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AUM – On The Structure of Space-Time: A Unifying Model for Classical, Relativistic and Quantum Space-Time

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Space-Time Structure – Background, Terminology, Agenda

Classical Space-Time – Newtonian, Inertial System – Huygens, …
Rest Frames

Relativistic Space-Time – Einstein, Minkowski's equation
Issues

Kinematical Model of Space-Time – AUM

Solutions for the Model: Analytical and Parametric

Physical Implications
Dependence of Space-Time structure on Speed
Concept of Quantum Space-Time
Unification of Classical, Relativistic and Quantum Space-Time

Philosophical Implications

Conclusions and Future Research Ideas

If we have time & interest …

History of this work

Genesis

Important Milestones

Past Attempts at publicizing this work

Current Status …

Classical Space Time – Newtonian Space-Time

Space and Time are independent entities
There is no space-time structure

Inertial Frames and Rest Frames

Any speed is allowed in the model

Newton's thoughts and ideas about Classical Space Time

Huygens' view about Space Time

Relativistic Space Time – Minkowski Space Time

Space-Time Complex

Inertial Frames and Constant Speed of Light
Arbitrariness of Constancy of Speed of Light

Space-Time Structure dependent on Speed – Lorentz Transformations
Supports zero speed but not infinite speeds

Minkowski's equation for Space-Time Structure:
Algebraic Equation

$$x^2 - c^2 t^2 = 0$$

0 on r.h.s has dimensions of area

Issues with this Model
Euclidean length (assuming Infinite speed) v/s Experimental length (Finite speed)
Simultaneity

Euclidean length measured assuming "infinite speed"

Experimental length measured assuming "constant" speed of light

Kinematical Model of Space-Time

Dimensional Consistency of the Equation
Introducing a non-zero "Area" on r.h.s

First Modification to Minkowski equation – Scaling
Minimum non-zero area
Introducing Planck's Length

Minimum non-zero area

$$x^2 - c^2 t^2 = (Gh/c^3)$$

Sq. of Planck's length
(Planck's Area)

Second Modification to Minkowski equation – Interpretation
'c' is no longer seen as constant (speed of light), but as any speed
Equation is examined as Differential Equation v/s an Algebraic Equation

$$c^3 (x^2 - c^2 t^2) = Gh$$

Modified Equation
1st Order, Non-Linear, Differential Equation with
'Gh' as Source / Control

$$(dx/dt)^3 (x^2 - (dx/dt)^2 t^2) = Gh$$

Solutions for the Kinematical Model

Two Types of Solutions

Analytical Solution (Non-Parametric)

Parametric Solution – Defined by parameter α, $-\infty < \alpha < \infty$

Speed is defined by parameter α

Parametric Solutions for the Kinematical Model

$$\psi_1(\alpha) = [\cosh(\alpha)] / [p_1(\alpha)]^{n/2}$$

Space is a function of Speed and α

$$\xi_1(\alpha) = [\sinh(\alpha)] / [p_1(\alpha)]^{(n+2)/2}$$

Time is a function of Speed and α

$$p_1(\alpha) = d\psi_1/d\xi_1 = [\{(n+1)\exp(-2\alpha) - 1\}]^{1/(n+1)}$$

Speed, where, $-\infty < \alpha < \alpha^*$

$$p_1(\alpha) = [\{1 - (n+1)\exp(-2\alpha)\}]^{1/(n+1)}$$

Speed, where, $\alpha^* < \alpha < +\infty$

Form-Equivalence of Parametric and Analytical Solutions

$$\psi_1^{n+2} = K_1 \xi_1^{n}$$

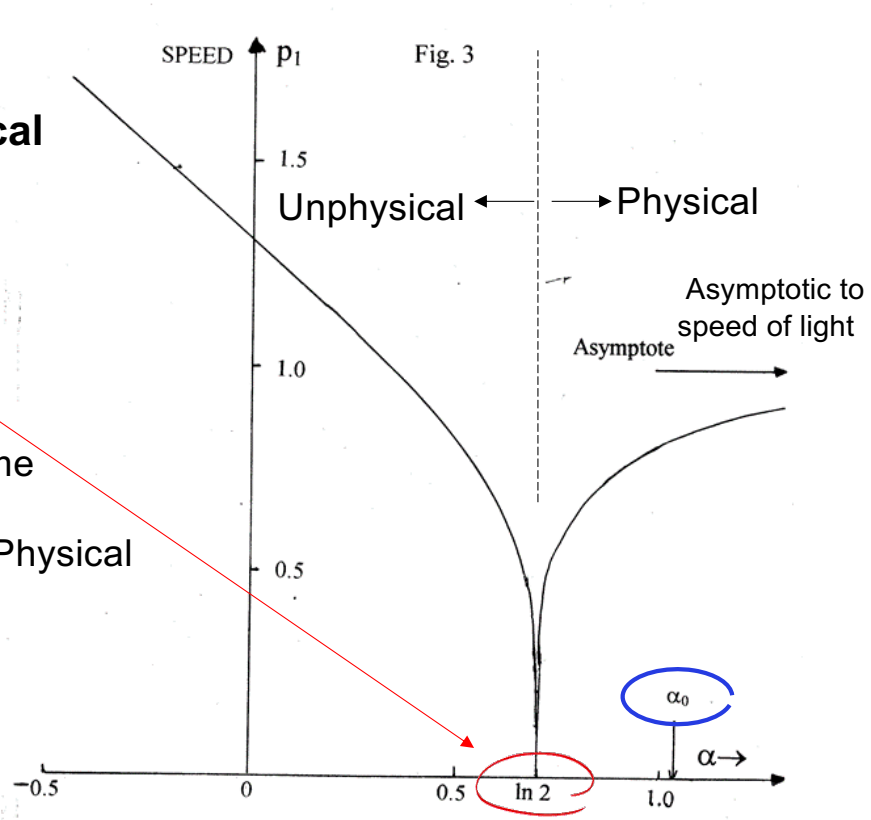
$$K_1 = [\cosh^{n+2}(\alpha)] / [\sinh^{n}(\alpha)] = K(n, \alpha)$$

Physical Implications of the Solutions – 1

Dependence of Space-Time structure on speed

Partitioning space-time into Physical and Unphysical

Physical portion conforms to TSR



$$p_1(\alpha) = d\psi_1/d\xi_1 = [\{(n+1)\exp(-2\alpha) - 1\}]^{1/(n+1)}$$

$$p_1(\alpha) = [\{1 - (n+1)\exp(-2\alpha)\}]^{1/(n+1)}$$

Variation of $p_1(\alpha)$ with α, $-\infty < \alpha < +\infty$, for n = 3

Physical Implications of the Solutions – 2

Concept of Quantum Space-Time

There are multiple Space-Time relations partitioned by values of α and Speed, p(α)

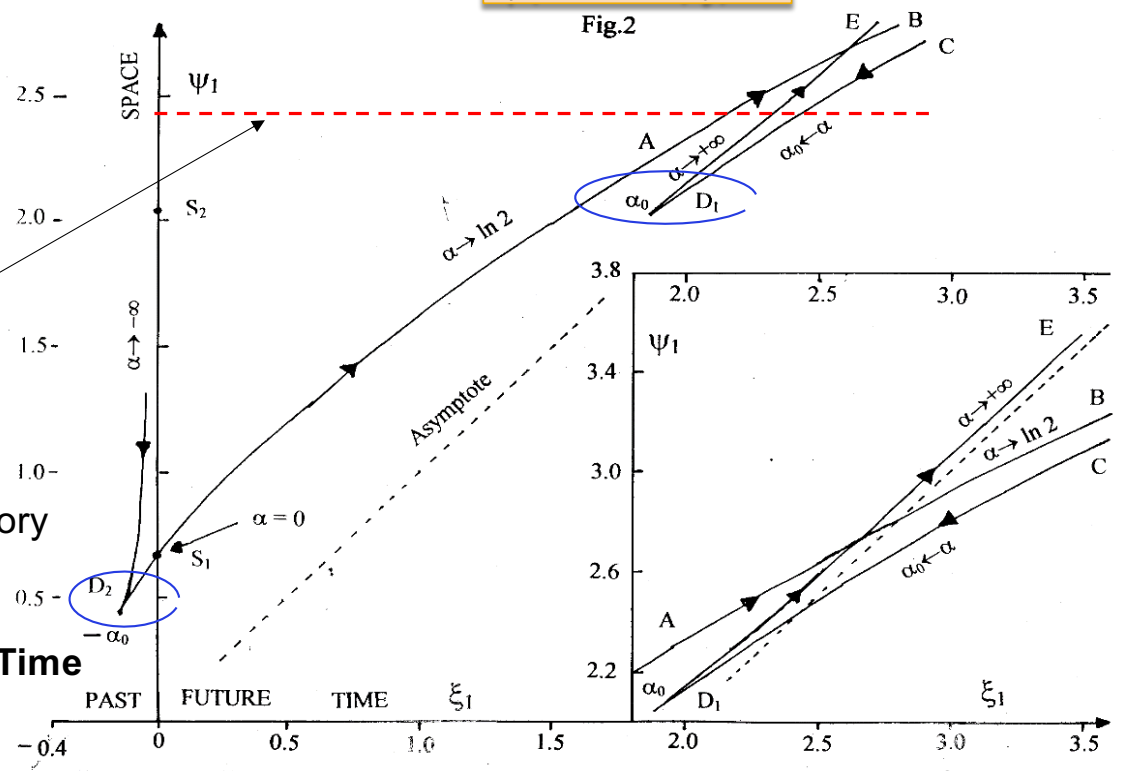
There are cusps implying multiple space-time relations, converging at ∞

As a consequence, for a fixed value of space variable there are multiple speeds, p.
Thereby, invalidating concept of Classical trajectory
Leading to non-determinism

Quantum nature emerges naturally in Space-Time as a consequence of our model

$\psi_1^{n+2} = K_1 \xi_1^n$

Fig.2



Parametric solutions showing variation ψ_1 with ξ_1, for n =3.

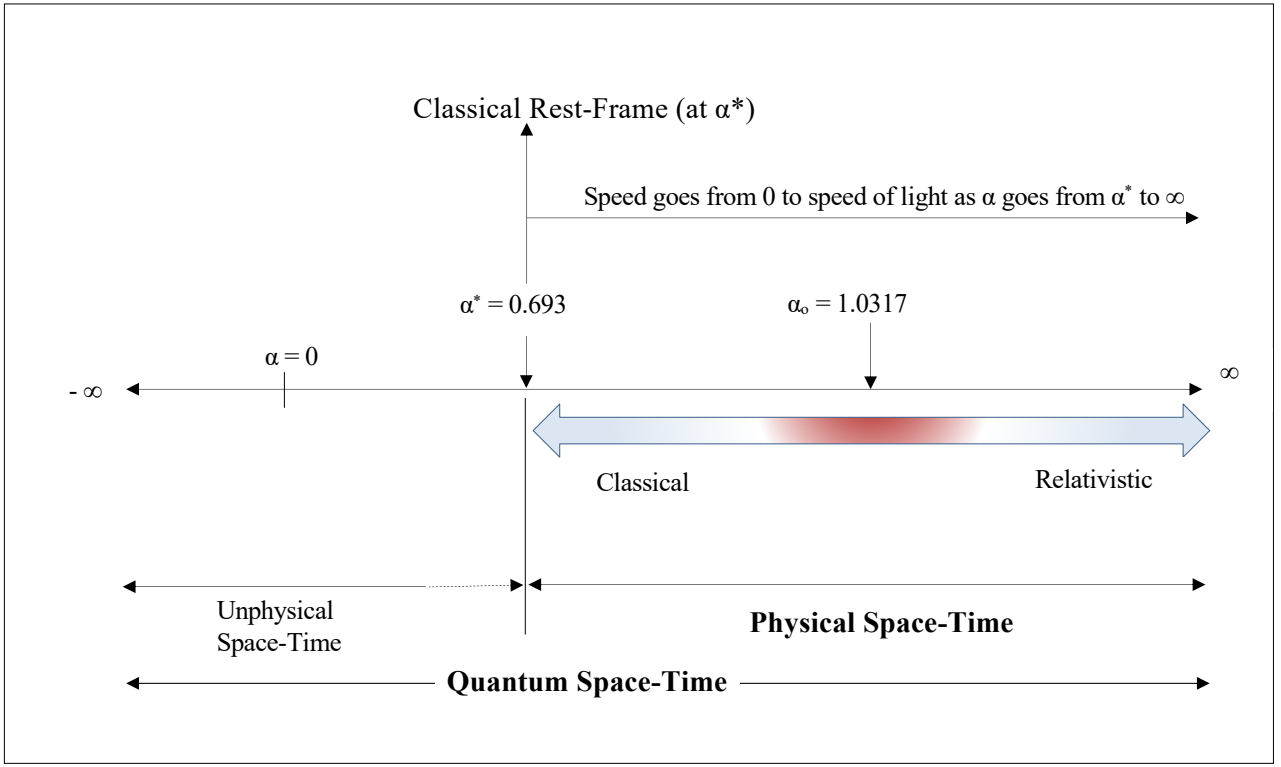
Physical Implications of the Solutions – 3

Unification of Classical, Relativistic and Quantum Space-Time

Entire Physical Space-Time is Quantum

Depending on the speed: Quantum effects are not dominant in certain regions

Space-Time morphs to Classical or Relativistic space-time of STR



Pictorial representation of Space-Time regimes for n=3

Philosophical Implications

Space and Time are Ontologically Different

Co-Existence of Future and Past – Does it imply any biological property known as "memory"?

Existence of transient conscious units

Schrödinger: "What is Life? What is Matter?"

Oskar Klein: "*It (TSR) implies that at a given space-time point there are a multitude of Rest Frames connected by Lorentz Transformations one of them being at rest at the given space-time point.*" … is justified in principle.

Conclusions and Ideas for Future Research

ॐ **AUM – is A Unifying Model for all of Space-Time of Physics**

Existence of stable matter : Attractive and Repulsive "relations" in the material world

Faster-than-Light particles, emission of photon by an atom

Stoneley Waves – Is our 3-dimensional space an interface of two 4-dimensional 'elastic spaces'?

Speed of light may not be strictly constant over cosmological time scales

Plasma Universe, Force-Free electro-magnetic fields ?

Periodic Table of Space-Time structures

Thank You, for Listening!

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Q & A – 1

Can you elaborate a little more on Rest-Frames? Are they only needed in Classical Physics, or are they also needed / defined in Relativistic, and now in this Quantum Space-time model? Why are they relevant to / important in this work?

What is parameter α? It is required by your model (mathematically), but is there any physical significance of α?

Does Quantum Space-time mostly manifest at sub-atomic particle levels, where Planck's length is meaningful? Where does Relativistic but non-Quantum Space-time structure manifest?

What is Plasma universe, and does it have any connection with Dark Energy, Dark Matter?

Slide #8 shows Unphysical space-time. If model shows it, does it manifest somewhere? What is it? In some universe?

Known "Forces" – Gravitational and Electro-magnetic. Quantum Gravity, that is product of Gh, is multiplying a "force" with an entity of "angular-momentum" (energy X time). What is this entity all about – is it a force, or a concept? This term is also used with, perhaps, different meaning in literature. Wiki: "Quantum gravity (**QG**) is a field of theoretical physics that seeks to describe gravity according to the principles of quantum mechanics, and where quantum effects cannot be ignored,[1] such as near compact astrophysical objects where the effects of gravity are strong."