

Stochastic nature of quantum physics

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December 11, 2013

Paginated model

The stochastic nature of quantum physics can best be comprehended by shifting to another space-progression model. This other model is called a paginated space-progression model and uses a universe wide time clock that ticks synchronously at the location of all observable items/events. As a consequence this model proceeds with universe wide progression steps from each static status quo to the next one. A straight forward consequence is that the whole universe is recreated at every progression step. It means that this dynamic model consists of an ordered sequence of static sub-models that each describes a universe wide static status quo. Suitable descriptors for these sub-models are quantum logic and its lattice isomorphic companion a separable Hilbert space. A quantum logic proposition corresponds to a closed subspace of the Hilbert space. This primitive model can be extended by adding the Gelfand triple to the separable Hilbert space. In this way operators become available via the Hilbert space that have a countable eigenspace and other operators become available via the Gelfand triple that have a continuum as eigenspaces.

The sequence counter of the static sub-models acts as progression parameter in the dynamic model. This model requires an extra correlation mechanism that takes care of the coherence between subsequent static sub-models, otherwise the dynamic model will generate dynamical chaos. On the other hand the coherence must not be too stiff otherwise no dynamics will take place.

Correlation mechanism

Let's consider the situation that the mechanism embeds eigenvalues of an operator in the Hilbert space into a continuum eigenspace of a suitable operator in the Gelfand triple. This embedding must recur at every progression step. It must not recur too precisely, otherwise no dynamics is possible. On the other hand sufficient coherence must exist between subsequent elements of the sequence. The result is that the embedded eigenvalue appears to walk in a micro-path that is formed by step stones that together form a coherent discrete distribution.

An extra restriction that is installed by the correlation mechanism is that the coherent discrete distribution of step stones can be characterized by a continuous step stone density distribution that exists in the embedding continuum. Further the mechanism ensures that this continuous object density distribution can be characterized as a probability density distribution. If this succeeds, then the object density distribution can be considered as the squared modulus of the wave function of the considered object. This describes the fundamental stochastic nature of the universe wide time clock model. These extra restrictions are far from obvious. The consequence is that the stochastic micro-path is generated in a recurrent fashion such that important statistical attributes are reinstalled in a cyclic fashion.

If after walking along the full micro-path the next walk keeps the average location of the step stones at the same location, then the object is considered to stay at rest or to take part in an oscillatory movement such that the micro-path is stretched along the path of the oscillation. If that is not the case, then the object is considered to move and the micro-path is considered to be stretched along a part of the path of that movement.

Here the correlation mechanism will put another restriction that concerns the stretching of the micro-path along the movement or oscillation paths. This must occur such that the Fourier transform of the density distribution of the step stones will reflect the probability distribution of the momenta that characterize the motion. This restriction reflects the impact of Heisenberg's uncertainty principle.

Together these restrictions render the model as a quantum physical system and support the particle-wave nature of the objects that are controlled by the correlation mechanism.

Fields

The full story is a lot more complex. The story above does not include fields or it must be the embedding continuum. Depending on the difference between the discrete symmetry properties of the step stones and the embedding continuum, the embedding process can give a violent reaction in the form of a singularity that with maximal speed extends its influence in the embedding continuum in the form of a 3, 2, or 1 dimensional wave front. The wave fronts that are emitted by the considered object combine in super-high frequency waves. This frequency is so high that these waves cannot be observed, but the averaged effects become noticeable as the object's potentials. The wave fronts slightly fold and thus curve the embedding continuum. This effect explains the origin of space curvature. The propagation of the waves is controlled by a mechanism similar to the Huygens principle. The Huygens principle acts differently in different numbers of dimensions. It defines the form of the Green's function that also specifies the contribution of the wave front to the potential. This mechanism must also cope with the fact that universe and thus all fields and waves are recreated at every progression step.

Thus the universe wide time clock model also features fields and objects that possess potentials. The model explains the origin of space curvature. Thus, it explains how particles get their mass.

In contemporary physics, red-shift is measured and interpreted as space expansion. Further the speed of information transport appears to be constant. The HBM takes this speed as a model constant. As a consequence space expansion goes together with a similar expansion of the progression step. With other words the universe wide time clock slows down as a function of progression.

Particles

The [Hilbert Book Model project](#) shows that in this way a full blown model of the lower layers of fundamental physics can be established.

In the Hilbert Book Model the step stones are represented by quaternions and the continuums are represented by quaternionic functions. These objects exist in 16 versions that only differ in their discrete symmetry set. When combined in an embedding process $16 \times 16 = 256$ combinations are possible. Half of them represent (elementary) particles, the other half represent anti-particles.

The resulting difference in discrete symmetry properties results in discrete properties such as electric charge, color charge, or being fermion or boson. Not all properties are measurable. Thus, not all particle types can be distinguished.

Entanglement

Entanglement restricts to systems and subsystems of elementary particles. The effect of entanglement uses the Pauli principle. It means that the Pauli principle always restricts to an

entangled system. That is why in universe electrons exist that have the same properties without excluding these properties in other systems..

A system is entangled when its quantum state function can be written as the superposition of the quantum state functions of its components. In this condition the system has focus and the squared modulus of the wave function can be interpreted as a probability distribution that is normalized to unity. As soon as the focus shifts to a fermionic component then the Pauli principle gets in action and other fermionic components can only adapt compatible properties.

Getting focus means that the wave function normalizes to unity.

Entanglement is also installed under the care of the correlation mechanism. It means that this mechanism determines what entangled systems are.

Foundation

It is possible to reason about the existence of a paginated space-progression model by starting from quantum logic as THE foundation of fundamental physics. Quantum logic offers no means for presenting dynamics. The only way to convert it in a dynamical model is by using an ordered sequence of quantum logical systems that differ slightly from each other. Through its lattice isomorphism with the set of closed subspaces of a separable Hilbert spaces it becomes clear that this static sub-model can be used for the description of a static status quo of the discrete part of the universe. By adding the Gelfand triple the whole static status quo can be covered.

Lattice structure

The choice for quantum logic can be justified by the following deliberation. It is taken from the Hilbert Book Model project.

In no way a model can give a precise description of physical reality. At the utmost it presents a correct view on physical reality. But, such a view is always an abstraction.

Physical reality is very complicated. It seems to belie Occam's razor. However, views on reality that apply sufficient abstraction can be rather simple and it is astonishing that such simple abstractions exist. Complexity is caused by the number and the diversity of the relations that exist between objects that play a role. A simple model has a small diversity of its relations.

Mathematical structures might fit onto observed physical reality because its relational structure is isomorphic to the relational structure of these observations.

The part of mathematics that treats relational structures is lattice theory. Logic systems are particular versions of lattice theory. Classical logic has a simple relational structure . However since 1936 we know that physical reality cheats classical logic. Since then we think that nature obeys quantum logic, which has a much more complicated relational structure. Mathematics offers structures that are lattice isomorphic to quantum logic. One of them is the set of subspaces of a separable Hilbert space.

The conclusion of this deliberation is that physical reality is not based on mathematics, but that it happens to feature relational structures that are similar to the relational structure that some mathematical constructs have. That is why mathematics fits so well in the formulation of physical laws. Physical laws formulate repetitive relational structure and behavior of observed aspects of nature.

Probability distributions

Much in quantum physics has to do with the fact that the wave function has a direct relation to a probability density distribution and that the Fourier transform of this probability density distribution describes a probability distribution of momenta that describe the motion of the considered object.

The HBM relates the wave function to a coherent discrete distribution of step stones that form a stochastic micro-path. During movements or quantum oscillations the micro-path stretches along the oscillation or movement path. This is done such that the above relation between locations and momenta is kept. With other words the mechanism that controls this, keeps Heisenberg's uncertainty principle intact.

The result of these measures is that under certain conditions the step stones can form interference patterns. This leads to the particle-wave duality of quantum scale objects.

Entanglement is based on the fact that the wave function of the considered system or particle is a probability density function and that the wave function of an entangled system equals the superposition of the wave functions of its components.

Statement

Both the paginated space-progression model that uses a universe wide time clock and the spacetime model that is used by contemporary physics seem to be valid models of physical reality.