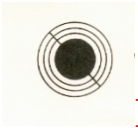
Part XIII

Gravitons and A Centered Linear Equation of State

(Page posted July31, 2021)

Summary

The missing "gravitons", or quantum particles of gravitation that support gravitational force, may now have been found. The new candidate graviton emerges from the linear, **centred**, Equation of State (p = ± v). This basic equation generates stable, quantised waves of both compression and rarefaction. Most importantly, it interacts **universally** with all other cosmic state equations i.e. with visible matter, dark matter and E/M states. Some relevant further questions are tabulated.



Introduction

The proper scientific characterisation of the force of universal gravitation is a subtle and difficult task. It has been done in several ways with more or less success. For example, one can use the "field" concept, say a force field, or again one can introduce a "space-time continuum" with tensor deformation properties to derive a force. In all cases today, the results must encompass the major quantitative successes of Newton, Kepler, and Einstein.

For many years this site (*www.energycompressibility.info*) has been introducing thermodynamic Equations of State to fit the known physical cosmic states, and then applying the principles of compressible fluid flow and gas dynamics to problems in quantum physics and physical cosmology. This has been done, for example, to explain the origin of the elementary particles of visible matter as arising at the Big Bang from compression shockwaves in a **hyperbolic** equation of state [1, 2, 9, 10].

The compressibility approach has been extended by the subsequent introduction of two additional equations of state, e**lliptical for the dark matter and linear, non-centred for electromagnetism and photonic radiation**. It has provided explanations for the origin, nature and interactions of the dark matter. More recently, the possibility of visible-to-dark matter transformations has emerged [9,10,11] as evidenced by the formation of dark matter "halos" in galaxies with the emission of microwave radiation MW into the cosmic microwave background CMB. Electromagnetism and its force quantum, the photon, have been fitted to the linear equation of state (p = Av + B) i.e. to the "/tangent gas" (8,9,10)).

There remains the problem of universal gravitation. We shall not attempt a full or complete theory. Rather, we shall present and explore only some of the main requirements for gravitation that are met by this c**entred**, **linear** equation of state.

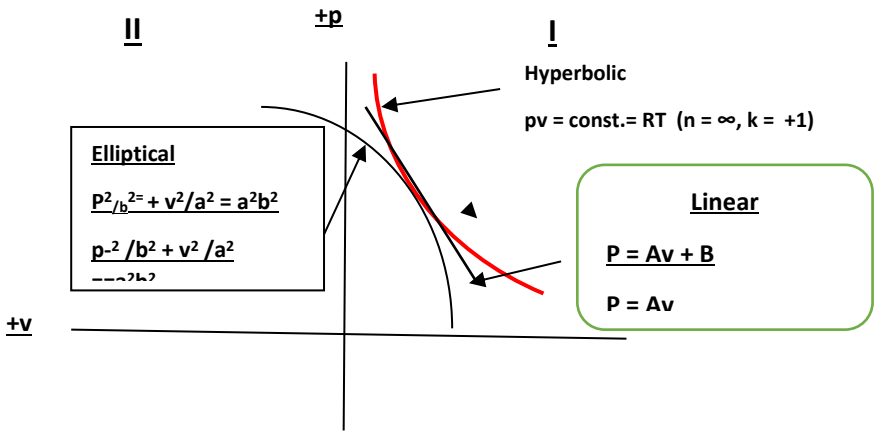
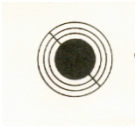


Fig. 1: Three Equations State in Quadrant 1 at a Tangent Point: Hyperbolic for Visible Matter, Elliptical for the Dark Matter, Linear for compressive Electromagnetic Photons



The Centred, Linear Equation of State and the Graviton

We now extend our examination of the linear case to show that the centred, linear Equation of State is a Universal, Quantum field which yields a quantum gravity. The state is depicted in Figure 2. It is seen as extending into all four Quadrants and so is uniquely capable of intersecting all other States, visible, dark and E/M, that is, it is the unique universal field.

As will be shown below the linear field is intrinsically quantised.

The centred, linear, Equation of State thus describes a Universal, Quantum Wave Field; we further propose that its fundamental quantum particle is the desired quantum of gravity or **Graviton**

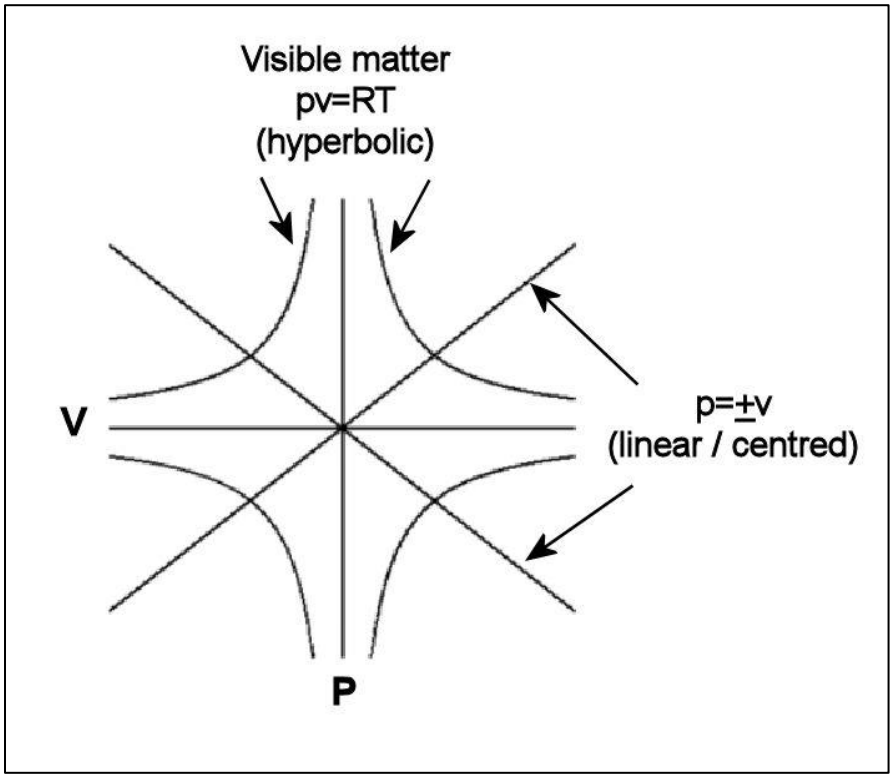
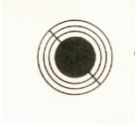


Figure 2. The Universal, Centred, Linear, State which uniquely and universally intersects with the hyperbolic visible matter states in Quadrant 1; (Note: the intersections with tbe elliptical and the tangent, linear states (Fig. 1) are similarly depictable).



The Graviton

An essential requirement is that the desired gravitational theory **must apply universally.** (Fig. 2)

Since the photon and graviton are here ascribed to two different forms of the same linear equation of state – one tangent and the other centred - we shall list and contrast their qualities and attributes together.

1. **Waves:** Both linear forms support stable waves of either compression or rarefaction. In addition, since the centered linear form is transverse to the

tangential form, Maxwell's transverse waves should arise automatically for both the photon and the graviton. The photon is a compression quantum particle, the graviton is a rarefaction quantum particle.

2. **Quantisation:** Both linear fields, photon and graviton, are intrinsically quantised as follows.

The wave speed c is given in the energy equation: $c^2 = k\, p/\rho$, where c is the phase wave speed, k is the adiabatic exponent [$k = C_p/C_v$, the ratio of specific heats). Here $k = (n+2) / n = (-1 +2)/ -1 = +1/-1 = -1$.

Going back to the energy equation and inserting this negative value for k, we have: $c^2 = k\,(p/\rho)$; so

$c = \sqrt{-1}\,(p//\rho)^{1/2} = \boldsymbol{i}\,(p//\rho)^{1/2}$ **which is complex and quantised.**

3. Force: The photon is the carrier or messenger particle for the E/M force. Symmetrically then, the graviton is the carrier of the gravitational force.

The **exclusively attractive** nature of this force is possibly explainable from parallel and anti-parallel spin considerations, but the matter is left for specialists in quantum spin physics.

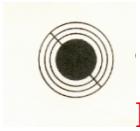
4. Quantum Spin:

For the photon, the number of degrees of energy freedom n is +3, and so $S = (n – 1)/2 = (3 – 1)/2 = 2/2 = 1$.

For the graviton, taking n equal to -3 we have Spin $S = (-3 -1)/2 = -4/2 = -2$, which agrees (in magnitude) with a requirement of general relativity for a spin 2 graviton.

5. Universality: The centred linear state assigned to the graviton is uniquely universal in that it alone interacts with all other states in all four Quadrants.

Our graviton candidate is thus the centred, linear wave/particle which is quantised, carries gravitational force, is universal and so interacts with all other states, and has Spin -2, matching in magnitude a requirement of general relativity for a Spin 2.



Relevant Further Questions

1. Why and how does the interaction of the graviton state with mass baryon particles produce a **force of attraction**?

2. Detail on the interaction of the graviton with the electromagnetic linear/tangential state?

3. Graviton Spin number derivation?

4. The value of n, the number of energy states or interactors for the graviton?

5. Confirmation of the value of the adiabatic index k = -1 for the graviton?

6. Design of a prediction test for verification/falsification of the proposed graviton candidate?

7. Dark Energy? Vacuum Energy? Cosmological Constant?

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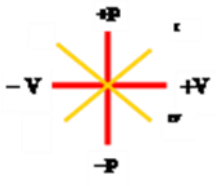
10.---------- *Part XI: Interactions and Transformations (Page posted November, 2020).*

11. ---------- *Part XII: Visible – to – Dark Matter Transformations*. Page posted June 2021.



"What is real is that which can be intelligently grasped and reasonably affirmed"

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Bernard Lonergan, S.J. in

"Insight: A Study of Human Understanding"

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