Uniting gravity, electromagnetism, weak and strong nuclear forces at the quantum level by straightforward dynamics/kinetics.

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Abstract.
Gravity and electromagnetism at the sub-atomic level are reduced to straightforward dynamics/kinetics and use the same mechanism to derive both Newton's law of gravitation and Coulomb's law for electrostatics. Weak and strong interactions are also considered.

Sub-atomic particles are all treated as speed of light particles which are either free, for example photons or confined, for example electrons (confined by boson vacuum pressure) and quarks (confined by boson pressure within their hadron). Confinement follows from an extension to Einstein's 1906 thought experiment on trapped radiation to deduce the mass/energy equation.

Fixed angular momentum gives the relationship between mass/frequency and radius of orbit that control the outward centrifugal and containing centripetal forces that yield the gravitational and electrostatic force laws.

Implications for gravity and cosmology include orbit orientation, boson blocking and expansion of the universe.

Contents.

1. Gravity/electromagnetism sharing the same mechanism/inverse square law.
Gravity is an attractive force which suggests one of three possibilities concerning two sub-atomic particles:
1. they pull together; or
2. they are pushed together; or
3. a combination of 1 and 2 above.

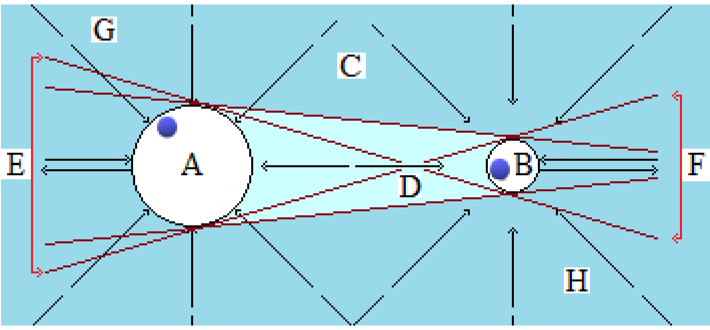

Figure 1.1 Sub-atomic particles interacting through gravity/electromagnetism.

The following are alternative captions for *Figure 1.1* - for gravity and for electromagnetism. They show the same mechanisms but with differing particles.

For gravity:
A = Particle A (confined).
B = Particle B (confined).
C = Full vacuum/'graviton' momentum flow.
D = Reduced vacuum/'graviton' momentum flow.
E = Region of momentum flow blocked by A that would have interacted with B.
F = Region of momentum flow blocked by B that would have interacted with A.
G = Momentum flow may also come from outside the region E if it has a momentum component that might be directed from A to B by collision within region E.
H = Similarly for region F.
Particle orbits vary in orientation (any plane in 3D space) and size (uncertainty from variations in angular momentum).

Particle system with two or more particles - attractive force.
The presence of a second particle will block some of the vacuum/'graviton' momentum reaching another particle and provide an overall force to make them move towards each other - attractive force.

Inverse square law: Blocking area.
Particle A has a blocking area of size S_A as seen by an observer on particle B.
S_A can be represented as a fraction of the surface of a sphere of radius r_1 where r_1 is the distance between particles A and B. The apparent area of S_A as observed at B is $S_A/(4\pi r_1^2)$.
If the distance between particles A and B is r_2 then the apparent area of S_A as observed at B is $S_A/(4\pi r_2^2)$.

With S_A and π constant this shows that the blocking of the momentum flow is inversely proportional to the square of the distance between the two masses.

Variation in the strength of the momentum flow at very close range.
If two or more sub-atomic particles are extremely close together then some quantum fluctuations may be prevented in the space between the two particles. Some vacuum momentum flow may be prevented leading to a small increase in the strength of the attractive force between the two particles.

Diffraction effects (momentum flow bending round an object) may also become significant with particles at very close range.

For electromagnetism:
Assume that either:
positively charged particles respond only to right handed photons; and
negatively charged particles respond only to left handed photons,

or the other way round:
positively charged particles respond only to left handed photons; and
negatively charged particles respond only to right handed photons.

The key is that charge and photon spin match.

A/B = 'source' electron/positron.
B/A = 'target' electron/positron.
C = Full vacuum/photon momentum flow.
D = Increased or decreased vacuum photon specific handedness momentum density.
If A and B have the same sign of charges (+1,+1) or (-1,-1) then D increases and the force is repulsive.
If A and B have opposite signs of charges (+1,-1) or (-1,+1) then D reduces and the force is attractive.
E = Region of momentum flow blocked by A that would have interacted with B.
F = Region of momentum flow blocked by B that would have interacted with A.
G = Momentum flow may also come from outside the region E if it has a momentum component that might be directed from A to B by collision within region E.
H = Similarly for region F.
Particle orbits vary in orientation (any plane in 3D space) and size (uncertainty from variations in angular momentum).

Electron/positron dynamics/kinetics.
If we can picture electrons/positrons as contained speed of light particles 'circling' about a centre at a distance r from the centre and with orbital angular momentum $m_e cr = h/4\pi$ then:
A and B exert a centrifugal force of $m_e c^2/r$ and are contained by the vacuum/photon momentum flow.

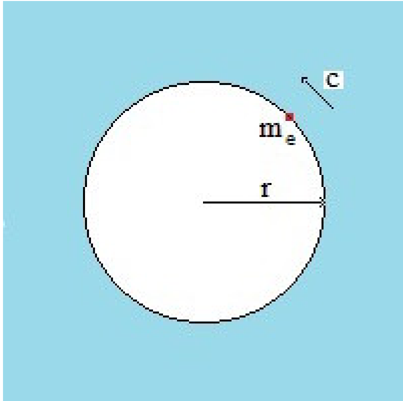

Figure 1.2 Electron - schematic diagram.

Using straightforward dynamics/kinetics the interaction cross-section between electron/electron or positron/positron or electron/positron is:
$\sigma = 8\alpha(\pi r^2) \cong (\pi r^2)/(17.13)$
α = fine structure constant.
Notice the exact number 8 coming from a calculation that does not rely on electromagnetic theory. What does the 8 signify? Please see section 3.

Notice that there are 2 spins involved in the electron:
the spin of the speed of light particle about its own axis (its frequency); and
the spin of the particle about the centre of the orbit.

Do the 2 spins have a bearing on the electron requiring a 720 degree rotation to return to its original state instead of 360 degrees for a single spin?

2. Gravitational mass equal to inertial mass - the reason why.
Gravity is a force that is proportional to the gravitational mass of an object (Newton's law of universal gravitation); and
the gravitational mass of the object is the same as its inertial mass (Einstein's general relativity equivalence principle).

By using dynamic/kinetic interactions to explain gravity *we see why the gravitational mass is the same as the inertial mass*.

Isolated particle - no net force (but please note section immediately below: 'Open and expanding universe - net outward force').
The average interaction between the vacuum and an isolated sub-atomic particle has no overall force to make it move in one direction or another.

There may be a temporary imbalance of forces as the momentum flows are unlikely to be uniform in strength and in arrival time.

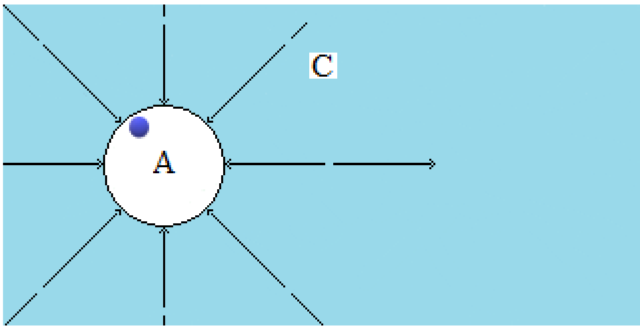

Figure 2.1 Isolated particle.

A = Particle A.
C = Full vacuum/photon momentum flow.

Open and expanding universe - net outward force.
With an open and expanding universe there should be a net force causing matter to move outwards from the centre because of a slight imbalance caused by a difference between the stronger density of the vacuum momentum on the side of a sub-atomic particle closer to the centre; and
the weaker density of the vacuum momentum on the side of a sub-atomic particle further from the centre.

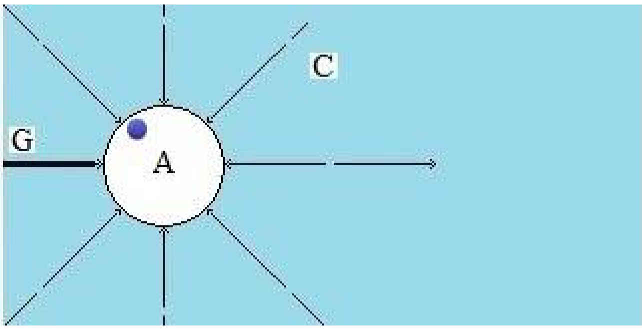

Figure 2.2 Open and expanding universe - net outward force.
A = Particle A.
C = Full vacuum/photon momentum flow.
G = Stronger momentum flow closer to centre of an open and expanding universe.

Particle system with two or more particles - attractive force.
The presence of a second particle will block some of the vacuum/'graviton' momentum reaching another particle and provide an overall force to make them move towards each other - attractive force.

This is a copy of *Figure 1.1* and the explanation below it.

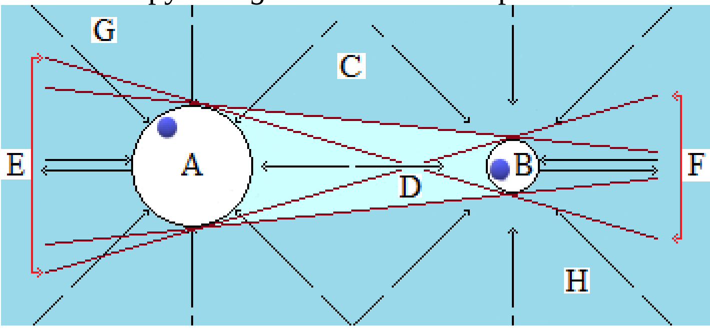

Figure 2.3 Sub-atomic particles interacting through gravity/electromagnetism.

For gravity:
A = Particle A (confined).
B = Particle B (confined).
C = Full vacuum/'graviton' momentum flow.
D = Reduced vacuum/'graviton' momentum flow.
E = Region of momentum flow blocked by A that would have interacted with B.
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Particle orbits vary in orientation (any plane in 3D space) and size (uncertainty from variations in angular momentum).
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The presence of a second particle will block some of the vacuum/'graviton' momentum reaching another particle and provide an overall force to make them move towards each other - attractive force.

3. Linking mass with vacuum momentum flow interactions.

This section suggests that sub-atomic particles are confined speed of light particles as in an extension of Einstein's box 1906 thought (gedanken) experiment. For example if we picture the electron as a confined speed of light particle with mass m_e and angular momentum $m_e cr = h/4\pi$ then Coulomb's law is derived from straightforward dynamics/kinetics giving the electron/electron or positron/positron or electron/positron cross section as:
$\sigma = 8\alpha(\pi r^2) \cong (\pi r^2)/(17.13)$
α = fine structure constant.
Please see Reference 7.
Notice the exact number 8 coming from a calculation that does not rely on electromagnetic theory. What does the 8 signify?
Is there a link to the 'Eightfold Way' of Murray Gell-Mann and Yuval Ne'eman (1961) linking charge and strangeness in hadrons?
There is the 'Octet Rule' of chemical bonding whereby atoms have or share eight electrons in their valence shell - the same configuration as in the noble gases.
Does the electron have eight identical 'facets' showing one after the other as it rotates about its own axis of forward contained motion?
Is the exact number 8 applicable to gravitation theory?

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3.1 Quotation.
Here is a quotation from the works of Sir Isaac Newton. (The word Bodies in Physics means objects with mass).

Are not gross Bodies and Light convertible into one another, and may not Bodies receive much of their activity from the Particles of Light which enter their Composition?

Source:
{Newton, The Third Book of Opticks (1718) Question 30.
Newton, Opticks (4th ed., 1730)
(http://www.newtonproject.ox.ac.uk/view/texts/normalized/NATP00051)}.
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3.2 Einstein's box 1906 thought (gedanken) experiment. Derivation of E = mc2

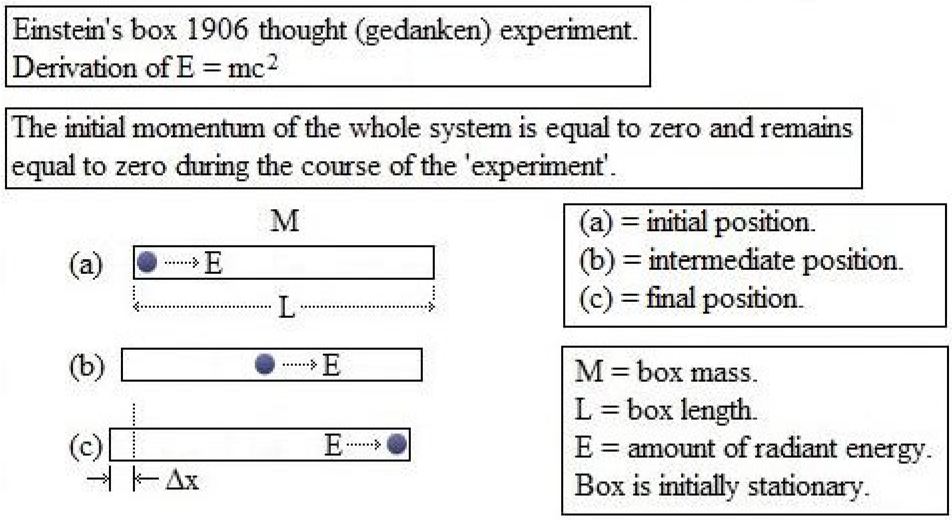


Figure 3.1 Einstein's box 1906 thought (gedanken) experiment.

A burst of radiation with energy E (and momentum E/c) pushes against the box making it recoil with speed v and momentum Mv = (-E/c) equal and opposite to that of the radiation.
v = -E/Mc

If v is much less than c then after a time $\Delta t = L/c$ the radiation hits the other end of the box and stops moving.
The box has moved a distance $\Delta x = v\Delta t = (-E/Mc) \times (L/c) = -EL/Mc^2$

As the box and radiation is an isolated system the centre of mass does not move.
So if the radiation has mass m then:
$mL + M\Delta x = 0$
$mL + M(-EL/Mc^2) = 0$
$m + (-E/c^2) = 0$
$m - E/c^2 = 0$
$E = mc^2$

This is a simplified version of events which nevertheless gives the 'correct' answer of $E = mc^2$.
The transit time L/c neglects the recoil of the box. Also the reduction in the mass of the box as some of it's mass is converted into radiation is ignored.
But if these are taken into account the result $E = mc^2$ still stands.

Please see Reference 5.

3.3 Speed of light and temperature.

In the kinetic theory of gases (*please see Reference 6.*) the following relation is derived:
$(1/3)Nmc^2 = RT$ where:
N = number of molecules in the gas
m = mass of molecule
c^2 = mean square speed of molecules
R = gas constant
T = absolute temperature of the gas.

If free speed of light particles (photons, neutrinos, 'gravitons' etc.); and
the components of contained particles
all travel at the speed of light

does the speed of light relate to a temperature of the universe?

4. Interaction between a confined sub-atomic particle and a vacuum particle.

<u>Confined sub-atomic particle:</u>
mass m_1 initial velocity $v_1\mathbf{i}$ final velocity $u_1(-\mathbf{i})$

<u>Vacuum particle:</u>
mass m_2 initial velocity $v_2(-\mathbf{i})$ final velocity $u_2\mathbf{i}$

Before interaction:

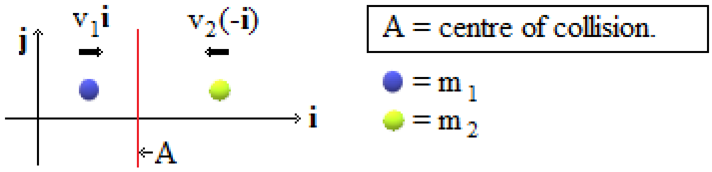


Figure 4.1

After interaction:

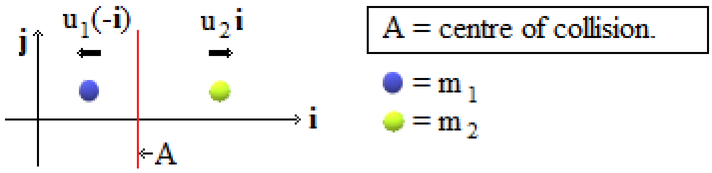


Figure 4.2.

Maintaining the speed of the confined particle:

For the particle with mass m_1 to have the same speed (magnitude of velocity) but opposite direction after colliding with the particle with mass m_2 we need the final velocity of m_1 $\{= u_1(-i)\}$ to be $v_1(-i)$.

Using the formula $v_1(-i) = \{2m_2v_2(-i) + (m_1 - m_2)v_1(\mathbf{i})\}/\{m_1 + m_2\}$
derived from the formulae for linear momentum conservation and kinetic energy conservation:
$m_1v_1 + m_2v_2 = m_1u_1 + m_2u_2$; and
$\frac{1}{2}m_1v_1^2 + \frac{1}{2}m_2v_2^2 = \frac{1}{2}m_1u_1^2 + \frac{1}{2}m_2u_2^2$

we obtain:
$v_1(-\mathbf{i}) = \{2m_2v_2(-\mathbf{i}) + (m_1 - m_2)v_1(\mathbf{i})\}/\{m_1 + m_2\}$
$v_1(-\mathbf{i})\{m_1 + m_2\} = \{2m_2v_2(-\mathbf{i}) + (m_1 - m_2)v_1(\mathbf{i})\}$
$-m_1v_1(\mathbf{i}) - m_2v_1(\mathbf{i}) = -2m_2v_2(\mathbf{i}) + m_1v_1(\mathbf{i}) - m_2v_1(\mathbf{i})$
$-m_1v_1(\mathbf{i}) = -2m_2v_2(\mathbf{i}) + m_1v_1(\mathbf{i})$
$0 = 2m_1v_1(\mathbf{i}) - 2m_2v_2(\mathbf{i})$
$m_1v_1(\mathbf{i}) + m_2v_2(-\mathbf{i}) = 0$

So to maintain the magnitude of the momentum of the confined particle we need:
the magnitude of the momentum of the vacuum particle to equal the magnitude of the momentum of the confined particle.

Speed of light particles.

For speed of light (relativistic) particles we need to look at the centre of momentum. If we have two speed of light particles colliding in one dimension (straight line) then the momentum (p) of each particle relative to the centre of momentum is maintained but its direction is reversed.

Before interaction:

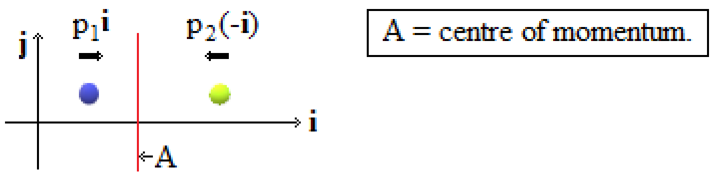


Figure 4.3

After interaction:

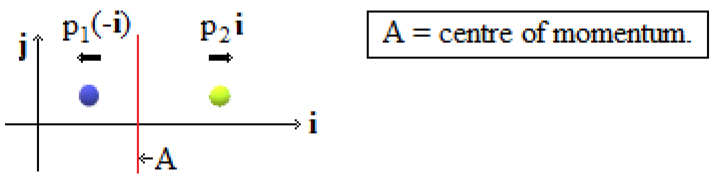


Figure 4.4

5. Interaction between a confined sub-atomic particle and a confined boson.

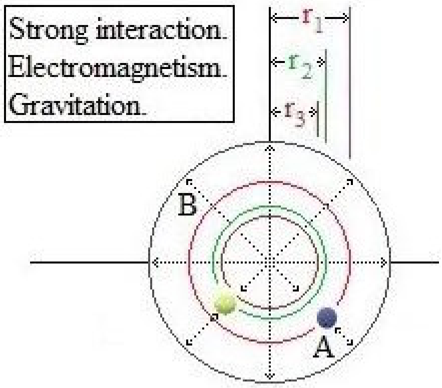


Figure 5.1 Sub-atomic particles interacting through the strong interaction.

Possible schematic for the positively charged pion (class - hadron, meson, boson).
Anti-down quark (charge = +1/3) in approximate orbit with radius r_1
Up quark (charge = +2/3) in approximate orbit with radius r_2

Bosons reflected radially on average. Reflection along path A is faster than along the longer path B leading to containment of the quark in an approximate orbit within the hadron.

<u>Orbits.</u>

r_1 = orbit corresponding to single boson containment	$r_1 = r_1/\sqrt{1}$	charge ±1/3
r_2 = orbit corresponding to double boson containment	$r_2 = r_1/\sqrt{2}$	charge ±2/3
r_3 = orbit corresponding to treble boson containment	$r_3 = r_1/\sqrt{3}$	charge ±3/3 = ±1

<u>Boson density per unit area to corresponds to boson containment of particle.</u>
The boson containment force on a quark or antiquark equals the centrifugal (outward) force exerted by the orbiting quark or antiquark on the 'radially' reflected bosons = mc^2/r

Using a quark's angular momentum as constant at mcr = h/4π
$mc^2/r = mcr \times c/r^2$
$mc^2/r = (h/4\pi) \times c/r^2$
$mc^2/r = hc/(4\pi r^2) \propto 1/4\pi r^2$
So the <u>containment force is inversely proportional to the surface area of a sphere with radius r</u>.

<u>Single</u> boson concentration per unit area occurs at r_1 over an area of $4\pi r_1^2$
<u>Double</u> boson concentration per unit area occurs at r_2 over an area of $4\pi r_2^2$ where $4\pi r_2^2$ is half the area of $4\pi r_1^2$
$4\pi r_2^2 = (4\pi r_1^2)/2 \Rightarrow r_2^2 = (r_1^2)/2 \Rightarrow r_2 = (r_1)/\sqrt{2}$
<u>Treble</u> boson concentration per unit area occurs at r_3 over an area of $4\pi r_3^2$ where $4\pi r_3^2$ is one third of the area of $4\pi r_1^2$
$4\pi r_3^2 = (4\pi r_1^2)/3 \Rightarrow r_3^2 = (r_1^2)/3 \Rightarrow r_3 = (r_1)/\sqrt{3}$
Notice that these radii correspond to the containment orbits shown above.

6. Containment of orbiting particle.

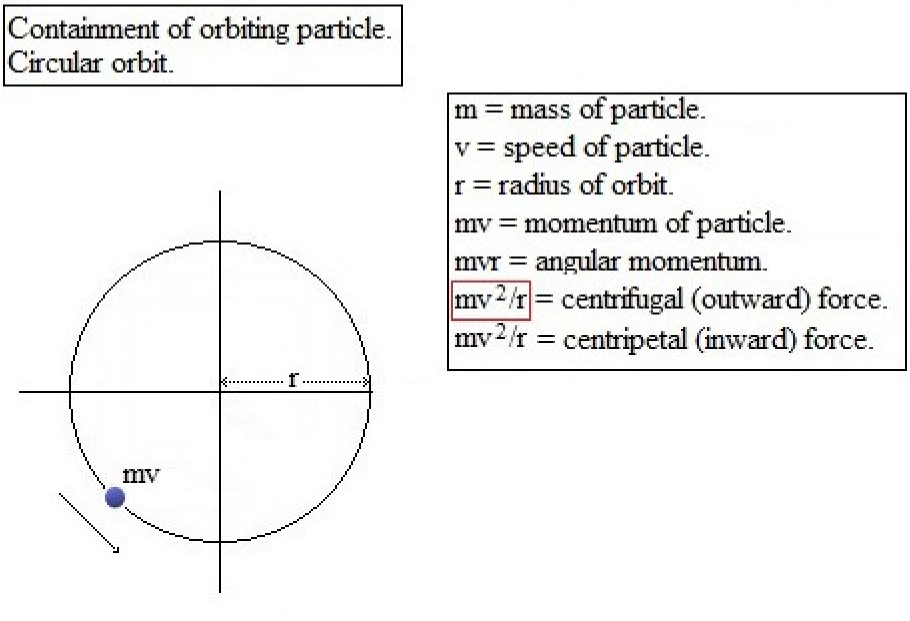


Figure 6.1 Containment of orbiting particle.

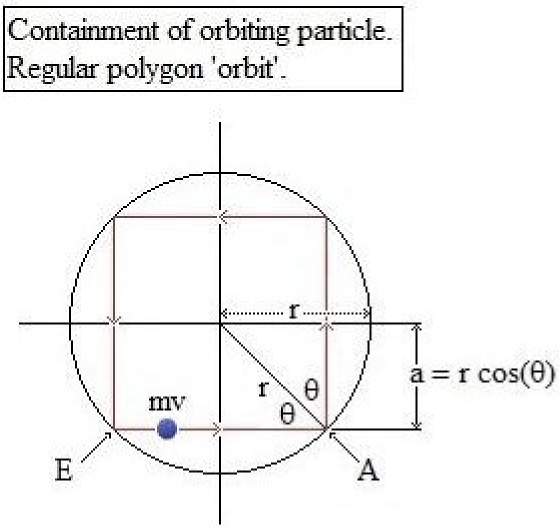


Figure 6.2 Containment of orbiting particle, regular polygon 'orbit'.

Containment force for any regular polygon orbit up to 'infinite' size equivalent to a circular orbit.

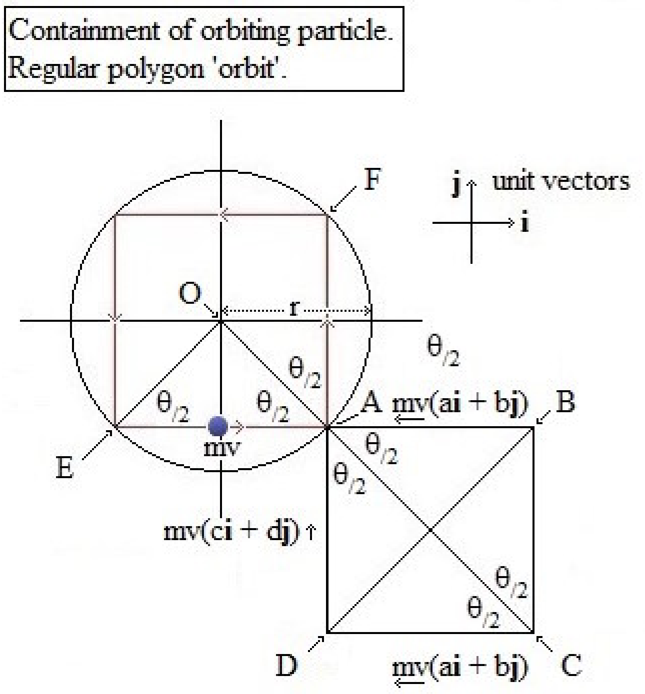


Figure 6.3.

Although this diagram shows a four-sided polygon the calculations for:
resultant momentum vector and containment force are
general and apply to a regular polygon with any number of sides.

Polygon details.
n = number of vertices of a regular polygon.
internal angles of a regular polygon = (2n - 4) right angles.
one internal angle = (2n -4)/n right angles.
θ/2 = half of one internal angle = (2n -4)/2n right angles.
a = half the length of one side of a regular polygon = r x cos(θ/2)
2a = length of one side of a regular polygon = 2r x cos(θ/2)
n2a = length of all sides of a regular polygon.
v = speed of particle.
time = distance/speed.
n2a/v = time for one revolution of the particle.

Notice that the angular momentum of the particle
= the momentum of the particle x the perpendicular distance from the centre
= mv x r sin(θ/2)

Particle containment.
At point A the particle of mass m and speed v has momentum m**v** and is redirected from the line of travel EA to the line of travel AF.
The momentum required for this has components along **BA** and **DA** and their resultant is along **CA**.

The <u>resultant momentum vector</u> **CA** along CA is found by copying the momentum vector **BA** along BA to the momentum vector **CD** along CD and adding **CD** and **DA** as a vector combination.
The magnitudes of **BA, CD** and **DA** are all mv

<u>Angles.</u>
Angles FAO and DAC and equal (vertically opposite angles)

Triangle DAC:
Angles DAC and DCA are equal (base angles of the isosceles triangle DAC with equal sides AD and CD proportionate to mv)
Angle CDA = $180° - \theta/2 - \theta/2 = 180° - \theta$
Triangle OEA:
Angles OEA and OAE are equal (base angles of the isosceles triangle OEA with equal sides OE and OA equal to the radius of the circle)
Angle EOA = $180° - \theta/2 - \theta/2 = 180° - \theta$

<u>Cosine rule.</u>
In this section A, B and C are general angles and <u>not related</u> to the letters in the above discussion.
The magnitude of vector **CA** (above) is found by using the general cosine rule for any triangle with sides of length a, b and c opposite the angles A, B and C respectively:
$c^2 = a^2 + b^2 - 2ab \cos C$

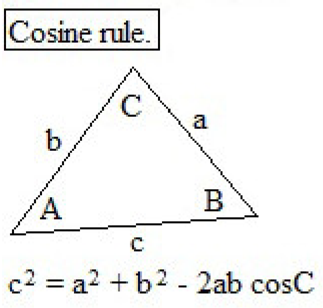


Figure 6.4

Using CA as c, CD as a, DA as b and angle CDA as C = $(180° - \theta)$:
$CA^2 = CD^2 + DA^2 - [2 \times CD \times DA \times \cos(180° - \theta)]$

To find $\cos(180° - \theta)$ we use the standard trigonometric identity:
$\cos(\alpha - \beta) = \cos\alpha\cos\beta + \sin\alpha\sin\beta$
$\cos(180° - \theta) = \cos180°\cos\theta + \sin180°\sin\theta$
$\cos(180° - \theta) = (-1) \times \cos\theta + (0) \times \sin\theta$
$\cos(180° - \theta) = -\cos\theta$

So:
$CA^2 = CD^2 + DA^2 - [2 \times CD \times DA \times \cos(180° - \theta)]$
$CA^2 = CD^2 + DA^2 - [2 \times CD \times DA \times (-\cos\theta)]$
$CA^2 = CD^2 + DA^2 + [2 \times CD \times DA \times \cos\theta]$

Using the magnitudes of **CD** and **DA** as mv:
$CA^2 = (mv)^2 + (mv)^2 + [2 \times mv \times mv \times \cos\theta]$
$CA^2 = 2(mv)^2 + 2(mv)^2\cos\theta$
$CA^2 = (mv)^2 (2 + 2\cos\theta)$
$CA = mv \sqrt{(2 + 2\cos\theta)}$ <u>this is the containment momentum at point A for a particle in a regular polygon path with any number of sides including up to 'infinite' size equivalent to a circular orbit.</u>

Similarly in triangle OEA:
$EA^2 = EO^2 + AO^2 - [2 \times EO \times AO \times \cos(180° - \theta)]$
$EA^2 = r^2 + r^2 - [2 \times r \times r \times -(\cos\theta)]$
$EA^2 = 2r^2 + 2r^2(\cos\theta)$
$EA^2 = r^2 (2 + 2\cos\theta)$
$EA = r \sqrt{(2 + 2\cos\theta)}$
* -----
EA is also found from triangle OEA as $2 \times r \cos(\theta/2)$
This section shows the conversion from $[r \sqrt{(2 + 2\cos\theta)}]$ to $[2 \times r \cos(\theta/2)]$
$r \sqrt{(2 + 2\cos\theta)} = r \sqrt{(2 + 2\cos(\theta/2 + \theta/2))}$
$r \sqrt{(2 + 2\cos\theta)} = r \sqrt{(2 + 2[\cos(\theta/2)\cos(\theta/2) - \sin(\theta/2)\sin(\theta/2)])}$
$r \sqrt{(2 + 2\cos\theta)} = r \sqrt{(2 + 2[\cos^2(\theta/2) - \sin^2(\theta/2)])}$

Using the trigonometric identity:
$\cos^2(\theta/2) + \sin^2(\theta/2 = 1 \Rightarrow \cos^2(\theta/2) - 1 = - \sin^2(\theta/2)$

$r \sqrt{(2 + 2\cos\theta)} = r \sqrt{(2 + 2[\cos^2(\theta/2) + \cos^2(\theta/2) - 1])}$
$r \sqrt{(2 + 2\cos\theta)} = r \sqrt{(2 + 2[2\cos^2(\theta/2) - 1])}$
$r \sqrt{(2 + 2\cos\theta)} = r \sqrt{(2 + 4\cos^2(\theta/2) - 2)}$
$r \sqrt{(2 + 2\cos\theta)} = r \sqrt{(4\cos^2(\theta/2))}$
$r \sqrt{(2 + 2\cos\theta)} = r \times 2\cos(\theta/2)$
$r \sqrt{(2 + 2\cos\theta)} = 2 \times r \cos(\theta/2)$
* -----

<u>time between containment impacts</u>:
= time taken to travel distance between E and A
= distance/speed = $EA/v = [r \sqrt{(2 + 2\cos\theta)}]/v$

<u>containment force</u>
= change of momentum per unit time
= (containment momentum at point A)/(time between containment impacts)
$= (mv \sqrt{(2 + 2\cos\theta)})/([r \sqrt{(2 + 2\cos\theta)}]/v)$
$= mv^2/r$ <u>this is the containment force for a particle in a regular polygon path with any number of sides including up to 'infinite' size equivalent to a circular orbit.</u>

7. Self-orbiting and travelling masses.

System of two orbiting masses (each with rest mass ½m) travelling at speed v and orbiting one another at the same speed v.

A system of two orbiting masses each with mass ½m have:
Total translational (linear) kinetic energy
$= ½(½m)v^2 + ½(½m)v^2 = ¼(mv^2) + ¼(mv^2) = ½mv^2$
Total orbiting kinetic energy
$= ½(½m)v^2 + ½(½m)v^2 = ¼(mv^2) + ¼(mv^2) = ½mv^2$

Total kinetic energy = translational (linear) kinetic energy + orbiting kinetic energy = $½mv^2 + ½mv^2 = mv^2$

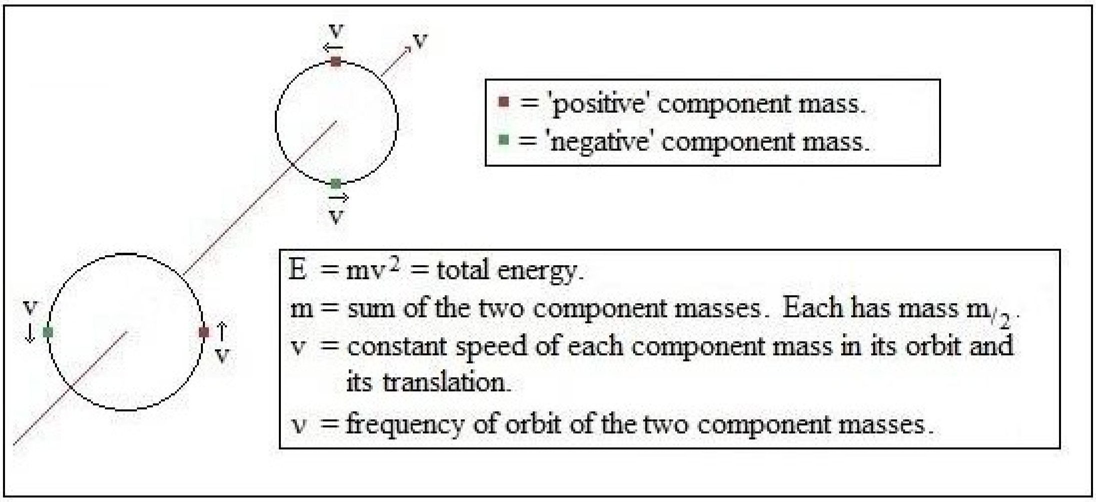


Figure 7.1 Two self-orbiting particles.

Electric/magnetic variation.
If the component masses possess opposite electric charges you will notice that an observer travelling alongside the system will observe an *oscillating sinusoidal electric and magnetic field* as the 'positive' and 'negative' components rotate about the centre of the system.

Angular momentum.
Linear momentum = mass of an object multiplied by it's velocity = mv
The angular momentum (the rotational equivalent of linear momentum) or an orbiting object = mvr where r = radius of orbit.

Angular momentum of two particles with each having a mass of ½m
= 2 x ½mvr = mvr

de Broglie wavelength.
In this section:
ν = frequency
λ = wavelength

For a photon: $E = mc^2 = h\nu$ (= Planck's constant times frequency).

Since both c (the speed of light) and h (Planck's constant) are unchanging, the mass of the photon is proportional to its frequency:
$m \propto \nu$

The speed of light is its frequency times its wavelength: $c = \nu\lambda$
Putting $c = \nu\lambda$ in: $E = mc^2 = h\nu$
Gives: $mc\nu\lambda = h\nu$
$mc\lambda = h$
$\lambda = h/mc$

In 1924 de Broglie extended the equations for light to be applicable to all other types of matter:
$E = mv^2 = h\nu$
Putting $v = \nu\lambda$ in: $E = mv^2 = h\nu$
Gives: $mv\nu\lambda = h\nu$
$mv\lambda = h$
$\lambda = h/mv$ <----- this is the *de Broglie wavelength.*

If we apply the equation: $mv\lambda = h$
to the above system of masses with each mass = ½m and keep v constant and $\lambda = r$ we get:
$½m \times r = h/v$ = constant
$m \times r = 2h/v$ = constant
$m \propto 1/r$
The mass is inversely proportional to the radius.

<u>We now apply the above to speed of light particles.</u>

Schematic diagram of a left-handed photon.
Left-handed = anticlockwise rotation looking in the direction of travel of the photon.

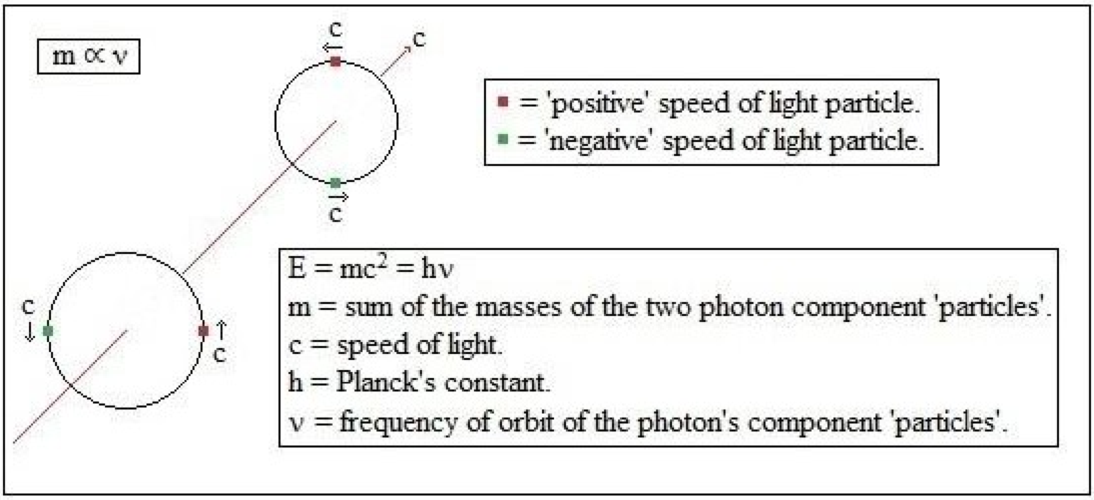


Figure 7.2 Two self-orbiting speed of light particles.

Electric/magnetic variation.
If the component masses possess opposite electric charges you will notice that an observer travelling alongside the system will observe an *oscillating sinusoidal electric and magnetic field* as the 'positive' and 'negative' components rotate about the centre of the system.

A speed of light particle with mass m and speed c rotating a distance r about a fixed point, has angular momentum = mcr
A speed of light particle with mass ½m and velocity c rotating a distance r about a fixed point, has angular momentum = (½m)cr

If we picture a photon as a speed of light system with 2 particles each with mass ½m:
rotating about a centre of mass with speed c; and
travelling through space with speed c.

Then:
linear kinetic energy = ½(½m + ½m)c^2 = ½mc^2
orbital kinetic energy = ½(½m + ½m)c^2 = ½mc^2

total kinetic energy E = linear kinetic energy + orbital kinetic energy
E = ½mc^2 + ½mc^2
E = mc^2

8. Containment by vacuum momentum and 'gravitons' and interaction cross section (σ).

Containment by vacuum momentum.

Please see *Figure 8.1* on next page.

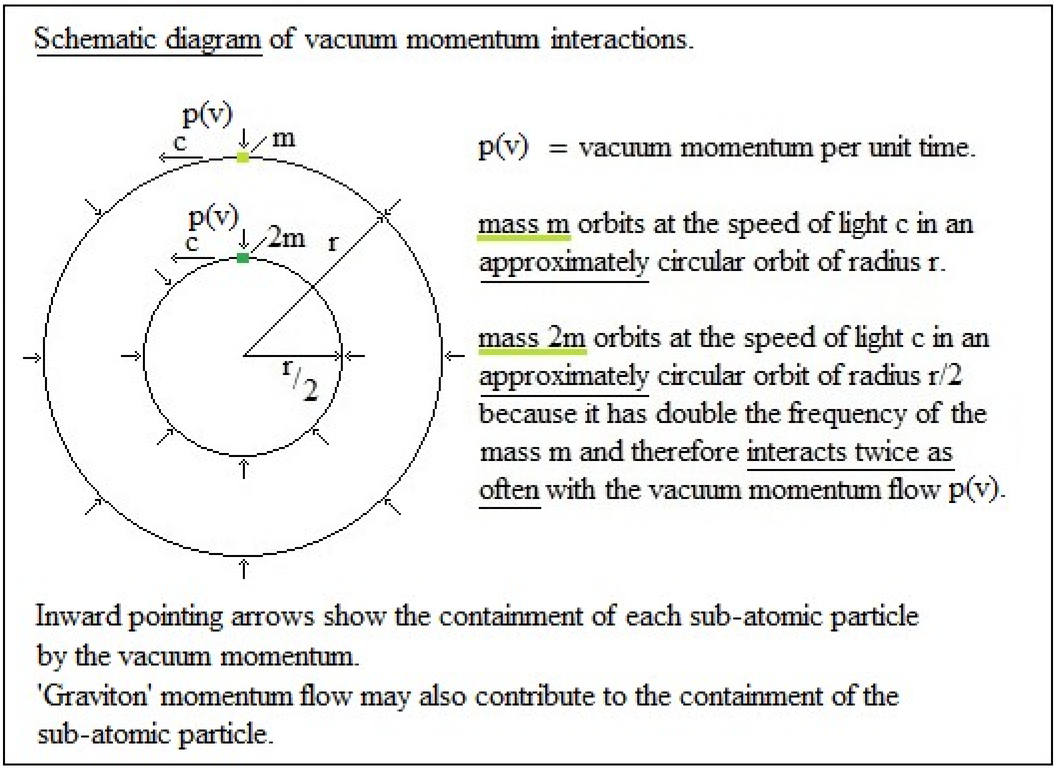


Figure 8.1

<u>Containment by 'graviton' momentum.</u>

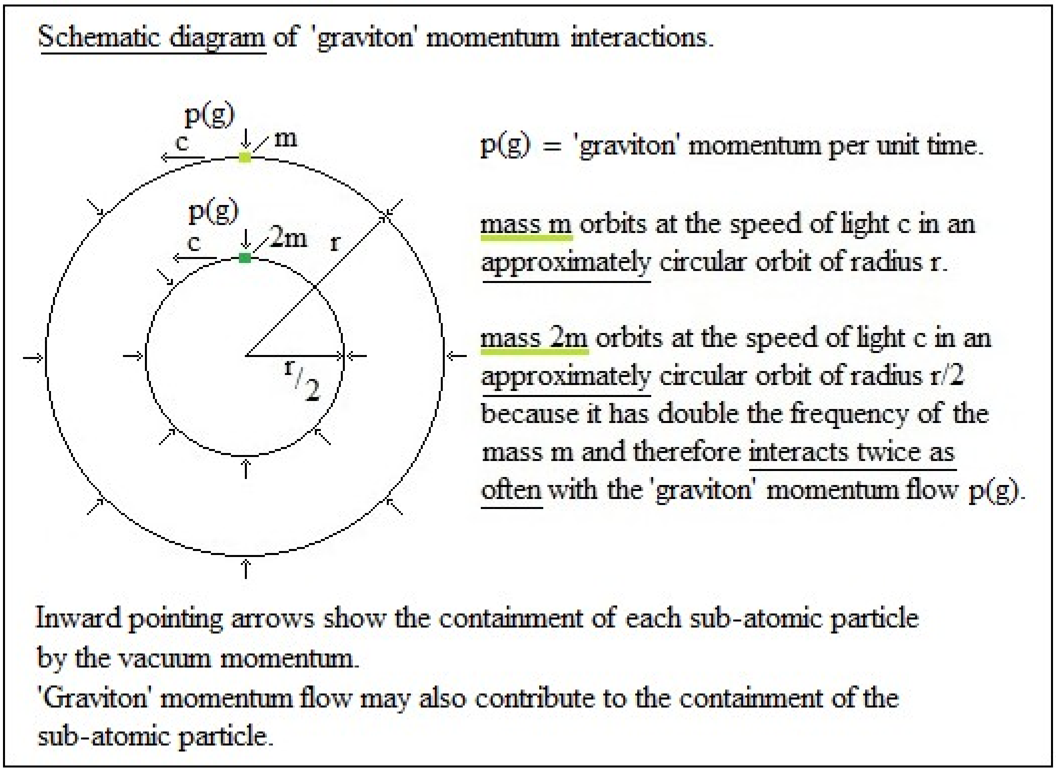


Figure 8.2

Charged particles and gravity.
If 'graviton' momentum contributes to the containment of the sub-atomic particle and the containment of a 'charged' particle is linked to electromagnetism does a variation in the strength of gravitation produce a variation in electric charge?

Interaction cross section (σ). Do all completely fundamental sub-atomic particles have the same size but differ only in frequency?

Newton's law of gravitation (suitable for non-relativistic situations) is:
$F = (Gm_1m_2)/r^2$

The force of gravity is proportional to the multiplication (product) of the masses involved provided the distance between them remains constant.
So for a constant second mass (m_2) and constant distance (r) the force of gravity is directly proportional to the mass m_1.

Directly proportional means that, for example, if
the mass m_1 doubles (while m_2 and r are constant) then:
the gravitational force doubles and;
the 'graviton' momentum captured by the mass m_1 doubles.

The strength of the interaction between a flow of 'gravitons' and a sub-atomic particle depends on how much of the 'graviton' momentum is captured by the sub-atomic particle per unit time.

The interaction cross section (σ) is a measure of the likelihood that two particles will interact and in this case depends on:
the probability that a 'graviton' will interact with a particle of mass;
which depends on the transverse area of the sub-atomic particle
and thereby produce a gravitational interaction per unit time.

In the lower part of *Figure 8.1* we see that a particle of mass 2m orbits twice for every single orbit of mass m and thereby interacts twice as often with the 'graviton' momentum flow as does mass m.

Does this suggest that the particle size does not increase with mass and that in fact all completely fundamental sub-atomic particles have the same size but differ only in frequency?

Are all completely fundamental sub-atomic particles identical but differing only in frequency and spin-handedness (as in left-handed or right-handed spin for those of specific frequency to account for electric charge difference)?

9. Orbits.

Gravitational strength is dependent on the orientation of the sub-atomic particle orbit and its instantaneous position in the orbit.

Transverse, longitudinal and intermediate orbits. Distortion orbits. Orbit orientation quivering.

<u>Transverse, longitudinal and intermediate orbits.</u>

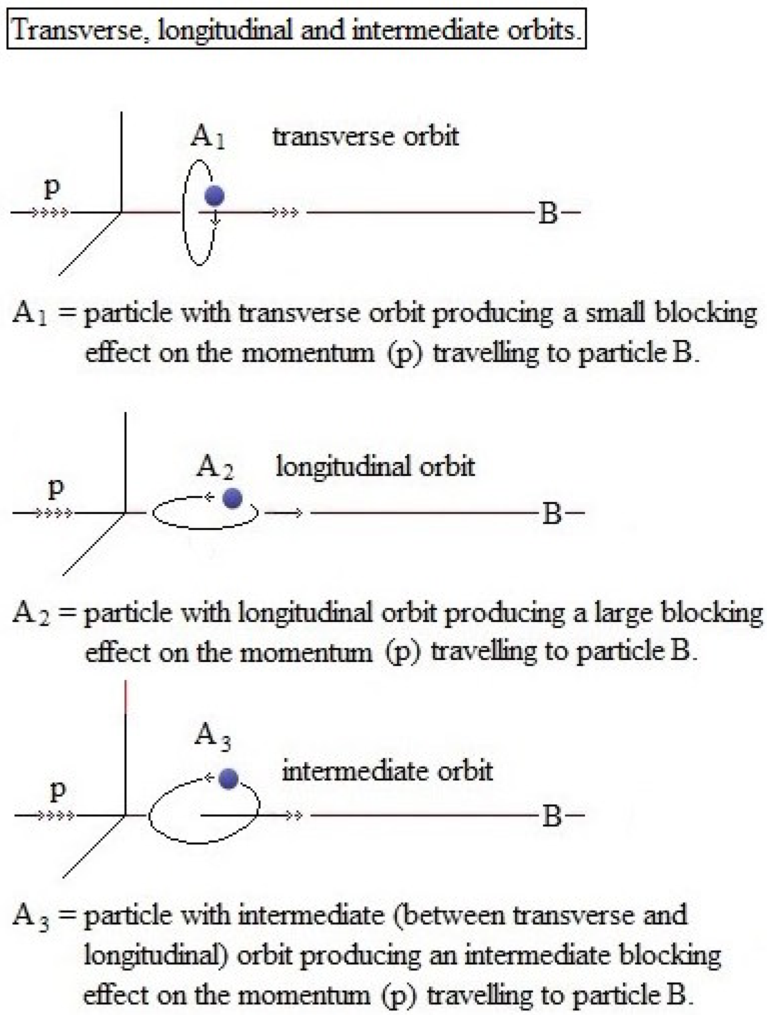
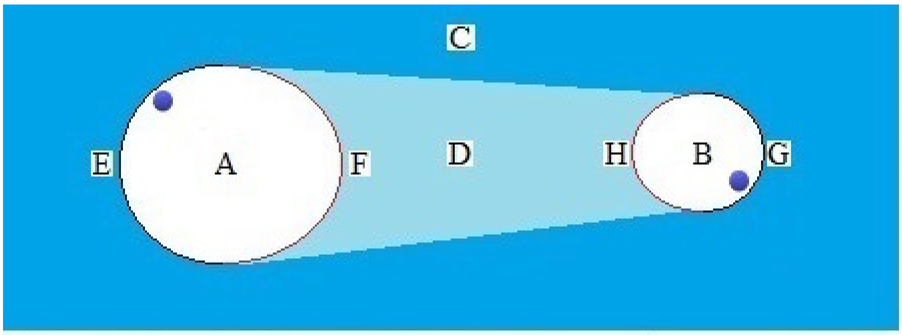


Figure 9.1

Distortion orbits.
Only longitudinal orbits are shown in this section.
Intermediate orbits will also be affected by distortion.
Only exactly transverse orbits will show no distortion because they have symmetry at right angles to the line between the two particles A and B.



A = Particle A orbit distorted to the right.
B = Particle B orbit distorted to the left.
C = Full vacuum momentum flow.
D = Reduced vacuum momentum flow due to the presence of Particles A and B.
For E, F, G and H please see the text.
Momentum flow at F is weaker than at E.
Momentum flow at H is weaker than at G.

Figure 9.2

The momentum flow at E is greater than the momentum flow at F because some of the momentum flow at F has been reduced by it being blocked by particle B.
Consequently A's orbit on the side near F is distorted towards B.
But this is partly compensated for, by the fact that as A's orbit is distorted closer to B the inverse square law of force that is closer to B is slightly stronger.

Similarly the momentum flow at G is greater than the momentum flow at H because some of the momentum flow at H has been reduced by it being blocked by particle A.
Consequently B's orbit on the side near H is distorted towards A.
But this is partly compensated for, by the fact that as B's orbit is distorted closer to A the inverse square law of force that is closer to A is slightly stronger.
* =====

Orbit orientation quivering.
Because of quantum momentum fluctuations the orbit of a particle may be changed between the states: transverse <-> intermediate <-> longitudinal.

The momentum pressure at different parts of the sub-atomic particle's orbit is unlikely to be constant in time or magnitude.

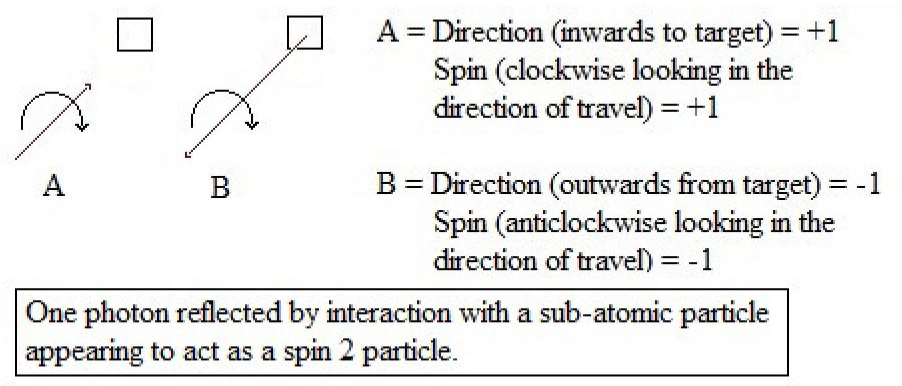
10. Gravity requires speed of light transmission of momentum, long range interaction and spin 2 particles.

Spin 2 particles.
Gravity travels at the speed of light as measured in the speed of gravitational waves.

The graviton is a hypothetical (not yet observed) particle which is:
long range; and
with spin 2
carrying energy which is equivalent to mass and therefore has momentum (mass x velocity {speed in a fixed direction}).

Could photons appear to act as spin 2 particles?
Is it possible that photons (which are long range spin 1 particles which travel at the speed of light) might appear to act as spin 2 particles if either:
one photon is reflected without its spin being reversed; or
two photons act in association.

'Spin 2 particle' - photon reversal.
Let us look at one photon reflected without its spin being reversed.
For example a right-handed photon moving in a direction designated as positive (spin = +1, direction = +1) which is then reflected will appear left-handed when looking in the reverse direction (spin = -1, direction = -1).
The total spin for the interaction is {(+1 x +1)} + {(-1 x -1)} = 1 + 1 = 2.



One photon reflected by interaction with a sub-atomic particle appearing to act as a spin 2 particle.

Figure 10.1

'Spin 2 particle' - two photons acting in association.
This is about one photon travelling in a direction designated as positive being blocked by one mass and a separate photon travelling in the opposite direction designated as negative being blocked by a second mass. The net result is attraction between the two masses.
For example a right-handed photon moving in a direction designated as positive (spin = +1, direction = +1) and a left-handed photon travelling in the opposite direction designated as negative (spin = -1, direction = -1).
The total spin for the interaction is {(+1 x +1)} + {(-1 x -1)} = 1 + 1 = 2.

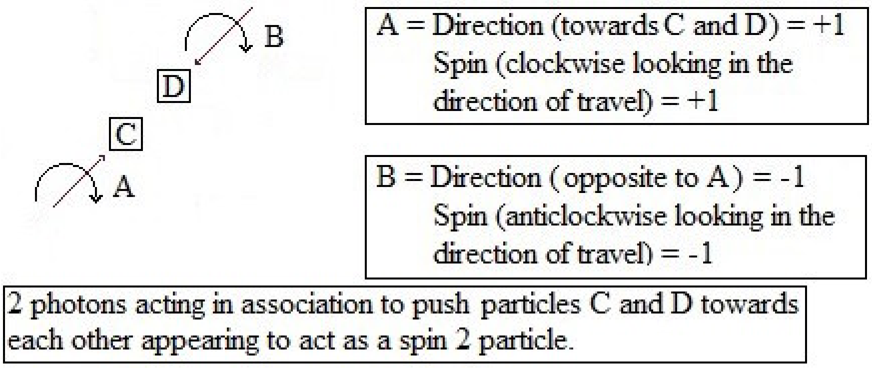


Figure 10.2

<u>Cosmic microwave background electromagnetic radiation.</u>
Could low energy photons such as the cosmic microwave background electromagnetic radiation be at least partially responsible for the gravitational force?

11. Gravity at the edges of an open universe (low containment by the vacuum momentum flow).

At, and towards the outer boundary of an open universe there should be:
a net outward flow of vacuum momentum.
This would suggest that gravity in this region becomes progressively weaker and:
<u>at the extreme becomes a repulsive force.</u>
A decrease in the density of momentum carrying particles from the centre of the universe to its extremities could contribute towards the <u>outward movement of matter in the universe.</u>

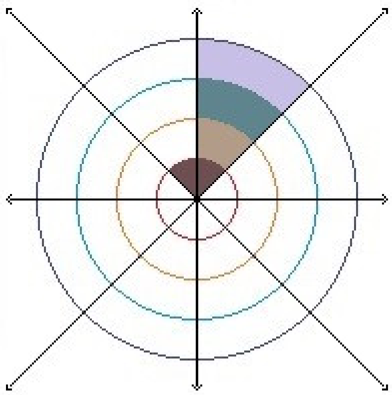


Figure 11.1

Please see Reference 4.

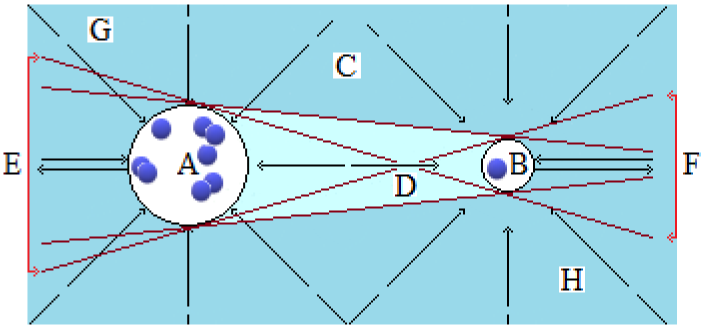
12. Gravity - maximum strength.

With this theory there is a <u>maximum strength to gravity</u> determined by the maximum 'graviton' flow within the vacuum.

This <u>may avoid infinite values</u> ascribed to gravity at distances approaching zero.

Please see Reference 1.

<u>Maximum strength of gravitation due to maximum vacuum/'graviton' momentum density per unit volume per unit time.</u>



A = Region of confined particles.
B = Particle B (confined).
C = Standard vacuum/'graviton' momentum flow.
D = Reduced vacuum/'graviton' momentum flow.
E = Region of momentum flow blocked by A
that would have interacted with B.
F = Region of momentum flow blocked by B
that would have interacted with A.
G= Momentum flow may also come from outside
the region E if it has a momentum component
that might be directed from A to B by collision
within region E.
H= Similarly for region F.

Figure 12.1

The region E contains a maximum number of vacuum/'graviton' particles at any one time.

If the particles in the region labelled A are massive and/or numerous enough then in the limit they could block all the vacuum/'graviton' particles travelling from region E to particle B.

<u>The gravitational attraction between A and B would have a limit (maximum strength).</u>

13. No selective particle/'graviton' interaction.

All particles with mass have to interact with 'gravitons' throughout the whole 'graviton' momentum spectrum. This also applies if 'gravitons' all have the same momentum.

If a sub-atomic particle only interacted with 'gravitons' of a particular momentum then the blocking of 'graviton' momentum by one particle of particular frequency would not affect another particle of different frequency which only responds to 'gravitons' of a different frequency.

This would produce a selective gravitational force varying between particles of different mass/frequency.

14. Local non-uniformity of vacuum/'graviton' momentum flow affecting sub-atomic particles of different mass/frequency because of differing orbit size.

If, for example, two sub-atomic particles of different mass/frequency are in the same region of space and the vacuum/'graviton' flow is not uniform then
because of the differing orbit sizes of the two particles,
one may experience a slightly different flow from the other.

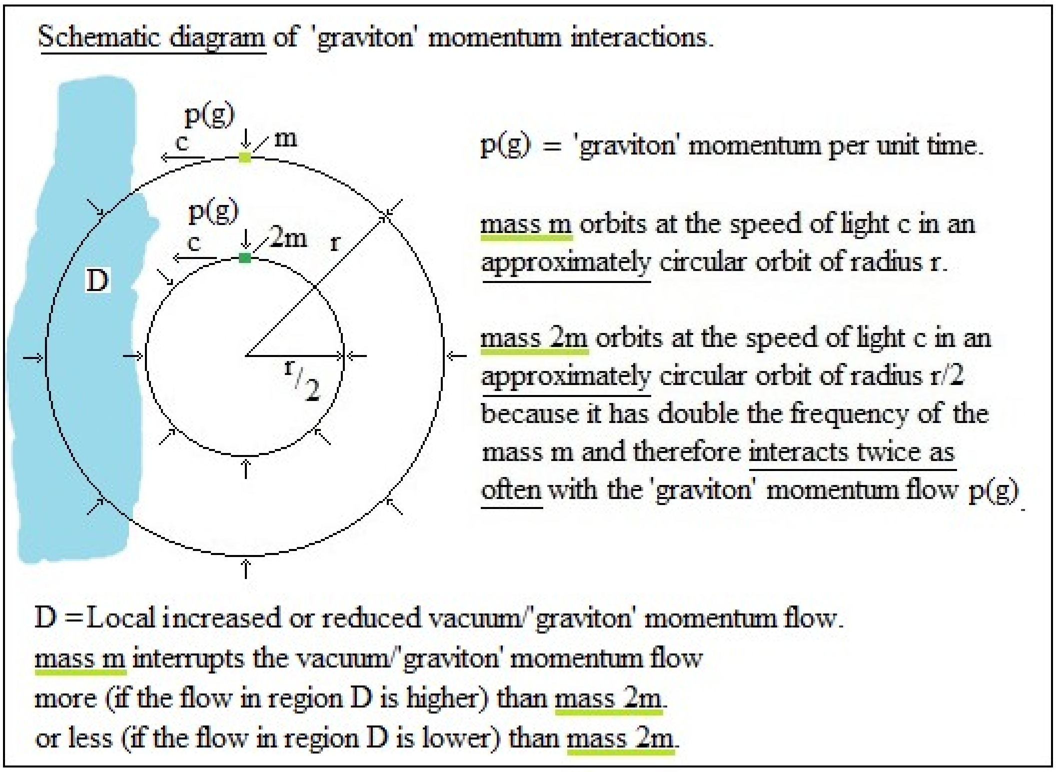


Figure 14.1

15. Weak interactions linked to gravity via electromagnetic interactions.

This section does not attempt to challenge the brilliant and well established theories covering the weak and strong nuclear forces.

It is merely to show that there might be support for also looking at the basic constituents of sub-atomic particles in a straightforward dynamic/kinetic way.

In this section we look at how <u>straightforward dynamics/kinetics may show how weak and electromagnetic interactions share common ground</u>.

Having suggested a link between gravitational and electromagnetic interactions via dynamics/kinetics we then link electromagnetic and weak interactions.

* -----

'Cell' occupation.

Imagine a three dimensional region (containing 2 particles) divided into a number of 'cells'. The 'cells' have no physical sides, they are just defined spaces within a volume.

'Cell' occupation - example.

2 particles labelled A and B are in any of the 3 'cell's labelled 1, 2 and 3 and can move freely between the 'cell's with both particles moving at the same fixed speed.

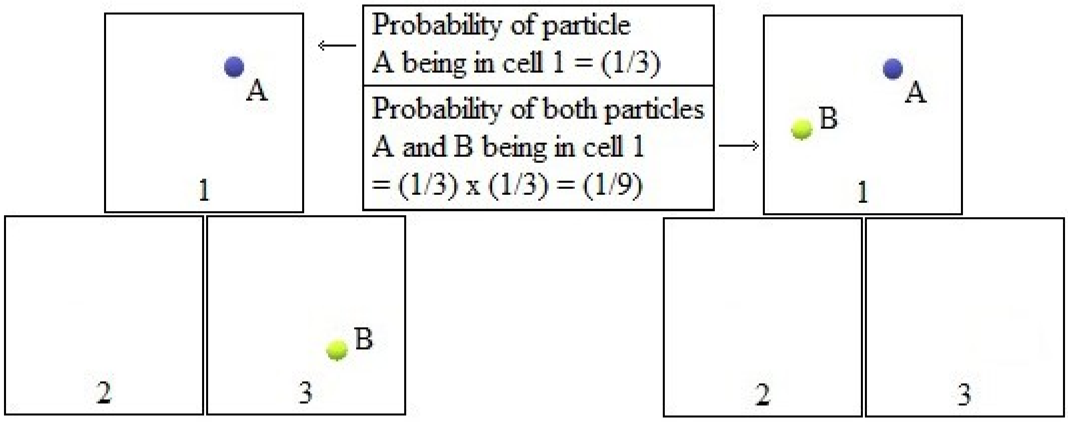


Figure 15.1

'Cell' occupation probabilities - 1 particle in a 'cell'.

Probability of particle A being in 'cell' 1 at any time is (1/number of 'cell's) = (1/3).
Probability of particle B being in 'cell' 1 at any time is (1/number of 'cell's) = (1/3).

'Cell' occupation probabilities - 2 particles in the same 'cell'.

Probability of both particles A and B being in 'cell' 1 at the same time = (1/3) x (1/3) = (1/9)   <----- S.
This is also the probability of both particles A and B meeting in *a specified 'cell'*.

'Cell' occupation probabilities - 2 particles in any of the 'cell's at the same time.

Probability of both particles A and B being in 'cell' 1 at the same time = (1/3) x (1/3) = (1/9).
Probability of both particles A and B being in 'cell' 2 at the same time = (1/3) x (1/3) = (1/9).
Probability of both particles A and B being in 'cell' 3 at the same time = (1/3) x (1/3) = (1/9).
Probability of both particles A and B being in any 'cell' 1, 2 or 3 at the same time = (1/9) + (1/9) + (1/9) = (3/9) = (1/3)   <----- T.

Notice that the value of S = (1/3 x (1/3) = T x T = T^2 = T squared

General formulae for a system of n 'cell's.

Probability of two particles meeting in a specified 'cell' in a system consisting of n 'cell's = $1/n^2$ <----- equivalent to equation S.
This is *slower* than two particles meeting in any 'cell'.

Probability of two particles meeting in any 'cell' in a system consisting of n 'cell's = 1/n.   <----- equivalent to equation T.
This is *faster* than two particles meeting in a specified 'cell'.
* -----

* -----
Charged pion decay rate: weak.
Charged pion weak interaction decay time ~ 2.6033 x 10-^{8}s ~ 10-^{8}s *{Please see Reference 2(a).}*
This is slower than the neutral pion electromagnetic interaction decay time and may be equivalent to two particles meeting in a *specified 'cell'* for example the central point of the system. ($1/n^2$).

Neutral pion decay rate: electromagnetic.
Neutral pion electromagnetic interaction decay time ~ 8.4 x 10-^{17}s ~ 10-^{16}s *{Please see Reference 2(c).}*
This is faster than the charged pion weak interaction decay time and may be equivalent to two particles meeting in *any 'cell'* (1/n).

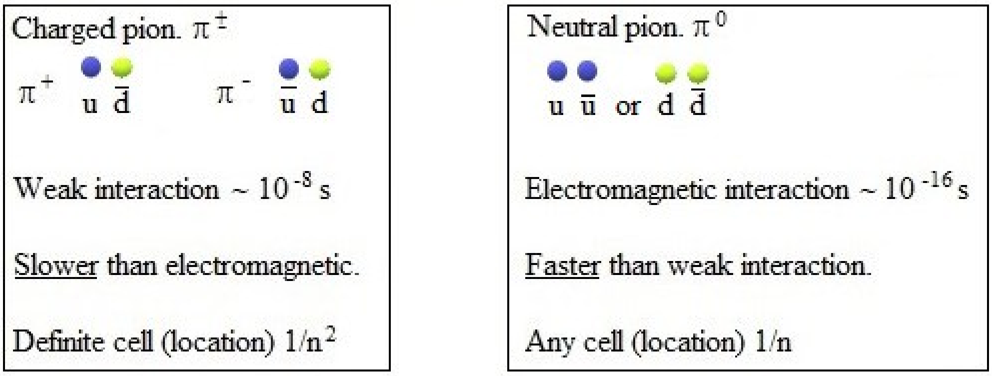


Figure 15.2

Notice that the neutral pion electromagnetic interaction decay time (~10^{-16}s) is approximately the square of the charged pion weak interaction decay time (~10^{-8}s).
~10^{-16}s = (~10^{-8})^{2}s

The electromagnetic interaction is much faster than the weak interaction corresponding to the higher probability of two particles meeting anywhere within the neutral pion.
The weak interaction is much slower than the electromagnetic interaction corresponding to the lower probability of two particles meeting in a specific part (for example the centre) within the charged pion.

Pion decay times: straightforward dynamic/kinetic formula relating electromagnetic and weak interactions (and therefore weak -> electromagnetic -> gravity).

Notice that with n = 10^8 this gives 1/n = 10^{-8}

(1/n) x (electromagnetic interaction decay time) = 10^{-8} x 10^{-16}s = 10^{-24}s

$(1/n)^2$ x (weak interaction decay time) = $(10^{-8})^2$ x 10^{-8}s = 10^{-24}s

In both cases (electromagnetic and weak):
(probability of interaction) x (interaction decay time) = constant

'Cell' size and key particle size.
If 'cell' size is approximately equal to key particle size then:
n = number of 'cell's = number of times a particle (A or B) can fit into the pion.

With n = 10^8 the particle size of the key particles in the electromagnetic and weak interactions in the pions is 10^8 times smaller than the size of the pions.

The size of the charge radius of charged pions is ~ 10^{-15}m *{Please see Reference 2(b).}* (and assume that the neutral pion has the same approximate dimension) and therefore 10^8 key particles involved in electromagnetic and weak interactions would fit into a volume of ~ $(10^{-15}\text{m})^3$ ~ 10^{-45}m^3

This makes the key particles involved in electromagnetic and weak interactions have a volume of ~ $(10^{-45}\text{m}^3)/10^8$ = ~ (10^{-53}m^3) which corresponds to a linear dimension of ~ 10^{-18}m.
* -----

* -----
Antineutrino/proton cross-section (from weak interaction).

We can look at the weak interaction between an antineutrino and a proton in terms of straightforward dynamics/kinetics as the coming together of two key particles at any 'cell' (approximately equal to key particle size) within a proton.

Approximate the proton to be shaped as a cube with sides 10^{-15}m

Key particle size = 10^{-18}m gives $10^{-15}\text{m}/10^{-18}\text{m} = 10^3$ key particle 'lengths' per side of the cube.
Total number of 'cells' with sides equal to key particle 'lengths' within the proton = $(10^3)^3 = 10^9$

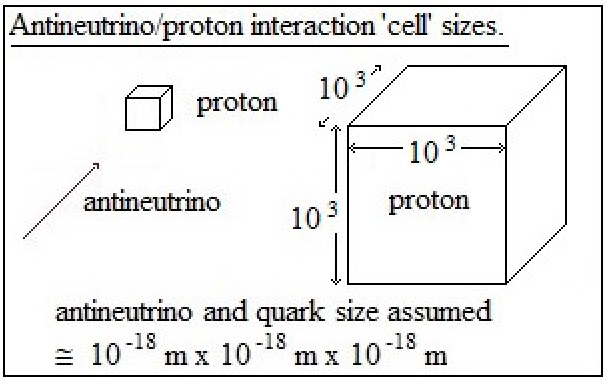


Figure 15.3

Probability of key particle (antineutrino) being in any specified 'cell'

= $(1/10^9)$

Probability of key particle (quark) being in any specified 'cell'
= $(1/10^9)$

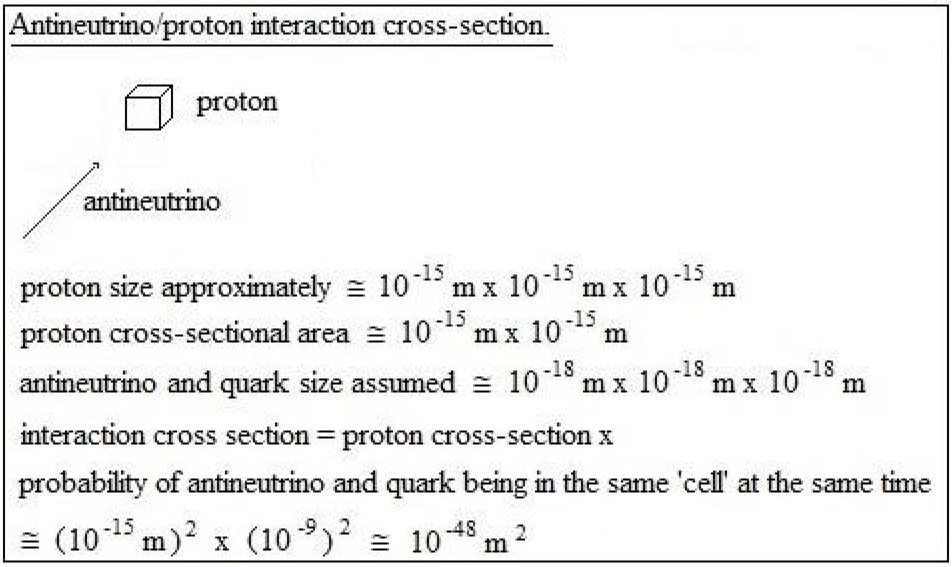


Figure 15.4

Probability of two key particles (antineutrino and quark) being in the same 'cell' at the same time = $(1/10^9) \times (1/10^9) = 1/(10^{18}) = 10^{-18}$

Interaction cross section = $(10^{-15}\text{m})^2 \times 10^{-18} = 10^{-48}\text{m}^2$

Reference 3 gives the measured cross section as
~ $5 \times 10^{-44}\ \text{cm}^2$ which is also ~ $5 \times 10^{-44} \times (10^{-2}\text{m})^2$ = ~ $5 \times 10^{-48}\text{m}^2$

{Please see Reference 3.}

The same cell probability suggests that a quark might have approximately the same dimensions as an antineutrino and the quark and antineutrino may be the same left/right spinning particle but with different frequencies and different properties because they are operating in different environments.
* -----

16. Strong and weak interactions linked to gravity.

The strong nuclear force holds together the quark constituents of the class of sub-atomic particles known as hadrons.
Hadrons include protons, neutrons and pions.

Quark containment.
If we look at the containment of quarks in a hadron we can see a parallel with the interactions of sub-atomic particles with 'gravitons'.

Assume that:
quarks are contained by boson momentum flow within hadrons in a manner parallel to containment of other sub-atomic particles outside of hadrons; and

quarks have energy, $mc^2 = ½h\nu$, and angular momentum, $mcr = h/4\pi$; and
the force containing a quark is equal to the centrifugal force (mc^2/r) of the contained quark.
centrifugal force of contained quark = $mc^2/r = m \text{ x } c^2/r = (h/(4\pi cr)) \text{ x } (c^2/r) = hc/(4\pi r^2)$
$\propto 1/r^2$

centrifugal force of contained quark $\propto 1/r^2$

$\boxed{\text{centrifugal force of contained quark} \propto 1/r_2}$

Figure 16.1

Double the centrifugal force that occurs at a radius $r_1 \propto 1/r_1{}^2$
happens at radius $r_2 = 2 \text{ x } (1/r_1{}^2) = (2/r_1{}^2) = (\surd 2/r_1)^2 = (1/\{r_{1/}\surd 2\})^2$

Treble the centrifugal force that occurs at a radius $r_1 \propto 1/r_1{}^2$
happens at radius $r_3 = 3 \text{ x } (1/r_1{}^2) = (3/r_1{}^2) = (\surd 3/r_1)^2 = (1/\{r_{1/}\surd 3\})^2$

Centrifugal forces at different radii.

r_1
centrifugal force of contained quark orbiting at radius $r_1 = m_1c^2/r_1 = hc/(4\pi r_1{}^2)$

r_2
centrifugal force of contained quark orbiting at radius $r_2 = m_2c^2/r_2 = hc/(4\pi r_2{}^2)$
$= hc/(4\pi\{r_1/\surd 2\}^2) = 2hc/(4\pi r_1{}^2)$ = twice that at orbit r_1

which is matched by double boson (gluon) density on a spherical surface area half the size of the spherical surface at distance r_1

r_3
centrifugal force of contained quark orbiting at radius $r_3 = m_3c^2/r_3 = hc/(4\pi r_3{}^2)$
$= hc/(4\pi\{r_1/\surd 3\}^2) = 3hc/(4\pi r_1{}^2)$ = three times that at orbit r_1

which is matched by treble boson (gluon) density on a spherical surface area one third of the size of the spherical surface at distance r_1

The centrifugal forces are in the ratios:

r_1 : 1 : 1/3
r_2 : 2 : 2/3
r_3 : 3 : 3/3 = 1

which match the ratios of the absolute values of the charges on the:
d (down) quark (-1/3) and s (strange) quark (-1/3) and b (bottom/beauty) quark (-1/3);
u (up) quark (+2/3) and c (charm) quark (+2/3) and t (top/truth) quark (+2/3) and;
electron (-1).

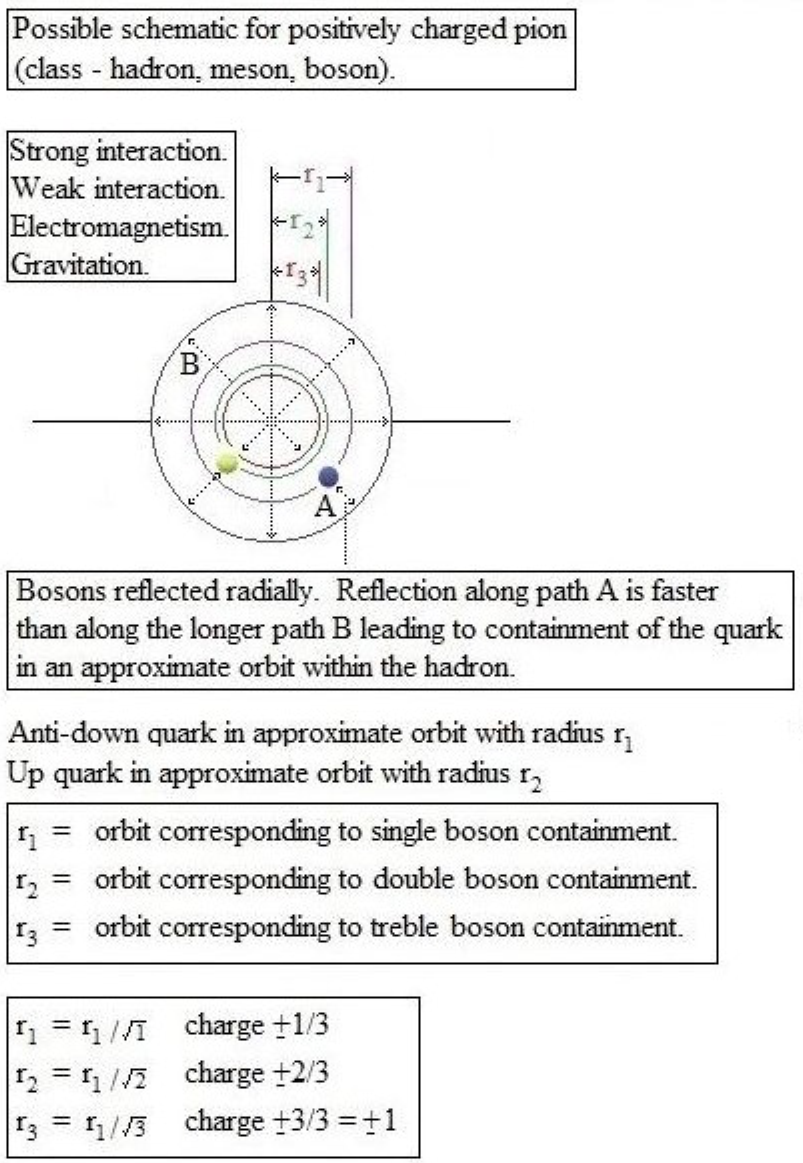


Figure 16.2

Handedness of bosons.
Quarks will be in an environment where they are contained by one handedness of bosons e.g. left; and
antiquarks will be in an environment where they are contained by the other handedness of bosons e.g. right.
The handedness may be the other way round i.e. quarks - right, antiquarks - left.

s (strange) quarks.
Is it possible that strange quarks are formed in a boson sub-system (of the main system) within the hadron and require the weak interaction (about 10^{-10} seconds) to

break down the sub-system before the strange quark is released to the main system?

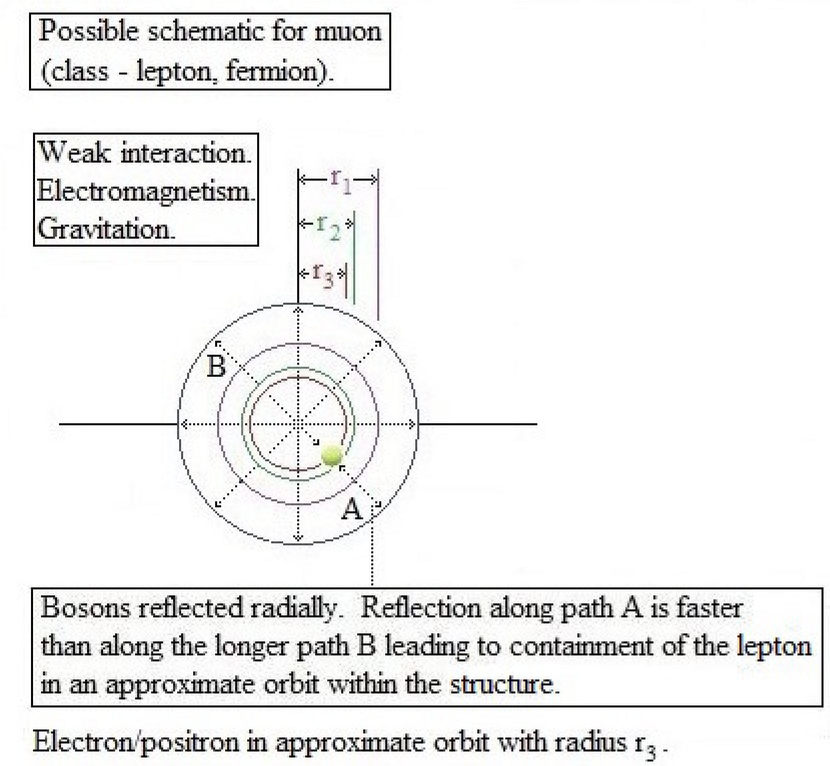


Figure 16.3

17. References.

* ----- *Reference 1.*
Dark Matter & Dark Energy. Brian Clegg.
ISBN 978-1-78578-550-4 Page 101.
The exact nature of black holes is extremely speculative as the <u>numbers describing their behaviour reach infinity, which is an indicator that our theory has broken down.</u>
Lines 23 to 26.
* -----

* ----- *Reference 2.*
Journal of Physics G. Nuclear and Particle Physics. Volume 37 Number 7A July 2010 Article 075021.
(a) Page 619. Charged pion mean life 2.6033 x 10^{-8}s
(b) Page 622. Charged pion charge radius 0.672 fm = 0.672 x 10^{-15}m
(c) Page 623. Neutral pion mean life 8.4 x 10^{-17}s
* -----

* ----- *Reference 3.*
Neutrino Interactions. Kevin McFarland. University of Rochester, Rochester, NY, USA 14627.
https://arxiv.org/pdf/0804.3899.pdf

Page 1 of 26. Line 3 up from the base of the page.

The prediction for the cross section of antineutrino + p -> e^+ n was first derived by Bethe and Peierls shortly after the Fermi theory was published (Bethe and Peierls 1934).
For neutrinos with energies of a few MeV from a reactor, a typical cross section in this theory was predicted to be σ: antineutrino + p ~ 5 x 10^{-44} cm^2. Interestingly, this prediction for reactor neutrino cross sections is still accurate today, up to a factor of two required to account for the then unknown phenomenon of maximal parity violation in the weak interaction!
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* ----- *Reference 4.*
Dark Matter & Dark Energy. Brian Clegg.
ISBN 978-1-78578-550-4 Pages 112/113 line 32 (page 112) and lines 1 to 6 (page (113).
Looking far out into the depths of the universe, red-shifted supernovas were less bright than the expected distance for that red shift predicted they should be.
The supernovas were further away than they were thought to be.
It seemed that something - some unknown source of energy - was <u>causing the rate of expansion of the universe to increase rather than slow down.</u>
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* ----- *Reference 5.*
Special Relativity. A. P. French.
ISBN 017 771075 6 Pages 16/17/18 and pages 27/28 and page 32 problem 1-13.
* -----

* ----- *Reference 6.*
Advanced Level Physics. M Nelkon and P Parker.
Heinemann Educational Books Ltd. 1958, 1959, 1960, 1961, 1962.
Second edition 1964 reprinted with additions 1966.
Page 235.
* -----

* ----- *Reference 7.*
https://vixra.org/abs/1611.0237
What is a photon? Photon kinetic and electromagnetic structure simplified and explained and how one photon can go through two different holes at the same time.
Pages 46 and 47.
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<u>Acknowledgement:</u> Captain H James.

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