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QFT in a de Sitter Universe: an Approach to Quantum Theory and Cosmological non-locality

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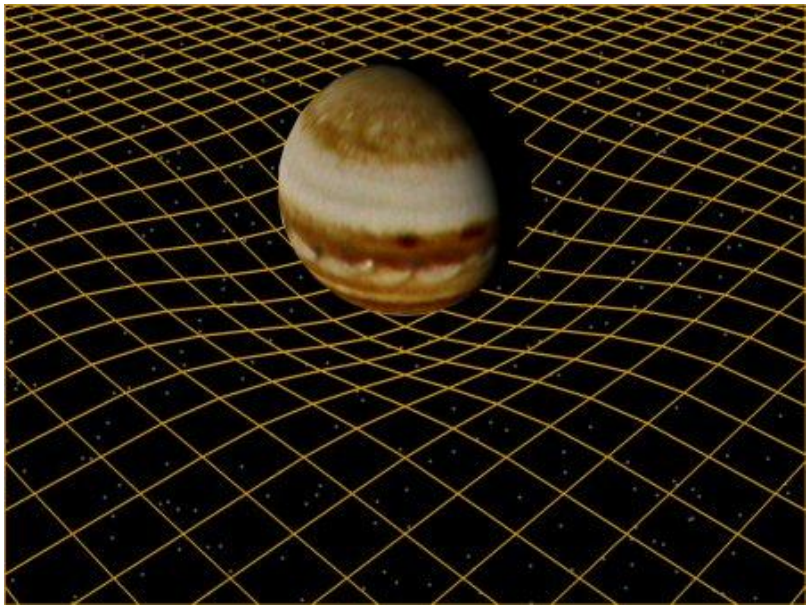
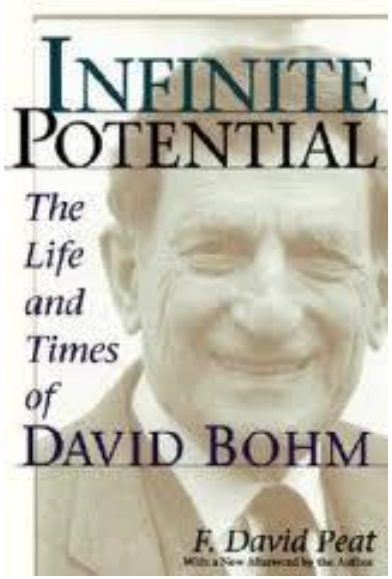
Why are peoples, magazines (and philosophers too) still back to 1927 and talk about "interpretations" of waves and particles, while the theoretical physicists talk about quantum field theory?

Since the non-local correlations
do not transport energy, they do not violate
Relativity but nonetheless remain
outside the bounds of the classical picture of the
world. This situation goes under the
name of “pacific coexistence” between Relativity
and Quantum Physics (Shimony).



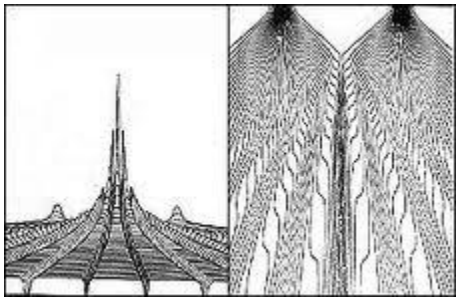
Quantum Geometrodynamics: Forcing quantum physics in an "extended" space-time arena! It takes its inspiration from the philosophy of General Relativity.

The early David Bohm: the quantum potential. The picture is that of a continuous motion along trajectories with non-local influences mediated by the quantum potential



$$Q = -\frac{\hbar^2}{2m}\frac{\nabla^2 R}{R}$$

Last David Bohm. "*My vision is a quantum non-mechanics purely algebraic*"!!!



Quantum potential contains global information of physical processes we can say that the evolution of the state of a quantum system changes active global information, and this in turn influences the state of the quantum system, redesigning the non-local geometry of the universe.

See :

- **Licata, Effective Physical Processes and Active Information in Quantum Computing, 2007, http://arxiv.org/abs/0705.1173**
- **D. Fiscaletti, I. Licata, Weyl Geometries, Fisher Information and Quantum Entropy in Quantum Mechanics, 2012, Int. Jour. of Theor. Phys**

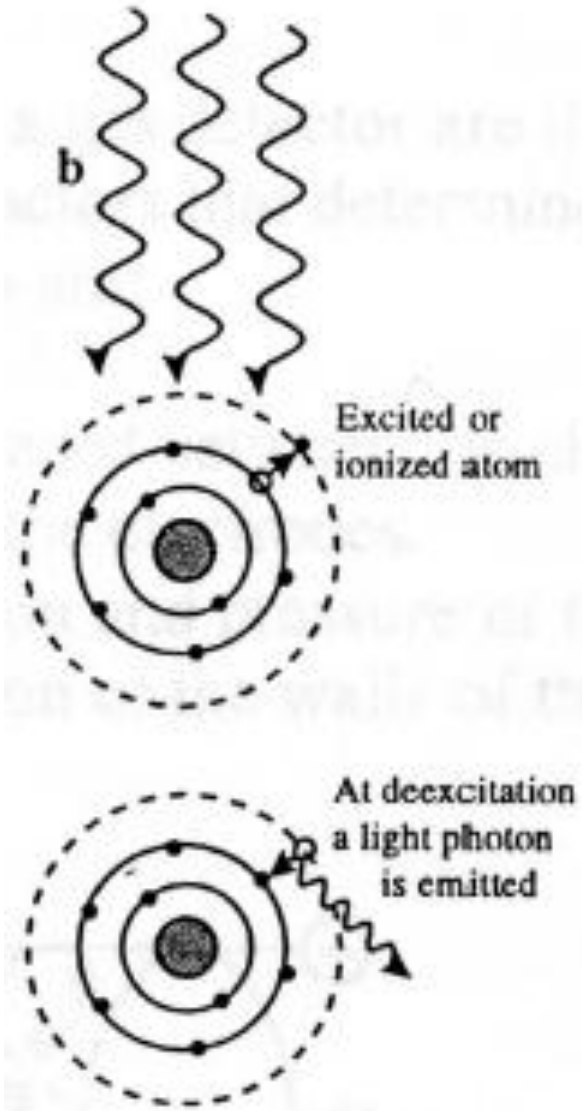
Some interesting results……

1. geometrize quantum mechanics based on Weyl space (W. R. Wood and G. Papini -1995)
2. The geometry subtending quantum potential (see for ex. Carroll, Fluctuation, Information , Gravity and the Quantum Potential, Springer, 2006)
3. M. Novello, J. M. Salim and F. T. Falciano, “On a geometrical description of quantum mechanics” , IJGMMP 8, 1, 87-98 (2011) , “Geometrizing Relativistic Quantum Mechanics”, Found. Of Phys. 40, 1885–1901 (2010). Bohm Potential & Weyl Geometry
4. Shojai, A., Shojai, F. (2004), Constraint algebra and equations of motion in the Bohmian interpretation of quantum gravity, Class. Quantum Grav. 21 1-9- connection with gravity

A radical Heisenberg and not so a “pacific coexistence”

Non-locality remains a phenomenon that rests uncomfortably on a “mechanical” vision of the universe, and it is not by chance that Bohm referred to his vision of QM as quantum non-mechanics, just to point out that quantum concepts could not be understood as a return to the classical view. As Heisenberg observed at the dawning of quantum theory, the quantum events are radically a-causal, and cannot therefore be retraced to a space-time vision

Non-Locality is at the bottom and <u>at the beginning</u> of the Quantum Theory

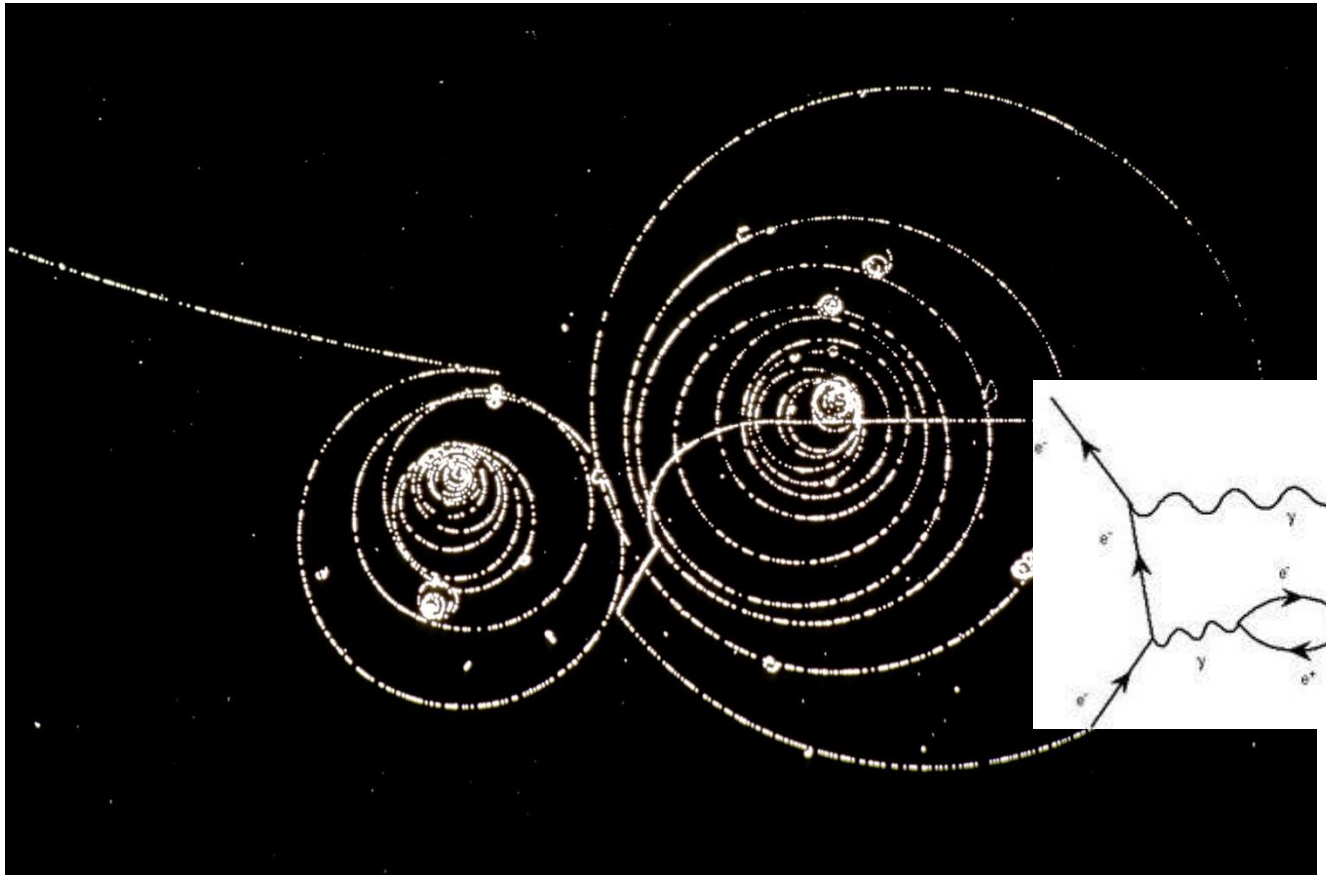


Quantum Mechanics

Quantum Field Theories

Quantum Jump! (Bohr , 1913)

Quantum Field Theory: Nor Particles neither waves but "intertwined" field modes



QFT and the “fabric” of Vacuum

a) **The physical world is described as a discrete set of interaction** vertices where **some properties** (space-time position, quadri-impulse, spin) **are destroyed and created in the vacuum**.

b) **Heisenberg uncertainty principle** in its more general and “right” form - **phase x number of quanta** – indicate that in the phenomena involving few interaction vertices the concept of a space-time/environment is no more applicable;

c) **Motion is no more a continuous phenomenon**, but a discontinuous process in the space-time coordinates, like a dislocation in a crystal. In general, if i indicates the creation event and j the destruction event for a X quantity, only if X (i,j) is diagonal the interaction will leave the X value unchanged and a measurement will be possible.

d) The particles are not “persistent object” but network of transactions.

It follows that the **quantum laws have generally a matrix-like** form and also the existence of quantities not simultaneously defined.

This frame modifies quite widely the semi-classical vision associated to QM.

Heisenberg Principle – *naive* form

$$\Delta x \, \Delta p \geq \frac{\hbar}{2}$$

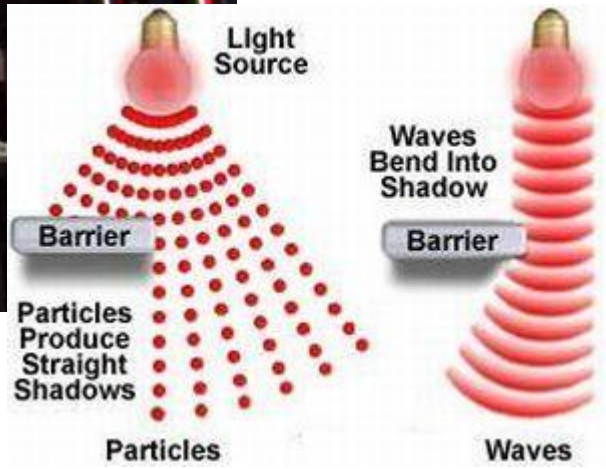
Heisenberg Principle -" noble" version

$$\Delta n \Delta \varphi \geq h$$

n: number of quanta

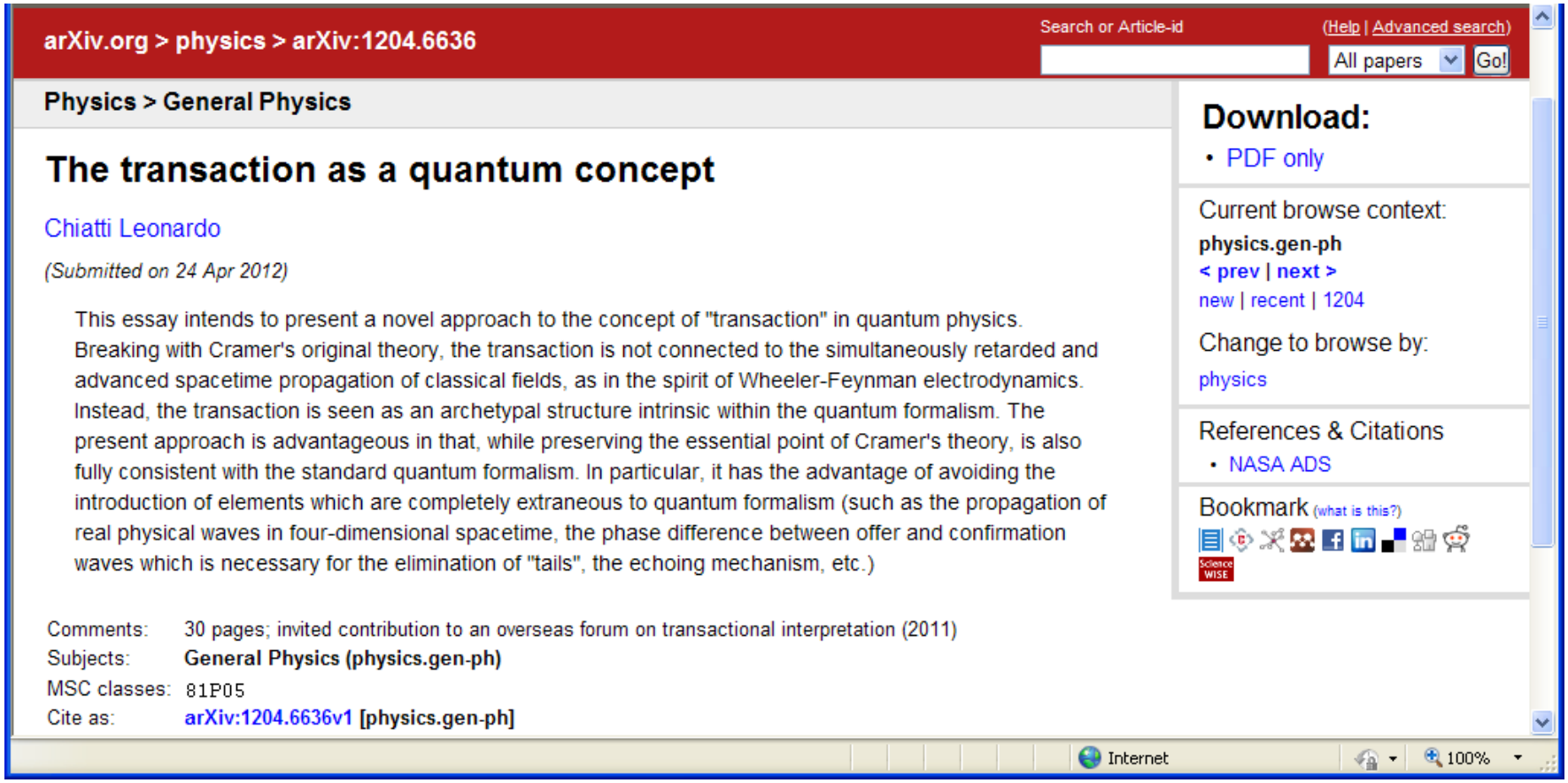
φ: phase

No Wave/Particles no mysteries in Afshar Experiment!



QFT: Correlated field modes with low intensity!

What QM is fixed by QFT?
A general framework for R processes (“clicks”)



?

The QM wave function is nothing but a statistical coverage of a great amount of QFT elementary transactions.

Dynamic vacuum as eigenstate of minimum energy

in space and time

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Quantum vacuum friction

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Abstract
The quantum vacuum may in certain circumstances be regarded as a type of fluid medium, or aether, exhibiting energy density, pressure, stress and friction. Vacuum friction may be thought of as being responsible for the spontaneous creation of particles from the vacuum state when the system is non-stationary. Examples include the expanding universe, rotating black holes, moving mirrors, atoms passing close to surfaces, and the activities of sub-cellular biosystems. The concept of vacuum friction will be reviewed and illustrated, and some suggestions for future experiments made.

$$T = \frac{\hbar a}{2\pi c k}$$

The strength of gentle virtual events!

Trajectories emerge from Quantum Field Theory

Brazilian Journal of Physics, vol. 35. no. 2A, June, 2005

Classical Trajectories and Quantum Field Theory

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Received on 11 December, 2004

The density matrix and the Wigner function formalism requires the doubling of the degrees of freedom in quantum mechanics (QM) and quantum field theory (QFT). The doubled degrees of freedom play the role of the thermal bath or environment degrees of freedom and are entangled with the system degrees of freedom. They also account for quantum noise in the fluctuating random forces in the system–environment coupling. The algebraic structure of QFT turns out to be the one of the deformed Hopf algebra. In such a frame, the trajectories in the space of the unitarily inequivalent representations of the canonical commutation relations turn out to be classical trajectories and, under convenient conditions, they may exhibit properties typical of classical chaotic trajectories in nonlinear dynamics. The quantum Brownian motion and the two-slit experiment in QM are discussed in connection with the doubling of the degrees of freedom.

Vacuum as Timeless “informational matrix” or pre-space

We can imagine the Vacuum not only as an eigenstate of minimum energy, but also as the network of all the possible transactions of the field modes in an undivided Oneness, and it has to be regarded as a radical non-local and event-symmetric state. Planck constant is then the measure of the fabric’s “elasticity”. The vacuum constrains and conveys the dynamical processes we observe. It is a fabric from which patterns emerge by R processes and such patterns influence the vacuum activity, in a quantum feedback

Some Clues in search for an Informational Matrix…….

•**Bohm, David** (1980), ***Wholeness and the Implicate Order***, London: Routledge

•**F. A. M. Frescura and B. J. Hiley** (1984) ***Algebras, Quantum Theory and pre-space,*** Revista Brasileira de Fisica, pp. 49-86.

•F. A. M. Frescura and B. J. Hiley (1980) ***The implicate order, algebras, and the spinor***, Found. of Phys. Volume 10, Numbers 1-2, 7-3

•**N. A. M. Monk, B. J. Hiley** (1998) ***A Unified Algebraic Approach to Quantum Theory***, Foundations of Physics Letters, Volume 11, Number 4, 371-377

•**David Ritz Finkelstein**: ***Quantum relativity: a synthesis of the ideas of Einstein and Heisenberg***, Springer, 1996

•**G. Chew** (1987) ***Gentle Quantum Events as the source of explicate order, in Quantum Implication*** (Peat & Hiley Eds), Routledge

•**Michael Silberstein, W.M. Stuckey & Timothy McDevitt** (2012), ***Being, Becoming and the Undivided Universe: A Dialogue between Relational Blockworld and the Implicate Order Concerning the Unification of Relativity and Quantum Theory***, To appear in Foundations of Physics (2012). http://arxiv.org/abs/1108.2261 . Appeared online 4 May 2012.

Explicate Order

Locality

Determinism

Continuity

Shannon-Turing Information

Space-time geometry

Implicate Order

Non-locality

Indeterminism

Quantum Jumps

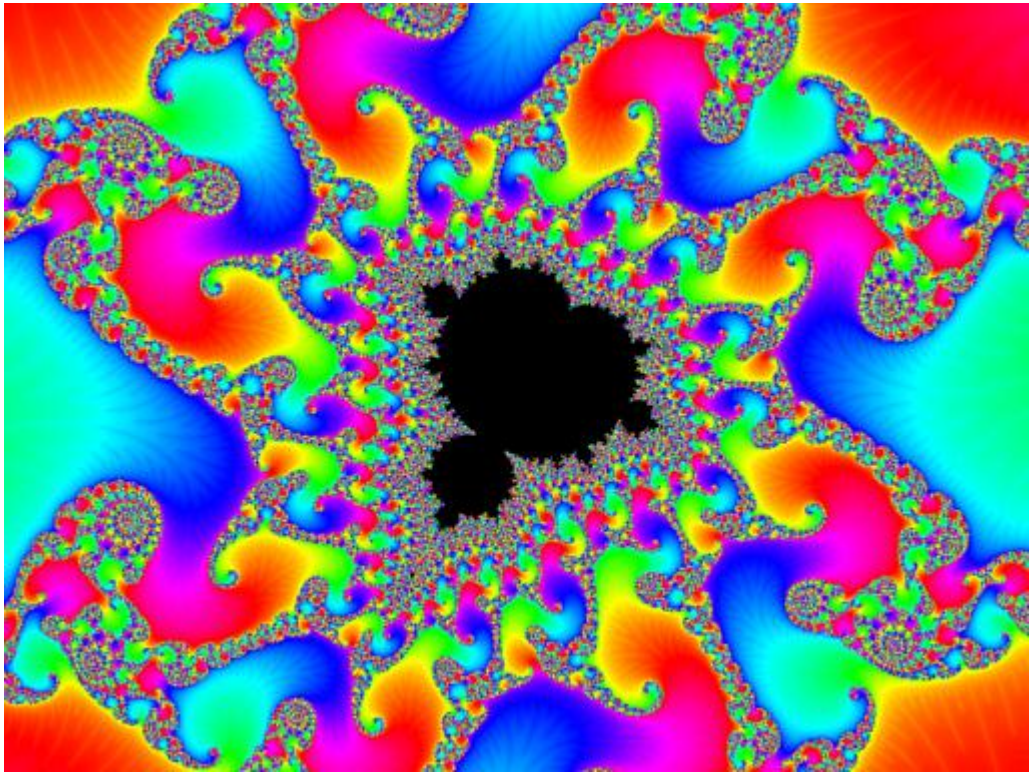
“Active” information

Transitions in Vacuun

Holomovement

Explicate Order	Implicate Order
Locality, Continuity & Determinism	Nonlocality, Jumps & Indeterministic!!
IN SPACE-TIME	NOT IN SPACE-TIME

Non-locality as formal causality: changing a single value will affect the wholeness' structure



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Universe Without Singularities
A Group Approach to De Sitter Cosmology

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Abstract: In the last years the traditional scenario of "Big Bang" has been deeply modified by the study of the quantum features of the Universe evolution, proposing again the problem of using "local" physical laws on cosmic scale, with particular regard to the cosmological constant role. The "group extention" method shows that the De Sitter group univocally generalizes the Poincarè group, formally justifies the cosmological constant use and suggests a new interpretation for Hartle-Hawking boundary conditions in Quantum Cosmology.

Keywords: Group Methods in Theoretical Physics, Projective Relativity, De Sitter Universe, Quantum Cosmology.
PACS (2006): 02.20.Bb, 02.20.Qs, 02.40.-k, 03.30.+p, 04.90.+e, 98.80.Qc

Int J Theor Phys
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The Archaic Universe: Big Bang, Cosmological Term and the Quantum Origin of Time in Projective Cosmology

Ignazio Licata · Leonardo Chiatti

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Abstract This article proposes some cosmological reflections at the qualitative and conjectural level, suggested by the Fantappié-Arcidiacono projective relativity theory. The difference will firstly be discussed between two types of singularity in this theory: geometric (de Sitter horizon) and physical (big bang, big crunch). The reasons for the existence of geometric singularities are deeply rooted in the principle of inertia and in the principle of relativity, while physical singularities are associated with the creation or destruction of matter.

In this framework, quantum mechanics is introduced through a particular interpretation of Bohm's holomovement. Finally, a possible mechanism is discussed for the genesis of the cosmological term. No form of inflation appears in the scenario described.

Keywords De Sitter cosmology · Holomovement · Imaginary time · Cosmological constant · Projective relativity

Int J Theor Phys
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Archaic Universe and Cosmological Model: "Big-Bang" as Nucleation by Vacuum

I. Licata · L. Chiatti

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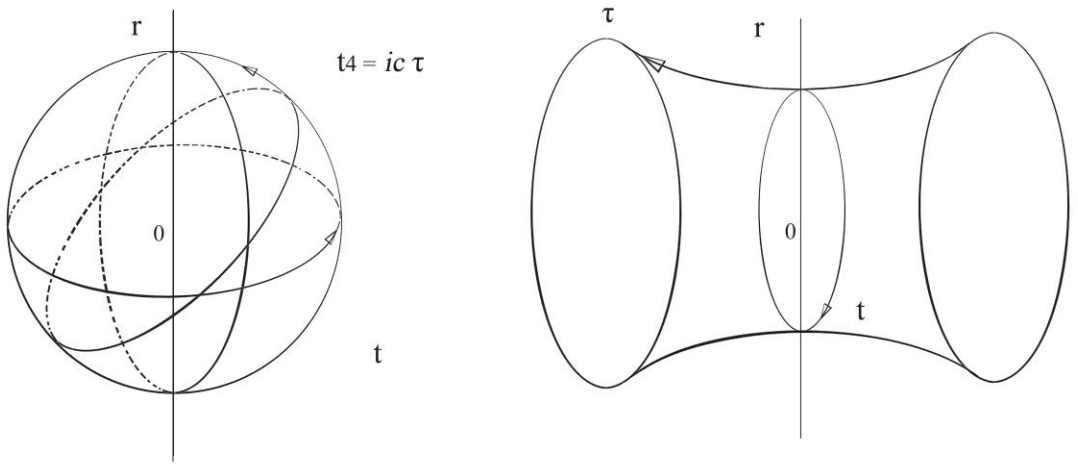
Abstract In this work, we examine in depth the physical aspects of the archaic universe described by Euclidean 5-sphere geometry, by using Projective Relativity techniques. We hypothesize that the expansion of the Universe was "ignited" by primordial R processes, and that the big bang consisted of a spatially extended nucleation process which took place at the end of a pre-cosmic phase, characterized by the evolution parameter $\underline{x}_0$. This parameter, which can be considered a quantum precursor of ordinary physical time, is a coordinate of Euclidean 5-sphere metrics. It is so possible to avoid many of the difficulties with standard model and to get rid of *ad hoc* assumptions. A complete solution to Projective General Relativity (PGR) equations is provided, so as to establish univocal relations between the scale factor $R(\tau)$ and cosmic time τ. In this way, the physics and geometry of the cosmological model are specified completely.

Keywords Quantum De Sitter Universe · Emergence of time · Wick rotation · Nucleation · Cosmological Bekenstein relation · Cosmological constant · Projective General Relativity Equations

The De Sitter Universe is the geometrical form of Quantum Vacuum!



Universo di De Sitter

a) a tempo immaginario ipersferico e b) a tempo reale, iperboloide in espansione-collasso.
Il passaggio da (a) a (b) è dato da una rotazione di Wick