Gravitational Waves and the Origin of Gravitation

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Abstract: Einstein assumed that gravitation propagates at light speed and claimed that he proved that.

Seeking the cause to his error, we found that Einstein's formula for the precession of the perihelion of a planet is for Electromagnetic potential. Not for Gravitational potential.

Thus, General Relativity is wrong for Gravitational Attraction (Mercury's Perihelion precession)

But it may work if Magnetism dominates Gravitation (Hulse-Taylor Pulsar)

The Quantum of Gravitational Radiation is the Neutrino, because Supernova Models indicate that 99% of the Gravitational Binding energy of a collapsing star is emitted in the form of Neutrinos' Radiation.

Since radiation is emitted in transition between energy levels, this suggests that ***the so called d-quark, and the so called u-quark, that have never been observed, are energy levels of the nucleon***.

An accelerated Nucleon will emit a Graviton=Neutrino if it transitions from a d-quark energy level, to a u-quark energy level in say $\mathrm{d} \rightarrow \mathrm{u} + \mathrm{e}^{-} + \overline{\nu}_{e}$

Namely, ***the origin of Gravitation is the transition between the d-quark energy level, and the u-quark energy level, of the Nucleon.***

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I.
Gravitational Waves Do Not Propagate at Light Speed, And Mercury's Perihelion Precession Does Not Confirm General Relativity

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December, 2013

Abstract Einstein derived General relativity under the erroneous assumption that Retarded Gravitational and Electromagnetic Potentials are identical, and his Gravitational Radiation is actually Electromagnetic because only photons propagate at light speed. Thus, assuming that gravitation propagates at light speed, he proved that gravitation propagates at light speed.

But gravitational waves are not photons, do not propagate at light speed, and the formula for Mercury's perihelion precession, that employs light speed c, does not confirm General Relativity.

In fact, Mercury Perihelion Precession was never well-

determined.

Keywords Gravitation, Gravitational Waves, Perihelion Precession, General Relativity, Electro-Magnetic Waves, Retarded Potential. GravitoMagnetism, Gravitons, Photon, Faster Than Light, Tests of General Relativity,

Physics & Astronomy Classification Scheme: 04; 04.20.-q; 04.20.Cv; 04.30.-w; 04.30.Nk; 04.80.-y; 04.80.Cc;

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References

1.

Einstein's Retarded Potential

Space-time coordinates are

$$x^{\mu} = (x, y, z, t).$$

A metric on space-time is the differential form

$$(ds)^2 = \sum_{\mu=1}^{\mu=4} \sum_{\nu=1}^{\nu=4} g_{\mu\nu} dx^{\mu} dx^{\nu} .$$

The 4×4 symmetric matrix $g_{\mu\nu}(x^{\alpha})$ is the metric tensor.

To first order we take [Einstein2],

$$g_{\mu\nu}(x^{\alpha}) = \begin{bmatrix} -1 & 0 & 0 & 0 \\ 0 & -1 & 0 & 0 \\ 0 & 0 & -1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} + \gamma_{\mu\nu}(x^{\alpha}), \quad \text{with } \left|\gamma_{\mu\nu}(x^{\alpha})\right| \ll 1.$$

Christoffel symbols are the Gravitational Potentials.

Christoffel symbols of the 1st kind is the $4 \times 4 \times 4$ symmetric matrix

$$\Gamma_{\lambda\mu\nu}(x^{\alpha}) = \tfrac{1}{2}\left[\partial_{x_{\lambda}} g_{\mu\nu} + \partial_{x_{\mu}} g_{\lambda\nu} - \partial_{x_{\nu}} g_{\lambda\mu}\right]$$

Christoffel symbols of the 2nd kind is the $4 \times 4 \times 4$ symmetric matrix

$$\Gamma^{\tau}_{\lambda\mu}(x^{\alpha}) = g^{\tau\nu}\Gamma_{\lambda\mu\nu}$$

Following the notations in [Einstein1], the equation of motion of a material point along a geodetic in space-time is

$$\frac{d^2x_\tau}{ds^2} = \Gamma_{\mu\nu\tau}\frac{dx_\mu}{ds}\frac{dx_\nu}{ds}. \quad \text{(22), on p.132}$$

(equation (46), p.158, is the same, except for a misprint)

On p. 158, Einstein assumes non-relativistic speed

$$v = \sqrt{\left(\frac{dx_1}{dx_4}\right)^2 + \left(\frac{dx_2}{dx_4}\right)^2 + \left(\frac{dx_3}{dx_4}\right)^2} \ll 1,$$

and concludes that

$$\left|\frac{dx_1}{ds}\right|, \left|\frac{dx_2}{ds}\right|, \left|\frac{dx_3}{ds}\right| \sim 0, \text{ while } \left|\frac{dx_4}{ds}\right| \sim 1.$$

Also, $\Gamma_{\mu\nu\tau}$ are small. Thus, equation (46) keeps only the terms with $\mu = \nu = 4$, and becomes

$$\frac{d^2x_\tau}{ds^2} = \Gamma_{44\tau} = \tfrac{1}{2}\left[\partial_4 g_{4\tau} + \partial_4 g_{4\tau} - \partial_\tau g_{44}\right],$$

$$\sim -\partial_\tau(\tfrac{1}{2}g_{44}), \quad \text{(67)},$$

neglecting the smaller size terms.

Taking $dx_4 = ds = dt$,

$$\frac{d^2x_\tau}{dt^2} = \Gamma_{44\tau} \sim -\nabla(\tfrac{1}{2}g_{44})$$

Thus, by Newton's law the Gravitational Potential is $\frac{1}{2}g_{44}$.

From equation (53) on p. 149, (correcting the misprint)

$$\partial_{x_\tau} T_{\mu\nu\tau} + T^{\alpha}_{\mu\beta} T^{\beta}_{\nu\alpha} = -\kappa (T_{\mu\nu} - \tfrac{1}{2} g_{\mu\nu} T).$$

Substituting

$$\mu = \nu = 4,$$

and

$$T_{44} = T = \rho = \text{matter density},$$

$$\underbrace{\partial_{x_\tau}}_{\nabla\cdot} \underbrace{T_{44\tau}}_{-\nabla(\frac{1}{2} g_{44})} + \underbrace{T^{\alpha}_{4\beta} T^{\beta}_{4\alpha}}_{\text{2nd order}} = -\kappa \underbrace{(T_{44} - \tfrac{1}{2} \underbrace{g_{44}}_{\sim 1} T)}_{\frac{1}{2}\rho}.$$

$$\nabla^2 \left(\tfrac{1}{2} g_{44} \right) = \tfrac{1}{2} \kappa \rho .$$

The Gravitational Potential is

$$\tfrac{1}{2} g_{44} = -\tfrac{1}{8\pi} \kappa \int \frac{\rho}{r} d\tau ,$$

because $\nabla^2 \left(-\tfrac{1}{8\pi} \kappa \int \frac{\rho}{r} d\tau \right) = -\tfrac{1}{8\pi} \kappa \int \underbrace{\nabla^2 \frac{1}{r}}_{-4\pi\delta(r)} \rho(\vec{r}) d\tau = \tfrac{1}{2} \kappa \rho .$

Einstein concludes with the fatally erroneous guess

"...Newton's Theory, with our chosen unit of time, gives (for the Gravitational Potential) $-\frac{G}{c^2} \int \frac{\rho}{r} d\tau$

where $G = 6.7 \times 10^{-8}$ *is the Gravitation constant.*

By comparison, $\kappa = \frac{1}{c^2} 8\pi G$ *"*

How does the speed of light
get into a "Newtonian" Potential?
Most likely, from the Lorentz transformations,
-that Einstein did not realize-,
deal with charges, and photons,
Not material particle devoid of charge.

The formulas for Electromagnetic Fields that embellish [Einstein1], did not help Einstein understand Electromagnetic retarded potentials.

The CGS system, that he used, ignores the crucial

vacuum permittivity ε_0,

and vacuum permeability μ_0,

and does not recognize the exclusiveness of

$$c^2 = \frac{1}{\varepsilon_0 \mu_0},$$

to electromagnetism.

Einstein also missed the exclusiveness of a photon, to thermal, and electromagnetic radiation.

We proceed with the meaning of retarded electromagnetic potentials:

2.

Retarded Potentials and Gravito-Magnetism

In Electrostatics, we assume an Electric Field $\vec{E}(r)$, derived from an Electric Potential $\phi(r)$, so that

$$\vec{E} = -\nabla\phi,$$

and generated by a charge distribution with density $\rho(r)$ so that

$$\nabla \cdot \underbrace{\vec{E}}_{-\nabla\phi} = \frac{\rho}{\varepsilon_0},$$

where ε_0 is the Electric Permittivity of the vacuum. Thus,

$$\nabla^2\phi = -\frac{\rho}{\varepsilon_0},$$

$$\phi = \frac{1}{4\pi\varepsilon_0}\int \frac{\rho(r)}{r} dV\,.$$

In Electrodynamics, we assume Magnetic Induction $\vec{B}(\vec{r},t)$, derived from a Magnetic Vector Potential $\vec{A}(\vec{r},t)$, so that

$$\vec{B} = \vec{\nabla} \times \vec{A}\,,$$

and Electric Field $\vec{E}(\vec{r},t)$, derived from an Electric Potential

$\phi(\vec{r},t)$, so that

$$\vec{E} = -\nabla\phi - \partial_t \vec{A}.$$

Then,

$$\nabla \cdot \underbrace{\vec{E}}_{-\nabla\phi - \partial_t \vec{A}} = \frac{\rho}{\varepsilon_0},$$

$$\nabla^2\phi + \partial_t \nabla \cdot \vec{A} = -\frac{\rho}{\varepsilon_0}.$$

Assuming Lorentz Condition, $\nabla \cdot \vec{A} = -\varepsilon_0\mu_0\partial_t\phi$, where μ_0 is the Magnetic Permeability of the vacuum

$$\nabla^2\phi - \underbrace{\varepsilon_0\mu_0}_{\frac{1}{c^2}}\partial_t^2\phi = -\frac{\rho}{\varepsilon_0}.$$

This is an electromagnetic wave equation for ϕ, with propagation speed

$$c = \frac{1}{\sqrt{\varepsilon_0\mu_0}}.$$

Then, the potential $\phi(\vec{r},t)$ at $\vec{r}$, at time t, is the summation on contributions at $\vec{\xi}$, at the retarded time $t - \frac{r}{c}$,

$$\phi(\vec{r},t) = \frac{1}{4\pi\varepsilon_0}\int \frac{\rho(\vec{\xi}, t - \frac{r}{c})}{\left|\vec{r} - \vec{\xi}\right|} dV_{\vec{\xi}}.$$

For Gravitation to follow from this formulation, we have to

assume a Gravito-Magnetic Field $\vec{B}_G$, derived from a Gravito-Magnetic $\vec{A}_G$, that was never detected, so that

$$\vec{B}_G = \vec{\nabla} \times \vec{A}_G ,$$

and a Gravitational Field $\vec{E}_G(\vec{r},t)$, derived from a Potential $\phi_G(\vec{r},t)$, so that

$$\vec{E}_G = -\nabla \phi_G - \partial_t \vec{A}_G .$$

Then we would need a Gravitational Lorentz Condition

$$\nabla \cdot \vec{A}_G = -\varepsilon_G \mu_G \partial_t \phi_G ,$$

where we would have to give meaning to

$$\varepsilon_G , \text{ and } \mu_G ,$$

and explain how

$$\frac{1}{\sqrt{\varepsilon_G \mu_G}} = \frac{1}{\sqrt{\varepsilon_0 \mu_0}} = c .$$

The relation $\frac{1}{\varepsilon_0 \mu_0} = c^2$ is exclusive to Electro-Magnetics.

In Gravitation, ε_0, and μ_0, have no parallel, and at most we can assume that Gravitational Waves exist, and propagate at some speed v_G.

Einstein's Gravitational waves propagate at light speed because he assumed so.

3.

Einstein's Gravitational Waves

Keeping $\kappa = \frac{8\pi G}{c^2}$, Einstein renews his erroneous claim that

Gravitational Waves propagate at light speed.

To first order he has [Einstein2],

$$g_{\mu\nu}(x^\alpha) \sim \begin{bmatrix} -1 & 0 & 0 & 0 \\ 0 & -1 & 0 & 0 \\ 0 & 0 & -1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} + \gamma_{\mu\nu}(x^\alpha), \quad \text{(1) on p.201}$$

where $\left|\gamma_{\mu\nu}(x^\alpha)\right| \ll 1$.

To first order, the Field Equations are

$$\sum_\alpha [\frac{\partial^2 \gamma_{\mu\alpha}}{\partial x_\nu \partial x_\alpha} + \frac{\partial^2 \gamma_{\nu\alpha}}{\partial x_\mu \partial x_\alpha} - \frac{\partial^2 \gamma_{\mu\nu}}{\partial x_\alpha^2}] - \frac{\partial^2 \sum_\alpha \gamma_{\alpha\alpha}}{\partial x_\mu \partial x_\nu} \sim -2\kappa(T_{\mu\nu} - \tfrac{1}{2}\delta_{\mu\nu}) \sum_\alpha T_{\alpha\alpha}\,, \quad (2)$$

where κ is understood as $\kappa = \frac{8\pi G}{c^2}$ from [Einstein1].

He substitutes

$$\gamma_{\mu\nu} = \gamma'_{\mu\nu} + \psi\delta_{\mu\nu}\,, \qquad (3)$$

where

$$\sum_\nu \partial_{x_\nu} \gamma'_{\mu\nu} = 0\,, \qquad (4)$$

$$\sum_{\alpha} \gamma'_{\alpha\alpha} = -2\psi, \qquad (5)$$

and obtains

$$\sum_{\alpha} \frac{\partial^2 \gamma'_{\mu\nu}}{\partial x_{\alpha}^2} = 2\kappa T_{\mu\nu}. \qquad (6)$$

He concludes with

"*... the* $\gamma'_{\mu\nu}$ *are the retarded potentials*

$$\gamma'_{\nu\mu} = -\tfrac{1}{2\pi}\kappa \int \frac{T_{\mu\nu}(x_0, y_0, z_0, t-r)}{r} dV_0 \qquad (9)"$$

And sums up on page 206,

" It follows from (6) and (9) that gravitational fields always propagate with velocity 1*, that is, with the speed of light."*

But

$\kappa = \dfrac{8\pi G}{c^2}$ **was established erroneously in [Einstein1].**

4.

The Meaning of Propagation at Light speed

The radiation quantum that propagates at light speed is the photon. It is unique to electromagnetics, specifically, to Black Body thermal radiation.

The photon is a charge-less packet of energy $h\nu$, with equivalent mass $\frac{h\nu}{c^2}$. It is emitted from charged particles, and carries the Electromagnetic Field.

No other particle has the photon characteristic that in the vacuum it travels at light speed. Other particles that have been presumed to travel at light speed, such as gluons have never been detected, and their speeds have never been measured.

To say that Gravitational waves propagate at the speed of light, is to say that the quantum of gravitational radiation is a photon, and that charged electrons, that emit photons, are the same as uncharged mass particles that emit gravitons.

Consequently, Einstein's misunderstanding of the crucial

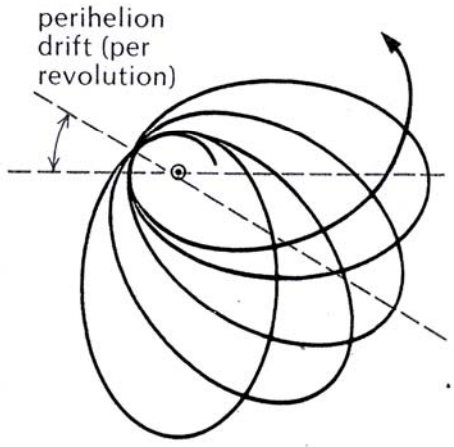
role of vacuum permittivity, ε_0, and vacuum permeability, μ_0, in determining the speed of electromagnetic waves, annuls his claim that his theory is confirmed by the precession of the perihelion of Mercury.

5.

The Precession of the Perihelion of Mercury

Einstein claimed that the unexplained part in the observed precession of the perihelion of the planet Mercury around the sun is explained by his General Relativity.

A planet elliptical orbit rotates slowly in the direction of its motion and its perihelion encircles the sun.



Einstein proposed that the unexplained precession in radians per revolution is

$$24\pi^3 \frac{a^2}{T^2 c^2 (1-e^2)},$$

where

$a =$ half the major axis of the ellipse (in centimeters)

$e =$ eccentricity

$c =$ light speed in the vacuum (in centimeters)

$T =$ period of a revolution (in seconds)

Substituting $c^2 = \frac{8\pi G}{\kappa}$, the unexplained precession is

$$3\pi^2 \frac{a^2}{T^2 G(1-e^2)} \kappa$$

According to Einstein, it equals the unexplained precession of the perihelion of Mercury by $43"$ per hundred years.

But $\kappa = \frac{8\pi G}{c^2}$ is based on the erroneous guess that retarded gravitational and electromagnetic potentials are identical.

So much for this confirmation of General Relativity.

Nevertheless, perhaps, the correct precession formula is

$$24\pi^3 \frac{a^2}{T^2 v_G^2 (1-e^2)}$$

where $v_G =$ average speed of gravitational waves.

Then, if the $43"$ per hundred years can be trusted, we could compute v_G.

But the $43"$ value is highly speculative.

By the Wikipedia's "Tests of General Relativity",
the observed perihelion precession of Mercury is $574"$.
By unspecified arguments, Gravitational pull of other planets accounts for $531"$, and $43"$ is unaccounted for.
Since the certainty of these claims is unknown, we have to consider them in terms of statistical confidence.
Note that 97% confidence in $531"$, allows for 3% error in $531"$ which is $15.93"$. But that means a 37% error in $43"$ which allows only 63% confidence in the $43"$.
Note that 95% confidence in $531"$ allows for $26.55"$ error, and only 38% confidence in the $43"$.
By obtaining the $43"$ with erroneous κ, Einstein's General Relativity establishes with 100% confidence that the unaccounted for perihelion precession of Mercury is NOT $43"$.
In a 11/28/1919 letter to the London Times, Einstein submitted that had any of his tests been wrong, the whole theory would be beyond repair, and would have to be given up:

> *"The chief attraction of the theory lies in its logical completeness. If a single one of the conclusions drawn from it proves wrong, it must be given up; to modify it without destroying the whole structure*

seems to be impossible"

He must have been aware of his unsubstantiated guess that Gravitational and Electromagnetic retarded potentials are identical, and of the speculative perihelion precession of Mercury that never confirmed his Theory.

References

[Einstein1], A. Einstein, "The Foundation of the General Theory of Relativity" in "The Principle of Relativity", Dover 1952.

[Einstein2], A. Einstein, "Approximative Integration of the Field Equations of Gravitation" Document 32 in "The Collected Papers of Albert Einstein", Volume 6, The Berlin Years Writings, 1914-1917.

[Einstein3], Albert Einstein, "The Meaning of Relativity" Fifth Edition, MJF Books, 1984.

[Kay], David Kay, "Tensor Calculus", Schaum's Outlines, McGraw Hill, 1988.

[Panofsky], Wolfgang Panofsky, and Melba Philips, "Classical Electricity and Magnetism", second edition, Addison Wesley, 1962.

http://en.wikipedia.org/wiki/Gravitation

http://en.wikipedia.org/wiki/Lorentz_transformation

http://en.wikipedia.org/wiki/Relativity_theory

http://en.wikipedia.org/wiki/Tests_of_general_relativity

http://en.wikipedia.org/wiki/Gravitational_wave

http://en.wikipedia.org/wiki/Gravitoelectromagnetism

II.
Hulse-Taylor Pulsar Periastron Precession is due to Magnetic Attraction propagating at light-speed by Electromagnetic Waves

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January, 2014

Abstract In [Dan], we showed how Einstein derived his General Relativity under the erroneous assumption that Retarded Gravitational Potentials, and Retarded Electromagnetic Potentials are similar, and concluded erroneously that Gravitational Radiation propagates at light speed. That is, Gravitational Radiation is electromagnetic.

In the case of the Hulse-Taylor Pulsar, the magnetic attraction dominates the gravitational, the radiation is electromagnetic, and the General Relativity formula gives the pulsar's orbit precession.

However, there are pulsars where the Magnetic attraction

does not dominate the gravitational attraction, and the General Relativity Formula fails.

Keywords Gravitation, Hulse-Taylor Pulsar, Periastron Precession, Magnetic Field, Magnetic Moment, Electromagnetic Radiation, General Relativity Tests, Gravitational Waves, Binary Star, Magnetar, Supernova, Magnetic Dipole, Star, Magnetosphere, Neutron Stars,
Physics & Astronomy Classification Scheme: 04; 97.60.Gb; 97.60.Bw; 97.60.Jd; 95.30.Sf; 97.10.Ld; 97.80.-d;

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4. The Precession of the Periastron of PSR 1534+12

References

Magnetic Attraction and Gravitation

Before Newton's Gravitation Law, Kepler suggested Magnetic Attraction as the cause of Gravitation.

While the earth and the Sun have Magnetic Fields, probes have established that the Moon, Venus, and Mars do not.

And the measured fields are weak:

The Earth's surface Field is about $3 \cdot 10^{-1} \text{Gauss}$, and the Sun's is about 1Gauss.

Mercury was found by Mariner 10 (1974-75) to have a field with dipole moment of $2-5 \cdot 10^{19} \text{Amp} \times \text{met}^2$, and surface values of $3 \cdot 10^{-3} \text{Gauss}$.

Thus, it was established that Gravitational force differs from Magnetic Force.

In [Dan], we showed how Einstein derived his General Relativity under the erroneous assumption that Retarded Gravitational Potentials, and Retarded Electromagnetic Potentials are similar, and concluded erroneously that Gravitational Radiation propagates at light speed. That is, Gravitational Waves are electromagnetic.

In the case of the Hulse-Taylor Pulsar, the magnetic

attraction dominates the gravitational, the radiation is electromagnetic, and the General Relativity formula gives the pulsar's orbit precession.

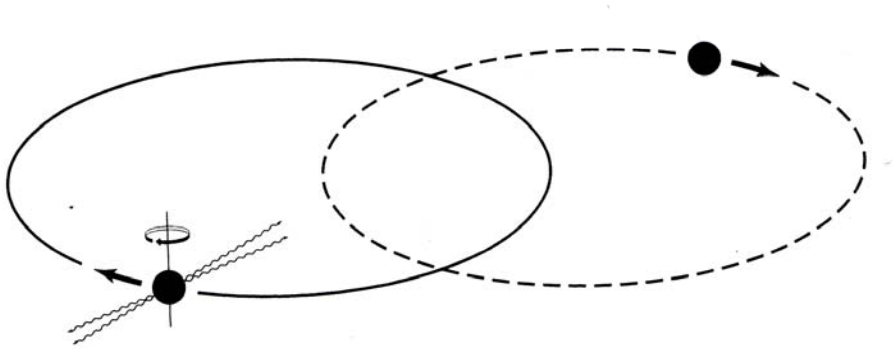
However, there are pulsars where the Magnetic attraction does not dominate the gravitational attraction, and the General Relativity Formula fails.

1.

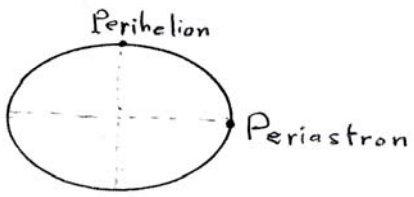
The Precession of the Periastron of the Hulse-Taylor Pulsar

In a 1974 Search for Pulsars, Hulse and Taylor discovered a Pulsating Neutron Star that had a companion, apparently, another Neutron star, with similar mass, and orbit.

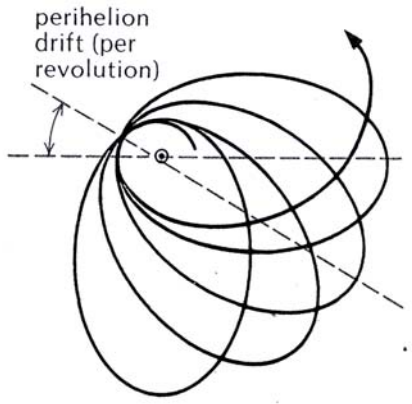
A sketch of the pulsar and its companion orbiting each other from Hulse Nobel lecture is



The Periastron on the pulsar orbit is on its major axis



The Pulsar's elliptic orbit rotates in the direction of its motion,



Then, the Perihelion, and the Periastron precess about the companion. In the case of Mercury, we refer to the precession of its Perihelion.

In the case of the Hulse–Taylor pulsar, the similar size of the orbits of the pulsar and its companion, makes it easier to refer to the precession of the Pulsar's Periastron.

Presumably, Mercury Perihelion has unexplained precession of $43"$ per hundred years. That was claimed by Einstein to confirm General Relativity.

Einstein proposed that the presumed Mercury's unexplained precession in radians per revolution is

$$24\pi^3 \frac{a^2}{T^2c^2(1-e^2)},$$

where

$a =$ half the major axis of the ellipse (in centimeters)

$e =$ eccentricity

$c =$ light speed in the vacuum (in centimeters)

$T =$ period of a revolution (in seconds)

In [Dan] we showed that Einstein's formula is based on the erroneous guess that retarded gravitational and electromagnetic potentials are identical.

Furthermore, the $43"$ value is highly speculative.

By the Wikipedia's "Tests of General Relativity", the observed perihelion precession of Mercury is $574"$.

By unspecified arguments, Gravitational pull of other planets accounts for $531"$, and $43"$ is unaccounted for.

Since the certainty of these claims is unknown, we have to consider them in terms of statistical confidence.

Note that 97% confidence in $531"$, allows for 3% error in $531"$ which is $15.93"$. But that means a 37% error in $43"$ which allows only 63% confidence in the $43"$.

Note that 95% confidence in $531"$ allows for $26.55"$ error, and only 38% confidence in the $43"$.

By confirming the $43"$ with erroneous κ, Einstein's General Relativity establishes with 100% confidence that the unaccounted-for, perihelion-precession of Mercury is not $43"$.

However, the Hulse-Taylor Pulsar orbits its companion in $7^{\mathrm{h}}45^{\mathrm{min}}$, and the advance of its Periastron at a rate of about 4° per year, is believed to be due only to the effect of the companion.

Then, Hulse and Taylor found that the General Relativity formula is confirmed.

That means that the radiation propagates at light speed, in which case the waves must be electromagnetic,

Indeed, the General Relativity formula would have been correct had the attraction been electromagnetic.

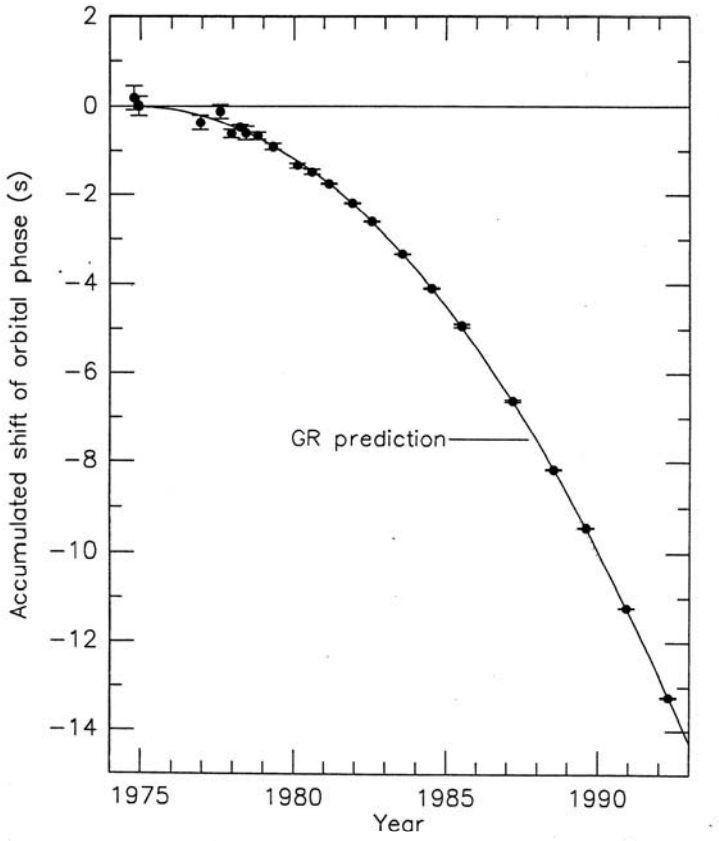
We will see that the General Relativity formula for precession applies to the Hulse-Taylor Pulsar because of the enormous Magnetic fields of the Neutron stars.

The Magnetic attraction between the Hulse-Taylor Pulsar and its companion dominates the gravitational attraction. The carrier of the magnetic field are photons, that is electromagnetic waves that propagate at light speed.

Thus, the General Relativity Formula describes the Periastron Precession of Neutron Stars Binary systems, whenever the Magnetic attraction dominates, and masks the Gravitational attraction.

The fit over recent years is given in Taylor's Nobel lecture,

by the following graph



Such 0.4% error fit does not apply to all pulsars. In the case of PSR 1534+12, Taylor reported that the fit has 20% error. Apparently, the Magnetic attraction does not dominate, and mask the Gravitational, and the General Relativity formula fails.

2.

The Magnetic Fields of Pulsars, and Magnetars

It is believed that in a Supernova, a star with mass greater than 1.44 solar masses, collapses under its gravity, its atoms crash, its electrons and protons transform into neutrons densely, and tightly packed in 10-12 kilometers ball.

Its density is estimated to vary from $10^9\ \mathrm{kg/m^3}$ in its crust, to $8\times 10^{17}\ \mathrm{kg/m^3}$ in its interior, exceeding the nuclear density of $3\times 10^{17}\ \mathrm{kg/m^3}$.

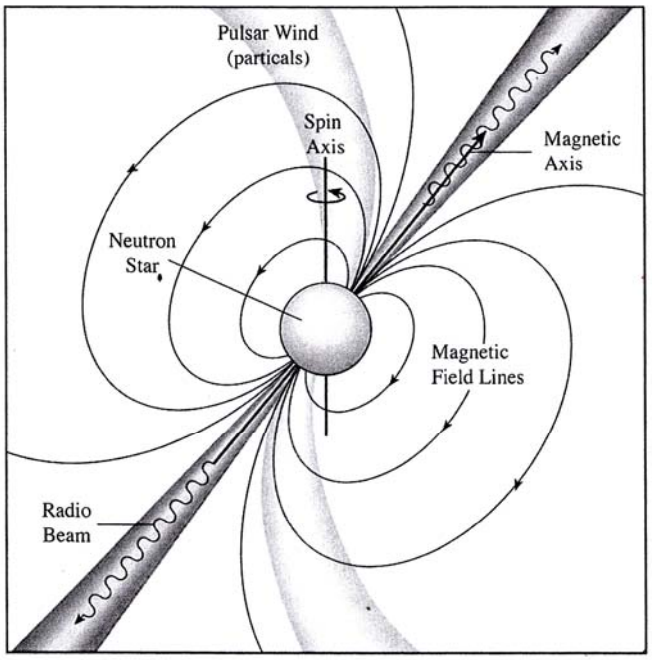
Since the Neutron star surface is very close to its mass center, the Star's surface gravity may be 10^{11} times that of the earth. But the Gravitational Field, computed with the mass considered as a point at its origin, remains the same.

The Angular Momentum of the slowly spinning collapsing star, conserved in the Neutron star with its smaller radius, may lead to hundreds of revolutions per second. Neutron Stars spin about their axis in $1\mathrm{mili\text{-}sec}$ to $10\,\mathrm{sec}$.

The rotation of electrical charges creates enormous Magnetic Fields, and turns the Neutron Star into a huge Magnetic

dipole.

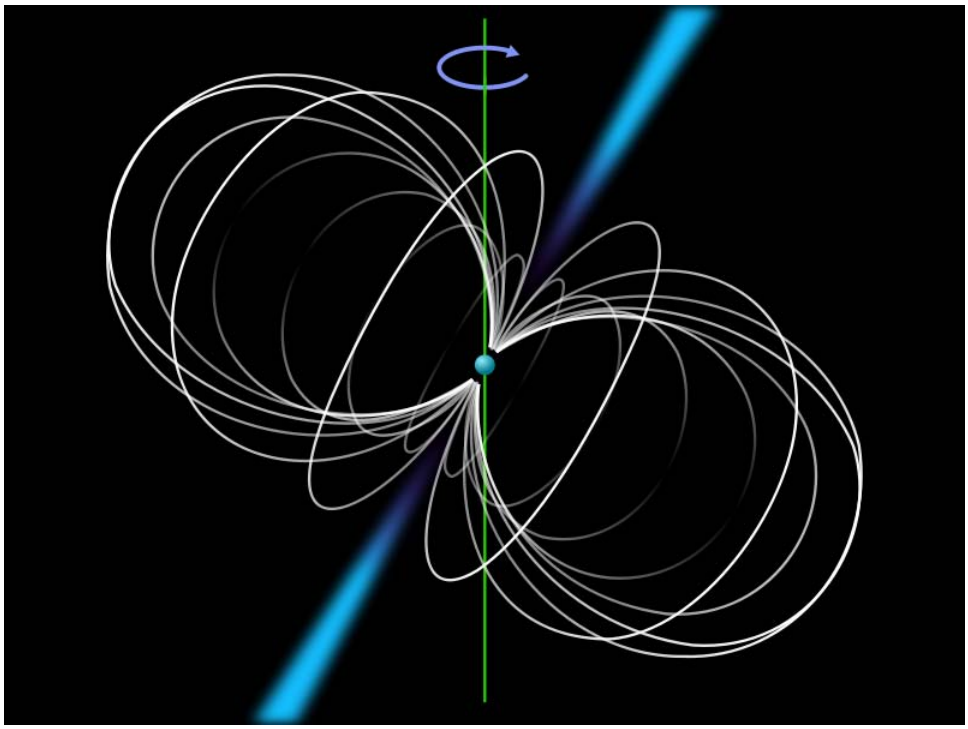
The Magnetic Dipole Moment is believed to be oriented at an angle to the rotation axis.



The spinning Magnet generates electric currents that radiate electromagnetic waves along the magnetic axis.

The radiation beam sweeps the sky like a light house, and an observatory swept by the beam, will record pulses of electromagnetic radiation.

A 3D picture, [Wikipedia, Pulsar]



These schematics, are confirmed by Optical, and X-rays images obtained in satellite observatories:

The best known Pulsar is at the center of the Crab Nebula, a supernova remnant with diameter of 10 light years, at a distance of 6300 light years from earth, expanding at 1800 km/sec. Its Pulses are in the optical, X-rays, and gamma-ray parts of the electromagnetic spectrum

In addition to the radiation along the magnetic Axis, Synchrotron Radiation of Radio waves, optical waves, and gamma rays in the surrounding pulsar wind nebula, is generated by electrons with energies up to $10^8 \mathrm{MeV}$ spiraling around the pulsar's magnetic fields force lines.

The electrons are pulled from the pulsar's surface by the induced Electric field against the pulsar's huge gravitation.

Early observations detected Magnetic Fields with strengths about $10^{12}\text{Gauss}=10^{8}\text{Tesla}$. But by 2010 data, [Leblanc], a typical Pulsar's Magnetic Field strength is about

$$10^{14}\text{Gauss}=10^{10}\text{Tesla},$$

where $\text{Tesla}=\dfrac{\text{Weber}}{\text{m}^2}=\dfrac{\text{kg}}{\text{sec}^2\text{Amp}}$.

The Sun's Magnetic Field is about 1Gauss.

Magnetars, Pulsars with fields that are

$$10^{14}\text{-}10^{15}\text{Gauss}=10^{10}\text{-}10^{11}\text{Tesla}$$

are the source of gamma-ray bursts.

The Magnetar SGR 1806-20 Field is $10^{15}\text{Gauss}=10^{11}\text{Tesla}$.

Our references state that such Magnetic fields can distort the electron shells of atoms of a living cell, and kill the cell from a distance of 1000km.

3.

The Magnetic Attraction in the Hulse-Taylor Binary Pulsar Dominates the Gravitational

The General Relativity Precession formula does not apply to retarded Gravitational Potentials, and to gravitational radiation, because they are not electromagnetic.

But Neutron stars are magnetic dipoles, and the Precession formula may apply to them, provided that the Magnetic Fields dominate the attraction.

If the Neutron star has a companion Neutron Star, as is the case of the Hulse-Taylor Pulsar the Magnetic attraction may dominate the Gravitational, and Electromagnetic waves are the carrier of the Magnetic Attraction.

Then, the General Relativity formula for the precession of the Periastron of the Neutron star may apply, because it was derived for retarded electromagnetic potentials, carried by electromagnetic waves.

4.

The Precession of the Periastron of PSR 1534+12

The Magnetic field of PSR 1534+12 does not dominate its Gravitational Field, and the radiation is not all electromagnetic.

By [Hulse-Taylor, p.87],

> *"PSR 1534+12…has*
>
> *orbital period* $P_b \approx 10.1\text{hour}$,
>
> *eccentricity* $e \approx 0.27$,
>
> *…Its times of arrivals have…uncertainties around* $3\mu\text{sec}$ *for five-minute observations*
>
> ***The orbital decay rate*** $\dot{P}_b$ ***is in accord with general relativity at about the*** 20% ***level"***

References

[Bartusiak], Marcia Bartusiak, "*Archives of the Universe, A treasury of Astronomy's Historic Works of Discovery*"

[Cohen] E. Richard Cohen, "*The Physics Quick Reference Guide*", American Institute of Physics, 1996.

[Dan] H. Vic Dannon, "*Gravitational Waves Do Not Propagate at Light Speed, And Mercury's Perihelion Precession Does Not confirm General Relativity*" Gauge Institute Journal of math and Physics, Volume 10, No. 2, May 2014, Also posted to www.gauge-institute.org

[Einstein1], A. Einstein, "*The Foundation of the General Theory of Relativity*" in "*The Principle of Relativity*", Dover 1952.

[Einstein2], A. Einstein, "*Approximative Integration of the Field Equations of Gravitation*" Document 32 in "*The Collected Papers of Albert Einstein*", Volume 6, The Berlin Years Writings, 1914-1917.

[Einstein3], Albert Einstein, "*The Meaning of Relativity*" Fifth Edition, MJF Books, 1984.

[Gaensler] Bryan Gaensler, "*Extreme Cosmos, A Guided Tour to the Fastest Brightest, Hottest, Heaviest, Oldest, and Most amazing aspects of our Universe*" Perigee, 2011.

[Hulse-Taylor] Russell A. Hulse, "*The Discovery of the Binary*

Pulsar", Nobel Lecture December 8, 1993, and Joseph H. Taylor, "*Binary Pulsars and Relativistic Gravity*", Nobel Lecture December 8, 1993, in "*Nobel Lectures Physics*", 1991-1995, World Scientific, 1997.

[Kaler], James Kaler, "*Extreme Stars At the edge of Creation*", Cambridge, 2001.

[Lang], Kenneth R. Lang, "*Parting the Cosmic Veil*", Springer, 2006.

[Leblanc], Francis Leblanc, "*An Introduction to Stellar Astrophysics*", Wiley, 2010.

[Panofsky], Wolfgang Panofsky, and Melba Philips, "*Classical Electricity and Magnetism*", second edition, Addison Wesley, 1962.

[Rose], William K. Rose, "*Advanced Stellar Astrophysics*", Chapter 10, "Stellar Magnetic Fields", pp. 302-322, Cambridge, 1998.

[Rudiger-Hollerbach], G. Rudigger and R. Hollerbach "*The Magnetic Universe, Geophysical and Astrophysical Dynamo Theory*", Chapter 7, "Neutron Star Magnetism", pp.265-279, Wiley-VCH, 2004.

[Shapiro-Teukolsky], Stuart L. Shapiro; Saul A. Teukolsky, "*Black Holes, White Dwarfs, and Neutron Stars*" Wiley, 1983.

[Zirker], J.B. Zirker, "*The Magnetic Universe, The Elusive*

Traces of an Invisible Force", Johns Hopkins, 2009.

http://en.wikipedia.org/wiki/Star

http://en.wikipedia.org/wiki/Supernova

http://en.wikipedia.org/wiki/Chandrasekhar_limit

http://en.wikipedia.org/wiki/Pulsar

http://en.wikipedia.org/wiki/Binary_star

http://en.wikipedia.org/wiki/Magnetar

http://en.wikipedia.org/wiki/Magnetic_field

http://en.wikipedia.org/wiki/Magnetic_moment

http://en.wikipedia.org/wiki/Magnetic_dipole%E2%80%93dipole_interaction

http://en.wikipedia.org/wiki/Magnetosphere

http://en.wikipedia.org/wiki/Tests_of_general_relativity

http://en.wikipedia.org/wiki/Gravitational_wave

III.
Supernova Models indicate that the Neutrino is the Quantum of The Gravitational Radiation. The Origin of Gravitation is the Transition between the d-quark energy level, and the u-quark energy level of a Nucleon

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November, 2013

Abstract ***The Quantum of Gravitational Radiation is the Neutrino***, because Supernova Models indicate that 99% of the Gravitational Binding energy of a collapsing star is emitted in the form of Neutrinos' Radiation.

Since radiation is emitted in transition between energy levels, this suggests that ***the so called d-quark, and the***

so called u-quark, that have never been observed, are energy levels of the nucleon.

An accelerated Nucleon will emit a Graviton=Neutrino if it transitions from a d-quark energy level, to a u-quark energy level in say $\mathrm{d} \to \mathrm{u} + \mathrm{e}^{-} + \overline{\nu}_{e}$

Namely, ***the origin of Gravitation is the transition between the d-quark energy level, and the u-quark energy level, of the Nucleon.***

Gravitational Radiation is the sum of the emissions from a collection of Nucleons transitioning between their energy levels, when accelerated.

Keywords Gravitation, Quantum Gravity, Gravitons, Neutrino's Mass, Neutrinos Oscillations, Helicity, Anti-Neutrino, Photon, Majorana Neutrino, Anti-Neutrino, Neutrino, Supernova, Quantum Gravitational Radiation
Cherenkov Radiation, Faster Than Light, Gravitational binding energy, Chandrasekhar limit, Neutron star, Tests of general relativity, Gravitational wave, Neutrino, Neutrino oscillation, Neutrino astronomy, Neutrino detector, Graviton

Physics & Astronomy Classification Scheme: 04;

14.70.Kv; 04.60.-m; 98.58.-w; 95.85.Ry; 14.60.Pq; 14.60.St; 98.70.Sa; 04.30.-w; 04.30.Tv; 04.80.Nn; 04.80.-y;

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1. Gravitons
2. Neutrinos
3. Neutrino's Mass, and Class
4. Neutrinos' Oscillations, and Mass
5. Helicity, Anti-Neutrino, and Majorana Neutrino
6. Neutrino's Speed
7. Supernova Models indicate that the Neutrino is the Quantum of Gravitational Radiation
8. The Origin of Gravitation

References

1.

Gravitons

The existence of a particle that carries the Gravitational Force, a Graviton, is certain.

Some of its properties can be predicted

1.1 Gravitons should be common, and plentiful, to the extent that they already may have been detected

Gravitons are exchanged in Gravitational Interaction. Thus, there should be many of them flying around. In fact, they might have been detected by now.

1.2 Gravitons should have Extremely Small Masses, Much Smaller than Photons' Masses, Thus, the Gravitons are Very Difficult to Detect

Because the gravitational Forces are much weaker than Electrical Forces. Therefore, the carrier of the gravitational forces will be far less energetic. Hence, due to energy-mass equivalence, the Graviton should have extremely small mass, much smaller than the $\frac{h\nu}{c^2}$ masses of photons.

1.3 Accelerating Matter Emits Gravitons. Thus, the Earth, and the Sun Emit gravitons

Because the effect of the acceleration is to generate the force carriers: The earth in its orbit around the sun emits gravitons towards the sun, and the sun in its orbit emits gravitons towards the earth.

1.4 The Earth-Sun Planetary System is Stable due to the Exchange of Gravitons

Just like the Electron-Proton Atom that is stable due to the exchange of photons between the photon and the proton

1.5 Gravitons could be Faster Than Light, Thus, Unseen, and Difficult to Detect

Because Faster than Light motion is allowed by special relativity [Dan]

1.6 Gravitons may not Carry Electrical Charge

Because matter is not electrically charged, and even photons, the carriers of the electromagnetic force, are not electrically charged.

2.

Neutrinos

To account for missing Energy, and Momentum in the balance of Radioactive Interaction, Pauli proposed the emission of electrically neutral, hence, unseen particle, with zero mass. Fermi coined the name Neutrino, ν.

A Neutrino beam mixes three types of Neutrinos, ν_e, ν_μ, and ν_τ. The Neutrino is one of the longest living particle, along with electrons, protons, and photons.

Neutrinos are generated for instance

- in the Atmosphere, by $\pi \to \mu + \nu_\mu \to e + 2\nu_e$
- in the Sun Core, by the fusion $4\mathrm{H} \to \mathrm{He} + \nu_e + \gamma$
- in the fusion of protons,
- in the fusion of Boron $^8\mathrm{B}$,
- in the fusion of Beryllium $^7\mathrm{B_e}$
- in Meson decay,
- in Supernova

And they are believed to fill the Universe. But their chance to collide with a particle is very low.

Their Cross Section, the effective target area that they

present to other particles, is as small as $\frac{1}{10^{43}}\mathrm{cm}^2$.

Thus, millions of them are believed to pass through the earth in a fraction of a second, with out interaction with any particles, as if the earth was transparent to them.

3.

Neutrino's Mass, and Class

Popular literature refers to the "illusive Neutrino".

A far more illusive Quark is never described as "illusive", although Quarks, assumed to exist only in pairs or triplets, have never been observed separately, in any interaction that involves them.

While Neutrinos have very small cross section, and their observations are infrequent, the illusiveness of the Neutrino indicates its unclear nature, due to imprecise definition, and erroneous classification.

3.1 The Neutrino's Mass equals $\frac{\text{Neutrino's Energy}}{c^2}$

The neutrino was proposed to balance energy, and momentum in radioactive emission. As such it was defined as a "particle".

Its energy is very small, hardly detectable, less than 2eV, and the question arose whether its mass might be zero.

Due to the equivalence of mass and energy, the Neutrino has a mass that equals $\frac{\text{Neutrino's Energy}}{c^2}$.

However small the Neutrino's Energy might be,

it cannot be zero, or else,

there would have been no need to propose the Neutrino.

The persistence of the question whether the Neutrino has mass, shows that the word "particle" was misguiding.

3.2 The Neutrino defines its own class

The Neutrino was classified as a Lepton, namely a low energy particle, that is similar to the electron.

But having no charge, the Neutrino is as similar to the electron as the photon is.

Being defined as an energy particle,

the Neutrino is a quantum of energy,

and being charge-less,

the Neutrino is similar to the Photon.

Thus,

the Neutrino does not belong with the electron.

But it is unlikely to belong with the photon either.

The photon is a quantum of thermal energy,

or, alternatively, electromagnetic energy.

The Neutrino is a Quantum of Nuclear Binding Energy,

which will be shown to be

Gravitational Binding Energy.

In the Particle Data Group booklet,

the Neutrino should be in the

GAUGE AND HIGGS BOSONS classification.

4.

Neutrinos Oscillations, and Mass

Neutrino oscillations between the three types of Neutrinos were suggested to explain the problem of missing neutrinos in Solar radiation.

Then, the claim that Neutrino's mass depended on the solution of the Neutrino's Solar Problem, helped to attract attention to the Solar Problem,

But as we pointed out in 2.2, due to the equivalence of mass and energy, the Neutrino has a mass, $\frac{\text{Neutrino's Energy}}{c^2}$.

Thus,

conditioning the existence of Neutrino's Mass on the solution of the Neutrino Solar Problem was misguided.

Moreover,

the argument that links Neutrino's Oscillations to Neutrino's Mass, is erroneous.

Such an argument is found in [Schutz, p.131]

"…mass-less particles travel at the speed of light,

and…particles moving at the speed of light experience no lapse of time: time stands still for them, and if they had an internal clock it would not advance at all. No dynamical process, like oscillation from one type of Neutrino to another, could happen; Nothing at all could change for a mass-less neutrino…"

First, there are no mass-less particles. Any particle has mass and energy. Even the photon that travels at light speed has mass $\frac{E}{c^2}$.

Second, the observed time interval of a particle moving at speed v is

$$\frac{\Delta t}{\sqrt{1-\frac{v^2}{c^2}}}.$$

At light speed,

$$v = c\,,$$

and we have meaningless division by zero. Thus, the formula cannot be used to draw any conclusions about particles moving at light speed.

5.

Helicity, Anti-Neutrino, and Majorana Neutrino

Just like the photon, the Neutrino may be spiraling along its propagation axis, with left handed Helicity, or with right handed Helicity.

Years ago, following through Dirac derivation of his wave equation that predicts the anti-electron, Majorana confirmed that unlike the electron which has an anti-electron, the different helicities do not distinguish between a particle, and an antiparticle. That is, the Neutrino is his own antiparticle.

For some Astrophysicists it is an open question whether the Neutrino is his own antiparticle, a Majorana Neutrino, or if the Neutrino's Helicity distinguishes between a particle and an antiparticle, a Dirac Neutrino.

But in Physics, the problem has been long resolved:

The Particle Data Group booklet

lists only the Neutrino,

just as it lists only the photon.

Each being its own anti-particle.

Just like the photon, the Neutrino is a mixture of both left handed Helicity, and right handed Helicity Neutrinos, and is considered its own anti-particle.

6.

Neutrino's Speed

Neutrinos were assumed to propagate at the highest possible speed, which was believed to be light speed.

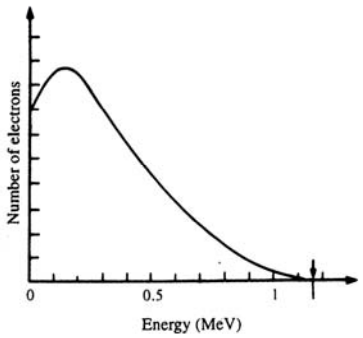
But Light speed is exclusive to the propagation of electromagnetic radiation, and its only carriers are photons.

Like the photon, the Neutrino is a charge-less quantum of radiation but the Neutrinos' Radiation is not electromagnetic Radiation.

Unlike Photons' Radiation that is generated in the Atomic shells,

Neutrinos' Radiation is generated in the Nucleonic Shells, commonly known as Quarks.

The different kinetic energies that electrons carry out of the radioactive interaction, imply different kinetic energies and velocities of the Neutrinos.



The energy distribution of the electrons emitted in the beta decay of bismuth 210. The kinetic energy of these electrons is between zero and 1.17 MeV.

Neutrinos' Observatories detect Neutrinos' Speeds on the order of light speed, and Faster Than Light, as evidenced by the emission of Cherenkov Radiation [Dan].

7.

Supernova Models indicate that the Neutrino is the Quantum of Gravitational Radiation

The Quantum of Gravitational Radiation is the Neutrino, because Supernova Models establish that 99% of the Gravitational Binding energy of a collapsing star is emitted in the form of Neutrinos' Radiation.

This fact seems to be well-known. By [Close, p139],

> *"…most of the energy produced in a supernova is radiated away in the form of an immense burst of neutrinos…"*

By [Bahcall, p.428],

> *"Most of the binding energy that is released when a neutron star is formed is believed to be emitted in the form of neutrinos"*

However, we could not find any believable substantiation to this claim, and we work it out in the following:

By [Swihart, p.120], to build a Star of constant density

$$\rho\,,$$

with mass

$$M\,,$$

and radius

$$R\,,$$

we will add to mass

$$m(r)=\tfrac{4\pi}{3}r^3\rho\,,$$

with radius

$$r\,,$$

an infinitesimal mass

$$dm(r)=4\pi r^2\rho dr\,,$$

which will add the Gravitational energy

$$-G\frac{m(r)dm(r)}{r}=-G\tfrac{16\pi^2}{3}\rho^2r^4dr\,.$$

Therefore, the total Gravitational energy of the Star is the Integration Sum

$$-G\int_{m=0}^{m=M}\frac{m(r)}{r}dm(r)=-\,G\tfrac{16\pi^2}{3}\rho^2\int_{r=0}^{r=R}r^4dr=-\tfrac{3}{5}G\frac{M^2}{R}\,.$$

[Landau-Lifshitz, pp.327-331], supply the analysis for the Supernova creation of a neutron star, and conclude (p.330-331) with the following:

> *"The conversion of the whole mass M from the electron-nucleus state to the neutron state requires an expenditure of energy…to counterbalance the*

binding energy of the nuclei.

In the process, energy is released because of the contraction of the body…This gain of energy is

$$\tfrac{3}{7}GM^2\left(\frac{1}{R_{\text{Neutron Star}}}-\frac{1}{R_{\text{electron-nucleus Star}}}\right)$$

The second term in the formula is negligible compared with the first, and

the Gravitational Binding released is

$$\tfrac{3}{7}GM^2\,\frac{1}{R_{\text{Neutron Star}}}.$$

Computing with the Chandrasekhar Limit,

$$M=1.4M_{\text{Sun}}=1.4\times 2\times 10^{30}\text{kg}\,,$$

and with

$$R_{\text{Neutron Star}}=10\text{km}=10^4\text{m}\,,$$

the **Gravitational Binding** is

$$\tfrac{3}{7}6.7\times 10^{-11}(2.8)^2 10^{60}\,\frac{1}{10^4}=2.25\times 10^{46}\text{Joul}$$

$$=2.25\times 10^{55}\text{erg}$$

The **Nuclear Binding energy** is

$$\begin{pmatrix}3.2\ \underbrace{\text{MeV}}_{1.6\times 10^{-11}\text{Joul}}\\ \text{per nucleus}\end{pmatrix}\times\begin{pmatrix}6\times 10^{23}\\ \#\text{ of nuclei/kg}\end{pmatrix}\times\underbrace{M}_{1.4\times 2\times 10^{30}\text{kg}}=8.6\times 10^{43}\text{Joul}\,,$$

$$=8.6\times 10^{52}\text{erg}\,.$$

This is less than 0.5% of the gravitational binding.

By [Kundt, p.40],

> *"Supernova shells tend to have masses…of order* $3M_{\text{Sun}}$ *-inferred from the times at which their spectra changes from optically thick (photospheric) to optically thin (nebular), usually between 6 and 18 weeks after launch- and radial velocities ranging from several* $10^5\, m/sec$ *up to several* $10^7\ m/sec$*, with a quadratic mean near* $10^{6.8}\ m/sec."$

Their **kinetic Energy** is of order

$$\tfrac{1}{2}3\underbrace{M_{\text{Sun}}}_{2\times 10^{30}}10^{13.6} = 1.2\times 10^{44}\text{Joul}$$

$$= 1.2\times 10^{53}\text{erg}$$

This is a little over 0.5% of the gravitational binding

By [Kundt],

Radio waves, optical, and X-ray radiation

average

$$3\times 10^{40}\text{Joul} = 3\times 10^{49}\text{erg}$$

This is negligible compared with the gravitational binding.

In conclusion, about 1% of the gravitational binding is released as nuclear binding energy, supernova shell kinetic energy, and electromagnetic radiation.

Consequently, 99% of the Gravitational Binding Energy is carried away by the radiated Neutrinos.

Thus,

Gravitational Radiation is made of Neutrinos,
and the Quantum of Gravitational Radiation
is the Neutrino.

8.

The Origin of Gravitation

Einstein was aware of the fact that his General Relativity does not give a clue as to what the quantum of Gravitational Radiation may be.

Using the CGS system that is devoid of the electric permittivity ε_0, and the magnetic permeability μ_0, he did not know the exclusiveness of light speed $c = \frac{1}{\sqrt{\varepsilon_0 \mu_0}}$ to electromagnetics, and did not realize that the only radiation quantum that may move at precisely light speed is the quantum of thermal radiation, the photon.

But assuming that gravitons will be generated similarly to photons by the same Atomic Spectroscopy mechanism,

he wrote in [Einstein, p.209],

> *"**...due to the inner-atomic movement of electrons**, atoms would have to radiate not only electromagnetic but also gravitational energy, even if only in tiny amounts."*

By Newton, the source of Gravitation is Mass.

By Rutherford, Mass resides the Nucleus.

And Gravity may reflect Quantum Processes in the Nucleus.
Modifying the first line of Einstein's writing we have

> *"…**due to the inner-<u>nuclear</u> movement of <u>quarks</u>,** atoms would have to radiate not only electromagnetic but also gravitational energy, even if only in tiny amounts."*

This modified statement points to the Origin of Gravitation:
The Quantum of Gravitational Radiation is the Neutrino, because Supernova Models indicate that 99% of the Gravitational Binding energy of a collapsing star is emitted in the form of Neutrinos' Radiation.

Since radiation is emitted in the transition between energy levels, this suggests that the so called d-quark, and the so called u-quark, that have never been observed, are two energy levels of the nucleon.

Then,

An accelerated Nucleon will emit a Graviton=Neutrino when it transitions from a d-quark energy level, to a u-quark energy level in the interaction

$$\mathrm{d} \rightarrow \mathrm{u} + \mathrm{e}^{-} + \overline{\nu}_{e}$$

Namely,

the origin of Gravitation
is the transition between the d-quark energy level,
and the u-quark energy level, of the Nucleon.

References

[Afanasiev], G. N. Afanasiev, "Vasilov-Cherenkov and Synchrotron Radiation Foundations and Aplications, Kluwer, 2004.

[Bahcall], John N. Bahcall, "*Neutrino Astrophysics*", Cambridge, 1989.

[Boehm-Vogel], Felix Boehm & Petr Vogel, "*Physics of Massive Neutrinos*", second edition, Cambridge, 1992.

[Close] Frank Close, "*Neutrino*", Oxford, 2010.

[Dan] H. Vic Dannon, "A Hypothesis that Dark Matter is Regular Matter, Invisible, because it moves Faster Than Light" Gauge Institute Journal of math and Physics, Volume 9, No. 4, November 2013, Also posted to www.gauge-institute.org

[Einstein], A. Einstein, "*Approximative Integration of the Field Equations of Gravitation*" Document 32 in "*The Collected Papers of Albert Einstein*", Volume 6, The Berlin Years Writings, 1914-1917.

[Friedlander], Michael Friedlander, "*A Thin Cosmic Rain, Particles from Outer Space*", Harvard, 2000.

[Hillebrandt], W. Hillebrandt, "*Neutrino Physics and Supernovae: What we have learned from SN 1987A*?", in "*Neutrinos*", edited by H. V. Klapdor, Springer, 1988.

[Jelley], J. V. Jelley, "*Cherenkov Radiation and its Applications*", Pergamon, 1958.

[Kim-Pevsner], Chung Wook Kim, and Aihud Pevsner, "*Neutrinos in Physics and Astrophysics*", hardwood academic, 1993.

[Kundt], Wolfgang Kundt, "*Astrophysics, A new approach*", second edition, Springer, 2005.

[Landau-Lifshitz], L. Landau and E. Lifshitz, Course of Theoretical Physics, Volume 5, "Statistical Physics", Third Edition Part 1, Pergamon, 1985.

[Martin] B. R. Martin, "*Nuclear and Particle Physics, An Introduction*", Wiley, 2006.

[Martin-Shaw], B. Martin and G. Shaw, "*Particle Physics*", third edition, Wiley, 2008.

[Mohapatra-Pal], Rabindra Mohapatra, and Palash Pal, "*Massive Neutrinos in Physics and Astrophysics*", World Scientific, 1991.

[Ne-eman-Kirsh], Yuval Ne-eman, and Yoram Kirsh, "*The Particle Hunters*" second edition, Cambridge, 1996

[PDG], Particle Data Group, Particle Physics Booklet, July 2012, APS.

[Schutz], Bernard Schutz, "Gravity from the ground up", Cambridge, 2003.

[Sutton], Christine Sutton, "*Spaceship Neutrino*", Cambridge, 1992.

[Swihart], Thomas L. Swihart, "*Quantitative Astronomy, Topics in Astrophysics*" Prentice Hall, 1992.

[Woan], Graham Woan, "*The Cambridge Handbook of Physics Formulas*", Cambridge, 2000.

http://en.wikipedia.org/wiki/Cherenkov_Radiation

http://en.wikipedia.org/wiki/Faster-than-light

http://en.wikipedia.org/wiki/Gravitation

http://en.wikipedia.org/wiki/Gravitational_binding_energy

http://en.wikipedia.org/wiki/Supernova

http://en.wikipedia.org/wiki/Chandrasekhar_limit

http://en.wikipedia.org/wiki/Neutron_star

http://en.wikipedia.org/wiki/Tests_of_general_relativity

http://en.wikipedia.org/wiki/Gravitational_wave

http://en.wikipedia.org/wiki/Neutrino

http://en.wikipedia.org/wiki/Neutrino_oscillation

http://en.wikipedia.org/wiki/Neutrino_astronomy

http://en.wikipedia.org/wiki/Neutrino_detector

http://en.wikipedia.org/wiki/Graviton