Atomic nuclei modelled without exotic particles and magic forces

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Abstract -This article proposes a revolutionary solution for the repulsive forces in atomic nuclei by modelling a neutron as a proton around which an electron is orbiting at extremely short ranges. The protons, determining the atomic number of the element, at their turn are supposed to orbit such neutrons at a much larger orbit. This alternative neutron represents energy densities up to 70 TJ/kg, fully consistent with published atomic bomb values. Such a neutron can generate (nuclear) photons along the same principle as (atomic) photons do: by assuming electrons to jump from one to another orbit. The enormous energy of these electrons can create N-photons with electro-magnetic field frequencies in the range 10^{16}-10^{24} Hertz. It has been shown that these frequencies obey the law $E^2 = \eta f$, with $\eta = 4.5x10^{-51}$ J^2s. The photon 'durations' are calculated as 44/f seconds. Both constants are built up of universal constants. The alternative model is also intended to replace the current theory, with which the mass of a particle is determined by applying $m = E/c^2$. It creates an almost infinite number of particle types, all having the same energy density: $E/m = c^2 = 90PJ/kg$!

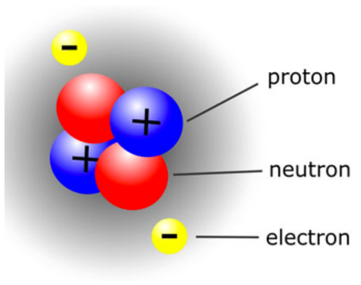
Introduction

The author asked himself the question whether the introduction of the exotic particles called quarks are indeed necessary to hold neutrons and protons in atomic nuclei together, given the enormous repulsive forces between protons. On their turn these quarks need even more exotic particles, called gluons, to hold them together in these protons and neutrons. Such a solution appears to create more problems than solutions for the original problem.

Contents

I Generally accepted configuration of the Helium nucleus

The nucleus of the Helium atom is normally drawn as a combination of two protons and two neutrons grouped together as close as possible. See figure below, being one of a countless number of similar representations.



Important parameter values			
Parameter	**Name**	**Value**	**Unit**
Atomic number	Z	2	NA
Electric charge electron	q	$1,6{\cdot}10^{-19}$	C
Electric charge proton	q	$1,6{\cdot}10^{-19}$	C
Coulomb's constant	k_e	$9{\cdot}10^{9}$	Nm^2C^{-2}
Gravitational constant	G	$6.7{\cdot}10^{-11}$	Nm^2kg^{-2}
Mass proton	m_P	$1.7{\cdot}10^{-27}$	kg
Mass neutron	m_N	$1.7{\cdot}10^{-27}$	kg
Mass electron	m_e	$9.1{\cdot}10^{-31}$	kg
Radius proton	r_{ptron}	$8.7{\cdot}10^{-16}$	m
Radius neutron	r_{ntron}	$8.7{\cdot}10^{-16}$	m

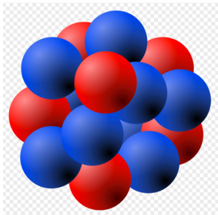
The possible radii of the orbiting electrons are represented by $r_n = n^2 a_0/Z$, with n is an integer and a_0 the so-called Bohr's radius: $a_0 = h^2/(4\pi^2\kappa q^2 m_e)$, $h = 6.626{\cdot}10^{-34}$ kg m^2 s^{-1}.
Variables following from these parameters are:

Parameter	**Name**	**Value**	**Unit**
Smallest radius of Helium atom	r_1	$2.7{\cdot}10^{-11}$	m
Centripetal force between orbiting electron and nucleus	$\kappa Zq^2/r_1^2$	$6.6{\cdot}10^{-7}$	N
Centrifugal force electron	$m_e v^2/r_1$	$6.6{\cdot}10^{-7}$	N
Orbital velocity of electron ($v = q\sqrt{(\kappa Z/m_e r_1)}$)	v	$4.4{\cdot}10^{6}$	m/s
Radius of grouped protons and neutrons (approximately)	r_{ncls}	$2{\cdot}10^{-15}$	m
Repulsive force F_C between protons ($\approx \kappa q^2/r_{ncls}^2$)	F_C	$2{\cdot}10^{2}$	N
Gravitational force F_G between protons or neutrons ($\approx G m_N m_P/r_{ncls}^2$)	F_G	10^{-34}	N

Preliminary conclusions: gravitational forces don't play any role; the radius of the atom is about 30thousand times larger than the radius of the nucleus (on the scale of the figure above, the nucleus has to be drawn as 1 micro meter!) and last but not least: the nucleus as presented has to 'explode' due to the enormous repulsive force, compared with the centripetal force.

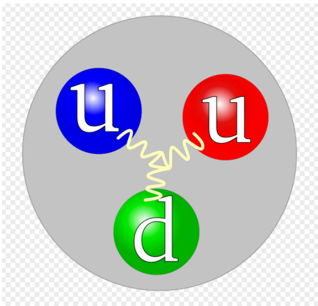
II Solution of quantum physics to prevent the 'explosion' of nuclei

Reference [1] presents the following information:



"An atomic nucleus is shown here as a compact bundle of the two types of nucleons, protons (red) and neutrons (blue). In this picture, the protons and neutrons are shown as distinct, which is the conventional view in chemistry, for example. But in an actual nucleus, as understood by modern nuclear physics, the nucleons are partially delocalized and organize themselves according to the laws of quantum chromodynamics."

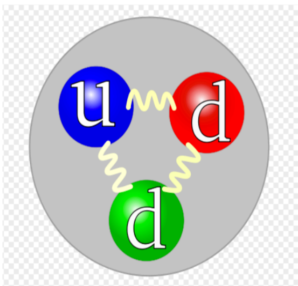
Reference [2] explains what is meant with quarks in a proton



"Three colored balls (symbolizing quarks) connected pairwise by springs (symbolizing gluons), all inside a gray circle (symbolizing a proton). The colors of the balls are red, green, and blue, to parallel each quark's color charge. The red and blue balls are labeled 'u' (for 'up' quark) and the green one is labeled 'd' (for 'down' quark).
A proton is composed of two up quarks, one down quark, and the gluons that mediate the forces 'binding' them together. The color assignment of individual quarks is arbitrary, but all three colors must be present. Electric charge +2/3 e, −1/3 e"

*Net electric charge: 2*2/3 e-1/3 e=1e.*

Reference [3] explains what is meant with quarks in a neutron



"The quark structure of the neutron. There are two down quark in and one up quark. The strong force is mediated by gluons (wavey). The strong force has three types of charges, the so called red, green and the blue. Note that the choice of blue for the up quark is arbitrary; the 'color charge' is thought of a circulating between the three quarks.
Electric charge 0 e $(-2\pm8)\times10^{-22}$ e (experimental limits)"

*Net electric charge is +2/3 e -2*1/3 e=0.*

The mentioned net electric charge of the proton resp. neutron thus is still 1e resp. 0, so the problem under consideration is not yet solved, in fact magnified, because now the quarks, at an even shorter distance between themselves, have to be held together also. If gluons would to solve the last mentioned problem, the question arises why these magic particles are not applied directly to the proton and neutron in the nucleus.

In the next chapter a philosophy is presented that might solve the problem with conventional physics.

III Electron-Proton paradox

Before the announced philosophy will be presented the radius of the electron, playing an essential role in this philosophy, has to be defined.
Reference [4] gives the following background:
"The classical electron radius is a combination of fundamental physical quantities that define a length scale for problems involving electrons interacting with electromagnetic radiation. According to modern understanding, the electron is a point particle with a point charge and no spatial extent. Attempts to model the electron as a non-point particle are considered ill-conceived and counter-pedagogic. Nevertheless, it is useful to define a length that arises in electron interactions in atomic-scale problems. The classical electron radius is given as (in SI units)"

$$r_e = 1/4\pi\varepsilon_0 \cdot e^2/m_e c^2 = 2.8 \cdot 10^{-15}\ \text{m}$$

The decimal numbers have been restricted to one, because the order of magnitude turns out to be much more important than the accuracy of the value.

If this definition would be applied to a proton the result would be:

$$r_P = 1/4\pi\varepsilon_0 \cdot e^2/m_P c^2 = 1.5 \cdot 10^{-18}\ \text{m}$$

This value deviates enormously from the generally accepted radius of a proton ($8.7 \cdot 10^{-16}$ m).
This is the first fundamental reason to reject the definition of the radius of the electron.
The second reason to do so is that the presented radius of an electron is 3 times larger than the generally accepted value of the radius of a proton, while its mass is about 2000 times lower.

In this article it is ***assumed*** that the mass density of an electron and a proton is the same.

Given the mass of an electron resp. proton as $9.1 \cdot 10^{-31}$ resp. $1.7 \cdot 10^{-27}$ kg and given the radius of a proton as $8.7 \cdot 10^{-16}$ m, the radius of an electron is calculated as $7.1 \cdot 10^{-17}$ m

The consequence of this definition is that the electrical charge density of an electron, whether it is expressed in C/kg or in C/m^3, is about 2000 times higher than the one of a proton.

This leaves us with the fundamental question: what is mass?

IV Philosophy about an alternative solution for the 'explosive' nucleus

The atomic model of Bohr in principle solves an equivalent but opposite problem as the one in the nucleus of the atom. In the Bohr model electrons and protons are close together, but do not fuse, by letting the electrons to orbit the gathering of protons in the nucleus. So the unavoidable solution seems to be that the protons in a nucleus have to orbit in order to eliminate their mutual repulse forces. Therefore it is assumed that:

- *a neutron is a proton around which an electron orbits at very short distance*
- *a proton in the nucleus orbit such a neutron at a much larger distance*

N.B.
In an atomic nucleus the number of neutrons is for any element greater or equal to the number of protons. So all protons can orbit a neutron.

The mass of a neutron is nowadays presented as the mass of a proton plus 2.5 times the mass of an electron. In this model it would simply be the sum of these masses.

The two protons will be distinguished symbolically by P_I respectively P_0. P_I is the proton **I**nside the neutron, P_O is the proton **O**utside the neutron. The electron will be named N-electron.

An important condition in this model is that the distance between the both protons is much larger than the distance between the N-electron and P_I, being the orbital radius.
Such a condition significantly decreases the repulse force between these two protons.
By modelling all the P_O's, represented by the atomic number Z, as orbiting a neutron the repulsive forces in the nucleus will completely be eliminated, solving the problem of the 'explosive' nucleus.

Considering the N-electron as a kind of shield between both protons it is assumed that the distance between the N-electron and P_O determines the attractive force between these two particles. So if the radius of the orbit of the N-electron is represented by r_{Ne} and the one of P_O by r_{PO}, the meant distance is $r_{PO} - r_{Ne}$. As a result there are three centripetal forces acting on P_O:

1 the repulsive force from P_I ($-\kappa q^2/r_{PO}^2$), from now on written as F_{POPI}
2 the attractive force of the N-electron ($+\kappa q^2/(r_{PO} - r_{Ne})^2$), from now on written as F_{PONe}
3 the fully negligible gravitational force between both protons.

The net result of the two remaining force $F_{PONe} - F_{POPI}$, from now on written as F_{net}, has to keep P_O in its orbit, balanced by the centrifugal force $m_P v_{PO}^2/r_{PO}$ as the result of its orbiting velocity v_{PO}.

So: $m_P v_{PO}^2/r_{PO} = F_{net}$ by approximation

resulting in: $v_{PO} = \sqrt{(F_{net} r_{PO}/m_P)}$.

The condition $r_{PO} >> r_{Ne}$ can be translated to the condition $v_{Ne} >> v_{PO}$, with v_{Ne} the orbital velocity of the N-electron.
Such a kind of shield of the N-electron around the proton P_I contributes to the reduction of the repulsive force between P_o and P_I.

V Investigation of the feasibility of the alternative atomic nucleus model

V.1 Condition: v_{Ne} much higher than v_{PO}

To investigate this condition all the mentioned variables in chapter IV will be calculated. That means that the calculations start with a value of r_{Ne} in the range 10^{-15} up to 10^{-12} m.

Variable	description	mathematical expression		dimension
r_{Ne}	orbital radius N-electron	value to be selected		m
F_{Ne}	centripetal force N-electron	$\kappa q^2/r_{Ne}^2$		N
v_{Ne}	orbital velocity N-electron	$\sqrt{F_{Ne}r_{Ne}/m_e}$	1)	m/s
r_{PO}	orbital radius P_O , chosen as:	10,8,6,4 and 2 times r_{Ne}		m
F_{POPI}	repulsive force P_O versus P_I	$\kappa q^2/r_{PO}^2$		N
F_{POe}	attractive force P_O versus N-e	$\kappa q^2/(r_{PO} - r_{Ne})^2$		N
F_{net}	net force on P_O	F_{Poe} - F_{POPI}		N
v_{PO}	orbital velocity P_O	$\sqrt{F_{net}r_{PO}/m_P}$	2)	m/s
with:				
κ	Coulomb's constant	$9.0\cdot10^{9}$		Nm^2C^{-2}
q	electric charge of the electron	$1.6\cdot10^{-19}$		C
m_e	mass of the electron	$9.1\cdot10^{-31}$		kg
m_p	mass of proton	$1.7\cdot10^{-27}$		kg

1) Based on the law for a circular orbit: centrifugal force equals centripetal force.
$m_e v_{Ne}^2/r_{Ne} = \kappa q^2/r_{Ne}^2 = F_{Ne}$, so $v_{Ne} = \sqrt{F_{Ne}r_{Ne}/m_e}$

2) $m_P v_{PO}^2/r_{PO} = F_{net} /r_{PO}^2$, so $v_{PO} = \sqrt{F_{net}r_{PO}/m_P}$ by approximation

Three situations will be investigated.

1: The minimum value of r_{Ne} is considered as at least the radius of a proton plus the radius of an electron, being at least $8.7\cdot10^{-16} + 7.1\cdot10^{-17} \sim 10^{-15}$ m. See chapter III for the radius of the electron. Table I shows that the criterion $v_{Ne} >> v_{PO}$ has been fulfilled.

r_{Ne}	F_{Ne}	v_{Ne}	r_{PO}	F_{POPI}	F_{PONe}	F_{net}	v_{PO}	v_{PO}/v_{Ne}
1,0E-15	2,3E+02	5,0E+08	1,0E-14	2,3E+00	2,8E+00	5,4E-01	1,8E+06	0,004
1,0E-15	2,3E+02	5,0E+08	8,0E-15	3,6E+00	4,7E+00	1,1E+00	2,3E+06	0,005
1,0E-15	2,3E+02	5,0E+08	6,0E-15	6,4E+00	9,2E+00	2,8E+00	3,2E+06	0,006
1,0E-15	2,3E+02	5,0E+08	4,0E-15	1,4E+01	2,6E+01	1,1E+01	5,2E+06	0,010
1,0E-15	2,3E+02	5,0E+08	2,0E-15	5,8E+01	2,3E+02	1,7E+02	1,4E+07	0,029

Table I : r_{Ne} has the minimum possible value for any atomic number Z

2: The maximum value of r_{PO} is restricted by the minimum orbit of the electron orbiting the nucleus of the atom. In the atom with Z = 1 this radius is $a_0 = 5\cdot10^{-11}$ m. In order to leaf space for the orbiting proton a maximum value for r_{Ne} has been chosen as 10^{-12} m. See Table II for the result. Surprisingly v_{PO}/v_{Ne} is exactly the same as in Table I.

r_{Ne}	F_{Ne}	v_{Ne}	r_{PO}	F_{POPI}	F_{PONe}	F_{net}	v_{PO}	v_{PO}/v_{Ne}
1,0E-12	2,3E-04	1,6E+07	1,0E-11	2,3E-06	2,8E-06	5,4E-07	5,7E+04	0,004
1,0E-12	2,3E-04	1,6E+07	8,0E-12	3,6E-06	4,7E-06	1,1E-06	7,3E+04	0,005
1,0E-12	2,3E-04	1,6E+07	6,0E-12	6,4E-06	9,2E-06	2,8E-06	1,0E+05	0,006
1,0E-12	2,3E-04	1,6E+07	4,0E-12	1,4E-05	2,6E-05	1,1E-05	1,6E+05	0,010
1,0E-12	2,3E-04	1,6E+07	2,0E-12	5,8E-05	2,3E-04	1,7E-04	4,5E+05	0,029

Table II : r_{Ne} has the maximum possible value for atomic number Z = 1

3: The minimum radius of the electron orbiting a nucleus is $4.5 \cdot 10^{-13}$ m (a_0/Z for Z = 118). The value for r_{Ne} roughly belonging to this outcome is 10^{-14} m. Table III shows the result.

r_{Ne}	F_{Ne}	v_{Ne}	r_{PO}	F_{POPI}	F_{PONe}	F_{net}	v_{PO}	v_{PO}/v_{Ne}
1,0E-14	2,3E+00	1,6E+08	1,0E-13	2,3E-02	2,8E-02	5,4E-03	5,7E+05	0,004
1,0E-14	2,3E+00	1,6E+08	8,0E-14	3,6E-02	4,7E-02	1,1E-02	7,3E+05	0,005
1,0E-14	2,3E+00	1,6E+08	6,0E-14	6,4E-02	9,2E-02	2,8E-02	1,0E+06	0,006
1,0E-14	2,3E+00	1,6E+08	4,0E-14	1,4E-01	2,6E-01	1,1E-01	1,6E+06	0,010
1,0E-14	2,3E+00	1,6E+08	2,0E-14	5,8E-01	2,3E+00	1,7E+00	4,5E+06	0,029

Table III : r_{Ne} has the maximum possible value for atomic number Z = 118

In this atom the radius r_{Ne} can only vary between 10^{-15} and 10^{-14} m.

V.2 Verification of the volumes needed to accommodate the alternative nuclei

The volume to accommodate the alternative nuclei is determined by the volume inside the sphere with radius a_0/Z, being: $(4/3)\pi(a_0/Z)^3$ m^3. In this volume at least Z neutron-proton pairs have to fit. The volume of such a pair is much larger than the volume of a single neutron, because $r_{PO} >> r_{Ne}$. For that reason the total volume of all the single neutrons can be neglected relative to the total volume of Z neutron-proton pairs.
So the total volume of these Z pairs has to be smaller than $(4/3)\pi(a_0/Z)^3$ m^3. The volume of one neutron-proton pair is $(4/3)\pi r_{PO}^3$. This volume has to be taken twice as large because adding volumes of spheres requires to take the volume of the cubic inside which this sphere just fits. A sphere with radius r/2 just fits in a cubic of size r. The ratio of these two volumes is ~2.
So a volume of $2Z \cdot (4/3)\pi r_{PO}^3$ has to fit in the volume $(4/3)\pi(a_0/Z)^3$. As a result r_{PO} can be expressed as function of Z: $r_{PO} = (a_0/Z) \cdot (2Z)^{-1/3}$ m.
Such a r_{PO} varies from $4 \cdot 10^{-11}$ m for Z=1 to $7.3 \cdot 10^{-14}$ m for Z = 118. Dividing these outcomes by 10 in order to compare them with possible radii r_{Ne} proves that for Z = 118 this radius still is significant larger than the orbiting radius of the N-electron in the neutron.

Intermediate conclusions:

1 The proposed model of a neutron (an (inner) proton around which an electron is orbiting at a very short distance, ranging from 10^{-15} to 10^{-12} m) need at this moment not yet to be rejected. Neither the model of the atomic nucleus: a neutron-proton pair in which an (outer) proton orbits such a neutron at significant larger distance than the distance between the electron and the (inner) proton of the neutron.

2 For $r_{Ne} = 10^{-14}$ m the magnetic field strength is $\approx 10^{16}$ [A/m]. This field strength multiplied by μ_0 ($4\pi \cdot 10^{-7}$ [NA^{-2}]) results in a magnetic flux density of $\approx 10^{10}$ [N/A.m] or [V.s/m^2] or Tesla. A comparable situation is the strength of a magnetar ("a type of neutron star with an extremely powerful magnetic field): 10^8 - 10^{11} Tesla".

VI Philosophy about orbiting electrons and emitting EM pulses

Reference [5] presents a model of a photon based on the idea that an electron orbiting a nucleus at an inner orbit and jumping to an outer orbit creates a photon. This model also shows that the energy of the photon is not directly generated by the loss of the kinetic energy of the electron, but by the loss of the magnetic energy created by the electron due to its orbit. So two types of energy are converted: the decrease of kinetic energy into the decrease of the magnetic energy and the last one converted into EM-radiation of the photon.

Remark:
The phenomenon potential energy does not play a role in an atomic orbiting system. The background for this conclusion is that the centripetal and centrifugal forces, applied to the orbiting electron, are fully and continuously in balance in such an orbit. The only phenomenon that contains real energy is the kinetic energy of the orbiting electrons and the magnetic energy. The misconception regarding the potential energy in an atom causes an incorrect image of it. The incorrect words below from [6] (**Orbital energy**) have been replaced by the correct ones.

> "In atoms with a single electron ...., the energy of an orbital ...... is determined exclusively by n. The n=1 orbital has the ~~lowest~~ *highest* possible energy in the atom. Each successively higher value of n has a ~~higher~~ *lower* level of energy, but the difference decreases as n increases. For high n, the level of energy becomes so ~~high~~ *low* that the electron can easily escape from the atom."

The ^1_1H atom looks like the here proposed neutron model: an electron orbiting a proton, but at a minimum radius of $a_0 = 5.3 \cdot 10^{-11}$ m, based on the equation: $a_0 = h^2/(4\pi^2 \kappa q^2 m_e)$.
A photon emitted by such an atom generates an EM radiation as shown in table IV. See [5].

n	r_{ne}	v_{ne}	E_{kin}	ΔE_{kin}	f_{hf}	f_{direct}
1	5,3E-11	2,2E+06	2,2E-18			
2	2,1E-10	1,1E+06	5,5E-19	1,64E-18	2,47E+15	2,47E+15
3	4,8E-10	7,3E+05	2,4E-19	1,94E-18	2,92E+15	2,92E+15
4	8,5E-10	5,5E+05	1,4E-19	2,04E-18	3,08E+15	3,08E+15
5	1,3E-09	4,4E+05	8,7E-20	2,09E-18	3,16E+15	3,16E+15

Table IV : Possible frequencies of an emitted photon by a ^1_1H atom

h	Planck constant : $6.6 \cdot 10^{-34}$ kg m^2 s^{-1}
r_{ne}	possible radii of the orbits relative to the nucleus of the ^1_1H
v_{ne}	orbital velocity of the (atomic) electron
E_{kin}	kinetic energy of the (atomic) electron
ΔE_{kin}	decrease of E_{kin} jumping from n=1 to n=i
f_{hf}	frequency of the photon calculated as $\Delta E_{kin}/h$
f_{direct}	frequency of the photon calculated as $c \cdot R\ (1/n_i^2 - 1/n_{i+1}^2)$
R	Rydberg's constant $mq^4/(8\varepsilon_0^2 h^3 c)$

Several tables like Table IV can be generated by choosing several different atomic numbers Z. The related possible radii of orbiting electrons around the nucleus are given as $r_{ne} = n^2 a_0/Z$. The idea behind this strictly quantitative presentation of the radii is based on the assumption, *for whatever reason*, that the angular momentum mvr_n of the electron is quantized, expressed as: $mvr_n = nh/2\pi$. The minimum value of n is 1, so the minimum angular momentum is assumed to be $h/2\pi$, also written as $\hbar$. But the remark: *for whatever reason*, remains.

It is in principle possible to copy the idea of the quantized radii to the alternative neutron model.

Doing so and striving for the same kind of equation for the emitted frequency for a photon [5]: $\Delta E_{kn} = hf = h \cdot c \cdot Z^2 \cdot R(1/n_1^2 - 1/n_2^2)$, the value for h has to be decreased, because it is the only parameter in a_0 that can be changed. This can be done by dividing h by an arbitrary number.

In this way, the variables f_{hf} and f_{direct}, as shown in Table IV, turned out to stay equal to each other. The consequences thus are that such a decreased h is applied to the minimum orbit a_0 via h^2, to the Rydberg constant via h^{-3} and directly to $E=hf$.

Given the fact that the atomic orbits depend on Z by the relation $r_{ne} = n^2 a_0/Z$, leaves us with the conclusion that the larger the number Z of neutron-proton pairs is, the smaller the volume is in which such a nucleus has to be accommodated. That argues also for a smaller orbital radius in the neutron the larger Z is. For that reason it has been decided to transform h into h/CZ, C yet to be determined. The largest Z (118) applied leads to a minimum radius of a_0/C^2Z^2. The real minimum radius is 10^{-15} m, so $C = (\sqrt{5.3 \cdot 10^{-11}/10^{-15}})/118 = 2$.
The value 2Z is the atomic weight number of an element with atomic number Z and the same number of protons and neutrons in its nucleus! For that reason 2Z has been named W.

Striving for a complete resemblance with the situation of the emission of normal photons, the same kind of quantisation of the orbits of the N-electron has been realized.

The radius of an electron orbiting the nucleus of an atom is expressed as $r_{ne} = n^2 a_0/Z$.
Now that the orbit of the N-electron in the nucleus of an atom with atomic number Z will expressed as $r_{Ne} = N^2 a_0/4Z^2$, the following information about N_{max} can be calculated.

As shown above, $r_{PO} = (a_0/Z) \cdot (2Z)^{-1/3}$ m. Taking for the ease of the calculation $r_{Nmax} = r_{PO}$, leads to: $N^2_{max} = (a_0/Z) \cdot (2Z)^{-1/3}/(a_0/4Z^2) = 2^{5/3} Z^{2/3}$, so $N_{max} = 2^{2,5/3} Z^{1/3}$.

For Z=1, N_{max} = 1.8, rounded to 2. For Z=118, N_{max} = 8.7, rounded to 8, because r_{Nmax} has to be smaller than r_{PO}.

This result strengths the trust in the correctness of the alternative model of the neutron and of the related alternative model of the atomic nucleus, fully resembling the atomic configuration.
For that reason the investigation of the emitted EM-field in case a N-electron in a neutron jumps to an outer orbit, or out of the neutron, is continued.
The frequency of the emitted N-photon has been calculated, via $r_{Ne} = N_e^2 a_0/W^2$, in two ways:

$f_{hWf} = \Delta E_{kin}/h_W = \Delta E_{kin} \cdot W/h$ and $f_{direct} = \boldsymbol{c} \cdot R_W(1/n_i^2 - 1/n_{i+1}^2)$, with $R_W = R \cdot W^3$

Two extreme examples have been chosen. For Z =1 the outcome is indeed only one frequency: $2 \cdot 10^{16}$ Hz. For Z = 118 the outcome is indeed 8 possible frequencies in the range 10^{20}-$4 \cdot 10^{22}$ Hz. Such a result is still promising.

Just for information:

Mega •	Giga •	Tera •	Peta •	Exa •	Zetta •	Yotta	Hertz
10^6	10^9	10^{12}	10^{15}	10^{18}	10^{21}	10^{24}	

However the next chapter shows what is wrong with this ‘surprising’ model.

VII Comparison of theoretical energy densities with practical values

Reference [14] mentions:

> "*The practical maximum yield-to-weight ratio for fusion weapons (thermonuclear weapons) has been estimated to 25 TJ/kg.*"

In order to compare such a number with the outcome of the alternatively modelled atomic nucleus the quantity energy density, in terms Joule/kg, has to be calculated with this model.

To transform the energy of a N-photon in element ${}^{W}_{Z}E$ to the density energy of that element, being the total energy per 1 kg of this element, the Avogadro constant ($6\cdot10^{23}$) will be used. This constant is defined as: W gram of element ${}^{W}_{Z}E$ contains $6\cdot10^{23}$ atoms of that element.

> The background of this constant is in principle plain: the atomic mass unit is defined as $(m_N+m_P+m_e)/2$ leading to m_P+m_e taking the alternative neutron model. Element ${}^{W}_{Z}E$ contains Z protons + electrons plus N neutrons, so W protons + electrons. The atomic mass unit is thus defined as $1.6735328364\cdot10^{-27}$ kg, applying the alternative neutron model. So 1 atom ${}^{W}_{Z}E$ has a mass of $W\cdot1.67...\cdot10^{-27}$ kg. As a result 1 kg of ${}^{W}_{Z}E$ contains $1/(W\cdot1.67...\cdot10^{-27})$ atoms and W kg of ${}^{W}_{Z}E$ contains $1/1.67.....\cdot10^{-27} \sim 6\cdot10^{+26}$ atoms.

The energy density is defined as the energy per kg. 1 kg of element ${}^{W}_{Z}E$ contains $6\cdot10^{26}/W$ atoms, but has N neutrons, because W = Z + N. The conversion factor from the kinetic energy E_{kin} of 1 electron in TeraJoule to this energy density E_d thus is: $(N/W)\cdot6\cdot10^{14}$ kg^{-1}, with N/W ~0,5.
One neutron-electron has a kinetic energy of $E_{kin} = ½m_e v_{Ne}^2$, with $v_{Ne}^2 = \kappa q^2/mr_{Ne}$ Joule.
The maximum E_{kin} in the model under consideration depends on the element, because the radius of the orbit of the N-electron has been chosen as $r_{Ne} = N^2a_0/4Z^2$. Table V shows three examples.

Experiments with hydrogen atomic bombs show that the energy density of this element belongs to the category Uranium. So the 'surprising' model as described above has to be rejected. But the other two elements show a perfect agreement with the above mentioned information:
"The practical maximum yield-to-weight ratio for fusion weapons has been estimated to 25 TJ/kg."

element	r	v	E_{kin}	E_d (TJ/kg)
H	1,3E-11	4,4E+06	8,7E-18	0,003
U	1,7E-15	3,9E+08	6,8E-14	20
Og	9,5E-16	5,2E+08	1,2E-13	36

Table V : Maximum nuclear energy densities for 3 elements

N.B. The maximum energy density of the alternative neutron (N/W = 1) is 70 TJ/kg.

The method of calculating the energy density has been checked by calculating this variable for the *chemical* reaction of hydrogen with oxygen to water. This reaction also produces a large amount of energy, given its application in rocket launchings. Table VI shows the kinetic energy of the orbiting electron in a ${}^{2}_{1}H$ <u>atom</u> at several possible orbits.

n_e	r_{ne}	v_{ne}	E_{kin}	E_d (MJ/kg)
1	5,3E-11	2,2E+06	2,2E-18	654
2	2,1E-10	1,1E+06	5,5E-19	164
3	4,8E-10	7,3E+05	2,4E-19	73
4	8,5E-10	5,5E+05	1,4E-19	41
5	1,3E-09	4,4E+05	8,7E-20	26

Table VI : possible energy densities in a Hydrogen atom

Reference [13] tells that the 'heating value' of hydrogen is 120 á 140 MJ/kg.

So the calculation of the energy densities of the alternative nuclear model is most likely correct.

VIII Detection of elementary particles

The detection of elementary particles is carried out by means of energy detection. The transformation to mass is based on the expression E = mc^2. This expression has also been used to define a new kind of mass unit: eV/c^2. The philosophy is as follows.

Multiplying one kg mass with c^2 results in an energy of $9{\cdot}10^{16}$ Joule. One Joule equals $6{\cdot}10^{18}$ eV. So $9{\cdot}10^{16}$ Joule = $54{\cdot}10^{34}$ eV. This applied in E = mc^2 gives: $5.4{\cdot}10^{35}$ eV = 1 kg · c^2, leading to:

1 kg = $5.4{\cdot}10^{35}$ eV/c^2 and 1 MeV/c^2 = $1.85{\cdot}10^{-30}$ kg. The result is shown in figure 1.

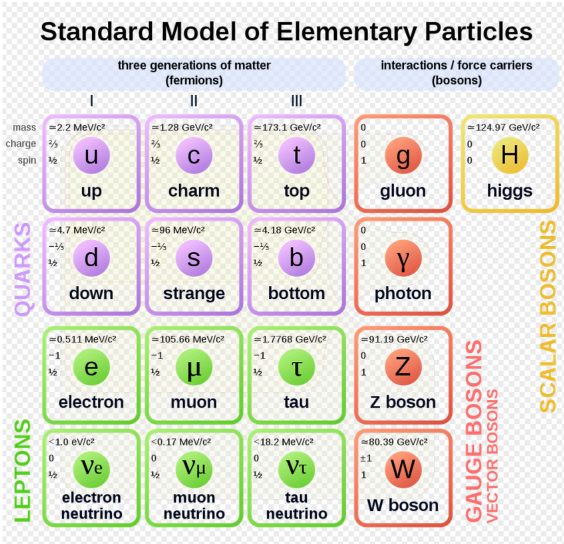


Figure 1: Copied from reference [15]

Table VII shows some examples from figure 1. In this table "Joule" shows kg · $\boldsymbol{c}^2$.
The highest possible energy, being $1.2{\cdot}10^{-13}$ Joule, is the one of the alternative neutron with an electron orbiting at a distance just larger than the radius of the proton, say 10^{-15} m. That shows that the energies related to the particles muon until Higgs in table VII are extremely unlikely.
The maximum energy density of the alternative neutron is $1.2{\cdot}10^{-13}$ J/$1.7{\cdot}10^{-27}$kg = 71 TJ/kg.
The outcome of the modern physics approach is that all elementary particles have the same energy density: 90 PetaJoule/kg! Expressed in J/kg the numerical outcome is E/m = $\boldsymbol{c}^2$!

Particle	MeV/c^2	kg	Joule	PJ/kg	v/c
electron	0,5	9,3E-31	8,3E-14	90	1,41
up	2,2	4,1E-30	3,7E-13	90	1,41
muon	106	2,0E-28	1,8E-11	90	1,41
charm	1280	2,4E-27	2,1E-10	90	1,41
Z-boson	91190	1,7E-25	1,5E-08	90	1,41
Higgs	125000	2,3E-25	2,1E-08	90	1,41

Table VII : Some examples of detected elementary particles

Speaking about the energy of a particle with a certain mass is only possible if it has a kinetic energy, relative to the detector. This in opposite to the alternative neutron that does have an internal energy. Given the 4 unlikely high Joule values in Table VII, the question arises how these kinetic energies have been detected.
The fact that only the kinetic energy of the particles can have been measured, leads to the conclusion that their velocity must be √(2·"Joule"/"kg") in Table VII. The outcome may not be surprisingly: v = $\boldsymbol{c}{\cdot}\sqrt{2}$. Another evidence of the unsustainability of the theories of relativity.

IX Calculation of the frequency and pulse width of nuclear photons

IX.1 Calculation of EM-field strengths and EM-power densities

The amplitude of the sinusoidal shaped magnetic field of the carrier of the N-photon will be represented by A_H, like A_E will be the amplitude of its sinusoidal electric field.
The relation between A_H and A_E is:

$$A_E = Z_v A_H \qquad \text{V/m}$$

where Z_v is the so called characteristic impedance for vacuum.

$$Z_v = (\mu_0/\varepsilon_0)^{½} = 377 \qquad \Omega$$

Based on these two amplitudes the power density of the EM-field is:

$$P_d = A_E/\sqrt{2}\cdot A_H/\sqrt{2} = Z_v A_H^2/2 \qquad \text{VA/m}^2$$

It is assumed that this power density is valid in the surface πr^2, comprised by the orbit r of the electron from which it jumps. So the power P of the N-photon is:

$$P = (Z_v A_H^2/2)\cdot\pi r^2 \qquad \text{W}$$

In order to be able to calculate the energy of such a photon, this power has to be multiplied with its length, expressed in seconds. This length will be represented by the name pulse width, abbreviated as plsw. This name originally comes from the radar technic, where such a pulse is generated with mutually independent power, pulse duration and frequency.

The energy of the photon can now mathematically be represented by:

$$E = \text{plsw}\cdot(Z_v A_H^2/2)\cdot\pi r^2 \qquad \text{Joule}$$

IX.2 Calculation of the pulse width

In the next situation a jump of the electron from orbit n_i to n_j in the alternative neutron will be considered. In such a situation holds: $v^2 = q^2\kappa/mr$. During the jump of the electron the

magnetic field jumps from: $H_i = q^2(\kappa/m)^{½}/4\pi r_i^{2.5}$ to $H_{ij} = q^2(\kappa/m)^{½}/4\pi r_j^{2.5}$

the power density from: $Z_v A_{Hi}^2/2$ to $Z_v A_{Hj}^2/2$

and the power from: $Z_v A_{Hi}^2/2 \cdot \pi r_i^2$ to $Z_v A_{Hj}^2/2 \cdot \pi r_j^2$

As a result:
The Δ power of the EM field is $\Delta P = (Z_v q^4\kappa/32\pi m)\cdot(r_i^{-3} - r_j^{-3})$

The Δ energy of the photon is $\Delta E = \text{plsw}\cdot\Delta P$

This Δ energy is also the Δ kinetic energy $\Delta E = ½q^2\kappa\cdot(r_i^{-1} - r_j^{-1})$

As a result: $\text{plsw} = 16\pi m q^{-2} Z_v^{-1}\cdot(r_i^{-1} - r_j^{-1})/(r_i^{-3} - r_j^{-3})$ s

In case $r_j >> r_i$: $\text{plsw} = 16\pi m q^{-2} Z_v^{-1}\cdot r_i^2$

IX.3 Two methods of calculating the frequency

IX.3.1 Method 1

Reference [5] shows that for arbitrary Z the ratio plsw/T can be expressed as $8\pi m(hZ_v)^{-1}\kappa a_0$ for all situations in which an electron jumps from the *smallest possible* radius (a_0/Z) far away from this orbit. Assuming that this property can be applied to the nuclear photon means that the emitted frequency will obey this law too, as long as the electron jumps from a certain orbit to an orbit far away from this one. The results for five, theoretically not impossible, orbiting radii are shown in table VIII.

r_N	v_N	E	plsw	f	E(keV)
2,0E-15	3,6E+08	5,8E-14	1,9E-23	2,3E+24	358
2,0E-14	1,1E+08	5,8E-15	1,9E-21	2,3E+22	36
2,0E-13	3,6E+07	5,8E-16	1,9E-19	2,3E+20	4
2,0E-12	1,1E+07	5,8E-17	1,9E-17	2,3E+18	0,4
2,0E-11	3,6E+06	5,8E-18	1,9E-15	2,3E+16	0,0

Table VIII : Pulse widths, frequencies and energies of emitted N-photons

The table shows that f looks like to be proportional to E^2. A mathematical investigation of the relation between E^2 and f results in the following expressions.
Given:

$f = 8\pi m(hZ_v)^{-1}\kappa a_0/plsw$, $plsw = 16\pi mq^{-2}Z_v^{-1}\cdot r_i^2$, $r_i^2 = ¼q^4\kappa^2/E^2$ and $a_0 = h^2/4\pi^2\kappa q^2 m$

the relation **$E^2 = \eta f$**

is found, with: $\eta = 2\pi^2 m\kappa^2 q^4/h = 4.5\cdot10^{-51}$ J^2s

Having found this mathematical expression, the relation $f = 8\pi m(hZ_v)^{-1}\kappa a_0/plsw$ can now be used to express the pulse width of the photon as function of the frequency:

$$plsw = 2h/\pi Z_v q^2 \cdot f^{-1} = 43.6/f \qquad s$$

The equation $E^2 = \eta f$ has been checked by comparing mathematically E^2/η with E/h, using the expressions for a_0 and η in universal constants. The original orbit has to be a_0 in as well the atomic (Z=1) as the nuclear configuration. The frequency f is then indeed η/h^2 and E is η/h Joule.

IX.3.2 Method 2

Reference [5] shows that the equation E = hf is based on the outcome of Rydberg's experiments: $1/\lambda = R(1/n_i^2-1/n_j^2)$, with λ the wavelength of the emitted EM-field and n_i the number of the respective orbits, related to their radii by $r = n_i^2 a_0$, for Z = 1. The assumption is now that the Rydberg expression is also valid for $n_j >> n_i$, resulting in $1/\lambda = R/n^2$, with $n^2 = r/a_0$ and r a radius in the range 10^{-11} until 10^{-15} m. As a result $f = c\cdot R\cdot a_0/r$, with $R=mq^4/8\varepsilon_0^2h^3c$ and $a_0=h^2/4\pi^2\kappa q^2 m$. The final outcome is: $E = q^2/8\pi\varepsilon_0 r$ and $f = E/h = q^2/8\pi\varepsilon_0 rh$. The result in the mentioned range of r is: $f = 1.7\cdot10^{16}$ until $1.7\cdot10^{20}$ Hz, so a much lower *maximum* frequency than in case of method 1.

Reference [12] promulgates:

> *"Frequencies observed in astronomy range from 2.4·10²³ Hz (1 GeV gamma rays) down to the local plasma frequency of the ionized interstellar medium (~1 kHz)."*

For that reason method 2 has been rejected.

Table VIII shows that the mentioned energy of 1 GeV is by far too high.

X Contemplations about nuclear reactions

X.1 Tritium

Ref. [7] presents considerations about nuclear reactions related to Tritium and Lithium.

> "*Tritium symbol ^3_1H, also known as hydrogen-3, is a radioactive isotope of hydrogen. The nucleus of tritium (sometimes called a triton) has one proton and two neutrons. Tritium is used as a radioactive tracer, in radio luminescent light sources for watches and instruments, and, along with deuterium, as a fuel for nuclear fusion reactions with applications in energy generation and weapons.*
>
> $^3_1H \rightarrow {}^3_2He^{1+} + e^- + \nu^-_e$ *ν^-_e is the symbol for an electron antineutrino*"

Comment:

Based on the alternative nuclear model the expression: ^x_yE = y.p + (x-y).(p+e) + ye = x.p + x.e shows that a neutral element ^x_yE contains x protons and x electrons, independent of y.

The nuclear reaction thus shows, applying the alternative model, that a neutron emitted an electron out of the atom, creating a high frequency N-photon and leaving an $^3_2He^{1+}$ ion.

In modern physics an electron antineutrino is supposed to be created.

X.2 Lithium

> "*Tritium is produced in nuclear reactors by neutron activation of lithium-6.* "
>
> $^6_3Li + n \rightarrow {}^4_2He + {}^3_1H$
>
> "*High-energy neutrons can also produce tritium from lithium-7…*"
>
> $^7_3Li + n \rightarrow {}^4_2He + {}^3_1H + n$

Comment:

In both situations the total number of protons and electrons has not been changed after the reaction, applying the alternative model, neither a neutron was split into a proton and electron. Thus no radiation will be detected. Unless a N-electron jumps from an inner into an outer orbit in the same neutron during such a process.

X.3 Carbon-14 decay

Carbon-14 decays into Nitrogen-14, symbolically expressed as: $^{14}_6C \rightarrow {}^{14}_7N + e^- + \nu^-_e$.

In the alternative model a neutron in $^{14}_6C$ emits an electron into the shell of the element under transition generating a N-photon and increasing the number of protons to 7. That changes $^{14}_6C$ into $^{14}_7N$. See X.1 regarding the addition $+ e^- + \nu^-_e$ in the reaction equation.

Quote from Wikipedia, regarding this nuclear reaction:

> "*The emitted beta particles have a maximum energy of 156 keV, while their weighted mean energy is 49 keV.*"

Table VIII shows that the mentioned energies belong to the possible energies of emitted N-photons in the alternative neutron model.

These energies are in modern physics used to calculate the mass of the alleged beta particles by means of E/c^2. The consequence of modern physics approach is that beta particles don't have a constant mass and are therefore undefined.

X.4 Alpha radiation

Reference [10] presents the following considerations.

> "*Alpha decay or α-decay is a type of radioactive decay in which an atomic nucleus emits an alpha particle (helium nucleus) and thereby transforms or 'decays' into an atom with a mass number that is reduced by four and an atomic number that is reduced by two. An alpha particle is identical to the nucleus of a helium-4 atom, ….*"

Comment:
The related symbolic equation is: $^{238}_{92}U \rightarrow ^{234}_{90}Th + ^{4}_{2}He^{?}$
On the left and right hand side of the arrow the total number of protons and neutrons are the same, so no neutron has been split into a proton and an electron. On the left side are 92 electrons. On the right side 90 in Th, so there will be 2 in $^{4}_{2}He^{?}$, resulting in a normal He *atom*, not a He *nucleus*! That would mean that the alpha particle is a normal He atom.

> "*Approximately 99% of the helium produced on Earth is the result of the alpha decay of underground deposits of minerals containing uranium or thorium*."

Comment:
So indeed, no Helium ions/nuclei, but $^{4}_{2}He$ atoms!

> "*Alpha particles have a typical kinetic energy of 5 MeV (or ≈ 0.13% of their total energy, 110 TJ/kg) and have a speed of about 15,000,000 m/s, or 5% of the speed of light*."

Comment:
A Helium atom/nucleus moving with the mentioned speed has indeed a kinetic energy of 5MeV! The shown 110 TJ/kg is not energy, but energy density! The maximum possible energy density is the one of the alternative neutron: 70 TJ/kg. See chapter VII, below Table V.

X.5 Beta-decays

Reference [11] shows examples of the so-called β decays, distinguished in β^- and β^+ decays. The first mentioned one is also presented as electron emission, the second one as positron emission.

" ***β^- decay (electron emission)***

> *An unstable atomic nucleus with an excess of neutrons may undergo β^- decay, where a neutron is converted into a proton, an electron, and an electron antineutrino..: $n \rightarrow p+e^-+\underline{\nu}_e$*"

Comment:
In the alternative neutron model a β^-decay is simply the emission of an electron out of the atom, accompanied by the emission of an N-photon with a frequency $f = E^2/\eta$ Hz.
In modern physics it is described as:

> *"This process is mediated by the weak interaction. The neutron turns into a proton through the emission of a virtual W− boson. At the quark level, W− emission turns a down quark into an up quark, turning a neutron (one up quark and two down quarks) into a proton (two up quarks and one down quark). The virtual W− boson then decays into an electron and an antineutrino."*

Reference [11] also presents:

> *"β^- decay commonly occurs among the neutron-rich fission by-products produced in nuclear reactors. Free neutrons also decay via this process. Both of these processes contribute to the copious quantities of beta rays and electron antineutrinos produced by fission-reactor fuel rods."*

Comment:
See the last sentence under X.3: "The consequence of the modern physics approach is that beta particles don't have a constant mass and are therefore undefined."

"β^+decay and electron capture

> *The nuclear reaction $^{4}_{2}He + ^{27}_{13}Al \rightarrow ^{30}_{15}P + ^{1}_{0}n$ emits a positron, like observed in cosmic rays"*

Comment:
The symbol $^{1}_{0}n$ suggest that this element has no protons neither electrons and 1 neutron. From the point of view of the alternative model, the symbol would be $^{1}_{1}n$, presenting that the element has one proton, one electron and no neutrons, exactly what this model says. The balance of protons and electrons, calculated by the expression: $^{x}_{y}E$ = x.p + x.e, shows that $^{1}_{0}n$ has to be a neutron as proposed in the alternative model. Modern physics presents $^{1}_{0}n$ as a positron symbolically written as e^+ or β^+, according to [8].

Element $^{30}_{15}P$ turns out to be an instable element, with a half-life time of 2.5 minutes changing into $^{31}_{15}P$, "*in decay mode β^+*", according to [9]. In such a case the element $^1{}_0n/^1{}_1n$ seemingly moved to the nucleus of the Phosphor isotope $^{30}_{15}P$. If emission of energy has been detected, then the alternative model would explain this by the emission of a N-photon, as a result of the jump of an electron, belonging to this neutron, from an inner to an outer orbit.

X.6 Gamma radiation

Reference [16] presents: "*Gamma rays are emitted during nuclear fission in nuclear explosions*."
The accompanying figure shows that Gamma radiation is supposed to start somewhere between 10^{19} and 10^{20} Hz, not showing the end. Table VIII shows a theoretical range of 2.10^{16} – 2.10^{24} Hz for N-photons. Reference [5] proves that theoretically a normal, so atomic, photon can have frequencies up to 4.10^{19} Hz. In the range 2.10^{16} - 4.10^{19}Hz both types of radiations can be found.
That may lead to confusion regarding what has to be understood with gamma radiation.

X.7 Geiger - Müller counter

The Geiger – Müller counter is, for example, explained in reference [17].

> "*The Geiger–Müller (G–M) tube is the sensing element of the Geiger counter instrument used for the detection of ionizing radiation*. ....*
> *It is a gaseous ionization detector and uses the Townsend avalanche phenomenon to produce an easily detectable electronic pulse from as little as a single ionising event due to a radiation particle. It is used for the detection of gamma radiation, X-rays, and alpha and beta particles. It can also be adapted to detect neutrons. ....*"

* Ionizing radiation is radiation with such a high energy that it is able to ionize an atom.

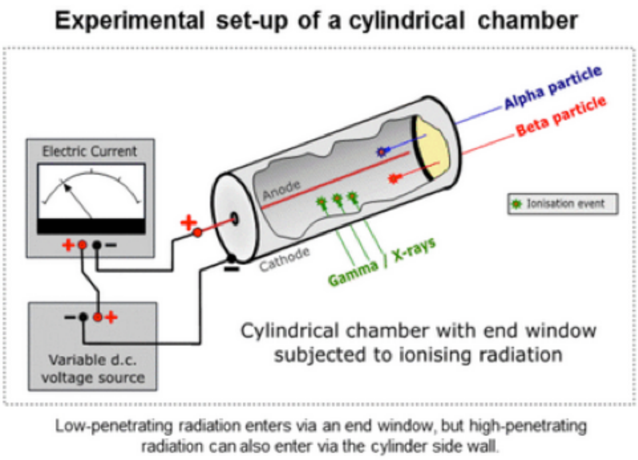


Figure 2: Geiger - Müller counter

Comment:

As has been presented above, a nuclear fusion in most cases causes a nuclear photon, being an EM-wave during a certain very short period. The EM-energy of such a pulse defines its frequency by means of $f = E^2/\eta$. So this energy doesn't have anything to do with kinetic energy.
Kinetic energy is generated where Helium atoms, neutrons, protons or electrons escape from the atomic nucleus. In all these situations the ionizing in the tube of the G-M counter can be activated.

So, whatever the frequency of an N-photon is, emitted by the alternatively modelled atomic nucleus, the G-M counter will detect such a radiation, assumed the energy of such an N-photon is high enough. Given the "specifications" of the G-M detector, most likely all N-photons do have enough energy, to activate it.

Conclusions

The proposed model of a neutron as an electron orbiting a proton at extremely short distance, leads to the following conclusions:

1. The repulsive forces between protons in nuclei are 'eliminated' by assuming that these protons on their turn orbit such neutrons.
2. The exotic particles quarks and gluons, held together by magic forces, have become unnecessary in the alternative model.
3. The proposed neutrons can emit photons, called nuclear-photon, like atoms do when orbiting electrons around the nuclei jump from an inner to an outer orbit. Their frequencies are found in the range 2.10^{16} – 2.10^{24} Hz.
4. In case the electron jumps far away from its orbit the emitted frequency of the nuclear-photon obeys the law $E^2 = \eta f$, with $\eta = 2\pi^2 m\kappa^2 q^4/h = 4.5 \cdot 10^{-51}$ J^2s, m the mass of the electron, q its electric charge, and κ and *h* Coulomb's resp. Planck's constant.
5. In contrast to the large number of different types of particles, which are claimed to be detected in several experiments, the alternative model claims that the energy of these alleged particles has to be interpreted as the EM-energy of nuclear-photons.
6. A closer look at the detection of particles learns that they all have the same energy density c^2 J/kg as a result of the application of $E = mc^2$. That doesn't look reliable.
7. Alpha particles, to be read as normal He atoms/ions, neutrons and electrons are indeed particles that can be emitted during certain nuclear reactions.
8. The alternative model shows that nuclear reactions can create energy densities in accordance with publicly presented values: several tens of TJ/kg.
9. The radius of an electron, based on $\kappa e^2/m_e c^2$, causes a significant contradiction with the generally accepted radius of a proton, applying this expression to a proton.
10. The here presented alternative model of the atomic nucleus claims that:
    - -the atomic mass unit equals the mass of a proton plus electron, so of a neutron,
    - -the atomic weight number is an integer,
    - -the only elementary particles in universe are the proton and the electron.

References

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