Quaternionic Quantum Physics

By Ir J.A.J. van Leunen

Retired physicist & software researcher

Location: Asten, the Netherlands

Website: http://www.crypts-of-physics.eu/

Communicate your comments to info at that site.

Last version: March 18, 2012

Abstract

This paper presents a reason for the existence of the wave function. Most physicist use a complex wave function as the representative of a quantum physical item without further thinking about why that choice is made.

A slightly different choice for the wave function throws a completely new light on fundamental physics. For example, a quaternionic wave function converts each linear equation of motion into a balance equation and turns fundamental physics into a space streaming problem.

The fact that such a slight change has such deep and unexpected effects shows that the fundaments of physics are still not well comprehended.

Wave functions

It is a mathematical fact that both the real numbers and the rational numbers contain an infinite amount of elements. It is possible to devise a procedure that assigns a label containing a different natural number to every rational number. This is not possible for the real numbers. Technically this means that the set of real numbers has a higher cardinality than the set of rational numbers. In simple words it means that there are far more real numbers than there are rational numbers. Still both sets can densely cover a selected continuum, such as a line. However, the rational numbers leave open places, because infinite many real numbers fit between each pair of rational numbers.

Complex numbers and quaternions have the same cardinality as the real numbers. They all form a continuum. Rational numbers have the same cardinality as the integers and the natural numbers. They all form (infinite) countable sets.

Now take the fact that the set of observations covers a continuum and presume that the observed objects form a countable set. This poses a problem when the proper observation must be attached to a selected observed object. The problem is over-determined and in general it is inconsistent. The problem can only be solved when a little inaccuracy is allowed in the value of the observations.

In quantum physics this inaccuracy is represented by the wave function, which is a probability amplitude distribution. It renders the inaccuracy stochastic.

According to analyzes in 1936 of John von Neumann[1] and Garret Birkhoff[2], quantum physics uses separable Hilbert spaces as the realm in which it does its mathematics. A separable Hilbert space has only a countable set of dimensions. So, a location-operator can only have a countable set of eigenvectors. Each eigenvector represents a location. As a consequence, only a countable set of relevant locations exists. That is why wave functions must solve the problems that are posed by the availability of a too large variety of observations.

In the Hilbert Book Model[3] this argument is used in order to explain why quantum physics contains wave functions and from the existence of wave functions the existence of physical fields is derived, thus this argument has far reaching consequences. One could apply non-separable Hilbert spaces, such as a rigged Hilbert space, but that takes the argument away why quantum physics must contain wave functions. It would also deprive quantum mechanics from its fundament; quantum logic.

Probability amplitude distributions

The wave function of physical particles is a typical example of a probability amplitude distribution. Most physicists use a complex probability amplitude distribution (CPAD) for that

[1] http://en.wikipedia.org/wiki/John_von_Neumann#Quantum_logics
[2] http://en.wikipedia.org/wiki/John_von_Neumann#Lattice_theory
[3] See the corresponding section

purpose. The squared modulus of a CPAD can be interpreted as the distribution of the probability density of the presence of the carrier of the properties of the particle. However, it is equally well possible to use a quaternionic probability amplitude distribution (QPAD) instead of a CPAD. This option has several advantages. A static QPAD can be considered as the combination of a real charge density distribution and an imaginary current density distribution. What these charges and currents are can be left to later investigation. It is appropriate to interpret the charge as the ensemble of the properties of the carrier of the charge. As with the CPAD, the squared modulus of a QPAD can still be interpreted as the distribution of the probability density of the presence of the carrier of the properties of the particle. The main difference is that with QPAD's fundamental physics can be interpreted as a streaming problem.

This can be taken one step further. This occurs by deliberating about the carriers. What can they be? What is moving across the parameter space of the QPAD? A daring and at the same time promising choice would be that they are tiny patches of the parameter space of the QPAD. The parameter space can be seen as the imaginary part of a quaternionic distribution. By transporting tiny patches that originate of that space to another location in that space the space can be locally compressed and may decompress at other locations. In this way a kind of space-atmosphere is created.

This daring interpretation immediately gives an explanation for the existence of space curvature in the neighborhood of particles.

QPAD versus CPAD

The choice for QPAD versus CPAD is a purely mathematical decision. It does not influence physical reality. It only changes the view that human's may have on physics. It appears that the choice for QPAD's turns the theory about fundamental physics into a streaming theory. In this quaternion oriented theory the usefulness of the toolkit of complex number oriented physics will reduce to special one-dimensional cases. It means that tricks that work in complex QED and complex QCD will in general not work for QPAD's.

Inside a QPAD occur features such as charge density distributions, current density distributions, sources, drains, compression regions and decompression regions. These features are unthinkable inside a CPAD. For that reason the QPAD approach is far richer than the CPAD approach. It is also richer than the GRT approach. It offers a much more detailed analysis of what happens in the undercrofts of physics.

The fact that such a small change in strategy has such great and unexpected impact signals that the fundamentals of physics are still not well understood.

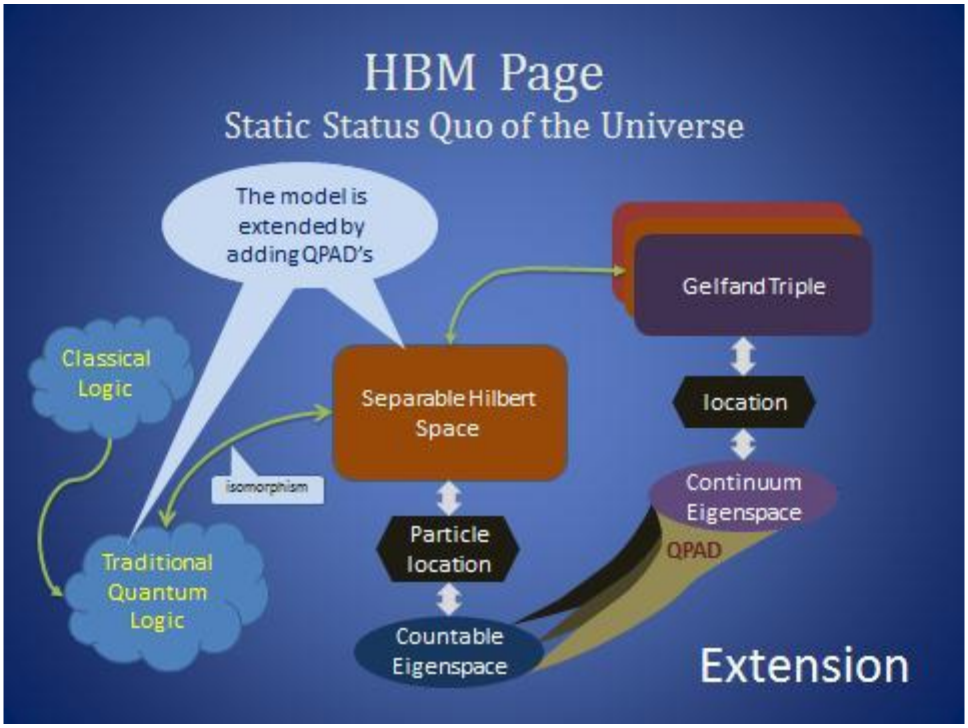
Sign flavors

QPAD's have still another advantage above CPAD's. Quaternions have two independent sign selections, where complex numbers have only one. One of the sign selections works isotropic. It is called conjugation and switches the sign of all three imaginary base vectors. The other is a reflection and exists in three independent directions. As a consequence eight different sign selections exist. This fact is hardly known.

Quaternionic distributions keep the same sign selection through all of their values. Thus quaternionic distributions exist in eight different sign flavors. Usually their parameter is a quaternion or the imaginary part of it. Thus the parameter space is itself a quaternionic distribution. This opens the possibility to use the parameter space as the reference for the characterization of the sign flavor of the quaternionic distribution.

QPAD's are no more than special kinds of quaternionic distributions.

The Hilbert Book Model



The Hilbert Book Model (HBM) is a simple Higgsless and self-consistent model of fundamental physics that is strictly based on the axioms of traditional quantum logic. It uses a sequence of instances of an extension of a quaternionic separable Hilbert space that each represents a static status quo of the whole universe. It widely uses the opportunities that are offered by QPAD's. The HBM uses the sign flavors of coupled QPAD's in order to construct all known elementary particles that occur in the standard model.

Due to its reliance on QPAD's rather than on CPAD's its methodology is unconventional and rather controversial. Methods that work in QDE and QCD cannot all be applied in the HBM. However, the HBM offers circumventions for this dilemma. It treats linear equations of motion such as the Dirac equation as balance equations. It treats fundamental physics as a space streaming problem.

See: http://vixra.org/abs/1112.0084 and http://vixra.org/abs/1202.0033

The parameter space

The parameter space of the QPAD can be interpreted as a quaternionic distribution. It has itself a parameter space, which is formed by a 3D continuum. This continuum is taken from the eigenspace of a location operator that resides in the Gelfand triple of the separable Hilbert space. Only the imaginary part of the quaternionic distribution is used. It can be considered as a 3D Riemannian manifold. The local metric defines the local curvature. What occurs in this manifold is described by the QPAD.

Personal experience and insight of the author might reveal what kinds of processes determine the dynamics in the parameter space. Two kinds of processes play a role. The first kind is formed by quantum generating or quantum annihilating Poisson processes[4]. The second kind is caused by the coupling of QPAD's. It means that the dynamics in the parameter space can be described by a combination of fluid dynamics and statistical mechanics. Since the HBM implements dynamics via a sequence of pages, each HBM page only shows the static status quo of the parameter space.

The elementary coupling equation is a continuity equation. At some distance from the elementary particle the dynamics can be described as incompressible flow. However, close to the particle, thus close to the coupling the dynamics must be treated as compressible flow. It means that features like compression and temperature will start to play a role.

Conclusion

The fact that a rather small change in the methodology, such as a switch from CPAD's to QPAD's is capable of causing a drastic change in the view on the fundaments of physics, shows that these fundaments are still not well comprehended and are far from well established.

[4] http://www.crypts-of-physics.eu/What_image_intensifiers_reveal.pdf