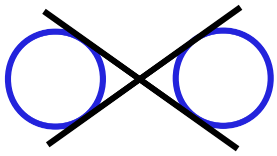
3 SO(4) The true physical space

SO(4) is far more complex and thus difficult to visualize than its related projective & sub-spaces S^3,SO(3), SU(2) and all their derivations. This is because we cannot separate the time dimension, meaning we must be able to think in (at least) 4 real, uniform space dimensions. Conceptualization becomes even more complicated as the common main center of mass is a 4D surface known as Clifford torus, that is single sided. Thus, in any projection to a 3-D space, we must be aware of the front/back side nature of (EM-) mass-flux.

(1) SO(4) = SU(2) X SU(2)

This topological equation shows one connection to existing physics and already explains why the previous models for dense space fail. The cross product is not commutative, respectively at least the sign changes. The only exception are scalars like energies that are square sums.

(2) SO(4) =



The Clifford torus is the “topological equivalent” of SO(4) namely the connection of two circles (staying in independent dimensions) with a 4 dimensional bundle of tangents.

(3) (wiki)

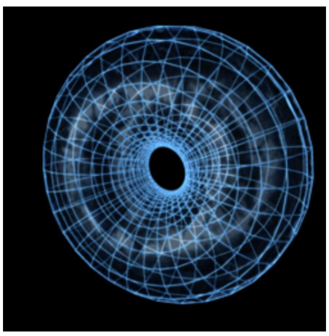
$$\mathrm{SU}(2) = \left\{ \begin{pmatrix} \alpha & -\overline{\beta} \\ \beta & \overline{\alpha} \end{pmatrix} : \ \alpha, \beta \in \mathbf{C}, |\alpha|^2 + |\beta|^2 = 1 \right\}$$

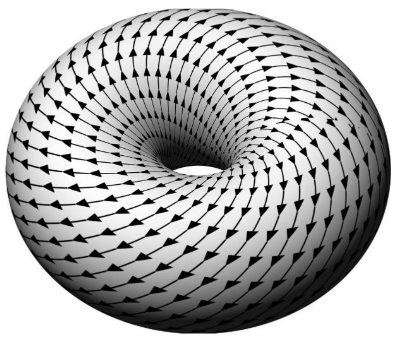
This is one possible representation of SU(2) as a 2x2 conjugate complex matrix.

(4) curvature of Clifford Torus: F''(X1,X2,X3,X4) = const

(5) Radial norm: $x^2_1 + x^2_2 + x^2_3 + x^2_4 = 1$

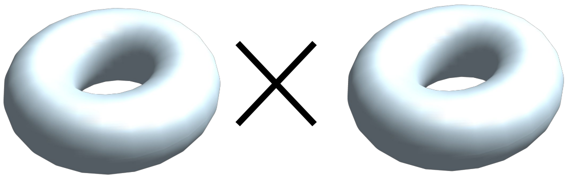
Graphical representations of Clifford Torus from *wikipedia*:





Or topologically:

SO(4) = SU(2) x SU(2)



Any projection of SU(2)xSU(2) to SO(3), SO(3)R, S(3) etc. leads to a **radial change of measure**:

(6) R^4 Nj R^3 : $r_3 = r_4$ * $\mathbf{(1/2)^{1/2}}$.

If two radii are involved, the the factor becomes ½ (or 2 in the other direction).

3.1 Energy in SO(4)

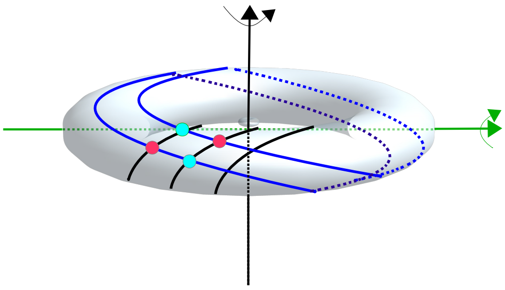


Fig 2: ^{4}He nucleus as torus projection red/blue dots represent n/p

In dense space most matter/energy is represented by rotations.

In SO(4) we may have 4 symmetric independent rotations, that – for simplification - can be mapped to two disjoint 3D tori, where each rotation is represented by the individual base radii of the two tori. If we map everything to one single 3D torus (Fig 2) then two rotations are given by the surface flux and the other two by the whole body rotation (green, black axis). This kind of simplification is only appropriate for highly symmetric nuclei like ^{4}He. Further this picture can only be used for scalar quantities like mass/energy of the nucleus.

The 4 rotations center energy structure of dense space is new, albeit it forms the core of any nucleus. Even more complex to understand is the 3D/4D flux of mass. In any 4D space we have a 3D subspace. This subspace contains the well known mass we know from a proton, but it performs one more independent rotation. This form of mass (the 3D/4D flux of mass) is new and is now spotlighted because time is becoming a uniform space-dimension. To imagine this movement just draw a proton (mass-flux represented by two spherical rotations) and add one more rotation given by the 4th dimension. This three times rotating proton (in fact the three mass/charge waves) is now flowing along the Clifford torus (touching red line Fig.1) surface of SO(4). In the following the 3D/4D flux is always counted in 1/3 units which is the weight of one wave. In the following text the term *4D space* means 4 symmetric rotations in SO(4).

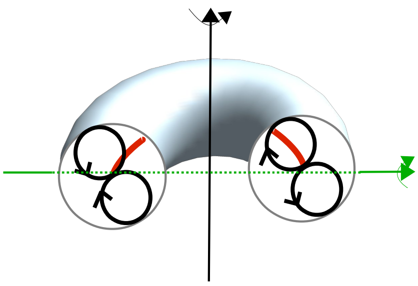


Fig. 2a. 3D/4D flux of mass

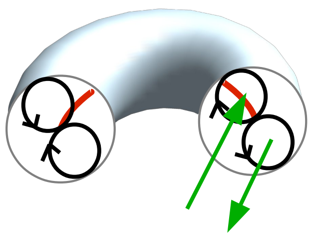
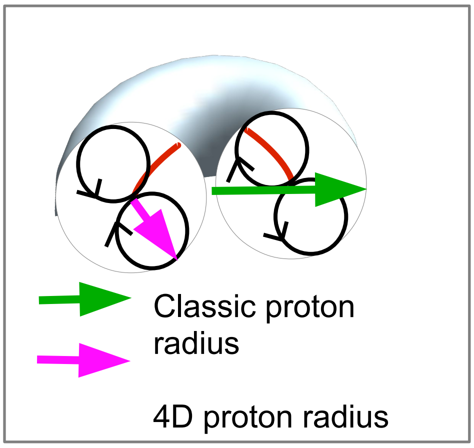


Fig. 2b. Field



In Fig. 2a the red line indicates the Clifford torus surface. The surface has two sides in a 3D projection thus the orthogonal (to Clifford torus surface) wave drawn as black circle is counter rotating on the front/back side. In addition we indicate the other two rotations as full body rotations. If we associate charge with one radius, Fig. 2b, which is logical given the magnetic moments, then we notice that in a perfect symmetric configuration (as in ^4He) the magnetic fields vanish (at least macroscopically!) - green front/back arrow. We also can conclude, if charge(-density) has the same property as in 3D space, that the two front/back-flux charge waves must be attractive if they run in the same plane. A slight change in the angle between front/back-flux could be the origin for deviations of the third flux compression constant we found.

Fig.2c 3D/4D radius

3.2 *Properties of 4D space*

In a rotating (3D,t) system, the base line is the equivalence "point" of forces/masses. In SO(4) this point is not the common center of mass it is the entire surface of the Clifford torus. In a perfectly balanced system the sum of back/front side mass/rotations must be equal. Expressed in mathematics: For a perfectly balanced system the quotient of front/back flux must be equal (=1) at any point of the surface.

For the 4D rotations this implies that all radii must be equal.

For the 3D/4D rotation flux a system is "balanced" if the resulting SU(2)XSU(2) quotient = 1 = M1/M2

M1/M2 front side/backside mass: All perturbation is measured as deviation (factor!) from 1!

Perturbations: f(u)*M1/M2*f(v) = 1

Simple projected closed 4D space (S^3) has the following metrics: (normed for r=1)

4D hyper volume = $\frac{1}{2}\pi^2$.
4D hyper surface = $2\pi^2$.
Internal 3D volume = $16/3\ \pi$.
Internal 3D surface = $16\ \pi$.

Later, when we include charge and internal forces we will see that there is a second center of mass/forces built by a manifold at a constant distance from the Clifford torus.

3.2.1 Magnetic flux compression in 1;2;3 Dimensions.

Basically long time stable flux reduction(compression) is only possible between proton and neutrons. Key for the n-p binding is the split nature of the neutron that can give or accept flux.

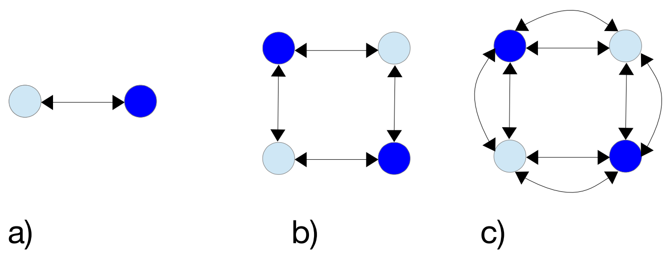


Fig. 3 N-P flux reduction "bonds" between protons and neutrons

The term bond is wrong as in reality the magnetic flux is unidirectional. Thus here double arrows are only illustrative. If we, in the following text, talk of a 3D/4D wave, then we mean a wave (in fact 3 connected waves), that is "equivalent" to a 3D (=3 rotation) mass, but traveling/rotating along a 4D surface in 4D

space!
In 4D space most energy is stored in flux, which is a synonym for compressed magnetic field lines.
Deuterium (n-p) Fig.3 a) is only able to exchange 3D-3D/4D flux in one dimension (through one plane!). Two deuterium Fig.3 b) that stay in the same plane in 3D(3, 1) space, can only build up 4 nodes of flux exchange. (2 x 2D wave =4 nodes , 2 planes). To further double the number of “connections”, to be able to model ^{4}He, at least 4 uniform space dimensions are needed, where we can get up to 6 disjoint planes (4 disjoint planes are needed), that can be used for 3D-3D/4D flux exchange. (If right/left associative math is used, then the number of hyper-planes (halfe-planes) - potentially can double.)

The base particle electron makes only two full rotations, because a large part of the disposable energy is stored in the radial field. The proton mass has a “large” (compared to electron) excess mass that needs a third dimension to flow in. in the 4D world, radial (potential) energy is converted into rotational mass/energy or will be disposed.

3.2.2 Sample mass calculation based on 1FC,2FC,3FC

Mass/ fusion energy calculations based on 1FC,2FC,3FC only work fine for nuclei with high symmetry and no neutron excess. The small deviation from measured values is due to internal charge interaction and orbit perturbations. Later we show the exact model that is based on orbits.
Masses for 1FC,2FC,3FC based fusion energy are given in mamu(s) (micro atomic mass units are standard for nuclear tables!).
^{2}H (Deuterium) is not totally symmetric as the n-p are only orbiting each other rather than joining their relativistic flux. Thus n-p are not bound by the “strong force”.
Deuterium (p+n Nj ^{2}H reaction.) fusion mass Summary: Measured freed energy (-) 2'388.177 mamu See table 1.
n,p start one common magnetic flux rotation on a 3D/4D (2FC) orbit and one charge coupled rotation on 1x1 orbit (1FC). This explains a flux loss of 2341.971 mamu (2FC) and for (1FC) 43.520 mamu total = 2385.491. The first deviation is 2.668 mamu.
Because the combination of a 1x1 orbit and a 3D/4D orbit looks like 2/3 of a 3D/ 4D orbit we have one missing wave in the compressed (fusion space). This so called flux hole that needs compression too.
Fine-tuning correction: New Sum flux released = 2385.491 * 2FC = 2.771 second order correction due to flux hole compression. The difference between the measured mamu value and the calculated one is now 0.084mamu!

Deuterium calculation	mamu	2FC	1FC
Neutron	1'008'664.923	0.0011614097	0.0000215820
Proton + electron	1'007'825.032	Reduction amount 2FC	Reduction amount 1FC
Sum particles	2'016'489.955	**2'341.971**	**43.520**
Sum first order adjustments	**2'385.491**		
Correction by 2FC on the Induced flux	**2.771**	2.771	0.0505443282
calculated difference	2'388.261		
measured difference	2'388.177	relative error	0.0000353391
Calculated Deuterium mass	2'014'101.694	absolute error	0.084 mamu
Deuterium mass measured	2'014'101.778	relative error	0.0000000419

Table 1 Deuterium mass-calculation

	tot.	micro amus	α/2π * 8 2D/4D flow c.
Amu Neutron	2	1'008'664.923	9'371.786
Amu Proton + electron	2	1'007'825.032	9'363.982
Amu sum(particles) / tot. bound flux	4	4'032'979.910	18'735.768
3FC (use 1 – 3FC)		0.9971130759	3D/4D flow c.
Used 4D He4 quanta	1	0.0028869241	11'642.907
Amu He measured	1	4'002'603.250	
Delta mamu measured		30'376.660	
Delta mamu calculated		30'378.675	30'378.675
Absolute error		-2.015	
Relative error total mass		0.0000005035	

Table 2a Helium mass-calculation

Helium base calc	tot.	micro amus	α/2π * 8 2D/4D flow c.
mamu Neutron	2	1'008'664.923	9'371.786
mamu Proton + electron	2	1'007'825.032	9'363.982
mamu sum(particles)/flux reduction 2FC	4	4'032'979.910	18'735.768
3FC (use 1 -3FC)		0.9971130759	3D/4D flow c.
Used 4D He4 quanta	1	0.0028869241	11'642.907
newly added particles			
mamu Neutron	1	1'008'664.923	
mamu Proton + electron	1	1'007'825.032	
Total Li6 particles sum		6'049'469.865	
Additional flux quanta released (5/3)	1.667	2'341.971	3'903.285
mamu Li6 measured	1	6'015'122.281	
Charge correction by 1FC	3	1'007'825.032	65.253
Delta mamu measured		34'347.584	
Delta mamu calculated		34'347.213	34'347.213
calculated mass		6'015'122.652	
Absolute error		0.371	
Relative error total mass		0.0000000617	

2b) ^{6}Li mass-calculation

In 4D (SO(4)) space Helium-4 builds out 4 more connections, than possible in 3D space, with magnetic flux going through in total 4 disjoint! planes. The resulting 3D/4D wave on a 4D curved surface releases 8 3D/4D (2FC) flux exchange quanta, (in total 18735.768 mamu), because it acquires one more degree of rotational freedom.
Additionally the flux of 4-He starts a 4D rotation and releases the so called 4D quantum (3FC) of energy. 4D rotations can be modeled by mechanical analogues.

A simple sample: The ^{6}Li mass (Tab3.b)

^{6}Li can be understood as a Helium (alpha particle) core that is orbited by a deuterium nucleus. The "deuterium" is bound to the ^{4}He core by two flux reduction waves, which finally gives a total of 5 flux reduction waves. Why only 2 bonds? Because in Deuterium we have 1x1 coupling with the 3 3D/4D waves and thus only 1/3 (one wave) can synchronize with the 2 neutrons/protons inside ^{4}He which adds 2 * 1/3 of 2FC + 3*1FC.

If you can derive the 3D/4D wave structure and the total charge coupling, then the mass calculated method is always highly accurate. But this is an averaging method and not absolutely precise.
As already said, below we will show the orbit based mass modeling, that is much more accurate as the perturbations can be counted in. But first we have to understand the internal structure of a proton and neutron.

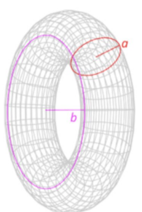
3.3 Can we directly see 2FC,3FC in the periodic table?

Si 28	mamu's		delta	missing 3FC quantum	
measured		27'976'926.533			
from particles	28'230'859.370	27'976'926.533	253'932.837		
From N-14	28'006'148.010	27'976'926.533	29'221.477	11'642.907	40'864.3838
From C-14	28'006'483.976	27'976'926.533	29'557.443	11'642.907	**41'200.3498**
				Missing compression	
From He-4	28'018'222.750	27'976'926.533	41'296.217	* 2FC * 2FC =	**41'200.3490**

Tab.3 ^{28}Si mass formed from different elements

^{28}Si is a magic nucleus that conforms with the missing torus rigid mass relation (Fig.4) being 7/4. The proton/neutron themselves conform with the second axes torus rigid mass relation being 9/8. This, in total, leads to a perfect mechanical match of all rotating masses that form the **only magic** nucleus ^{28}Si.
We show (Tab.3) the build up of ^{28}Si from particles (n,p) and from other isotopes ^{4}He & ^{14}C, ^{14}N. We know that for each 2* n/p pair = *alpha particle* one 4D quanta (11'672.907 mamu) is released. This quantum is missing if we form ^{28}Si from ^{14}C, ^{14}N because Z is odd or lower. But both, ^{14}C, ^{14}N contain one 4D excess quanta, thus, in total we must add one 4D quantum to get the same flux difference. On the other side we know that simply summing up 7 ^{4}He neglects the binding force at work inside ^{14}C, ^{14}N. As in SO(4) physics only symmetric orbits are exactly conform with the basic form factors we must choose ^{14}C to get the right result as in ^{14}C charge and mass are symmetric. If we correct the ^{28}Si missing mass from ^{4}He (41'296.217 mamu) by 2FC^{2} then the missing mass from ^{14}C and ^{4}He do exactly match (= 41'200.349 mamu).
This finding is against common knowledge as people generally believe that charge (Z) is important in the mass forming process. Here we exactly see that internal and external charge are just a matter of matching orbits. Charge is a consequence of an internal orbit relation inside dense mass! Similar exact matches can be seen for ^{56}Ni with one more internal compression step or for ^{84}Kr with more 2 steps.

Torus with minor radius a, major radius b and mass m.



About an axis passing through the center and perpendicular to the diameter: $\frac{m}{4}\left(4a^2+3b^2\right)$ [5]

About a diameter: $\frac{m}{8}\left(4a^2+5b^2\right)$ [5]

Fig.4 Torus rigid mass form factors. (From https://ipfs.io/ipfs/QmXoypizjW3WknFiJnKLwHCnL72vedxjQkDDP1mXWo6uco)

4 The 4D Neutron and Proton

Almost all nuclear mass is built of protons and neutrons. But classic theory tells us nothing about the internal structure of neutrons/protons. The SM postulation of quarks is an oversimplification of the reality and has no predictive power for quantitative variables as not even the masses of the quarks are known. Furthermore, using exchange particle like Gluons is nonsensical in a model that it based on relativistic magnetic flux, because such exchange cannot happen at light speed. The SO(4) 4D physics modeling reveals some internal structure of the particles and allows us to exactly calculate some properties.

4.1 *Magnetic moment of Proton*

As a first illustrative sample we will calculate the magnetic moment of the proton. For that purpose we will use a simple 3D physics formula for a magnetic moment.

(7) $$Current = \frac{c*e}{a_0*2\pi} \Rightarrow (A*10^3)$$

(8) $$Magnetic-moment = Area*current = \frac{c*e}{a_0*2\pi}*a_0^2*\pi \Rightarrow 10^{-26}JT^{-1}$$

(9) $$M-moment-simplyfied = \frac{c*e*a_0}{2}$$

Magnetic moment of Proton	Exper. chg. Radius 0.84087 fm.
Measured μp	**1.4106067873**
3D μp from exp. Charge radius	2.0194353567
Metric change is $2^{(1/2)}$	1.4142135624
μp= r_p*c*e/2 corrected 4D-->3D	1.4279564349
First error ratio $\mu p_{mes.}$ /μp_{calc}	0.9878500162
$Error^{(1/3)}$ of one dimension	0.9959334913
4D correction : **3FC*2FC*1FC**	0.9959335244
calculated moment	1.4106069281
absolute error meas -clc	0.0000001408
relative error	0.0000000998

Table 3 proton magnetic moment and perturbation

The only parameter of interest in this example is the radius (a_o) which is given by the latest measurement.

Because the proton has a magnetic moment, in average charge must flow on one radius, that is the 3D projection of the measured 4D radius. If we use the measured radius the moment will be to large because in the 4D torus (see Fig.2) the effective radius is ½ of the classic radius. If we stick to the 3D model, then we have to divide the result of formula (9) by $2^{1/2}$. The other way round is a bit more complex to understand. If we use $a_o/2$ as the input the we must multiply the result by $2^{1/2}$.

The uncorrected result for the calculated proton magnetic moment is only 98,8% exact (see tab.3 light blue) because the proton mass is highly perturbed by its own magnetic field that is fully expanded to 4 dimensions (that can be normalized to 3). Because, the proton can only acquire 3D/4D flux energy the number of involved radii is 3. According to our method we calculate the perturbation for one radius that is 0.99593349. The big surprise is that the perturbation is the “exact” product (0.99593352) of the well known 3D/4D flux compression constants. After applying the correction the result is far below the precision of the radius measurement.

If we do a reverse 3D radius calculation then we get **0.840869916** instead of the experimental 0.84087.

4.2 *Proton mass calculations*

The proton magnetic mass formula (10) below can be derived from the electron magnetic mass formula (0). In the electron formula the radius to use is r = “electron de Broglie radius”. In the proton case we use the 3D equivalent 4D radius derived from the 4-He charge radius (1.6753fm). Keep in mind that the effective radius in 4D is ½ of the 3D equivalent. Thus, in formula (10), we must divide 1.6753fm by two Nj r=0.83765.. what gives the 3D equivalent (-4D) radius of the proton. For the 4D proton radius we must divide once more by 2 (because ^4He has 4 times more flux than a proton) and flux is proportional to r^2 or one can multiply the result of (10) by 8!

(10) $M_{proton}(eV) = \mu_p^2 * 4 * \pi$ * **100000/(*α* * π* r^3*e)**

In formula (10) 4* π * 100000 stays for μ_o and the adjustment of the dimensions to get electron volts but the factor π can be crossed out. (Here the mass is given in eV and thus ε_0 is replaced by μ_0.

Because the magnetic mass stays in 4 dimensions in the very first calculation we used an estimated radius derived from ^{4}He flux. The ^{4}He charge radius (1.6753/2 fm. from Russian database with correct electron measurement) can be used because ^{4}He has no free 3D/4D flux mass/waves, what can be seen from the (not existing) gamma spectrum. To the intermediate result we apply the same perturbation correction we found for the exact 3D calculation of the proton magnetic moment, namely: $(3FC*2FC*1FC)^3$. (See chpt. 4.1 above) It is obvious that a formula that follows the proton magnetic moment has its perturbation. Using the uncorrected ^{4}He radius equivalent (Tab.4a) already delivers a good approximation for the proton mass.

But for finding the exact details given in Tab 4b) more must be done. There is a mathematical relation that maps 5 rotations into 3 rotations analogue to the sin(5x)/sin(3x) energy relation of two waves. Furthermore we must know the radius of a 5 rotations particle. Thus we initially used the 5 rotations neutron radius to derive the relativistic proton radius of 0.83765300697fm that is close to 1eV exact. This allowed us to derive the proton internal structure.

µproton	1.4106067873
3D/4D radius from 4-He (fm)	0.837650000000
magnetic energy uncorrected	926'613'063.470
4D correction µproton	0.9878501147
correcting with µp perturbation	938'009'774.596
Top down mass using 4D potential	937'999'671.493
Error ratio proton mass	0.9997204364
Alpha quantization for 3D/4D	262306.703831434
(1-(alpha/(PI()*16)))^2	0.9997096686
Mass corrected by above factor	938'282'187.337
proton mass	938'272'081.300
mass difference	10'106.037
relative error	0.0000107708

Tab. 4a proton magnetic mass-calculation

µproton	1.4106067873
3D/4D radius from 4-He (fm)	0.837653007404
magnetic energy uncorrected	926'603'083.121
4D correction µproton	0.9878501147
correcting with µp perturbation	937'999'671.495
Top down mass using 4D potential	937'999'671.493
Error ratio proton mass	0.9997096686
Alpha quantization for 3D/4D	272409.804500937
(1-(alpha/(PI()*16)))^2	0.9997096686
Mass corrected by above factor	938'272'081.302
proton mass	938'272'081.300
mass difference	0.002
relative error	0.0000000000

Tab. 4b optimized radius

The second perturbation of the proton mass is $(1-(\boldsymbol{\alpha}/(\pi*16)))^2$ (corresponds to exactly 272'409.8 eV if derived from the proton mass). $(1-(\boldsymbol{\alpha}/(\pi*16)))^2$ is the relation of alpha to the whole 3D/4D surface (4 inner/outer spheres) of 4D space. About the same perturbation can be calculated from the de Broglie radius potential of the proton.

The result shown in Tab. 4b is the reverse calculation starting with the proton mass and the known mass/wave structure. Formula (11) is the final proton magnetic mass formula that shows an possible ***α*-quantization.**

(11) (Mass proton in eV) = μ_p^{2}*4* π * **100000/(*α* * π* r³*e***$(3FC*2FC*1FC)^3*(1-(\boldsymbol{\alpha}/(\pi*16)))^2$)

The 4D potential part $(1-(\boldsymbol{\alpha}/(\pi*16)))^2$ of the mass is a square form of ***α***. This allows the prediction that the proton mass based on the magnetic moment can undergo a quantization.

The first five (unperturbed) levels of the proton quantization are the following: (2'002.34, 4'034.33, 6'096.64, 8'189.95 ,10'314.96 eV using ((1/ ***α***) -n); n= 1,2,3,..). In [1][2][5] the experimenter(s) found that at 1keV particle (proton) stimulation energy strange resonances do occur. 1keV is half of the first alpha quantization. This is the correct 3D,t resonance energy as in a su(2) x su(2) quotient only one half (outside running mass) can kinetically interact! The cut-off of the spectrum seems to fit the quantization.

An other interesting aspect is that the proton quantization $(1-(\boldsymbol{\alpha}/(\pi*16)))^{2)}$ delivers very exactly ¼ of the **de Broglie radial potential energy**, that can be further refined by the known $1FC^3$ radial perturbation. Seen from this perspective, we can say that the quantization energy (with high precision) is directly coupled with the classic potential energy as seen in experiments [1][2][5]. As you may see in tab 4a already a small deviation in the radius leads to a “large” error in the overall fit. Using the best experimental radius approximations (virtual deuterium model[6]) gives errors in the 200eV range but with a much larger error bar!

4.2.1 Radius discussion

The ideal ^{4}He compression is (1-5*2FC) “=” $0.994192951338^{1.51..}$ = 0.9961649819 (1.51... = $2^{3/5}$). This corresponds to the folding of 5 dimensions of potential energy into 3 rotations. The base flux compression of “nature” can be derived from the 4-He mass as it is the sole nucleus that has no free 3D/4D flux. As flux can be modeled/measured as units of energy passing through a boundary in plane (manifold) the square root of the natural compression gives a first approximation (0.99622..) of the effective (magnetic) flux compression. As 4He has an internal structure the overall value is not an average.

Detailed derivation see table 5 below. From the 4D model of the neutron we know that the neutron has a 4D flux hole and also the ability to release 4D excess flux.

mamu He4	4'002'603.25	4'002'351.58	4'002'603.25	4'002'603.25
He4 from particles	4'032'979.91	4'033'231.59	4'033'483.26	4'033'480.84
compression ratio (CR)	0.9924679367	0.9923436058	0.9923440836	0.9923446793
torus area r*r → r * $CR^{1/2}$	0.9962268500	0.9961644472	0.9961646870	0.9961649860
Ideal compression				0.9961649819

Table 5. Possible approximation of ideal 4He flux compression.

The base assumption is that in ^{4}He there is hidden internal flux compression happening between the two neutrons that explains the mass difference given in Tab 2a. Basically one neutron (see 4.3 below) can release three hole wave equivalents (503mamu) of flux and accept two more waves. The first column of table 5 shows the unchanged ^{4}He compression (0.99622 for torus flux area) based on measured data. The next two columns show adding hidden mass (three waves) compression symmetrically (column 2) and on top (column 3). With this (blue field) we already see 6 digits agreement with the optimal ^{4}He compression. In the last column we did add the 3 waves with the corresponding***** weights multiplied by the expected 2FC/3FC compression, what gives 8 digits (green field). This is just to show that there is a physical explanation for the factors we finally used.

*****Used weights: 500.929=336.541*$3FC^2$*$2FC^4$ + 168.271*$2FC^2$. 4D excess mass must first be once compressed by 3FC*$2FC^2$ to be again plain mass and the once more compressed by 3FC and $2FC^2$ to get the 4He mass density equivalent mass. The 4D hole needs only a $2FC^2$ compression (As seen above in ^{28}Si!)

4D potential free neutron radius	0.840877788500
3D radius	0.837653006969
Quotient	0.996164981909
1-5*2FC	0.994192951338
$2^{3/5}$	1.515716566510
$(\text{Quotient})^{1.5157165665}$	0.994192951338

The neutron 4D potential free radius (0.840877885fm) is about 10 digits exact because it can be exactly derived from the neutron mass. Thus the 3/4D radius is 10 digits exact too, because it is found by a mathematical relation. The quotient of R_{4D}/R_{3D} is the ideal (real) ^{4}He compression of the involved particles..

Table 6. Logarithmic radius/compression relation

The factor (1-5*2FC') can also be found in the 4D mass build up because (1-2.5*2FC') gives the exact amount of 3D/4D energy that is converted into additional 4D energy in nuclei starting with ^{11}B.

For people interested in basics math: Relations of frequencies are relations of energy. They (e.g. sin((3/5) *x) can be mutually expressed in quaternion math by exponents and logarithms. That's exactly what is used above.

4.2.2 The potential free neutron radius

Because the neutron is a proton with excess mass, we did look for a consistent interaction radius for the neutron, that is slightly larger than the proton radius.

Details for Neutron see chapter below. The 4D excess-energy of the neutron is “neutron mass” * 3FC'=2'712'454eV. The coulomb-potential for e.g. the largest possible proton 3D radius (0.8408739) is 1'712'462 eV. The difference of the two potentials is 999'992 eV. In 4D physics we usually build quotients to compare quantities. The quotient base of the 4D/3D potential is 1'000'000. This is coincidentally the same base we also use for μ_0.(radius in denominator!) The above radius of 0.8408777885fm is just the coulomb radius where the difference of 4D-3D pot is the quotient base. In [6], one year ago, we already used this radius (0.8408777885) for the virtual deuterium model and found a 7 digits agreement between the magnetic moments of proton/neutron deuterium radius and the above radius. The problem with such experimental data is the low quality/precision of any charge radius measurement.

4.3 The Neutron mass

This again shows the "historical" path for finding the neutron structure using known quantities from 3D models. The exact SO(4) neutron structure is shown in chpt.7 based on the SO(4) orbit model.

The neutron is a 4D excess Energy particle. This is obvious as the source of all neutrons is the nucleus where they "live" in a 4D environment. A combination of an electron and a proton is only possible with maximally **two charge coupling** rotations. The so called 4D-excess-energy part of the neutron is calculated by 3FC' applied to the neutron mass. This gives a value for **4 rotations**. According to Mills we can reduce one dimension by applying the above (see 1.1) mentioned γ^* factor. The result (tab.7) , by applying the factor twice is the so called "electron *sec* factor" that can also be calculated by using the Mills formula for mass equivalence. The effective neutron 4D excess mass has about the **same mass density as the electron** and is 2'398'967... eV (yellow field).

Tabulated neutron excess mass	782'332.96
Neutron mass in eV	939'565'413.21
Neutron mass * 3FC' = excess 4D flux	2'712'454.00
compensation for electron excess	
** (1+PI()*D2^2)^2 : Mills 36.15 3D → 2D	1.0003346161
3FC** charge normalized by* 4D--> 2D	0.9974467260
4D excess flux gained by neutron-mass * 3FC**	2'398'967.91
Corresponds to electron 4D->2D/3D flux loss (M:36.4)	313'486.10

Table 7. The neutron 4D energy

The values of table 7, above and table 8 below, are calculated as 3D externalized energy amounts of the neutron decay. We show this first neutron model as it historically allowed to find the neutron radius and the important neutron energy hole wave energy (Tab.7 brown 313 keV). The term/quantity spin-flip energy is borrowed from Mills. The same quantity (10eV smaller) can be derived from the delta between a 4D quantum and the corresponding 3D/4D mass. If a neutron decays the potential energy of 1.7 MeV (tab 8) must be built up again. The potential is calculated at the calculated magnetic radius (0.840869916fm). After this step about 686505 eV of 4D energy remain. The flux captured by the electron can be calculated according to Mills formula as rest-mass of electron divided by "2π". During the decay classically one spin of a down quark is flipped. This energy has been calculated by Mills. Further the de Broglie energy of the neutron changes to the proton's. This are the terms marked green. They together constitute the so called kinetic energy terms and are, in their sum, exactly the ones measured in the "aSPECT" experiments[10]. The green marked energies are directly coupled with the e-p bond.

The blue marked energies are the 3D/4D and 4D excess energy parts of the **electron rest mass.** These energies stay in 4 dimensions. Summed up, the neutron excess energy is (5^+ digits) correctly calculated. Some small parts are still unknown like the role of the 13.6eV at the Bohr radius. Do we have to account them in the electron rest mass? The 1FC correction (second torus radius potential) might then also be slightly different

magnetic proton charge radius in fm.	0.8408699160
electron potential at exp p-radius	1'712'470.04
(4D flux gain) – (potential to overcome)	686'497.87
Freed excess electron flux of neutron e_0/2pi()	81'328.01
rebuild 1FC potential	-11.03
Freed excess electron flux 3D/4D (2FC) induced	94.46
Freed excess electron flux 4D (3FC) induced flux	234.79
Spin flip energy N-->P (Mills: 39.7)	15'691.94
(less gain) – de Broglie wave correction Rn--> Rp	-1'502.11
Neutron kinetic excess mass 4D--> 2D/3D	782'015.71
Missing to measured Neutron excess	317.25
Adding 3D & 4D flux to 81238.01 eV e excess	318.21

Table 8 Neutron 3D/4D "excess-energy" parts

	mamu	eV
Neutron excess in mamu	839.869	782'332.965
Neutron 4D hole	336.541	313'486.098
Freed energy neutron->4D	503.328	468'846.867

Table 9 Relevant amounts of neutron energies.

Table 9 shows the two junks of energy we must take into account if a neutron stays inside a nucleus. The neutron 4D hole (168.271mamu = 313'486 eV => 2 waves) consists of two missing, uncompressed waves that initially contain no mass. The neutron excess energy has the weight of 3 waves and consists of matter with a reverse ^4He compression.

This neutron wave structure is immanent in the periodic system of elements and can directly be seen in the

mass build up of e.g. 9-Be, 10-B, 14-C, 15N,.. with one hole wave or: 10-Be, 15-O, 56-Co,57-Fe,.. with two hole waves. Or: 3-H,3-He,13C,17-O, 21Ne etc. with 3 excess waves.
For an example see Tab 9.b . ^{10}B SO(4) mass structure with neutron hole wave.
In total the neutron can make 5 “wave connection”, with the above shown small differences.

	^{10}B mass calculation		
measured mass			10'012'937.027
mass from particles			
mamu Neutron	5	1'008'664.923	5'043'324.615
mamu Proton + electron	5	1'007'825.032	5'039'125.160
sum 5*(n+p+e)			10'082'449.775
mass loss (sum particles -measured mass)			69'512.748
2 x ^{4}He base mass reduction			mamu
Bound flux	2	18'735.768	37'471.537
4D flux	2	11'642.907	23'285.814
newly added particles			
mamu Neutron	1	1'008'664.923	1'171.473
mamu Proton + electron	1	1'007'825.032	1'170.498
3 base flux reduction waves n+p			2'341.971
8 additional waves			6'245.256
Neutron waves	1	168.271	168.271
Sum flux compression calculated			69'512.848
calculated mass			10'012'936.927
Absolute error			-0.100
Relative error total mass			-0.00000001

4.3.1 Conclusion

The neutron hole and excess waves are a fact seen already in the mass structure. The kinetic & 4D excess energies are used in [6] to calculate the exact neutron half live. Thus we know the neutron structure with about 5 digits precision.

5 Some measured and derived quantities we use

Charge	$\mathbf{e}$	: 1.6021766208 e-19 C
Speed of light	$\mathbf{c}$	: 2.99792458 e8 m/s
Fine structure constant	$\boldsymbol{\alpha}$	: 0.00729735256635
Gravitation constant	$\mathbf{G}$	: 6.67408 e-11 m^3/s^2kg
Electron g-factor	$\mathbf{e_g}$	: 1.00115965218091
Electron mass	$\mathbf{m_e}$	: 510'998.9461eV
Perturbative electron mass	$\mathbf{m_{ep}}$	: 1183.1037eV
relativistic electron mass	$\mathbf{m_{er}}$	: 509'815.8424eV
relativistic bound charge mass	$\mathbf{m_{erb}}$	: 508'632.7eV = $\mathbf{m_{er}}$ - $\mathbf{m_{ep}}$
electron ionization energy	$\mathbf{m_{ei}}$	: 13.59843449eV
Proton mass (eV)	$\mathbf{m_p}$	: 938'272'081.4797eV
Proton mass	$\mathbf{m_p}$	: 1.67262189821 E-27 kg
relativistic proton mass	$\mathbf{m_{pr}}$	: 926'603'083.294eV
Perturbative proton mass	$\mathbf{m_{pp}}$	: 11'668'998.2eV
Proton mass 3D/4D	$\mathbf{m_{p3D4D}}$	: 11'396'588.4eV
Proton 4D/1D potential mass	$\mathbf{m_{ppo}}$	: 272'409.8066eV - (as factor: $((1-(\alpha /(\pi*16)))^2)$)
Proton de Broglie radius	$\mathbf{p_{dbr}}$	: 1.3214098537fm
Proton de Broglie radius potential	$\mathbf{E_{pdbr}}$	: 1089718.3271eV
Proton de Broglie radius potential 1D	1/4* $\mathbf{E_{pdbr}}$	: 272'429.5818eV
Proton magnetic radius	$\mathbf{r_{pm}}$	: 0.840869916095fm (measured 0.84087fm)
Proton relativistic mass radius	$\mathbf{r_{pr}}$	: 0.837653007404fm
Proton 4D/3D**** de Broglie radius	$\mathbf{r_{pdbr}}$	: 0.841235640192fm
Hydrogen Bohr radius	$\mathbf{r_B}$	: 52.9177210527pm

6 The semi classic magnetic Bohr (Hydrogen) model

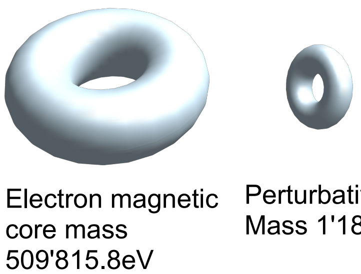
If physics would work as expected conventionally then the total ionization energy of hydrogen should be the sum of formulas 11+12. From table 10 (below) it is easy to see that the calculated magnetic energy (base is classic Bohr radius!) is far to large.

(11) E-coulomb = $e^2/8\pi\varepsilon 0 r_B$

(12) $E_{magnetic}(eV) = \mu_B{}^2 * 4\pi * \mu_o/(\mathbf{r_B}^{3} * \mathbf{e})$

The 4D model assumes that all energy is stored in magnetic flux. This implies that the electron orbiting a proton is not only behaving as a charge. The electron effectively behaves as magnetic flux. Thus if we have to calculate magnetic coupling we can use the orbiting weight(s).

The electron mass in an SU(2) x SU(2) representation can be normalized into two parts. The magnetic core mass and the perturbative mass given by the magnetic moment perturbation, also known as electron g-factor. The coupling is given by a (1x1)x(1x1) mass/wave structure what implies that the perturbative mass is rotating (2D) orthogonal the electron core mass.



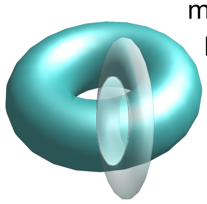


Fig.4a Electron 4D mass components 4b) projected 4D orbits

The first 4 lines of table 10 show the classic electron ionization energy (light blue classic result) calculation based on the reduced mass. The assumption of a reduced mass is a core error of SM as this concept only works in the "real" 3D,t world where the coupling is working in the center of mass. Already Mills [4] formula 1.253 showed (eq.16 below) that the reduced mass factor in reality is the magnetic coupling of the electron/proton system. Thus the classic assumption that the proton is a rigid mass is wrong.

Rf: reduced electron factor	0.9994556794
Bohr radius (Rb)	52.9177210527
reduced mass Bohr radius (rRb)= Rb/Rf	52.9465409443
potential at reduced e_{rRb}	13.5982871554
classic error absolute (eV)	0.0001473346
classic error relative	0.0000108347
electron magnetic excess mass	1'183.1037038626
electron core mass+ ½ excess mass	510407.394248069
Relativistic excess-mass/electron mass ratio	0.0023179596
uncorrected magnetic energy at Rb (eV)	0.0572059311
only coupling with rest-mass (eV)	0.0001326010
First adjusted ionization energy	13.5984197565
error absolute (eV)	0.0000147335
error relative	0.0000010835
magnetic correction (1 +1/9)*0.0001326010	0.0001473345
measured Ionization energy	13.5984344900
final corrected value (spin/spin corrected)	13.5984344899

For the radial coupling we nevertheless can use the reduced mass instead of the stored magnetic energy as they are equal for - Hydrogen only! The reduced mass Bohr model ignores the second magnetic effect caused by the two additional 4D rotation axes. One axes resonances are well known from the Larmor precision of the electron but they are dissipative. But in SO(4) the axes is stable and thus in the ground state the wave energy will be added orthogonal (in respect to the base magnetic energy produce by the electron orbit) This second momentum only couples with the non relativistic rest-mass of the electron.

Table 10a) 4D magnetic Bohr model energies.

For our calculations the magnetic energy correction is given by the standing wave (formula (13)) Larmor factor – angle = 60 degrees what results in a factor 1/9 that get's added to the source magnetic mass. A classic sample how to do this is given in Mills muonium fine structure formula Eq. (14).

In a (1x1)x(1x1) rotation coupling system only the inner coupling of the outer mass does act. Below we will show the analogue, much simpler model based on 4D orbits only. The reason for this inner coupling is that the Biot-Savart coupling works only from the rotation that is synchronous to the core mass. This small coupling force finally gets added to the overall attractive force according to the relative masses at work. The coupling of the magnetic mass with has already be included (reduced mass) thus the fraction of mass involved in coupling is 0.002317..times the weight of the magnetic energy = 0.05720..eV = 0.0001326..eV The first 4D adjustment of the Hydrogen ionization energy is given by the dark yellow field figure in tab.10. It is about 5.6 digits exact which is quite good. Because this mass is added according a wave we must do the additional correction by 10/9.

The measured ionization energy (NIST) is given in the dark blue field. The calculated Ionization energy is exact. The same calculation also works for Deuterium with the same precision inside measurement error bar. result (Tab 10b). Also the simple SO(4) orbit model delivers the same exact result.

Rf: reduced electron factor	0.9997276305
Bohr radius (Rb)	52.9177210527
reduced mass Bohr radius (rRb)= Rb/Rf	52.9321381531
potential at reduced e_{rRb}	13.6019872382
classic error absolute (eV)	0.0001472818
classic error relative	0.0000108278
electron perturbation = e_g factor	**1.0011596522**
el. magn. excess mass = Me*(1-1/elg²)	1'183.1037038626
electron core mass+ ½ excess mass	510420.996382589
Relativistic excess-mass/electron mass ratio	0.0023178978
uncorrected magnetic energy at Rb (eV)	0.0572059311
only coupling with rest-mass (eV)	0.0001325975
First adjusted ionization energy	13.6021198357
error absolute (eV)	0.0000146843
error relative	0.0000010796
magnetic correction (1 +1/9)*0.0001326010	0.0001473306
measured Ionization energy	13.6021345200
final corrected value (spin/spin corrected)	13.6021345687

Tab 10b) deuterium ionization energy

6.1 Used formulas for stored magnetic energy of an electron orbiting a proton.

The formulas (13,14) to derive the coupling energy are given below. They are valid for the muonium (and 4-He). Because we already did the relativistic correction, when using the correct reduced (split) electron mass, we only do compensate for the "Larmor energy" given by the cosine term of (14). The final calculated value is given in the orange field. The correction factor is given proportional to the Bohr magneton (μ_B^2) used in the magnetic energy.

The following equations of R.Mills are given for the muonium.

(13) Mills 2.243 $$\mathbf{E} = \frac{e}{4\pi\varepsilon_0 r^2}\left[Y_0^0(\theta,\phi)\mathbf{i}_\mathbf{r} + \mathrm{Re}\left\{Y_\ell^m(\theta,\phi)e^{im\omega_n t}\right\}\mathbf{i}_\mathbf{y}\delta(r-r_1)\right]$$

This is the energy of a spherical harmonic dipole of the magneto static "Larmor" field caused by the spin/spin interaction. The spherical harmonics is represented by SIN(θ). We use this formula to find the coupling if the SU(2) x SU(2) interaction of the core magnetic X perturbative electron mass with the proton magnetic moment. The solution of the integral delivers the cosine term (14) of the correction.

(14) Mills 2.244 Delta E_{mag} muon: $$= -\left(1+\left(\frac{2}{3}\cos\frac{\pi}{3}\right)^2 + \alpha\right)4\pi\mu_0\mu_B^2\left(\frac{1}{r_{2+}^3}-\frac{1}{r_{2-}^3}\right)$$

(15) Mills 1.162 $$E_{mag\ \mathrm{total}} = \frac{4\pi\mu_0\mu_B^2}{r^3}$$

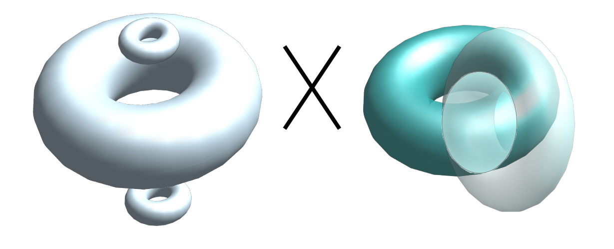
(16) Mills 1.253 $$\frac{m_e}{4\pi r_1^2}\frac{v_1^2}{r_1} = \frac{1}{4\pi r_1^2}\frac{\hbar^2}{m_e r_1^3} = \frac{e}{4\pi r_1^2}\frac{Ze}{4\pi\varepsilon_0 r_1^2} - \frac{1}{4\pi r_1^2}\frac{\hbar^2}{m r_1^3}$$

Force-flux equation for the p-e system including the magnetic energy.

We here do not show the calculation for higher orbital states with n > 1. All states are at least 8 digits exact and the states 2,3,4 show some interesting behavior.

7 The orbit based model of dense mass

This drawing shows the proton orbit structure that, when detailed looks like (1) x ((1)x(1x1)) x((1x1)x(1x1)) x ((1x1)x(1x1)) x ((1x1)x(1)) x (1) x wrap around.



Or simplified (2x2) x (2x1) x (1x1) = 4 rotations coupled with 3 rotations coupled with 2 rotations. Because single Biot-Savart 1:1 coupling is equivalent to Coulomb coupling we could also write 1*1 instead if 1x1. The three (3D/4D) rotation mass is only given on the right side, but runs on both projected half torus covers of SO(4). The 1x1 mass is shown as two separate torus albeit it runs on a 5 rotations (1 x 1 x 5) surface which is not simply done in a projection. But it usually couples only 1 x 1. (Energy Eigenvalues.)

Fig.5 proton orbits

7.1 Hydrogen ionization based on orbit coupling

Perturbations are proportional to neighbor coupling orbit forces. As a result the total force balance must be "1". f(u)*M1/M2*f(v) = 1. The deviation can be written as. 1+f(v)/f(u).

from the proton magnetic mass/moment formula we know that the radial force is given by (3FC*2FC*1FC), the spin pairing (1x1) electric force is given by 1FC the change in mass is given by 1FC' because f(v) is a mass only as it does not couple with the proton again we must used the change in mass. The coupling weight has already been discussed above and is ½. The resulting coefficient is 1.0000108..(Tab.11). The matching is within the tiny measurement error of +-1 to the last digit.

Bohr radius	52.9177210527
Bohr potential	27.2113860282
classic red mass	0.9994556794
Bohr Hydrogen potential	13.6056930141
a) Corrected by reduced mass	13.5982871496
1FC attach to proton	
b)1+0.5*1FC'/(3FC*2FC*1FC)	1.000010835
corrected potential a)*b)	13.5984344876
measured potential	13.5984344900
error: none	within measurement

Table 11. Orbit based Hydrogen model

7.2 The orbit structure of Neutron,Deuterium, 4-He

a) neutron excess mass	1'293'332.000
b) Neutron excess energy (a – e)	782'333.054
c) Proton 4D potential 1D	272'409.807
d) electron perturbative mass	1'183.104
electron mass	510'998.946
e) electron relativistic mass	509'815.842
remaining mass : b - c – e	107.404932022
f) 2* 4D potential (2*m_p*1FC)	40'499.503
g) 2*f*2FC	94.073
h) 2*f*1FC	1.748
i) g + h	95.821
Rest excess (delta 3D/4D pot!)	11.584
k) repulsive potential 2* c * 1FC	11.758
rest error absolute	0.1744950623

Tab.12a) Neutron orbit masses

	eV
DD bond	2'224'572.773
a) 2*proton 3D pot (mp*2FC')	2'179'436.654
b) 2* 4D potential (second radius)	40'499.503
c) 4* electron perturbative mass	4'732.415
Delta before repulsion	-95.798
d) 2*3D pot of 4D pot mass	94.073
e) 2*4D pot of 4D pot mass	1.748
delta mass	0.023

Tab 12b) deuterium obit masses

To understand the neutron the best way is to look at Deuterium and the neutron in parallel. The Deuterium orbit model (Tab.12b) is simple and the internal neutron shows a 5 rotation charge based coupling. In

Tab.12a) you see that in the formation process one $\mathbf{m}_{ep}$ is released (d) as in a neutron 2 $\mathbf{m}_{er}$ do couple and share one $\mathbf{m}_{ep}$. During the formation of Deuterium 4 more $\mathbf{m}_{ep}$ get released which gives in total 5 $\mathbf{m}_{ep}$,that are released, if we form Deuterium from proton an electron only.The coupling mass - (1x1) orbit to mass - remains the same as inside the SO(4) frame the charge mass is $\mathbf{m}_{erb}$.

Thus Deuterium is formed by one 1FC bond between the two proton masses. Tab 12b/ line d). In the joined flux plane = 2 dimensions the de Broglie radius potential gets released**** 12b/ a). The two symmetric charge masses change from a 1x1 orbit to 1x1x5 orbit. The two corrections d,e) are the "missing" coupling of the 1x1 orbit with the electric forces (1FC,2FC) and the released potential b).

Now it is easy to understand the free neutron mass Tab.12a). The symmetric charge masses $\mathbf{m}_{er}$ are the same the coupling mass is also $\mathbf{m}_{ep}$. But the neutron must cancel the proton charge this is done by anti symmetric proton 4D potential mass. These two masses are already 107eV close to the neutron excess mass. The small corrections are the same as for deuterium. The remaining 11.6eV are given by the repulsion between the two proton 4D potential masses.

****The release of the two de Broglie radius potentials can also directly be seen in the first ^{6}Li gamma line (2186.2keV) that is given by the sum of the 2 de Broglie radius potentials and the charge masses (and tiny perturbations).

7.2.1 4-He Orbit structure

a) 4-He from deuterium	23'846'533.869
b) 2* perturbative mass proton	23'337'993.471
c) dense charge mass	508'632.739
e) sum a – b – c	-92.341
f) 2*1FC*m_p	40'499.503
g) 2*f*2FC	94.073
h) 2*f*1FC	1.748
l) e + g – h	-0.016

The formation of ^{4}He from Deuterium is straight forward (Tab.13a). The full 3D/4D flux joins its orbits and migrates to a radius with double the proton relativistic radius. As we will see later if the radius doubles, then the internal charge doubles too, thus half of the 3D/4D flux gets released and the same happens to the associated dense charge mass. The resulting error in mass is -92eV.

Tab.13a ^{4}He from deuterium

Because the 3D/4D flux in 4He does 4 fully symmetric rotations we see one more perturbative (Tab 13a g+h) excess mass that couples with the 1FC paired orbit that we already know from the deuterium mass calculation above. If we assume that in ^{4}He the 1FC orbit is attractive as all mass is doing 4 rotations, then the final result (Tab 13a i) is exact. But there are many ways, we could think of how these -92 eV are generated. Tab. 13b shows some likely ones.

a) 4-He missing mass	-92.341
b) Bohr potential	13.598
c) Delta pot 3D/4D proton	79.101
f) unexplained = a+c	-13.240
delta = f + b	0.358
h) ^{4}HeIonization 24.5874+54.4178	79.005
l) unexplained = a+h	-13.335
delta = l + b	0.263

From the alpha particle mass we know that the ionization energies get added to the nuclear mass. Or the other hand the alpha particle is heavier than the measured ^{4}He mass minus the mass of two electrons. About the same value (79eV) is calculated from the change from a 3D de Broglie potential to a 4D potential. Because 2 Deuterium join also one Bohr potential gets lost. This could also be just a coincidence!

Tab. 13b alternative explanation for missing 92eV fraction

7.2.2 Conclusion

The picture for the Neutron, Deuterium and 4-He masses is very clear and consistent. We also may note that the orbit model is extremely exact whereas the averaging n-p pair model is already very good. For asymmetric nuclei like ^{3}He, ^{3}H, the averaging model delivers reliable results as we know the changing weight of the neutron-proton interaction. The averaging model (using n+p+e) may also be used for magnetic moment calculations as it usually delivers a result that is better than 99% exact. Given that most charge radius are only known by 3.5 to 4.5 digits it is anyway a challenge to do better.

Because we want show the NPP theory relation to LENR we give only one more sample for the magnetic moment calculation of Deuterium.

7.3 The magnetic moment of Deuterium

DD bond	2'224'572.773
a) 2*proton 3D pot (mp*2FC')	2'179'436.654
b) 2* 4D potential (second radius)	40'499.503
c) 4* electron perturbative mass	4'732.415
Delta before repulsion	-95.798
d) 2*b*(2FC')	94.073
e) 2*b*(1FC')	1.748
delta mass	0.023
f) = a + 0.5*(b+c) + 2* (d+e)	2'202'244.209
g) moment mass = f/6	367'040.702
h) = g/a	0.1684108143
deuterium radius	1.07075
Magnetic moment from weight (h)	0.4330710533
measured magnetic moment	0.4330735035

Tab 14 Deuterium magnetic moment

In SO(4) physics the magnetic moment can be calculated from the charge radius that either is 2D,4D,5D (number of rotations). In Deuterium the charge does 5 rotations. The perturbative mass couples 3x2 which gives 6 waves equivalent for producing a magnetic moment. But 5 out of 6 waves are a perfect cover of S^5 and thus are magnetic neutral. The base weight factor for the magnetic moment is 1/6 of the total mass.

In SO(4) the modeling can be simplified as the removed mass is linear dependent with the remaining mass and can be treated as an energy hole. As long as we add hole masses and do fractions this gives the same result as using the full masses and the corrections. The base (Tab. 14) weight is a) couples ½ with b,c). d,e) only depend on b but add to a).

The magnetic moment from weight is calculated by formula (9) - proton - and multiplied with the weight given in Tab.14/h). It is not yet totally clear why we need this weight (d+e) twice. But we change the frame of reference which is a change by two coupling radius, which is according to group measure a factor of 2. Charge bound mass usually has half the weight, whereas perturbative charge bound mass normally doubles the weight. The Deuterium charge radius is only known with about 4.5 digits and thus if we neglect (Tab 14 lines d,e) the calculated moment is still fine with the given radius precision.

8 Proton – electron mass relation

top down 4D proton radius	0.837653007404
	eV
(8/9) magnetic mass of proton	823'647'184.997
reduced charge mass e/4π	**40'664.004**
metric change 1D	1.4142135624
4D charge mass to subtract	57'507.586
weight of Mpr - charge	823'589'677.410
electron mass	510'998.946
electron perturbative mass	1'183.104
charge expansion 2-3D (+2Mep)	513'365.154
going from 2--> 3 rotations $a^{-3/2}$	1'604.176
Relativistic Mass electron 3D	823'528'042.048
metric factor for 2-->3(5) rotations $2^{3/5}$	1.5157165665
electron charge added for 3th dim	61'635.105
Rel. Mass electron 3D + charge	823'589'677.152
delta projected mass	0.258

Tab.15a) p/e Torus mass projection

top down proton radius	0.8376530074046
	823'647'184.99473
charge flux expansion $(2^{3/5} + 2^{1/2})*m_e/4\pi$	119'142.69075
a) 8/9 proton mg. mass + reduced charge	823'528'042.30398
b) reducing : a) * $alpha^{3/2}$	513'365.15367
c) electron pert. Mass	1'183.10370
calculated electron mass = b - 2*c	510'998.94626
electron measured	510'998.94610

15b) electron mass from proton mass

For the proton electron mass relation (Tab 15a) we use the proton relativistic mass that can be exactly calculated from the proton mass. The proton has the rigid mass form factor of 9/8. Thus to get the mass equivalence we choose 8/9 of the proton relativistic mass. This is equivalent to stopping one rotation that produces the 9/8 of mass. The charge-mass associated with this operation is stopping one rotation * group measure.

From the electron side we must use excess mass formulas. Thus we must start with the opposite as the dense electron mass. Then we must speed-up the electron from 1 x 1 rotation to (1 x 1)x (1x1) rotation and then from 2 Nj 3 rotations this factor of total 1.5 can be seen in the α exponent being -3/2. The associated charge mass for going from 2 Nj 3 rotations (out of 5) is given by the factor $2^{3/5}$.

The change in charge mass for 1--> 2 rotations did only affect the perturbative mass which is reflected with starting at $\mathbf{m_e}$+ 2* $\mathbf{m_{ep}}$. The factor $2^{3/5}$ = 1.5157.. has already been used to derive the proton relativistic radius from the neutron interaction radius. It is the weighted sum of 3 rotations (waves) running on a single side SO(4) manifold.

In table 15b) the electron mass derived from the proton mass is shown. The only simplification we used is the pre-calculated electron perturbative mass (c), that depends on the highly precise electron g-factor.

9 The proton inner force equation

In our model we also assume that the magnetic flux in SO(4) is bound to the surface of the projected 3D torus and the "virtual charge" stays on the torus center line. (Thus in 3D the magnetic flux is homogeneous inside the 3D torus.) This 4D model reflects the difference in dimensionality of charge/magnetic flux. Normally magnetic flux occupies one more space dimension than charge.
A classical pictures we can use: The torus surface that encloses the magnetic flux is the time horizon of the EM-flux/mass it cannot escape. Thus the frequency (in radians) that defines the amount of current or finally the mechanical centrifugal force on the mass is given by the radius $\mathbf{r_{pr}}$ and the speed of light and the number of windings the magnetic mass takes.

(1) $m_{pr} = \mu_p^{2} * 4 * \pi * \mathbf{100000/(\boldsymbol{\alpha} * \pi * r_{pr}^{3} * e)}$ = 926'603'083.294eV

Because in dense space all magnetic field lines are contained inside the current loop (due to the complex 4D rotation) the Biot Savart force (integrated over the torus cross section) and the coulomb force are **interchangeable**. (Under full torus symmetry!)

The base frequency of the charge that finally defines the current is given in (2).

(2) $\omega = c/(4*2^{1/2}*\pi*r_{pr})$ = 0.2013871189 E23

On a torus the combined trajectory that covers both radius has the length r* $2^{1/2}$. This simply is the group measure of SO(4) for one radius. This is the true frequency and not a projected one. 4 is counting front & backside.

From this we can derive the projected mechanical (centrifugal -cf) force on the EM point mass that in SO(4) has a constant distance $\mathbf{r_{pr}}$ to the "center" of rotation. (To remind you once more: In SO(4) the effective center of rotation/mass is the total surface on the single sided Clifford torus boundary!) . But EM mass is mechanically connected by the induced charge that in this *first approach* stays at a distance of $\mathbf{r_{pr}}$ from the Clifford Torus surface.

(3) $F_{cf} = m_{pcgs} * m_{pr4D} * \omega^2 \mathbf{r_{pr}}$ = 280.6647723036N

m_{pcgs} is the metric proton mass, where as m_{pr4D} is the fraction of mass that is rotating in 4D

(4) $m_{pr4D} := \mathbf{(m_{pr} + m_{ppo} + m_{ei})/}m_p$

The following equations treats the charge as a point charge = the integral over the total torus surface.

The electric force (5) 4D coulomb force over the same distance -using the torus norm - is given as following:

(5) $F_{ef4D} = e^2/(\varepsilon_0 4\, \pi^2 \mathbf{r_{pr}}^2)$ = 418.6431608349N

If we make the simple quotient then we get:

(6) F_{ef4D} / F_{cf} = 0.67041528098495

This (6) is roughly 2/3. Why? The distance between 2 current circles (virtual ring currents is not $\mathbf{r_{pr}}$! Its $(3/2)^{1/2}$ as the true distance is given by 3 components (vectors). The center of the circles has a distance of r in the projection only but not the average path of attraction in SO(4). This again is somewhat simplified as the true relativistic 4D radius is $\mathbf{r_{pr} /}\ 2^{1/2}$ given by the metric and all points stay on the Clifford Torus surface. And thus the distance between to "parallel" circles is e.g. $(r_z^2+r_y^2+r_u^2)^{1/2}/ 2^{1/2} =(3/2)^{1/2}\mathbf{r_{pr}}$.- all having the same length. (The charge does not stay on the Clifford torus surface where we can map 4 rotations without adding one more dimension!)

The final deviation of the simplified force model is. (Due to r^2 in eq (6)

(7) $F_{ef4D} / F_{cf} =(3/2)*(\mathbf{r_{pr}}*m'_{pr}/(4*PI()*64*e^2)) = 1.0056229215$

(8) $F_{cf} /F_{ec4D} = 0.99440851898129$

Equation (7) is the reduced quotient that shows that "the electric" force **increases** with the radius, which is in agreement with the strong force behavior seen in experiments. This counter intuitive effect is due to the way the frequency is defined. The frequency decreases with r^2, which implies that the centrifugal force decrease with increasing r. From the 4D physical point of view the explanation is that charge Q^2 (e^2) produced is proportional to r and also to the product of radius*mass, thus **in reality the central charge force increases if we try to split the relativistic mass**.

This, 0.9944.., is a very good match for this simplified model that only respects the proton relativistic mass and the attached symmetric potential orbit. But in reality the center of mass coupling is the charge radius what we already corrected. What is very difficult to model is the connection of the 5,4,3,2 rotation masses. The only feasible approach that does not need a lot of modeling is looking at the orbit relations.

9.1 The perturbation of the orbit

The difference in rotations between the proton relativistic mass and perturbed mass is 1 rotation. This is also responsible for the unfolding of the proton potential. Thus the expected perturbation must be proportional to 2FC the potential folding factor for one dimension. Further we see two coupled torus which will lead to a product of 2FC with 1FC. (The coupling 3D/4D torus runs see Fig. 5 over both dimensions of the 4D torus, thus the coupling involves 2 times 1FC – the torus second radius force (derivation of 2FC)

In fact the expected perturbation of 2FC(1+2*1FC') does give the exact deviation for **one dimension**.

The second last line of Tab.2 below gives the value for all 5 dimension. It is just sum as only one radial dimension is involved (no r^2,r^3 coupling). Once more. 1FC' is the correction for the second radius torus force. Usually if we find a general solution that is conforms with the SO(4) modeling the chosen approach is safe.

In chpt. 8 we did show the all digits exact mass equivalence formula for the proton-electron particles. This formula was already based on the assumption that charge is running on 5 rotations.

R_{rp} relativistic proton radius	0.837653007352
1) relativistic proton mass at R_{rp}	926'603'083.294
2) 4D potential (1D) at R_{rp}	272409.80657182
3) coulomb potential	-27.2113860282
mf=orbiting mass factor $(1+2+3)/m_p$	0.98785361342663
orbiting frequency $c/(4*2^{1/2}*pi*R_{rp})$ =w	0.20138711900196
4)mechanical force $m_p w^2 R_{rp} mf$	280.6647723036
5) torodial Coulomb force $e^2/(\varepsilon_{04} pi^2 R_{rp}^2)$	418.6431608349
Ratio (4)/(5)	0.67041528098495
Correction for charge radius in (5)	1.00562292147742
Factor 1/x	0.99440851898129
1-5(1-2FC(1+2*1FC'))	0.99440852029356
matching	1.00000000131964

Tab 16. Proton inner force summary

The reduced formula (7) above shows that the force quotient is proportional to mass. Mass is always the sum of all rotating masses = Eigenvalues of all 5 dimensions. Thus the found perturbation of the proton inner force equation works symmetrically over the full SO(4) space.

An other approach to fix the quotient (7) would be the calculation of the coupling mass that lowers the coefficient "mf" Tab.16. The mass release in the reaction D+H Nj ^{3}He reaction is 5'493'486 eV which is pretty close (final q = 0.9996..) to the mass needed to do such a correction to get a quotient of 1. A third approach would be to calculate the force induced by the proton perturbative mass.

10 Gravitation

For decades people have accepted and were taught that electrons do orbit nuclei and may acquire relativistic speed, which contradicts the fact that most electron mass already is at light speed. This old reasoning was based on the undisputed fact, that in a conservative 3D,t field the potential energy and the kinetic energy must match. For example an electron joining 4-He would then be heavier – acquiring more kinetic mass - after falling to its potential being about 54.4 eV. Unluckily nobody tried to understand he experimental data, which shows a net excess mass of 4.884eV in the 4-He case.

4He mass	3'728'401'292.003
alpha mass	3'727'379'378.000
difference	1'021'914.003
Subtract 2 electrons	-83.889
orbital reduction +54.4 +24.587	79.005
error	-4.884

Table 17 Helium mass and orbits

Table 17 shows the mass of the alpha particle compared to the 4-He mass, minus 2 times the electron mass. Then if the potential energy of the two electrons is subtracted, it leaves 4.884eV that cannot be explained by relativistic mass gain and is not measured or seen to be dissipated! This extra mass can only be explained by the 4D spin pairing that defines the elevated first ionization energy, something that does not follow classic potential rules. But again how is this mass dissipated in the bound case? The answer?... it is not dissipated!

All NPP2.0 reasoning, so far, is based on the fact, that only the field generated by the electron/proton charge pair contains gravitational mass. To get the last digits we must always subtract the lost potentials. The disappearing of 4.884 eV can only be explained by the fact the (free) electrons do not gravitate. As you may know the two electrons of 4-He undergo spin-pairing. This mass of the spin-paring is not given by the classic potential, but it is reflected in the measured helion (=alpha particle) mass too. If we calculate the second radius potential-dependent mass (given by 1FC) of the spin-pairing field mass, we get the same amount (about 11eV) for the spin-pairing energy as calculated from the measured ionization energies. The rigid mass of a torus is defined as $(r^2m/8)*(4+5)$ assuming equal radii. From this it is easy to see that 4/9 (4.884eV) of the total spin-pairing energy gets attached to the electron perturbative mass (follows electron 4D torus projection) and in fact do vanish because the electron perturbative mass does not gravitate! According to the models above only ½ of the electron perturbative mass does indirectly gravitate as it is bound to the magnetic mass.

This was a first indication that a part of the electron flux is mediating gravitation. If this part stays in between two masses then it is quasi a force free point. Unluckily NIST recently did believe that SM can somehow explain this 4.884eV difference and used fudging formulas derived from the ^{36}Ar mass as a correction...

How should this force be structured based on the known constants of SO(4)?

- We expect gravity to be an EM force based on full 5 rotations of SO(4)
- We expect a potential is mediating the force Nj 2 rotations (2D).
- We expect the force to work outside dense mass just upfront at the Bohr level of the electron.
- Remember that in NPP2.0 all dense matter forces are r x r (magnetic) forces!

How will we proceed: We will calculate the gravitational potential energy of 2 neighbor (touching) protons. As gravitation works in open space we have to identify which mass exerts the same magnetic force on two protons as gravity does. As magnetic potential energy decays with $1/r^2$ we have to use r x r potential for the scaling.

The base assumption is that the weak spin force = second radius torus potential = 1FC (1FC' effective pot.) is responsible for gravity. Line (a) of Tab.18 gives the 5D – rotations 1FC' potential. Line (b) projects (2D) the potential from the magnetic proton radius to the Bohr radius. Line (c) is the product of (a)*(b). Line (d) boosts the potential by the radial potential unfolding factor (2FC) for r x r. This is the change of reference frame for two rotations.

proton mass : Mp	1.6726218982	e-27
electron g-factor eg:	1.00115965218091	
Bohr radius (Rb)	52.917721052700	e-12
4D relativistic radius of proton (Rp)	0.837653007340	e-15
measured gravity G	6.674080000000	e-11
a) 1FC'^{5}	4.682249193937	e-24
Rp/Rb	1.582934772466	e-5
b) (Rp/Rb)^2	2.505682493883	e-10
c) scale factor of force = (a)*(b)	1.173222983725	e-33
d) 1/2FC^2	1.002326872358	
e) 2D potential correction for (Rp/Rb)^2 : (c)/(d)	1.175952923855	e-33
Gravitation potential Mp^2*G/Rp*e		
f) Rest potential of gravity at Rp in eV	1'391.273210064050	e-33 e
coupling mass (f)/(e)	1'183.102811210050	eV
electron perturb mass : me*(1-1/eg^2)	1'183.103703862580	eV
ratio	0.999999245499	
reverse gravity	6.674085035884	
relative error	0.000000754543	

Line (e) shows the gravitational potential of two aligned protons = distance is magnetic radius. As you might notice the dimensions of (e)/(f) do match. If we now divide the rest potential (f) by the scale factor(e) we should get the energy of the "particle"/mass that produces the same potential energy. The result is, as suspected, very close to the electron perturbative mass.

Table 18 gravitation from week spin force (1FC)

The match with the electron perturbative mass is excellent. There is a small error remaining which can be explained by already known perturbations. But do not believe that this is the final word in deriving gravity from SO(4) spin forces. There are many reasons to believe that there could be other sources for the last small error like an average radius to project the force, or an average "electron perturbative mass" found in all different Isotopes. Especially this points to the assumption that gravity could really be a varying (after 7th digit) force, depending on the structure of big objects.

The first proof of a varying gravity would be comparing experiments run during day and night time. During day time the sun with a high Hydrogen content and only a small part of low z should produce a different gravity than experiments during night time, where the earth is partially shielding the sun.

Reverse gravitation from basic SO(4) constants:

$$G = \mathbf{m_e c^{2}*(1-1/e_g^{\,2})}(r_{p4D}{}^3/a_0{}^2)*1FC'^5/(2FC*m_p)^2 = 6.6740850357\text{ e-11 - m}^3/\text{kgs}^2$$

Comment: We did use gravitation between 2 protons for symmetry reasons. If you just look at Hydrogen, then the force/potential energy for one proton would be equivalent to halve of $\mathbf{m_{ep}}$. This is the same picture we see in the magnetic Bohr model. But this picture would not explain that $\mathbf{m_{ep}}$ does not gravitate because it is mediating gravitation. The correct picture is that half of $\mathbf{m_{ep}}$ does not gravitate when it is bound in a spin pairing 1FC orbit because the coupling other half is bound to the gravitating core mass/field.

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second part:

SO(4) physics and LENR

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Abstract: This is the LENR related part of the NPP2.0 poster. The here mentioned experiments have been prepared by Russ George at the Ecalox lab in Essex (UK). Most of the measurements have been done by the author. The environment was not ideal as it had a relatively noisy background with a short-time fluctuation of +-10%. Heavy lead shielding of the equipment could reduce the background by a factor of 2.2 on average. Calibration adjustments in the range of interest 20...600keV were done on a regular basis with 3 different strong lines (Cs,Am). The line matching was done within a range of +- 300eV.

The LENR reaction we show here did elevate the gamma radiation level by 100% and in selective areas individual lines by a factor of 10 to 20. The fuel mass was in the range of 3-6 grams at most and the volume not larger than 1ccm. The produced energy of such a small pellet was in the range of 10-20 watts and some times even more. The goal was not to get a high COP. The main interest was watt/g.

Two points are interesting: Active LENR reactions suppress (consume) background radiation, thus comparing a spectrum with a background is just giving the worst case scenario. Dense hydrogen is coupling with gamma radiation what leads to peak shifts. This can only be seen when we sit in front of the spectrometer and suddenly the background drifts by 2,4,6keV or some center line is shifting the neighbor lines. Such effects are not lasting very long and deliver the daily thrill what helps to survive the long “down times” during measurement.

We here only show the theoretically interesting part of the results as the details of the spectra are still proprietary. Fact: Most of the measured excess to background gamma lines are so called magnetic lines, produced by states that express a magnetic moment.

11 Experimental findings

This part of the poster deals with the relation of SO(4) physics to experiments. The focus will be on orbiting mass that attaches to nuclear flux and finally causes fusion. We will see that the electro weak force equivalent constant 1FC plays a key role in LENR. 1FC orbits are (1x1) that can directly attach to the nuclear core flux that is 2 x 2 or effectively ((1x1)x(1x1)). Please remember that the "x" is 1x1 stays for magnetic or vector product coupling.

In the theoretical part we did show that 1FC is also the spin-pairing force we see in the ^{4}He orbit. One thing we did not say and we can derive from the proton inner force equation is the fact that the electron has no fixed relativistic radius. Thus any rotating flux can couple to any neighbor rotating flux. Classically we see this coupling as continuous Coulomb potential, but remember that this potential is generated by two coupled rotating magnetic masses.

The key problem in LENR is to get rid of the excess (3D/4D) flux that is (1x1x1) coupling to ((1x1)x(1x1)). There is a mismatch in rotation number between 1FC,2FC & 3FC orbits that prevents matter from spontaneously fusing.

11.1 Proton magnetic moment quantization

After finding the SO(4) conforming proton quantization, we tried to find and finally support experiments that could answer how magnetism affects LENR. In the following table 1 we give the first 32 -unperturbed - quantization energy steps of the proton magnetic moment based mass.

1	2'002.337	9	19'146.941	17	38'576.618	25	60'780.825
2	4'034.328	10	21'441.834	18	41'188.941	26	63'781.300
3	6'096.637	11	23'773.139	19	43'845.523	27	66'836.307
4	8'189.947	12	26'141.732	20	46'547.499	28	69'947.345
5	10'314.963	13	28'548.514	21	49'296.042	29	73'115.971
6	12'472.410	14	30'994.416	22	52'092.367	30	76'343.798
7	14'663.038	15	33'480.400	23	54'937.731	31	79'632.500
8	16'887.616	16	36'007.458	24	57'833.434	32	82'983.818

Table 1 Proton 4D $\boldsymbol{\alpha}$ **-** quantization: $(1-(\boldsymbol{\alpha}/(\pi*16)))^2$

Proton magnetic base mass: $M_{proton}(eV) = \mu_p^{\,2}*4*100000/(\alpha * r_{p4D}^{\,3} * e)$ = 926'603'083.3eV
Proton magnetic perturbation "p-1Dimension" = 0.9959335244; For full moment : $(p\text{-}1D)^3$ = 0.9878501147
Rest-mass of perturbative proton potential: 272409.8eV. Quantization with $((1/\boldsymbol{\alpha}) - n) : n = 1,2,3,4,....$

Currently three experiments show a proton resonance at 1keV Iglev[1] & Lipinski [2] Schenkel & [5] reported the highest proton resonance at 1000eV. Lipinski(s) did find/confirm this in several independent experiments. The above tabulated values are 4D equivalent energies that are valid for emitted radiation energy. In a kinetic experiment with non relativistic protons only half of the SO(4) = SU(2) x SU(2) responds to a proton event, because in SO(4) physics the "kinetic mass" is flowing inside and outside of the center of mass surface. Thus the 1000eV perfectly matches the first proton quantization step.
The proton magnetic moment quantization still is a hypothesis with strong support but less than conclusive experimental details are known. E.g. we assume that only integer quantum steps for "n" do occur. Why is ½ not possible or even steps of 1/3 if there is a coupling with the 3D/4D flux?. Does the 2:3 orbit coupling modulate the peeks/coupling strength? The 2:4 rotation coupling should be weak because of the large difference in mass.

11.2 *The first LENR experiment with constant gamma ray production*

In June 2018 there was a big surprise ! We, the first time, had access to a along running LENR experiment that allowed to measure gamma radiation over weeks. At first sight we had no explanation for the seen lines, that were nowhere conforming with known lines. Then I detected that the central peak closely corresponded to the predicted neutron 4D energy hole wave resonance. After that we started to count the peaks between 20 & 80 keV and found that they exactly correspond to the expected number of lines due to proton quantization. We thus in Fig.1 very likely see a modulation of a Neutron wave energy centered spectrum by the proton momentum quantization.

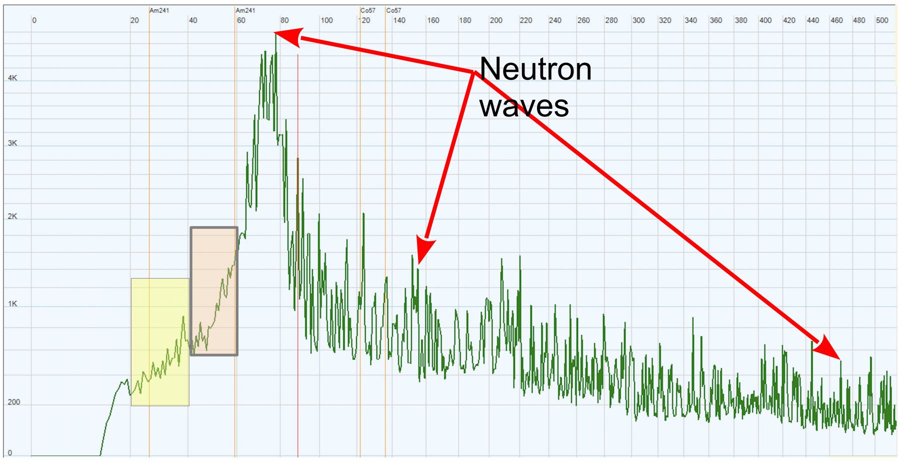


Fig.1 Spectrum from a running LENR experiment measured by **Russ George (Atom-Ecology)**

The above spectrum has been collected by a very long run of more than 3 hours. The total energy of the measured gamma-lines is far less than 10^{-6} of the total LENR energy produced. Thus gamma radiation only delivers a tiny signature of the involved magnetic moments. Such signatures can be obtained by carefully done backgrounds that can be subtracted from the active reaction spectra.

12 Spin or 1FC orbit pairing

If two electrons on the same orbit couple then they join one of their (1x1) waves that forms the (3D,t) relativistic mass $\mathbf{m}_{er}$. The product of 1FC'*$\mathbf{m}_{er}$ delivers exact 11eV. (Seen in ^{4}He are 10.99).

From a 3D,t perspective spins must be parallel to be attractive. Thus one key functionality of a LENR catalyst must be supporting singlet Hydrogen with parallel spins. It looks like on catalyst surfaces such small ensembles of H/D can form out large regions of spin paired orbits.

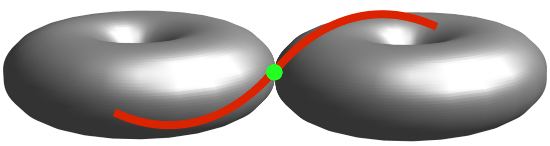


Fig. 2a Electron flux torus

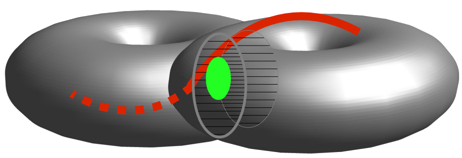
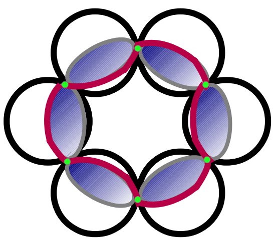


Fig2b Joined flux torus.



In SO(4) physics all waves have at least a (1x1) orbit structure – also photons. Thus if (magnetic) flux joins two rotation dimension are involve and the classic flux node (Fig. 2a green dot) in reality is a torus intersection circle like area. At the node surface (circle frame) flux changes from outside to inside due to momentum conservation.

In a circular configuration also called H7,H19,H37 these 1FC orbits can span the whole circumference. This Fig.3 red orbit is a super conduction orbit and it is assumed that such a H7,H19 forms a stable molecular rotator. The flux released is proportional to the number of electrons and also defines the frequency of the rotating mass.

Fig. 3 Larger 1FC SC spin orbits

There is good reason to believe that such **long range** coupled 1FC orbits in general are able to explain super conduction. The current research of Rydberg matter – dense hydrogen still is based on good heuristic approximation for orbitals and what people believe to be spin.

What experiments must show is whether the 1FC orbits also do allow a quantization and whether it is possible, when more flux is running in parallel, e.g. in the from of two stacked rotators, that the free electrons (Rydberg electrons) do form two spin connections.

Because 1FC spin pairing delivers 11eV for two electrons, this effect allows (in catalysts) to split H_2 bonds and also allows other electrons to migrate to higher (Rydberg) orbits.

This simple 1FC paired mass or electron spin caused Rydberg matter is important for the final phonon coupling step, of LENR. An aggregate of about 100 1FC paired electrons is able to resonantly accept the 1keV (D* case) that a proton magnetic moment is able to dispose of.

12.1 Dense Hydrogen

Dense Hydrogen is the ultimate 1FC spin paired mass that is based on a pairing of 2 $\mathbf{m_{pp}}$. If an external resonance mass exists that is able to accept about 500eV the two proton can join their 3D/4D excess flux on a nuclear 1FC orbit.

m_{pp}	11'668'998.0057
a) 1FC' spin pairing of 2*m_{pp}	503.6797
2D coupling with potential	
Weight (1FC'+(2FC'*1FC'*2))	504.8497
Bohr potential	27.2114
2/3 wave freed potential = 1/3	9.0705
Net energy gain H*-H*	495.7792

The spin pairing delivers uncorrected 503.7eV. This must be slightly corrected by the neighbor orbit forces. See Tab2. 2*2FC'*1FC' is the same perturbation we did see in the proton inner force equation. Because the potential bound 3D/4D flux couples now only with 2/3 the external visible potential is reduced by 1/3.

Tab. 2 H*-H* dense hydrogen

The value of 495.8 eV matches very closely with the value Mills measured for his “Hydrino” condensate. The values that are posted in countless Holmlid papers are less reliable because such spin-paired H*-H* on surfaces do couple and form clusters of 3,4 and more atoms where some also can be in a normal Rydberg state.

From the Deuterium orbit model it is clear that D*-D*can do up to 4 1FC orbit connections. In Tab.3 we use the same values as in Tab 2. If we look at the final energy balance then we may see the connection to the first electron magnetic moment relaxation energy. This is no coincidence as the potential factor is similar to 1FC.

4*s-s energy	2'019.3987
2* potential	18.1409
Sub 2* potential lost (9eV)	2'001.2578

Tab 3 D*-D* dense Hydrogen.

If Deuterium does only two connections we get again the famous 1keV proton resonance figure. Now we already understand two steps of the LENR reaction path.

1) 1FC orbital electron spin-paired mass couples to phonons (e.g H doppler frequency or e magnetic mass)

2) 1FC 3D/4D flux paired mass couples to 1)

3) Missing step

13 The decay of D*-D*

If D*-D* aka dense Hydrogen wants to condense to ^{4}He then it must get rid of the entire 3D/4D flux of 2 protons. Details see modeling part Tab. 13a) . 3D/4D flux does 3 rotations that can be modeled as 3 waves. The resulting D*-D* pre fusion cluster is a highly asymmetric EM mass that has the following coupling based on the perturbative mass waves (2x2)x2. (2x2) is given by 4 (out of 6 proton perturbative mass waves now running on symmetric (inside/outside !) orbits. Such a structure with a large difference in dimensionality leads to a strong **temporary** increase of **internal charge** needed to compensate the eccentricity induced force, which in turn generates a strong oscillating B-field. In SO(4) physics charge is produce by a topological difference (e.g. different rotation number) between rotating mass and dimensions. Principally the average change of magnetic flux that is responsible for the induction of charge is constant but only in a projection to the classic space. In 5 rotation space the “missing” flux flows through all 5 dimensions which is a dynamic process as the first derivative (of magnetic flux) for each dimensions is finally given by a harmonic function (sin,cos). In the 4:2 asymmetric case (coupling mass) the flux change is one magnitude larger than in the proton case 5:4. (2x2) of (2x2):2 is given by 4 (out of the 6) coupling proton perturbative mass waves that are running on symmetric orbits and do not produce external charge. In the model we also can see the the 2 excess waves finally are disposed.

We assume that the lower bound for this D*-D* oscillation is the relativistic proton radius ($\mathbf{r}_{pr}$) where the higher bound is given by the measured (Holmlid[7]: Extrapolated with Coulomb law) dense deuterium radius (2.15pm).
The (2x2) subset of the 3D/4D mass wave can directly attach to 2x2 relativistic core mass wave structure. As said above the 3FC force factor tries to compress the remaining flux further, but as long as the energy cannot be removed the major part of the flux has to use the 2FC mass radius (so called 3D/4D mass radius no given by 1FC).
The maximal strength of the temporary nuclear field produced by 23'846'533eV D-D fusion excess mass can be roughly estimated by the energy density formula of a magnetic field. This works because we know that the mass of any particle is mostly EM mass (-flux), that is equivalent to compressed magnetic field lines.
The B field equivalence for a proton mass of 938'272'081.3 eV inside a torus volume is 3.609E14 T. Broken down to 23'846'533eV, that will be disposed by one D-D fusion event, it is 0.917E13 T. Realistically maximally 1/3 of this field is really generated as the asymmetry of the 2x2D(x2) oscillating mass is 2:1. At the beginning of the fusion the field starts at half of the fusion radius that typically is in the region of 2pm. This are lowest case assumptions.

w_p E-density := $8m_pc^2/(2\pi^2 r_{pr}^3)$	10.365899023	e34 W/m³
H= $(w_p/\mu_0)^{1/2}$	2.8720933739	e20
B=	3.6091789763	e14 T

Tab 4. Proton energy density/B-field equivalence

13.1 *What experiments show*

All our experiments with magnetic elements do show gamma radiation with coupling magnetic gamma states of neighbor nuclei. This leads directly to the conclusion that one path for disposing LENR energy is coupling to neighbor nuclei magnetic gamma states. There are two kinds of coupling. See Tab. 5 that shows a small selection of active isotopes we measured in one spectrum of 10 minutes duration. The total counts of this spectrum were 90% above background (assuming 10% fluctuation) . About 20% of the additional line counts were known magnetic lines with > 100% above background.

element	mass number	line(eV)	count	backg. count	ratio to bg.
Pd	105	38720	22	1	22.0
Sm	151	25710	14	0	14.0
Sm	151	35130	15	1	15.0
Sm	151	39010	44	6	7.3
Sm	151	61010	31	14	2.2
Sm	152	275410	15	2	7.5
Ag	109	44770	15	4	3.8

Tab 5 some*** of the most active magnetic states

There are “catalytic” nuclei like Pd, Ag, ^{152}Sm that couple with D*-D* and partial fusion products of e.g ^{147}Sm+D*-D* that seem to act like ^{151}Sm. In fact the intermediate ^{149}Sm+D* should stop at ^{151}Eu. We also identified many A+D* reaction paths that confirm that D* gets added like p-p and the first produced z is z+2. Usually all these intermediate states do Beta+ decay.

***Some not shown data is confidential

13.2 The D-D* ^{61}Ni -Pd environment (Mizuno)*

External EM coupling forces decreases according the expected magnetic coupling. Classically the magnetic force decays by 1/r^3 and the electric -cyclotron - coupling force by 1/r (radial velocity). But in the nuclear case the field lines do not have a 3D space symmetry and in fact the magnetic flux is more or less uni-directional (up to the fusion radius) and locally (at poles) looks similar to an electric potential as the flux at a pole expands slowly by less than r^2 r being the distance. The same knowledge can be gained from the proton inner force equation that explains the charge mass equivalence (see chpt. 9 (7) theory part) . This explains if mass is 4D oscillating = expands its radius, then charge produced increases according to the weight of the q^2_{new} =! r_{new} *m (=! for proportional) thus the charge weight is proportional to r^2_{new} thus the field at 2pm is still given by the above maximum. Any neighboring nucleus will undergo a toroidal polarization of its electron cloud, which leads to an indirect transport of a strong B field

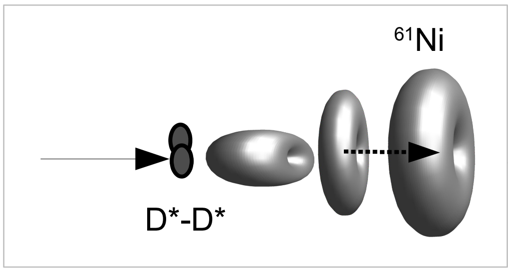


Fig. 4 toroidal coupling flux oscillation

13.2.1 D*-D* Ni coupling

We assume that D*-D* is symmetrically coupling and the unsettled flux is oscillating in 4:2 dimensions. Nickel is a very special element with an electron shell that allows a pairing (hybridization) for all 10 outer electrons on a common orbit. This hybridization radius is smaller (=39pm) than the Hydrogen radius. This could be one reason why nickel easily attaches to H*-H* or D*-D*. An coincidence is the sum of all 10 first potentials that is 1017eV which is pretty close to the proton magnetic resonance energy of 1001eV. This allows the conclusion that Ni10$^+$ state is resonant with H*/D*.

^{61}Ni (Z=28;N=33)		
charge radius	3.8225	fm
first gamma line	67'418.00	eV
base state magnetic moment	-0.378818879	-26J/T
gamma state magnetic moment	0.2424376176	-26J/T
state half live	5.34	ns
covalent 1:1 bond radius	124	+-4 pm
covalent 1:10 radius 0.74*r_B	39.159113579	pm !
a) 2 neutron E-hole waves	313'485.95	eV
one SO(4) wave weight a* 1/5	62'697.19	eV
b) change of 2 charges (perturbation)	4'732.41	eV
c) sum a + b	67'429.61	eV
E magnetic binding at Ni charge radius	2'058'038.00	eV

Tab.6 some properties of ^{61}Ni

The first magnetic gamma state of Nickel is 67.418keV. The analysis of the ^{61}Ni mass shows that it owns 2 neutron hole waves. Also does the polarization of the moment change during the decay. This indicates that this state is charge coupled which is also the case with the neutron hole wave. Charge runs on 5 rotation orbits and 1/5 of the hole wave mass and two dense charge coupling masses explain the line perfectly.

There are some observations that H*/D* can act like a halo nucleus, because the strong temporary field allows them to penetrate the “coulomb-barrier”, that in fact is only the sum of the potentials released!
The magnetic mass formula at the Nickel charge radius with the Deuterium (using 4 protons) and the state magnetic moment give a mass energy equivalence of about 2MeV. This is far more than needed to load the magnetic state.

13.2.2 The D*-D* Pd coupling

105Gd (Z=46;N=59)		
charge radius	4.515	fm
a) first gamma line	280'410	eV
b) second gamma line	38'720	eV
base state magnetic moment	-0.3242603135	-26J/T
first gamma state magnetic moment	-0.0373757994	-26J/T
second gamma state magnetic moment	0.4545705329	-26J/T
first gamma half live	67	ps
second gamma half live	39	ps
covalent 1:1 bond radius	139	+-4 pm
c) 2 neutron E-hole waves	313'485.95	eV
d) change of 5 charges (perturbation)	5'915.52	eV
wave energy + D	319'401.47	eV
e) sum a + b	319'130.00	eV
E magnetic binding at Pd charge radius	2'341'660.22	eV

Tab.6 some properties of ^{105}Pd

Pd is known to be highly active in the LENR energy down-scaling path. See Tab.5 where we could measure it with a signal : noise ratio of 20:1. In ^{105}Pd the second gamma state is coupling or visible not the first one. To load the second state the sum of the first & second gamma state must be transferred being 319.13keV. This momentum also work much faster than the ^{61}Ni one most likely because 319.13keV is a direct match with 2 neutron energy hole waves and no internal flux reordering must happen. The magnetic binding energy at the nuclear charge radius is slightly higher than in the ^{61}Ni case.

The exact resonance conditions are not yet known/understood but experiments show that the gamma state coupling is strongly temperature dependent. This allows one conclusion:

1) 1FC orbital electron spin-paired mass couples to phonons (0)

2) 1FC 3D/4D flux paired mass D*/H* couples to 1)

3) Missing step = magnetic gamma state coupling Nj couples to 2)

Steps: 1:2:3 are coupled. The weight of the phonons increases with temperature whereas H*/D* are only marginally affected by T and of course gamma states “never”. The experiments show that the optimal coupling weight can change more than 1keV /degree C. Such a high sensitivity explains that even careful reproduction of an experimental setup easily can fail if e.g. the sea of coupled phonons is to small or the temperature at the reaction zone has drifted by some degrees.

13.3 The Mizuno situation

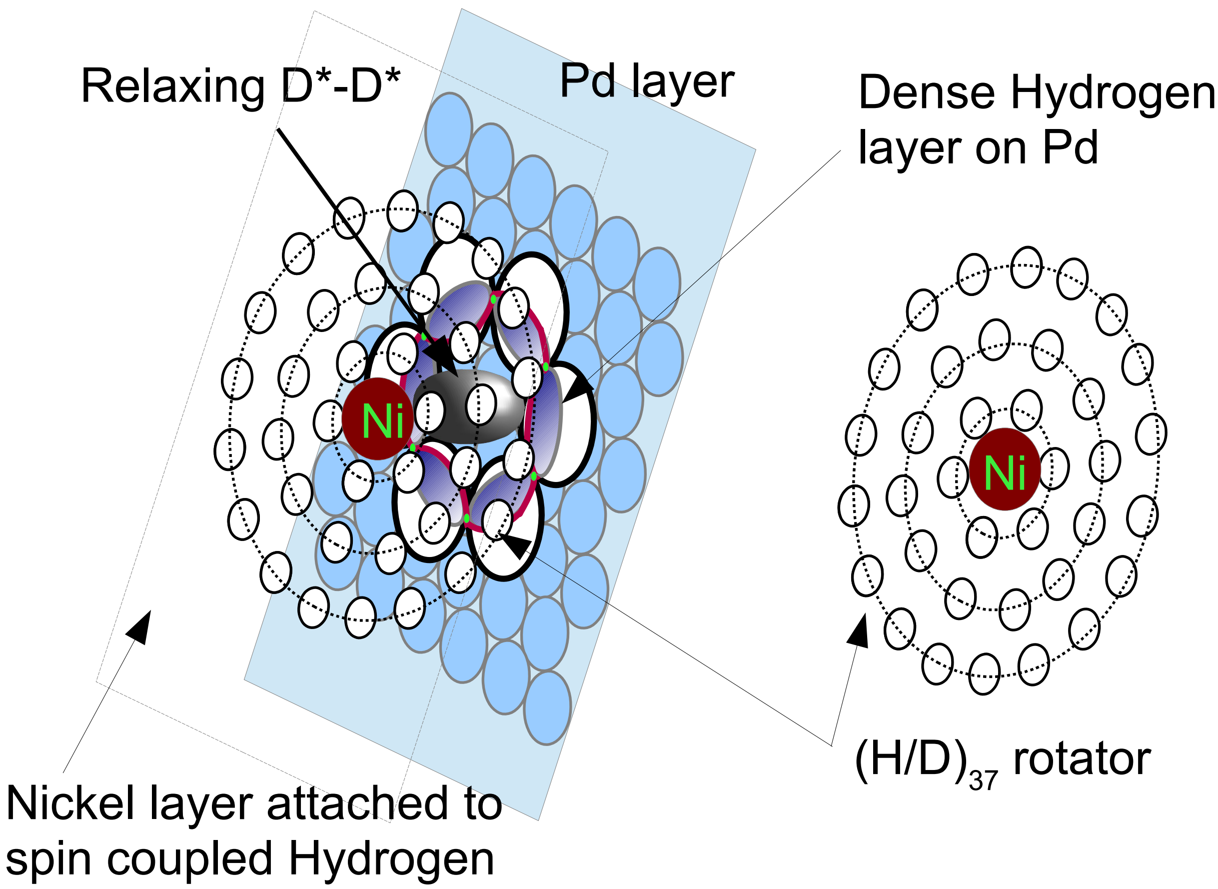


Fig.5 The Ni-D*-PD system

Nickel, Palladium is an ideal combination as Pd is known to support the production of dense Hydrogen and Nickel is able to balance up to 10 charges which enables the forming of electron spin based Hydrogen (Rydberg matter). Both ^{61}Ni and ^{105}Pd have ideal, coupling down-scaling moments for the temperature range Mizuno uses.
The D*-D* Nj ^{4}He energy down scaling with ^{61}Ni looks as following 23.6 MeV Nj 67.418keV Nj 1001eV Nj 11eV Nj 0.05..0.07eV. Ideally this is a resonant coupling where all the partners at the low end (1001eV Nj 11eV Nj 0.05..0.07eV) can also couple with multiple weights. The scale factors for each step are in the range of 100..300.
The same path for ^{105}Pd is: 23.6 MeV Nj 38.720keV (319.130keV) Nj 1001eV Nj 11eV Nj 0.05..0.07eV.

The ^{61}Ni 67.418keV state has a long live time of 5.34ns, which seems to help for the final phonon coupling. The ^{105}Pd 38.720keV state can be loaded much faster which avoids a broken pipeline (drain out before reloading) We assume that once a chain is in resonance the full 23.6 MeV drain out into phonon energy.

The much simpler path with cyclotron like coupling is always working in parallel. A field of about 10E13T at the primary fusion radius of 2pm is at 2um still 10E4T and very strong if all nuclei following the strong field axes of Fig.4. get polarized, then the same strength can still be seen at 0.06 mm. Adding a field to a cyclotron orbit is non dissipative, but the associated expansion/shrinking of the electron cloud radius is doing **mechanical work** which is dissipative.

14 Conclusion

We now just know how the most interesting down-scaling path for D*-D* fusion looks like. We have some empirical knowledge how the magnetic gamma state coupling works. Now systematic experiments must be done with a reproducible LENR reaction setup to narrow the parameters of interest, which will us allow to understand the “exact” relation between strength of magnetic moments, relaxation time nuclear charge radius etc..