Richard A. Peters

rapwrap44@cox.net

Affiliation: None

Conjecture on Coupling Constants and the Fields of Space

Abstract

Two fields of space are introduced: a ***temporal field*** that supports the propagation of photons and an ***inertial field*** that is involved in the inertial reaction of matter particles. Arguments are advanced to support the assertion that both the temporal and inertial fields are subject to gravity and, hence, the fields comprise a single ***temporal-inertial (TI) field.*** Coupling among the TI field, matter particles and gravity affects measures of inertia, mass and the gravitational constant. The coupling of a matter particle with the TI field is a measure of the inertial mass of that particle. Acceleration of a matter particle with respect to the TI field produces the inertial reaction force. It follows that 1) acceleration of particles of the TI field by gravity transmits the gravitational force to matter particles that then move with the same acceleration and 2) matter particles are not directly subject to the gravitational force. The TI field supports the propagation of light that moves at the velocity c relative to the field. A third field, the ***static field*** is not subject to gravity, but is coupled with the TI field and counteracts the acceleration of particles of the TI field in their response to gravity.

A Balance of Forces

An important concept of this conjecture is that the acceleration of a particle in response to an applied force produces a force opposing that acceleration so that a balance is achieved in which the reactive force equals the applied force. Any decrease in the acceleration of the particle decreases the reactive force that then allows the acceleration to increase. This negative feedback action yields stability.

A similar phenomenon occurs when we consider the acceleration of particles of either the inertial or temporal field in response to gravity. In either case, the acceleration of particles of the field is resisted by interaction with the static field so that the accelerating force of gravity is balanced by the reactive force of the static field. In their reaction to the force of gravity, particles of the inertial and temporal fields exhibit inertial mass. This inertial mass expresses the resistance of particles of these fields to acceleration relative to the static field and has no gravitational counterpart.

To iterate, the static field moderates the temporal and inertial fields' acceleration in response to gravity. The static field's reactive force to the acceleration of particles of the temporal and inertial fields is proportional to their acceleration relative to the static field. The change in acceleration of the particles of the fields is zero when the gravitational force on them is balanced with the reactive force of the static field.

Competing Models for the Temporal and Inertial Fields of Space

We have seen in two referenced documents [1] and [2] that fields of space exist that support the propagation of light and that produce an inertial reactive force in response to the acceleration of matter relative to the field. The questions to be addressed in this conjecture are how these fields interact with each other, with the gravitational field and with matter. Indeed, can the question be answered about whether these fields are separate or one field, populated by a single species of particle, that supports the phenomena of inertia, the mediation of the gravitational force and the propagation of light?

Four models are considered:

1. The Inertial and temporal fields are separate and neither is subject to gravity. Matter particles are directly subject to gravity.
2. The inertial and temporal fields are separate; the temporal field is subject to gravity, but the inertial field is not. Matter particles are directly subject to gravity.
3. The inertial and temporal fields are separate; the inertial field is subject to gravity, but the temporal field is not. Matter particles are not directly subject to gravity.
4. The inertial and temporal fields comprise a single field subject to gravity. Matter particles are not directly subject to gravity.

The objective of examining these models is to determine which, if any, best supports observed phenomena. The Cosmological Principle and four phenomena: the speed of light, time dilation, gravitational redshift and the increase of a moving body's mass as its velocity increases offer keys to discriminate among the four models. Implications of the four modes of coupling of the temporal and inertial fields with gravity are given in Table 1.

In models in which either the inertial or temporal field is subject to gravity, the static field interacts with that field to limit the acceleration of the field.

In Model 1 the inertial and temporal fields are separate and neither is coupled with gravity. Matter particles are subject to gravity. This model can be rejected out of hand as contradicted by the *Conjecture on Time Dilation, Gravity and Inertia* [2] that concludes that the temporal field is subject to gravity.

In Model 2 particles of the temporal field are subject to gravity as are matter particles. The acceleration of particles of the temporal field in response to gravity must be the same as those of matter. Acceleration of the particles of the temporal field is limited by the reactive force of the static field. Acceleration of matter particles is limited by the reactive force of the inertial field. Conclusions in *Conjecture on Time Dilation, Gravity and Inertia* assert that these two accelerations must be equal. The null expectation that the acceleration of two different particle species reacting with two different fields would be equal is cause for rejection of this model.

Table 1. Coupling of Different Field Structures with Gravity

Model	Inertial Field and Gravity	Temporal Field and Gravity	Matter and Gravity	Implications
1	No	No	Yes	This model is eliminated by the *Conjecture on Time Dilation, Gravity and Inertia* that concludes that the temporal field is subject to gravity.
2	No	Yes	Yes	Acceleration of particles of the temporal field must be the same as those of matter. Acceleration of particles of the temporal field is moderated by the Static field.
3	Yes	No	No	This model is eliminated by the *Conjecture on Time Dilation, Gravity and Inertia* that concludes that the temporal field is subject to gravity.

Model	Inertial Field and Gravity	Temporal Field and Gravity	Matter and Gravity	Implications
4	Yes	Yes	No	Acceleration of particles of both the temporal and inertial fields must be the same as those of matter. This supports the argument for a single field, the Temporal-Inertial (TI) field. A single species of particle unites the temporal and inertial fields and supports the inertial force, the mediation of the gravitational force and the propagation of light.

In Model 3 only particles of the inertial field are coupled with gravity. Their acceleration is moderated by the static field. Matter particles are not subject to gravity and hence are accelerated only indirectly by gravity through the acceleration of the inertial field. As in model 1, this model can be rejected out of hand as contradicted by the *Conjecture on Time Dilation, Gravity and Inertia* [2] that concludes that the temporal field is subject to gravity.

In Model 4 a single species of particle comprises both the temporal and inertial fields. I refer to the combined field as the temporal-inertial (TI) field. It should be emphasized that the apparent combination of two fields into one represents the recognition, after the arguments to follow, that a single particle species comprising the TI field is believed to incorporate properties previously divided between the two separate fields.

This TI field supports the phenomena of inertia, the mediation of the gravitational force and the propagation of light. The static field moderates the acceleration of particles of the TI field in response to the gravitational force as described in the subsection *A Balance of Forces.* Matter particles are not subject to gravity and hence are accelerated only indirectly by gravity through the acceleration of what is now identified as the TI field.

Arguments for the Coupling of the Temporal Field with Gravity

Argument for the Coupling of the Temporal Field with Gravity is Supported by the Speed of Light

Davis and Lineweaver [3] state ‘all observers measure light locally to be traveling at c...’. Invoking the cosmological principle I assert that the speed of light is c relative to the space in which light propagates whether that space is in the vicinity of earth or in some distant galaxy receding away from earth at relativistic speed. I draw two conclusions from this behavior of light:

1. A medium, that I’ve identified for now as the temporal field, supports the propagation of light.

2. The temporal field comprises particles that permeate space and is subject to gravity and is accelerated the same amount as matter particles by gravitational bodies.

One can then conclude that the temporal field is not stationary, but moves with the expansion of space and follows the complex acceleration profile around each gravitational body in the universe. In a well ordered system like the solar system, the velocity profile of the temporal field conforms to that of the planetary orbits. Superimposed on the orbital velocity of the temporal field is the radial infall velocity of the field as it falls toward the barycenter of each planet. A scientist on an earthlike planet in a distant galaxy can therefore measure the speed of light locally to be c because locally the temporal field is moving right along with her galaxy, parent star and planet.

Argument for the Coupling of the Temporal Field with Gravity is Supported by the Phenomenon of Time Dilation

Additional support for the conclusion that the temporal field is subject to gravity and moves with the earth in its orbit around the sun is described in reference [2]. In this paper it is argued that in the Global Positioning System, calculation of the effect of velocity of a GPS satellite on the time dilation of its clock does not consider the velocity of earth relative to the temporal field and yet, the GPS works flawlessly. According to the conjecture of the paper this behavior is possible only if earth does not move relative to the temporal field. Since earth clearly moves about the sun and the galaxy, and the galaxy itself moves relative to the Cosmic Background Radiation, the temporal field itself must move as does the earth and therefore is subject to gravity.

Argument for the Coupling of the Temporal Field with Gravity is Supported by Gravitational Time Dilation

The time dilation experienced by an object in a gravitational field is caused by its velocity relative to the temporal field as the field is accelerated toward the gravitational body. If the object itself is in free fall it accelerates at the same rate as the temporal field at the object and its velocity relative to the temporal field remains constant. Hence, the time dilation at the object does not change. As the object gets closer to the gravitational body, the graviton flux increases, but the time dilation at the object does not change.

Thus, during its fall the clock will retain the same period it had when it started its descent. The ratio of this period to that of a distant clock, unaffected by gravity, is expressed by Eq. (1).

$$t_1 / t_0 = 1 / (1 - v_{escape}^2 / Rc^2)^{1/2} \quad (1)$$

where

t_0 is the period of a clock outside any gravitational influence.

t_1 is the period of a stationary clock at a distance R from the center of the gravitational body.

v_{escape} is the escape velocity from earth at a radius R from the earth. This value is the radial velocity of the temporal field of space at R as particles of the field fall toward the center of the earth.

R is the distance of the clock at the point where the period is measured.

c is the speed of light relative to the temporal field.

If no change in time dilation occurs during its fall, neither the object's acceleration nor the flux of gravitons at the object causes time dilation. The time dilation of a stationary process at a given radius from the gravitational body is caused, again, by the infall velocity of the temporal field at that radius.

The clock's period will change to the value of its rest position when it stops at the surface of the gravitational mass. (It will tick more slowly than when it started its descent.) This behavior is in accord with Schutz's [4], p115 analysis and conclusion that "there is no redshift in a freely falling frame." The conjecture that the temporal field falls toward the earth is consistent with this example.

To repeat, yet again, gravity does not directly cause gravitational time dilation. Reference [2] argues that the velocity of the temporal field* falling toward a gravitational body in response to gravity is the cause of the so-called gravitational time dilation.

* In the referenced paper, and as concluded in this conjecture, the temporal and inertial fields are combined in the temporal-inertial field.

The Cosmological Principle Supports Coupling of the Temporal Field With Gravity

"The cosmological principle is usually stated formally as 'Viewed on a sufficiently large scale, the properties of the Universe are the same for all observers.' This amounts to the strongly philosophical statement that the part of the Universe which we can see is a fair sample, and that the same physical laws apply throughout." [5] The high recessional velocity and possibly high peculiar velocity of a distant galaxy relative to our frame of reference do not affect the physical laws there any more than our high velocity relative to that distant galaxy affects our physical laws. A element in this parity is the fact that as these two galaxies diverge from one another the space that they inhabit and that permeates them moves with them in concert and is bound with them by gravity.

Argument for the Coupling of the Inertial Field with Gravity is Supported by the Flux Model of Gravity [8]

In the referenced conjecture it is argued that as particles of the TI field are accelerated toward a gravitational body they experience an increase in the flux of gravitons from the body. At a given radius from the center of the body the velocity of the TI field reaches the so-called escape velocity from that body at that radius. The graviton flux is proportional to the sum of the velocities of gravitons and the TI field. This addition is allowable because gravitons propagate in the static field, a field separate from the TI field. The relative increase in flux is given by the ratio of the combined velocities to the velocity c of the gravitons alone as given by Eq (2).

$$vGraviton / c = 1 + (2GM / r c^2)^{1/2} \qquad (2)$$

The acceleration of particles of the TI field (Eq (3)) is increased by this factor over the acceleration expressed by the Newtonian value of Eq (4).

$$aTotal = (GM / r^2) * (1 + (2GM / r c^2)^{1/2}) \qquad (3)$$

$$aNewton = (GM / r^2) \qquad (4)$$

Massive particles are thus accelerated by the same amount as expressed in Eq (3). Applying similar logic to the model in which the gravitational force is mediated between masses directly, the flux model would assert that the flux increase due to a matter particle moving toward a gravitational body at velocity v would be proportional to

$$vParticle / c = 1 + v / c \qquad (5)$$

The acceleration of the particle (or object comprising particles) would then be

$$aParticle = (GM / r^2) * (1 + v / c) \qquad (6)$$

The acceleration of objects near a gravitational body would thus depend both on their distance from the body and on their velocity relative to the body. This behavior is chaotic, and while the effect is feeble in the moderate gravitational fields of the solar system, it would be considerable in the field of a black hole. The gravitational field of such a model could not be characterized solely as a function of the mass of the gravitational body.

Newton's Law of Universal Gravitation and Variations

Newton's familiar law of gravitation states the relationship of the gravitational force between two gravitational bodies:

$$F = G(M_1 M_2)/r^2 \qquad (7)$$

where

F is the force between two gravitational masses M_1 and M_2 that are separated by a distance of r.

G is the gravitational constant

Say that M_1 is a 10 kg weight, W, at rest on the surface of the earth. It's mass is valued as it's weight divided by the acceleration of gravity at the surface of the earth.

$$M_1 = W/g \qquad (8)$$

This is not remedial physics, bear with me. We apply a force to the weight (horizontally with the weight on a frictionless surface in a vacuum) and it accelerates. When its acceleration is 1g, we measure the inertial reaction force of the weight to be 10 kg. We measure the weight, the applied force and the acceleration very carefully and decide that the gravitational and inertial masses are equal. Logically, the gravitational and inertial masses of M_2 must also be equal. Numerous experiments support this equality.

Coupling Between the Temporal-Inertial Field and Matter

Equation (9) expresses Newton's Second Law of motion

$$F = Ma \qquad (9)$$

where

F is the force applied to an object of mass M.

a is the acceleration of the object in response to the application of the force.

For a given force, the acceleration is inversely proportional to the value M of the mass. We may regard the value M of the object's mass as the coupling constant between mass and the TI field. The stronger the coupling between the mass and the TI field, the more the TI field resists acceleration of the mass. Consider now how the variation of this coupling 'constant' affects the evaluation of the gravitational constant.

Imagine a thought experiment in which the coupling constant relating the force produced by accelerating a mass is doubled. In other words, when a force is applied to a mass it accelerates at half the rate before the change. Now assume the weight resting on the surface of the earth weighs precisely 10 kg, but when we measure its acceleration when dropped (in a vacuum) it is half its value before the experiment. When we apply a force as before, the acceleration of the weight reaches 0.5 g when the applied force is 10 kg. We evaluate the mass of the weight as before as the weight of 10 kg divided by its acceleration of 0.5 g. The mass is judged to be double its previous value. We observe, again, that the acceleration of the weight in free fall is the same 0.5 g as in response to the application of a 10 kg force and decide that the gravitational and inertial masses are, again, equal.

Logically the same judgement can be made for M_2 (Eq (7)) so its mass is also double its previous value. The gravitational acceleration of the weight in the thought experiment is one-half as much, but each mass is double its previous value. For the weight of M_1 to be 10 kg, we must adjust the value of G, the gravitational constant, to be one fourth its value before the thought experiment. Thus G varies inversely as the square of the coupling 'constant' between matter and the TI field. The same conclusions can be drawn from a cursory examination of Eq (7). Keep in mind that, in our thought experiment, when we change M we are not adding mass, we are changing the coupling between mass and the TI field. This change affects the acceleration of the mass in response to a force, but not the force itself, whether gravitational or otherwise.

The effects of coupling M between the temporal-inertial field and mass are summarized in Table 2. Values in the table are normalized.

Table 2. The Effects of Coupling Between Temporal-Inertial Field and Matter ($K = 1/r^2$)

Coupling, M	Weight, $W = KGM^2$	Acceleration, $a = KGM$	Mass $M = W / a$	$G = K / M^2$
1.0	1.0	1.0	1.0	1.0
2.0	1.0	0.5	2.0	0.25

The effects of doubling the coupling constant M between the TI field and mass are:

- The measurement of weight is unaffected.
- Acceleration is inversely proportional to M and is halved.
- Mass, the independent variable in our thought experiment, is doubled.
- G, the gravitational constant, is inversely proportional to the square of M and is divided by four.

Coupling Between the Temporal-Inertial Field and Gravity

We want to determine how the coupling between gravity and the TI field effects the valuation of weight, acceleration and mass of a massive object. Newton's familiar law of gravitation states the relationship of the gravitational force between two masses. In Eq (10), I've expressed the force between the two masses as the weight of an object of mass M_1 at rest on the surface of a gravitational body of mass M_2.

$$W = G(M_1 M_2)/r^2 \qquad (10)$$

where

W is the weight of mass M_1 resting on the surface of a gravitational mass M_2.

G is the gravitational constant.

r is the radius of the gravitational mass M_2.

Table 3. The Effects of Coupling Between Temporal-Inertial Field and Gravity ($K = 1/r^2$)

Coupling, G	Weight, $W = KGM^2$	Acceleration, $a = KGM$	Mass $M = W / a$	G
1.0	1.0	1.0	1.0	1.0
2.0	2.0	2.0	1.0	2.0

The effects of doubling the coupling constant G, known as the gravitational constant, between gravity and the temporal-inertial field are summarized in Table 3. The effects of doubling the coupling constant G between the TI field and gravity are:

- The coupling constant G, the independent variable in this thought experiment, is doubled.
- The weight W is proportional to G and is doubled.
- The acceleration of a massive object is proportional to G and is doubled.
- The mass M of a massive object is unchanged.

Coupling Between the Temporal-Inertial and Static Fields

We want to determine how the coupling between the TI and static fields effects the valuation of mass and the gravitational constant. The acceleration of particles of the TI field in response to gravity is counteracted by the reactive force of the static field. This reactive force is proportional both to the acceleration of particles of the TI field relative to particles of the static field and to the coupling between the two fields. This relationship is shown in Eq (11).

$$F_{is} = M_{is} a_{is} \qquad (11)$$

where

F_{is} is the reactive force of the static field on particles of the TI field.

F_{is} also equals the value of the gravitational force applied to the particles of the TI field by the gravitational mass.

M_{is} is the coupling between particles of the TI and static fields.

(M_{is} may be interpreted as the ‘mass’ of a particle of the TI field as measured in the static field.)

a_{is} is the acceleration of particles of the TI field relative to the static field.

a_{is} is also the acceleration of particles of the TI field relative to the gravitational mass.

According to Eq (11), if the coupling M_{is} between the TI and static fields is doubled, the acceleration a_{is} in response to a given force F_{is} will be halved. In other words the acceleration in response to a force applied to a particle of the TI field is inversely proportional to the coupling between particles of the TI and static fields.

How does the coupling between particles of the TI and static fields affect the valuations of mass and the gravitational constant? Consider a 10 kg weight, our test mass, at rest on the surface of the earth. According to the conjecture, the weight of the test mass is produced by the downward acceleration of particles of the TI field. In other words, gravity is not pulling the weight down, space is pushing it down. The acceleration of particles of the TI field is caused by the balance of the gravitational force and the reactive force of the static field. If we double the coupling between the TI and static fields, we halve the downward acceleration of the particles of the TI field in response to gravity.

We have previously argued that the gravitational force is mediated by the acceleration of particles of the TI field and that this acceleration is applied to massive particles within the field. Now, assume the test mass rests on a frictionless surface in a vacuum. Let's apply a lateral of force of 10 kg to the test mass. The mass will accelerate laterally at one-half g, where g is the nominal acceleration of gravity at the surface of the earth. The resistance of the mass to acceleration is doubled. What do we determine the mass of the 10 kg test mass to be? Equation (12) shows the mass to be inversely proportional to acceleration and, hence, inversely proportional to the coupling between the TI and static fields.

$$M = F / a \qquad (12)$$

How does the weight of the test mass vary when the coupling between the TI and static fields is doubled? Again, according to Eq (12), as the acceleration is halved, the mass is doubled and the weight (F in the equation) remains the same. This is logical; the graviton flux from the gravitational mass of earth to the TI field has not changed in our experiment.

Now, what is the valuation of the gravitational constant G? The expression for the acceleration of particles of the TI field in response to gravity is given by

$$a = (G\ M) / r^2 \qquad (13)$$

where

a is the acceleration of a particle of the TI field.

G is the gravitational constant.

M is the gravitational mass.

r is the distance from the center of the gravitational mass to the point where the acceleration is measured.

The value of acceleration a is halved in our experiment and the mass M is doubled. Accordingly, the valuation of the gravitational constant G must be divided by four. The gravitational constant is thus inversely proportional to the square of the coupling constant between the TI and static fields. The relationships among the coupling constant between the TI and static fields, the valuation of mass and weight and the gravitational constant are summarized in Table 4. Values in the table are normalized.

Table 4. The Effects of Coupling Between the Temporal-Inertial and Static Fields ($K = 1/r^2$)

Coupling, M_{is}	Weight, $W = KGM^2$	Acceleration, $a = KGM$	Mass $M = W / a$	$G = a / (KM)$
1.0	1.0	1.0	1.0	1.0
2.0	1.0	0.5	2.0	0.25

The effects of the coupling between the temporal-inertial field and the static field are summarized in Table 4. The effects of doubling the coupling constant M_{is} between the TI field and the static field are:

- The coupling M_{is} between the TI and static fields is the independent variable in this evaluation and is doubled.
- The weight of a massive object is unchanged.
- The acceleration of a massive object in response to gravity is inversely proportional to the coupling M_{is} and is halved.
- The mass of a massive object is proportional to the coupling constant M_{is} and is doubled.
- The gravitational constant G is inversely proportional to the square of the coupling constant M_{is} and is divided by four.

Interaction of The Temporal-Inertial Field of Space With Gravity and the Static Field

Table 5 summarizes the effects of coupling among the TI field, matter, gravity and the static field.

The inertial mass of a particle is a measure of the coupling between a matter particle and the TI field. This coupling factor expresses the acceleration of the matter particle in response to an applied force.

The gravitational constant G is the coupling factor between matter and particles of the TI field and is one of the two factors determining the acceleration of particles of the TI field in response to gravity.

Shown in the third row of the table, the coupling between the TI and static fields balances the gravitational force on the TI field with the reactive force of the static field. This coupling represents the inertial mass of a particle of the TI field in resisting acceleration caused by gravity.

Table 5. Summary of the Effects of Coupling of the TI Field with Matter, Gravity and the Static Field

Coupling	Effects
Coupling M between the TI field and matter	• Measurement of weight is unaffected. • Acceleration is inversely proportional to the coupling constant M. • G, the gravitational constant, is inversely proportional to the square of the coupling constant M.
Coupling G between the TI field and gravity	• Weight is proportional to the coupling (gravitational) constant G. • The acceleration of a massive object is proportional to the coupling constant G. • The mass of a massive object is independent of the coupling constant G.
Coupling M_{is} between the TI field and the static field	• The weight of a massive object is independent of the coupling constant M_{is}. • The acceleration of a massive object in response to gravity is inversely proportional to the coupling constant M_{is}. • The mass of a massive object is proportional to the coupling constant M_{is}. • The gravitational constant G is inversely proportional to the square of the coupling constant M_{is}.

Conclusions

1. The velocity of a photon is c relative to the field of space that it is in.
2. This field of space must exist to support the propagation of light. The conjecture calls this field the temporal-inertial (TI) field.
3. The TI field exerts the inertial force on matter particles in proportion with the acceleration of matter particles relative to the field.
4. The TI field participates in three phenomena that implement the gravitational force:
   a. Gravity accelerates particles of the TI field.
   b. The acceleration of the TI field is moderated by the static field. (See item 7.)
   c. The TI field accelerates matter particles.
5. On a large scale the TI field moves in concert with each galaxy.
6. On a finer scale the TI field moves in concert with each gravitational body in the universe.
7. A second field of space, the static field, moderates the acceleration of the TI field in its response to gravity. The static field exerts a reactive force on particles of the TI field proportional with the acceleration of those particles relative to the static field.
8. The gravitational constant is inversely proportional to the square of the coupling between the TI field and mass. This coupling is the mass itself.
9. The gravitational constant is inversely proportional to the square of the coupling between the TI field and the static field.
10. The evaluation of mass is independent of the coupling between the TI field and gravity.
11. The evaluation of mass is proportional to the coupling between the TI and static fields.

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