Mills's The Grand Unified Theory of Classical Physics (GUTCP) shows amazing equations and calculations that indicate his theory is correct.

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Niels Bohr was close. In 1913, using classical physics, he proposed a model of the hydrogen atom that produced equations that matched the spectrographic light emissions from hydrogen atoms. But the model failed when applied to other experimental data.

So Standard Quantum Physics (SQM)was invented but it uses complex equations to describe the atom. Few people really understand Standard Quantum Mechanics, including most physicists. It can be considered curve fitting since there is no unifying methodology in the derivation of the equations.

Randell Mills has come up with a theory named The Grand Unified Theory of Classical Physics (GUTCP) which uses classical physics to describe the atom that produce equations that match all the experimental data far better than the previous two listed. Equations produced using GUTCP are based on classical physics and special relativity that are applied in a consistent way and result in much simpler equations than Standard Quantum Mechanics.

For example, in the Bohr Model and SQM, the hydrogen is at its smallest size at principal quantum number **n** = 1. But in Mills's GUTCP, the electron in the hydrogen atom can release energy as it drops to smaller sized fractional orbit states (termed hydrinos) such as **n** = 1/2 or **n** = 1/3 or **n** = 1/4 etc. The smallest orbit state is **n** = α = 1/137.035999, (i.e. alpha, the fine structure constant) where the electron is orbiting at the speed of light **c**. Mills terms the electron at this orbit state the *transition state orbitsphere* (TSO) and it is the orbit state at which the energy of the photon is converted into an electron having mass. At that orbit state, five different energy equations for the TSO match Einstein's energy equation for the electron:

$E = mc^2$ = 510998.896 eV.

Those five energies are:

1. **Planck equation energy = 510998.896 eV**
2. **Resonant energy = 510998.896 eV**
3. **Electric potential energy = 510998.896 eV**
4. **Magnetic energy = 510998.896 eV**
5. **Mass/Spacetime metric energy = 510998.896 eV**

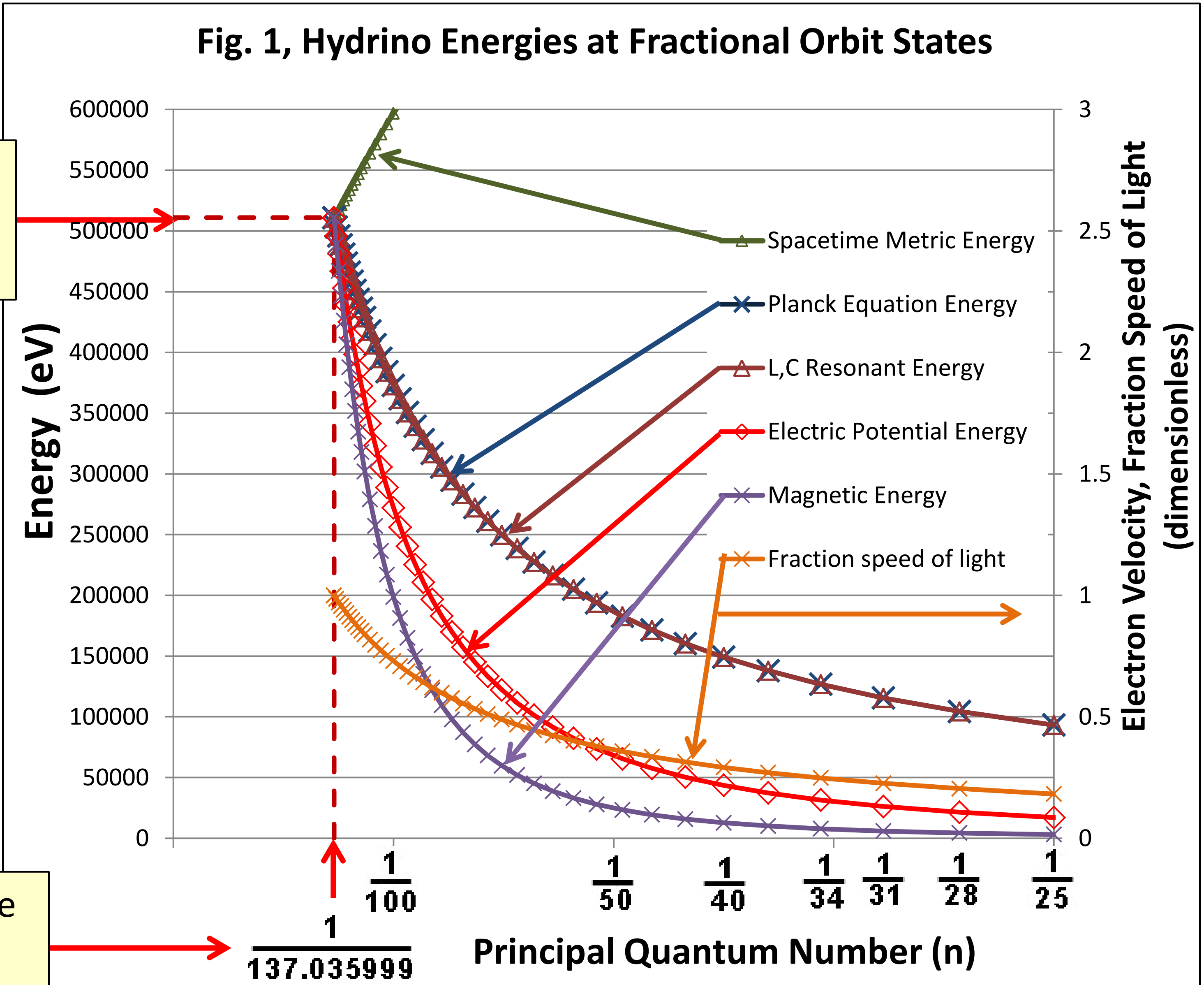
These five energies occur at different times during the process that a photon is converted into an electron and therefore the law of conservation of energy is preserved.

The most dramatic method of showing this is by graphing the different energies of the electron in the hydrogen atom as a function of orbit state **n**. Figures 1 and 2 show that the energies all converge to the rest mass of the electron (510998.896 eV) at orbit state **n** = α = 1/137.035999 (i.e. the orbit state of the TSO). The equations that are graphed are shown on page 10 of this document which is a single page taken from a PowerPoint presentation from Blacklight Power.

Figure 3 shows that when the same equations are adjusted to correspond to the Bohr Model (i.e. using the postulates of the Bohr Model), there is no intersection at 510998.896 eV except for the Electric Potential Energy (note that the other four energies intersect at the square root of the fine structure constant which is 1/11.7). The right hand axis shows the velocity of the electron which reaches the speed of light **c** right at **n** = α = 1/137.035999.

When equations from page 10 are graphed, they all intersect at principal quantum number **n** = $\boldsymbol{\alpha}$ = 1/137.035999, which is the orbit state of the TSO and right where the electron is created!

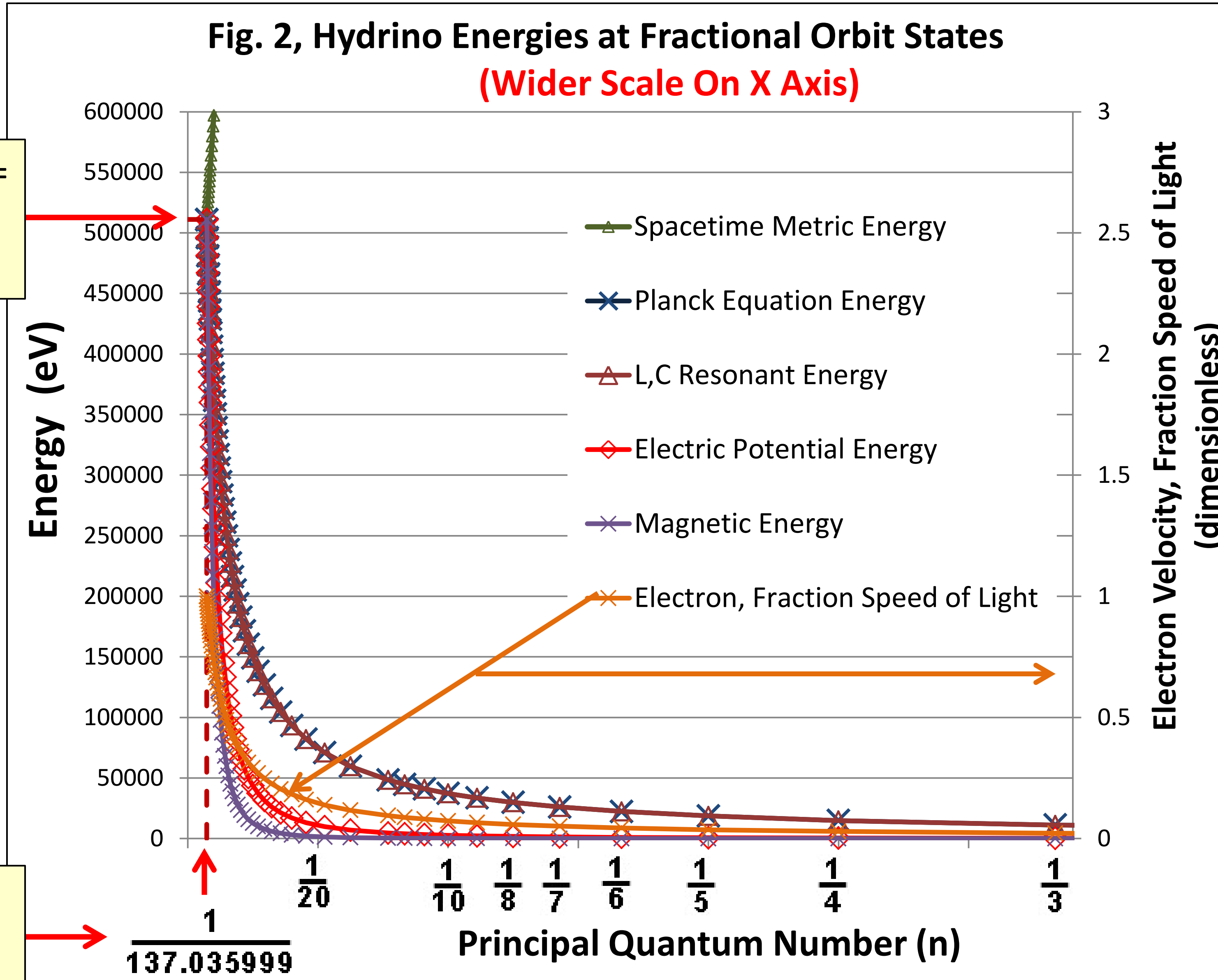
510998.896 eV = rest mass of electron = **mc²**



Transition state orbitsphere (TSO)

α (alpha)

When equations from page 10 are graphed, they all intersect at principal quantum number **n** = α = 1/137.035999, which is the orbit state of the TSO and right where the electron is created!



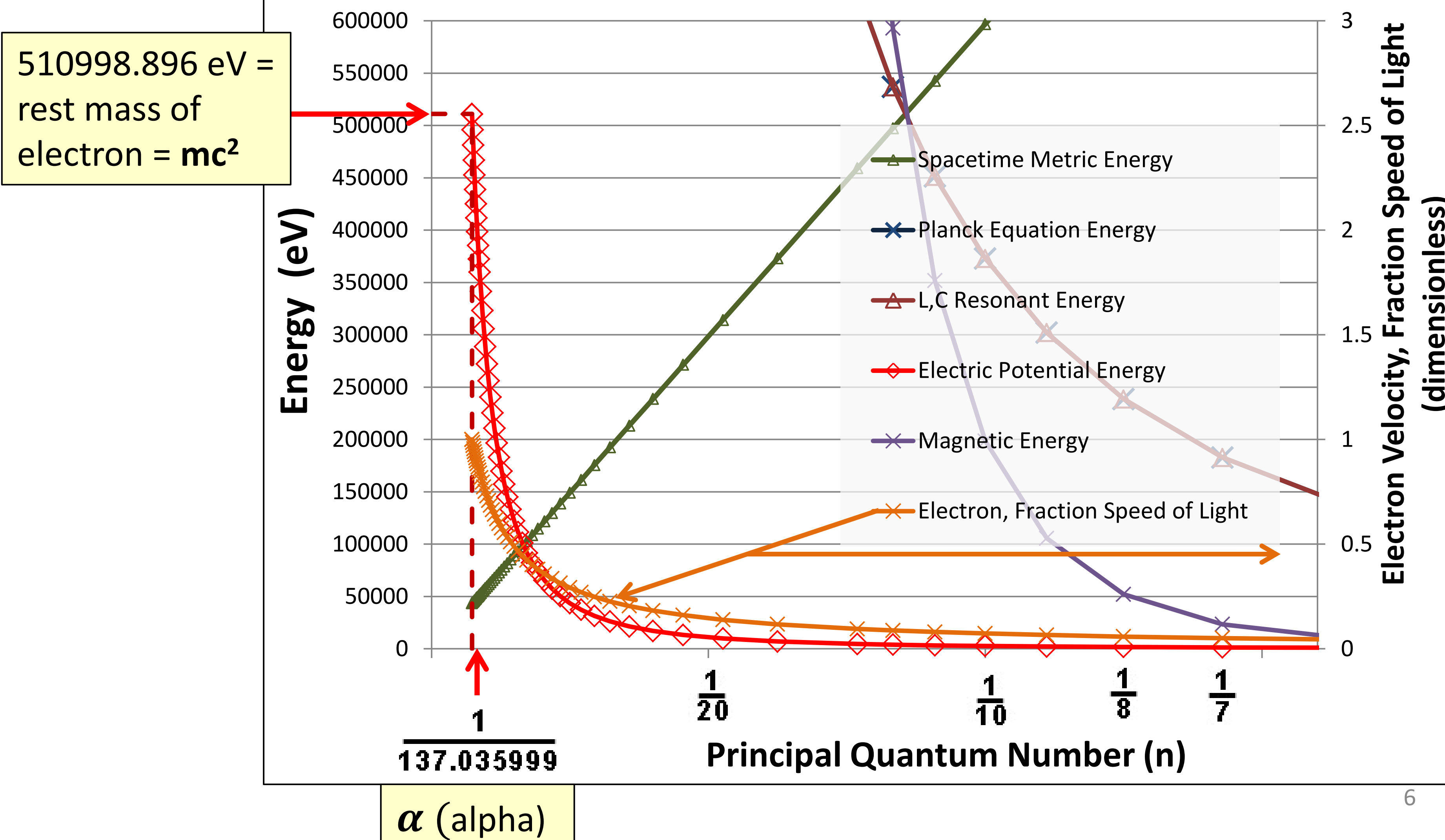
510998.896 eV = rest mass of electron = **mc²**

Transition state orbitsphere (TSO)

α (alpha)

When equations from page 10 are graphed using the Bohr Model assumptions with fractional orbit states there are *no* intersections at 510998.896 eV (except for Electric Potential Energy).

Fig. 3, Bohr Model Energies at Fractional Orbit States (though fractional orbit states are not allowed in Bohr model)



For decades, physicists have struggled with how to interpret the fine structure constant:

Fine Structure Constant (alpha) = $\alpha = \dfrac{1}{137.035999}$

In 1985, Physicist Richard Feynman said the following:

"It has been a mystery ever since it was discovered more than fifty years ago, and all good theoretical physicists put this number up on their wall and worry about it."

"It's one of the greatest damn mysteries of physics: A magic number with no understanding by man"

Fine structure constant $= \alpha = \dfrac{e^2}{\hbar c(4\pi\varepsilon_0)} = \dfrac{e^2 c\mu_0}{2h} = \dfrac{1}{137.035999}$

Where:

- c = speed of light
- e = elementary charge
- h = Planck constant
- $\hbar$ = reduced Planck's constant
- ε_0 = permittivity of free space
- μ_0 = the permeability of free space

$$\textbf{fine structure constant} = \alpha = \frac{1}{137.035999}$$

The value of the fine structure constant and where it comes from is explained by Randell Mills's GUTCP model of the atom. In GUTCP, the principal quantum number **n** for the hydrogen atom can take on integer and fractional values:

$$\text{allowed orbit states for electron in hydrogen atom} = \mathbf{n} = \begin{cases} 1,2,3,4 \ldots \text{infinity} \\ \frac{1}{2}, \frac{1}{3}, \frac{1}{4} \ldots \frac{1}{p} \quad \text{and } p \leq 137 \end{cases}$$

Mills's GUTCP terms the hydrogen atom an "electron orbitsphere" which is a stable hydrogen atom with an electron orbiting a proton at the center and has a spherical shape. It can have a stable fractional orbit state as low as 1/137 according to the "allowed orbit states" listed above. But the absolute lowest orbit state is reserved for a special case of the electron orbitsphere (termed the **transition state orbitsphere or TSO**) which occurs during pair production and is orbit state (i.e. principal quantum number) **n** = $\boldsymbol{\alpha}$ = 1/137.035999.

The **transition state orbitsphere at n =** $\boldsymbol{\alpha}$ has the following properties:

- There is no *proton* at the center but there is a *positron* (the anti-electron) that supplies the central electric field.
- The electron orbits the positron at the speed of light **c** and the orbit velocity is 137.035999 times faster than normal hydrogen in the ground state at **n** = 1.
- The radius of the TSO is 137.035999 times smaller than normal hydrogen in the ground state.
- The electron orbit frequency matches the frequency of a photon having an energy of 510998.896 eV (i.e. the rest mass of the electron).

This document focuses mainly on page 18 from a pdf document that can be found on the website www.blacklightpower.com. The link is:

http://www.blacklightpower.com/wp-content/uploads/theory/TheoryPresentationPt3.pdf

Page 18 of that pdf is shown on the next page.

Also, more details can be found in Mills's GUTCP book, The Grand Unified Theory of Classical Physics (GUTCP). Search for "Pair Production" (Chapter 29). Additional details are also in "Gravity" (Chapter 32) which has a sub section "Particle Production".

Shown below is page 18 of BLP's pdf:
http://www.blacklightpower.com/wp-content/uploads/theory/TheoryPresentationPt3.pdf

Relationship of the Equivalent Particle Production Energies

When the orbitsphere velocity is the speed of light:

Continuity conditions based on the constant maximum speed of light given by **Maxwell's equations:**

(Mass energy = Planck equation energy = electric potential energy = magnetic energy = mass/spacetime metric energy)

source: <u>The Grand Unified Theory of Classical Physics</u>, R. Mills.

$$m_o c^2 = \hbar\omega^* = V = E_{mag} = E_{spacetime}$$

$$m_0 c^2 = \hbar\omega^* = \frac{\hbar^2}{m_0 \lambda\!\!\!^{-}{}_C^2} = \alpha^{-1}\frac{e^2}{4\pi\varepsilon_0 \lambda\!\!\!^{-}{}_C} = \alpha^{-1}\frac{\pi\mu_0 e^2\hbar^2}{(2\pi m_0)^2 \lambda\!\!\!^{-}{}_C^3} = \frac{\alpha h}{1\sec}\sqrt{\frac{\lambda\!\!\!^{-}{}_C c^2}{2Gm}}$$

rest mass energy of electron = 1. Planck equation energy = 3. Electric potential energy = 4. Magnetic energy = 5. Mass/Spacetime metric energy

This is an amazing result of Randell Mills's classical physics!

Table 1. Five energy equations related to the transition state orbitsphere.

#	Energy	Description	Notes
1	**Planck equation energy.**	510998.896 eV is the minimum energy of a photon required to create the electron in the TSO and has a wavelength that matches the circumference of the TSO.	A superimposed photon of at least 510998.896 eV creates the positron so that the minimum total energy of the photon required is 1.02 MeV (i.e. twice 511 keV)
2	**Resonant energy (photon energy equivalent).**	A volume of free space equal to ½ the volume of the TSO has a resonant energy equal to 510998.896 eV.	The other ½ of the TSO volume resonates with 510998.896 eV and creates the positron. Total resonant energy equals 1.02 MeV.
3	**Electric potential energy.**	Electric potential energy of the electron in the hydrogen atom evaluated between TSO radius and infinity is 510998.896 eV.	There is no proton at the center of the TSO but there is a positron that supplies the central electric field.
4	**Magnetic energy.**	Energy in magnetic field of TSO from orbiting *negative* charge currents is 510998.896 eV.	Same applies to positron where energy in magnetic field of TSO from orbiting *positive* charge currents is 510998.896 eV.
5	**Mass/Spacetime metric energy.**	Mass/Spacetime metric energy ties together electric, magnetic and gravitational energy.	

Notes regarding Table 1:

- The rest mass of the electron is 510998.896 eV according to the mass energy equation

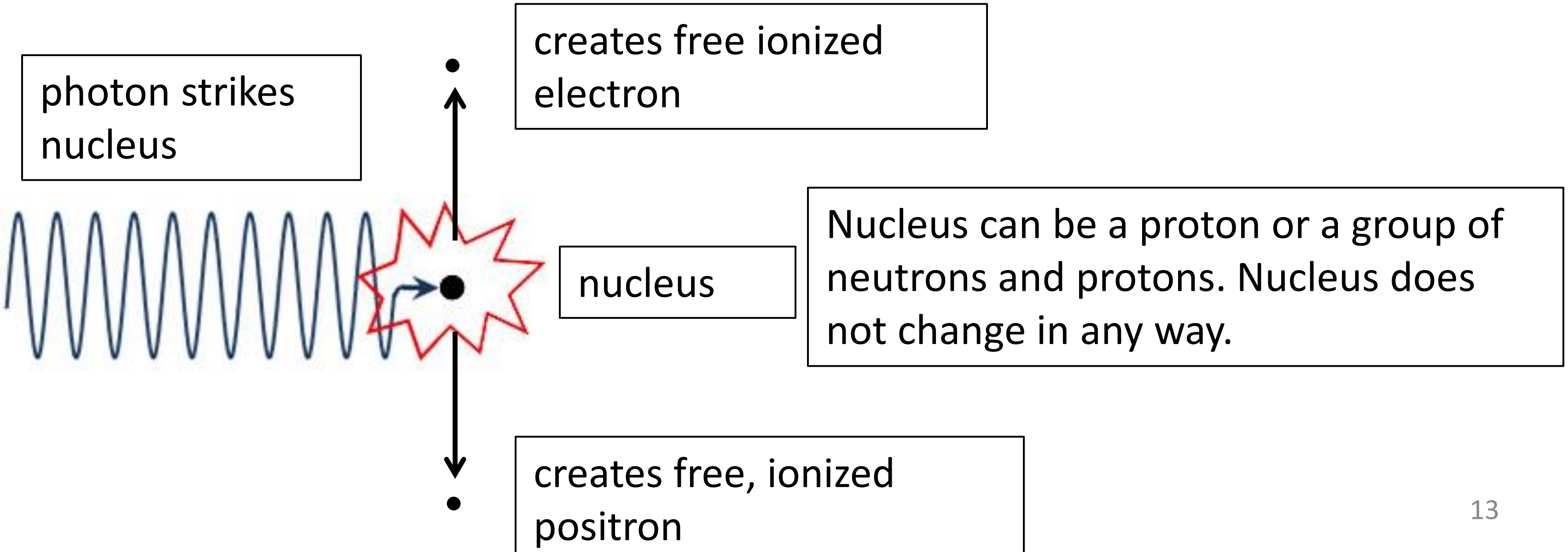
$$E=m_0c^2 = 510998.896 \text{ eV}$$

- The energies listed in Table 1 do not occur at the same instant of time because that would violate the law of conservation of energy. Each energy occurs in a step by step fashion and at a different point in time.
- The resonant energy in Table 1: "2. Resonant energy (photon energy equivalent)" is an energy calculated using the photon energy equation (Planck equation) applied to the resonant frequency of ½ the volume of the TSO.
- GUTCP does not mention that ½ of the TSO volume resonates with the electron and the other ½ resonates with the positron. I only base that on the fact that the resonant frequency equation uses ½ of the capacitance and ½ of the inductance of a sphere that is the size of the TSO. Details are shown in the derivation of that equation in this document.
- The "3. Electric potential energy" uses a formula that matches the hydrogen atom with the proton at the center while the TSO does *not* have a proton at the center. But at one instant of its life, the TSO is made of two concentric spherical orbitspheres – a positively charged positron and a negatively charged electron. The positively charged positron takes the place of the proton in supplying the central electric field and the electric field is in a small gap between the two orbitsphere shells. The electric field energy between these two shells can be written in a form that *matches* the form for the hydrogen atom with the *proton* at the center. GUTCP derives the electric potential energy for the TSO starting at GUTCP Eq. (29.1) and ending with GUTCP Eq. (29.10).

Pair Production: the conversion of energy into matter.

In conventionally accepted physics, a photon can be converted into an electron and a positron (the anti-electron) when it strikes a nucleus and is known as “Pair Production” or “Particle Production”. Quantum Mechanics describes this in a messy and confusing way. But the GUTCP equations that describe this are classical, meaning no quantum theory is involved and it uses Newtonian dynamics and Maxwell’s equations and includes Einstein’s Special Relativity. Much of it can be understood by people with a medium knowledge of physics.

The fact that 5 completely different equations involving the radius of the TSO equate to exactly the rest mass of the electron strongly indicates that Mills has the right theory.



Pair Production

- Photon converted into free electron and free positron (i.e. a pair).
- Requires two superimposed photons each having at least 511 keV that have opposite circular polarization (total 1.022 MeV).
- The superimposed photons strike a nucleus such as a proton or a group of bonded protons and neutrons. The photon has linear momentum which is conserved in the collision with the nucleus.
- "Transition state orbitsphere" (TSO) is created at orbit state **n** = $\boldsymbol{\alpha}$ = 1/137.035999 (i.e. the fine structure constant) with radius equal to: $r = na_0 = \alpha a_0$
- For an electron at **n** = $\boldsymbol{\alpha}$, "matter and energy are indistinguishable by any physical property" according to GUTCP.
- The transition state orbitsphere lasts for a fraction of a second before creating an electron and a positron that then ionize to infinity. Creates free unbound electron and free unbound positron each having a mass of 510998.896 eV (total mass created equals 1.022 MeV)
- Any excess energy above 1.022 MeV that the photon had is converted into kinetic energy of the nucleus that was struck and the kinetic energy of the positron and electron created (possibly other lower energy photons, but maybe that would violate conservation of angular momentum? I'm not sure).

Conversion of energy into matter (photon converted into an electron).

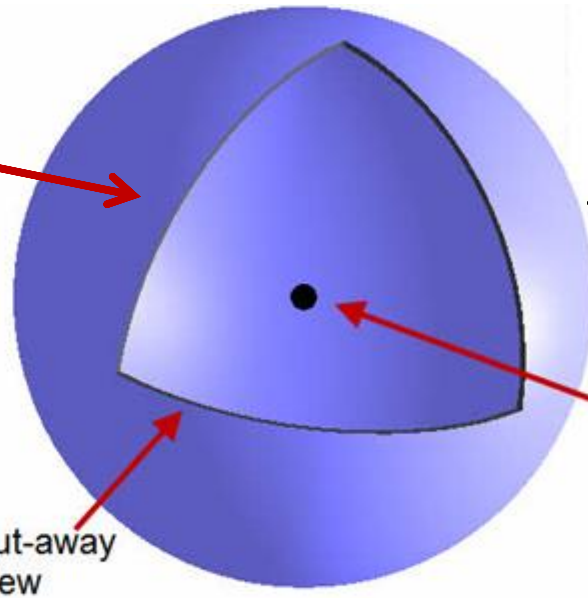
The steps for the conversion of energy (a photon) into matter (an electron and positron) are the following:

Step 1. A photon having an energy equal to or greater than 1.02 MeV strikes some type of nucleus such as a proton. Photon is made of two oppositely circularly polarized photons having at least 511 keV each.
Step 2. This collision causes a volume of space equal to the TSO to resonate between electric and magnetic energy. This resonant frequency matches the frequency of a 510998.896 eV photon.
Step 3. TSO is created and has two superimposed magnetic field energies of 510998.896 eV (one for the electron and the other for the positron) from the positive and negative electric charge traveling in a circular path on the TSO at the speed of light. The orbit frequency of the charge currents on the TSO matches the frequency of a 510998.896 eV photon.
Step 4. The electron velocity (surface charge current velocity) slow down to zero as it ionizes to infinity and the magnetic field energy also drops to zero. The change in electric potential energy is (2) X 510998.896 eV which equals 1.022 MeV at infinite distance apart.

The overall result is that a 1.022 MeV photon (minimum) has been converted into a free ionized electron and a free ionized positron that both have a rest mass of 510998.896 eV.

Definition of the Electron Orbitsphere (for the hydrogen atom with one electron orbiting one proton):

In GUTCP, the electron orbitsphere is a spherical shaped thin shell of negative electric charge that surrounds the positive proton at the nucleus. Charge currents orbit on an infinite number of circular paths around this sphere and the sum of the charge currents amounts to the charge of an electron, -1e (or -1.6021 X 10^{19} Coulombs).

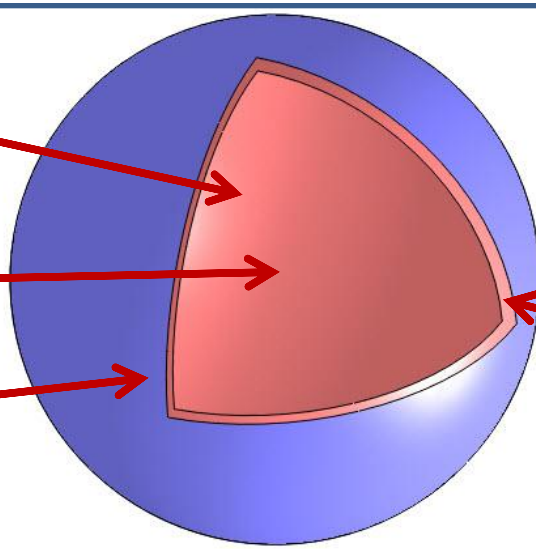


radius: $r = na_0$

Electron Orbitsphere
(bound to proton)

stable (allowed) orbit states:	$n = 1,2,3 \ldots$ infinity ← (normal hydrogen)
	$n = \frac{1}{2}, \frac{1}{3}, \frac{1}{4} \ldots \frac{1}{p}$ where $p \leq 137$ ← (hydrinos)

Definition of the Transition State Orbitsphere (TSO):
The transition state orbitsphere (TSO) is a special case of the electron orbitsphere with principal quantum number (i.e. orbit state) $n = \alpha = 1/137.035999$ (alpha, the fine structure constant) and is the smallest allowable principal quantum number for the electron in GUTCP. The TSO has a radius $r = na_0 = \alpha a_0$ where a_0 equals the Bohr radius which means that the TSO is 137.035999 times smaller than normal hydrogen at principal quantum number **n** = 1 (and the electron orbits at a velocity that is 137.035999 times faster than the **n** = 1 orbit state).
There is *no* proton at the center of the TSO, instead there is a positron (anti-electron) that provides the central attractive force for the electron. The positron and the electron are both orbitspheres that are temporarily superimposed on top of one another with one of them having a radius that is slightly smaller than the other. This is a temporary orbit state during pair production that lasts for a fraction of a second before the electron and positron both ionize out to infinity (i.e. separate from each other to an infinite distance).



radius: $r = na_0 = \alpha a_0$

transition state orbitsphere (TSO)

orbit state: $n = \alpha = 1/137.035999$

The next pages go through the steps of Pair Production and the equations involved.

Pair Production

Two superimposed photons create the TSO with each one having a minimum of 510998.896 eV. The photons are oppositely circularly polarized having a total of 1.022 MeV (minimum) where one creates the electron, the other creates the positron.

Rest mass of the electron.

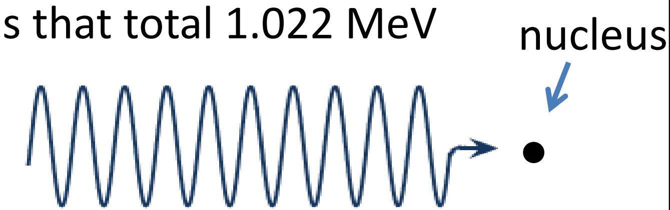
from Table 1

1. Planck Equation Energy $= \hbar\omega = m_0 c^2 = 510998.896\ \text{eV}$

GUTCP Eq. (32.48b)

Details:
The photon strikes <u>any</u> nucleus (such as a proton or a group of bonded protons and neutrons). The linear momentum of the photon is conserved in the collision with the nucleus.

(2) X 511 keV (minimum) photons that total 1.022 MeV



Proof is seen by inserting the equations below into the Planck energy equation on the previous page and making the following two assumptions

1. The photon frequency matches the orbit frequency of the charge currents orbiting on great circles of the TSO.
2. The charge currents travel at the speed of light **c** (see surface current velocity equation on page 29 of this document).

$\omega = 2\pi f$ (angular frequency of charge currents on TSO great circle)

$$\alpha = \frac{e^2}{\hbar c(4\pi\varepsilon_0)}$$ (fine structure constant)

$$f = \frac{c}{2\pi r}$$ (orbit frequency)

$$a_0 = \frac{\hbar^2(4\pi\varepsilon_0)}{m_0 e^2}$$ (Bohr radius)

$r = na_0$ (radius* of TSO, GUTCP Eq. (I.107))

$n = \alpha$ (orbit state)

$\hbar$ = reduced Planck's constant

*Note: This presentation mostly uses the Bohr radius $\mathbf{a_0}$ which does not include the "reduced mass" concept since the equations are used to calculate quantities for the TSO. The TSO does not have a proton at the center and therefore there is no reduced mass correction. See note on page 96 of this document for more details.

This collision causes a volume of space equal to the volume of the TSO to resonate between electric and magnetic energy with a total energy of 1.022 MeV. One half of the volume resonates with 510998.896 eV and creates the electron and the other half resonates with 510998.896 eV and creates the positron.

from Table 1	2. Resonant Energy (photon energy equivalent) $= m_0c^2 = 510998.896eV$

GUTCP Eq. (29.19)

Details:

The collision of the photon and the nucleus (such as a proton) results in a volume of space the size of the transition state orbitsphere (TSO) ringing at its resonant frequency with a magnetic and electric oscillation similar to a resonant **LC** electrical circuit. This resonant frequency is calculated using ½ of the inductance **L** and ½ of the capacitance **C** of a conducting sphere (the bound electron is a conducting sphere) that is the size of the TSO. Multiplying this resonant angular frequency by $\hbar$ (hbar) gives 510998.896 eV.

*Note: I am unsure about the method of inserting the factor of ½ into the capacitance and inductance formulas but it is clear that the factors need to be there. GUTCP does not explicitly state that **½** of the capacitance and **½** of the inductance of a conducting sphere is used. But the **½** factor seems to be implied by the equations in GUTCP* <u>*assuming*</u> *a sphere is the proper geometry that should be used.*

I think this ½ factor comes from the fact that ½ the volume of the sphere resonates for the electron and (independently) the other ½ resonates for the positron. I found the following statement in the Leptons section of GUTCP (Chapter 36) which might back up my reasoning:

*Because **two** magnetic moments are produced, the magnetic energy (and corresponding photon frequency) in the proper frame is two times that of the electron frame. Thus, the electron time is corrected by a factor of **two** relative to the proper time.* [emphasis added]

The quote above can be found just above GUTCP Eq. (36.7) in the chapter on Leptons.

The standard equation for the capacitance of an isolated sphere of radius **r** is

$$C = 4\pi\varepsilon_0 r \qquad \text{(the field lines extend out to infinity)}$$

then insert the TSO radius

$$r = na_0 = \alpha a_0 \qquad \text{(radius of TSO)}$$

so the capacitance becomes

$$C = 4\pi\varepsilon_0 \alpha a_0$$

GUTCP then includes a $\frac{1}{2\pi}$ relativistic factor (see Figure 1.33 in GUTCP) and also includes an *unstated* factor of ½. I am speculating that the ½ factor comes from the fact that ½ of the TSO volume resonates due to the electron (from one 511 keV photon) and the other ½ of the volume resonates due to the positron (from the other 511 keV photon). The capacitance then becomes

(capacitance) $$C = \left(\frac{1}{2\pi}\right)\left(\frac{1}{2}\right) 4\pi\varepsilon_0 \alpha a_0 = \alpha a_0 \varepsilon_0$$ ← See GUTCP Eq. (29.17)

GUTCP uses a similar looking formula for the inductance of the sphere but swaps the permittivity ε_0 factor for the permeability factor μ_0. The inductance of the sphere is

(inductance) $L = \alpha a_0 \mu_0$ ← GUTCP Eq. (29.18)

I was not able to confirm this equation for the inductance of a sphere but GUTCP must be correct since the characteristic impedance of free space is equal to:

$$\text{Characteristic impedance of free space} = \sqrt{\frac{L}{C}} = \sqrt{\frac{\mu_0}{\varepsilon_0}} = 376.7303 \text{ ohms}$$ ← GUTCP Eq. (29.16)

Since there are *no* factors in front of the permittivity constant ε_0 or the permeability constant μ_0 in the equation for the impedance of free space (GUTCP Eq. (29.16)), the conclusion is that those constants are equal and cancel out. This indicates that GUTCP has the correct equation for the inductance **L** assuming the capacitance equation for **C** is correct. Using these equations for capacitance and inductance, the electric and magnetic resonance of a volume of space that equals ½ the volume of the TSO is

$$\text{TSO resonant frequency} = \omega = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{\alpha a_0 \varepsilon_0 \alpha a_0 \mu_0}} = \frac{m_0 c^2}{\hbar} = 7.7634408 \times 10^{20} \text{ rad/s}$$ ← GUTCP Eq. (29.19)

Multiplying this frequency by $\hbar$ (the reduced Planck constant) gives 510998.896 eV.

Where:

ε_0 = permittivity of free space

μ_0 = permeability of free space

$$a_0 = \frac{\hbar^2(4\pi\varepsilon_0)}{m_0e^2}$$ = the Bohr radius

$$c = \frac{1}{\sqrt{\varepsilon_0\mu_0}}$$ = speed of light

$$\alpha = \frac{e^2}{\hbar c(4\pi\varepsilon_0)}$$ = fine structure constant

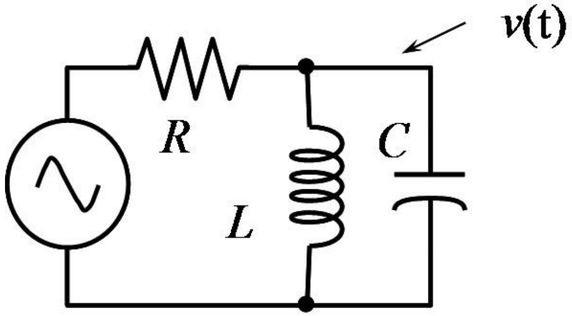
The resonant frequency for the TSO matches the frequency of a 510998.896 eV photon:

$$\omega = \frac{E}{\hbar} = \frac{m_0c^2}{\hbar} = 7.7634408 \times 10^{20} \text{ rad/sec}$$

The calculations show that the resonant frequency of a volume of space equal to ½ the TSO volume matches the frequency of a photon having 510998.896 eV. Therefore Table 1 lists this as “Resonant Energy (photon energy equivalent)”.

The electric / magnetic oscillation of free space during pair production is similar to a parallel LC circuit where the resonant frequency is a function of the capacitance and inductance:

$$\omega = \frac{1}{\sqrt{LC}}$$



The electron orbit velocity slows down to zero as it ionizes to infinity. The magnetic field energy also drops to zero. The *change* in electric potential energy between the positron and the electron in the TSO as each ionizes to infinity is given in GUTCP using an equation that *matches* the form used for the hydrogen atom with the trapped photon (and **1/n** electric field factor) included*. Even though the GUTCP derivation for the electric potential energy is hard to follow, (see GUTCP Eq. 29.1 through Eq. 29.10) it is clear that the electric potential energy for the hydrogen atom approaches 510998.896 eV as the radius approaches **n =** $\boldsymbol{\alpha}$ (alpha = 1/137.035999). The electric potential energy equation for the hydrogen atom has to be multiplied by two to get 1.022 MeV because the electric potential energy calculation for one TSO sized hydrogen atom amounts to 510998.896 eV.

from Table 1

3. Electric Potential Energy $=\Delta PE = \dfrac{e^2}{n(4\pi\varepsilon_0)r_2} - \dfrac{e^2}{n(4\pi\varepsilon_0)r_1} = -m_0c^2 = -510998.896 \text{ eV}$

Evaluated at: r_1 = radius of TSO | r_2 = infinity

see GUTCP Eq. (29.3)

*The TSO doesn't have a trapped photon but the hydrogen atom does. See the discussion near GUTCP Eq. (29.10) for the TSO electric potential energy equation where it includes the multiplication factor α (alpha = 1/137.035999) and says it "***arises from Gauss' law surface integral and the relativistic invariance of charge***"**.**

Details: The electron and the positron in the transition state orbitsphere (TSO) ionize to infinity (i.e. become a free electron and a free positron) with the energy to separate them equal to 2 X 510998.896 eV (1.022 MeV total). GUTCP derives the electric potential energy for the electron in the TSO:

$$\Delta PE = -\frac{e^2}{\alpha^2 (4\pi\varepsilon_0) a_0} = -510998.896 \text{ eV} \qquad \text{(GUTCP Eq. (29.10))}$$

The equation above *matches* the electric potential energy equation for the hydrogen atom. For this document, it will be easier to derive the equation for the hydrogen atom instead of the TSO and the reader can go to GUTCP for the TSO version which can be seen starting at GUTCP Eq. (29.1) and ending with GUTCP Eq. (29.10).

The derivation starts with the equation for change in electric potential energy between the proton and the electron in the hydrogen atom evaluated at $\mathbf{r_1}$ and $\mathbf{r_2}$ where $\mathbf{r_1}$ will be set to the TSO radius and $\mathbf{r_2}$ will be set to infinity

$$\Delta PE = \frac{e^2}{(4\pi\varepsilon_0) r_2} - \frac{e^2}{(4\pi\varepsilon_0) r_1} \qquad \text{(Eq. (A))}$$

In the electron orbitsphere, the charge of the electron is the elementary charge **e** but the electric field that the electron experiences changes with **1/n** for each orbit state **n** due to the "trapped photon".

As a result, in Eq. (A) on the previous page , $\mathbf{e^2}$ becomes $\frac{e^2}{n}$ and Eq. (A) becomes

$$\Delta PE = \frac{e^2}{n(4\pi\varepsilon_0)r_2} - \frac{e^2}{n(4\pi\varepsilon_0)r_1} \qquad \text{(Eq. (B))}$$

Inserting the 5 equations below into Eq. (B) gives $-\mathbf{m_0c^2}$ or -510998.896 eV which is the negative of the rest mass of the electron. The negative sign only means that it needs energy input to move the electron from the TSO orbit out to infinity.

$r_1 = na_0$ (radius of transition state orbitsphere)	$n = \alpha$ (orbit state)
r_2 = infinity	$a_0 = \frac{\hbar^2(4\pi\varepsilon_0)}{m_0e^2}$ (Bohr radius)
$\alpha = \frac{e^2}{\hbar c(4\pi\varepsilon_0)}$ (fine structure constant)	

The TSO has a magnetic field energy of two times 510998.896 eV from the electric charge traveling in a circular path on the surface of the TSO at the speed of light (total of 1.022 MeV). The positive charge currents from the positron creates 510998.896 eV of magnetic field energy and the negative charge currents from the electron creates 510998.896 eV of magnetic field energy*. Also the orbit frequency of the charge currents on the TSO matches the frequency of a 510998.896 eV photon.

from Table 1

4. Magnetic Energy = $$E_{mag} = \frac{\pi\mu_0 e^2\hbar^2}{\alpha(2\pi m_0)^2 r^3} = m_0c^2 = 510998.896 \text{ eV}$$

See GUTCP Eq. (1.162, 29.14 and 32.32b)

Details:

The resonant magnetic and electric oscillation of the TSO transitions into charge currents that travel on an infinite number of circular paths at the speed of light **c** on the surface of the transition state orbitsphere (TSO). Collectively they cover the entire surface of the electron orbitsphere and travel on great circles (a great circle is the largest circle that can be drawn on a sphere). The charge currents create a magnetic field energy and the total magnetic field energy is equal to two multiplied by 510998.896 eV which equals 1.022 MeV (for the electron and the positron). The equation for this magnetic energy is derived in GUTCP. Insert the following equations on the next page into the equation above for proof.

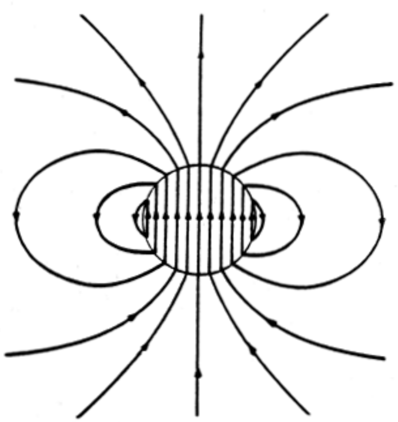
*Question: Do these two magnetic fields cancel each other?? Are they sinusoidally out of phase with each other by 90 or 180 degrees??.

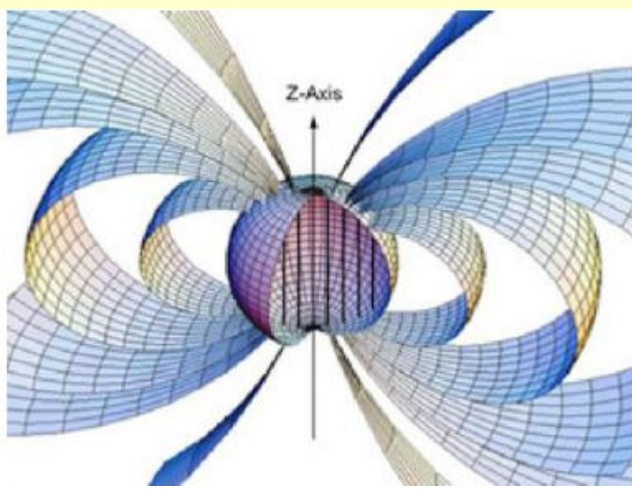
(insert the equations below into the magnetic energy equation on the previous page)

$r = na_0$ (radius of Transition State Orbitsphere)	$\alpha = \frac{\mu_0 e^2 c}{2h}$ (fine structure constant)
$n = \alpha$ (orbit state)	$c = \frac{1}{\sqrt{\varepsilon_0 \mu_0}}$ (speed of light)
$a_0 = \frac{\hbar^2 (4\pi\varepsilon_0)}{m_0 e^2}$ (Bohr radius)	$\hbar$ = reduced Planck's constant

In other words:
The energy stored in the magnetic field of the electron orbitsphere equals 510998.896 eV if the radius is equal to the transition state orbitsphere (TSO).

TSO radius = $r = na_0 = \alpha a_0$ =.00386159 Angstroms





Magnetic field energy = 510998.896 eV (cut-away view)

Image source: The Grand Unified Theory of Classical Physics, R. Mills.

Cut-away view of magnetic field of electron orbitsphere

Orbitsphere surface current velocity:

In the TSO, the velocity of the electron charge currents as they orbit around the proton on the great circles is equal to the speed of light **c**. The velocity equation is derived in The Grand Unified Theory of Classical Physics and it applies at all orbit states **n**. It should be noted that the velocity of the electron in the GUTCP model matches the velocity of the electron in the Bohr Model for the same principal quantum number **n** but the angular frequency is not the same because the radius is different (additionally, the Bohr Model does not allow fractional principal quantum numbers **n**).

$$\text{TSO surface current velocity} = v = \frac{e^2}{n\,\hbar(4\pi\varepsilon_0)} = c$$

Equation is derived in GUTCP and similar version shown in GUTCP Eq. (1.35). Also matches electron velocity equation for Bohr Model.

Proof is seen by inserting following equations into the equation above:

$n = \alpha$ (orbit state)

$$\alpha = \frac{e^2}{\hbar c(4\pi\varepsilon_0)} \quad \text{(fine structure constant)}$$

c = speed of light

This can also be derived by starting with GUTCP Eq. (I.61) (in the Introduction) and inserting the TSO radius $r = \alpha a_0$

In GUTCP, the Mass/Spacetime Metric Energy is equal to

from Table 1

5. Mass/Spacetime Metric Energy	$= \alpha^{-1} \frac{\mu_0 e^2 c^2}{2h} \sqrt{\frac{Gm_0}{\lambda\!\!\!^{-}_C}} \sqrt{\frac{\hbar c}{G}} = m_0 c^2$

GUTCP Eq. (32.48b)

derivation details of Mass/Spacetime Metric Energy are on pages 67-84 of this document

GUTCP writes a similar equation in Eq. (32.48b) and includes the "sec" which seems to be a correction due to the Gravitational constant being off by 0.25%.

$$E = \frac{\alpha h}{1\,\mathrm{sec}} \sqrt{\frac{\lambda\!\!\!^{-}_C c^2}{2Gm}} = m_0 c^2$$

(GUTCP Eq. (32.48b))

GUTCP equates "1 sec" with .9975 seconds. See details related to GUTCP Eq. (32.1.2) and (32.2.1)

Proof is seen by inserting the following equations into the two equations above:

$\lambda\!\!\!^{-}_C = r$	Compton wavelength bar = radius of TSO

$r = na_0$ (TSO radius)

$n = \alpha$ (orbit state)

G = 6.67384 x 10^{-11} $m^3 kg^{-1} s^{-2}$ (gravitational constant)

$$a_0 = \frac{\hbar^2 (4\pi\varepsilon_0)}{m_0 e^2}$$ (Bohr radius)

In this document it was shown that 5 calculated energies related to the transition state orbitsphere are exactly equal to the rest mass of the electron (510998.896 eV).

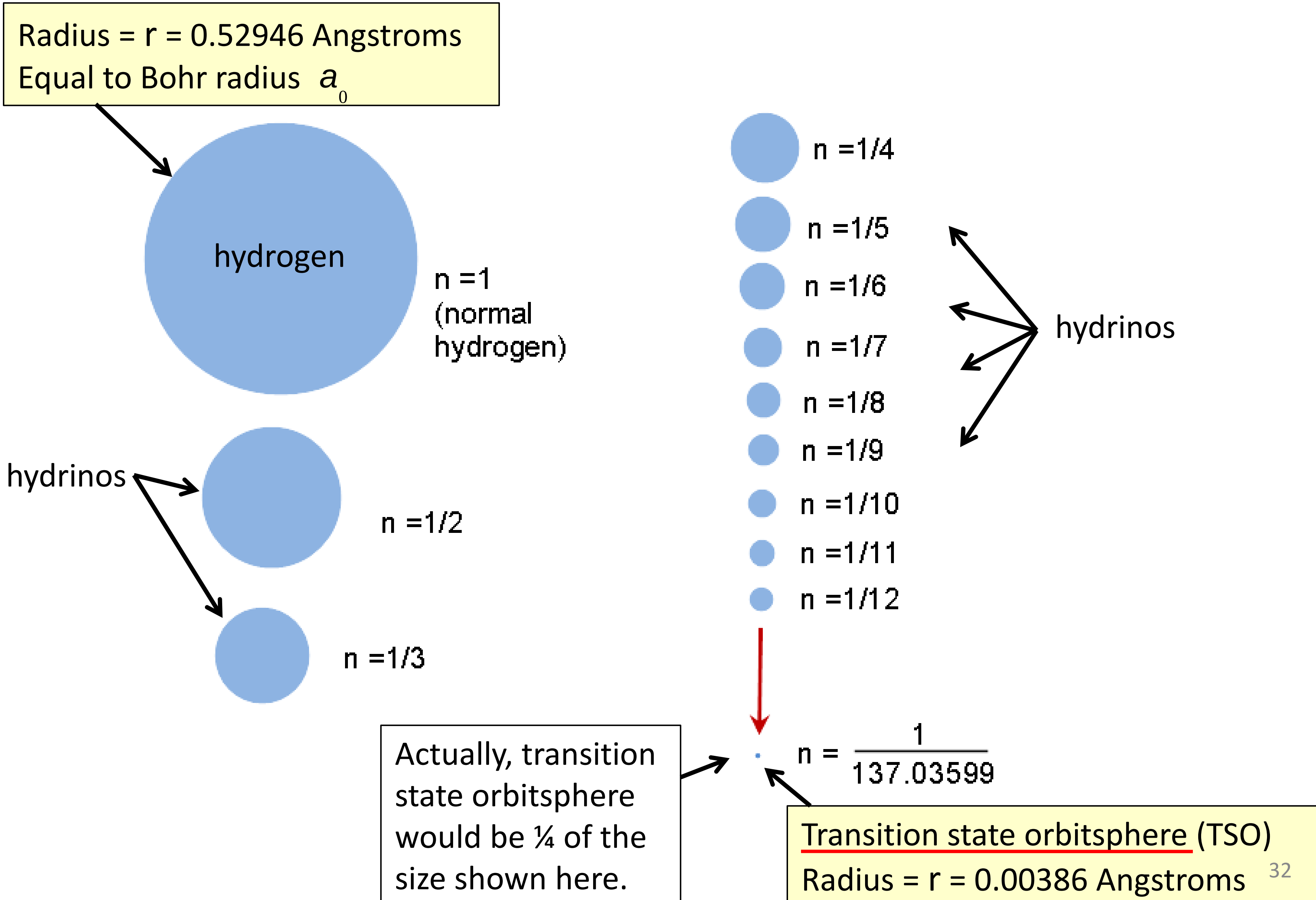
The 5 equations are very different classical equations:

1. **Planck equation energy.**
2. **Resonant energy (photon energy equivalent).**
3. **Electric potential energy.**
4. **Magnetic energy.**
5. **Mass/Spacetime metric energy.**

The equations are completely consistent with a classical approach to atomic theory that includes Special Relativity.

The fact that five calculated energies all equal exactly 510998.896 eV is a strong indication that Randell Mills has the correct model of the atom!

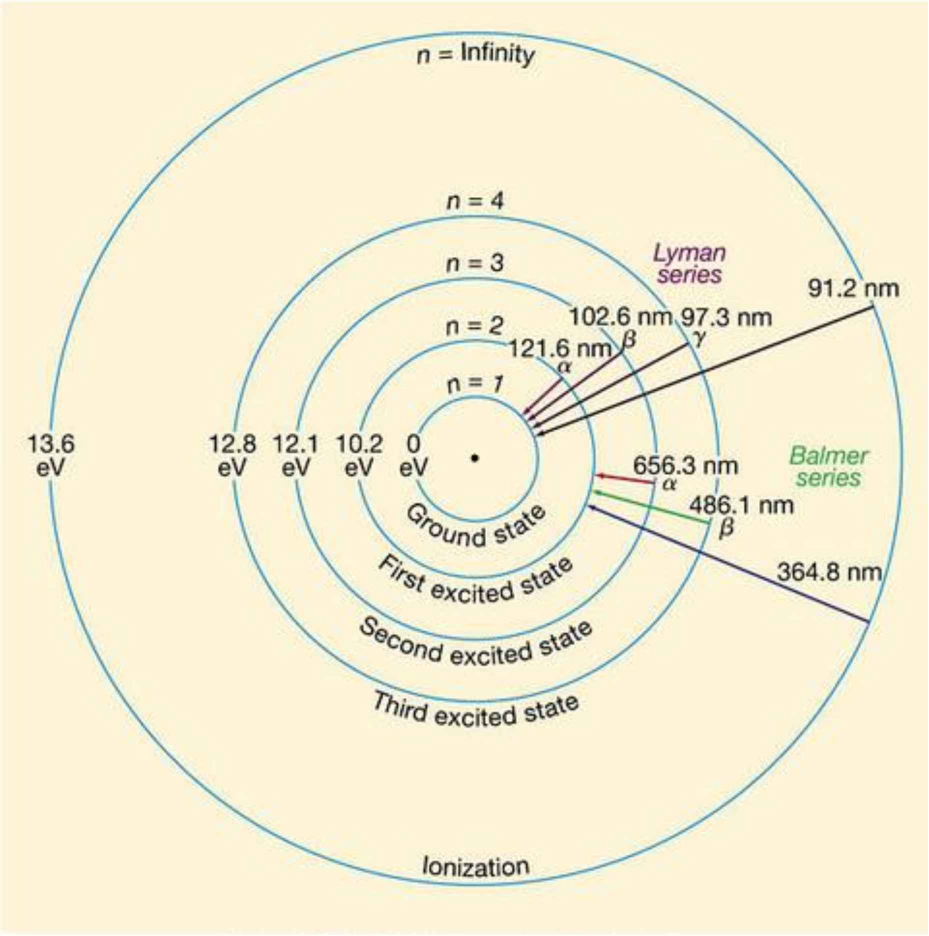
Relative size of hydrogen atoms and hydrinos.



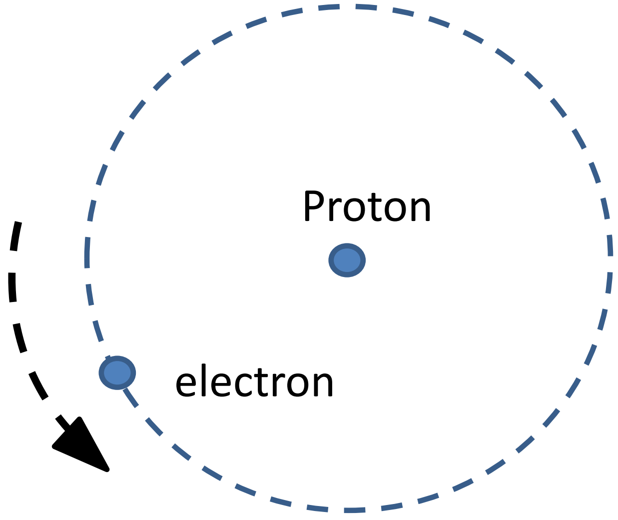
Bohr Model

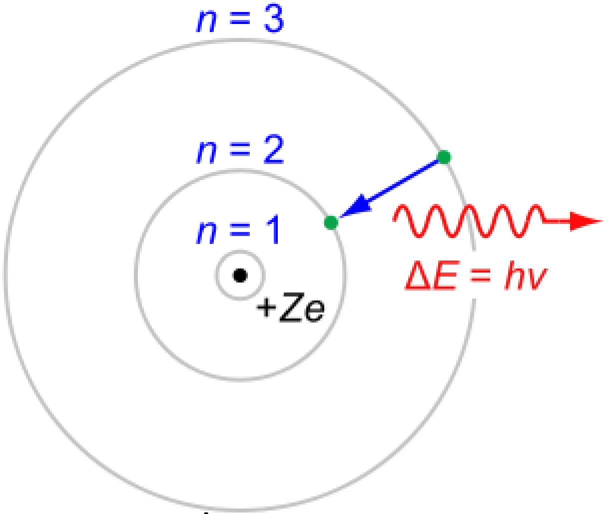
Bohr Model

Successful for simple hydrogen type (i.e. one electron) atoms.



Hydrogen photon emission

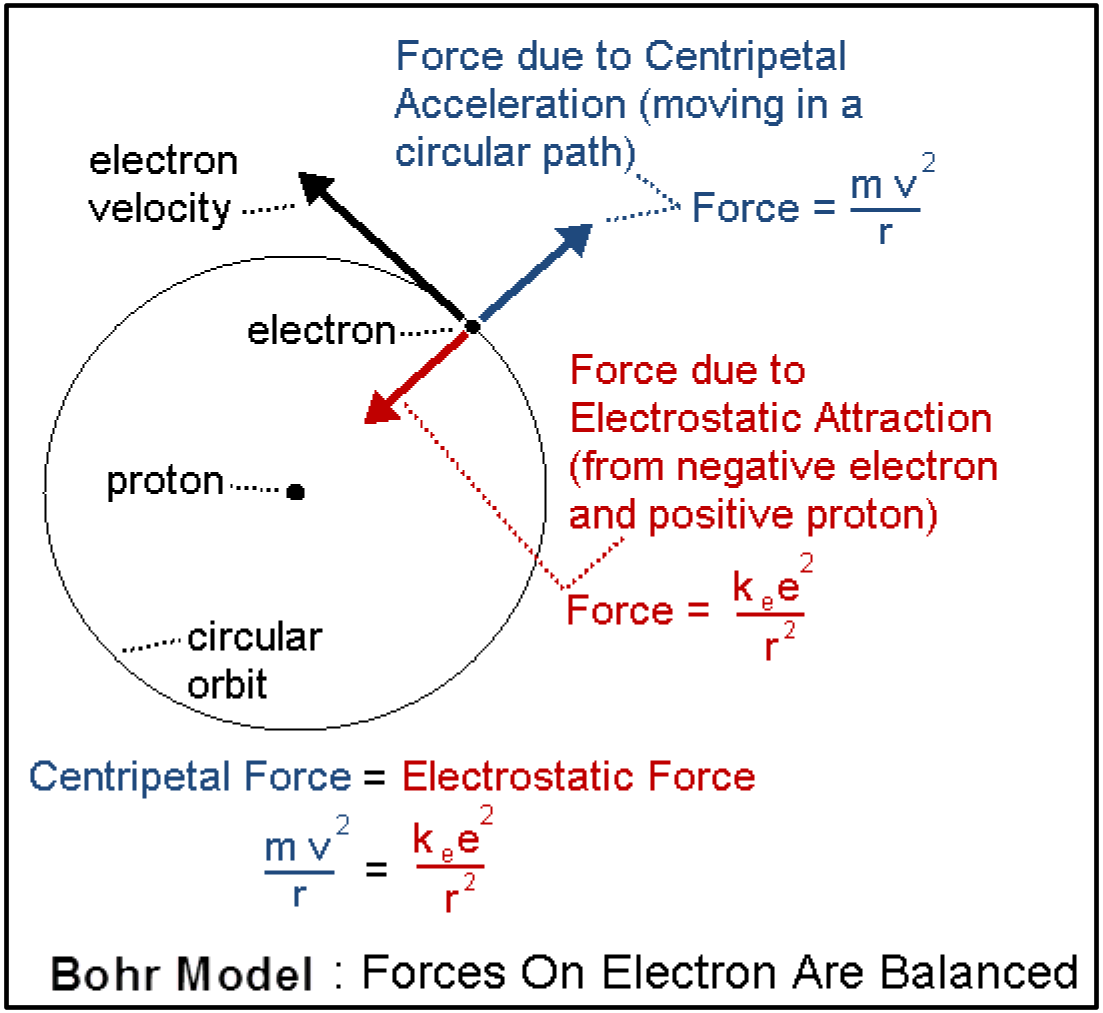




One electron atom photon emission

Bohr Model

- Uses **classical** electrodynamic equations. Does not include Einstein's Special Relativity.
- Successfully calculates the light emission lines of hydrogen and other one electron atoms to an accuracy of 1 part in 2000 (or 1 part in 30,000 with reduced mass concept included).
- Derivation of energy equations starts by setting the centripetal acceleration force equal to the electrostatic force.



Bohr Model: Postulates used in derivation of energy equations:

Angular momentum L for each orbit state **n**:

$$L = mvr = n\hbar$$

(n = 1,2,3,4 … infinity)
L = angular momentum
m = mass
v = velocity of electron (point charge)
r = radius of orbit
$\hbar$ = reduced Planck constant
n = principal quantum number

$$\text{Potential Energy} = -\frac{e^2}{(4\pi\varepsilon_0)\, n^2\, a_0}$$

$$\text{Kinetic Energy} = \frac{e^2}{2(4\pi\varepsilon_0)\, n^2\, a_0}$$

$$\text{Total Energy} = -\frac{e^2}{2(4\pi\varepsilon_0)\, n^2\, a_0}$$

$$\text{electron velocity} = v = \frac{e^2}{n\,\hbar(4\pi\varepsilon_0)}$$

$$\text{electron radius} = r = n^2\, a_0$$

Final Bohr Model equations.

Total Energy equation is used to calculate energy of an emitted photon when the electron drops from one orbit state **n** to a lower orbit state **n** (where **n** is the principal quantum number).

Classical Electrodynamics

- Forces on electric charges and currents described using simple equations.
- Developed in the 1800's by Maxwell and others.
- Includes Maxwell's Equations, Lorentz Force, Coulomb Force, Newton's Equations etc.
- Does not include quantum theory.

Bohr Model

Successful in some areas…

Hydrogen emission lines calculated with 0.05% accuracy (i.e. 1 part in 2000).

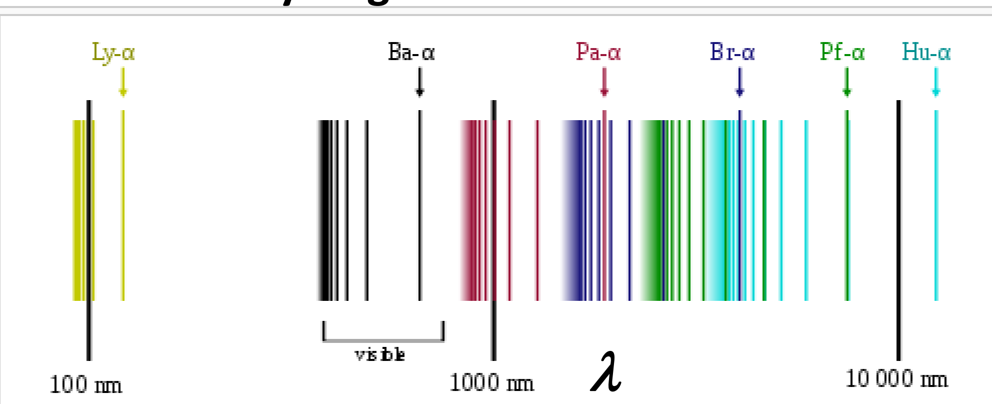
Inverse of photon wavelength equals:

$$\frac{1}{\lambda} = \frac{R_E}{h\,c}\left(\frac{1}{n_f^{\,2}} - \frac{1}{n_i^{\,2}}\right)$$

where

$$\text{Rydberg Energy} = R_E = \frac{e^4 m}{8\varepsilon_0^2 h^2}$$

Hydrogen emission lines

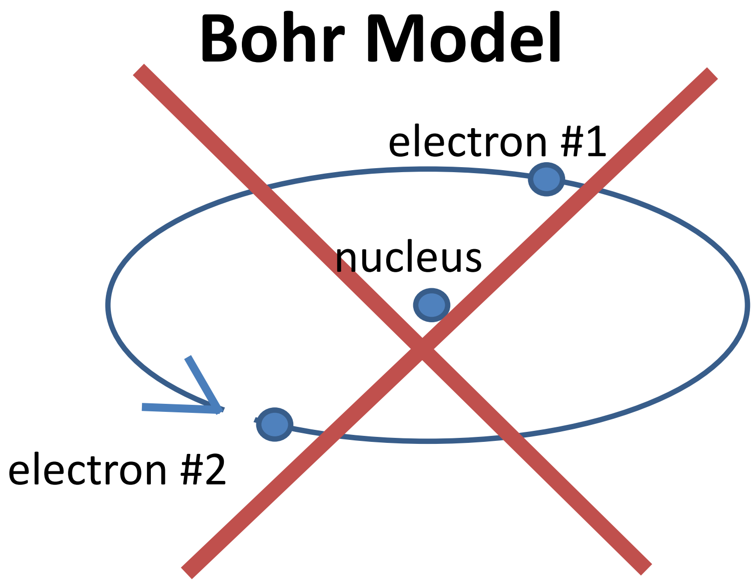


The spectral series of hydrogen, on a logarithmic scale. Photon wavelength

Light Emissions From Hydrogen Atom. Measured Values and Calculated Values Using Bohr Model. Based On Standard Accepted Theory.

1. Electron Orbit Transition n = 1,2,3, … inf.	2. Wavelength Calculated From Bohr Model Equations (nanometers)	3. Wavelength Measurement Using Spectroscopy (nanometers)	4. Series Name
2 → 1	121.50	121.5	Lyman Series
3 → 1	102.52	102.5	
4 → 1	97.20	97.2	
5 → 1	94.92	94.9	
6 → 1	93.73	93.7	
7 → 1	93.03	93	
8 → 1	92.57	92.6	
9 → 1	92.27	92.3	
10 → 1	92.05	92	
11 → 1	91.89	91.9	
infinity → 1	91.13	91.12	
3 → 2	656.11	656.3	Balmer Series
4 → 2	486.01	486.1	
5 → 2	433.94	434.1	
6 → 2	410.07	410.2	
7 → 2	396.91	397	
8 → 2	388.81	388.9	
9 → 2	383.44	383.5	
infinity → 2	364.5	364.6	
4 → 3	1874.6	1870	Paschen Series
5 → 3	1281.5	1280	
6 → 3	1093.5	1090	
7 → 3	1004.7	1000	
8 → 3	954.3	954	
infinity → 3	820.1	820	

But...



Fail

Bohr Model of the atom fails to predict other atomic quantities (including quantities for 2 electron atoms).

As a result, **Standard Quantum Mechanics** was created and it too had problems predicting many quantities.

But **GUTCP** succeeds everywhere including where the previous two models (Bohr Model and Standard Quantum Mechanics) fail.

Randell Mills's

The Grand Unified Theory of Classical Physics (GUTCP)

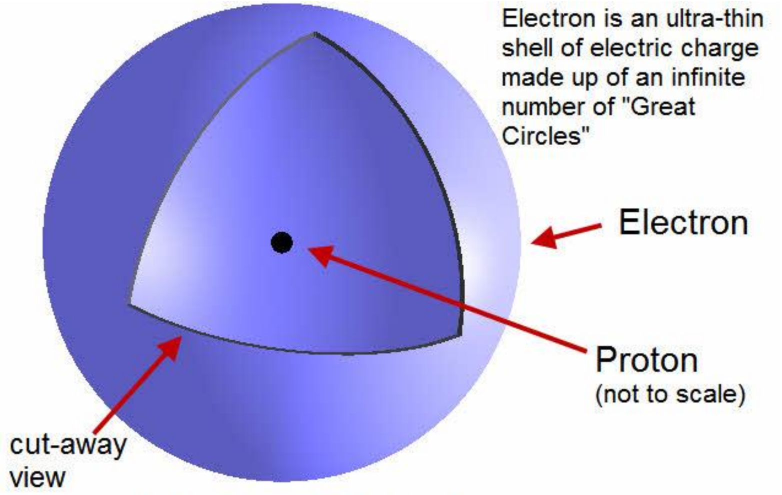
GUTCP is similar to Bohr Model for the hydrogen atom.

Except that GUTCP:

- Includes a "trapped photon" that results in an the electron experiencing an electric charge equal to $\frac{e}{n}$ between the electron and the proton.
- Has a radius $r = n a_0$ (where **n** = orbit state and a_0 = Bohr radius).
- Electron is made of infinitesimal charges and masses that orbit on a sphere.
- Includes relativistic effects (i.e. Special Relativity) .
- Allows integer and fractional principal orbit states

n = 1,2,3,4 … infinity

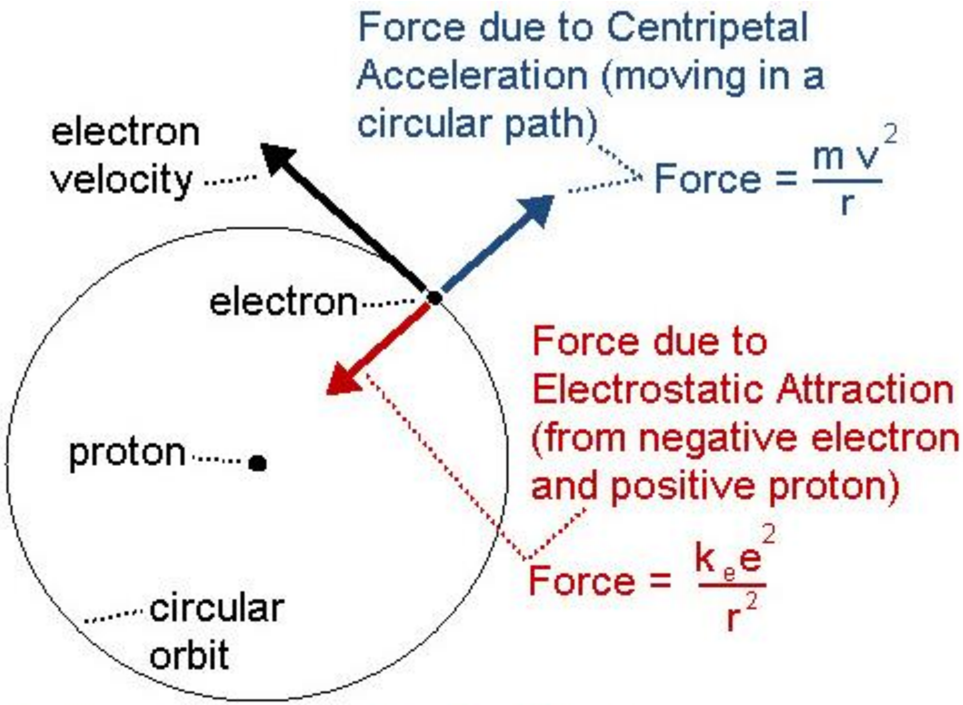
$$n = \frac{1}{2}, \frac{1}{3}, \frac{1}{4} \ldots \frac{1}{p} \text{ where } p \leq 137$$



Electron Orbitsphere

GUTCP

- Uses **classical** electrodynamic equations. Includes Einstein's Special Relativity.
- Matches Bohr model in successfully calculating the emission lines of hydrogen and other one electron atoms (though GUTCP successfully goes much further than this).
- Derivation of energy equations starts by setting the centripetal acceleration force equal to the electrostatic force (same as Bohr model).
- Postulates used in derivation of energy equations are different than the Bohr Model.



Centripetal Force = Electrostatic Force

$$\frac{m v^2}{r} = \frac{k_e e^2}{r^2}$$

Mills's model : Forces On Electron Are Balanced

GUTCP: Postulates used in derivation of energy equations:

$L = mvr = \hbar$	
electric charge experienced by electron	$= \frac{e}{n}$

In the Bohr Model, this is just e, the charge of the proton

$$n = \begin{cases} n = 1,2,3,4 \ldots \text{infinity} \\ \frac{1}{2}, \frac{1}{3}, \frac{1}{4} \ldots \frac{1}{p} \quad \text{and } p \le 137 \end{cases}$$

Where **L** equals angular momentum (**L** = mass*velocity *radius).

$$\text{Potential Energy} = -\frac{e^2}{(4\pi\varepsilon_0)\, n^2\, a_0}$$

Final GUTCP equations.

$$\text{Kinetic Energy} = \frac{e^2}{2(4\pi\varepsilon_0)\, n^2\, a_0}$$

$$\text{Total Energy} = -\frac{e^2}{2(4\pi\varepsilon_0)\, n^2\, a_0}$$

$$\text{electron velocity} = v = \frac{e^2}{n\,\hbar(4\pi\varepsilon_0)}$$

$$\text{electron radius} = r = n\, a_0$$

Total Energy equation is used to calculate energy of an emitted photon when the electron drops from one orbit state **n** to a lower orbit state **n** (where **n** is the principal quantum number).

Note that all equations listed here match the Bohr Model equations except for electron radius.

Classical Electrodynamics

- Forces on electric charges and currents described using simple equations.
- Developed in the 1800's by Maxwell and others.
- Includes Maxwell's Equations, Lorentz Force, Coulomb Force, Newton's Equations etc.
- Does not include quantum theory.

Comparison of Postulates used by Bohr Model and GUTCP during derivation of energy equations.

	Electric field factor between electron and proton	Angular momentum for each orbit state **n** (L = mass*velocity*radius) **L = mvr**	Principal quantum number **n**
Bohr Model	1	$n\hbar$	**n** = 1,2,3,4 ... infinity
GUTCP	$\frac{1}{n}$ (due to trapped photon)	$\hbar$ (reduced Planck constant)	$n = \begin{cases} 1,2,3 \ldots \text{infinity} \\ \frac{1}{2}, \frac{1}{3}, \frac{1}{4} \ldots \frac{1}{p} \text{ and } p \le 137 \end{cases}$

Side Note: The postulate for angular momentum used in the Bohr Model can alternatively be that the circumference of the electron orbit is equal to the principal quantum number **n** multiplied by the electron's de Broglie wavelength while in GUTCP it can be that the circumference of the orbit circle is equal to one de Broglie wavelength at all orbit states **n**. Using this wavelength postulate gives the same result as the angular momentum postulate in this column.

GUTCP model of the atom

Successfully calculates many quantities for the atom such as:

- spectral line emission from the hydrogen atom (same as Bohr Model)
- magnetic moment
- g factor
- spin
- orbital angular momentum
- spin orbit splitting
- Lamb Shift
- fine and hyperfine structure line splitting
- lifetime of excited states
- selection rules
- multi-electron atoms
- ionization energies for atoms with 1 to 20 electrons

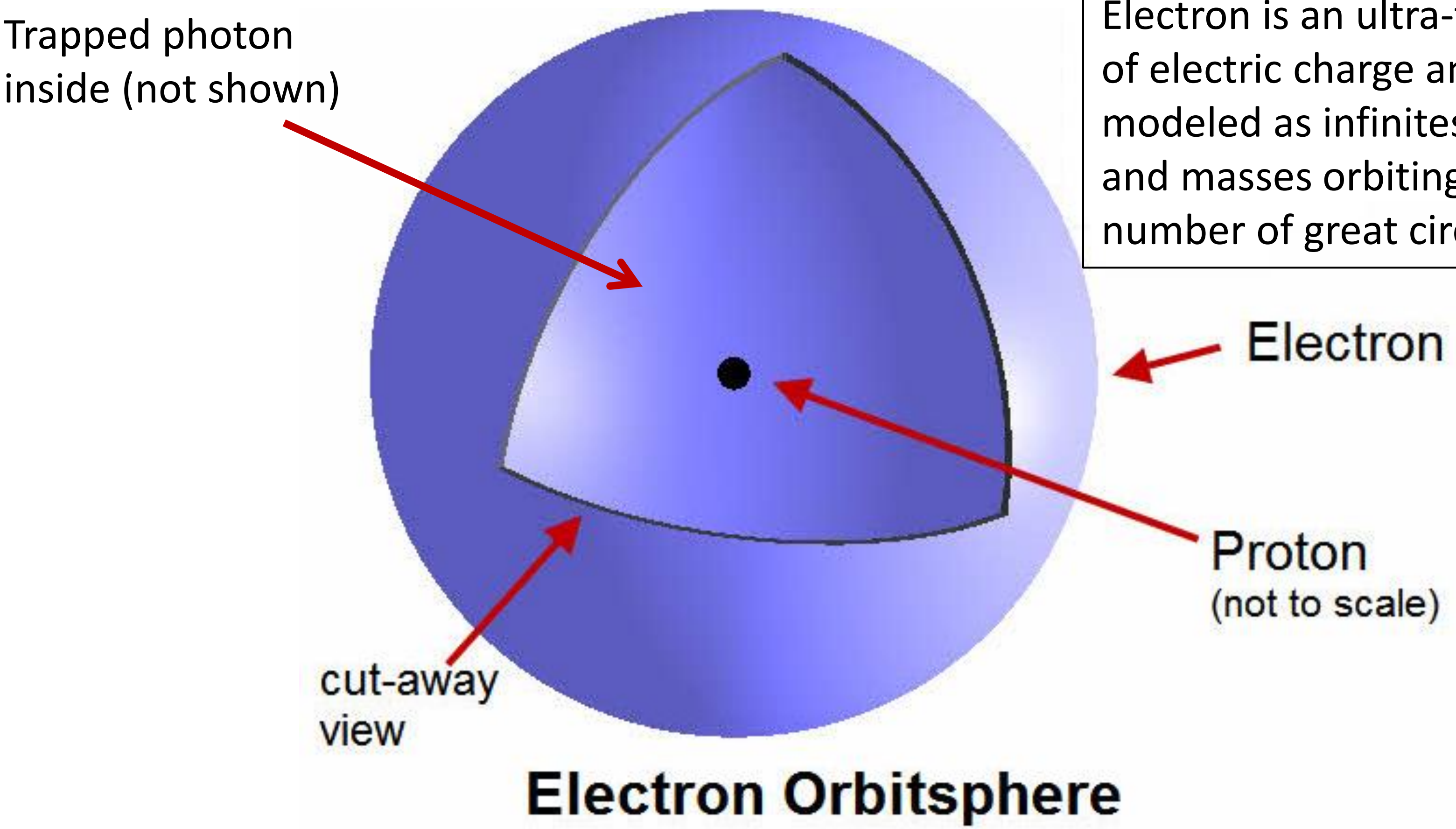
And more using much simpler equations compared to Standard Quantum Mechanics.

GUTCP model of the hydrogen atom:

1.Positive charged nucleus at the center

2.Negative charged electron in the form of a thin spherical shell called an electron orbitsphere.

Electron is an ultra-thin shell of electric charge and can be modeled as infinitesimal charges and masses orbiting on an infinite number of great circles.



The Electron Orbitsphere is the hydrogen atom when the proton is at the center.

Electron Orbitsphere

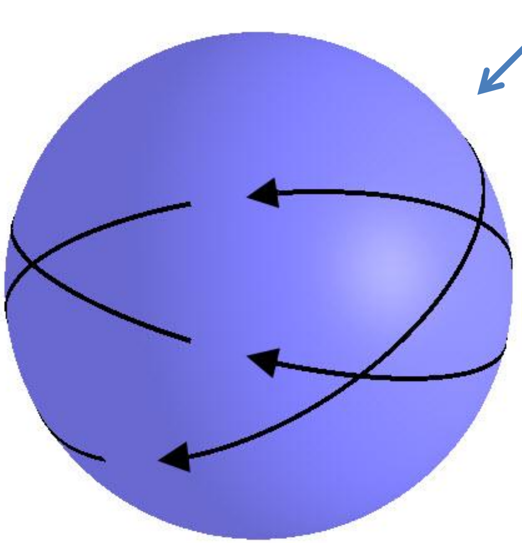
- Electron is a shell of electric charge surrounding the proton nucleus (or a positron).
- Can be modeled as an infinite number of infinitesimal sized charge currents that orbit on circular paths ("great circles") around the proton (or around the positron).
- The transition state orbitsphere (TSO) is a special case of the electron orbitsphere with the positron (not the proton) providing the central electric field which gives the spherical shape.

Analogy used in the mathematical model:

Break an electron into an infinite number of infinitesimal pieces of mass and charge and have each piece orbit on an infinite number of "great circles" of a sphere.

In the model, each infinitesimal charge and mass is in force balance.

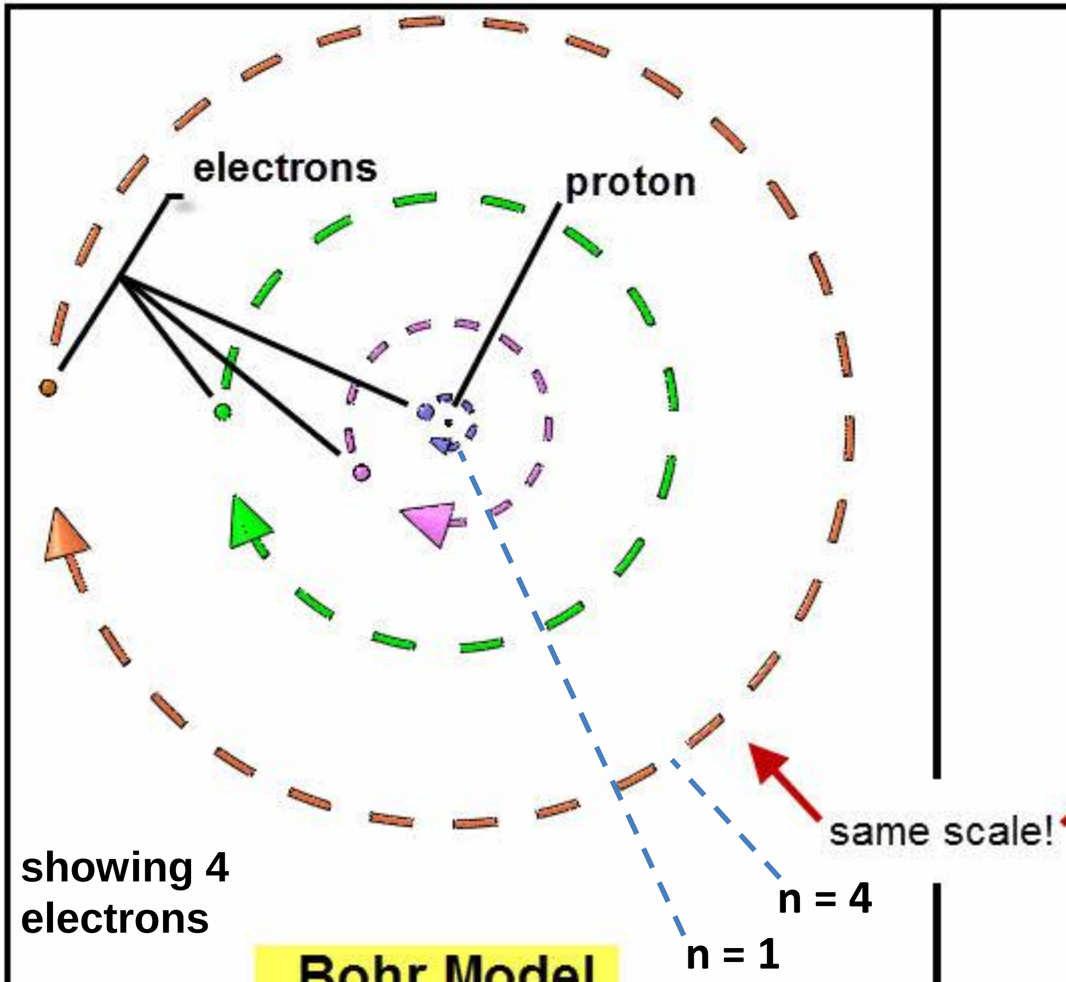
3 randomly drawn great circles



electron orbitsphere

Each infinitesimal point charge and point mass orbits with the same velocity **v** and angular frequency ω on each great circle.

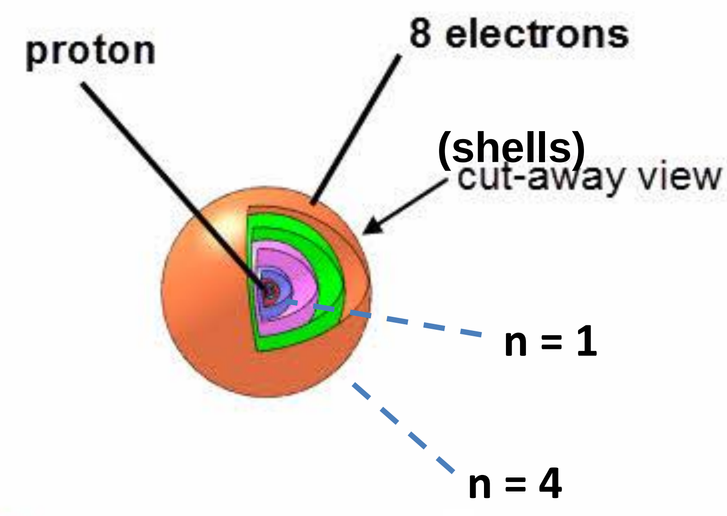
Note: For hydrogen, the electron is only in one of the orbits shown below and at left.



showing 4 electrons

Bohr Model

Point sized electrons orbit the proton like the planets orbit the Sun



Randell Mills Model

Electrons are concentric spherical shells of electric charge

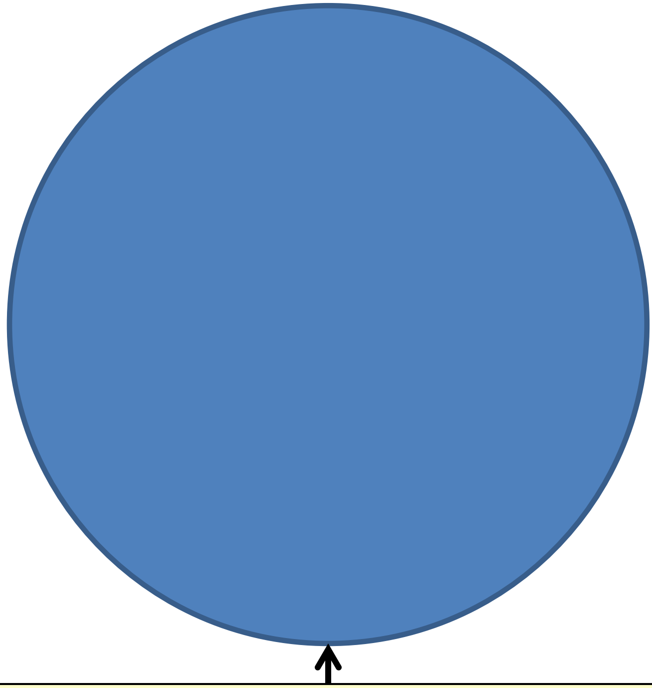
Differences between Bohr Model and GUTCP

Item	Bohr Model	GUTCP	Notes
radius	$r = n^2 a_0$	$r = n a_0$	a_0 = .0529 nm
electric field experienced by electron (between proton and electron)	e	$\frac{e}{n}$	e = elementary charge
bound electron	orbiting point particle around proton	spherical shell of charge (infinitesimal orbiting point charges, masses)	
trapped photon?	none	yes	contributes to electric field between electron and proton
orbit motion	planetary	orbit on "great circles"	
angular momentum	equal to $n\hbar$	equal to $\hbar$ at all orbit states n	= reduced Planck's constant
Principal quantum numbers allowed	n =1,2,3 … infinity	$n = \begin{cases} 1,2,3 \ldots \text{infinity} \\ \frac{1}{2}, \frac{1}{3}, \frac{1}{4} \ldots \frac{1}{p} \text{ and } p \leq 137 \end{cases}$	
Includes general relativity (time dilation, length contraction)	No	Yes	

Appendix

Section 1

Hydrogen at orbit state n = 1.



Normal hydrogen in the ground state. Radius is equal to the bohr radius or:
r = a_0 = 0.52946 Angstroms

TSO at orbit state n = 1/137.035999. The radius is 137.035999 times smaller than the normal hydrogen shown at left and its relative size is the size of the period below:

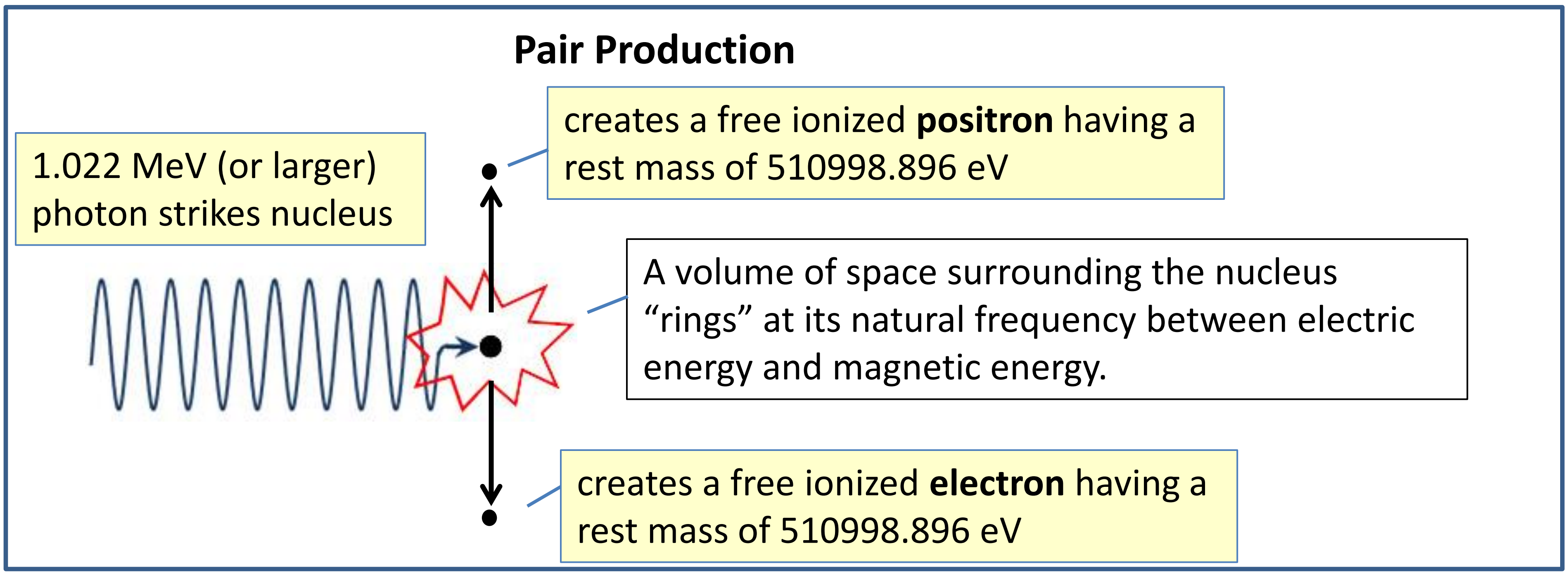
.

TSO at orbit state n = 1/137.035999
Radius = r = a_0 /137.035999 = 0.00386 Angstroms

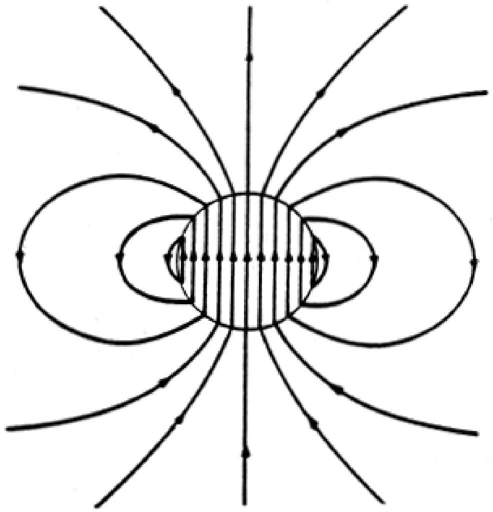
As described earlier in this document, the lowest possible ***stable*** orbit state for hydrogen (an electron and a ***proton)*** is **n** = 1/137. The transition state orbitsphere (TSO), which is an electron and a ***positron***, has orbit state **n** = 1/137.035999.

When a hammer strikes a bell, it oscillates at its natural frequency between potential energy (stored stresses in the metal) and kinetic energy (velocity of the vibrating bell surface).

The atomic version of that is when a photon strikes a nucleus and creates a free electron and a free positron during “pair production”.



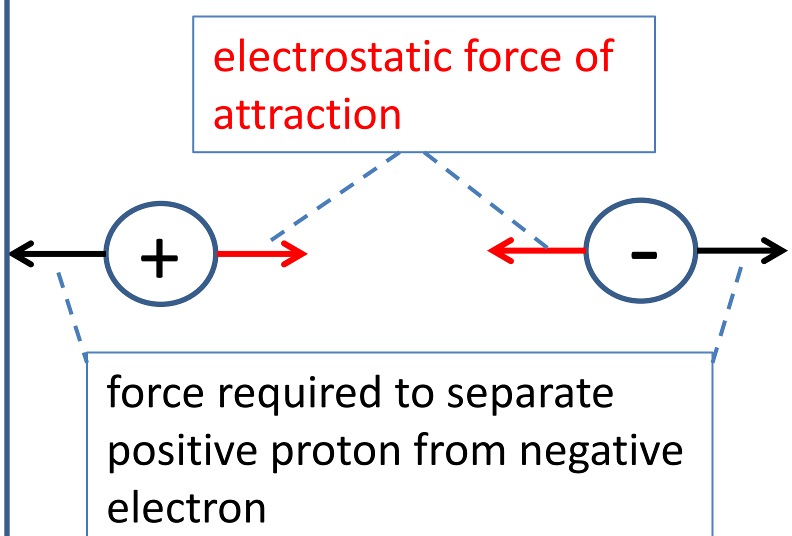
The volume of space that “rings” has a radius that is 137.03599 times smaller than normal hydrogen in the ground state (**n** = 1) and has a frequency that matches a 510998.896 eV photon. **An electron and a positron are created that each have a rest mass of 510998.896 eV (1.022 MeV combined).**



magnetic field of hydrogen atom and TSO

The transition state orbitsphere at orbit state **n** = 1/137.035999 has a magnetic field energy equal to 2 X 510998.896 eV (i.e. the rest mass of the electron and the positron).

<u>If</u> a hydrogen atom could reach **n** = 1/137.035999 (which it can't since the lowest allowable orbit state is n = 1/137) then it would have a magnetic field energy of 510998.896 eV.



The energy required to fully ionize (i.e. overcome electrostatic force of attraction and separate out to infinity) the electron from the proton is 510998.896 eV <u>if</u> the hydrogen were initially at orbit state **n** = 1/137.035999. At this orbit state, the radius is 137.035999 times smaller than normal hydrogen in the **n** = 1 ground state.

Energy = Force x Distance

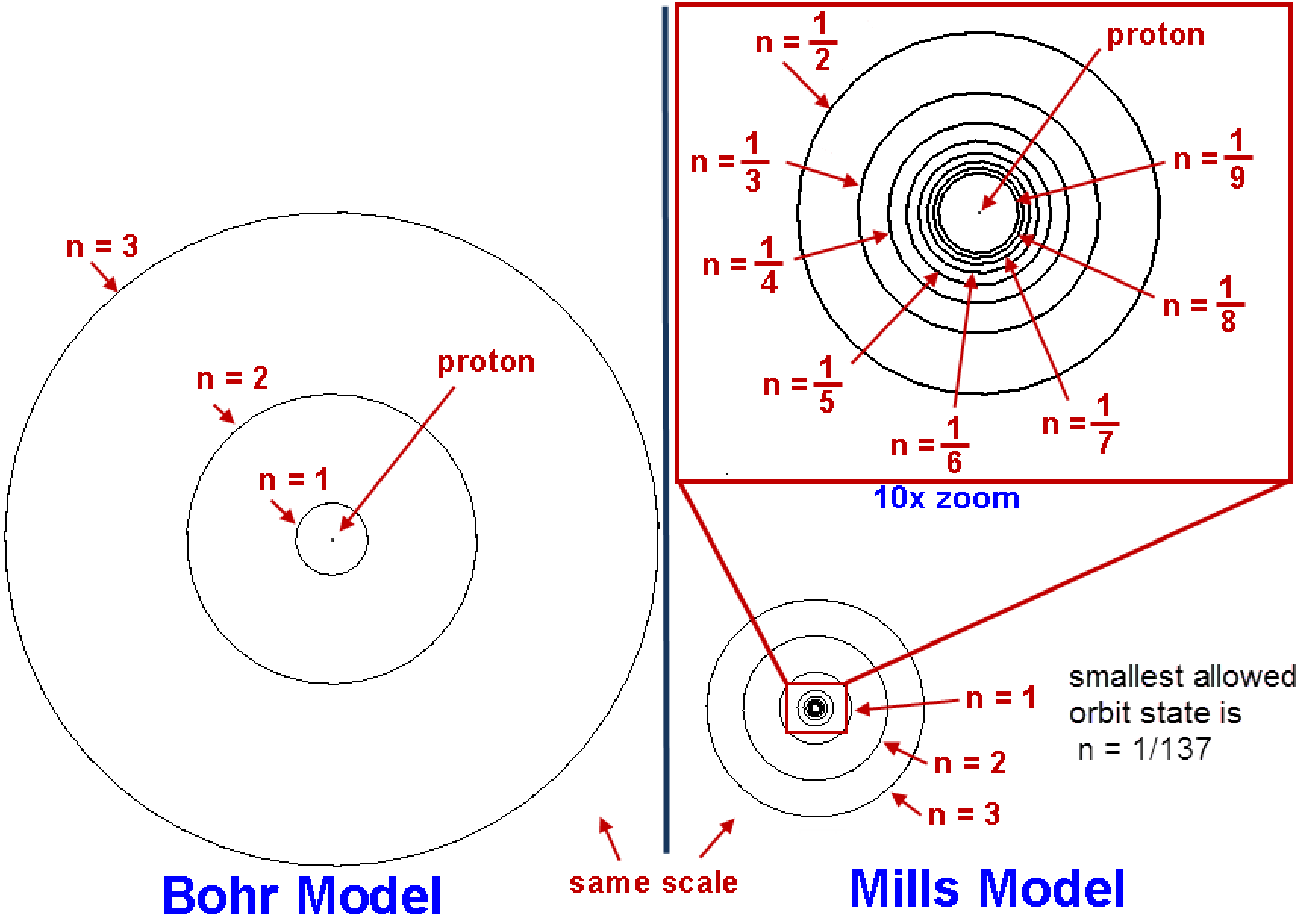
The key to understanding pair production and GUTCP can be seen in Chap 29 "Pair Production" of Mills's book "The Grand Unified Theory of Classical Physics" (GUTCP) Below are two quotes from that chapter:

Quoting from GUTCP, just below GUTCP Eq. (29.20), in chapter 29 "Pair Production"

Thus, the LC resonance frequency of free space for a transition state electron orbitsphere equals the frequency of the photon, which forms the transition state orbitsphere.
The impedance of any LC circuit goes to infinity when it is excited at the resonance frequency. ***Thus, the electron transition state orbitsphere is an LC circuit excited at the corresponding resonance frequency of free space.*** *The impedance of free space becomes infinite, and electromagnetic radiation cannot propagate. At this event the frequency, wavelength, velocity and energy of the transition state orbitsphere equal that of the photon. The energy of the photon is equal to the rest mass energy of the particle at zero potential energy [fully ionized free electron], and charge is conserved.* [emphasis added]

And from GUTCP, just below GUTCP Eq. (29.15):

Thus, the energy stored in the magnetic field of the transition state electron orbitsphere equals the electrical potential energy of the transition state orbitsphere. ***The magnetic field is a relativistic effect of the electrical field;*** *thus, equivalence of the potential and magnetic energies when v = c is given by Special Relativity where these energies are calculated using Maxwell's Equations. The energy stored in electric and magnetic fields of a photon are equivalent. The corresponding equivalent energies of the transition state orbitsphere are the electrical potential energy and the energy stored in the magnetic field of the orbitsphere.* [emphasis added]



Comparison of allowed orbits in hydrogen for GUTCP and Bohr Model

Ionization energy for one electron atoms. Derived using GUTCP.

Ionization energy E_B for one electron atoms equals

$$E_B = \frac{(\alpha Z)^2 m_{e0} c^2}{\left(\sqrt{1 - \left(\frac{\alpha Z}{\left(1 + \frac{m_{e0}}{2 m_p A}\right)}\right)^2} + \frac{m_{e0}}{m_p A}\right)} - m_{e0} c^2 \left(\frac{1}{\sqrt{1 - \left(\frac{\alpha Z}{\left(1 + \frac{m_{e0}}{2 m_p A}\right)}\right)^2}} - 1\right) \qquad (1.293)$$

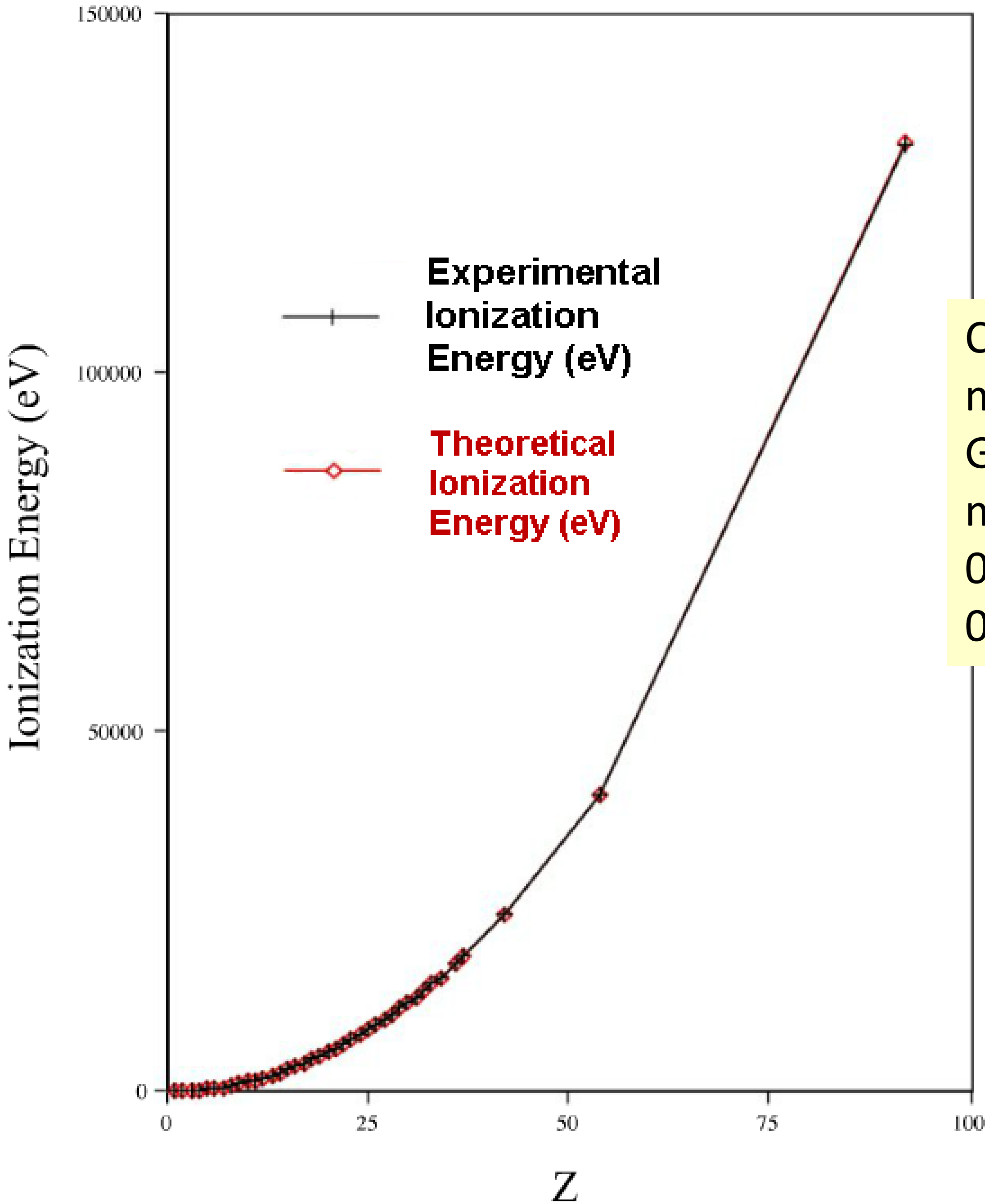
α = fine structure constant

m_p = mass proton

A = atomic mass number

m_{e0} = rest mass electron

Image source: The Grand Unified Theory of Classical Physics, R. Mills.



Number of protons

Comparison of theoretical and measured ionization energy using GUTCP. Theoretical matches measured value to within:

0.06% for Z <35

0.3% for Z = 92 (Uranium)

Image source: The Grand Unified Theory of Classical Physics, R. Mills.

Ionization for 1 electron atoms

Table 1.5. Relativistic ionization energies for some one-electron atoms.

One e Atom	Z	β (Eq. (1.288))	Theoretical Ionization Energies (eV) (Eq. (1.293))	Experimental Ionization Energies (eV) [a]	Relative Difference between Experimental and Calculated [b]
H	1	0.00730	13.59847	13.59844	-0.000002
He^{+}	2	0.01459	54.41826	54.41778	-0.000009
Li^{2+}	3	0.02189	122.45637	122.45429	-0.000017
Be^{3+}	4	0.02919	217.72427	217.71865	-0.000026
B^{4+}	5	0.03649	340.23871	340.2258	-0.000038
C^{5+}	6	0.04378	490.01759	489.99334	-0.000049
N^{6+}	7	0.05108	667.08834	667.046	-0.000063
O^{7+}	8	0.05838	871.47768	871.4101	-0.000078
F^{8+}	9	0.06568	1103.220	1103.1176	-0.000093
Ne^{9+}	10	0.07297	1362.348	1362.1995	-0.000109
Na^{10+}	11	0.08027	1648.910	1648.702	-0.000126
Mg^{11+}	12	0.08757	1962.945	1962.665	-0.000143
Al^{12+}	13	0.09486	2304.512	2304.141	-0.000161
Si^{13+}	14	0.10216	2673.658	2673.182	-0.000178
P^{14+}	15	0.10946	3070.451	3069.842	-0.000198
S^{15+}	16	0.11676	3494.949	3494.1892	-0.000217
Cl^{16+}	17	0.12405	3947.228	3946.296	-0.000236
Ar^{17+}	18	0.13135	4427.363	4426.2296	-0.000256
K^{18+}	19	0.13865	4935.419	4934.046	-0.000278
Ca^{19+}	20	0.14595	5471.494	5469.864	-0.000298
Sc^{20+}	21	0.15324	6035.681	6033.712	-0.000326
Ti^{21+}	22	0.16054	6628.064	6625.82	-0.000339
V^{22+}	23	0.16784	7248.745	7246.12	-0.000362
Cr^{23+}	24	0.17514	7897.827	7894.81	-0.000382
Mn^{24+}	25	0.18243	8575.426	8571.94	-0.000407
Fe^{25+}	26	0.18973	9281.650	9277.69	-0.000427
Co^{26+}	27	0.19703	10016.63	10012.12	-0.000450
Ni^{27+}	28	0.20432	10780.48	10775.4	-0.000471
Cu^{28+}	29	0.21162	11573.34	11567.617	-0.000495
Zn^{29+}	30	0.21892	12395.35	12388.93	-0.000518

Comparison of theoretical and measured ionization of one electron atoms using GUTCP.

Error = 0.0126%

Error = 0.049%

Image source: The Grand Unified Theory of Classical Physics, R. Mills.

Ionization of 2 electron atoms

$$r_2 = r_1 = a_0\left(\frac{1}{Z-1} - \frac{\sqrt{s(s+1)}}{Z(Z-1)}\right);\ s = \frac{1}{2} \qquad (7.35)$$

$$r_n = r_n'\left[\sqrt{1-\left(\frac{v}{c}\right)^2}\sin\left[\frac{\pi}{2}\left(1-\left(\frac{v}{c}\right)^2\right)^{3/2}\right] + \frac{1}{2\pi}\cos\left[\frac{\pi}{2}\left(1-\left(\frac{v}{c}\right)^2\right)^{3/2}\right]\right] \qquad (1.280)$$

$$E(electric) = -\frac{(Z-1)e^2}{8\pi\varepsilon_0 r_1} \qquad (7.45)$$

$$E(magnetic) = \frac{2\pi\mu_0 e^2\hbar^2}{m_e^2 r_1^3} = \frac{8\pi\mu_0\mu_B^2}{r_1^3} \qquad (7.46)$$

$$Ionization\ Energy = -Electric\ Energy - \frac{1}{Z}Magnetic\ Energy \qquad (7.63)$$

Image source: The Grand Unified Theory of Classical Physics, R. Mills.

Ionization energy for Helium

$$r_2 = r_1 = a_0\left(\frac{1}{Z-1} - \frac{\sqrt{s(s+1)}}{Z(Z-1)}\right);\; s = \frac{1}{2} \qquad (7.35)$$

$$E(electric) = -\frac{(Z-1)e^2}{8\pi\varepsilon_0 r_1} \qquad (7.45)$$

$$E(magnetic) = \frac{2\pi\mu_0 e^2\hbar^2}{m_e^2 r_1^3} = \frac{8\pi\mu_0\mu_B^2}{r_1^3} \qquad (7.46)$$

$$Ionization\ Energy(He) = -E(electric) + E(magnetic)\left(1 - \frac{1}{2}\left(\left(\frac{2}{3}\cos\frac{\pi}{3}\right)^2 + \alpha\right)\right) \qquad (7.44)$$

Image source: The Grand Unified Theory of Classical Physics, R. Mills.

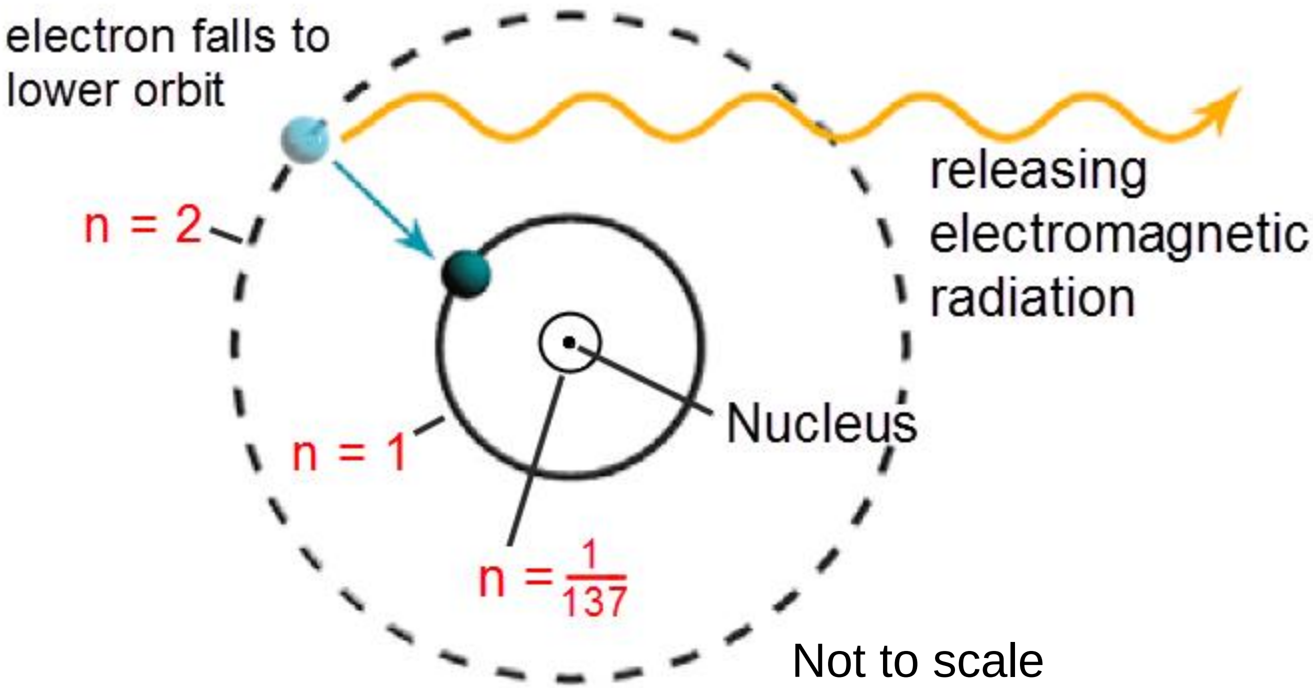
Standard Accepted Theory

Electron falls from higher orbit state to lower orbit state and emits electromagnetic radiation. Lowest possible orbit state is n = 1.

GUTCP

Electron falls from higher orbit state to lower orbit state and emits electromagnetic radiation and thermal kinetic energy. Lowest possible orbit state is $n = {}^{1}/_{137}$

Fractional orbits are allowed, i.e. ($n = {}^{1}/_{2}, {}^{1}/_{3}, {}^{1}/_{4} \ldots {}^{1}/_{137}$).



Not to scale

Where does GUTCP diverge from the Bohr Model in terms of the derivation of the energy equations?

GUTCP is very similar to the Bohr Model in deriving the energy equations for the hydrogen atom the atom.

But …

GUTCP makes the postulate that the electric charge experienced by the electron is equal to the elementary charge **e** divided by the principal quantum number **n**, or **e/n,** and is due to the proton and the trapped photon. It also makes the postulate that the angular momentum (L = mvr or mass*velocity*radius) of the electron is equal to $\hbar$ or the reduced Planck constant at all principal orbit states n.

The Bohr Model makes the postulate that the electron has an angular momentum (L = mvr) equal to a $n\hbar$ at all principal orbit states **n**. The electric charge experienced by the electron is equal to the proton's elementary charge **e** (although this is not a postulate since it is standard physics).

Side Note: The postulate used in the Bohr Model can alternatively be that the circumference of the electron orbit is equal to the principal quantum number **n** multiplied by the electron's de Broglie wavelength while in GUTCP it can be that the circumference of the orbit circle is equal to one electron de Broglie wavelength at all principal quantum number **n**.

Appendix
Section 2

Capacitive Electric Energy of the TSO

Capacitive Electric Energy of the TSO

The following calculation of "Capacitive Electric Energy" for the TSO at pair production is somewhat speculative on my part and does not come directly from GUTCP. It includes a factor of 1/2 in the capacitance equation (see Eq. (4) on page 65) which might be related to the following statement in GUTCP which is for the tau and muon lepton:

*Because **two** magnetic moments are produced, the magnetic energy (**and corresponding photon frequency**) in the proper frame is two times that of the electron frame. Thus, the electron time is corrected by a factor of two relative to the proper time.* [emphasis added]

The quote above can be found just above GUTCP Eq. (36.7) in the chapter on Leptons. If I find out later that this "Capacitive Electric Energy" is irrelevant then I will delete this section.

The calculation of the electric energy stored in the resonant electric/magnetic oscillation of the TSO starts with the standard equation for energy stored in a capacitor

$$E = \frac{1}{2}QV \qquad \text{(Eq. (1))}$$

Where Q in Eq. (1) above is the charge of the electron and equals the elementary charge **-e**

$$Q = -e$$

the equation for voltage in a capacitor is

$$V = \frac{Q}{C} \qquad \text{(Eq. (2))}$$

But “Q” in Eq. (2) is the electric field that the electron experiences. For the hydrogen atom, this field is not simply the charge of the proton **e** but is instead equal to **e/n** because in GUTCP the “trapped photon” alters the electric field experienced by the electron by a factor of **1/n**. Since this is a derivation for the TSO which does not have a “trapped photon”, GUTCP inserts a factor of **1/n** into the energy equation and says it **"*arises from Gauss' law surface integral and the relativistic invariance of charge*”** (see text right above GUTCP Eq. (29.10) in GUTCP).

With this **1/n** factor, Eq. (2) becomes

$$V = \frac{Q}{C} = \frac{(e/n)}{C} \qquad \text{(Eq. (3))}$$

The capacitance of an isolated sphere of radius **r** is

$$C = 4\pi\varepsilon_0 r$$

inserting the radius of the TSO

$$r = na_0 = \alpha a_0 \qquad \text{(radius of TSO)}$$

gives

$$C = 4\pi\varepsilon_0 \alpha a_0$$

At this point, the only way to make the final energy equation work is to include a factor of 1/2.

I am speculating that the ½ factor comes from the fact that ½ the volume of the TSO resonates due to the electron and ½ the volume resonates due to the positron (the anti-electron).

The capacitance then becomes

$$C = \left(\frac{1}{2}\right) 4\pi\varepsilon_0 \alpha a_0 = 2\pi\varepsilon_0 \alpha a_0 \quad \text{(Eq. (4))}$$

Putting Eq. (4) and Eq. (3) into Eq. (1) with principal quantum number **n =** α gives

Capacitive Electric Energy $= E = \frac{1}{2}QV = \frac{1}{2}e\left(\frac{(e/n)}{2\pi\alpha a_0\varepsilon_0}\right) = \frac{e^2}{4\pi\alpha^2 a_0\varepsilon_0} = m_0c^2 = 510998.896 \text{ eV}$

Rest mass of the electron.

Appendix

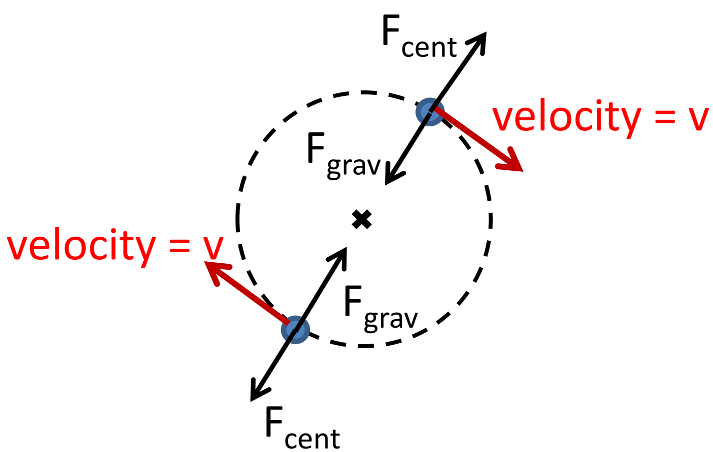
Section 3

Mass/Spacetime Metric Energy equation

Derivation of Mass/Spacetime Metric Energy equation (GUTCP Eq. (32.48b))

Mass/Spacetime Metric Energy $= \alpha^{-1} \dfrac{\mu_0 e^2 c^2}{2h} \sqrt{\dfrac{Gm_0}{\lambda\!\!\!^{-}_C}} \sqrt{\dfrac{\hbar c}{G}} \cong 510998.896 \text{ eV} = m_0 c^2$

$F_{centripetal} = F_{gravitational}$



Two uncharged masses each having the same mass orbiting each other at velocity **v**.

Figure 1

The derivation of the Mass/Spacetime Metric Energy is based on the model shown in Figure 1 at left which shows two uncharged masses orbiting each other on a circle of radius **r**. The masses are in force balance where the attractive gravitational force towards each other balances the outward centripetal force (i.e. force due to centripetal acceleration). The derivation includes Special Relativity.

GUTCP first lists the following time dilation equation (just above GUTCP Eq. (32.18)) and says it is based on using polar coordinates combined with Special Relativity and it can be derived using the same techniques as those in GUTCP Eq. (30.11 - 30.15) (though GUTCP seems to have a typo here and it should say Eq. (31.11 - 31.15)).

$$\frac{\text{Proper time}}{\text{Coordinate time}} = \frac{m_0}{m_u} = \frac{v_G}{c} \quad \text{(Eq. (A))}$$

This equation can be found just above GUTCP Eq. (32.18).

where $$m_u = \sqrt{\frac{\hbar c}{G}} \quad \text{(GUTCP Eq. (32.31))}$$

$$v_G = \sqrt{\frac{Gm_0}{r}} \quad \text{(GUTCP Eq. (32.33))}$$

Definitions:

$\mathbf{v_G}$ = the gravitational velocity

$\mathbf{m_0}$ = rest mass of fundamental particle orbiting at $\mathbf{v_G}$

$\mathbf{m_u}$ = Planck mass (derived on page 71 of this document)

Proper time = time as experienced by a fundamental particle (such as leptons and quarks) at velocity $\mathbf{v_G}$ in a stable circular orbit around its anti-particle (such as the positron).

Coordinate time = time as experienced by the Planck mass at a velocity equal to the speed of light **c** in a stable circular orbit around another Planck mass that orbits on the same orbit circle.

Next, GUTCP derives the equation for the mass-energy of an orbitsphere that causes its gravitational radius to be equal to its Compton wavelength bar $\lambda\!\!\!^{-}_C$.

The gravitational radius is defined as

$$r_G = \frac{Gm_0}{c^2} \qquad \text{(GUTCP Eq. (32.22))}$$

gravitational radius

Compton wavelength bar

$$r_G = \lambda\!\!\!^{-}_C \Rightarrow \frac{Gm_0}{c^2} = \frac{\hbar}{m_0 c} \qquad \text{(GUTCP Eq. (32.23))}$$

At this point, GUTCP uses more steps than listed here but essentially multiples both sides of GUTCP Eq. (32.23) by $\mathbf{m_0 c^2}$ and divides both sides by the Compton wavelength bar $\lambda\!\!\!^{-}_C$ and then inserts the equation

$$\omega = \frac{c}{\lambda\!\!\!^{-}_C}$$

speed of light

which results in

$$\frac{Gm_0^2}{\lambda\!\!\!^{-*}_C} = \hbar\omega^* \qquad \text{(GUTCP Eq. (32.26))}$$

The asterisk symbol * indicates that the equation only applies to allowed wavelengths where the circumference of the orbit circle is <u>one</u> de Broglie wavelength. At an allowed wavelength, the orbiting masses have an angular momentum equal to $\hbar$ (i.e. the reduced Planck constant, also known as hbar).

GUTCP Eq. (32.26) shows the gravitational potential energy for this orbitsphere is equal to the energy of a photon that has the same radius. Therefore the following equations must also be equal

V = electric potential energy

$$E = m_0c^2 = V = \hbar\omega^* = E_{mag} = \frac{Gm_0^2}{\lambda_C^*}$$ (GUTCP Eq. (32.27))

The mass energy = Planck equation energy = electric potential energy = magnetic energy = gravitational energy.

Important: this is only for a for a very specific orbitsphere at particle production where the gravitational radius equals its Compton wavelength bar **(which will be shown below to be the Planck mass)**. So for example, inserting the electron's mass and the electron TSO radius into GUTCP Eq. (32.27) will *not* give 510998.896 eV. However, inserting the Planck mass and its Compton wavelength bar (or the Planck mass gravitational radius - which is the same) *will* show GUTCP Eq. (32.27) to be correct.

Side note: The final equation for gravitational energy for the electron includes charge and Special Relativity and therefore looks different than the gravitational energy term (i.e. the last term) in GUTCP Eq. (32.27) above.

It is shown next that the Planck mass is obtained simply by solving GUTCP Eq. (32.23) for mass $\mathbf{m_0}$.

GUTCP then solves GUTCP Eq. (32.23) for mass $\mathbf{m_0}$

$$\frac{Gm_0}{c^2} = \frac{\hbar}{m_0 c} \qquad \text{(GUTCP Eq. (32.23))}$$

solving for $\mathbf{m_0}$ by rearranging the variables gives

$$m_0 = \sqrt{\frac{\hbar c}{G}}$$

In the equation above, GUTCP changes the subscript from "0" to "u" and designates it the **Grand Unification Mass-Energy** (in standard physics this is known as the **Planck mass**).

$$m_u = \sqrt{\frac{\hbar c}{G}} \qquad \text{(GUTCP Eq. (32.31))}$$

The Grand Unification Mass-Energy is the mass of an orbitsphere that causes its gravitational radius to be equal to its Compton wavelength bar $\bar{\lambda}_C$.

The **Grand Unification Mass-Energy** is 2×10^{22} times heavier than the mass of the electron, 1.3×10^{19} times heavier than the mass of the proton and about 1/30 the mass of the smallest known bacteria.

GUTCP describes the Planck mass this way in Chap 32 (just below GUTCP Eq. (32.36)):

A fourth family [of leptons] *is not observed. A pair of particles each of the Planck mass corresponding to the conditions of Eq. (32.22), Eq. (32.32) and Eq. (32.33), is not observed since the velocity of each of the point masses of the transition state orbitsphere is the gravitational velocity* $\mathbf{v}_G$ *that in this case is the speed of light; whereas, the Newtonian gravitational escape velocity* $\mathbf{v}_g$ *of the superposition of the point masses of the antiparticle would be* $\sqrt{2}$ *the speed of light (Eq. (32.35)). In this case, an electromagnetic wave of mass energy equivalent to the Planck mass travels in a circular orbit around the center of mass of another electromagnetic wave of mass energy equivalent to the Planck mass wherein the eccentricity is equal to zero (Eq. (35.21)), and the escape velocity can never be reached. The Planck mass is a "measuring stick". The extraordinarily high Planck mass (* $m_u = \sqrt{\frac{\hbar c}{G}}$ *= 2.18X10*$^{-8}$ *kg) is the unobtainable mass bound imposed by the angular momentum and speed of the photon relative to the gravitational constant.*

Summarizing what was just done:

1. GUTCP Eq. (32.23) was derived by setting the gravitational radius $\mathbf{r_G}$ of mass $\mathbf{m_0}$ equal to the Compton wavelength bar $\lambda\!\!\!^{-}_C$ of a photon (i.e. specifying that the photon agrees with the de Broglie formula <u>or</u> specifying that the orbiting masses has $\hbar$ of angular momentum).

$$r_G = \lambda\!\!\!^{-}_C \Rightarrow \frac{Gm_0}{c^2} = \frac{\hbar}{m_0 c}$$ (GUTCP Eq. (32.23))

2. Simple algebra was used to get the left side of GUTCP Eq. (32.23) into a form that <u>matches Newton's law of universal gravitation</u> where the equation for this law is:

$$\text{Gravitational Potential Energy} = \frac{Gmm}{r} = \frac{Gm^2}{r}$$

the end result is GUTCP Eq. (32.26)

$$\frac{Gm_0^2}{\lambda\!\!\!^{-*}_C} = \hbar\omega^*$$ (GUTCP Eq. (32.26))

which then led to GUTCP Eq. (32.27)

$$E = m_0c^2 = V = \hbar\omega^* = E_{mag} = \frac{Gm_0^2}{\lambda\!\!\!^{-*}_C}$$ (GUTCP Eq. (32.27))

3. Next, GUTCP Equation (32.23) was solved for mass which gives the Planck mass

$$m_u = \sqrt{\frac{\hbar c}{G}}$$ (GUTCP Eq. (32.31))

(end of summary)

This is only a summary, refer to chap. 32 in GUTCP for details.

GUTCP then lists the equivalent particle production energies in GUTCP Eq. (32.32b) below:

GUTCP Eq. (32.32b)

$$m_0c^2 = \left(\hbar\omega^* = \frac{\hbar^2}{m_0 \lambda\!\!\!^{-}_C{}^2}\right) = \alpha^{-1}\frac{e^2}{4\pi\varepsilon_0 \lambda\!\!\!^{-}_C} = \alpha^{-1}\frac{\pi\mu_0 e^2\hbar^2}{(2\pi m_0)^2\ \lambda\!\!\!^{-}_C{}^3} = \alpha^{-1}\frac{\mu_0 e^2 c^2}{2h}\sqrt{\frac{Gm_0}{\lambda\!\!\!^{-}_C}}\sqrt{\frac{\hbar c}{G}}$$

mass energy = Planck equation energy = electric potential energy = magnetic energy = gravitational energy

where $\mathbf{m_0}$ is the rest mass of the fundamental particle.
Fundamental particles are leptons (such as the electron, muon, tau and their antiparticles) and quarks (up, down, charm etc.).

The gravitational energy term in GUTCP Eq. (32.32b) (the term furthest to the right) can be derived algebraically by starting with the mass energy equal to the Planck energy which are the 1st and 2nd terms in GUTCP Eq. (32.32b)

mass energy = Planck equation energy

$$m_0c^2 = \hbar\omega^* = \frac{\hbar c}{\lambda\!\!\!^{-}_C} \qquad \text{(GUTCP Eq. (32.28))}$$

dividing both sides by $\mathbf{c^2}$ gives

$$m_0 = \frac{\hbar}{\lambda_C c} \qquad \text{(Eq. (B))}$$

and then defining the gravitational velocity $\mathbf{v_G}$ at particle production where $\mathbf{v_G}$ is defined as

$$v_G = \sqrt{\frac{Gm_0}{r}} = \sqrt{\frac{Gm_0}{\lambda_C}} \qquad \text{(GUTCP Eq. (32.33))}$$

Rewriting the Planck mass equation and the gravitational velocity equation so that the left and right sides equal 1 gives

$$\frac{v_G}{\sqrt{\frac{Gm_0}{\lambda_C}}} = 1 \qquad \text{(Eq. (C))}$$

$$\frac{m_u}{\sqrt{\frac{\hbar c}{G}}} = 1 \qquad \text{(Eq. (D))}$$

Eq. (B) can be multiplied by Eq. (C) and Eq. (D) to give

$$m_0 = \frac{\hbar \quad v_G \quad m_u}{\lambda_C c \sqrt{\frac{Gm_0}{\lambda_C}} \sqrt{\frac{\hbar c}{G}}}$$

which simplifies to

$$m_0 = \frac{\hbar v_G m_u}{\lambda_C c \sqrt{\frac{m_0 \hbar c}{\lambda_C}}}$$

Inserting $m_0 = \frac{\hbar}{\lambda_C c}$ for $\mathbf{m_0}$ on the right side only gives

$$m_0 = \frac{\hbar v_G \; m_u}{\lambda_C c \sqrt{\dfrac{\hbar\hbar c}{\lambda_C \; \lambda_C c}}}$$

which simplifies to

$$m_0 = \frac{\hbar v_G \; m_u}{\lambda_C c \left(\dfrac{\hbar}{\lambda_C}\right)}$$

which further simplifies to GUTCP Eq. (32.34)

$$m_0 = m_u \left(\frac{v_G}{c}\right)$$ (truncated version of GUTCP Eq. (32.34))

At this point, both sides of GUTCP Eq. (32.34) can be multiplied by $\mathbf{c^2}$ which gives

$$m_0 c^2 = c \, m_u v_G$$ (Eq. (E))

Then the right side of Eq. (E) can be multiplied by $\boldsymbol{\alpha/\alpha}$ (which equals 1).

where $\alpha = \dfrac{\mu_0 e^2 c}{2h}$ (fine structure constant)

and $\boldsymbol{\alpha/\alpha}$ = 1 can be arranged to look like the following

$$\frac{\alpha}{\alpha} = \alpha^{-1}\alpha = \alpha^{-1}\frac{\mu_0 e^2 c}{2h} = 1$$ (Eq. (F))

Since Eq. (F) is equal to one, it can be multiplied by Eq. (E) which then makes the equation look like the gravitational term in GUTCP Eq. (32.32b) (and Eq. (32.48b)).

$$m_0c^2 = \alpha^{-1}\frac{\mu_0 e^2 c^2}{2h}\sqrt{\frac{Gm_0}{\lambda\!\!\!^{-}{}_C}}\sqrt{\frac{\hbar c}{G}}$$

(truncated version of GUTCP Eq. (32.32b))

mass energy = gravitational energy

GUTCP Eq. (32.34) can be verified that it is correct by inserting the values for $\mathbf{v_G}$, $\mathbf{m_u}$ and **c** *or* inserting the equations for $\mathbf{m_u}$ and $\mathbf{v_G}$ and using algebra. The values and equations are

$$m_0 = m_u \left(\frac{v_G}{c} \right) \qquad \text{(truncated version of GUTCP Eq. (32.34))}$$

insert the values:

$m_u = \sqrt{\frac{\hbar c}{G}} = 2.17650915 \times 10^{-8}\,\text{kg}$	$v_G = \sqrt{\frac{G m_0}{r}} = 1.25472666 \times 10^{-14}\,\text{m/s}$
$c = 2.99792458 \times 10^{8}\,\text{m/s}$	

or insert the equations and solve GUTCP Eq. (32.34) algebraically using equations above and

$$r = n a_0 \qquad \text{(radius of TSO)}$$

$$n = \alpha \qquad \text{(orbit state)}$$

$$a_0 = \frac{\hbar^2 (4\pi\varepsilon_0)}{m_0 e^2} \qquad \text{(Bohr radius)}$$

$$\alpha = \frac{e^2}{\hbar c (4\pi\varepsilon_0)} \qquad \text{(fine structure constant)}$$

The interesting thing is that the ratio of $\mathbf{v_G}$ to **c** is absolutely tiny (ratio is about 4×10^{-23}) and the equations work perfectly.

Notes on angular momentum and fundamental particles:

GUTCP states that all (circularly polarized) photons have $\pm\hbar$ of angular momentum (is this true of only superimposed left and right handed photons?). This can be visualized as two angular momentum components of $+\hbar$ and $-\hbar$ superimposed on one top of one another. A real life visualization would be two bicycle wheels face to face that each spin with an angular momentum of $\hbar$ but in opposite directions and thus the total angular momentum is $\pm\hbar$.

Fundamental particles include leptons (such as the electron, muon, tau etc.) and quarks. These particles are created at particle production from photons. One particle gets $\hbar$ of angular momentum (from either the $-\hbar$ or $+\hbar$ component of the photon) and the anti-particle gets $\hbar$ of angular momentum (from either the $-\hbar$ or $+\hbar$ component). Thus angular momentum is conserved during particle production. **[Though I still need to verify that I have stated this correctly.]**

Note that the electron's Compton wavelength bar equation

$$\lambdabar_C = \frac{\hbar}{m_0 c}$$

can be arranged to look like

$$m_0 c \lambdabar_C = \hbar$$

and the left side has the same form as the equation for angular momentum for a thin ring (or a great circle!) with a tangential velocity equal to the speed of light **c**. It is also the equation for angular momentum of two orbiting point particles, each having mass 1/2 $\mathbf{m_0}$ with tangential velocity equal to the speed of light **c**. The equation for angular momentum for a ring _or_ two orbiting point masses having total mass $\mathbf{m_0}$ is **L = m v r.**

The following quantities are all tied together by the law conservation of angular momentum and the equation for angular momentum: **L = m v r**

- The de Broglie equation $$\lambda = \frac{h}{p} = \frac{h}{mc} = \frac{hc}{E_{photon}}$$
- The Compton wavelength bar equation $$\bar{\lambda}_C = \frac{\hbar}{m_0 c}$$
- angular momentum for a photon = $\hbar$ (reduced Planck constant hbar)
- the angular momentum for a ring: **L = m v r**
- angular momentum for two orbiting point particles: **L = m v r**
- total angular momentum for the hydrogen atom (at ***all*** orbit states n) is $\hbar$

Next, GUTCP relates the gravitational escape velocity

$$v_g = \sqrt{\frac{2Gm_0}{r}} = \sqrt{\frac{2Gm_0}{ƛ_C}} \qquad \text{(GUTCP Eq. (32.35))}$$

and the corresponding Newtonian gravitational radius

$$r_g = \frac{2Gm_0}{c^2} \qquad \text{(GUTCP Eq. (32.36))}$$

this is also known as the Schwarzschild radius

to proper time and coordinate time during particle production.

GUTCP lists the following equation and calls it a modified version of the Schwarzschild metric

$$d\tau^2 = \left(1 - \frac{2Gm_0}{c^2 r}\right)dt^2 - \frac{1}{c^2}\left[\left(1 - \frac{2Gm_0}{c^2 r}\right)^{-1} dr^2 + r^2 d\theta^2 + r^2 \sin^2\theta d\phi^2\right] \qquad \text{(GUTCP Eq. (32.38))}$$

$d\tau$ = change in proper time of the particle and antiparticle.
dt = change in coordinate time (i.e. time at some far away location such as infinity).

GUTCP then says the following (just below GUTCP Eq. (32.38))

One interpretation of the relativistic correction of spacetime due to conversion of energy into matter and matter into energy is that spacetime contracts and expands, respectively, in the radial and time dimensions. Thus, matter energy conversion can be considered to conserve spacetime.

Again, quoting directly from GUTCP (just above GUTCP Eq. (32.42)):

Mass and charge are concomitantly created with the transition of a photon to a particle and antiparticle. Thus, the energies, which are equal to the mass energies apply for the proper time of the particle (antiparticle) given by the general relativity, Eq. (32.38). ***The transition state from a photon to a particle and antiparticle pair comprises two concentric orbitspheres called transition state orbitspheres.*** *The gravitational effect of a spherical shell on an object outside of the radius of the shell is equivalent to that of a point of equal mass at the origin. Thus, the proper time of the concentric transition state orbitsphere with radius $^+r^*$ (the radius is infinitesimally greater than that of the inner transition state orbitsphere with radius r^*) is given by the Schwarzschild metric, Eq. (32.38). The proper time applies to each point on the orbitsphere. Therefore, consider a general point in the xy plane having*

$$r = \lambda\!\!\!^{-}_C ; \quad dr = 0 ; \quad d\theta = 0 ; \quad \sin^2\theta = 1$$

Substitution of these parameters into Eq. (32.38) gives

$$d\tau^2 = \left(1 - \frac{2Gm}{c^2 r_\alpha^*} - \frac{v^2}{c^2}\right) dt^2$$

(GUTCP Eq. (32.42))

Schwarzschild metric

??Does this highlighted term come from the term in square brackets of GUTCP Eq. (32.38)??

At particle production, the surface currents of the TSO orbit at the speed of light. Inserting $v = c$ into GUTCP Eq. (32.42) makes the highlighted yellow term equal to 1. The equation is then

this term equals 1

$$d\tau^2 = \left(1 - \frac{2Gm}{c^2 r_\alpha^*} - \frac{c^2}{c^2}\right) dt^2 = \left(- \frac{2Gm}{c^2 r_\alpha^*}\right) dt^2$$

taking the square root of both sides and pulling out the imaginary number "*i*" which is the square root of negative one gives

$$d\tau = \sqrt{-\frac{2Gm}{c^2 r_\alpha^*}}\, dt = i\sqrt{\frac{2Gm}{c^2 r_\alpha^*}}\, dt$$

the negative sign in this square root becomes *i* (the imaginary unit) which has the equation $i = \sqrt{-1}$

integrating both sides (with respect to time) gives

$$\tau = ti\sqrt{\frac{2Gm_0}{c^2 r_\alpha^*}}$$

τ = Proper time of the particle and antiparticle.
t = Coordinate time (i.e. time at some far away location).

inserting the equations for $\mathbf{v_g}$ (GUTCP Eq. (32.35)) and $\mathbf{r_g}$ (GUTCP Eq. (32.36)) and setting r^* equal to λ_C (i.e. the radius at particle production equals the electron TSO radius) gives

$$\tau = ti\sqrt{\frac{2Gm_0}{c^2 r_\alpha^*}} = ti\sqrt{\frac{2Gm_0}{c^2\ \lambda_C}} = ti\sqrt{\frac{r_g}{\lambda_C}} = ti\,\frac{v_g}{c} \qquad \text{(GUTCP Eq. (32.43))}$$

GUTCP then writes (just below GUTCP Eq. (32.43)) [**emphasis added**]

*On a cosmological scale, **imaginary time** corresponds to spacetime expansion and contraction as a consequence of the harmonic interconversion of matter and energy as given by Eq. (32.40). **The left hand side of Eq. (32.43) represents the proper time of the particle/antiparticle as the photon orbitsphere becomes matter. The right hand side of Eq. (32.43) represents the correction to the laboratory coordinate metric for time corresponding to the relativistic correction of spacetime by the particle production event.***

Repeating GUTCP Eq. (32.43):

$$\tau = ti\sqrt{\frac{2Gm_0}{c^2 r_\alpha^*}} = ti\sqrt{\frac{2Gm_0}{c^2\ \bar{\lambda}_C}} = ti\sqrt{\frac{r_g}{\bar{\lambda}_C}} = ti\,\frac{v_g}{c} \qquad \text{(GUTCP Eq. (32.43))}$$

Dividing GUTCP Eq. (32.43) by *ti* gives the following relation

electron gravitational radius $\mathbf{r_g}$, also known as the Schwarzschild radius (from page 81 of this document)

electron TSO radius or electron Compton wavelength bar

$$\sqrt{\frac{r_g}{\bar{\lambda}_C}} = \frac{v_g}{c} \qquad \text{(Eq. (G))}$$

Newtonian escape velocity $\mathbf{v_g}$ (from page 81 of this document)

speed of light **c**

Appendix

Section 4

Correspondence Principle

Correspondence Principle

The behavior of systems described by the theory of quantum mechanics (or by the old quantum theory) reproduces classical physics in the limit of large quantum numbers. **In other words, it says that for large orbits and for large energies the quantum calculations must agree with classical calculations**[1].

The Bohr Model, which is based on classical physics, was the first successful model that described the photon emission spectrum for the hydrogen atom. But if failed to match other experimental quantities for the atom and was abandoned and replaced with Standard Quantum Mechanics. Both Standard Quantum Mechanics and the Bohr Model adhere to the Correspondence Principle which was used in the postulates that formed each of the theories. Mills's GUTCP and the (abandoned) Bohr Model both match the Correspondence Principle as applied to the frequency of the photon emitted by the hydrogen atom and the change in orbit frequency of the electron in that hydrogen atom. But GUTCP does it with zero "error" at all initial and final orbit states **n** while the Bohr Model only has a small "error" when the electron drops from large orbit states to small orbit states (see Table 1 and Figure 1 in this Appendix). **The "error" in this case is the difference between the emitted photon frequency and ½ of the change in the orbit frequency of the electron.** This error expressed as a percentage is:

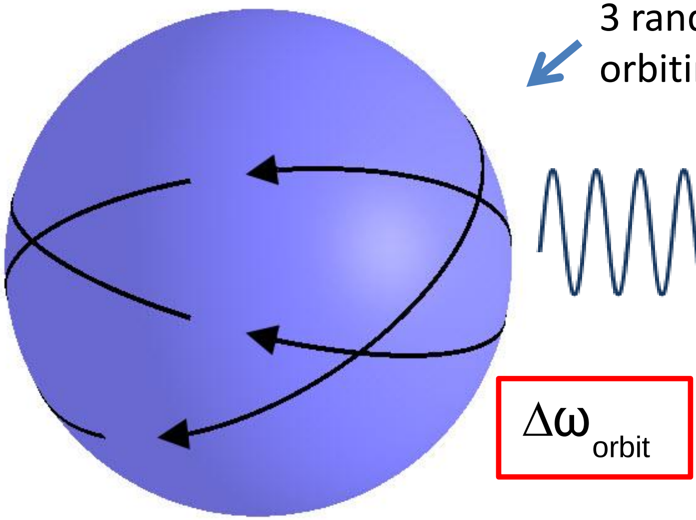
$$\text{Error\%} = (100\%)\left(\frac{\frac{1}{2}\left(\Delta\omega_{orbit}\right)}{\omega_{photon}} - 1\right) \quad \text{(Eq. (A))}$$

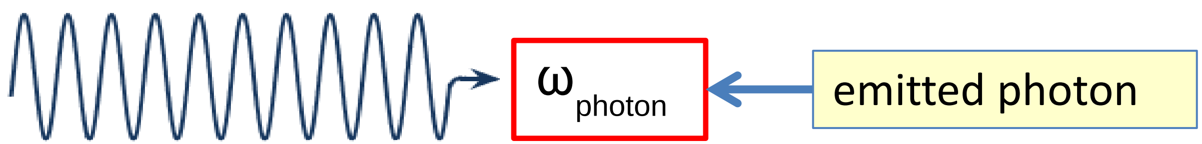
ω_{photon} = emitted photon angular frequency

$\Delta\omega_{orbit}$ = change in electron orbital angular frequency

[1] Tipler, Paul; Llewellyn, Ralph (2008). *Modern Physics* (5 ed.). W. H. Freeman and Company. pp. 160–161

3 randomly drawn great circles on the electron orbitsphere with orbiting infinitesimal point masses and charges



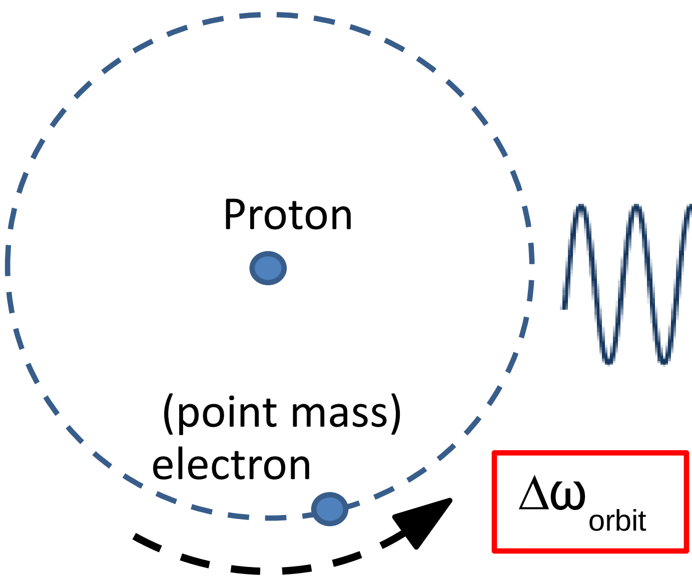


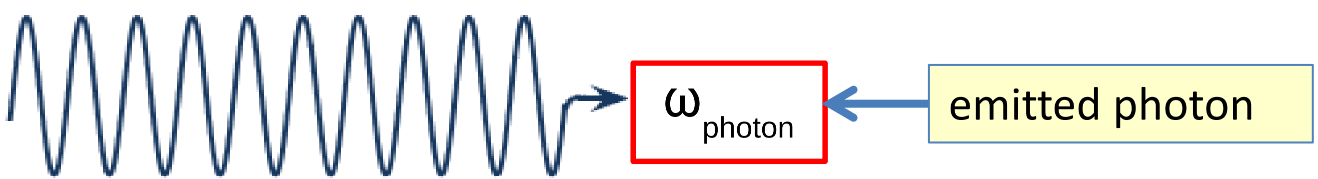
Hydrogen (based on **GUTCP**)

Correspondence Principle

This section* compares the electron's change in orbital angular frequency $\Delta\omega_{orbit}$ during an orbit transition from $\mathbf{n_i}$ to $\mathbf{n_f}$ with the angular frequency ω_{photon} of the emitted photon.

*This is one of many versions of the Correspondence Principle.

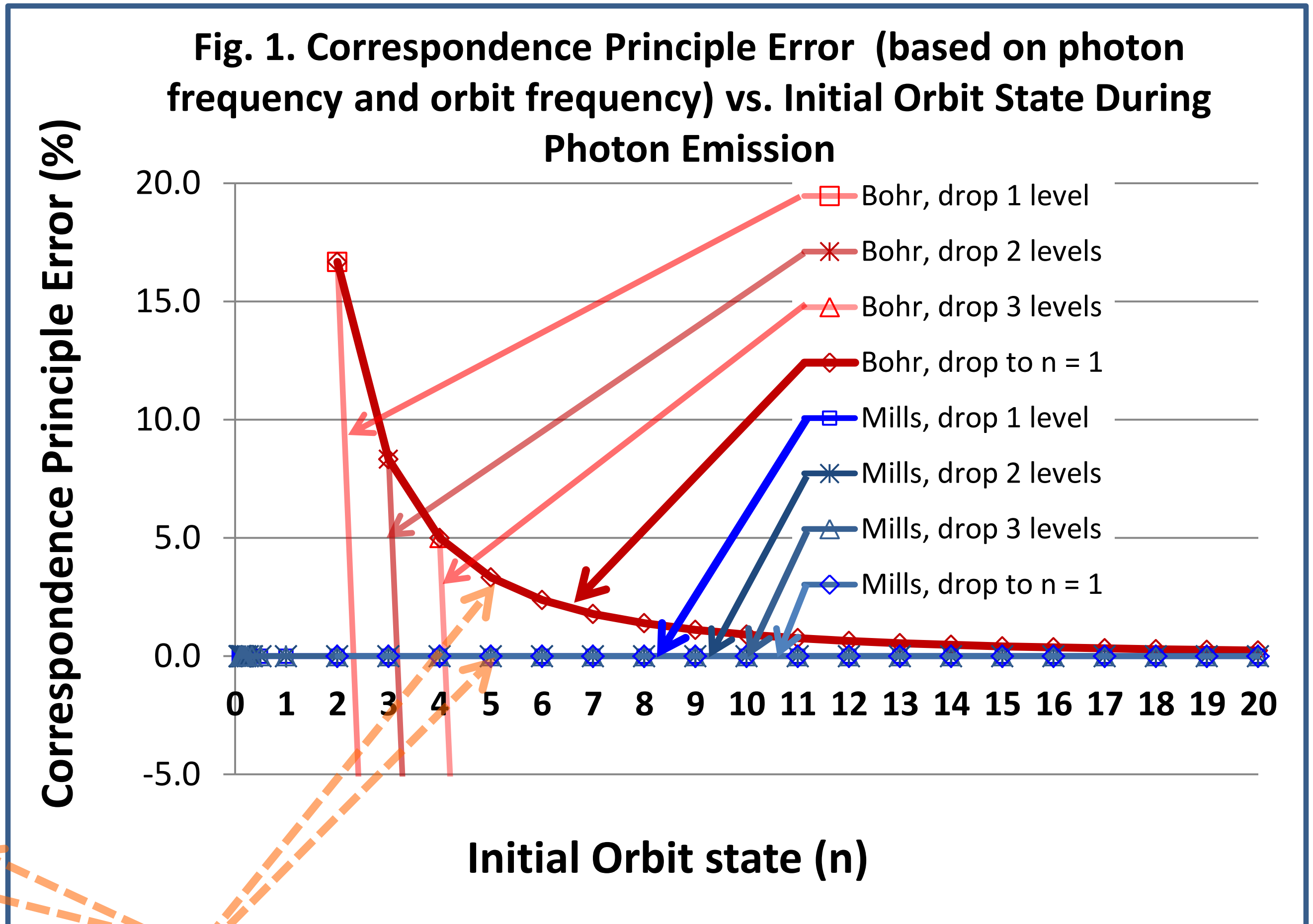




Hydrogen (based on **Bohr Model**)

Table 1. Correspondence Principle Error (%) Based On Photon Frequency and Electron Orbit Frequency

Orbit State Drop	Bohr	GUTCP
n = 2 to n = 1	16.67	0.000000
n = 3 to n = 2	-36.67	0.000000
n =100 to n = 99	-98.49	0.000000
n = 1000 to n = 999	-99.85	0.000000
n = 2 to n = 1	16.67	0.000000
n = 3 to n = 1	8.33	0.000000
n = 5 to n = 1	3.33	0.000000
n = 50 to n = 1	0.0392	0.000000
n = 100 to n = 1	0.0099	0.000000
n = 500 to n = 1	0.00040	0.000000



For example, error in the Bohr Model when the electron drops from **n** = 5 to **n** = 1 is 3.33% while error in GUTCP model is 0.000000%

This is the correspondence principle in action. The error in the Bohr model goes to zero when the drop in the orbit state is large. So for example, a drop of n = 500 to **n** = 1 gives an error of .0004%. But the percentage error for GUTCP is zero at <u>all</u> orbit state level drops, including small drops from **n** = 2 to **n** = 1 and large drops from **n** = 500 to **n** = 1.

Equations for the Correspondence Principle applied to the Bohr Model and GUTCP during photon emission and absorption.

The following equations are common to both the Bohr Model and GUTCP when the hydrogen atom absorbs or emits a photon:

$$\Delta PE = \Delta KE + E_{photon} = \Delta KE + \hbar\omega$$

where

ΔPE = the change in potential energy, based on electrostatic force between electron and proton

ΔKE = the change in kinetic energy, based on mass and velocity of electron

$\hbar\omega$ = E_{photon} = energy of the emitted (or absorbed) photon

ω = angular frequency of emitted (or absorbed) photon (rad/s)

$\hbar$ = reduced Planck constant (hbar)

The change in potential energy of the electron is evenly split into two quantities, (1) the change in kinetic energy of the electron and (2) the energy of the emitted or absorbed photon.
As a result, the following three equations are true for both the Bohr Model and GUTCP during photon emission or absorption:

$$\Delta KE = E_{photon} = \hbar\omega$$

$\hbar\omega$ is the energy of the emitted or absorbed photon. Also, the energy of the photon is considered negative for an emitted photon and positive for an absorbed photon.

$$\Delta KE = \frac{1}{2}\Delta PE$$

$$E_{photon} = \hbar\omega = \frac{1}{2}\Delta PE$$

GUTCP and the Bohr Model are based on different postulates. The hydrogen radius equations are different and GUTCP includes a trapped photon that results in the electric field between the electron and the proton being adjusted by a factor of **1/n**.

Table 2. Postulates Used in Development of Hydrogen Model.			
	Bohr	**GUTCP**	**Notes**
radius	$r = na_0$	$r = n^2 a_0$	a_0 = bohr radius n = orbit state
Electric field factor between electron and proton	1	$\frac{1}{n}$	GUTCP includes a trapped photon which adjusts electric field by **1/n** while the Bohr Model has no trapped photon and the factor is just **1**.

The end result of these different postulates are different equations for the change in electron orbit angular frequency compared to the emitted photon angular frequency. The equation for the emitted photon frequency as a function of the change in electron orbital angular frequency for the Bohr Model is

Bohr Model

$$\omega_{photon} = \left(\frac{1}{2}\Delta\omega_{orbit}\right)\frac{\left(\frac{1}{n_f^2} - \frac{1}{n_i^2}\right)}{\left(\frac{1}{n_f^3} - \frac{1}{n_i^3}\right)}$$

where

n_i = initial orbit state

n_f = final orbit state

ω_{photon} = Emitted (or absorbed) photon angular frequency (rad/s).

$\Delta\omega_{orbit}$ = Change in electron orbit angular frequency around the proton (rad/s).

If the final orbit state is **n_f** = 1 then the equation above becomes

Bohr Model

$$\omega_{photon} = \left(\frac{1}{2}\Delta\omega_{orbit}\right)\frac{\left(1 - \frac{1}{n_i^2}\right)}{\left(1 - \frac{1}{n_i^3}\right)} \qquad \text{(Eq. (B))}$$

Now, compare the equation above to the angular frequency equation based on the GUTCP model:

GUTCP $$\omega_{photon} = \frac{1}{2}\Delta\omega_{orbit} \qquad \text{(Eq. (C))}$$

The equation for the GUTCP model and the Bohr Model differ by the following factor

$$\text{factor} = \frac{\left(1 - \frac{1}{n_i^2}\right)}{\left(1 - \frac{1}{n_i^3}\right)}$$

This factor is what causes the Bohr model to have decreasing error for increasing initial orbit states because the factor shown above goes to 1 as $\mathbf{n_i}$ goes to infinity. Eq. (C) for GUTCP shows a true classical result that has zero error regardless of the starting orbit state $\mathbf{n_i}$ or final orbit state $\mathbf{n_f}$. **In GUTCP, the emitted photon frequency is *always* ½ the change in the electron orbit frequency in all orbit transitions small and large.** This can be seen in Table 1 (of this Appendix).

Why is the photon frequency exactly ½ the change in the electron orbit frequency?

In GUTCP, an electron starting at $\mathbf{n_i}$ = infinity (i.e. an ionized electron) has an orbit frequency around the proton of 0 Hz. If it is then captured by a proton and has a final orbit state $\mathbf{n_f}$ = 1 then the final orbit frequency is $6.6X10^{15}$ Hz (note that this is cycles/sec). For this transition, the emitted photon frequency is $3.3X10^{15}$ Hz. One interpretation *might* be that the emitted photon frequency ($3.3X10^{15}$ Hz) is just the average of the starting frequency (0 Hz) and the ending frequency ($6.6X10^{15}$ Hz). But this interpretation would ignore the real reason which is that the change in potential energy is converted into two energies, ½ goes into the final kinetic energy of the electron and ½ goes into the emitted photon.

Consider the reverse situation where an electron starting at $\mathbf{n_i}$ = 1 absorbs a $3.3X10^{15}$ Hz photon and becomes ionized where $\mathbf{n_f}$ = infinity and the final orbit frequency is 0 Hz. *It might seem more "classical"* that the emitted photon was exactly equal to the starting frequency of the electron but that is not the case. The reason (as before) is that the ionization process uses the combined energy of the ionizing photon <u>*and*</u> the change in kinetic energy (where the final kinetic energy is zero) to ionize the electron. In other words, the electron needs to increase its potential energy during ionization and ½ of the energy comes from the change in the kinetic energy and ½ comes from the photon that causes the electron ionization. Note that the frequencies mentioned in these two examples also match the Bohr Model because the change in orbit state was large (i.e. either $\mathbf{n_i}$ or $\mathbf{n_f}$ was equal to infinity while the opposite orbit state was equal to 1). If this had used the example of $\mathbf{n_i}$ = 2 and $\mathbf{n_f}$ = 1 then the Bohr Model would have had an "error" of 16.7% (see Table 1 of this Appendix).

GUTCP derivation for the change in electron orbital angular frequency $\Delta\omega_{orbit}$ during photon emission or absorption.

The derivation of the orbital angular frequency $\Delta\omega_{orbit}$ for the electron around the proton using the GUTCP model is shown below with orange boxed highlights where the derivation differs from the Bohr Model. Including these orange boxed highlight differences in the derivation would result in an equation of $\Delta\omega_{orbit}$ for the Bohr Model.

Start with GUTCP Eq. (I.106) which is the force balance equation for the electron in the hydrogen atom where the centripetal force is equal to the electrostatic force. Note that the electrostatic force equation includes the factor **1/n** for the central electric field due to the trapped photon.

e/n due to trapped photon in GUTCP model

For Bohr model derivation, change (**e/n**) to just "**e**".

$$F_{centripetal} = F_{electrostatic} \Rightarrow \frac{m_e v_n^2}{r_n} = \frac{\left(\frac{e}{n}\right)e}{(4\pi\varepsilon_0)r_n^2} = \frac{e^2}{n(4\pi\varepsilon_0)r_n^2} \qquad \text{(GUTCP Eq. (I.106))}$$

where

m_e = mass of electron

r_n = orbit radius

e = charge of electron

n = orbit state

v_n = tangential velocity

ε_0 = electric permittivity

$F_{centripetal}$ = force due to motion along a circular path

$F_{electrostatic}$ = force due to charge attraction

Then use the postulate that the allowed radii are

$r_n = na_0$ (allowed radii of hydrogen atom) (GUTCP Eq. (I.107))

for Bohr model derivation, change this to $r_n = n^2 a_0$

Solve GUTCP Eq. (I.106) for (tangential) orbit velocity

$$v_n = \frac{e^2}{n\hbar(4\pi\varepsilon_0)} \qquad \text{(Eq. (D))}$$

rearrange the equation for the Bohr radius to create 1= $\mathbf{a_0/a_0}$

$$a_0 = \frac{\hbar^2(4\pi\varepsilon_0)}{m_e e^2} \Longrightarrow 1 = \frac{\hbar^2(4\pi\varepsilon_0)}{m_e e^2 a_0} = \frac{a_0}{a_0} \qquad \text{(Eq. (E))}$$

multiply the velocity equation (Eq. (D)) by $\mathbf{a_0/a_0}$ (Eq. (E)) to put the velocity in terms of the Bohr radius $\mathbf{a_0}$

$$v_n = \left(\frac{e^2}{n\hbar(4\pi\varepsilon_0)}\right)\left(\frac{\hbar^2(4\pi\varepsilon_0)}{m_e e^2 a_0}\right)$$

$$v_n = \frac{\hbar}{m_e n a_0} \qquad \text{(GUTCP Eq. (1.35) and GUTCP Eq. (I.61))}$$

Note: To keep things simpler in this document, the equations used in the discussion of the correspondence principal use $\mathbf{a_0}$ (5.291777 X 10^{-11} m) for the Bohr radius instead of $\mathbf{a_H}$ (5.28890 X 10^{-11} m) and μ_e (.9994557) where $\mathbf{a_H}$ is the bohr radius with the reduced mass concept included and μ_e is the dimensionless reduced mass factor. In GUTCP, $\mathbf{a_H}$ is used in all equations that ***don't*** involve the TSO which includes the equations listed for the correspondence principle discussion. In GUTCP, any equation that does involve the TSO uses the bohr radius $\mathbf{a_0}$ and *no* reduced mass factor μ_e. The reason that the TSO equations in GUTCP don't use $\mathbf{a_H}$ is because the TSO does not have a proton at the center and therefore there is no electrodynamic interaction between the proton and the electron (i.e. no "reduced mass" effect). Note that $\mathbf{a_H}$ is .05% smaller than $\mathbf{a_0}$ and that $a_H = a_0 \mu_e$

The Kinetic Energy (KE) equation and Potential Energy (PE) equation for the electron are

$$KE = \frac{1}{2} m_e v_n^2$$

e/n due to trapped photon in GUTCP model

For Bohr model derivation, change (**e/n**) to just "**e**".

$$PE = -\frac{\left(\frac{e}{n}\right)e}{(4\pi\varepsilon_0)r_n} = -\frac{e^2}{n(4\pi\varepsilon_0)r_n}$$

note that there is a negative sign in front of this term

Note that the potential energy equation is based on the electrostatic force equation and includes the GUTCP postulate that the central electric field is adjusted by **1/n** due to the trapped photon. Also, the potential energy is a negative number indicating that the electron is bound to the proton.

Inserting the velocity equation (GUTCP Eq. (I.61)) into the Kinetic Energy equation gives

$$KE = \frac{1}{2} m_e \left(\frac{\hbar}{m_0 n a_0} \right)^2 = \frac{\hbar^2}{2 m_e n^2 (a_0)^2}$$

Inserting the allowed radii equation (GUTCP Eq. (I.107)) into the Potential Energy equation gives

$$PE = -\frac{e^2}{n(4\pi\varepsilon_0) r_n} = -\frac{e^2}{n(4\pi\varepsilon_0) n a_0}$$

multiplying the potential energy equation by $\mathbf{a_0/a_0}$ (Eq. (E)) to put it in terms of $(\mathbf{a_0})^2$ so that it matches the form of the kinetic energy equation gives

$$PE = \left(\frac{e^2}{n(4\pi\varepsilon_0) n a_0} \right) \left(\frac{a_0}{a_0} \right) = \left(\frac{e^2}{n(4\pi\varepsilon_0) n a_0} \right) \left(\frac{\hbar^2 (4\pi\varepsilon_0)}{m_e e^2 a_0} \right) = \frac{\hbar^2}{m_e n^2 (a_0)^2}$$

The total energy of the electron is the sum of the potential energy and the kinetic energy

note that the PE term is negative

$$E_{total} = PE + KE = -\frac{\hbar^2}{2 m_e n^2 (a_0)^2} + \frac{\hbar^2}{m_e n^2 (a_0)^2} = \frac{\hbar^2}{2 m_e n^2 (a_0)^2} \qquad \text{(Eq. (F))}$$

The equation above is the total energy of the electron in the hydrogen atom for a given orbit state **n**. The change in total energy between an initial orbit state $\mathbf{n_i}$ and a final orbit state $\mathbf{n_f}$ is equal to the energy of a photon that it absorbs or emits and is

$$\Delta E_{total} = \frac{\hbar^2}{2m_e n_f^2 (a_0)^2} - \frac{\hbar^2}{2m_e n_i^2 (a_0)^2} = \frac{\hbar^2}{2m_e (a_0)^2}\left(\frac{1}{n_f^2} - \frac{1}{n_i^2}\right) = E_{photon}$$

the equation above can be written as

$$E_{photon} = \frac{\hbar^2}{2m_e (a_0)^2}\left(\frac{1}{n_f^2} - \frac{1}{n_i^2}\right) = hf = \hbar\omega$$

if a photon is emitted and the final state is $\mathbf{n_f}$ = 1 then the equation above becomes

$$E_{photon} = \frac{\hbar^2}{2m_e (a_0)^2}\left(1 - \frac{1}{n_i^2}\right) = \hbar\omega$$

Side Note: In the equation above, getting rid of the squared term $(\mathbf{a_0})^2$ by inserting the equation for $\mathbf{a_0}$ (just once) gives GUTCP Eq. (I.108):

$$E_{photon} = \frac{\hbar^2}{2m_e a_0 \left(\frac{\hbar^2 (4\pi\varepsilon_0)}{m_e e^2}\right)}\left(1 - \frac{1}{n_i^2}\right) = \frac{e^2}{(8\pi\varepsilon_0) a_0} = \hbar\omega \qquad \text{(GUTCP Eq. (I.108))}$$

dividing by $\hbar$ gives the angular frequency of the emitted photon

$$\omega_{photon} = \frac{E_{photon}}{\hbar} = \frac{\hbar}{2m_e\left(a_0\right)^2}\left(1 - \frac{1}{n_i^2}\right) \qquad \text{(Eq. (G))}$$

This applies to both the Bohr Model and GUTCP.

Now, calculate the change in orbital angular frequency $\Delta\omega_{orbit}$ for the electron during a transition between orbit states.

Starting with the allowed radius equation, the orbit velocity of the electron equation and the equation for angular frequency:

$$r_n = na_0 \qquad \text{(GUTCP Eq. (I.107)) (allowed radii)}$$

$$v_n = \frac{\hbar}{m_e n a_0} = \frac{\hbar}{m_e r_n} \qquad \text{(GUTCP Eq. (1.35) and GUTCP Eq. (I.61)) (velocity)}$$

$$\omega = \frac{\text{velocity}}{\text{radius}} = \frac{v}{r} \qquad \text{(Eq. (H)) (angular frequency)}$$

Inserting the velocity equation (GUTCP Eq. (I.61)) and the radius equation (GUTCP Eq. (I.107)) into the angular frequency equation (Eq. (G)) gives the electron's orbital angular frequency

$$\omega_n = \frac{v_n}{r_n} = \frac{\left(\frac{\hbar}{m_e n a_0}\right)}{n a_0} = \frac{\hbar}{m_e (n a_0)^2}$$

(similar to GUTCP Eq. (1.36) and GUTCP Eq. (I.62))

and the change in orbital angular frequency for the electron between an initial orbit state $\mathbf{n_i}$ and a final orbit state $\mathbf{n_f}$ is

$$\Delta\omega_{orbit} = \frac{\hbar}{m_e (n_f a_0)^2} - \frac{\hbar}{m_e (n_i a_0)^2} = \frac{\hbar}{m_e (a_0)^2}\left(\frac{1}{n_f^2} - \frac{1}{n_i^2}\right)$$

where the subscript "orbit" for the angular velocity indicates it is for the orbiting electron.

If the final state is $\mathbf{n_f} = 1$ then

$$\Delta\omega_{orbit} = \frac{\hbar}{m_e (a_0)^2}\left(1 - \frac{1}{n_i^2}\right)$$

(GUTCP Eq. (I.109))

compare this to the emitted photon angular frequency equation derived earlier which was

$$\omega_{photon} = \frac{E_{photon}}{\hbar} = \frac{\hbar}{2 m_e (a_0)^2}\left(1 - \frac{1}{n_i^2}\right)$$

(Eq. (G))

With some basic algebraic manipulation of the previous 2 equations, it can be seen that the following is true (this is for GUTCP only)

$$\omega_{photon} = \frac{1}{2}\Delta\omega_{orbit} \qquad \text{(Eq. (C))}$$

← GUTCP

Therefore, in GUTCP, the angular frequency of the emitted photon is *exactly* equal to ½ the change in the electron's orbital angular frequency in the hydrogen atom. This applies for all initial orbit states between $\mathbf{n_i}$ = 1 and $\mathbf{n_i}$ = infinity and all final orbit states from $\mathbf{n_f}$ = 1 to $\mathbf{n_f}$ = infinity (where $\mathbf{n_i}$ does not equal $\mathbf{n_f}$). Eq. (C) is exactly what Classical Physics would predict and thus GUTCP follows the Correspondence Principle at *all* orbit state transitions *without* error.

Side Note: ω is the angular frequency in radians per second. Since $\omega = 2\pi f$, Eq. (C) can be written as the following

$$f_{photon} = \frac{1}{2}\Delta f_{orbit} \qquad \text{(where f = frequency (Hz))}$$

Correspondence Principle error equation for the Bohr Model.

Below is one method of generating the equation for the Bohr Model "error" that is graphed in Figure 1 and listed in Table 1 (of this Appendix).

Starting with Eq. (B)

Bohr Model

$$\omega_{photon} = \left(\frac{1}{2}\Delta\omega_{orbit}\right)\frac{\left(1 - \frac{1}{n_i^2}\right)}{\left(1 - \frac{1}{n_i^3}\right)} \qquad \text{(Eq. (B))}$$

solve for $\Delta\omega_{orbit}$

Bohr Model

$$\Delta\omega_{orbit} = 2\omega_{photon}\left[\frac{\left(1 - \frac{1}{n_i^2}\right)}{\left(1 - \frac{1}{n_i^3}\right)}\right]^{-1} \qquad \text{(Eq. (I))}$$

Eq. (A) is

$$\text{Error\%} = (100\%)\left(\frac{\frac{1}{2}\left(\Delta\omega_{orbit}\right)}{\omega_{photon}} - 1\right) \qquad \text{(Eq. (A))}$$

inserting Eq. (H) into Eq. (A) gives

Bohr Model

$$\text{Error\%} = (100\%)\left(\frac{\frac{1}{2}\left(\Delta\omega_{orbit}\right)}{\omega_{photon}} - 1\right) = (100\%)\left(\frac{\frac{1}{2}\left(2\omega_{photon}\left[\frac{\left(1-\frac{1}{n_i^2}\right)}{\left(1-\frac{1}{n_i^3}\right)}\right]^{-1}\right)}{\omega_{photon}} - 1\right)$$

which simplifies to

Bohr Model

$$\text{Error\%} = (100\%)\left(\left[\frac{\left(1 - \frac{1}{n_i^2}\right)}{\left(1 - \frac{1}{n_i^3}\right)}\right]^{-1} - 1\right) \qquad \text{(Eq. (J))}$$

Eq. (J) is the Bohr Model error shown in Figure 1 and Table 1 (of this Appendix) as it relates to the photon frequency and the change in electron orbital angular frequency.

Side Note: GUTCP Equation (I.107) for the allowed radii of the hydrogen atom

$$r_n = na_0 \qquad \text{(GUTCP Eq. (I.107))}$$

directly implies that the angular momentum **L** (i.e. mass X velocity X radius) of the electron in the hydrogen atom at <u>all</u> orbit states is equal to

$$L = m_e v_n r_n = \hbar \qquad \text{(angular momentum of electron in GUTCP)}$$

and results in the angular momentum being conserved at the start and end of the photon excitation. This conforms to the deBroglie relation <u>*and*</u> the conservation of angular momentum because the hydrogen atom has $\hbar$ of angular momentum before and after the orbit state transition. Compare this to the Bohr Model which makes the postulate that the allowed radius is equal to

$$r_n = n^2 a_0$$

which results in the angular momentum **L** of the electron at all orbit states being

$$L = m_e v_n r_n = n\hbar \qquad \text{(angular momentum of electron in Bohr Model)}$$

and does <u>*not*</u> result in in angular momentum being conserved at the start and end of the excitation. This is one of many failings in the Bohr Model. In the Bohr model, ionization of the electron would mean infinite angular momentum at $\mathbf{n_f}$ = infinity and this implies infinite energy which is impossible. Therefore the Bohr Model, which attempts to be based on classical physics, was abandoned and replaced with Standard Quantum Mechanics (SQM) which is <u>*not*</u> based on classical physics. Compare this with GUTCP which is based on classical physics and special relativity in a consistent way.

Side Note continued:

In other words, the GUTCP postulate that the allowed radii is

$$r_n = na_0 \qquad \text{(GUTCP Eq. (I.107))}$$

could have been the postulate that the angular momentum **L** is equal to $\hbar$ at all stable orbit states **n**

$$L = m_e v_n \; r_n = \hbar \qquad \text{(angular momentum of electron in GUTCP)}$$

Either of these postulates results in the same equation for total energy (Eq. (F)) for the electron in the hydrogen atom as a function of orbit state **n**. They are postulates in the sense that they guide the derivation of the theory. But in the end there are classical experimentation results that back them up, specifically the deBroglie relation and the law of conservation of angular momentum.