CHAPTER EIGHT

ECE COSMOLOGY.

8.1. INTRODUCTION

Astronomy is one of the oldest of the sciences and has become a precise subject area. Cosmology began to develop as a subject when the observations of the orbit of Mars by Tycho Brahe were analyzed by Johannes Kepler to give three planetary laws reduced by Newton to universal gravitation and the equivalence of gravitational and inertial mass. The famous Newtonian dynamics were developed to include rotational motions in non inertial frames by Euler, Bernoulli, Coriolis and others, and Laplace developed his elegant celestial mechanics. Lagrange developed the subject of dynamics from a different perspective, and using more general concepts which were taken up by Hamilton to produce the Hamilton equations and the idea of the Hamiltonian. The latter became the basis of quantum mechanics. Orbital theory can be developed elegantly with the idea of the Lagrangian and the Euler Lagrange equations. For example, conservation of angular momentum and the Euler Lagrange equations can be used to show that if the orbit of a mass m around a mass M is observed to be an ellipse, then the force between m and M is inversely proportional to the square of the distance r between m and M - the famous inverse square law as inferred by Newton. The same method also gives the three Kepler laws of planetary motion. However the Lagrangian method is more general than that of Newton because it can give the force law for any orbit.

In the eighteenth and early nineteenth centuries the orbits of all masses m around a mass M were thought to be ellipses to an excellent approximation, with M at one focus of the ellipse, so the subject was thought to be complete, and m travelled on the ellipse. The orbits of planets could be observed with precision, and objects such as galaxies were unknown. So the famous Newtonian concept of universal gravitation was thought to be as near to perfection as human intellect could devise. Newtonian dynamics worked for astronomy and also back on the ground. The apocryphal apple was governed by the acceleration due to gravity g of the earth. The apple and the moon were governed by the same law, universal gravitation.

The gods however are offended by human pretence to perfection, the orbit of a planet precesses, a point of the ellipse such as its perihelion moves forward a little every orbit. In the Newtonian dynamics the elliptical orbit does not move forward if one considers only m and M and the force between them. From precise astronomical observations of orbits by ancient astronomers the precession of the perihelion had been known well before Newton's time. In Newton's time, the seventeenth century, it was thought to be caused by the gravitational pull of other planets. It is a very tiny effect so was not thought to be due to any flaw in Newton's universal gravitation. When the human intellect contrives something that it thinks to be perfect, no data are allowed to stand in the way, and it is human nature to hang on to a theory even though the data show that the theory is not quite right. Sometimes the theory is totally wrong and always gave an illusion of the truth. The precession of planetary orbits can indeed be explained to a large extent by Newtonian concepts, but there seems to be a tiny part of the precession that cannot be explained.

Following the Michelson Morley experiment the entire subject of dynamics was changed and the concept of special relativity introduced as described in chapter one of this book. The Newtonian and Lagrangian dynamics were recovered as limits of special relativity. However, special relativity is restricted to the Lorentz transform and a constant inter frame velocity. In order to consider acceleration and similar effects a new relativity was needed. Another profound change in thought occurred when Einstein and others decided to base dynamics on geometry. This was also Kepler's idea, and went back to the ancient Greeks, who thought of geometry as beauty itself, or perfect beauty. Effectively this means that the

Lorentz transform becomes the general coordinate transform. It is not in any way clear to the human intuition that space should become part of time, that the familiar three dimensions should be abandoned, and that the familiar concepts of Euclid should be replaced by a different geometry. The very idea of a different geometry had been considered only by a few mathematicians up to about 1905.

Among the first to consider such as geometry was Riemann in the early nineteenth century, followed in the eighteen sixties by Christoffel. These two prominent mathematicians devised the concept of metric and connection. The metric is a symmetric object by definition, but the connection has no particular symmetry in the lower two of its three indices. About forty years later Ricci and Levi Civita devised the concept of curvature of space of any dimension, including four dimensional spacetime, that of special relativity. In physics concomitant progress was being made by Noether, who linked the conservation laws of physics to symmetry laws. The subject of physics introduced the canonical energy momentum tensor, which is also symmetric in its indices. In mathematics, in about 1900, Levi-Civita defined the Christoffel connection as being symmetric. This was an axiom, or hypothesis, not a rigorous proof. In 1900 it was not known that there existed a fundamental property of any mathematical space in any dimension, the torsion.

In 1902 Bianchi inferred an identity in which a well defined cyclic sum of curvature tensors vanishes. This is known as the first Bianchi identity, from which the second Bianchi identity can be inferred. The two Bianchi identities were also inferred in ignorance of the existence of torsion, and using a symmetric connection. The ingredients available to Einstein from 1905 to 1915 were therefore the second Bianchi identity and the Noether Theorem, thought to be fundamental principles of geometry and physics. Proceeding on the ancient basis that geometry gives physics, Einstein attempted for a decade to arrive at a field equation linking the two concepts. This was finally published in 1915 and asserts that the second Bianchi identity is proportional to the covariant derivative of the canonical energy momentum tensor. With the benefit of hindsight this is an over complicated procedure. By Ockham's Razor a simpler theory is preferred, and that theory is ECE theory. In addition the Einstein field equation was arrived at in ignorance of torsion. So it was bound to fail qualitatively, and has indeed done so. The velocity curve of a whirlpool galaxy shows that the Einstein theory is incorrect qualitatively, or completely. The proof of this is given later in this chapter.

At first the field equation of Einstein seemed to be logical, but on closer inspection it contains an assumption made a priori, i.e. guesswork. This is the assumption of the symmetric connection made by Levi-Civita fifteen years before the field equation appeared. The second Bianchi identity used by Einstein relies on a symmetric connection, so is true if and only if the torsion is zero. This was of course unknown to Einstein and also unknown to Levi-Civita and Ricci. The procedure used in deriving the Einstein field equation is to reduce the second Bianchi identity to the covariant derivative of the Einstein tensor, which is symmetric in its lower two indices, and which is made up of a combination of the Ricci tensor and the Ricci scalar. Unknown to Einstein and all his contemporaries this procedure is true if and only if the torsion is zero. If the torsion is finite it fails completely as explained in UFT88 on www.aias.us .

The field equation was criticized immediately and severely by Schwarzschild in a letter to Einstein of December 1915 as explained earlier in this book. Apart from the assumption of a symmetric connection, there are other flaws in the attempted first solution of the field equation by Einstein. Schwarzschild solved the equation using a metric which does not contain a singularity. So it was known as early as 1915 that there are no black holes and big bang, concepts which were ridiculed by Einstein and Hoyle independently. The cold truth is that these concepts are just mathematical flaws. Experimental data have shown many times over that there was no big bang, and black holes have never been discovered. They are simply asserted to exist by dogmatists. The confusion was greatly compounded by the introduction of a metric that was attributed falsely to Schwarzschild. This metric contains singularities or infinities, so by definition should be rejected as a valid solution of the Einstein field equation. The Schwarzschild metrics, true (1915), and false, fail completely in whirlpool galaxies. This fact has been known for sixty years. A plethora of such metrics have been inferred in a century of work on the Einstein field equation but all fail completely in view of the failure of the field equation in whirlpool galaxies and in view of the fact that they all neglect torsion (M. W. Evans, S. J. Crothers, H. Eckardt and K. Pendergast, "Criticisms of the Einstein Field Equation" referred to in chapter one).

The existence of torsion is a fundamental building block of ECE theory, which set out in 2003 to rebuild general relativity using a rigorously correct geometry, one which does not contain guesswork. So it is essential to prove that torsion cannot be discarded in any valid geometry. In the Cartan geometry used in ECE theory the torsion is defined by the first Maurer Cartan structure equation, inferred in the twenties. This procedure has been explained earlier in this book and the basis of ECE cosmology and unified field theory is that torsion and curvature are identically non zero in any valid geometry. The reason is that they are both generated by the commutator of covariant derivatives acting on any tensor in any space of any dimension. They are always produced simultaneously, and the commutator always produces the two structure equations of Cartan simultaneously. The commutator always produces the torsion tensor as the difference of two anti symmetric connections, so the anti symmetry of the connection is the anti symmetry of the commutator.

A symmetric connection produces a symmetric commutator which vanishes, and a symmetric connection means that the torsion vanishes. This means that the curvature vanishes if the torsion vanishes because torsion and curvature are always produced simultaneously by the commutator. A null commutator means both a null torsion and null curvature, so a symmetric connection means a null torsion AND a null curvature.

The incorrect procedure used by the Einsteinian general relativity is to omit the torsion tensor, and to assume that the commutator produces only the curvature. This is mathematical nonsense that has become dogma. The fact that the torsion always exists means that the first and second Bianchi identities are changed completely in structure. The first Bianchi identity becomes the Cartan identity and the second Bianchi identity becomes the equation given in chapter one. These mathematical flaws are obvious in retrospect, and were compounded greatly through the illusion of accuracy of the Einstein theory in the solar system. In chapter 8.2 the correct explanation for light deflection by gravitation is given in terms of the spin connection of ECE theory, which is also capable of giving a satisfactory explanation of the velocity curve of a whirlpool galaxy. Currently both the ECE and the Einsteinian theories are influential in science, but obvious and drastic flaws in geometry cannot remain indefinitely without being remedied. The fundamental aim of ECE theory is to improve on the ideas used by Einstein and his contemporaries, ideas which go back to Kepler and to ancient times.

8.2 ECE THEORY OF LIGHT DEFLECTION DUE TO GRAVITATION.

Consider as in UFT 215 the linear orbital velocity in cylindrical polar coordinates (r , θ):

$$\underline{v} = \dot{r}\,\underline{e}_r + r\dot{\theta}\,\underline{e}_\theta \qquad -(1)$$

where $\underline{e}_r$ and $\underline{e}_\theta$ are the unit vectors of the cylindrical polar system. The velocity squared is:

$$v^2 = \dot{r}^2 + r^2\dot{\theta}^2 \qquad -(2)$$

The precession of an elliptical orbit can be described by the equation:

$$r = \frac{\alpha}{1+\epsilon\cos(x\theta)} \quad -(3)$$

when x is much less than unity. In this equation, α is the half right latitude and ϵ is the eccentricity. When x becomes large, some very interesting mathematical results are obtained, the subject area of precessing conical sections which show fractal behaviour as described and illustrated in the UFT papers on www.aias.us. However in astronomy the factor x is close to unity for all types of precessing orbits, in the solar system and in binary systems which exhibit the largest precessions. When x is exactly one, the subject of conical sections is recovered, for example static ellipse, the static hyperbola and so on.

Elementary kinematics of plane polar coordinates produce the acceleration:

$$\underline{a} = (\ddot{r} - r\dot{\theta}^2)\underline{e}_r + (r\ddot{\theta} + 2\dot{r}\dot{\theta})\underline{e}_\theta \quad -(4)$$

This is a well known general result described in several UFT papers. From the equation (3) of precessing conical sections

$$\frac{dr}{d\theta} = \frac{x\epsilon}{\alpha} r^2 \sin(x\theta). \quad -(5)$$

From lagrangian dynamics the conserved orbital angular momentum is well known to be:

$$L = mr^2\dot{\theta} = mr^2\frac{d\theta}{dt}. \quad -(6)$$

Therefore:

$$\dot{r} = \frac{dr}{dt} = \frac{dr}{d\theta}\frac{d\theta}{dt} = \frac{xL\epsilon}{m\alpha}\sin(x\theta) \quad -(7)$$

and from Eq. (6):

$$\dot{\theta} = \frac{L}{mr^2}. \quad -(8)$$

The second derivatives are:

$$\ddot{r} = \frac{x^2 L^2 \epsilon}{m^2 \alpha r^2} \cos(x\theta) \quad -(9)$$

and:

$$\ddot{\theta} = -\frac{2L^2 x \epsilon}{m^2 r^3 \alpha} \sin(x\theta) \quad -(10)$$

and the angular dependent part of the acceleration vanishes:

$$r\ddot{\theta} + 2\dot{r}\dot{\theta} = 0. \quad -(11)$$

The radial part is given by:

$$\ddot{r} - r\dot{\theta}^2 = \frac{x^2 L^2 \epsilon}{m^2 \alpha r^2} \cos(x\theta) - \frac{L^2}{m^2 r^3}. \quad -(12)$$

From Eq. (3):

$$\cos(x\theta) = \frac{1}{\epsilon}\left(\frac{\alpha}{r} - 1\right) \quad -(13)$$

and the acceleration of an object in orbit is:

$$\underline{a} = \left(\frac{L}{m}\right)^2 \left(\frac{(x^2 - 1)}{r^3} - \frac{x^2}{\alpha r^2}\right) \underline{e}_r. \quad -(14)$$

The force is defined conventionally as:

$$\underline{F} = m\underline{a} \quad -(15)$$

If there is no precession then:

$$x = 1 \quad - (16)$$

and the force law reduces to the inverse square law:

$$\underline{F} = -\frac{L^2}{m\alpha r^2}\,\underline{e}_r . \quad -(17)$$

This is the Newtonian inverse square law if:

$$\alpha = \frac{L^2}{m^2 M G} . \quad -(18)$$

The same force law is obtained elegantly from Lagrangian dynamics, which gives the following equation for any orbit:

$$\frac{d^2}{d\theta^2}\left(\frac{1}{r}\right) + \frac{1}{r} = -\frac{m r^2}{L} F(r) . \quad -(19)$$

From Eqs. (3) and (19):

$$F(r) = \frac{L^2}{m}\left(\frac{(x^2-1)}{r^3} - \frac{x^2}{\alpha r^2}\right) \quad -(20)$$

which is the same as Eq. (14).

The square of the orbital velocity can therefore be expressed as:

$$v^2 = \left(\frac{L}{m\alpha}\right)^2\left[\frac{2x^2\alpha}{r} - x^2(1-\epsilon^2) + \frac{\alpha^2}{r^2}(1-x^2)\right] \quad -(21)$$

and when

$$x = 1 \quad - (22)$$

the Keplerian equation for orbital linear velocity is obtained:

$$v^2 \xrightarrow[x=1]{} \left(\frac{L}{m\alpha}\right)^2 \left[\frac{2\alpha}{r} - \left(1-\epsilon^2\right)\right] \qquad -(23)$$

thus checking that the theory is correct and self consistent. At the distance R_0 of closest approach of m to M in an orbit:

$$R_0 = \frac{\alpha}{1+\epsilon} \qquad -(24)$$

so Eq. (21) becomes:

$$v^2 = \frac{L^2}{m^2 R_0}\left[\frac{x^2}{\alpha}\left(1+\epsilon\right) - \frac{\left(x^2-1\right)}{R_0}\right] \qquad -(25)$$

and solving for the eccentricity ϵ gives:

$$\epsilon = \frac{m^2 \alpha R_0}{x^2 L^2}\left(v^2 - \frac{L^2}{m^2}\left(\frac{x^2-1}{R_0}\right)\right) - 1 \qquad -(26)$$

This equation can be used in the problem of determining the angle of deflection of a hyperbolic orbit of m around M.

The total deflection for a hyperbola, as in UFT 216, is 2ϕ :

$$\Delta\phi = 2\phi = 2\sin^{-1}\frac{1}{\epsilon} \qquad -(27)$$

where

$$\phi = \tan^{-1}\frac{a}{b} \qquad -(28)$$

where a and b are the major and minor semi axes. Therefore:

$$\Delta\phi = 2\sin^{-1}\frac{1}{\epsilon} = 2\tan^{-1}\frac{a}{b} \quad -(29)$$

where the eccentricity is defined by:

$$\epsilon = \left(1 + \frac{b^2}{a^2}\right)^{1/2} . \quad -(30)$$

The half right latitude is defined by:

$$\alpha = \frac{b^2}{a} . \quad -(31)$$

At the distance of closest approach of m to M in a hyperbolic orbit:

$$R_0 = \frac{\alpha}{1+\epsilon} \quad -(32)$$

so:

$$\cos(x\theta) = 1 \quad -(33)$$

as in Eq. (24).

For very small angles of deflection such as that observed in the deflection of light from a distant source by the sun:

$$\sin\phi \sim \phi = \frac{1}{\epsilon} = \left[\frac{m^2\alpha R_0}{x^2 L^2}\left(v^2 - \frac{L^2}{m^2}\left(\frac{x^2-1}{R_0^2}\right)\right) - 1\right]^{-1} \quad -(34)$$

If v could be measured experimentally, m can be found. For light v is very close to c and m is the mass of the photon. Theoretically, photon mass can be obtained in this way. In the Newtonian limit:

$$x = 1 \quad -(35)$$

and

$$\sin\phi \sim \phi = \frac{1}{\epsilon} = \left[\frac{m^2 \alpha R_0 v^2}{L^2} - 1\right]^{-1} \quad -(36)$$

in which the Newtonian half right latitude is:

$$\alpha = \frac{L^2}{m^2 M G}. \quad -(37)$$

So the well known Newtonian theory of the orbital deflection is recovered:

$$\sin\phi \sim \phi = \frac{1}{\epsilon} = \left(\frac{R_0 v^2}{MG} - 1\right)^{-1}. \quad -(38)$$

Note that m cancels out of the calculation in the Newtonian limit, but does not cancel in the rigorous equation (34). If the photon velocity is assumed to be c for all practical purposes, i.e. to be very close to c, then

$$\Delta\phi = 2\phi = \frac{2MG}{R_0 c^2} \quad -(39)$$

to an excellent approximation. This is the famous Newtonian value for light deflection by gravitation.

The experimentally observed value is always:

$$\Delta\phi = 2\phi = \frac{4MG}{R_0 c^2} \quad -(40)$$

to high precision, for electromagnetic radiation grazing any object of mass M. This is twice the Newtonian value.

The reason for this famous result cannot be found in the deeply flawed Einsteinian theory, but a straightforward explanation can be found using the principles of this book.