The Hilbert Book Model

A simple Higgsless model of fundamental physics

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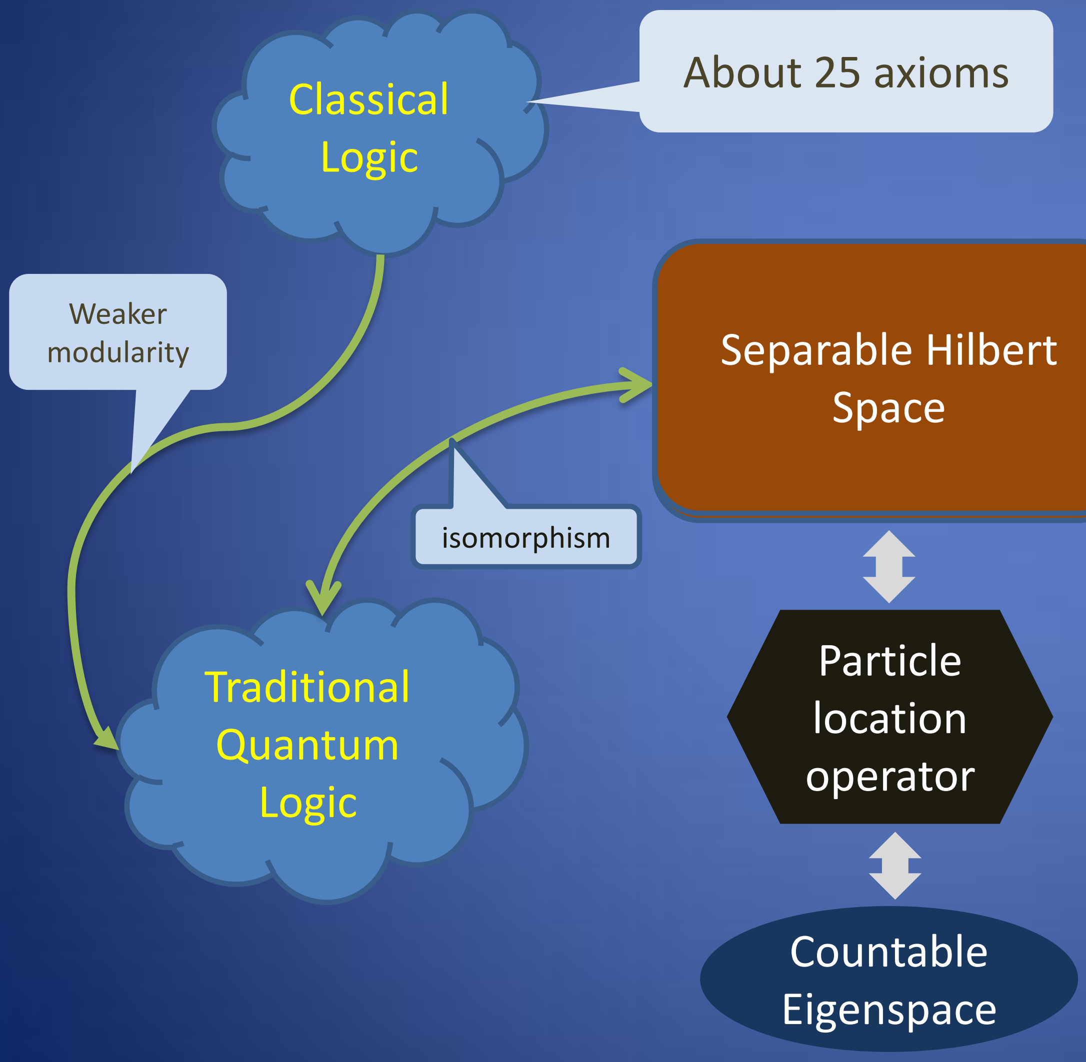
First Model



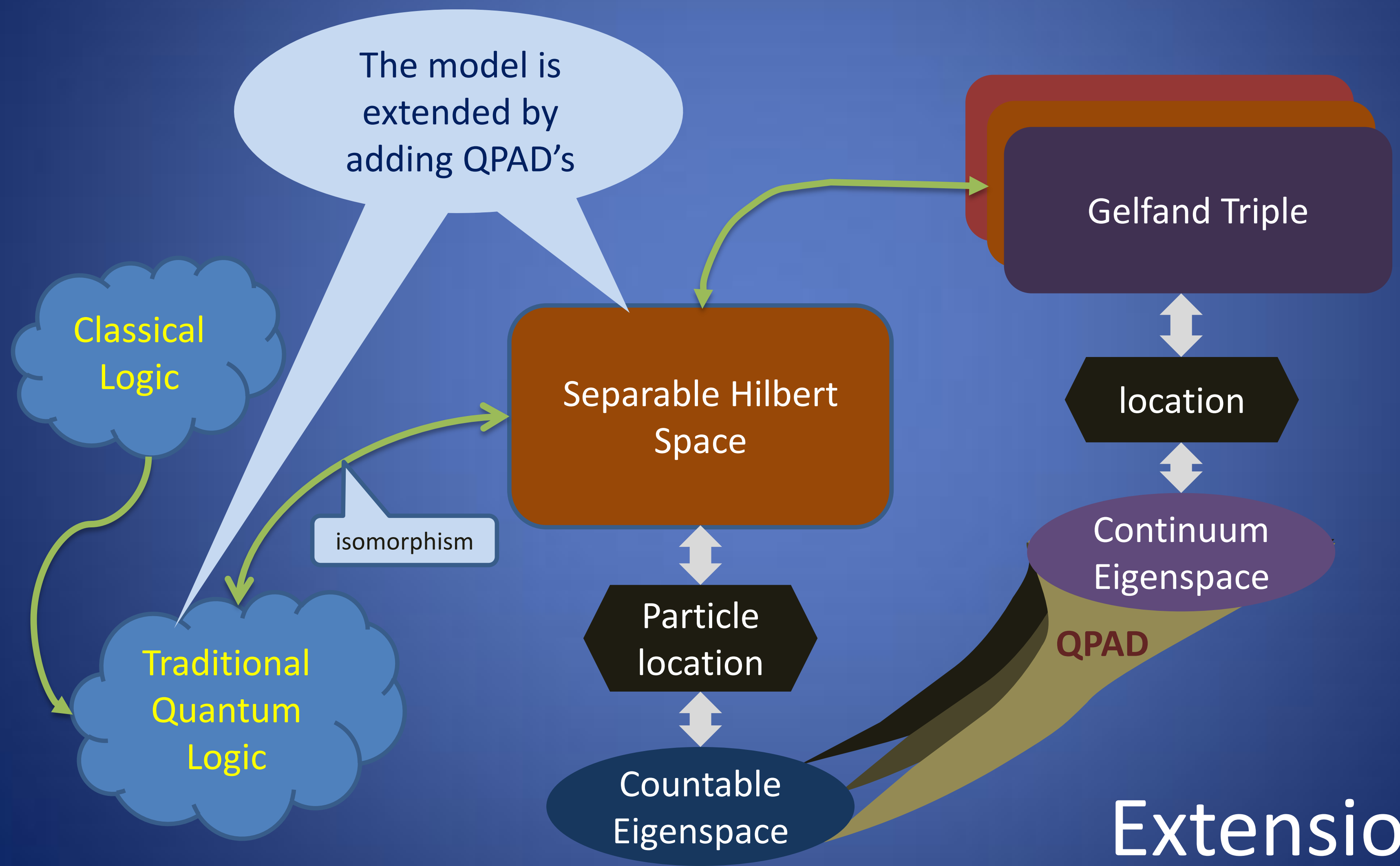
Only static status quo

&

No fields

HBM Page

Static Status Quo of the Universe



Extension

QPAD

Quaternionic Probability Amplitude Distribution

Probability Amplitude Distributions

Wave functions are probability amplitude distributions.

Instead of Complex Probability Amplitude Distributions (CPAD’s) , the HBM uses the more flexible QPAD’s

Magic Wand

= QPAD + Hilbert eigenvector

QPAD's I

- A QPAD is a quaternionic probability amplitude distribution.
- Wave function QPAD's link Hilbert eigenvectors to a continuum eigenspace in the Gelfand triple.
- Operators in a separable Hilbert space have a countable number of eigenvalues

Nature’s Strategy

This represents the way that nature solves the dilemma that a potentially much larger set of observations that reside in a continuum must fit onto a restricted set of problem carriers (the Hilbert eigenvectors)

QPAD's II

The real part of the QPAD is a "charge" density distribution.

The imaginary part is a "current" density distribution.

The squared modulus of the QPAD describes the distribution of the probability of the presence of the carrier of the charges.

A static QPAD can still have currents = moving charges!

QPAD’s III

The charge can be any property of the carrier or even the complete ensemble of properties of the carrier (except location).

The parameter space of the QPAD is a coordinate system.

QPAD’s extend over the whole parameter space.
(cover the whole universe)

Typical Source QPAD I

An isotropic source QPAD is generated by a Poisson process.

The result is a Poisson distribution of charge carriers.

If the efficiency of the process is high enough, then the distribution approaches a Gaussian distribution.

The currents are directed outward.

Typical Source QPAD II

The charges go together with a potential that has the form of an Error function. At a small distance from the center, this function can be approached by $1/r$.
(No singularity occurs!)

The produced carriers can be interpreted as tiny patches of the parameter space.

In this way the QPAD may influence the curvature of the parameter space

The background QPAD is an example of an isotropic source QPAD

Typical Drain QPAD

Similar to source QPAD, but the currents are reversed.

Here, the carriers ride on parameter space patches that were stolen from the carriers in the tails of other QPAD's

An example of an isotropic drain QPAD is the average wave function QPAD.

Hybrid QPAD's

Some QPAD's are a mixture of a source QPAD in one or two dimensions and a drain QPAD in the other dimension(s).

Examples are formed by the wave functions of neutrinos and down-quarks.

Oscillating QPAD's

If QPAD's are not coupled, then they must oscillate. Otherwise, their value is zero.

These QPAD's oscillate between source and drain modes.

Or they constitute plain waves.

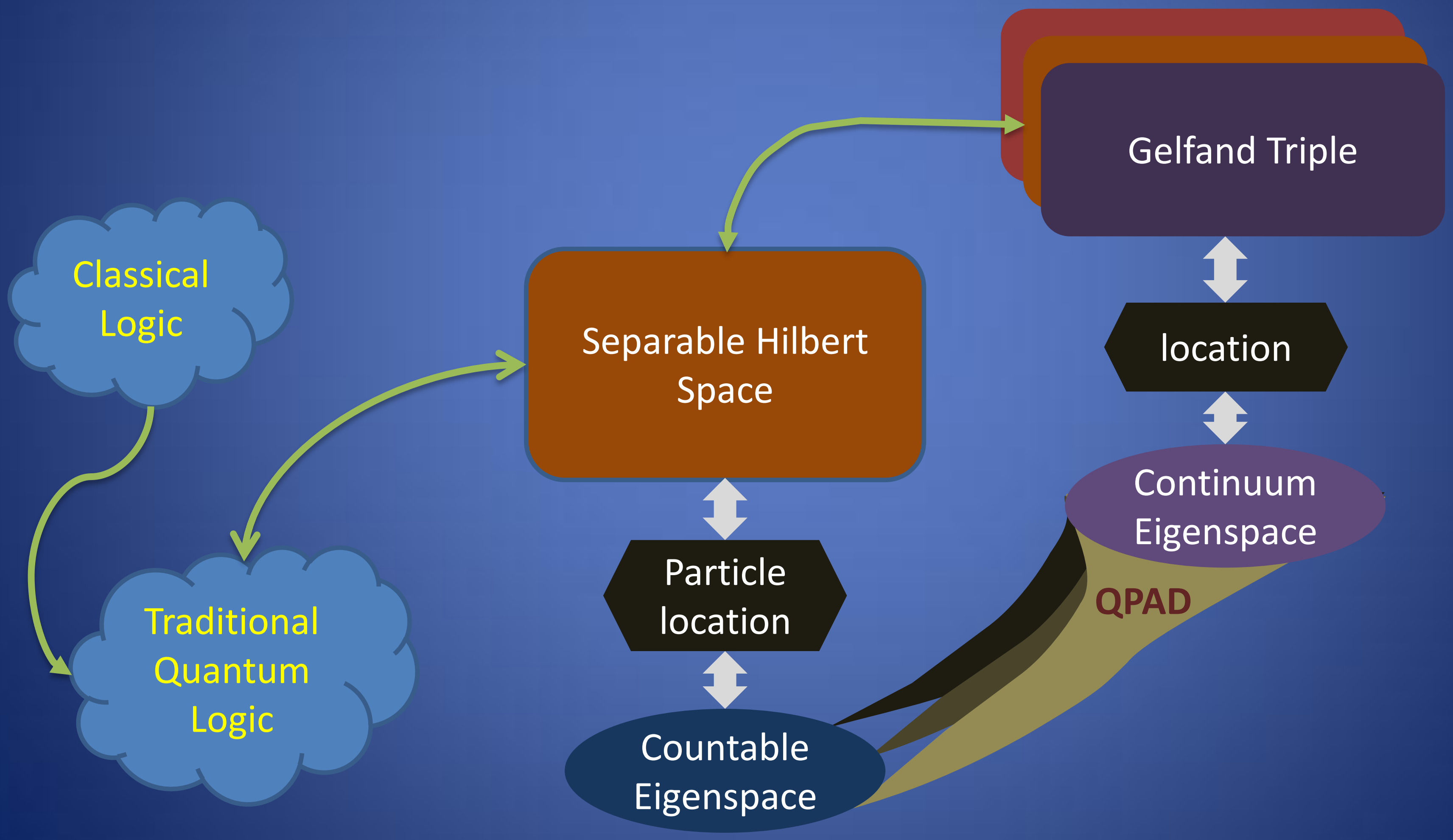
Examples are formed by photons and gluons.

Dynamics

The way the HBM implements dynamics

Single HBM Page

Static Status Quo of the Universe



Dynamics

- The HBM implements dynamics by considering a sequence of HBM pages that each represents a static status quo of the whole universe.

- This renders the model as a book:

The Hilbert Book Model

- The page counter acts as the progression parameter.

Spacetime

- The progression parameter differs from our common notion of time.
- Space and time are only related when an observed item moves with respect to the observer.
- Displacements are governed by the displacement group.

Uniform displacements

- When uniform displacements are involved, the properties of the displacement group lead to three cases:
  - Displacements described by a Galileo transformation
  - Displacements described by a Lorentz transformation (when a maximum speed exists)
  - A non-physical case where space can be transformed into time and vice versa

Notions of time

- The Lorentz transform introduces two notions of time:
  - Proper time = time of the observed item
  - Coordinate time = time of the observer
- The Lorentz transform introduces several special features:
  - Time dilatation
  - Length contraction

Progression

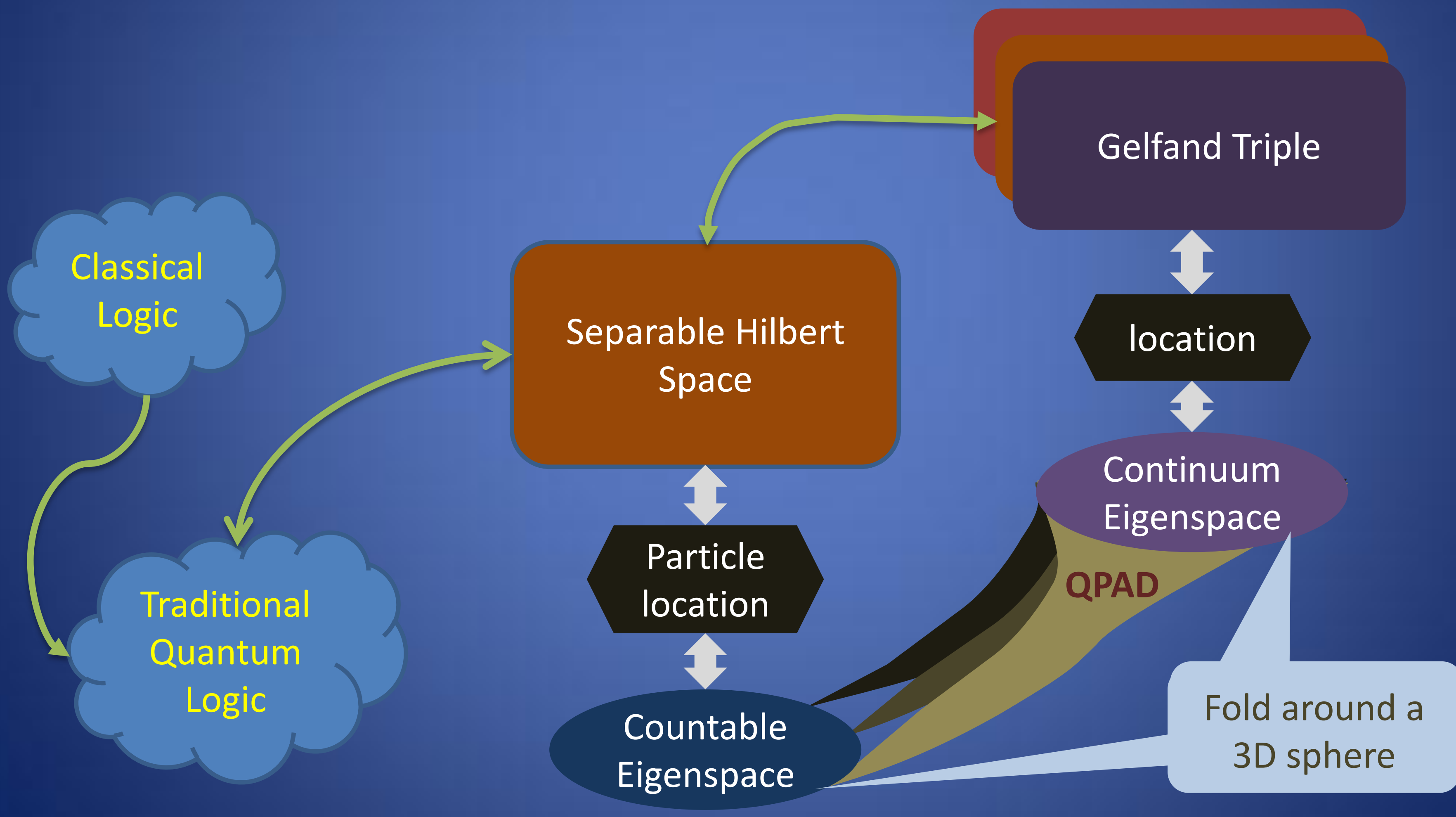
- If not otherwise stated the HBM uses the progression parameter.
- In some cases it uses the spacetime step, which characterizes the Minkowski space:
- $ds^2 = dt^2 - dq^2/c^2$
- ds = spacetime step
- dt = coordinate time step
- dq = position step
- $\tau = \int_{path} ds = \int_{path} \sqrt{dt^2 - dq^2/c^2}$ = proper time

The QPAD-sphere

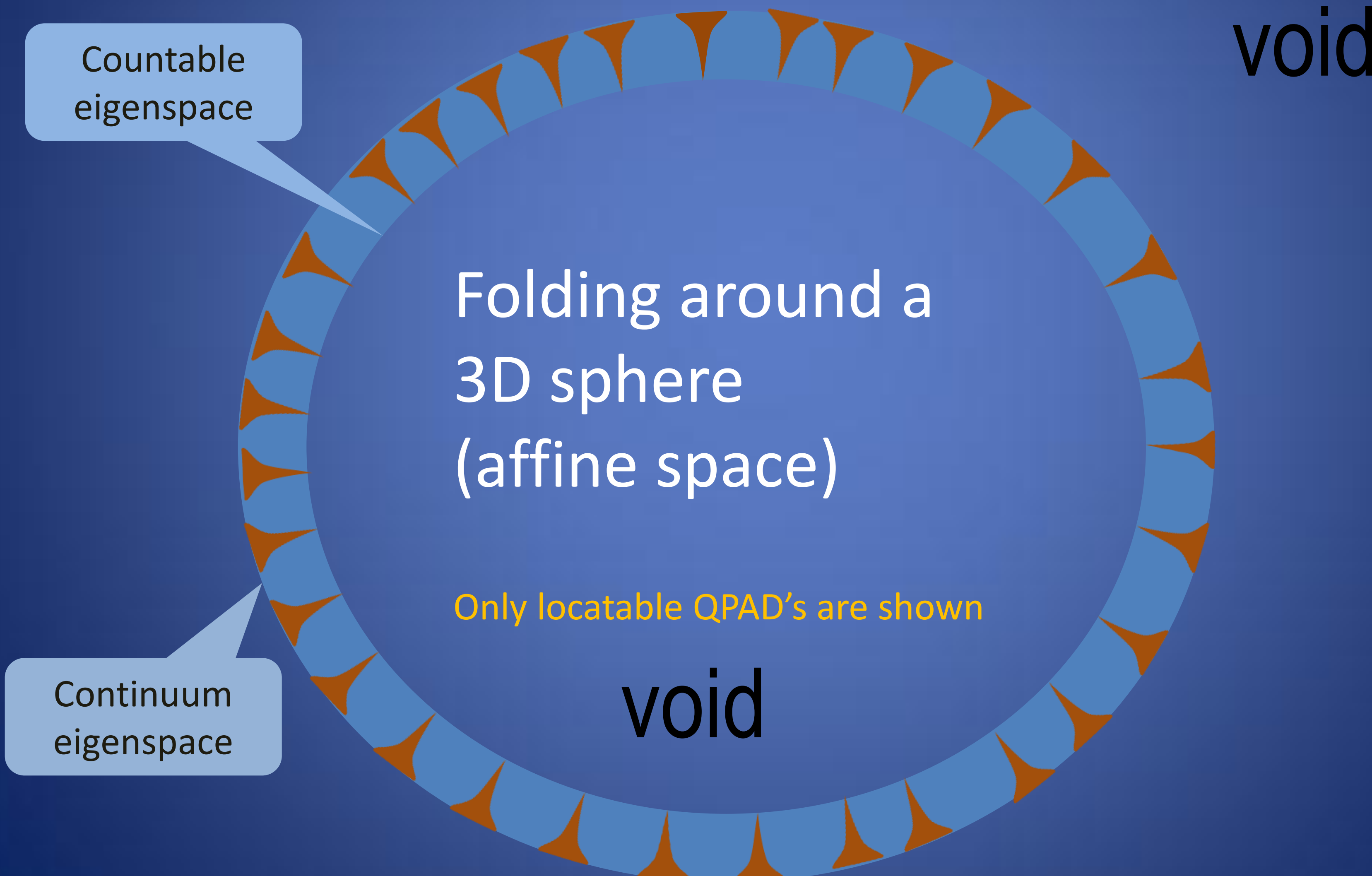
The space atmosphere

Single HBM Page

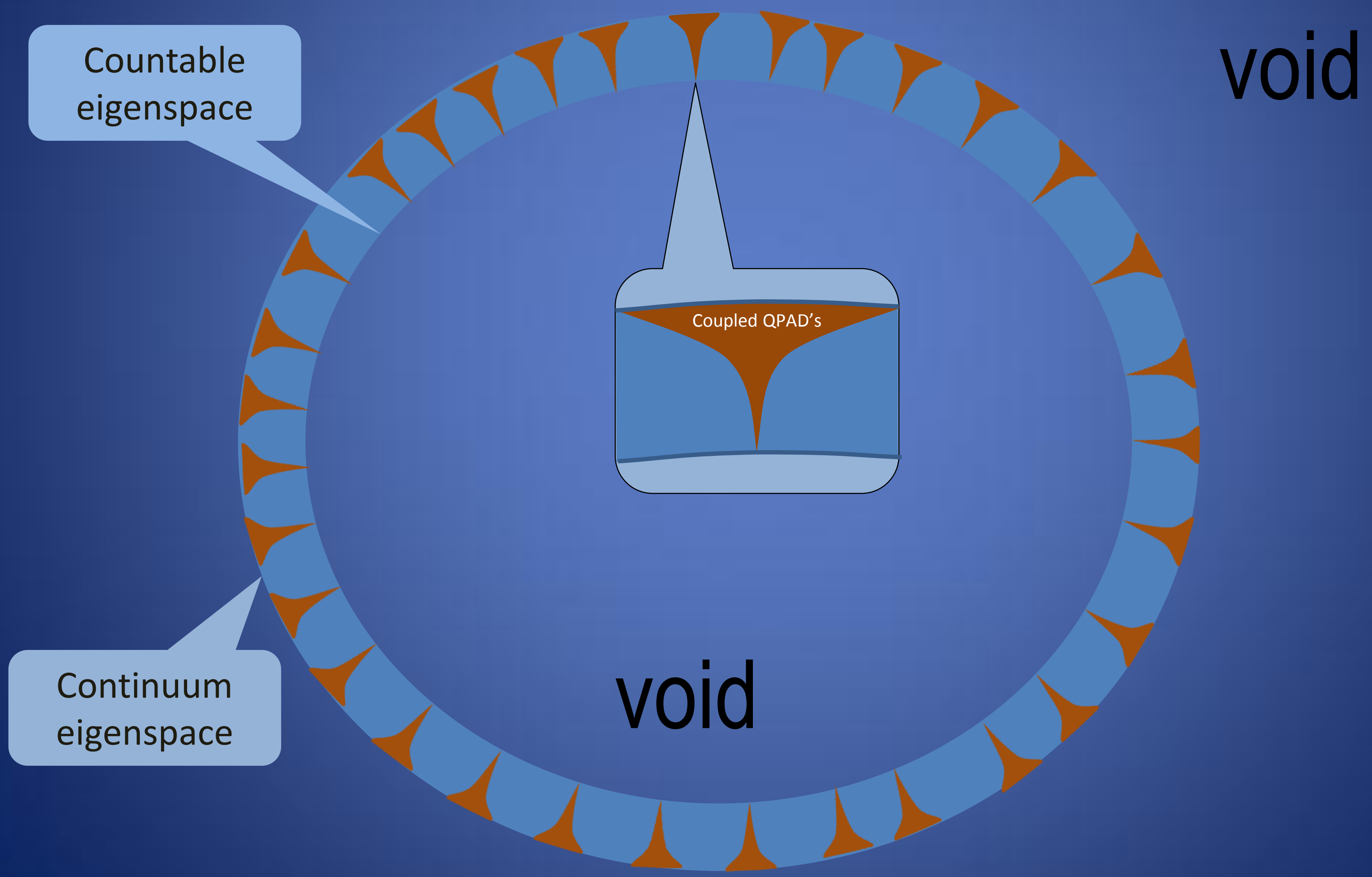
Static Status Quo of the Universe



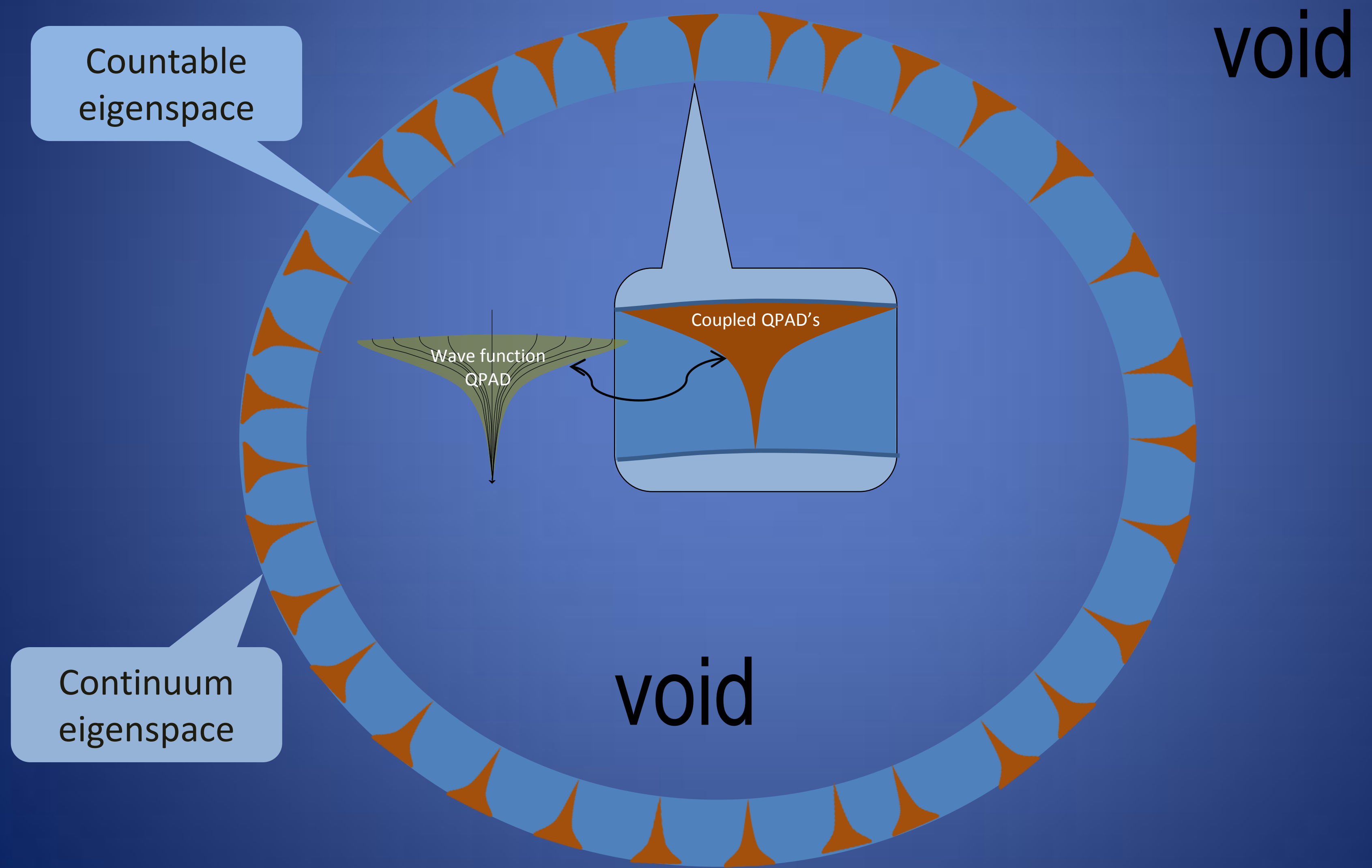
QPAD-sphere
Configuration space



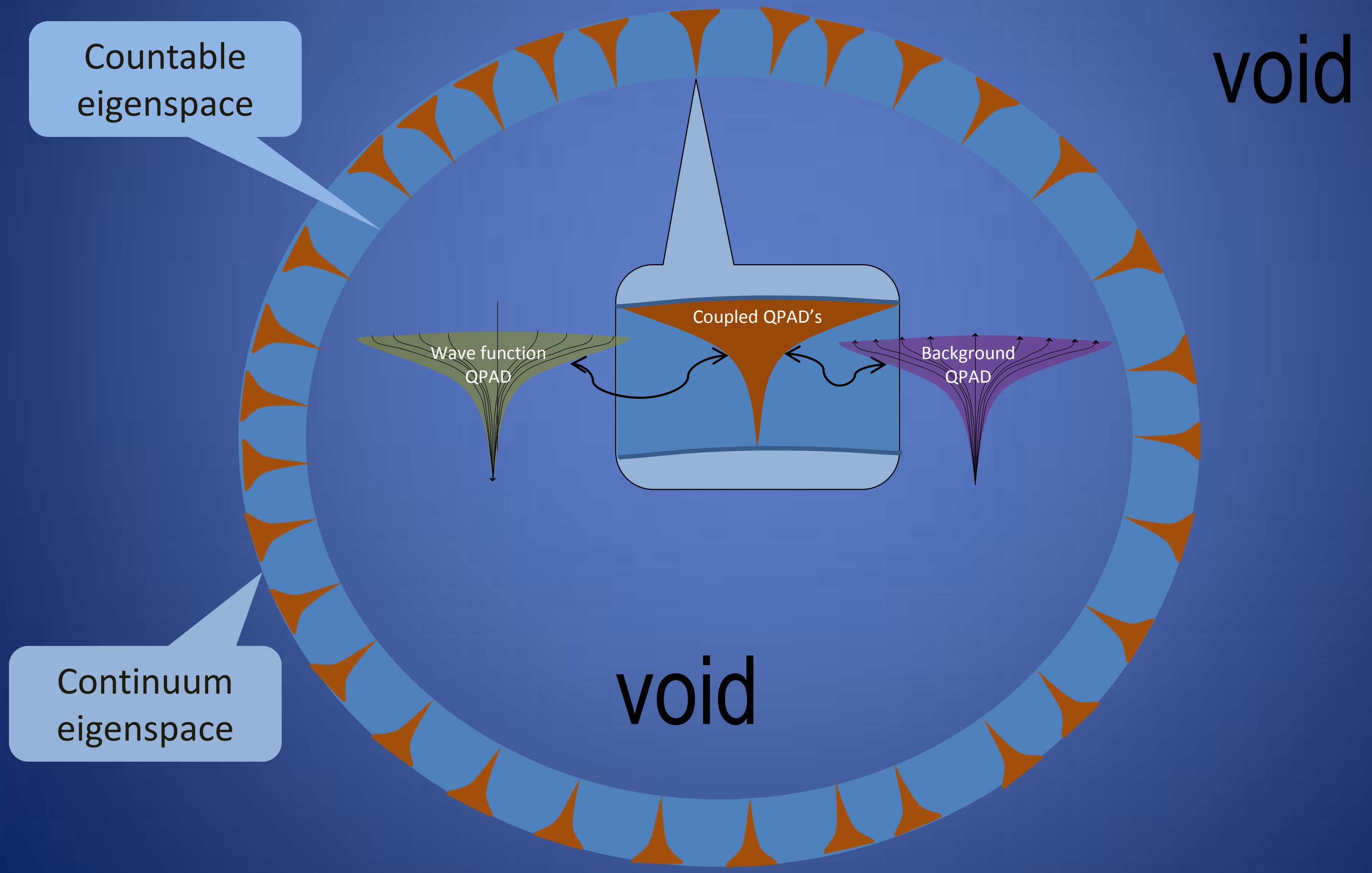
QPAD-sphere
Configuration space



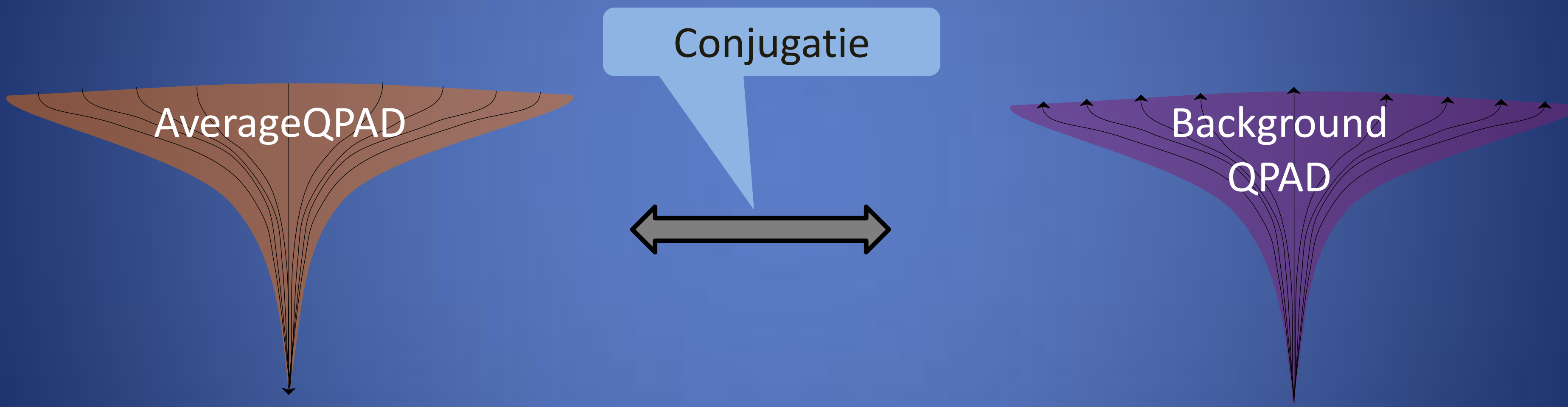
QPAD-sphere
Configuration space



QPAD-sphere
Configuration space

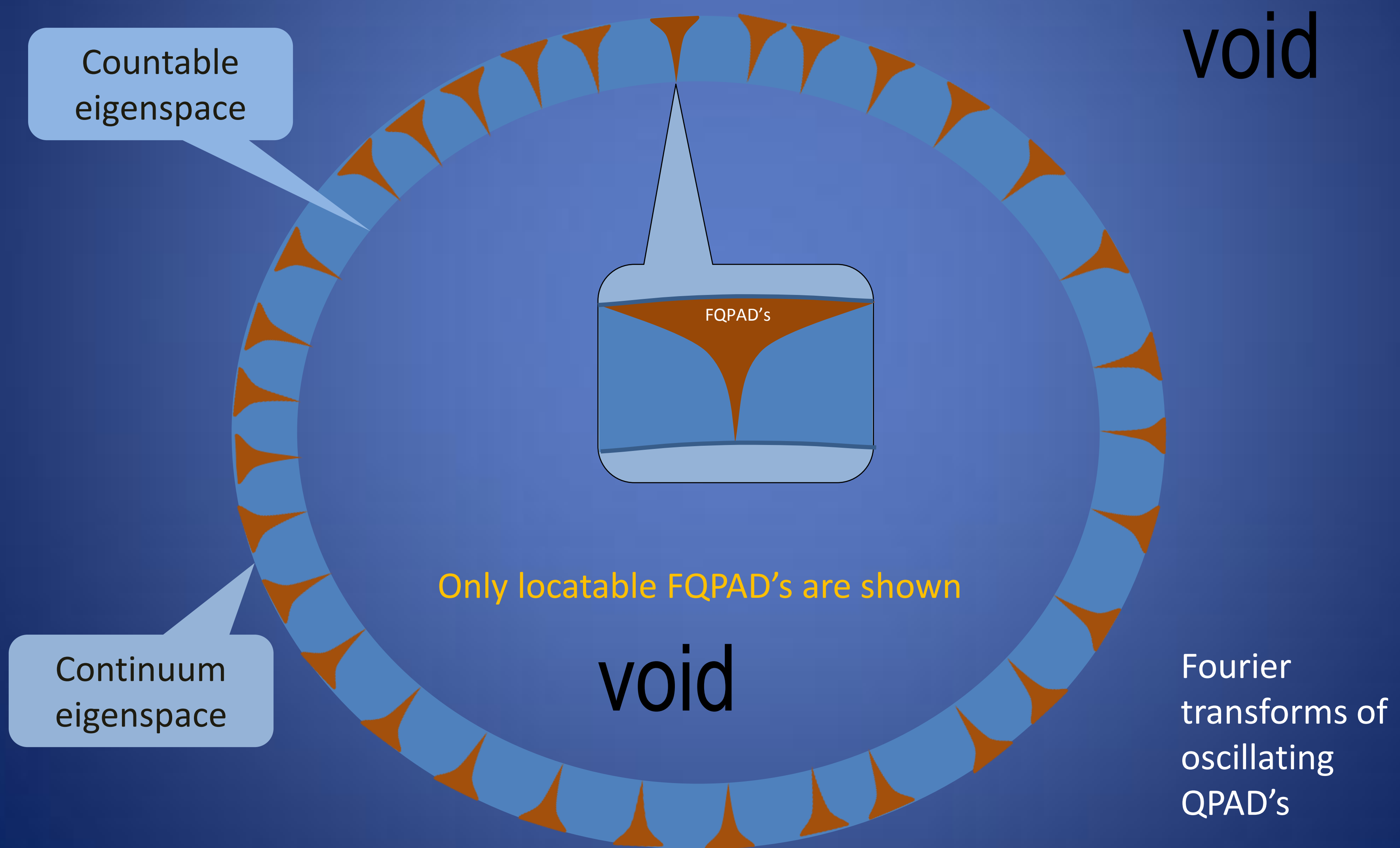


Average Wave function QPAD



This picture holds for isotropic background QPAD’s.
Anisotropic background QPAD’s have a similar relation.

FQPAD-sphere
Momentum space



Motion

Space Balance Equation

Equations of motion

- Using QPAD’s as wave equations changes equations of motion into continuity
- (= balance) equations.

- This avoids the road via geodesics, geodesic equations and the minimal action principle

Continuity Equation
Global view

Total change within *V* = flow into *V* + production inside *V*

$$\frac{d}{dt}\int\limits_V \rho_0 \, dV = \oint_S \hat{\boldsymbol{n}}\rho_0 \frac{\boldsymbol{v}}{c}\, dS + \int\limits_V s_0 \, dV$$

$$\int\limits_V \nabla_0 \rho_0 \, dV = \int\limits_V \langle \boldsymbol{\nabla}, \boldsymbol{\rho} \rangle \, dV + \int\limits_V s_0 \, dV$$

Here $\hat{\boldsymbol{n}}$ is the normal vector pointing outward the surrounding surface *S*, $\boldsymbol{v}(t, \boldsymbol{q})$ is the velocity at which the charge density $\rho_0(t, \boldsymbol{q})$ enters volume *V* and s_0 is the source density inside *V.* In the above formula $\boldsymbol{\rho}$ stands for

$$\boldsymbol{\rho} = \rho_0 \boldsymbol{v}/c$$

Continuity equation
Local view

$\boldsymbol{\rho}(t,\boldsymbol{q})$ is the flux (flow per unit area and per unit time) of ρ_0 .

The combination of $\rho_0(t,\boldsymbol{q})$ and $\boldsymbol{\rho}(t,\boldsymbol{q})$ is a quaternionic skew field $\rho(t,\boldsymbol{q})$ and can be seen as a probability amplitude distribution (QPAD).

$$\nabla_0\rho_0 = \langle \boldsymbol{\nabla}, \boldsymbol{\rho} \rangle + s_0$$

Quaternionic nabla

Full differential:

Source or drain

$$\nabla\rho = s$$

Dirac equation

The quaternionic format of the Dirac equation and of the Majorana equation induces the general format of the elementary coupling equation.

spinor

$$\nabla_0[\psi] + \boldsymbol{\nabla\alpha}[\psi] = m\beta[\psi]$$

QPAD

$$\nabla_0\psi_R + \boldsymbol{\nabla}\psi_R = m\psi_L$$

QPAD

$$\nabla_0\psi_L - \boldsymbol{\nabla}\psi_L = m\psi_R$$

Elementary coupling

Special form of continuity equation

Quaternionic nabla

Sign flavor index

$$\nabla\psi^x = m\,\psi^y$$

Source term

Wave function QPAD

Coupling factor

Coupled QPAD

Couples different sign flavors of the same base QPAD ψ^0

Anti-particle Equation

Quaternionic nabla

Sign flavor index

$$\nabla^* \psi^{x*} = m\, \psi^{y*}$$

Source term

Wave function QPAD

Coupling factor

Coupled QPAD

Taking conjugates of all terms, including nabla operator, but not of parameters. So, it is a different equation!

Shadow Particle Equation

Quaternionic nabla

Sign flavor index

$$\nabla \psi^{x*} = m\, \psi^{y*}$$

Source term

Wave function QPAD

Coupling factor

Coupled QPAD

Taking conjugates of all terms, excluding nabla operator, but not of parameters.
It is the shadow of the antiparticle.

Coupling Factor m

$$\nabla\psi^x = m\,\psi^y$$

$$\int_V \psi^{y*}\nabla\psi^x\, dV = m \int_V \psi^{y*}\psi^y\, dV$$

Positive real number

$$\int_V \psi^{y*}\nabla\psi^x\, dV = m\, g$$

m can be computed from ψ

Zero Coupling Factor

$$\nabla\psi^x = m\,\psi^x$$

Involves:

$$\nabla\psi^x = 0$$

Thus, either

$$\psi^x = 0,\ \text{or}$$
$$\nabla\nabla^*\psi^x = 0, \text{or}$$
$$\nabla\nabla\psi^x = 0$$

This leads to oscillating (Maxwell) fields

Relation to Maxwell Fields

$$\nabla\psi^{x} = 0$$

$$\nabla_0\psi_0^{x} = \langle \boldsymbol{\nabla}, \boldsymbol{\psi}^{x} \rangle$$

$$\boldsymbol{\nabla} \times \boldsymbol{\psi}^{x} + \boldsymbol{\nabla}\psi_0^{x} + \nabla_0\boldsymbol{\psi}^{x} = \mathbf{0}$$

$$\boldsymbol{B} = \boldsymbol{\nabla} \times \boldsymbol{\psi}^{x}$$

$$\boldsymbol{\mathfrak{E}} = -\boldsymbol{\nabla}\psi_0^{x}$$

$$\boldsymbol{E} = -\boldsymbol{\nabla}\psi_0^{x} - \nabla_0\boldsymbol{\psi}^{x} = \boldsymbol{\mathfrak{E}} - \nabla_0\boldsymbol{\psi}^{x}$$

Elementary particles and waves

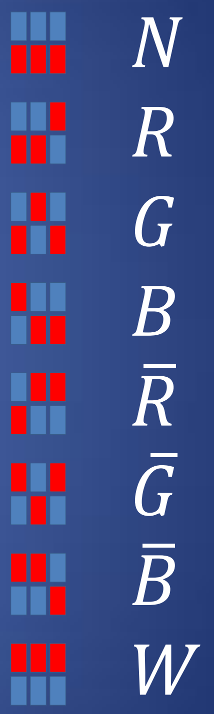
Elementary Coupling Mechanism

Sign selections

Quaternions allow four independent sign selections

- Conjugation
- Reflection (3 directions, colors)

Together they constitute eight mixed sign selections



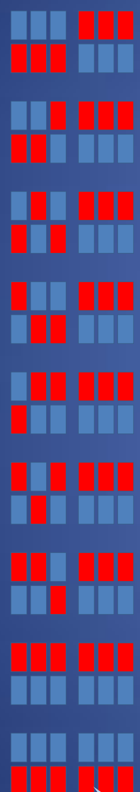
Sign flavors

Quaternionic distributions (QD’s) exist in eight different sign flavors

Sign flavors of QD’s refer for their base to the sign flavor of the parameter space

Elementary couplings couple sign flavors that belong to the same base QPAD

Elementary couplings

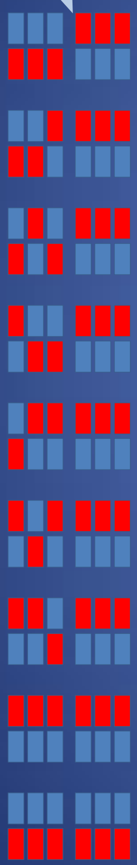


# switches	Handedness	Charge	F/B	Color	m	type
-3	Switched					
-2	Same					
-2	Same					
-2	Same					
-1	Switched					
-1	Switched					
-1	Switched					
0	Same					
0	Same					

What are these?

Elementary couplings

QPAD pairs



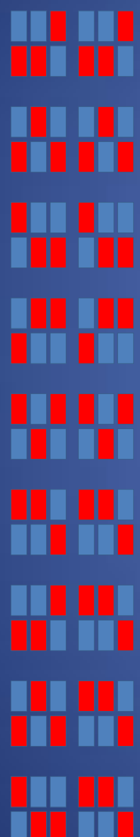
# switches	Handedness	Charge	F/B	Color	m	type
-3	Switched	-e	Fermion	N	>0	Elec-tron
-2	Same	0	Fermion	R	>0	Neu-trino
-2	Same	0	Fermion	G	>0	Neu-trino
-2	Same	0	Fermion	B	>0	Neu-trino
-1	Switched	-1/3 e	Fermion	$\bar{B}$	>0	d quark
-1	Switched	-1/3 e	Fermion	$\bar{G}$	>0	d quark
-1	Switched	-1/3 e	Fermion	$\bar{R}$	>0	d quark
1	Same	0	Boson	W	0	Pho-ton
1	Same	0	Boson	N	0	Pho-ton

Guessing types

Guessing the Rules

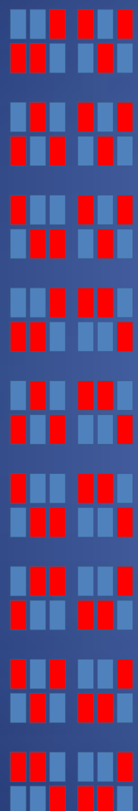
- If handedness is the same, then no charge
- Else, # switches determines charge
- Fermions are coupled to an isotropic background QPAD
- Anisotropic conditions define a direction dependent color charge

Promising Couplings I



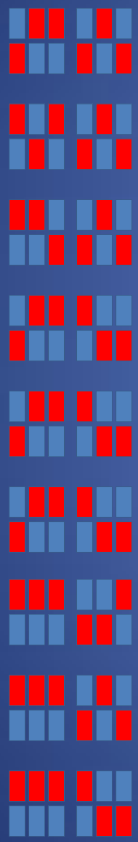
# switches	Handedness	Charge	F/B	Color	m	type
0	Same	0	Boson	R	0	Glu-on
0	Same	0	Boson	G	0	Glu-on
0	Same	0	Boson	B	0	Glu-on
0	Same	0	Boson	$\bar{B}$	0	Glu-on
0	Same	0	Boson	$\bar{G}$	0	Glu-on
0	Same	0	Boson	$\bar{R}$	0	Glu-on
-3	Switched	-e	Boson	$R\bar{R}$	>0	W_-
-3	Switched	-e	Boson	G$\bar{R}$	>0	W_-
-3	Switched	-e	Boson	$B\bar{R}$	>0	W_-

Promising Couplings II



# switches	Handedness	Charge	F/B	Color	m	type
-3	Switched	-e	Boson	$R\bar{G}$	>0	W_{-}
-3	Switched	-e	Boson	$G\bar{G}$	>0	W_{-}
-3	Switched	-e	Boson	$B\bar{G}$	>0	W_{-}
-3	Switched	-e	Boson	$R\bar{B}$	>0	W_{-}
-3	Switched	-e	Boson	$G\bar{B}$	>0	W_{-}
-3	Switched	-e	Boson	$B\bar{B}$	>0	W_{-}
3	Switched	e	Boson	$\bar{B}R$	>0	W_{+}
3	Switched	e	Boson	$\bar{G}R$	>0	W_{+}
3	Switched	e	Boson	$\bar{R}R$	>0	W_{+}

Promising Couplings III



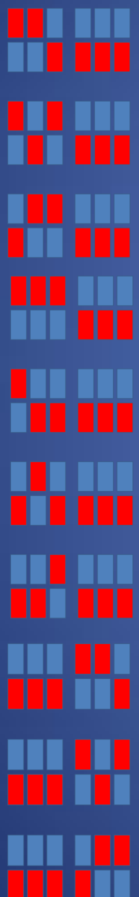
# switches	Handedness	Charge	F/B	Color	m	type
3	Switched	e	Boson	$\bar{R}$G	>0	W_+
3	Switched	e	Boson	$\bar{G}$G	>0	W_+
3	Switched	e	Boson	$\bar{B}$G	>0	W_+
3	Switched	e	Boson	$\bar{B}B$	>0	W_+
3	Switched	e	Boson	$\bar{G}B$	>0	W_+
3	Switched	e	Boson	$\bar{R}B$	>0	W_+
2	Same	0	Boson	WR	>0	Z
2	Same	0	Boson	WG	>0	Z
2	Same	0	Boson	WB	>0	Z

Summary of Results

64 different sign flavor pairs exist.
Until now we analyzed 36

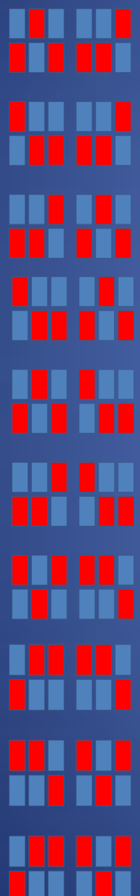
- We discovered potential representations for all known elementary particles.
- However, the scheme ***cannot*** provide up-quarks
- Anti-particles extend this list. The anti-particles are accompanied by shadow particles.
- W_+ bosons are the anti-particle shadows of W_- bosons.

Other Couplings



# switches	Handedness	What?
2	Same	Shadow anti-neutrino
2	Same	Shadow anti-neutrino
2	Same	Shadow anti-neutrino
3	Switched	Shadow positron
2	Switched	Shadow anti-d-quark
2	Switched	Shadow anti-d-quark
2	Switched	Shadow anti-d-quark
2	Same	Shadow anti-Z
2	Same	Shadow anti Z
2	Same	Shadow anti Z

Mixed Colors

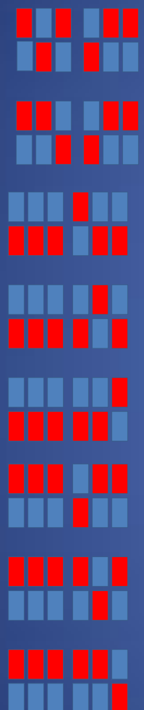


# switches	Handedness	What?
0	Same	Mixed (are they mesons?)
0	Same	Mixed
0	Same	Mixed
0	Same	Mixed
0	Same	Mixed
0	Same	Mixed
0	Same	Mixed
0	Same	Mixed
0	Same	Mixed
0	Same	Mixed

Are they mesons?

If the mixed color couplings are mesons, then they are elementary particles rather than composites (hadrons).

Mixed /exchanged



# switches	Handedness	What?
0	Same	Mixed
0	Same	Mixed
-1	Switched	d-quark-like (are they bosons?)
-1	Switched	d-quark-like (are they bosons?)
-1	Switched	d-quark-like (are they bosons?)
1	Switched	anti-d-quark-like (are they bosons?)
1	Switched	anti-d-quark-like (are they bosons?)
1	Switched	anti-d-quark-like (are they bosons?)

Standard model

Of the above combinations belong 38 elementary particles and 8 elementary waves to the known standard model

The resulting 64-46 = 18 coupled QPAD's might be unobservable or they hide behind existing particles

Anti-particles

Just like the universe is filled with a huge number of particles, it is also filled with a huge number of anti-particles. Otherwise the anti-particles would not sense the same kind of inertia that particles do.

The anti-world has its own kind of general background QPAD.
We christen this version the “background anti-QPAD”.

The isotropic background anti-QPAD represents the local superposition of the tails of the wave functions of all anti-particles in universe.

Summary of Discoveries

- The coupling of sign flavors produces products that are similar to known elementary particles.
- All known elementary particles and their anti-particles are covered, except for up-quarks.
- Resulting particles have similar properties/behavior and may hide behind known ones.
- Mixed color coupling may be unobservable or represent $m = 0$

Creation and Annihilation

The event of coupling two different sign flavors of the same base QPAD creates an elementary particle

Decoupling the QPAD’s that form an elementary particle annihilates the particle and frees the composing QPAD’s

The creation and annihilation must obey corresponding conservation laws

Physical fields

Secondary QPAD’s

Properties of primary couplings

- Location
  - Position
  - Momentum
- Coupling factor m
- Electric charge
- Color charge
- Spin
  - Fermion (half integer spin)
  - Boson (full integer spin)

Physical fields I

Static primary QPAD's are not observable

Secondary QPAD's become noticeable as corresponding physical fields

Physical fields use properties of primary couplings as their sources/drains

However, non-coupled primary QPAD's are also noticeable as oscillating physical fields.

Physical fields II

Where the carriers that are transported by wave functions are virtual sources/drains, the sources/drains of physical fields are actual sources/drains.

The virtual sources/drains are formed by tiny patches that are exchanged with the parameter space.

Physical fields III

Part of the properties give rise to dedicated fields

Property	Field	Influence
Coupling factor	gravitation	Yes
Electric charge	Maxwell	Yes
spin	??	Yes
color	??	??

It looks as if these fields give rise to a local curvature. This is a misinterpretation.

Curvature and inertia

The Next Binding Principle

Curvature

The primary QPAD's cause a local pressure in the QPAD-sphere

On its turn that local pressure causes the local space curvature.

The Kerr-Newman metric equation gives a rough impression on how this works.
However, it uses the sources/drains of physical fields instead of the primary couplings.

Curvature and Inertia

All primary couplings affect the locall curvature

Only the wave function QPAD's that couple to a background QPAD will experience inertia

This also holds for anti-particles and their background anti-QPAD

Inertia versus anti-particle

Besides of the fact that all particles possess corresponding anti-particles, each wave function category seems to correspond with a corresponding background QPAD, which in many cases is the conjugate of the wave function QPAD.

Not all wave functions seem to use their “own” background QPAD.

Fermions share the same (isotropic) background QPAD and anti-fermions do the same for the (isotropic) background anti-QPAD.

W and Z bosons use their “own” background QPAD, which is anisotropic.

Inertia of W and Z Bosons

The background QPAD of a W_- boson has the form of the wave function QPAD of a W_+ boson.

The background QPAD of a W_+ boson has the form of the wave function QPAD of a W_- boson.

The background QPAD of a Z boson has the form of the form of the wave function QPAD of the anti-Z boson.

Effect of primary coupling

The coupling may compress or decompress the local parameter space.

Above, 56 different kinds of primary coupling are discerned.

Together with the balance equations that differ for particles and anti-particles this defines a large number of ways of how the local parameter space is affected.

Higher level coupling

The streams of space patches that result after the primary couplings will be used in higher level interactions.

Hypothesis:

In these interactions the properties of the primary couplings are conserved

Role of secondary QPAD’s

The properties that characterize primary couplings act as sources/drains of secondary QPAD’s

The primary couplings are responsible for affecting the local curvature, but it looks as if the secondary QPAD’s have this role

This is a false impression!

Kerr-Newman

The Kerr-Newman equation describes the effects of physical fields on curvature for elementary particles as well as for black holes

The Kerr-Newman equation uses the properties that characterize the local sources/drains of the physical fields

In this way it can only give a rough description.

Kerr-Newman metric

$$c^2\,d\tau^2 = -\left(\frac{dr^2}{\Delta} + d\theta^2\right)\rho^2 + (c\,dt - \alpha\ sin^2(\theta)\ d\phi)^2\frac{\Delta}{\rho^2}$$

$$-\left((r^2+\alpha^2)\,d\phi - \alpha\,c\,dt\right)^2\ \frac{sin^2(\theta)}{\rho^2}$$

$$\rho^2 = r^2 + \alpha^2\,cos^2\,(\theta)$$

$$\Delta = r^2 - r_s\,r + \alpha^2 + r_Q^2$$

$$\alpha = \frac{J}{M\,c};\ r_s = \frac{2GM}{c^2};\ r_Q^2 = \frac{Q^2G}{4\pi\varepsilon_0 c^4}$$

Horizon Criterion

Radius of ergo region

$$r = m + \sqrt{m^2 - r_Q^2 - \alpha^2 \cos^2(\theta)}$$

Radius of event horizon

$$r = m + \sqrt{m^2 - r_Q^2 - \alpha^2}$$

Requirement for event horizon

$$m^2 > r_Q^2 + \alpha^2$$

Otherwise the included particles stay naked.

Composite particles

Combinations of Elementary Particles

Hadrons I

Hadrons form the next level of coupling

Hadrons are composite particles

In the HBM, up-quarks are hadrons

We treat quarks as one category:

- Down-quarks
- Up-quarks

Hadrons II

Two types of hadrons exist:

- Mesons
- Baryons

Mesons are composed out of quarks and anti-quarks

Baryons are composed out of triples of quarks

Mesons might be mixed color particles

Remarks

The HBM requires different methods

Remark

Some methodologies that work in conventional complex number based physics do not work in the HBM, which is quaternion based.

Examples: covariant derivation, gauges

When choosing for the HBM, physicists must forget old tricks and learn new tricks.

Quaternionic work arounds exist

Derivation differs

In general holds for the quaternionic nabla:

$$\nabla(f\ g) \neq (\nabla f)\ g + f\ \nabla g$$

This inhibits application of covariant derivative

Part two

What the HBM does not (yet) explain

General

- The HBM takes several aspects of experimental physics for granted and uses them without explaining the reason of existence of these aspects
- The HBM does not explain some aspects that affect the model

Aspects not treated

- The HBM does neither explain nor treat the existence of generations of elementary particles.

- Suggestion:
- Generations relate to curls in QPAD’s

Aspects not explained I

- The interpretation of equations of motion as balance equations is explained.
- However, the HBM does not explain why the elementary coupling equation is THE equation that describes primary couplings.
- In particular it is not explained why wave function QPAD and coupled QPAD must be sign flavors of the same base QPAD

Aspects not explained II

- The HBM does not explain why elementary fermions and anti-fermions all couple to isotropic background QPAD's

- The HBM does not explain why elementary fermions have half-integer spin and why bosons have full integer spin

Aspects not explained III

- The HBM does not explain why elementary particles are charged electrically if and only if when the coupling switches handedness.

Part three

Unique aspects of the
Hilbert Book Model

Unique Aspects of the HBM I

- Strictly based on the axioms of Tradional Quantum Logic
- Uses Quaternionic Separable Hilbert Space
- Uses Quaternionic Probability Amplitude Distributions (QPAD’s)
- QPAD’s link Hilbert eigenvectors to a continuum eigenspace.
- Uses backround QPAD’s

Unique Aspects of the HBM II

- Applies Quaternionic Sign Selections
- Applies Sign Flavors of Quaternionic Distributions
- Replaces Spinors and Dirac Matrices by QPAD’s
- Uses QPAD’s as wave functions

Unique Aspects of the HBM IV

- Uses coupling of QPAD's
- Interprets equations of motion as continuity equations
- Uses Quaternionic formats of Dirac and Majorana equations
- Uses general form of these equations
- Produces representations for all known elementary particles

Unique Aspects of the HBM V

- Computes coupling factor for all massive particles
- Relates properties of elementary particles to local curvature
- Implements inertia
- Notion of QPAD-sphere
- Notion of transport of parameter space patches

Unique Aspects of the HBM VI

- Primary QPAD coupling delivers 56 elementary particles
- Higher level couplings based on resulting streams
- Properties of primary couplings are conserved
- Properties generate physical fields
- Universe-wide stepping between static status quos of the universe.
- Notion of progression counter