

# 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**

$$a = a_0 + \mathbf{a}$$

$$c = ab = a_0b_0 - \langle \mathbf{a}, \mathbf{b} \rangle + a_0\mathbf{b} + b_0\mathbf{a} + \mathbf{a} \times \mathbf{b}$$

- **Quaternionic distributions**

- **Differential equation**

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

Two equations

$$\left\{ \begin{array}{l} g_0 = \nabla_0 f_0 - \langle \nabla, \mathbf{f} \rangle \\ \mathbf{g} = \nabla_0 \mathbf{f} + \nabla b_0 + \nabla \times \mathbf{b} \end{array} \right.$$

Three kinds

Differential  
Coupling  
Continuity } equation

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

# Field equations

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

Spin of a field:

$$\Sigma_{field} = \int_V \mathfrak{E} \times \psi \, dV$$

- $\mathfrak{E} \equiv \nabla_0\psi + \nabla\psi_0$
- $\mathfrak{B} \equiv \nabla \times \psi$
- $\phi = \mathfrak{E} + \mathfrak{B}$
- $E \equiv |\phi| = \sqrt{\phi_0\phi_0 + \langle \phi, \phi \rangle}$   
 $= \sqrt{\phi_0\phi_0 + \langle \mathfrak{E}, \mathfrak{E} \rangle + \langle \mathfrak{B}, \mathfrak{B} \rangle + 2\langle \mathfrak{E}, \mathfrak{B} \rangle}$

Is zero  
?

# QPAD's

- Quaternionic distribution

- $f = f_0 + \mathbf{f}$

Scalar  
field

Vector  
field

- Quaternionic Probability Amplitude Distribution

- $\psi = \psi_0 + \boldsymbol{\psi} = \rho_0 + \rho_0 \mathbf{v}$

Density  
distribution

Current density  
distribution

# Coupling equation

- **Differential**

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

$$|\psi| = |\varphi|$$

- **Integral**

$$\int_V |\psi|^2 dV = \int_V |\varphi|^2 dV = 1$$

$$\int_V |\phi|^2 dV = m^2$$

$\psi$  and  $\varphi$   
are **normalized**

$m$  = total energy  
= rest mass +  
kinetic energy

Flat space

# Coupling in Fourier space

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

$$\mathcal{M}\tilde{\psi} = \tilde{\phi} = m \tilde{\varphi}$$

$$\langle\tilde{\psi}|\mathcal{M}\tilde{\psi}\rangle = m \langle\tilde{\psi}|\tilde{\varphi}\rangle$$

$$\mathcal{M} = \mathcal{M}_0 + \mathbf{M}$$

$$\mathcal{M}_0\tilde{\psi}_0 - \langle\mathbf{M}, \tilde{\psi}\rangle = m \tilde{\varphi}_0$$

$$\mathcal{M}_0\tilde{\psi} + \mathbf{M}\tilde{\psi}_0 + \mathbf{M} \times \tilde{\psi} = m \tilde{\varphi}$$

$$\int_{\tilde{V}} \tilde{\phi}^2 d\tilde{V} = \int_{\tilde{V}} (\overline{\mathcal{M}\tilde{\psi}})^2 d\tilde{V} = m^2$$

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

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

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

$$\psi_R = \psi_L^* = \psi_0 + \psi$$









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,  $\bar{R}$ ,  $\bar{G}$ ,  $\bar{B}$ , W
- Right and left handedness
  - R,L

## Sign flavors

	$\psi^{(0)}_{NR}$
	$\psi^{(1)}_{RL}$
	$\psi^{(2)}_{GL}$
	$\psi^{(3)}_{BL}$
	$\psi^{(4)}_{\bar{B}R}$
	$\psi^{(5)}_{\bar{G}R}$
	$\psi^{(6)}_{\bar{R}R}$
	$\psi^{(7)}_{\bar{N}L}$

Discrete  
symmetries

# Spin

- HYPOTHESIS : Spin relates to the fact whether the coupled Qpattern is the reference Qpattern  $\psi^{\textcircled{0}}$ .
- 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  $Q$ pattern 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	Handedness	SM Name
$\{\psi^{\textcircled{7}}, \psi^{\textcircled{0}}\}$	fermion	-1	N	LR	electron
$\{\psi^{\textcircled{0}}, \psi^{\textcircled{7}}\}$	Anti-fermion	+1	W	RL	positron

# Quarks

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

# Reverse quarks

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



# W-particles

$\{\psi^{(6)}, \psi^{(1)}\}$	boson	-1	$\bar{R}R$	RL	$W_-$
$\{\psi^{(1)}, \psi^{(6)}\}$	Anti-boson	+1	$R\bar{R}$	LR	$W_+$
$\{\psi^{(6)}, \psi^{(2)}\}$	boson	-1	$\bar{R}G$	RL	$W_-$
$\{\psi^{(2)}, \psi^{(6)}\}$	Anti-boson	+1	$G\bar{R}$	LR	$W_+$
$\{\psi^{(6)}, \psi^{(3)}\}$	boson	-1	$\bar{R}B$	RL	$W_-$
$\{\psi^{(3)}, \psi^{(6)}\}$	Anti-boson	+1	$B\bar{R}$	LR	$W_+$
$\{\psi^{(5)}, \psi^{(1)}\}$	boson	-1	$\bar{G}G$	RL	$W_-$
$\{\psi^{(1)}, \psi^{(5)}\}$	Anti-boson	+1	$G\bar{G}$	LR	$W_+$
$\{\psi^{(5)}, \psi^{(2)}\}$	boson	-1	$\bar{G}G$	RL	$W_-$
$\{\psi^{(2)}, \psi^{(5)}\}$	Anti-boson	+1	$G\bar{G}$	LR	$W_+$
$\{\psi^{(5)}, \psi^{(3)}\}$	boson	-1	$\bar{G}B$	RL	$W_-$
$\{\psi^{(3)}, \psi^{(5)}\}$	Anti-boson	+1	$B\bar{G}$	LR	$W_+$
$\{\psi^{(4)}, \psi^{(1)}\}$	boson	-1	$\bar{B}R$	RL	$W_-$
$\{\psi^{(1)}, \psi^{(4)}\}$	Anti-boson	+1	$R\bar{B}$	LR	$W_+$
$\{\psi^{(4)}, \psi^{(2)}\}$	boson	-1	$\bar{B}G$	RL	$W_-$
$\{\psi^{(2)}, \psi^{(4)}\}$	Anti-boson	+1	$G\bar{B}$	LR	$W_+$
$\{\psi^{(4)}, \psi^{(3)}\}$	boson	-1	$\bar{B}B$	RL	$W_-$
$\{\psi^{(3)}, \psi^{(4)}\}$	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	o	GR	LL	Z
$\{\psi^{(5)}, \psi^{(6)}\}$	Anti-boson	o	$\overline{GR}$	RR	Z
$\{\psi^{(3)}, \psi^{(1)}\}$	boson	o	BR	LL	Z
$\{\psi^{(4)}, \psi^{(6)}\}$	Anti-boson	o	$\overline{RB}$	RR	Z
$\{\psi^{(3)}, \psi^{(2)}\}$	boson	o	BR	LL	Z
$\{\psi^{(4)}, \psi^{(5)}\}$	Anti-boson	o	$\overline{RB}$	RR	Z
$\{\psi^{(1)}, \psi^{(2)}\}$	boson	o	RG	LL	Z
$\{\psi^{(6)}, \psi^{(5)}\}$	Anti-boson	o	$\overline{RG}$	RR	Z
$\{\psi^{(1)}, \psi^{(3)}\}$	boson	o	RB	LL	Z
$\{\psi^{(6)}, \psi^{(4)}\}$	Anti-boson	o	$\overline{RB}$	RR	Z
$\{\psi^{(2)}, \psi^{(3)}\}$	boson	o	RB	LL	Z
$\{\psi^{(5)}, \psi^{(4)}\}$	Anti-boson	o	$\overline{RB}$	RR	Z

# Neutrinos

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

To Logic Systems slides:

<http://vixra.org/abs/1302.0122>

To start of Hilbert Book slides:

<http://vixra.org/abs/1302.0125>

To “Physics of the Hilbert Book Model”

<http://vixra.org/abs/1307.0106>