Exploring the Origin of Gravity

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Abstract

Physicists assume that the origin of gravity is still obscure. However, since more than two centuries the essence of the origin of gravity occurs in scientific papers. The interpretation of this root is not straightforward and telling the whole story requires a solid mathematical model.

Introduction

Newtons gravitation law describes the attraction of point-like masses that locate in a flat Euclidean field. The law does not indicate that the owner of mass deforms the field that embeds this owner. The gravitation theory of Einstein brought this insight. That theory speaks about the deformation of spacetime, but in physical reality, the deformed field is our living space, and that field can be described by a dynamic function of a flat Euclidean field. Spacetime is a coordinate system in which observers perceive their environment. This paper describes the field by a quaternionic function, which applies a quaternionic parameter space. A hyperbolic transform that was formulated by Lorentz converts the field to spacetime coordinates.

Theoretical physicists keep stating that a discrepancy exists between quantum physics and gravitation theory. One of the reasons locates in the scale of the theories that handle these subjects. Quantum physics treats quantum scales, and gravity shows its behavior merely at cosmic scales. However, it is well known that even elementary particles own an amount of mass and for that reason, they must deform their living space a bit. At the same time, quantum physics does not use the fact that elementary particles deform their environment. At cosmic scales, the consequences of the uncertainty of quantum scale effects can be ignored. This discrepancy can only be resolved by no longer ignoring these tiny effects and instead analyze what happens when the tiny effects cooperate into a significant contribution.

When looking at very tiny scales that are much smaller than the scale of an elementary particle, some phenomena occur that withdraw from any kind of observation. Solutions of the wave equation exist that by no means can be detected in isolation. Probably, it is the reason that all involved scientists ignored these solutions. The concerned solutions were treated as curiosities and not as physical phenomena. However, physical reality appears to arrange these phenomena in huge quantities so that they produce a significant and observable impact. In fact, the elementary particles and the photons are examples of objects that nature constructs in this way.

Modeling platform

The approach that we take here is based on a modeling platform that develops from a simple relational structure that was discovered less than a century ago by two scholars that were searching for a platform in which the behavior of tiny quantum objects can be modelled [1]. Garrett Birkhoff was a specialist in relational structures that mathematicians call lattices. John von Neumann was a broadly oriented scientist that was analyzing topologies that would fit the requirements of quantum systems. Together they detected quantum logic, which is a lattice that closely resembles the already known lattice that describes classical logic. Where the elements of classical logic are logical propositions, the duo concluded that the closed subspaces of a recently discovered topology that mathematicians call a separable Hilbert space represent the elements of quantum logic. Together, the closed subspaces span the separable Hilbert space. The mathematicians gave quantum logic the name orthomodular lattice. Thus, the orthomodular lattice and the separable Hilbert space form the same relational structure. Hilbert spaces are extensions of vector spaces that apply a number system for specifying the inner product of pairs of Hilbert vectors. Mathematicians quickly detected that Hilbert spaces can only cope with number systems that are division rings. Only three suitable division rings exist. The set comprises the real numbers, the complex numbers and the quaternions. Due to their four dimensions, quaternionic number systems exist in multiple versions that distinguish in the way that coordinate systems can sequence them. In fact, a single vector space can support numerous separable Hilbert spaces that vary in the selected version of the number system. Operators map the separable Hilbert spaces onto themselves. If a normed Hilbert vector maps onto the same ray, then the operator adds via the inner product an eigenvalue to the corresponding eigenvector. In this way a reference operator can manage an eigenspace that acts as a parameter space that represents all rational values of the selected version of the number system. A quaternionic function can apply this parameter space to construct an eigenspace of a defined operator that applies the target values of the quaternionic function as its eigenvalues.

Every infinite dimensional separable Hilbert space owns a unique non-separable companion Hilbert space that features operators which own continuums as eigenspaces. The eigenspace of the reference operator becomes the full continuum of the selected version of the quaternionic number system.

In this way the modeling platform combines Hilbert space operator technology with quaternionic function theory and indirectly, with quaternionic differential and integral calculus. Together these Hilbert spaces form a very powerful modeling platform.

The non-separable Hilbert space and its separable companion Hilbert space act as combined background platform. The floating platforms act as living spaces of elementary objects.

Super-tiny objects

The super-tiny objects are field excitations that are the result of point-shaped artifacts that trigger the carrier field. We describe the field by a quaternionic function that applies a quaternionic parameter space. Since the carrier field obeys quaternionic first and second order partial differential equations, the super-tiny objects do what the paper describes below. One of the second order partial differential equations is the quaternionic equivalent of the well-known wave equation. Googling for the wave equation and the Poisson equation shows that these equations and their solutions were discovered more than two centuries ago. Because of their four dimensions, quaternionic number systems exist in different versions that distinguish in their symmetry or in the handedness of the product rule. The point-shaped artifact is a quaternion that is taken from another version of the quaternionic number system that has a different symmetry or a different handedness than the version of the quaternionic number system that the quaternionic function applies. Embedding of a quaternion that breaks the symmetry in an isotropic way can result in a spherical pulse response. Also a break in the right, or left-handedness of the product rule can cause a spherical pulse response of the embedding field. The spherical pulse response is a spherical shock front. During travel, the front keeps its shape, but its amplitude diminishes as 1/r with distance r from the trigger location. Over time the front integrates into the Green’s function of the field. The shape of the Green’s function follows the amplitude of the front. It is a solution of the Poisson equation, while the spherical shock front is a solution of the wave equation. The Green’s function owns some volume, and that volume is locally injected into the field. The dynamics of the pulse response show that the injected volume spreads over the field. This means that the local deformation of the field that was caused by the injected volume, quickly fades away. However, the added volume becomes part of the field and persistently expands the field.

Shock fronts only occur in odd dimensions. Thus, apart from spherical shock fronts, also one-dimensional shock fronts occur. During travel, these fronts not only keep their shape. They also keep their amplitude. Thus, during the trip, nothing changes in the integrity of the one-dimensional shock fronts. Arranged equidistantly in strings these shock fronts can implement the functionality of photons.

Two-dimensional shock fronts do not exist, but the two-dimensional actuator can produce an excitation that looks much like the effect of throwing a stone in the center of a pond.

Despite the name wave equation, the shock fronts are neither waves nor wave packages. During travel, wave packages disperse. The shock fronts do not disperse. During travel, they keep the shape of their front.

Ensembles

Nature appears to apply the shock fronts in huge ensembles. Long strings of equidistant one-dimensional shock fronts that obey the Einstein-Planck relation $E = h\,\nu$ implement the functionality of photons. This implicates that all one-dimensional shock fronts carry a standard bit of pure energy. It also implicates that all photons share the same emission duration. The emission duration is set by Planck's constant and is managed by the emitter. Since shock fronts travel with fixed speed c, the spatial length of photons is also fixed by the emitter.

Elementary particles reside on a private platform that is implemented by a separable Hilbert space, and that platform provides them with a private version of the quaternionic number system that spans a private parameter space. A private stochastic process generates the hop landing locations of the particle on this parameter space. These locations form a hopping path and a hop landing location swarm. The process owns a characteristic function that ensures that the swarm is dense and coherent. It equals the Fourier transform of the location density distribution that describes the hop landing location swarm. The embedding process maps the swarm onto the embedding field. The parameter space of the platform of the particle floats over the parameter space of the function that describes the embedding field. Thus, the swarm moves as one unit over the embedding field. A displacement generator describes this movement and can be added in the form of a gauge factor to the characteristic function of the stochastic process. Together they represent the platform and the hop landing location swarm in Fourier space.

The local deformation of the embedding field by the swarm of overlapping spherical pulse responses equals the convolution of the Green's function of the embedding field and the location density distribution of the swarm. If the location density distribution is close to a Gaussian distribution, then the deformation will look like ERF(r)/r. At a small distance from the swarm, it will already look like the usual 1/r shape function of the gravitation potential, but the deformation is a perfectly smooth function that does not feature the central singularity.

Several types of elementary particles exist. Each type corresponds to a type of version of the quaternionic number system. Important is the difference between the symmetry of the platform version and the symmetry of the background version. This difference results in the electric charge and the color charge of the platform. These charges characterize the platforms and not the swarms. The particle that corresponds to the swarm inherits the properties of the platform.

Embedding

The embedding continuum is the eigenspace of an operator that resides in a non-separable Hilbert space. It is the unique companion of an infinite dimensional separable Hilbert space that acts as the background platform and provides the background parameter space. This separable Hilbert space embeds fluently into the non-separable Hilbert space. They share the same parameter space, but the separable Hilbert space only uses the rational elements of the number system.

The floating platforms are represented by separable Hilbert spaces. The separable Hilbert space applies the selected version of the quaternionic Hilbert spaces for specifying its inner products, and indirectly this selects the kind of eigenvalues that operators support. A reference operator manages the private parameter space. Another operator manages the hop landing locations as a combination of a time stamp and a three-dimensional spatial location. The embedding of the floating platforms into the embedding continuum is an ongoing process in which for each platform step by step the content of the hop landing location storage bins is embedded in the embedding continuum.

The stochastic processes control the selection of the storage bins that will be embedded. The stochastic processes are combinations of a genuine Poisson process and a binomial process. A spatial Point Spread Function that equals the location density distribution of the hop landing location swarm implements the binomial process. The characteristic function of the stochastic process equals the Fourier transform of the Point Spread Function. It is the Optical Transfer Function of the stochastic process. It controls the coherence of the generated hop landing location swarm.

Floating platform

On the floating platform the stochastic hopping path is closed. This means that the hop landing location swarm is recurrently regenerated. The deformation of the embedding field is defined by the convolution of the Green's function of the embedding field and the location density distribution of the swarm. Thus, the Green's function blurs the location density distribution. The result is the gravitation potential of the elementary particle.

The movement of the platform can be characterized by a displacement generator and this generator can be represented by a gauge factor that can be added to the characteristic function of the stochastic process. This combination describes the particle as a single moving object.

Modules

Elementary particles are elementary modules. Together the elementary particles constitute all modules that exist in the universe. Some of the modules constitute modular systems.

Composed modules own a stochastic process that governs their composition. This stochastic process also owns a characteristic function. That characteristic function equals a dynamic superposition of the characteristic functions of the stochastic processes that control the composing modules. The superposition coefficients can act as gauge factors that represent displacement generators. In this way the superposition coefficients control the internal locations of the components. It is a dynamic location. Since the internal movements stay within the module they are internal oscillations. The overall stochastic process controls the coherence of the footprints of the constituents. An extra gauge factor that combines with the overall characteristic function acts as a displacement generator for the whole module and ensures that it moves as a single object. With other words, the characteristic processes and the gauge factors control the binding of the components of the module.

The conclusion of this sketch is that superpositions occur in Fourier space and not in configuration space.

Dark quanta

In isolation and in ensembles of spuriously distributed objects the shock fronts represent nature's dark quanta. The spherical shock fronts can represent dark matter and the one-dimensional shock fronts may represent dark energy.

A halo of spurious spherical shock fronts that surrounds a series of coherent swarms of spherical shock fronts can implement gravitational lensing in a way that is like the swarms themselves can cause gravitational lensing. The Fourier transform of the location density distribution of the spherical pulse responses acts as an Optical Transfer Function that qualifies the imaging process. A similar phenomenon in optics is known as veiling glare.

Origin of gravitation

The origin of gravitation locates in the capability of spherical shock fronts to inject a bit of volume into the field that acts as our living space. On itself this mechanism does not cause a persistent deformation of our living space. The effect of each spherical shock front quickly fades away. Only the expansion of our living space stays. Special mechanisms must cause a recurrent regeneration of spherical shock fronts that overlap in time and in space, such that a persistent deformation is obtained.

The stochastic processes that result from the ongoing embedding of separable Hilbert spaces into a non-separable Hilbert space perform this job.

The requirement that the actuator of the spherical shock front must be isotropic represents the reason of existence of color confinement.

References

The Hilbert Book Model Project [2] explores the mathematical foundation of physical reality. An e-print archive [3] contains documents that highlight certain aspects of this project.

[1] "Structure in Physical Reality"; http://vixra.org/abs/1802.0086

[2] https://en.wikiversity.org/wiki/Hilbert_Book_Model_Project

[3] http://vixra.org/author/j_a_j_van_leunen