6 Variations on the Theme of Space-Time

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(1) Relative Motion and Reference Frames

(i)   Another look at the equivalence of Gravity and

Space-Time Curvature. Modification in 2 ways:

A: Alter right side of field equations (gravity and

energy momentum tensor.)

B: Alter left side (Riemann curvature tensor)

(ii)   What about intrinsically curved spaces or space-

times *prior* to gravity? Here is the argument:

(a)   Particles drawn towards each other by

gravitational attraction are subject to a *causal*

interaction. However:

(b) Particles moving *inertially at random* are deemed to be causally independent./ *This is indeed the basic assumption (Stoss-Zahl-Ansatz) underlying the Boltzmann constructions in Statistical Mechanics*

(c) Therefore, the random motions of molecules and other particles that generate heat, could be moving on a curved space or space-time and not be subject to gravity. To make it simple, one could consider motions on cones and cylinders whicha re flat, or on spheres, which are uniform.

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(2) Projective Concepts and Constructs

(a)   Definitions of Projective Concepts, Projective Constructs

    (i)   Projective Concepts are framed entirely in the language of pure projective geometry (plus Set Theory and Logic of course)

    (ii)   Projective Constructs are models for a projective concepts in the Projective Plane. Example: A "Self-intersecting line" is a projective concept but not possible as a projective construct.

(b)   Dualism: Point Bundles, Line Bundles

(c)   Dualism: Seperal Points , Parallel Lines

(d)   The 9 Non-Euclidean Geometries based on parallels and seperals that are relevant to the description of physical reality.

    (i)   Euclidean: no seperals, unique parallel

    (ii)   Klein/Riemann sphere No parallels, no seperals

    (iii)   Hyperbolic geometry: many parallels, no seperals

(iv)   Dual Euclidean: unique seperal (Given a point, there is one and only one point that can't be connected with a line), no parallels

(v)   Classical Space-Time Cartesian Plane: Unique parallel, unique seperal (two points can't be connected if the velocity is infinite)

(vi)   Minkowski: Many parallels, unique seperal

(vii)   Dual Minkowski: Unique parallel, many seperals

(viii) Dual Hyperbolic: No parallels, many seperals

(ix)   Hyperbolic/ Dual Hyperbolic: Many parallels, many seperals

(e) Projective Postulate

"If some observable in nature has the form of a projective construct, then its' dual is also an observable in nature".

Examples:

(i)   Speed of Light, Hubble Expansion

(ii)   Wave/Particle duality

(iii)   **Matter/Radiation**

(iv)

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(3) On the Spontaneous Alteration of the Speed of Light

(a)   Changes in the speed of light are ruled out within the structure of Special Relativity because of the assumption of total homogeneity of the Space-Time Geometry. If the meter for example , for example were to become longer in one direction, then the ruler that measures it , being a physical object, will also alter in that direction so that no change can be detected. Likewise , if the second were to "lengthen", the periods of clocks would also alter to keep the speed of light a constant. Indeed, the speed of light is a pure dimensionless constant in Special Relativity.

(b)   Going beyond Special Relativity, what are the

theoretically possible clocks that might allow for a

change in the speed of light? We invesitigate these

possibilities:

(i)   Light reflection clock

(ii)   Photon Clock

(iii)   Inertial Clock

(iv)   Pendulum Clock

(v)   Earth's Rotation

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4.   Barrier Theory

(A) Potential and actual infinity in classical physics

(i)   *Actual* infinity was ruled out. For example, if an

actually

infinite velocity were possible, items could be the same place at the

same time. If the "infinite" gravitational potential at the heart of a

massive star actually existed, one could, in theory, separate it into two infinite potentials, both equal to the original.

(ii)   However, *potential infinity* was generally accepted. There were no "barriers" on velocity, the extent of the universe, pressure and density. Matter was treated as infinitely divisable, though it might be impossible to carry out the operation. Perpetual motion was ruled out, but there was no potential limit on the length of time a machine could keep operating.

(iii)   Thermodynamics, Quantum Theory and Special Relativity changed that. There is now a natural "barrier" on velocity. Likewise, the "barrier" on certain knowledge posed by Planck's Constant. (Observation: shouldn't "perpetual rest" be as forbidden as "perpetual motion"? Or perhaps "zero point energy" takes care of that.

(B) Suggested List of Postulates of Physical Finitism

 I. In any natural phenomenon in which actual infinity is ruled out, there is also a barrier against potential infinity

 II. There is also some real entity with its magnitude at the barrier level (example: radiation)

 III. Relative Continuity

  (i) Nature at the infinitesimal level is always discrete (Democritus)

  (ii) Natural magnitudes may approach continuity as they approach the barrier limit. (Correspondence Principle)

(C) This paper discusses possible barriers to density, velocity, acceleration, energy and time:

 (i) Density: to assert that physical magnitudes,

such as mass, energy, pressure, can be made infinite by decreasing

the volume while keeping the magnitude the same, is to assert that

the corresponding observables are topologically reducible

(Example: The plane is topologically reducible, but the sphere is

not. Democritus argued that matter, at least, was not topologically

reducible, while in Aristotle one finds the germ of the idea of an

irreducible energy quantum, the *minime* .

    (D)   Theorem (Page 18) : It is *consistent* with Special

Relativity that the spectrum of inertial paths may be discrete, that,

in other words, this is a discrete minimum velocity barrier ε, as

well as the maximum barrier c. The velocity observable then

approaches continuity as the velocities of massive objects approach

the speed of light.

    (E) Barrier to acceleration. This is only mentioned in passing

        in this article.

    (F) The discrete time quantum. 5 arguments are given for the

        presence of a discrete time quantum in nature:

(i)   **Requirement for a standard clock**

(ii)   **Quantum Time derivatives**

(iii)   **Zeno's Paradoxes: since time is measured by discrete pulses. Continuous time measurements cannot be assumed.**

(iv)   **A minimum interval of time needed for wave packet collapse to occur**

(v)   **Embedding the Uncertainty Principle in nature.**

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5.   Observations on the expansion of the universe

(a)   Aristotelian viewpoint: All masses have volume. Point masses and point particles are a mathematical abstraction. They imply infinite potentials (electro-magnetic and gravitational for example) at points, which is unphysical.

(b) Since classical "3-D Euclidean Space" has been replaced in Relativity by "4-D Pseudo-Euclidean Space-Time", it is incorrect to speak about "point instants" as well. Any complete (one does not always need descriptions to be complete) description of physical phenomena must be in terms of *space-time events* , with positive volume and positive time interval.

(c) Therefore it is an error to talk about the "expansion of space". One must talk about the "expansion of space-time". However, this, too, is incorrect.

(i) Space cannot "expand": only material objects can expand or shrink in space. A spatial measurement is a magnitude . If "everything" were to double in length, then rulers would also double in length and no evidence of a change in length would be recorded.

(ii) "Time" also cannot 'expand' or 'shrink, for the same reasons. However, as Relativity as shown, the

relative expansion or shrinking of space and time is a

property of motion. Motion is, once again, the mediator

(iii) One can, however, speak of the (local) presence of

matter and energy.

(iv) *Energy* is a basic observable from which the

magnitudes matter and momentum can be derived. Matter

is given by E/c^2 , and momentum is (apart from a constant

of proportionality) the triple of components of the energy

in the 3 directions of space.

(iv) Space can no more expand than time can move

(d)   Proposal for a model: what is called the "Hubble

expansion of space" is best interpreted as the intrusion

into an encompassing external 4+2 (4 spatial, 2 temporal)

dimensional *Void* by a 3+1 dimensional *universal field*.

(e)   Justifications are given in this paper for the extra space

dimension and the extra time dimension.

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(6)Non-Metrizable Time

(a)

(i) If a universe model U incorporates a time dimension T, yet allows for no way to build a clock to measure time, we will say that it possesses a "non-metrizable" time dimension. Traditionally there is no justification for extending any kind of spatial (geometric) metric to the time dimension.

(ii) Example: Consider a body K in some universe with standard thermodynamics, at constant temperature t . Obviously there exists a time dimension, because heat and temperature are measures of energy. But (see examples in paper) there may be no internal clock for measuring the passage of time. However, there can be an external clock.

(iii)Some of the heat inside K can be used to make a clock, which is itself a dynamical system that uses energy. This

changes the temperature, which declines through time,

leading to the extinction of the temperature of K.

(b)   Page 5 questions the assumption that the existence of a

time dimension guarantees a way of measuring it. At most

one can speak of "before" and "after".

(c)   Time can have a topology (Time, Euclidean Geometry and

Relativity) http://philsci-archive.pitt.edu/1290/

However, in contrast to Space, one must have the metric

first to determine the topology.

(d)   The 10 postulates for a Metrizable Time:

(i)   Establishing the initial state

(ii)   Isolating the clock from external disturbances

(iii)   Conservation of Energy: clocks do not run down

(iv)   Identifying the periodic return to the initial state

(v)   Causation: clocks do not become erratic,

unpredictable

(vi)   **Universality: Same time dimension, same dynamic laws throughout the universe model.**

(vii)   **The rest of the paper lists examples of universes with a Non-Metrizable time dimension.**

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