Part XV

Some Relevant Futher Questions

on

Dark Energy, The Quantum Wave Function

and

Solutions to Two Current Major Problems

Epilogue 1982- 2021

Page posted   2021;Revised and Reposted, June 2022

Contents

 Introduction

For several decades this web site has been exploring and applying thermodynamic equations of state to fundamental problems in physical cosmology. This application of **compressible flow theory** began with the use of the hyperbolic, ideal gas law [pv = RT] to describe expansions and motions in the observable universe. For example, it was used via compressible strong shockwave theory to apply predicted mass ratios of elementary particles of matter to the Big Bang theory and to the Standard Model. This prediction verifies to within one or two percent (1,2,3.).

Then, an answer to the mystery of the nature and origin of the **dark matter** of the cosmos emerged from the elliptical state equation [$p^2/b^2 + v^2/b^2 = a^2b^2$]. which successfully described it as being particulate matter, but, because it was also rarefied, it was invisible or 'dark' (1,2,3,9,10,11,12). (Fig. 1).

The tangent linear equation of state [p = ±Av + B]   yielded **the equations of electromagnetic radiation**. (9).

While the worlds of visible matter, electromagnetic radiation and dark matter were successfully explained, there remained the mysteries of universal gravitation, the quantum vacuum and the Dark Energy to fit in. In June and October of 2021 the **centered, linear equation of state   [p = ± v] was proposed** and applications made to the quantum field, to the graviton and to the dark energy. [11,12]. Here we further explore this new, and apparently universal, physical state.
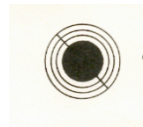
Equations of State: Visible Matter, the Dark Matter and Radiation
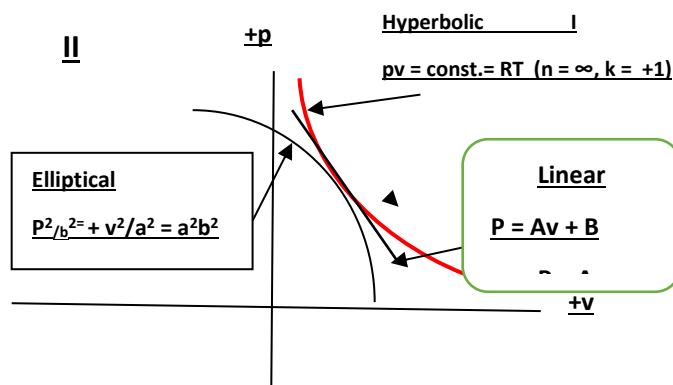
Fig. 1: Three Equations State in Quadrant 1 at a Tangent Point: Hyperbolic for Visible Matter, Elliptical for the Dark Matter, Tangent Linear for Compressive Electromagnetic Photons

The hyperbolic gas law - -Ideal Gas Law --[p v =const. – RT] supports   the elementary particles of matter associated with the strong force, while the associated weak compression shock fits the weak state and weak force particles.

The numerical fit of the shock strengths to the known particle mass ratios of the Standard Model is within 1 to 2% [1,2,3,9].

The elliptical state [$p^2/a^2 + v^2/b^2 = a^2b^2$] shown in   Fig. 1, supports strong and weak rarefactions which we have assigned to describe proposed strong and weak **rarefied** shock particles. (**dark matter** or *celestons)* [9].

The linear, tangential equation of state [$p = \pm Av + B$] Fig. 1 supports stable waves of both compression and rarefaction. Shocks are ruled out. Theses stable compression forms are assigned to the electromagnetic compression photons. The stable rarefaction linear waves may support invisible, rarefied, radiation 'photons'

Most recently, this equation of state approach has yielded the **centered**, linear, equation of state   [$p = \pm v$] (Fig. 2) .which appears to offer a basic quantum state as well as an explanation for the mysterious dark energy which makes up around 69% of the known universe. It also apparently yields the graviton or quantum of gravitation.
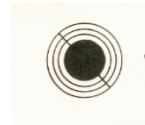
The Universal, Linear, Centered, Equation of State for The Graviton and The Quantum State
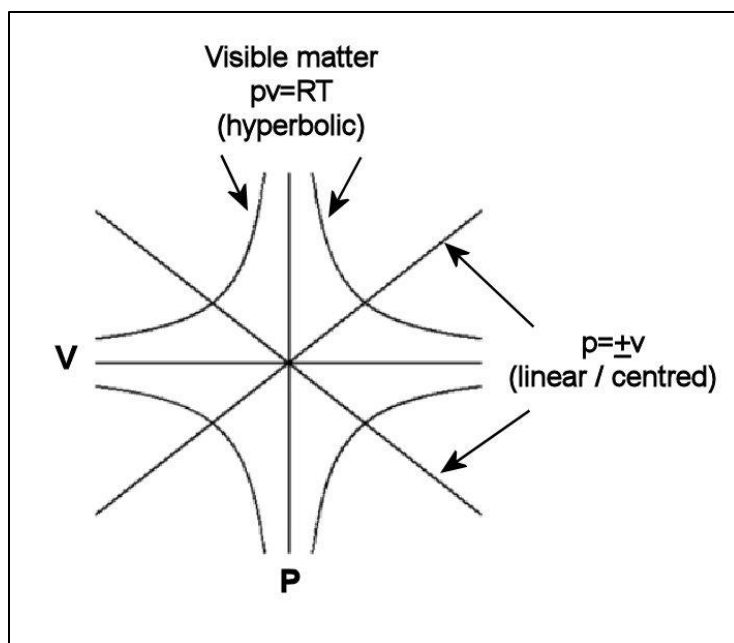
Figure 2. The Universal, Centered, Linear, States which uniquely and universally intersects with the hyperbolic, visible matter states in Quadrant 1;(Note: the universal intersections with tbe elliptical and the tangent, linear states (Fig. 1) are similarly depictable)

A basic quality of this state or field is that it is automatically quantised [12] *Part XIII: Gravitons and a Centered Linear Equation of State. Posted August 2021*].

The **graviton** or quantum gravity force- carrying wave/particle arises in this state, **being generated** we theorize**, by the continual vibrational motions of the atoms** of massive particles of both visible and of dark matter. We also reason that it is because the graviton quanta are rarefied that the attractive nature of gravity arises.

There are three aspects to touch on here: First, there is the universal quantum vacuum field, second, the universal gravitational field and third, the dark energy field responsible for the accelerated expansion of the entire cosmos.

First, the <u>quantum vacuum phenomena</u> we have assigned <u>to the rarefaction wave capability of the new field.</u> [$p = \pm v$] in which all the quantum generation and annihilations take place and which, of course forms the <u>vacuum energy.</u>

Second, the thermodynamic **vibrations of the visible and dark matter atoms** generate the rarefaction **gravitons that carry the force of gravity** from the atoms of one mass particle to the atoms of all the other masses of the cosmos.

Finally**, the kinetic motions of the mass particles generate** compression quantum energy particles in the dark energy field whose collective kinetic **pressure then induces** the observed **acceleration in the rate of expansion of the cosmos.**

<u>**Quantisation**</u>: <u>Both linear fields, photon and graviton, are intrinsically quantised</u> as can be argued in several ways.:

(1) The compressible flow wave speed c is given in the energy equation as: $c^2 = k\, p/\rho$, where c is the phase wave speed, k is the adiabatic exponent [$k = c_p/c_v$, the ratio of specific heats). Here $k = (n+2)/n = (-1+2)/-1 = +1/-1 = -i$. Going back to the energy equation and inserting this negative value for k , we have: $c^2 = k\,(p/\rho)$;and so $c = \sqrt{-1}\,(p//\rho)^{1/2} = i\,(p//\rho)^{1/2}$ <u>which is complex and quantised.</u>

We now deal with the Quantum Field. the Gravitational Field and the Dark Energy field in turn.
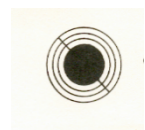
A. The Quantum Field

We may summarise the main features of the field as follows:

1.<u>Derivation:</u> The basic equation of state for the baryonic/Hubble universe is usually some form of the ideal gas equation $pv = \text{constant} = RT$.   If we now express this in its adiabatic gas form, $pv^k = \text{const.}$ where $k = c_p/c_v$, the ratio of the specific heats, then the relationship of the two equation of states, becomes for $k = -1$, just $pv^{-1} = p/v = \text{const}$, or $p = \pm v$, <u>which is the proposed quantum field equation of state.</u>

2. <u>Quantisation:</u> Both linear fields , photon and graviton, are intrinsically <u>quantised</u> as can be argued in several ways.:

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

 The complex nature of the wave forms in this new linear field leads to a view of its quantum wave/particles (photons and gravitons) as being quasi- point energy concentrations surrounded by very sharply attenuating energy fields.

B. The Universal Quantum Gravitational Field

Note: A satisfactory theory of quantum gravity has been a main goal of current cosmology. Here, we have approached this complicated task by proposing the centered, rarefied, linear equation as the sought for quantised gravitational equation of state. We have shown that it is universal, is intrinsically quantised <u>and that a certain class of its quantum wave particles qualify as the graviton.</u>*[Ref. 12. Part XIII: Gravitons and a Centered Linear Equation of State .Posted August 2021].*

 <u>Quantum Spin:</u> 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 <u>$S = (-3 -1)/2 = -4/2 = -2$</u>

4. <u>Relativity:</u> A basic current theory of gravitational force is that of general relativity which requires a spin 2 for the graviton. We have just derived Spin -2 which <u>agrees (in magnitude) .</u>

Also, conceptually, compressible flow physics postulates that all its flows V must be <u>relative </u>and so it basically fits special and general relativity. For example,

uniform flows plot on the flow space- time coordinate diagram (x,t) as straight lines, corresponding to special relativity,   while accelerated flows plot as curved space time trajectories corresponding to general relativity. The corresponding force is that of gravity. It seems clear that our compressible, quantum field p = ± v can accommodate both relativities.

5. Universality: An essential requirement is that the desired gravitational theory must apply universally. Our candidate field equation uniquely meets this requirement (Fig. 2).


6. Gravitational 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 the gravitational force is also possibly explainable from parallel and anti-parallel spin considerations, but this matter is left for specialists in quantum spin physics. Another mechanism to consider in explaining this attractive nature of gravity is the effect of the rarefaction nature of the graviton in the interaction of a graviton and a mass energy particle. The net lower pressure of a mass particle plus its interacting graviton would seem to result in a net pressure lowering, and hence of attraction, towards the gravitating source This approach would essentially be a pressure gradient field approach.

Additionally, we now propose that: (1) the rarefied **graviton** is generated in the new centred basic field **from in situ vibrations of the constituent atoms** of the mass particles . (2) The **kinetic motions of the mass particles** themselves generate another type of compressional wave/particles which we designate as **the source of the pressure that is postulated to cause the acceleration in the rate of expansion of the universe**. This new centered field   approach thus accounts for both gravity and for accelerate expansion, arising by atomic vibrations for gravity and by mass particle kinetic motions for accelerated cosmic expansion.

 Quantum Gravity Infinities and Renormalization: These are specialities, but the proposed quantum field may be of assistance in visualizing them physically.
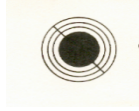
C. The Dark Energy Field

The questions of the existence and nature of the dark energy of the cosmos are central in cosmology. This mysterious energy is needed to account for the observed acceleration in the expansion of the observable universe. It also makes up by far the largest portion of the theoretical mass/energy of the entire universe (visible matter 4.9 %, dark matter 26%, and dark matter 69%).

There are three aspects to touch on here : First there is the universal quantum vacuum field, second the universal gravitational field and third the dark energy field responsible for the accelerated expansion of the entire cosmos.

First, the **quantum vacuum phenomena** we have assigned **to the rarefaction wave capability of the new field.** [$p = \pm v$] in which all the quantum generation and annihilations take place and which of course forms the **vacuum energy density.**

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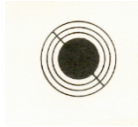
A Solution to the Vacuum Catastrophe Problem' in Quantum Physics

Dark energy is not a cosmological, directly detectible entity; instead, it arose from a need to explain the observed expansion rates of the visible Hubble universe. We now assign this dark energy field as forming the basic quantum field. Its quantum entities are rarefaction in nature. With this assignment we are able to solve various problems in quantum physics.

First of all, it seems to easily resolve one of the more startling problems in physics, namely the '**vacuum catastrophe' or the 'cosmological constant problem'** which refers to the huge difference or conflict between the calculated value of the quantum vacuum energy at around 10^{60} while the observed vacuum energy value seems to be around zero!

This conflict, however, **vanishes with our assignment of the dark energy to the rarefaction waves capability   of the linear, centered equation, since rarefaction entities or forms, just like the rarefied 'dark matter' forms, will simply not be visible or observable by us from our standpoint in our visible, compressed matter universe.**   Since quantum rarefied forms then are 'dark' or invisible, the huge vacuum energy value can be there, but it is just not observable, and so the problem vanishes.
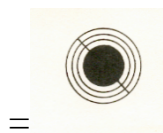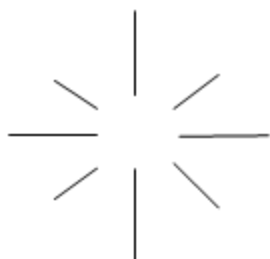
=   **Solutions to the Quantum Non -locality /Entanglement and the Vacuum Energy Problems**

With the repeated emergence of experimental proofs of the violation of Bell's *Inequality by Aspect et al , a* solution to the theoretical implications for quantum mechanic has become more urgent. Apparently q**uantum physics has become definitely non-local, entanglement is a reality, information exchange and signaling is quasi-instantaneous etc, etc**.

` Towards a solution to these problems, we note that both the quantum wave functions and the gravitons are now placed in the same state or field. Therefore, a gravitational -quantum interaction of some sort may arise. For example, we note that the ratio of the Gravitational constant G and Planck's constant G/h has the dimensions of velocity or speed.

. Inserting the numerical values for G and h in this ratio, we <u>have a possible quantum phase wave speed c_o</u>

$$c_Q = G/h = 6.67 \times 10^{-11} / 6.63 \times 10^{-34} = 10^{23} \text{ m/s}$$

This enormous phase wave speed would makes the collapse of the wave function effectively instantaneous and thereby eliminate several problems at once. to wit, the vacuum energy problem and the entanglement/collapse of the wave function problem

First, the vacuum energy density actually is just as calculated by quantum physics but its particles are rarefaction units which are not detectible or measurable just as dark matter is not detectable by visible compression methods or instruments. In addition, we have $c_\Psi^2 + c_o^2 = 10^{46} + 10^{16} = 10^{62}$ which is about the usual **calculated value for the quantum vacuum energy** . And so, the quantum calculations are actually correct but are just not observable from our visible cosmos. standpoint.

Second, with regards to **the problem of the instantaneous collapse of the wave function in quantum measurements**, the same enormous wave velocity c = 10^{23} m/s provides a solution, since, when a measurement is made on a system the signal and the collapse both travel quasi-instantaneously as required by quantum theory. We assign the rarefaction wave functions to the dark energy and quantum phenomena with the enormous said wave speed, while the compression waves which travel at the speed of light are allotted to the graviton. Thus general relativity is retained to account for gravitational force and motions.
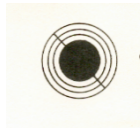
The two above examples, of solutions to current quantum problems by the proposed universal field (p = ± v) are striking of course. But, we point out that

whether or not they fit in completely with the rest of quantum theory is a matter for specialists. If they are found to fit then attention can turn to additional further questions such as those listed n the next section.
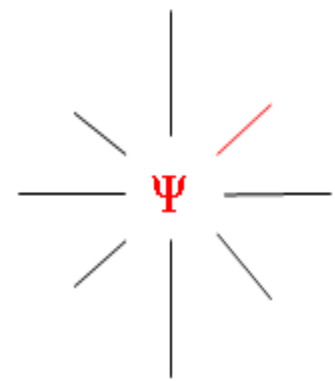

Relevant Further Questions

1. Does the new field offer any insight or help with the **problem of infinities** in quantum calculations which leads to the necessity for renormalization?

2. Develop a solution for the problem of the nature of gravitational **attractive force.**

3. Explore the linear, centered field in Quadrants II,III and IV (Fig. 2)

4.What else does the new field have to offer to the problem of **vacuum density?** Of the **cosmological constant**?

5. What is the relevance of the proposed energy field to the "**flatness problem**?-

6. Pursue the application of the new energy field to the problem of the **rate of cosmic expansion**?

7. For the new centred linear equation of state, examine any problem set by a physical vacuum and the consequent absolute discontinuity found at the graphical origin point where p and v are both zero.

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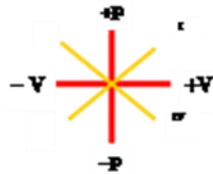
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10. --Part XI: Interactions and Transformations (Page posted November, 2020).

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12. ---*Part XIII: Gravitons and a Centered Linear Equation of State. Posted August 2021*

13. ---*Part XIV Dark Energy and a Centered Linear Equation of State. Page posted October 2021*

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

Bernard Lonergan, S.J. in his treatise

"Insight: A Study of Human Understanding"

"Insight is Joyous" ……………. Richard Feynman

Epilogue

Compressible Flow Theory and a New Cosmology

1982 – 2022

Posted 2021: Revised 2022

General

Cosmological History: **Genesis and Science**

Visible-to-Dark -Matter Transformations

Cosmic "End Time" Scenarios

General   Our work on the application of compressible flow theory to cosmology began about forty years ago in 1982 with the finding that the well-known ideal gas has shockwave- strength ratios which match the observed mass ratios of the elementary particles of matter to within 1 to 2 percent [1,2,3]. This strongly indicated that the Big Bang was actually a compressible- flow, strong shock in which the matter of the visible cosmos was formed by an energy compression shockwave.

Chronologically our work has been, first, the introduction of this shock wave and the mass ratios, then the ideal gas law   [pv = RT] as the equation of state for the mass ratios of the elementary particles of visible   matter

produced in the Big Bang shockwave (1,2,3), then the linear tangent gas state [$p = \pm A\, v$] as support for electromagnetic radiation (9), the elliptical state equation for the mysterious dark matter (10,11) [$p^2/a^2 + v^2/b^2 = a^2 b^2$], and finally, the centered, linear state equation [$p = \pm v$].for the basic dark energy, the quantum state and the graviton (12, 13).

Cosmological History: **Genesis and Science** With the Dark Energy State and the Graviton field now sketched out (12, 13, plus this current Page) we have a sense of an ending to the search for a cosmological explanatory outline --- but, at the same time, the sense of a beginning for a historical schema as follows:–

It appears then that, on scientific theory, physical reasoning and physical evidence that the cosmos began as a linear, compressible field of dark energy [$p = \pm v$] capable of stable wave motions as described by compressible flow physics.[3,4,5,6,7]. This primordial dark energy field energized and stimulated the elliptical state [$pv = RT$] into linear wave motions, which being unstable grew into a super-massive strong shock we call the Big Bang and which brought forth the elementary particles of matter and the physics described by the Big Bang to form the visible astronomical cosmos.

In a somewhat similar way the inflationary expansion that immediately followed the Big Bang set off a cosmic weak or rarefied shock in the elliptical state [$p^2/a^2 + v^2/b^2 = a^2 b$] which supports such rarefaction waves and the so-called dark matter was formed in that state.

Again , as to radiation waves and photons, they can be understood as being linear waves and particles [$p = \pm Av$] respectively stable and condensed E/M photons for the visible hyperbolic case ,and some sort of stable and rarefied or "dark "photons for the corresponding rarefied or dark matter state ,

Thus there is produced, the elementary particles of visible or condensed matter which coalesced to form the visible astronomical cosmos, and the rarefied or so called dark matter and dark photons and all held together by the universal, primal, graviton field.

Curiously indeed, our science -based cosmic schema parallels the archetypical account of creation in Genesis where "*In the Beginning*" there was " *darkness on the face of The Deep*" and then God said "*Let there be Light*". This creation of light on the first Day before any matter was formed is surprising, but likewise in

our compressible science-based account we have the emergence of light and radiation jn its primordial basic linear dark energy equation and its tangent linear state. Thus, light appears in both Genesis and now in our science account .before any matter appears.

In the Genesis account the second Step or Second Day event is the formation of a   "*Vault*" which separated the " *waters above the Vault*" from those under or below the vault. In our compressible schema, on the second step, , there is a low amplitude wave in a dark energy field which immediately grows in the hyperbolic state into an immensely strong spherical shock wave which we equate with the Big Bang. In other words we, like Genesis, have a physical event preceding the Big Bang, namely an expanding spherical wave growing towards the strong shock Event we call the Big Bang. We could with little effort equate our pre -shock expanding sphere with the hemispherical "Vault "of Genesis. In the Standard current scientific cosmology there is nothing to match a 'Vault' . Our physical scheme , on the other hand , matches Genesis on both its First Day and Second Day Events.

The First Event in the Standard science model is the Big Bang, of unexplained physical origin, in which Matter and Light are formed. This "first day " of the standard science model is what we and Genesis could both call a Third Day.

On this Third Day, the Genesis account has the creation of Matter from the "gathering of waters " under the Vault. Our new compressibility schema has our dark energy shockwave from Day Two culminating in the Big Bang in the hyperbolic state to form physical matter mingled with intense radiation.

s **Visible into Dark Matter Transformation**

The Question What came before the Big Bang? has no answer in Standard Cosmology.   In our compressible flow cosmology , however, a compressive stable pulse generated a compressive stable counterpart in the hyperbolic stste where it was now unstable and grew at once to form the strong   shock called the Big Bang. This occurred in the visible hyperbolic , state along with the formation of visible matter. This answer as to events after the Big Bang came only after some 40 years of study this past   summer [12,13].with the discovery of   the extremely simple basics linear equation of state [$p = \pm v$]   from which energy there was formed first in the hyperbolic state the strong the shockwave we call the Big Bang the Big

Bang and from whose compression was formed the compressed elementary particles of visible Matter in the hyperbolic state, and then in the inflationary expansion which followed was formed the rarefied particles of the dark matter in the elliptical state

Now the visible world accounts for only 4.9% of the total mass energy, while the dark matter is 26% and the dark energy is 69**%. The explanation of the visible and dark matter 5 to 1 ratio we feel may in a transformation of visible matter into dark matter** . Evidence for this transformation lies in the observed strange gravitational "haloes" calculated to permeate and surround the spiral rotating galaxies. To reiterate, we explain the observed gravitational haloes surrounding rotational galaxies and their accompanying emission of microwave radiation, to a transformation of visible matter into dark matter, with the emission of molecular rotational bond energy as the observed microwave radiation [11].

Thus, existing astronomical observations verify the theoretical prediction from our compressible cosmology as to the ongoing visible to dark transformation. In a general way, it also may offer insight as to why the dark matter accounts for about 26% of the total mass energy of the universe, whereas visible matter accounts for only 4.9% . The unstable visible world is apparently continuing to transform widely here and there into a stable rarefied world we call the dark matter.

In our posting [Part XII – *Visible to Dark Matter Transformations.* June 2021] [11] we explored the process by which our present unstable hyperbolic cosmos of ordinary visible matter is transforming into the stable 'dark' or rarefied matter. We dealt with this transformation at some length, pointing out that it may lead to an eventual complete transformation of our visible expanding universe into a rarefied dark matter universe at some future time. This prediction inevitably raises the question of whether or not it agrees with the Genesis "End Times" account. This is a matter for others, but it seems that in both viewpoints there is a pervasive **optimism.**

Thus we are proposing a cosmic transformation process in which our visible world is even now being slowly transformed into a rarefied world of 'dark' or invisible matter, but one which is theoretically open to a 'rarefied light' even more remarkable than our own compressed photonic light.

The fact that the visible to dark matter transformations take place in the swirling vortices in the heart of spiral galaxies indicates that it is a pressure lowering that triggers the transformation event. Thus, the currently observed accelerated overall expansion and pressure lowering of the visible cosmos would suggest an increase in the rate of these galactic type transformations in the future**. It would therefore suggest the possibility of a distant closure time to the existence of our visible compression cosmos and the emergence of a unitary rarefied 'dark'matter cosmos. illuminated by a rarefied light and other rarefied radiation.**

Cosmic "End Time" Scenarios

In conclusion, we note that current Standard cosmological extrapolation of our visible cosmos into the future usually predicts a cataclysmic run- away pressure expansion ending in a total chaos,
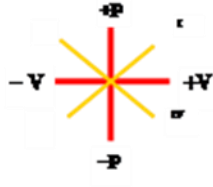
The visible to dark matter transformation extrapolation in compressible flow theory, in contrast, ends in a stable, rather wondrous, elliptical state world of rarefied matter, and a matching rarefied radiation. The visible expansionary 'end-times' scenario is calamitous: The elliptical rarefaction transformative scenario is optimistic.
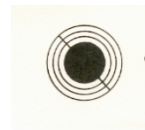
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"Insight: A Study of Human Understanding"

"Insight is Joyous" …………….. Richard Feynman

" And I saw a New Heaven and a New Earth"………………………………. Saint John, *Revelations Ch 21, v.1*

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