Chapter 5
GRAVITY AND INERTIA

A.Powerful Insights

The reader may have followed along thus far in the text, seeing how that an aether model can account for special and general relativistic effects without seeing the staggering and simple consequences of this model. If special relativistic effects are observational phenomena only, without an aether, then there is nothing that can be done, for example, about unwanted relative mass increase. Nothing can be done about purely observational phenomena, if there is no physical mechanism that links the phenomena. Relative mass increase means kinetic energy. And kinetic energy means work done upon the object in accelerating it. And work means force times distance. There will be an inertial force accompanying the relative mass increase. If special relativity is just an observational phenomena of rotation in complex space-time, then there is nothing that can be done about inertial forces except to live with them. That means there is a limit to the maneuverability of jet aircraft, for there is a limit to human endurance to G-forces.

But we have seen that there may indeed be a physical explanation of relativistic effects--an aether. The relative mass increase may not come about merely by the relative velocity to some other object in space or even to some distant fixed stars, as in Mach's Principle, but by the relative velocity to the aether--to the intimately local aether at that--not some distant aether. In our aether model, relative mass increase comes about due to the temporary change of the permittivity of space in the transverse direction due to the altered speed of light in that direction. In order to affect the mass of the particle, this speed of light change in the transverse direction has to be in the confines of the local matter wave fields of the particle--within the dimensions of the particle. That means the aether particles must actually penetrate and travel through subatomic particles in order to redefine the speed of light in the internal dimensions of the subatomic particles, which is necessary in order for the subatomic particles to experience relative mass increase.

There is one powerful and simple thought question. What if some means were devised whereby the aether particles were accelerated around a man-made craft, instead of permitted to zing through the craft, as has always before occurred with man-made vehicles. Let the aether particles on the outside be guided around the craft much as air flows around a car or airplane, and let the aether particles within the craft ride with the vehicle at the velocity of the craft, as air does in a car or airplane. What would happen to the relative mass increase then? Well, according to the aether model, relative mass increase only occurs when the aether travels *through* a massive particle, redefining the speed of light *within* the particle. The particle has no way of sensing the speed of the aether some distance away from itself. Therefore, if the aether particles in the craft ride with the vehicle, and the aether particles outside the craft are deflected around the vehicle, then the craft experiences no relative mass increase--regardless of the speed of travel. If there is no relative mass increase, then there is no increase in kinetic energy. If there is no increase in kinetic energy, then there is no work done in accelerating the craft. And if there is no work done in accelerating the craft, then there is no inertial G-force experienced by the occupants upon acceleration and deceleration--regardless of the rate of acceleration. And if there is no

relative mass increase, then there is no speed of light barrier. As long as the aether particles could be accelerated out of the way fast enough to provide passage for the craft, the craft could go at any arbitrarily large speed. (As it turns out, streamline acceleration of the exterior aether particles may be impossible. But reflection of the aether from the surface of the craft to achieve inertialess travel may be possible.) Travel to distant planets in the solar system may take only minutes instead of months and years as at present. And trips to distant solar systems and galaxies would then become humanly feasible. By the way, the clocks would not be slowed in inertia-less craft. The vehicles could operate on standard coordinate time. And there would be no large kinetic energy investment in space travel. The aether model of the universe would liberate man from the confines of this solar system.

While inertia may be a local aether phenomenon, gravitational acceleration may also be a local aether phenomenon. Einstein's equivalence principle is relatively, though not absolutely, true. Except for clock differences, there are no apparent differences between the force of gravity and the inertial force of acceleration. That is because both may be due to changes of aether velocities either in space or in time. We recall that we depended upon the aether being accelerated by gravitational bodies in order to account for general relativistic effects. This means that there would not only be a length contraction in the radial direction near a gravitational body, and a slowing of atomic clocks in a gravitational field, there must also be a relative mass increase for mass in a gravitational field. And we have seen from special relativity that with relative mass increase there is an increase in kinetic energy and an inertial force. Thus we expect an inertia-like force in a gravitational field, due to the acceleration of the aether.

B. Centrifugal Force

Consider the so-called fictitious centrifugal force of inertia in a rotating reference frame. Newton noticed that absolute rotational motion can be detected by a water in a bucket type experiment. General Relativity and even Mach's Principle shed little light on the mechanics of such a phenomenon. Those scientific theories only offer a mathematical description of the phenomena–comparable to kinematics, as opposed to dynamics. But the aether model gives a simple physical, dynamical explanation of the inertial force in a rotating reference frame. In the aether model, there is aether distributed in the space in which the moving frame rotates. The aether is not disturbed by the spin of objects in the frame. The objects plow through the aether (or rather the aether zings through the objects) without the objects deflecting the aether. But the relative aether speed through objects in the rotating frame alters the speed of light in the particles of each object, thus causing relative mass increase depending upon distance from the center of rotation and the angular velocity. At the center of rotation, velocity relative to the aether is zero (in the plane of rotation), and the velocity relative to the aether (in the plane of rotation) increases linearly with distance from the center of rotation. This means there is a gradient of the square of the aether velocity relative to objects in the rotating frame. This we believe is the cause of the inertial centrifugal force felt by objects in a rotating frame of reference.

In centripetal acceleration,

$$a = v^2/r, \text{where } v = \omega r, \text{and } v \gg c.$$

$$a = \omega^2 r.$$

$$v^2 = \omega^2 r^2,$$

$$\nabla(v^2) = 2\omega^2 r.$$

Thus
Now,
so that

$$\text{\textperthousand}\nabla(v^2) = \omega^2 r = a, \text{and } F = ma.$$

Thus

$$F = m\,\text{\textperthousand}\nabla\,v^2$$

Del(v^2) is directed in the direction of increasing r, as is also the felt centrifugal force. We see that gives the correct value for centrifugal force in terms of the velocity and velocity gradient of the aether.

C. Gravitational Acceleration

If an object feels an inertial force because of acceleration relative to the aether, or a gradient of the square of the aether speed (as in centripetal acceleration), then an object in a gravitationally accelerated ether fluid must also feel an inertial force due to the gradient of the square of the aether speed caused by the gravitational acceleration of the aether. We cannot expect an object to differentiate identical aether velocity gradients which are caused by different phenomena.

A body held at rest (in the coordinate frame) in a gravitational field experiences a gravitational force. The aether particles are accelerated in time in their travel in the vertical direction through the object. Yet the object senses no time derivative aether acceleration at any point in the object. There would be, however, an aether velocity gradient through the object. The gradient is a spatial derivative of the field evaluated at a point. Thus the gradient is a value that is a limit as the spatial difference

goes to zero. Thus, to test the aether v^2 gradient in a gravitational field, we can take the approximation of a constant acceleration, such as is common in calculations for gravitation acceleration near the

$$F = -m\,g,$$

surface of the earth. In such calculations, the force is taken to be
where g is approximately a constant.

In the simple gravitational force problem, let us allow the aether velocity at some point P in space and T in time be v (as the aether is accelerated near a gravitational body). Let the acceleration of the aether be -g at that point. At some brief time Δt later, the aether will be at a distance $v\Delta t$ below P. But since the particle is undergoing acceleration, the new velocity will be $v + g\Delta t$ at the new time $T + \Delta t$ and the new position $v\Delta t$ below P. Let us now calculate the value of $\nabla(v^2)$. In order to keep dr

$$\nabla(v^2) = \lim_{\Delta t \to o} \frac{v^2 - (v + g\Delta t)^2}{v\Delta t}$$

$$= \lim_{\Delta t \to o} \frac{-2vg\Delta t - g^2(\Delta t)^2}{v\Delta t} = -2g\,1_r.$$

positive, we subtract the later velocity squared from the earlier velocity squared.

$$F = m(\text{\textperthousand}\nabla(v^2)).$$

Let us use the same aether force equation we derived in the last section for centripetal force, namely:

$$F = m(\text{\textperthousand}\nabla(v^2)) = m(\text{\textperthousand}(-2g\,1_r))$$

$$= -mg\,1_r,$$

For an object in a gravitational field the (inertial) force felt is
which is the value we expected.

We can look at the gravitational aether velocity gradient and the associated felt gravitational (inertial) force another way. In Chapter 4 we learned that each point in a gravitational field has an escape velocity associated with it, namely

$$v_e = \left(\frac{2GM}{r}\right)^{1/2}.$$

It is the change from point to point in space around the gravitational field source of this escape velocity (the inward velocity of the aether particles) that in our ether model causes a felt gravitational (inertial) force by an observer in that gravitational field. Let us now take the gradient of the square of

$$\nabla(v_e^2) = \nabla\left(\frac{2GM}{r}\right) = 2GM(-1\,r^{-2})1_r = -\frac{2GM}{r^2}1_r.$$

that escape velocity as above:

$$F = m(‰\nabla(v^2)).$$

Let us now apply the aether inertial force formula we first derived for centripetal force:

$$F = m(‰\nabla(v_e^2)) = ‰m\left(-\frac{2GM}{r^2}\right)1_r$$

$$= -\frac{GMm}{r^2}1_r,$$

Applying Eqn. (5-13) to our current problem we obtain
where the final expression in the above equation is the familiar Classical formula for the gravitational force valid in all non-relativistic cases (weak gravitational fields or velocities « c, which is the same thing).

   Notice that our equation of the inertial force gives the expected value of the gravitational force. We must conclude that the gravitational force itself is an inertial force mediated only by the aether, and has no direct action-at-a-distance force complementing it. A gravitational body may accelerate the aether, and the aether then accelerates the objects in a gravitational field. The mechanics of this aether particle acceleration may be simple. Each massive body is accelerated by an aether velocity gradient (or rather gradient of v^2) of the aether particles it feels across its particles. But aether particles such as gravitons are in this model themselves non-zero massive particles. They may simply obey the inertial law that every other massive particles do, and be accelerated by the aether velocity gradient of the aether particles that go through or near them. The geometry is such that such aether accelerations toward a massive particle or group of particles are perpetually self sustaining as long as, and in the proportion that, the aether particles closest to the massive source are accelerated.

D. Ordinary Acceleration

In the simple case of linear acceleration of an object relative to a zero gradient aether velocity field,

$$F = m\frac{d\mathbf{v}}{dt}.$$

we would have

This is just as we would expect from Classical physics. In Classical physics the applied force equals F = ma, and the inertial force is F = - ma, when the acceleration is calculated relative to the rest frame. But in our equation, we are calculating the aether velocity relative to the observer, so the inertial relation bears the positive sign.

E. Formal Aether Model Expression for Gravitational and Inertial Force

Equation (5-15) is different than Eqn. (5-13), yet the two equations are not contradictory. One contains a spatial derivative of aether velocity, and the other contains a time derivative of aether velocity. We may now combine these two equations to obtain a unification of gravity and inertia in

$$F = m\left[\frac{d\mathbf{v}}{dt} + \text{‰}\nabla(v^2)\right].$$

nonrelativistic conditions.
This equation holds for subrelativistic aether velocities (v « c) and weak gravitational fields (which are the same thing). The v in this equation is not the velocity of an object relative to the rest frame of the aether. It is just the reverse--the aether velocity relative to the observer. Also, accordingly, the force **F** is not the force applied to accelerate the object, but the reverse, the inertial force felt by the object. The equation gives the inertial or gravitational force felt by an observer in a changing velocity field of the aether particles.

F. Vertical Free Fall

Before we move on to more important things, let us give a couple of more simple tests to Eqn. (5-16). Let us consider first the case of a vertical free fall of an object in a gravitational field. In this case neither the term $(d\mathbf{v}/dt)$ nor $(\tfrac{1}{2}\nabla(v^2))$ individually vanish. But they add to zero.

First, let us calculate the term $(d\mathbf{v}/dt)$. The whole object travels at the velocity of the center point P. At T = 0 the point P is at elevation r = R. We set the object at rest at time T = 0 in the coordinate frame. Thus its velocity at time zero in the coordinate frame is v = 0. The aether velocity in the

$$V = -\left(\frac{2GM}{R}\right)^{1/2}.$$

coordinate frame at point P at time T = 0 is

$$u = V - v = -\left(\frac{2GM}{R}\right)^{1/2}.$$

The aether velocity relative to the point P in the object, at time T = 0 is

$$r \approx R - \%oa(\Delta t\ )^2,\ where\ a = -\frac{GM}{r^2},$$

At time T' = 0 + Δt, the point P in the object has fallen to a point

$$F = -\frac{GMm}{r^2}1_r = ma.$$

as can be seen by

$$v' \approx -\frac{GM}{R^2}\Delta t,$$

The new v' at T' = Δt is

$$V' = -\left(\frac{2GM}{R - \%o\dfrac{GM}{R^2}(\Delta t\ )^2}\right)^{1/2}.$$

whereas the new coordinate aether velocity
The new aether velocity relative to the point P is

$$u' \approx - \left(\frac{2GM}{R - \text{‰} \frac{GM}{R^2}(\Delta t)^2} \right)^{1/2} + \frac{GM}{R^2} \Delta t.$$

$$\frac{d\text{u}}{dt} = \lim_{\Delta t \to o} \frac{u' - u}{\Delta t}$$

$$\approx \lim_{\Delta t \to o} \frac{- \left(\frac{2GM}{R - \text{‰} \frac{GM}{R}(\Delta t)^2} \right)^{1/2} + \frac{GM}{R^2} \Delta t + \left(\frac{2GM}{R} \right)^{1/2}}{\Delta t} 1_r$$

Now let us take the time derivative of the relative aether velocity vector.

$$\approx \lim_{\Delta t \to o} \frac{\left[\left(\frac{2GM}{R} \right)^{1/2} - \left(\frac{2GM}{R} \right)^{1/2} \right]}{\Delta t} 1_r + \frac{GM}{R^2} 1_r$$

$$= \lim_{\Delta t \to o} \frac{0}{\Delta t} 1_r + \frac{GM}{R^2} 1_r$$

$$= \frac{GM}{R^2} 1_r.$$

Now let us calculate the gradient of v^2. At time zero, the position of point P in the object is at location r = R. At that position the aether velocity relative to the coordinate frame is

$$V = -\left(\frac{2GM}{R}\right)^{1/2} 1_r ;$$

and we let the object velocity be v relative to the coordinate frame. At point P, at the fixed point in

$$u = -\left(\frac{2GM}{R}\right)^{1/2} - v.$$

time, the net aether velocity relative to the object at point P is

$$u^2 = \frac{2GM}{R} + 2v\left(\frac{2GM}{R}\right)^{1/2} + v^2.$$

$$\nabla(u^2) = \lim_{\Delta r \to o} \frac{\left(\dfrac{2GM}{R} + 2v\left(\dfrac{2GM}{R}\right)^{1/2} + v^2\right)}{\Delta r} 1_r -$$

$$\lim_{\Delta r \to o} \frac{\left(\dfrac{2GM}{R - \Delta r} + 2v\left(\dfrac{2GM}{R - \Delta r}\right)^{1/2} + v^2\right)}{\Delta r} 1_r$$

$$= \lim_{\Delta r \to o} \frac{\left(\dfrac{2GM}{R} - \dfrac{2GM}{R - \Delta r}\right)}{\Delta r} 1_r +$$

We now take the gradient of u².

$$\lim_{\Delta r \to o} \frac{\left(2v\left[\dfrac{2GM}{R}\right]^{1/2} - 2v\left[\dfrac{2GM}{r-\Delta r}\right]^{1/2}\right)}{\Delta r} 1_r$$

$$= \lim_{\Delta r \to o} \frac{2GM(R-\Delta r) - 2GMR}{R(R-\Delta r)\Delta r} 1_r +$$

$$\lim_{\Delta r \to o} 2v\sqrt{\frac{2GM}{R}}\left(1 - \sqrt{\frac{1}{1-\dfrac{\Delta r}{R}}}\right) 1_r$$

$$= \lim_{\Delta r \to o} \frac{-2GM\Delta r}{R(R-\Delta r)\Delta r} 1_r + 0\,1_r$$

$$= \lim_{\Delta r \to o} \frac{-2GM}{R(R-\Delta r)} 1_r = \frac{-2GM}{R^2} 1_r.$$

We now combine the results we obtained for the time derivative of the relative aether velocity vector and the gradient of the aether velocity squared, by Eqn. (5-16), to obtain the felt inertial force

$$F = m\left[\frac{du}{dt} + \text{‰}\nabla(u^2)\right] = m\left[\frac{GM}{R^2}1_r + \text{‰}\left(\frac{-2GM}{R^2}1_r\right)\right]$$

upon a vertically falling object in a gravitational field. The result is

$$= 0.$$

The inertial force vanishes in the case of a free falling object falling in the vertical direction in a gravitational field.

G. Orbital Fall

Now let us try the case of the free falling object in a circular orbit about a gravitational body. In this case (if we consider the object making one rotation every orbit), the time derivative of the relative ether velocity vector vanishes. The gradient of v^2 also vanishes, but for an unusual reason. As we

learned in the section "Evidence of Aether Drift Across Planets," Chapter 4, Section G., the square of the inward accelerated aether velocity is twice the square of the lateral orbital aether velocity. Thus the true relative aether velocity to an orbiting satellite is the vector sum of two velocity vectors at right angles to each other as in Figure 5-1 below.

In order for the gradient of v^2 to vanish for an orbiting object, the magnitude of v_{net} must remain constant for a small change in the position (in the radial direction) of a point in an object in a fixed circular orbit. If the point P is at distance r = R from the center of the gravitational body, and point Q is at the distance r = R + Δr in the same orbiting object along the same radial, then the vertical aether velocity component is less at Q than at P, but the horizontal velocity component is more at Q than at P because the angular velocity is the same for both P and Q, and Q is farther from the origin than P. In

$$(v_e + dv_e)^2 + (v_\ell + dv_\ell)^2 = v_e^2 + v_\ell^2.$$

order for the gradient of v^2 to vanish for this case, the following relation must hold true:

$$2 v_e dv_e + (dv_e)^2 + 2 v_\ell dv_\ell + (dv_\ell)^2 = 0$$

Thus the following equation must also hold true:
We can neglect the squares of the differentials and divide the equation by 2. We see that in order for

$$v_e dv_e = - v_\ell dv_\ell.$$

the gradient of v^2 to vanish for this case, the following relation must hold true:

$$v_e = \sqrt{2GM} \ r^{-1/2}.$$

$$dv_e = - ‰ \sqrt{2GM} \ r^{-3/2} dr.$$

At point P, the inward aether velocity component is

$$v_\ell = \sqrt{GM} \ r^{-1/2}.$$

The differential dv_l cannot be calculated directly like dv_e, because the point Q is not orbiting independently of the point P, but is rigidly bound to point P and orbits at the angular velocity at which point P orbits. We find dv_l by the following method:

122

$$v_\ell + dv_\ell = \frac{v_\ell (r + dr)}{r},$$

$$dv_\ell = \frac{v_\ell (r + dr)}{r} - v_\ell = v_\ell \frac{dr}{r} =$$

$$\sqrt{GM} \; r^{-1/2} \frac{dr}{r} = \sqrt{GM} \; r^{-3/2} \; dr.$$

$$v_e \, dv_e - v_\ell \, dv_\ell.$$

$$\sqrt{2GM} \; r^{-1/2} \, (\text{-\textperthousand} \sqrt{2GM} \; r^{-3/2} \, dr) -$$

$$- \sqrt{GM} \; r^{-1/2} \, (\sqrt{GM} \; r^{-3/2} \, dr).$$

$$- \frac{GM}{r^2} \, dr \equiv - \frac{GM}{r^2} \, dr,$$

$$F = m \left[\frac{dv}{dt} + \text{\textperthousand} \nabla (v^2) \right],$$

Now we inquire,
and the point is proved. The length of the aether velocity vector remains unchanged with change in radial position in an orbiting object in a circular orbit around a gravitational body, though the direction of the aether velocity vector changes. Thus grad v^2 vanishes, and since the time derivative of the aether velocity vector also vanishes, the inertial force vanishes in a free falling body in a circular orbit about a gravitational body. The equation of inertia
where **v** is the aether velocity relative to the observer, appears to hold true for all cases for subrelativistic mechanics.

H. Relativistic Aether Model Force Equation for Gravity and Inertia

It is now desirous that we should expand and refine our synthesis of gravitational and inertial force to apply to all velocities and velocity gradients of the aether particles relative to the observer. In equation (5-48) we recognize the first term as the time derivative of the nonrelativistic momentum. In relativity the mass as well as the velocity can vary in the momentum. So we generalize this term as the time derivative of the three vector relativistic momentum. The second term in equation (5-48) is the three vector spatial gradient of the kinetic energy (for nonrelativistic velocities, but we can generalize to the relativistic kinetic energy). But the kinetic energy is the t component of the four-vector momentum

$$F = [\frac{\partial}{\partial t} P_3 + \nabla P_t].$$

P_4. We can therefore translate equation (5-48) into the following valid at all velocities:

I. Summary and Forward Look

In the next chapters we will be able to continue our study of gravity and inertia and the other forces. We will study their effects in the smallest structures of matter--electrinos and echons. In the author's model, electrinos are the smallest particles in the Universe, and echons are the lowest level orbital structures made out of electrinos. We will find how gravity and inertia are united to the other forces.

We derived also in this chapter two important results which will be useful in future work.

$$F = m\left[\frac{dv}{dt} + \text{‰}\nabla(v^2)\right] \text{ where } v \gg c.$$

$$F = [\frac{\partial}{\partial t} P_3 + \nabla P_t].$$

Important Derived Results

Problem Set 5

1. In the aether model, what is responsible for relative mass increase?

2. What would happen if aether exterior to a craft were kept exterior to the craft and aether interior to the craft were kept interior to the craft as the craft accelerated?

3. Give a reason why centripetal force should not be considered a "fictitious" force in the aether model.

4. Give an evidence that gravity is an inertial force mediated only by the aether, and has no direct action-at-a-distance force complementing it.

5. What could accelerate aether particles if a gradient of aether velocity squared accelerates other massive particles?

6. What formulas in this chapter especially unite gravity and inertia?

7. In terms of Eq. (5-16), why is the felt inertial force on a vertical free-falling object 0?

8. In terms of Eq. (5-16), why is the felt inertial force on a circularly orbiting object 0?