Major Principles of Physics: Poincaré Invariance, Analyticity and Unitarity and Complex Minkowski Space

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The principles of modern physics can be stated in terms of Poincairé invaqriance, or the homogeneity of spacetime analyzability or causality and unitarity or the conservation of probability. Essentially all theories of physics must obey these principles.

1. Introduction

Major progress in physics was made with the realization of such principles of energy and mass conservation, cause – effect relations and the isotropy and homogeneity of spacetime. The concept of Lorentz invariance in which where and when i.e. in which coordinate system an experiment is conducted does not alter the laws of physics that the system obeys. In this chapter, we examine the major principles of physics and the manner in which they apply to the structure of the complexification of Minkowski 4-space. [1] Three major universal principles are used to determine the structure and nature of physical laws. These are Poincairé invariance and its corollary Lorentz invariance (which expresses the spacetime independence of scientific laws) [2-4] analyticity (which is a general statement of causality), and unitarity (which can be related to the conservation of physical qualities). These principles can apply to macroscopic as well as microscopic phenomena. Poincairé invariance has implications for both macroscopic and microscopic phenomena and unitarity is a condition on the wave function description in quantum physics. The quantum description of elementary particle physics has led to a detailed formation of the analyticity principle in the complex momentum plane. [5-9]

In table 1 we list (top row) the major principles of physics, (second row) a brief statement of physical phenomena related to these principles, and (third row) the aspect of the theoretical model that applies to a particular category of remote, nonlocal phenomena. We illustrate the three principles of physics with brief explanations and with specific physical models such as Bell's theorem, complex coordinate model and the physics of vacuum state polarization. We also present a diagrammatic map of the relationships between the major principles of physics and nonlocality, anticipatory and complex multideimensional geometries. These geometries are fundamental to physics and to describing spacetime attributes on the manifold, (Fig. 1).

We suggest relationships of these principles to nonlocal, anticipatory systems [9-11]. We give details as to the manner in which we can utilize these physical theories to accommodate nonlocality at the macro as well as micro levels. In particular we consider a multidimensional geometrical model which appears to reconcile nonlocality and anticipation and causality in a self consistent theoretical framework. Complex physical variables which can be tested for their consistency with the main body of physics and also may demonstrate a fundamental relationship between relativity and quantum and electromagnetic phenomena. We also demonstrate that nonlocal and anticipatory phenomena is not denied by, but is compatible with Poincairé invariance, and the other major principles of the foundation of physics.

Table 1. The Principles of Physics and Their Suggested Relationship to Remote Connectedness Phenomenon

PRINCIPLE	Poincaré invariance	Analyticity	Unitarity
BRIEF STATEMENT OF THE PRINCIPLE	Homogeneity of spacetime	Causality	Conservation of probability
THEORY RELATED TO THE PRINCIPLE	Bell's theorem	Complex hyperdeminsional geometry	Vacuum state polarization, Dirac states
REMOTE SPACETIME PHENOMENON	Non-Locality	Anticipation	Action at a distance

Poincairé invariance is the statement of the independence of physical laws and generalized coordinate transformations. The Poincairé invariance of the energy Hamiltonian implies the conservation of energy. Bell's inequality nonlocal interactions do not violate Poincairé or Lorentz invariance. In remote effects at a distance are allowed where not only information is distantly correlated but apparent energy or physical effects are transmitted, this could effect the Hamiltonian, which would no longer be Poincairé invariant. Local energy state changes from distant correlated informational events may act through the vertual Fermi-Dirac vacuum polarization and may conserve energy or unitarity and Poincaré invariance and analyticity. The analytic S-matrix can be seen as a matrix valued generalization of the Schrödinger probability amplitude, $\Psi^*\Psi = |\Psi|^2$, which is complexified but yields real measurable values. The zero-energy analytic S-matrix can be formulated in terms of the Feynman formalism to the category of operators. The physically motivated hypothesis is that S has an expression S = $\sqrt{\rho}$ S_0, such that S_0 is a universal unitary S-matrix and $\sqrt{\rho}$ is the square root of the state dependent density matrix. The S-matrix can be identified as a "square root" of the positive energy density matrix $S = \rho_x \frac{1}{2} S_0$ where S_0 is a unitary matrix and ρ_x is the density matrix for postive energy part as the zero-energy state. Then $SS^+ = \rho_+$ and $S^+ S = \rho_-$ which gives the density matrix for the negative part of zero energy state. It is obvious that the S-matrix can be interpreted as a matrix valued generalization of the Schrödinger amplitude. The indicies of the S-matrix correspond to configuration space spinors addressed in Chap. 11. The S-matrix is strongly associated to unitarity and the conservation of angular momentum energy and relevant quantum numbers such as charge, spin, etc. [9].

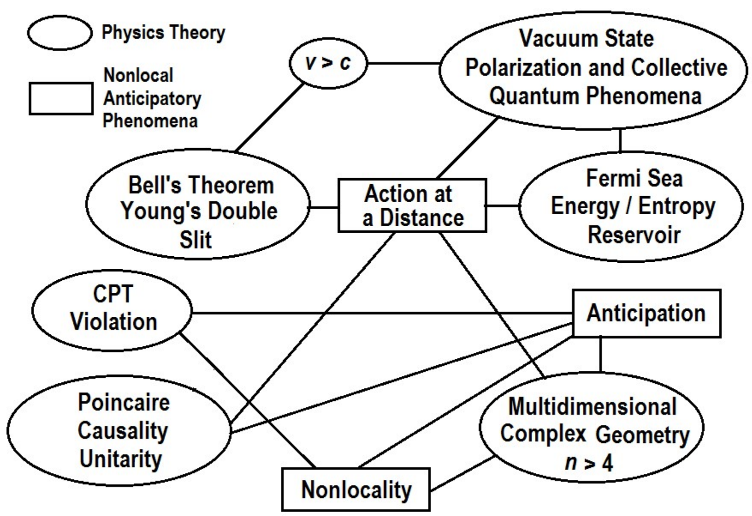

Figure 1. "Map" of Physics and the relationship to existing physical theory that accommodates the fundamental principles of nonlocal events in spacetime.

As applied to S-matrix theory Poincairé theorem tells us that if a parameter of a differential equation such as ℓ or k appears only in functions which are holomorphic in some domain of the parameter, and if in some other domain, a solution of the equation is defined by a boundry condition which is independent of the parameter then this solution is holomorphic as a function of the parameter in the intersection of the two domains. Such parameters can be ℓ and k. In S-matrix theory, Argand plots in complex ℓ space where poles correspond to resonances or particles where ℓ is an angular momentum parameter. Also plots can be constructed in a complex energy space associated with the parameter, k, as $k = 1/\lambda$, the wave number and $p = \hbar/\lambda$, $p = mv = mc$, $E = mc^2$ so that $k \propto m \propto E$ for $c = 1$. These parameters are the independent variable of the differential equation which are hypergeometric and in non-relativistic form reduce to a time independent Schrodinger like wave equation.

The ℓ, k variables are analogous to phase space variable (p,q) in momentum – distance. Other sets of complementary variables (E, t) and also others such as (p, E) and (x,t). See [12] on the generalization of the Heisenberg relations. Not the the variable (p, E) act independent variables in the Lippman-Schwinger equation, which has an anlology to the Schrodinger equation. The independent variable (x,t) are those of the Schrodinger equation and most equations of physics.

An anticipatory system has the information, known and defined in the presence, to make an inference and discussion about the next action or inaction to be taken and hence, to make a change in the present to change the next or future states based on the predictions and fore knowledge about the relevant potential future states. Anticipation or "precognition" or to cognite a future even before the now on the light cone axis cannot be explained by superliminal signalling in 4-spacetime alone [10,11].

Tachyons or a superluminal signal alone will not explain anticipation precognition [13]. Feinberg states that tachyonic signals even at near the velocity of light will net one only a few naoseconds/foot into the future on the light cone. If we choose a null light cone signal of v~c and for ~3 x 10^{10}cm/sec, then 1/c ~ 1/3 x 10^{-10} sec/cm and a nanosec = 10^{-9} sec so that 1/c nanosec x 1/30 cm for 2.54 cm = 1 inch, then 2.54 cm x 12^{11}/ft = 30.48 cm/ft or 30.48 cm = 1 ft ~ 30 cm therefore 1/c = 1 nanosec/inch. In our consideration of anticipatory responses require the consideration of significant temperal advantages perhaps even hours. In the Gisin [14] test of Bell's theorem over Km of distance [15-22]. One nanosec / inch ≅ 3 nanosec/cm and 10 Km ~ 10^6 cm, then the Gisin experimental results require a factor of over 10^9 times over the 1 nanosec/inch (for signalling tranbsmission of the velocity of light)! If the time delay between the initial anticipation time at t_o and the verified result of anticipation or participation was t_1 then, for tachyonic signalling in $n = 4$ space would yield a requirement for a spatial separation of the events at t_0 and t_1 of 10^9 miles or greater (or about 10^{14} cm).

In order to accommodate precognition, anticipation or the results of Bell's theorem, one is required to address the issue and resolve the paradox by using on $n > 4$D space. As we stated before, the use of complex 8-space has the symmetry properties to satisfy the major principles of physics. The geometric approach to accommodate nonlocality is very consistent with Wheeler's statements that our understanding of physics will "come from the geometry, and not from the fields." [23]

Hypothesis about the manner such anticipatyory systems can exist are:

- An advanced wave, such as the Tachyon proposed by Feinberg [13]
- Heisenbergs quantum wave potentia model [24]
- Electromagnetic advanced and retarded waves [25]
- Cramer's advanced and retorad standing wave transortural analysis. [26]

In remote connected events, such as in Bell's theorem, the remote collapse of a wave function at one spacetime location $\Psi_1(x_1,t_1)$ determines the measured state collapse of the other spacetime, location Ψ_2 (x_2,t_2). In temperal separations of anticipatiory systems between an initial event at t_1 as $\Psi_1(x_n,t_1)$ determines the state collapse of the wave function at t_2 for $\Psi_2(x_n,t_2)$. Note that for Ψ_1 and Ψ_2, x_n can have either both wave functions at $x_n = x_1$ or for both wave functions Ψ_1 at $x_n = x_1$ and Ψ_2 at $x_n = x_2$ where $\Delta x = x_2 - x_1$ can be an arbitrary spatial seperation. Also, temporal separation or anticipatory nonlocality occures, which we reconcile in Chap. 2 and the following chapter [26].

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