Quaternionic physics

How to use

Quaternionic Distributions

and

Quaternionic Probability Amplitude Distributions

The HBM is a quaternionic model

- The HBM concerns quaternionic physics rather than complex physics.
- The peculiarities of the quaternionic Hilbert model are supposed to bubble down to the complex Hilbert space model and to the real Hilbert space model
- The complex Hilbert space model is considered as an abstraction of the quaternionic Hilbert space model
  - This can only be done properly in the right circumstances

Continuous Quaternionic Distributions

- Quaternions

$a = a_0 + \boldsymbol{a}$

$c = ab = a_0 b_0 - \langle \boldsymbol{a}, \boldsymbol{b} \rangle + a_0 \boldsymbol{b} + b_0 \boldsymbol{a} + \boldsymbol{a} \times \boldsymbol{b}$

- Quaternionic distributions
  - Differential equation

$g = \nabla f = \nabla_0 f_0 - \langle \boldsymbol{\nabla}, \boldsymbol{f} \rangle + \nabla_0 \boldsymbol{f} + \boldsymbol{\nabla} b_0 + \boldsymbol{\nabla} \times \boldsymbol{b}$

$$\begin{cases} g_0 = \nabla_0 f_0 - \langle \boldsymbol{\nabla}, \boldsymbol{f} \rangle \\ \mathbf{g} = \nabla_0 \boldsymbol{f} + \boldsymbol{\nabla} b_0 + \boldsymbol{\nabla} \times \boldsymbol{b} \end{cases}$$

Two equations

Three kinds

Differential
Coupling
Continuity
} equation

$\phi = \nabla \psi = m\, \varphi$

Field equations

- $\phi = \nabla\psi$
  - $\phi_0 = \nabla_0\psi_0 - \langle\boldsymbol{\nabla}, \psi\rangle$
  - $\boldsymbol{\phi} = \nabla_0\psi + \boldsymbol{\nabla}\psi_0 + \boldsymbol{\nabla} \times \psi$

Spin of a field:

$$\boldsymbol{\Sigma}_{field} = \int_V \mathfrak{E} \times \boldsymbol{\psi}\, dV$$

- $\mathfrak{E} \equiv \nabla_0\boldsymbol{\psi} + \boldsymbol{\nabla}\psi_0$
- $\mathfrak{B} \equiv \boldsymbol{\nabla} \times \boldsymbol{\psi}$
- $\boldsymbol{\phi} = \mathfrak{E} + \mathfrak{B}$
- $E \equiv |\phi| = \sqrt{\phi_0\phi_0 + \langle\boldsymbol{\phi}, \boldsymbol{\phi}\rangle}$

$$= \sqrt{\phi_0\phi_0 + \langle\mathfrak{E}, \mathfrak{E}\rangle + \langle\mathfrak{B}, \mathfrak{B}\rangle + 2\langle\mathfrak{E}, \mathfrak{B}\rangle}$$

Is zero ?

QPAD's

- Quaternionic distribution
  - $f = f_0 + \boldsymbol{f}$

Scalar field

Vector field

- Quaternionic Probability Amplitude Distribution
  - $\psi = \psi_0 + \boldsymbol{\psi} = \rho_0 + \rho_0 \boldsymbol{v}$

Density distribution

Current density distribution

Coupling equation

- Differential

$$\phi = \nabla\psi = m\varphi$$
$$|\psi| = |\varphi|$$

- Integral

$$\int_V |\psi|^2 \, dV = \int_V |\varphi|^2 \, dV = 1$$
$$\int_V |\phi|^2 \, dV = m^2$$

ψ and φ are normalized

m = total energy
= rest mass +
kinetic energy

Flat space

Coupling in Fourier space

$\nabla\psi = \phi = m\,\varphi$
$\mathcal{M}\tilde{\psi} = \tilde{\phi} = m\,\tilde{\varphi}$
$\langle\tilde{\psi}|\mathcal{M}\tilde{\psi}\rangle = \; m\,\langle\tilde{\psi}|\tilde{\varphi}\rangle$

$\mathcal{M} = \mathcal{M}_0 + \boldsymbol{M}$
$\mathcal{M}_0\tilde{\psi}_0 - \langle\boldsymbol{M},\tilde{\boldsymbol{\psi}}\rangle \; = m\,\tilde{\varphi}_0$
$\mathcal{M}_0\boldsymbol{\psi} \; + \boldsymbol{M}\tilde{\psi}_0 \; + \boldsymbol{M}\times\tilde{\boldsymbol{\psi}} \; = m\,\tilde{\boldsymbol{\varphi}}$

$$\int_{\tilde{V}} \tilde{\phi}^2\, d\tilde{V} = \int_{\tilde{V}} \left(\widetilde{\mathcal{M}\psi}\right)^2 d\tilde{V} = m^2$$

In general $|\tilde{\psi}\rangle$ is not an eigenfunction of operator $\mathcal{M}$.
That is only true when $|\tilde{\psi}\rangle$ and $|\tilde{\varphi}\rangle$ are equal.
For elementary particles they are equal
apart from their difference in discrete symmetry.

Dirac equation

Flat space

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

- Spinor $[\psi]$
- Dirac matrices $\boldsymbol{\alpha}$, β
  - $\nabla_0\psi_R + \boldsymbol{\nabla}\psi_R = m\psi_L$
  - $\nabla_0\psi_L - \boldsymbol{\nabla}\psi_L = m\psi_R$
- In quaternion format
  - $\nabla\psi = m\psi^*$
  - $\nabla^*\psi^* = m\psi$

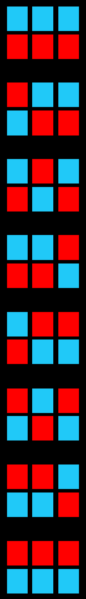
$$\psi_R = \psi_L^* = \psi_0 + \boldsymbol{\psi}$$

Qpattern

Elementary particles

- Coupling equation
  - $\nabla\psi^{x} = m\,\psi^{y}$
  - $(\nabla\psi^{x})^{*} = m\,(\psi^{y})^{*}$
- Coupling occurs between pairs
  - $\{\psi^{x}, \psi^{y}\}$
- Colors
  - N, R, G, B, $\overline{\text{R}}$, $\overline{\text{G}}$, $\overline{\text{B}}$, W
- Right and left handedness
  - **R,L**

Sign flavors



$\boldsymbol{\psi}^{⓪}$ N **R**

$\boldsymbol{\psi}^{①}$ R **L**

$\boldsymbol{\psi}^{②}$ G **L**

$\boldsymbol{\psi}^{③}$ B **L**

$\boldsymbol{\psi}^{④}$ $\bar{B}$ **R**

$\boldsymbol{\psi}^{⑤}$ $\bar{G}$ **R**

$\boldsymbol{\psi}^{⑥}$ $\bar{R}$ **R**

$\boldsymbol{\psi}^{⑦}$ $\bar{N}$ **L**

Discrete symmetries

Spin

- HYPOTHESIS : Spin relates to the fact whether the coupled Qpattern is the reference Qpattern $\boldsymbol{\psi}^{⓪}$.
- Each generation has its own reference Qpattern.
- Fermions couple to the reference Qpattern.
- Fermions have half integer spin.
- Bosons have integer spin.
- The spin of a composite equals the sum of the spins of its components.

Electric charge

- HYPOTHESIS : Electric charge depends on the difference and direction of the base vectors for the Qpattern pair.
- Each sign difference stands for one third of a full electric charge.
- Further it depends on the fact whether the handedness differs.
- If the handedness differs then the sign of the count is changed as well.

Color charge

- HYPOTHESIS : Color charge is related to the direction of the anisotropy of the considered Qpattern with respect to the reference Qpattern.
- The anisotropy lays in the discrete symmetry of the imaginary part.
- The color charge of the reference Qpattern is white.
- The corresponding anti-color is black.
- The color charge of the coupled pair is determined by the colors of its members.

- All composite particles are black or white.
- The neutral colors black and white correspond to isotropic Qpatterns.

- Currently, color charge cannot be measured.
- In the Standard Model the existence of color charge is derived via the Pauli principle.

Total energy

- Mass is related to the number of involved Qpatches.
- It is directly related to the square root of the volume integral of the square of the local field energy E.
- Any internal kinetic energy is included in E.
- The same mass rule holds for composite particles.
- The fields of the composite particles are dynamic superpositions of the fields of their components.

Leptons

Pair	s-type	e-charge	c-charge	Handed ness	SM Name
$\{\psi^{⑦}, \psi^{⓪}\}$	fermion	-1	N	LR	electron
$\{\psi^{⓪}, \psi^{⑦}\}$	Anti-fermion	+1	W	RL	positron

Quarks

Pair	s-type	e-charge	c-charge	Handedness	SM Name
$\{\psi^{①}, \psi^{⓪}\}$	fermion	-1/3	R	LR	down-quark
$\{\psi^{⑥}, \psi^{⑦}\}$	Anti-fermion	+1/3	$\bar{R}$	RL	Anti-down-quark
$\{\psi^{②}, \psi^{⓪}\}$	fermion	-1/3	G	LR	down-quark
$\{\psi^{⑤}, \psi^{⑦}\}$	Anti-fermion	+1/3	$\bar{G}$	RL	Anti-down-quark
$\{\psi^{③}, \psi^{⓪}\}$	fermion	-1/3	B	LR	down-quark
$\{\psi^{④}, \psi^{⑦}\}$	Anti-fermion	+1/3	$\bar{B}$	RL	Anti-down-quark
$\{\psi^{④}, \psi^{⓪}\}$	fermion	+2/3	$\bar{B}$	RR	up-quark
$\{\psi^{③}, \psi^{⑦}\}$	Anti-fermion	-2/3	B	LL	Anti-up-quark
$\{\psi^{⑤}, \psi^{⓪}\}$	fermion	+2/3	$\bar{G}$	RR	up-quark
$\{\psi^{②}, \psi^{⑦}\}$	Anti-fermion	-2/3	G	LL	Anti-up-quark
$\{\psi^{⑥}, \psi^{⓪}\}$	fermion	+2/3	$\bar{R}$	RR	up-quark
$\{\psi^{①}, \psi^{⑦}\}$	Anti-fermion	-2/3	R	LL	Anti-up-quark

Reverse quarks

Pair	s-type	e-charge	c-charge	Handedness	SM Name
$\{\psi^{⓪}, \psi^{①}\}$	fermion	+1/3	R	RL	down-r-quark
$\{\psi^{⑦}, \psi^{⑥}\}$	Anti-fermion	-1/3	$\bar{R}$	LR	Anti-down-r-quark
$\{\psi^{⓪}, \psi^{②}\}$	fermion	+1/3	G	RL	down-r-quark
$\{\psi^{⑦}, \psi^{⑤}\}$	Anti-fermion	-1/3	$\bar{G}$	LR	Anti-down-r-quark
$\{\psi^{⓪}, \psi^{③}\}$	fermion	+1/3	B	RL	down-r-quark
$\{\psi^{⑦}, \psi^{④}\}$	Anti-fermion	-1/3	$\bar{B}$	LR	Anti-down-r_quark
$\{\psi^{⓪}, \psi^{④}\}$	fermion	-2/3	$\bar{B}$	RR	up-r-quark
$\{\psi^{⑦}, \psi^{③}\}$	Anti-fermion	+2/3	B	LL	Anti-up-r-quark
$\{\psi^{⓪}, \psi^{⑤}\}$	fermion	-2/3	$\bar{G}$	RR	up-r-quark
$\{\psi^{⑦}, \psi^{②}\}$	Anti-fermion	+2/3	G	LL	Anti-up-r-quark
$\{\psi^{⓪}, \psi^{⑥}\}$	fermion	-2/3	$\bar{R}$	RR	up-r-quark
$\{\psi^{⑦}, \psi^{①}\}$	Anti-fermion	+2/3	R	LL	Anti-up-r-quark

W-particles

$\{\psi^{\textcircled{6}},\psi^{\textcircled{1}}\}$	**boson**	**-1**	$\bar{R}R$	**RL**	W_{-}
$\{\psi^{\textcircled{1}},\psi^{\textcircled{6}}\}$	Anti-boson	+1	$R\bar{R}$	LR	W_{+}
$\{\psi^{\textcircled{6}},\psi^{\textcircled{2}}\}$	boson	-1	$\bar{R}G$	RL	W_{-}
$\{\psi^{\textcircled{2}},\psi^{\textcircled{6}}\}$	Anti-boson	+1	$G\bar{R}$	LR	W_{+}
$\{\psi^{\textcircled{6}},\psi^{\textcircled{3}}\}$	boson	-1	$\bar{R}B$	RL	W_{-}
$\{\psi^{\textcircled{3}},\psi^{\textcircled{6}}\}$	Anti-boson	+1	$B\bar{R}$	LR	W_{+}
$\{\psi^{\textcircled{5}},\psi^{\textcircled{1}}\}$	boson	-1	$\bar{G}G$	RL	W_{-}
$\{\psi^{\textcircled{1}},\psi^{\textcircled{5}}\}$	Anti-boson	+1	$G\bar{G}$	LR	W_{+}
$\{\psi^{\textcircled{5}},\psi^{\textcircled{2}}\}$	boson	-1	$\bar{G}G$	RL	W_{-}
$\{\psi^{\textcircled{2}},\psi^{\textcircled{5}}\}$	Anti-boson	+1	$G\bar{G}$	LR	W_{+}
$\{\psi^{\textcircled{5}},\psi^{\textcircled{3}}\}$	boson	-1	$\bar{G}B$	RL	W_{-}
$\{\psi^{\textcircled{3}},\psi^{\textcircled{5}}\}$	Anti-boson	+1	$B\bar{G}$	LR	W_{+}
$\{\psi^{\textcircled{4}},\psi^{\textcircled{1}}\}$	boson	-1	$\bar{B}R$	RL	W_{-}
$\{\psi^{\textcircled{1}},\psi^{\textcircled{4}}\}$	Anti-boson	+1	$R\bar{B}$	LR	W_{+}
$\{\psi^{\textcircled{4}},\psi^{\textcircled{2}}\}$	boson	-1	$\bar{B}G$	RL	W_{-}
$\{\psi^{\textcircled{2}},\psi^{\textcircled{4}}\}$	Anti-boson	+1	$G\bar{B}$	LR	W_{+}
$\{\psi^{\textcircled{4}},\psi^{\textcircled{3}}\}$	boson	-1	$\bar{B}B$	RL	W_{-}
$\{\psi^{\textcircled{3}},\psi^{\textcircled{4}}\}$	Anti-boson	+1	$B\bar{B}$	LR	W_{+}

Z-particles

Pair	s-type	e-charge	c-charge	Handedness	SM Name
$\{\psi^{②},\psi^{①}\}$	boson	0	GR	LL	Z
$\{\psi^{⑤},\psi^{⑥}\}$	Anti-boson	0	$\overline{G}\overline{R}$	RR	Z
$\{\psi^{③},\psi^{①}\}$	boson	0	BR	LL	Z
$\{\psi^{④},\psi^{⑥}\}$	Anti-boson	0	$\overline{R}\overline{B}$	RR	Z
$\{\psi^{③},\psi^{②}\}$	boson	0	BR	LL	Z
$\{\psi^{④},\psi^{⑤}\}$	Anti-boson	0	$\overline{R}\overline{B}$	RR	Z
$\{\psi^{①},\psi^{②}\}$	boson	0	RG	LL	Z
$\{\psi^{⑥},\psi^{⑤}\}$	Anti-boson	0	$\overline{R}\overline{G}$	RR	Z
$\{\psi^{①},\psi^{③}\}$	boson	0	RB	LL	Z
$\{\psi^{⑥},\psi^{④}\}$	Anti-boson	0	$\overline{R}\overline{B}$	RR	Z
$\{\psi^{②},\psi^{③}\}$	boson	0	RB	LL	Z
$\{\psi^{⑤},\psi^{④}\}$	Anti-boson	0	$\overline{R}\overline{B}$	RR	Z

Neutrinos

type	s-type	e-charge	c-charge	Handedness	SM Name
$\{\psi^{⑦}, \psi^{⑦}\}$	fermion	0	NN	RR	neutrino
$\{\psi^{⓪}, \psi^{⓪}\}$	Anti-fermion	0	WW	LL	neutrino
$\{\psi^{⑥}, \psi^{⑥}\}$	boson?	0	$\bar{R}\bar{R}$	RR	neutrino
$\{\psi^{①}, \psi^{①}\}$	Anti- boson?	0	RR	LL	neutrino
$\{\psi^{⑤}, \psi^{⑤}\}$	boson?	0	$\bar{G}\bar{G}$	RR	neutrino
$\{\psi^{②}, \psi^{②}\}$	Anti- boson?	0	GG	LL	neutrino
$\{\psi^{④}, \psi^{④}\}$	boson?	0	$\bar{B}\bar{B}$	RR	neutrino
$\{\psi^{③}, \psi^{③}\}$	Anti- boson?	0	BB	LL	neutrino

Color confinement

The ***color confinement rule*** forbids the generation of individual particles that have non-neutral color charge

Color confinement

- Color confinement forbids the generation of individual quarks

- Quarks can appear in hadrons

- Color confinement blocks observation of gluons

Photons & gluons

type	s-type	e-charge	c-charge	Handedness	SM Name
$\{\psi^{⑦}\}$	boson	0	N	R	photon
$\{\psi^{⓪}\}$	boson	0	W	L	photon
$\{\psi^{⑥}\}$	boson	0	$\bar{R}$	R	gluon
$\{\psi^{①}\}$	boson	0	R	L	gluon
$\{\psi^{⑤}\}$	boson	0	$\bar{G}$	R	gluon
$\{\psi^{②}\}$	boson	0	G	L	gluon
$\{\psi^{④}\}$	boson	0	$\bar{B}$	R	gluon
$\{\psi^{③}\}$	boson	0	B	L	gluon

Photons & gluons

- Photons and gluons are NOT particles

- Ultra-high frequency waves are constituted by wave fronts that at every progression step are emitted by elementary particles

- Photons and gluons are modulations of ultra-high frequency carrier waves.

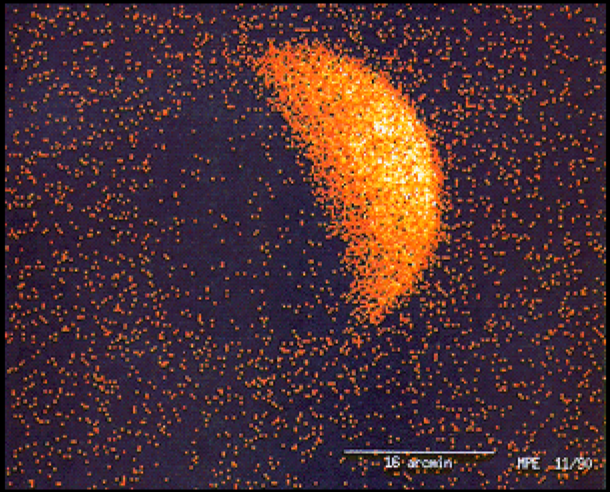
Quanta

The noise of low dose imaging

Low dose X-ray imaging

Film of cold cathode emission

Shot noise



Low dose X-ray image of the moon

Shot noise

Navigate

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http://vixra.org/abs/1302.0122

To Hilbert Book slide, part 2:
http://vixra.org/abs/1302.0121

To Hilbert Book slides, part 4:
http://vixra.org/abs/1309.0017

To “Physics of the Hilbert Book Model”
http://vixra.org/abs/1307.0106