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GÖDELIZING FINE STRUCTURE

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Abstract. We have questioned the value of the Planck constant, such that its value is likely different for a physical reality with parameters for dimensionality beyond the four of the Standard Model. Now the fundamental basis of the fine structure constant (FSC) itself also comes under scrutiny. The FSC is generally determined in terms of other constants; therefore, its origin yet remains a profound mystery. One must go 'out of bounds' to obtain a holistic picture. Our understanding of the physical world has progressed from Classical to Quantum; and now to the brink of the 3rd regime of Unified Field Mechanics (UFM). We review the 2nd regime origin and development of the FSC, then propose new insights gleaned from 3rd regime UFM insights and review importance of the FSC in developing empirical protocols for gaining access to the 3rd regime.

In order to more fully understand this reality, we must take into account other dimensions of a broader reality. - John Archibald Wheeler

1 Introduction Parameters of Fine Structure

From boyhood I dreamed of a career studying the nature of awareness, now having solved the mind-body problem (to my satisfaction) [1-3]; I realize that discovery, as profound as it is, pales in the face of understanding Fine Structure, which relates to the nature of our very existence! We can measure what physicists call the Fine Structure Constant (FSC) but its fundamental origin remains a profound mystery. Bowdlerizing the original usage of the term 'Gödelization' to mean in general instead, that something 'cannot be fully understood in terms of itself'; that one must go 'out of bounds' to obtain a holistic

THE BIENTROPY OF SOME KNOTS ON THE SIMPLE CUBIC LATTICE

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Binary representations of the trefoil and other knots of up to ten crossings in the simple cubic lattice were created. The BiEntropy of each knot was computed using a variety of binary encodings and compared against controls. This showed that binary encoded knots are highly disordered information objects. The BiEntropy of knots on the simple cubic lattice increases slightly as the number of crossings and length of encoding increases. The non-alternating knots of nine and ten crossings are more disordered than equivalent alternating knots.

1 INTRODUCTION

We developed our BiEntropy function [Croll, 2013] as a simple method for determining the order and disorder of finite binary strings of arbitrary length. We successfully tested our BiEntropy function in a variety of domains including number theory, cryptography, quantitative finance and random number generation. We have started further work enumerating the algebras of BiEntropy [Croll, 2014] for possible application in bit string physics [Noyes, 1997]. Other teams have been able to successfully apply BiEntropy in cryptographic, internet information processing and random number generation domains [Costa et al, 2015][Jin & Zeng, 2015][Kotě et al, 2014][Stakhanova et al, 2016].

We have become aware of Kauffman's work on knots [Kauffman, 2001] and physics [Kauffman, 2013] over a period of ten years or more. It was inevitable that we should at some point want to consider whether we could measure the BiEntropy of knots expressed in binary form.

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BRAIDING AND MAJORANA FERMIONS

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ABSTRACT: In this paper we study the remarkable unitary braid group representations associated with Majorana fermions.

1 INTRODUCTION

In this paper we study a Clifford algebra generalization of the quaternions and its relationship with braid group representations related to Majorana fermions. The Fibonacci model for topological quantum computing is based on the fusion rules for a Majorana fermion. Majorana fermions can be seen not only in the structure of collectivies of electrons, as in the quantum Hall effect, but also in the structure of single electrons both by experiments with electrons in nanowires and also by the decomposition of the operator algebra for a fermion into a Clifford algebra generated by two Majorana operators. The purpose of this paper is to discuss these braiding representations, important for relationships among physics, quantum information and topology. A new result in this paper is the Clifford Braiding Theorem of Section 3. This theorem shows that the Majorana operators give rise to a particularly robust representation of the braid group that is then further represented to find the phases of the fermions under their exchanges in a plane space. The more robust representation in our braiding theorem will be the subject of further work on our part.

4 SEMANTICS OF HIERARCHICAL SPACE-LIKE COMPUTATION

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The concept of *hierarchy* - the controlled reversible hiding of information that supplies both context and locality - is of central interest in Computer Science because it is the key to achieving and maintaining conceptual control over very complex software creations. An example of this is the success of object-oriented programming languages (C++, Java, etc.), which offer the programmer sophisticated tools for building complex hierarchies of software objects, which hierarchies then implicitly funnel higher level functionality down to more detailed levels. Contemporary computer systems would be impossible to implement and maintain without these tools.

However, if one looks "under the hood" at what is actually going on at run-time, all of the programmers' fancy hierarchical constructions have been utterly flattened - by the compiler - into long sequences of nested function calls. The sophisticated object-oriented hierarchical structures at the programming language level are actually just syntactic sugar, disguising the fact that the only *real* hierarchy concept in contemporary software thinking is good old, tried-and-true function composition: $y = f(x)$ and $z = g(y)$ combine into $z = g(f(x))$, which says first do f, then do g.

Or instead of "objects", look at "remote procedure call", or "agents": in the end, virtually *everything* is made out of function composition, with maybe a little memory on the side. Thus, as a hierarchy concept, *function composition is fundamentally sequential*, that is, it really isn't hierarchical at all. Rather, it's fundamentally flat: we ourselves *designed*

This paper contains a new section that has been added to the *Topsy Test* paper in the 2014 ANPA Proceedings. The updated expanded version of this latter paper, *The Topsy Test for Awareness*, is available at RootsOfUnity.org and arXiv.org.

5 THE SUPERPOSITION PRINCIPLE AND BINARY IMAGES IN SPACETIME

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Abstract: Feynman's path integral approach to the Young double-slit experiment makes it clear that phase and the superposition principle are necessary to obtain interference fringes. However, the origins of phase and superposition are not considered in the PI approach, and the relation to classical physics remains elegant but formal. In this work we show that both phase and superposition emerge from special relativity extended to account for binary periodic clocks in piecewise inertial frames. This pushes the peculiarities of quantum propagation back to the interaction of the two relativity postulates. The effects discussed are illustrated by considering images of binary clocks in spacetime diagrams.

introduction

The invention of the path integral by Feynman[1] brought two new features to quantum mechanics. The first was a calculational tool that assembled solutions of Schrödinger's equation via a series whose terms could be visualized as arising from particle trajectories. This had strong intuitive appeal as it borrowed the classical picture of a moving particle producing a continuous path in spacetime. It provided a 'particle' picture to complement the 'wave' picture of Schrödinger's equation.

The second feature was a conceptual sharpening of the contrast between quantum and classical physics through the use of the superposition principle in the path integral context. By analysing the double-slit experiment with the path integral method[2], the non-locality of

6 ABSTRACT RELATIONS AND ALLEGORICAL CATEGORIES

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Abstract: The World is concerned with relationships between entities whether living or inanimate. Representing relationships is therefore a key activity in the physical sciences, life sciences and the social sciences. These may all be modelled formally within information systems. Mathematically relations can be represented as a generalisation of the function in sets but there are a number of problems with such treatment: the fundamental basis of set theory is discrete elements rather than morphisms between sets. There is no inherent natural way in set theory of employing higher-level mappings as is often required for a full solution to real-world problems.

The topos within category theory with its emphasis on morphisms (instead of sets of elements) and with a multilevel architecture is a promising candidate as a structure for representing relations. At recent ANPA meetings the authors have explored the topos with its potential of the Cartesian closed category as the leading contender in meeting requirements for handling relations. Pure mathematics on the other hand has developed the use of the category REL as a categorification of the relation in set theory. However REL is not Cartesian closed which severely limits its usability. Recognising the limitations of REL Freyd and Scedrov, working in set based category theory have developed the 'category of allegories'.

The purpose of the current paper is to understand limitations in REL, to describe allegorical categories and to explore and evaluate their use in comparison with the topos approach in the context of information systems.

A HIERARCHY OF SYMMETRIES

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Abstract. Symmetry occurs at all levels in Nature and provides one of the prime methods of scientific investigation, reflecting its role in our evolution as a species. At the most fundamental level physics appears to be governed by a hierarchy of symmetries, beginning with the Klein-4 group structure connecting the fundamental parameters mass, time, charge and space. The algebras associated with these parameters emerge can be shown to emerge in a sequence which successively generates real numbers, complex numbers, quaternions and multivariate vectors. Remarkably, the combined algebra appears to be identical to that of the Dirac equation of relativistic quantum mechanics, the equation that applies to the point-like fermion, the most fundamental physical state. Other significant symmetries and the symmetry-breaking mechanism between the four physical interactions can be shown to emerge from this foundational symmetric structure.

Introduction

Although humans are not very good observers and find science a struggle, one particular talent developed during our evolution continues to serve us well. This is pattern recognition. The fact that we have evolved to recognise pattern and that pattern, in the form of symmetry, is found in many places at the deepest and most foundational level in physics, suggests that it is a recurring, possibly even fractal, organizing principle in Nature.

Significantly, the symmetries observed in fundamental physics often appear to be ‘broken’, that is disguised or hidden. Space and time provide a classic, but little recognised, case for though they can be combined in a

THE DETERMINISTIC APPROACH TO QUANTUM MECHANICS.

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ABSTRACT

The author of the present work is a follower of the deterministic (causal) interpretation of quantum mechanics. The deterministic interpretation agrees with quantum formalism only if “nonlocal hidden variables” are taken into consideration. It is proven in the work (under assumption that hidden variables exist), that the time-independent Schrödinger equation extracts from solutions of the Hamilton-Jacobi equation only those solutions (1) for which the orbital angular momentum of a particle moving along a closed trajectory is quantized and (2) that satisfy a necessary condition of stability under small perturbation forces. It follows from the latter, in particular, that among solutions of the Schrödinger equation there can be “extra” solutions that despite satisfying the necessary condition are unstable, and, therefore, are not realized in nature.

It is also proven that Bohr orbits are the solutions of the Schrödinger equation for the hydrogen atom under the deterministic approach. Besides that, from this approach it follows that an electron’s spin in an atom precesses and the energy of the precessional motion on the Bohr orbits is determined by the Rydberg’s formula.

In addition, the assumption about the existence of “the hidden variables” leads to the conclusion that structures (quasi-particles) form in the physical vacuum. These structures are the ones that stabilize the motion of electrons in an atom.

1. Nonlocal hidden variables

While the mathematical formalism of quantum mechanics describes many experiments well there are heated discussions among scientists about its physical interpretation. The various interpretations offer dif-

9 BETELGEUSEAN PHYSICS; A POSSIBLE ANSATZ TO A UNIFIED THEORY.

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ABSTRACT: Would extraterrestrial intelligence develop the same description of nature as we humans did? This deep philosophical question is explored. *Betelgeusean Physics*, describes an alternative natural philosophy; it provides known results, and is in accord with experience, even though the fundamental assumptions differ from our accepted understanding.

Mathematics is the physicist language; ideally there should be no physical law in the physics toolbox that is not underpinned mathematically. Yet the very first law of mechanics, which is taught to us at school, has no mathematical explanation. This leads me to ask:

QUESTION 1. *Is there a mathematical explanation for Newton's first law?*

We usually take it for granted that Newton's first law of motion is true, supposedly corroborated by experience. We give it no further thought, yet use it daily to develop complicated mathematical formulations that then become heralded theories, which are all based on a non mathematical assumption. On the premise that the universe is mathematical, explaining Newton first law mathematically should be part of a theory that explains the universe. Have we missed something and started with wrong fundamental assumptions? If yes, then we are precluded not only from explaining a simple law, we are blocked from reaching a unified field theory. This inspired the deep philosophical question:

QUESTION 2. *Would extraterrestrial intelligence develop the same description of nature as we humans did?*

The name *Betelgeusean Physics* originated from my 2012 FQXi essay *Rethinking Geometry and Experience* in which I put two fictional characters from Douglas Adams' Hitchhiker's Guide to the Galaxy, in conversation; Zaphod from 'Betelgeuse Five' and Tricia, brilliant mathematician and astrophysicist.