Dark objects

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Summary

Dark objects are field excitations that are caused by point-shaped actuators. The carrier field reacts with shock fronts. The effect of these excitations is so tiny that in isolation these phenomena cannot be observed.

1 Modeling platform

Treating the structure and behavior of dark objects requires a suitable modeling platform. For that purpose, we chose the base model of the Hilbert Book Model. That base model consists of a series of quaternionic separable Hilbert spaces that all share the same underlying vector space.

Each quaternionic separable Hilbert space selects a version of the quaternionic number system for specifying the inner product of pairs of vectors. The eigenvalues of operators use the same version of the number system. This version is maintained in the eigenspace of a reference operator. That eigenspace acts as the private parameter space of the Hilbert space. The selected version of the quaternionic number system is determined by the way that a Cartesian coordinate system and a polar coordinate system sequence the members of the number system.

A background platform consisting of an infinite dimensional separable Hilbert space and its non-separable Hilbert space that embeds its separable companion applies a reference Cartesian coordinate system and a reference polar coordinate system. All applied Cartesian coordinate systems must apply axes that are parallel or perpendicular to the axes of the reference Cartesian coordinate system. In this way, the selected coordinate system determines the symmetry of an applied Hilbert space in relation to the symmetry of the background platform. The differences between the symmetry of the floating platform and the symmetry of the background platform determine the symmetry-related properties of the floating platform. One of these properties is a symmetry-related charge that locates at the geometric center of the private parameter space. This symmetry related charge combines electric charge and color charge. Further, the selected version of the quaternionic number system is determined by the handedness of the arithmetic of the number system.

Quaternionic eigenvalues can act as storage bins that archive the dynamic geometric data of a point-like object as the combination of a time-stamp and a three-dimensional location in Euclidean format.

An infinite dimensional quaternionic separable Hilbert space acts as background platform that provides a background parameter space. All other quaternionic separable Hilbert spaces in the system float with the geometric center of their parameter space over the background parameter space. All applied quaternionic separable Hilbert spaces share the subspace of the underlying vector space that corresponds to the real part of their parameter space. A subspace of the underlying vector space scans as a function of a progression parameter over the full vector space. This scanning subspace divides the structure of the base model between a historic part, the current static status quo, and a future part.

Due to its infinite number of dimensions, the background quaternionic separable Hilbert space owns a unique non-separable Hilbert space that embeds its separable companion. Together they constitute the background platform of the base model. The eigenspaces in the separable Hilbert spaces are countable. The non-separable Hilbert space also provides operators that own continuum eigenspaces.

The reference operators offer the opportunity to specify a category of defined operators that reuse the eigenvectors of the reference operators and use the target values of a selected quaternionic function for the corresponding parameter value as new eigenvalues. In this way, the eigenspaces of these defined operators represent fields that are described by the selected quaternionic function. In the separable Hilbert spaces these fields are represented by countable sets of the sampled rational values of the field.

2 Embedding

Each of the floating separable Hilbert spaces harbors an elementary particle. A footprint operator archives the life story of the elementary particle in the eigenspace of this footprint operator. A point spread function defines the imaginary part of the eigenvalues of the footprint operator. A cyclic random distribution defines the real parts of these eigenvalues. After sequencing of these real parts, the eigenspace of the footprint operator tells the life story of the elementary particle as an ongoing hopping path that recurrently regenerates a coherent hop landing location swarm. Each random value is used only once. The point spread function equals the square of the modulus of the wavefunction of the particle.

Apart from the floating of the separable Hilbert spaces of the elementary particles, the dynamism of the model is caused by the ongoing embedding of the eigenvalues of the footprint operator into the continuum eigenspace of a dedicated operator, which resides in the non-separable background Hilbert space. This continuum is a field that represents the common living space of the model. Physics calls this living space the universe. A quaternionic function describes this field.

3 Defining dark objects

Dark objects are field excitations. Point shaped pulses generate these excitations. The effect of dark objects is so tiny that in isolation these objects can in no way be observed. And that includes detection by the most sophisticated equipment. That does not mean that these objects cannot become noticeable when they operate in huge coherent ensembles. In fact, all discrete objects in the universe are constituted by these dark objects.

More than two centuries ago, dark objects were already described theoretically. They are pulse responses that are solutions of second order partial differential equations.

Two second-order partial differential equations describe the behavior of dark objects.

$$\varphi=(\partial^2/\partial\tau^2 \pm \langle\nabla, \nabla\rangle)\psi$$

A third equation skips the first term

$$\varphi= \langle\nabla, \nabla\rangle\psi$$

In fact, these equations are quaternionic differential equations. Thus, φ and ψ are quaternionic functions that own a scalar real part and an imaginary vector part. The solutions are quaternionic functions.

The equation using the − sign is the quaternionic equivalent of the wave equation. The other equation follows from

$$\zeta=\nabla^*\phi=(\nabla_r-\boldsymbol{\nabla})\,(\nabla_r+\boldsymbol{\nabla})\,(\psi_r+\boldsymbol{\psi})=\{\nabla_r\nabla_r+\langle\boldsymbol{\nabla},\boldsymbol{\nabla}\rangle\}\,(\psi_r+\boldsymbol{\psi})=\{\nabla_r\nabla_r+\langle\boldsymbol{\nabla},\boldsymbol{\nabla}\rangle\}\,\psi$$

This second equation does not offer waves as solutions. The equation can be split into two first-order partial differential equations $\phi=\nabla\psi$ and $\zeta=\nabla^*\phi$

The dark objects behave as shock fronts and operate only as odd dimensional field excitations. During travel, all shock fronts keep the shape of the front.

3.1 One-dimensional shock fronts

The one-dimensional shock fronts also keep their amplitude. Consequently, the one-dimensional shock fronts can travel huge distances without losing their properties. Combined equidistantly in strings they represent the functionality of photons. This means that the one-dimensional shock fronts are the tiniest possible packages of pure energy.

Depending on the PDE the solutions can be described by different equations. The solution for the wave equation is

$$g(\mathbf{q}\,,\tau)=f(c\,\tau\pm|\mathbf{q}-\mathbf{q}_\circ|)$$

This solution cannot represent polarization.

The solution for the other equation is

$$g(\mathbf{q}\,,\tau)=f(c\,\tau\pm|\mathbf{q}-\mathbf{q}_\circ|\,\mathbf{i})$$

The vector $\mathbf{i}$ can indicate the polarization of the shock front.

A photon is a string of equidistant energy packages that obeys the Einstein-Planck relation

$$E = h\,\nu.$$

Since photons possess polarization, they use the second solution for their energy packages. Thus, the constituents of photons are not solutions of the wave equation.

3.2 Green’s function

One of the solutions of the Poisson equation is the Green’s function

$$g(\mathbf{q})=1/|\mathbf{q}-\mathbf{q}_\circ|$$

$$\boldsymbol{\nabla}g(\mathbf{q})=(\mathbf{q}-\mathbf{q}_\circ)/|\mathbf{q}-\mathbf{q}_\circ|^3$$

$$\langle\boldsymbol{\nabla},\boldsymbol{\nabla}\rangle\,g(\mathbf{q})=\langle\boldsymbol{\nabla},\boldsymbol{\nabla}g(\mathbf{q})\rangle=4\pi\delta(\mathbf{q}-\mathbf{q}_\circ)$$

Thus, the Green’s function is a static pulse response under purely isotropic conditions.

3.3 Three-dimensional shock front

The three-dimensional shock fronts require an isotropic trigger. These field excitations integrate over time into the Green's function of the field. That function has some volume, and the pulse response injects this volume into the field. Subsequently, the front spreads the volume over the field. The corresponding solution of the wave equation is

$$g(r\ ,t)=f(c\,\tau \pm r)/r$$

The parameter r is the radius of the spherical front. No other field excitation that is generated by a point-like actuator can deform its carrier field.

The other second order PDE offers

$$g(\mathbf{q}\ ,\tau)=f(c\,\tau \pm |\mathbf{q}-\mathbf{q}_{\circ}|\ \mathbf{i})/|\mathbf{q}-\mathbf{q}_{\circ}|$$

Here $\mathbf{i}$ can be interpreted as a spin vector.

Thus, the initial deformation quickly fades away, but the expansion of the field stays. Having the capability to deform the carrier field corresponds to owning a corresponding amount of mass. This means that temporarily, the spherical pulse response owns some mass. This mass vanishes, but the expansion stays.

A huge coherent recurrently regenerated swarm of spherical pulse responses can generate a significant and persistent deformation that moves with the swarm. This happens in the footprint of elementary particles. The spherical pulses are generated by the hop landing locations of the particle. The hopping path forms a hop landing location swarm that is described by a location density distribution. This distribution equals the square of the modulus of the wavefunction of the particle.

If the location density distribution is a Gaussian distribution, then the resulting deformation of the embedding field equals

$$g(r)= mG\ ERF(r)/r$$

The error function divided by its argument is the result of the convolution of the Gaussian distribution and the Green's function. Here m represents the mass of the particle. G corrects for physical units.

Far enough from the center this formula approaches

$$g(r)\approx mG/r$$

This is the well-known formula for the gravitation potential of massive objects. The value of m corrects for the imperfect overlap of the contributing pulse responses. The mass m depends on the density of the hop landing location swarm and on the speed at which the injected volume fades away.

The two formulas represent a more general principle. Physicists use the second formula to define the mass of more arbitrary distributions of the Green's function. The above explanation indicates that this mass stands for the equivalent of the amount of volume that was injected into the field in the covered regeneration cycle. The Green's function is the field response to a Dirac pulse. The spherical shock front is the field response to the combination of a Dirac pulse in the spatial domain and a step function in the time domain. Only the volume of each Green's function adds to the value of the mass of the distribution. The principle also uses the fact that far enough of the center and independent of the shape of the analyzed pulse distribution, the shape of the integral deformation conforms to the second formula.

3.4 Generations

Fermions exist in three generations that differ in their mass. Currently, nobody has a suitable explanation for the extra generations. It is not clear whether the explanation must be sought in a longer regeneration cycle or in a higher packing density of the pulses.

3.5 Inertia

The mechanism that recurrently regenerates the footprint of analyzed pulse distribution will keep the shape of this footprint constant. We use the fact that the distribution moves as one unit with the same speed $\mathbf{v}$. In fact, the whole parameter space of the distribution moves with this speed relative to the background parameter space. This enables the definition of a new field that installs inertia. The real part of the field is constituted by the convolution of the pulse distribution and the Green's function. This describes the deformation of the field. The imaginary part of the new field is the vector field that represents the moving pulses. This new field is supposed to keep its total change equal to zero.

$$\nabla \equiv \nabla_r + \boldsymbol{\nabla}$$

$$\boldsymbol{\nabla} \equiv \{\partial/\partial x, \partial/\partial y, \partial/\partial z\}$$

$$\nabla_r \equiv \partial/\partial \tau$$

In the quaternionic differential calculus, differentiation is a multiplier operation:

$$\phi = \phi_r + \boldsymbol{\phi} = \nabla\psi \equiv (\nabla_r + \boldsymbol{\nabla})\,(\psi_r + \boldsymbol{\psi}) = \nabla_r\psi_r - \langle\boldsymbol{\nabla},\boldsymbol{\psi}\rangle + \boldsymbol{\nabla}\psi_r + \nabla_r\boldsymbol{\psi} \pm \boldsymbol{\nabla}\times\boldsymbol{\psi}$$

Here ϕ equals the total change of field ψ. This change contains five terms.

Here $\psi_r = m\,G/|\mathbf{q}-\mathbf{q}_\circ|$ and $\boldsymbol{\psi}=\mathbf{v}$. For this field most terms in the first order partial differential equation are zero. The only relevant terms that are supposed to compensates each other are

$$\boldsymbol{\nabla}\{m\,G/|\mathbf{q}-\mathbf{q}_\circ|\} + \nabla_r\mathbf{v} = 0$$

$$m\,G\,(\mathbf{q}-\mathbf{q}_\circ)/|\mathbf{q}-\mathbf{q}_\circ|^3 = -\partial\mathbf{v}/\partial\tau = -\mathbf{a}$$

Two massive objects with masses m_1 and m_2 with their centers located at $\mathbf{q}_1$ and $\mathbf{q}_2$, will attract each other with force $\mathbf{f}$

$$\mathbf{f} = m_1\,m_2\,G\,(\mathbf{q}_1-\mathbf{q}_2)/|\mathbf{q}_1-\mathbf{q}_2|^3$$

This is Newton's formula for the gravitation force.

4 Modules

All elementary particles are elementary modules. Together, they constitute all other modules and some modules constitute modular systems. A private stochastic process that owns a characteristic function controls the recurrent and coherent regeneration of the elementary particles. This process can be considered as the combination of a Poisson process and a binomial process. The binomial process is implemented by a spatial point spread function, which is the Fourier transform of the characteristic function of the process. A private stochastic process also controls the recurrent regeneration of composed modules. This is another type of stochastic process. It also owns a characteristic function, but that function equals a dynamic superposition of the characteristic functions of the components of the module. The superposition coefficients act as displacement generators and in this way, they determine the internal positions of the components. Thus, all modules obtain their definition in Fourier space. Both elementary and composed modules own a displacement generator that add to the characteristic function of the stochastic process.

It appears that W_+, W_-, and Z particles are incapable of forming components of composed modules. It might be so that these bosons are themselves composed modules. That would mean that only fermions can be elementary modules.

5 Color confinement

Spherical shock fronts require an isotropic pulse. The pulse is caused by a symmetry breaking between the embedded hopping location and the embedding field. Not all elementary particles feature a symmetry that breaks the symmetry of the embedding field in an isotropic way. These elementary particles belong to the quark family. Quarks must first combine into hadrons before they can produce a deformation. Quarks have a color charge. In isolation, they have no mass. Hadrons are colorless conglomerates of quarks.

6 Less coherent ensembles of dark objects

The dark objects exist already as constituents of known objects. This does not forbid that these objects also occur in much less coherent ensembles. For example, a halo of spherical shock fronts around a star can cause gravitational lensing.

Theoretical physicists knew these objects for centuries, but they were neglected because, in isolation, these objects cannot be detected.

It is a shame that nowadays these dark objects still stay ignored. The equations that describe them can be found in books and papers that treat fundamental optics.

7 The effects of dark objects

The effect of dark objects can be estimated from the combined effect that they generate in the objects that they constitute.

Since at the instant of their emission photons obey the Einstein-Planck relation

$$E = h\,\nu.$$

all photons that are emitted at the same instant must share the same spatial length and the same emission duration. The author does not know reliable measurements of photon lengths. The energy of the annihilation photon of an electron indicates that each 10^{-20} second a new energy package of that photon is emitted. The number of energy packages inside this annihilation photon must equal the number of spherical shock fronts that constitute the footprint of the electron. If that number equals about 10^{10}, then the length of a photon is about 3 cm and the regeneration cycle time of an electron will equal 10^{-10} second. The energy of a separate one-dimensional shock front will be about 500 micro eV. The mass contribution of one spherical shock front to an electron will be about 10^{-30}kg. This mass fades away within a regeneration cycle.

The electron spin resonances are of the order of 10^{-10}Herz. Thus, the spin can switch at every regeneration cycle. Nuclear spin resonates much faster. This indicates that the spin vector of the spherical shock fronts acts as the resonator.

These estimates show that, in isolation, these dark objects are not detectable by measuring instruments.

7.1 Gravitational waves, shock fronts and wave packages

The solutions of a homogeneous second order partial differential equation can superpose into solutions of that equation. When travelling all pulse responses are solutions of the homogeneous second order partial differential equation. Periodic actuators cause waves or wave packages that are solutions of the wave equation.

Probably what are called "gravitational waves" are superpositions of spherical pulse responses.

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