FAQ Realism vs Quantism

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First they laugh at you
Then they ignore you
Then they fight you
Then you win

Mahatma Gandhi

Contents:

The reader, we assume, is familiar with Quantism, but an elementary course is enough. This FAQ will be specially useful to persons combining enough technical knowledge of Quantism with a healthy skepticism about its esoteric proposals.

Realism and Quantism

1.- *What is Realism?*

Realism, as a branch of Physics, is the theory that uses causal, continuous and deterministic models to describe and predict physical phenomena associated with atoms, electrons, photons and other microscopic particles.

Technically Realism is a continuous and deterministic non-linear wave theory based on Schrödinger self-adjoint operator.

The word Realism is also used in Physics with other meanings, but these will not be considered here.

2.- *Why the name Realism?*
Because only *real valued* wave functions are used. Realism does not require complex valued wave functions because it does not use Schrödinger unitary evolution equation.

3.- *What is Quantism?*
Quantism is a collection of erroneous physical theories –regrettably accepted– that preach discontinuity of phenomena and postulate uncertainty, randomness and breakdown of causality as the basic behavior of small physical entities.
Given the number of persons involved, the high standing it has been accorded and the sophistication of contemporary civilization, Quantism is the greatest scientific mistake in the history of humankind. The error is a direct consequence of Schrödinger unitary linear evolution equation.

Change and Evolution

4.- *What is evolution?*
In general, evolution is the way things move. The manner they change in time.
For biologists the term evolution has a more specialized meaning.

5.- *What is physical evolution?*
Physical evolution is the way physical objects change and move. It has been going on for as long as the Universe has existed and will keep going for as long as it exist, that is, forever. It includes all scales, from galactic arrangements to subatomic processes. Physical evolution is much older than life on Earth and works independently of theories and ideas invented by the human mind to explain it.

Mathematics of Evolution

6.- *What is an evolution equation?*
It is a way to specify how mathematical objects move and change. If the mathematical object represents an entity –stock market prices, asteroid or bound electron– it is reasonable to demand consistency with the way the entity moves.
In the present context an evolution equation is defined by means of a differential equation.
Besides the differential equation one can also use its flow, which is the way to simultaneously deal with all its solutions.

7.- *What are differential equations?*
They are mathematical relations between values of quantities and the way these values change. This goes back to Newton.
Formally a differential equation is a relation between a function and its derivatives.

8.- *What is a linear differential equation?*
Is when the relation between the values of quantities and their derivatives is a linear function. They are defined on linear spaces (or vector spaces), that is, on spaces where all elements are vectors.

9.- *What is a linear evolution equation?*
They are those defined by linear differential equations.

10.- *What is a unitary linear evolution equation?*
Is a linear evolution equation defined by a linear differential equation over a complex linear space and having all the coefficients of the linear combination equal to purely imaginary numbers. This kind of evolution equation is typical of Quantism.

11.- *What is a non-linear evolution equation?*
Is one specified by means of a non-linear differential equation.

12.- *What is a non-linear differential equation?*
Is one defined by means of general functional relations. Non-linear differential equations are an extensive class containing linear ones as particular cases. They are defined over non-linear spaces called differentiable manifolds.

13.- *What is a differentiable manifold?*
Is a collection of quantities that locally behave like vectors. Thus, small enough subcollections of quantities are similar to small enough subcollections of vectors. Linear spaces indeed have such property and are special instances of differentiable manifolds.
The class of differentiable manifolds does not excludes linear spaces; they are included as particular cases. But in general, due to their global properties, differentiable manifolds are remarkably distinct from linear spaces.

14.- *How can unitary evolution be wrong when so many theorems on the subject have been mathematically proved?*
There is nothing wrong with the mathematics of unitary evolution. It is possible to develop many mathematical theories –including very difficult ones– that have little to do with natural phenomena.

15.- *Why worry about so many types of evolution?*
There is a unique physical universe, and presumably a unique physical evolution. On the other hand there are many theories about the Universe and many theoretical evolution equations. But these –theories, evolution equations, wave functions– exist only inside the human mind.
Since theoretically so many evolutions equations are possible the basic question is: Which evolution equations better reflect physical phenomena?

Outline of Realism

16.- *Are there formal descriptions of Realism?*
Yes. A good example is the hydrogen atom.
Consider Schrödinger self-adjoint energy operator $H = -\nabla^2 + U$. There is a space E of real valued wave functions ψ, a *space of states* PE equal to the real projective space associated to E, with states equal to the elements

$$[\psi] = \{\lambda\psi \,|\, \lambda = \text{real scalar}\}$$

an *energy function* $e_H : PE \to \mathbb{R}$ given as

$$e_H([\psi]) = \frac{\langle H\psi, \psi\rangle}{\langle \psi, \psi\rangle}$$

and an evolution equation

$$-(1/2h)\nabla e_H : PE \to T(PE)$$

way down the energy gradient; here h=Planck constant.
The global geometric structure of PE turns out to be an exuberant architecture, much more sophisticated than linear spaces, and provides the key that correctly explain the behavior of the physical system. For more details see the papers bundled with the freeware *Real vs Quantism.exe* or in the web page
http://euler.ciens.ucv.ve/~dcrespin/Pub.

17.- *Is a shorter description possible?*
Yes. A summary of the above. The hydrogen atom is descried by the three objects

$$PE \qquad e_H \qquad -(1/2h)\nabla e_H$$

Discussion of Realism

18.- *Why is Schrödinger unitary evolution equation physically mistaken?*
Because the unitary evolution of the wave function, and therefore the movement it predicts for the electron, is inconsistent with the experimentally observed electron behavior.
According that evolution waves move without radiating energy. But it is a well known fact that electrons make transitions between stationary states and these movements imply an energy exchange.
Quantists placed responsibility for the transitions not on the evolution equation –where it naturally belongs– but on the states themselves. Their trick was to invoke probabilities.

19.- *Is not the real evolution the same as Schrödinger unitary evolution equation?*
No. They differ remarkably.
The real evolution equation is a non-linear flow defined by the negative energy gradient in the non-linear space of states PE. The rich architecture of PE together with the gradient flow correctly explains –while preserving causality, continuity and determinism– the physical behavior of the system.
By way of contrast, the evolution postulated by Quantism is an energy conservative Hamiltonian that provides a flow perpendicular to the gradient.

20.- *But if Schrödinger evolution equation is physically mistaken why Realism discards it and still keeps Schrödinger self adjoint operator?*
Schrödinger self adjoint operator is a wonderful object whose eigenvectors and eigenvalues provide Realism (as well as Quantism) the stationary states and energies of the system.

21.- *If, again, Schrödinger evolution equation is physically mistaken, how could Quantism be so successful during eighty years?*
Precisely because with the self adjoint operator the stationary states and energies of the physical system are calculated. This impressive feat by Erwin Schrödinger was invoked by the followers of Quantism and, mixing it up with the erroneous unitary evolution equation, delayed for over three quarters of a century the correct understanding of microscopic physical systems.

22.- *If discontinuous quantum jumps do not exist, how can there be transitions between stationary states?*
Transitions are a real phenomenon. Discontinuous quantum jumps are a wrong explanation of this phenomenon. In reality transitions are continuous processes.
By means of its equations Realism provides the mathematical tools to eliminate once and for all the very serious scientific mistake of Quantism.

23.- *What about the interpretation of wave functions as probability densities?*
This is a typical artifact of Quantism. Originally it was a forced loan from Statistical Mechanics.
Since the unitary evolution equation contradicts the experimentally observed transitions between stationary states, quantists claimed that the transitions did not arise from the dynamics –that is, from the evolution equation– of the system but were some mysterious consequence of a passive kinematic object, that is, of the state itself.
They invented that the state had a probability, or was in itself a probability, of suddenly becoming, thanks to the discontinuous quantum jumps, another state.
Believe it or not this extravagance became, after countless repetitions, a scientifically accepted truth.
As a consequence of this mistake a huge effort is still wasted in understanding, extending, modifying, interpreting, reformulating, transmitting and explaining Quantism, a theory that now turns out to be incomprehensible due to its erroneous dynamical content.

24.- *In order to be a physical theory should not Realism provide a physical interpretation of wave functions?*
In Realism a state $[\psi] \in PE$ is a collection of functions related to each other by a proportionality factor. Thus ψ, $-\psi$, $\sqrt{2}\psi$, etc. all represent one and the same physical state. Hence the physical relevance is not in the value $\psi(\mathbf{r})$ but in the proportions $\psi(\mathbf{r})/\psi(\bar{\mathbf{r}})$ at the various points $\mathbf{r}$, $\bar{\mathbf{r}}$ of ordinary three dimensional physical space.
Assume now that the wave functions are interpreted by assigning them some physical magnitude [M]. Since

$$\frac{\psi(\mathbf{r})[\mathrm{M}]}{\psi(\bar{\mathbf{r}})[\mathrm{M}]} = \frac{\psi(\mathbf{r})}{\psi(\bar{\mathbf{r}})}$$

we see that when proportions are considered the physical magnitude cancels out. Hence Realism does not depend on the particular magnitude and therefore is consistent with any reasonable physical interpretation that could possibly be given to the wave functions.
In one of his original papers Schrödinger interpreted $|\psi|^2$ is charge density so that ψ somehow is 'square root of charge density'. Until a better interpretation is proposed this one can be safely used.
The fact that $[\psi]$ represents a state independently of physical magnitudes suggests also that a fundamental physical limit has been achieved.

25.- *What about electron spin?*
Quantum spin is an incredibly complicated formalism invented by quantists in order to explain rotational microscopic phenomena. Such abstruse formalism is not required by Realism. The reason Quantum spin went so complicated was the use of complex wave functions together with the probabilistic interpretation. This made ψ and $e^{i\,m\phi}\psi$ represent the same physical state. Hence it is impossible to distinguish the state from those obtained rotating itself.
Realism has no need for the convolved quantum spin. Because imaginary numbers are not used, electron spin can be seen in Realism as a rotation in its standard sense. Rotations are easily described by the flow.
As an example, for the pair of linearly independent real valued hydrogen atom eigenfunctions

$$\begin{aligned} \psi^c = \psi^c_{n\,\ell\,m}(\mathbf{r}) &= \psi^c_{n\,\ell\,m}(\theta,\phi,r) = \cos(m\phi)R(r)\Theta(\theta) \\ \psi^s = \psi^s_{n\,\ell\,m}(\mathbf{r}) &= \psi^s_{n\,\ell\,m}(\theta,\phi,r) = \sin(m\phi)R(r)\Theta(\theta) \end{aligned}$$

the expression

$$[\psi_t] = [\cos(mt)\psi^c + \sin(mt)\psi^s]$$

is a periodic trajectory in PE. Note that in real projective space $[\psi] = [-\psi]$, hence $[\psi_t] = [\psi_{t+(\pi/m)}]$ has frequency m/π (instead of $m/2\pi$). This says that in Realism frequency doubling is automatic.
Also, in Realism periodic trajectories are reversed by replacing t with $-t$.

26.- *With Quantum Electrodynamics transitions are deterministic and continuous. Why prefer Realism?*
It is false that Quantum Electrodynamics –or any of the quantum theories– provides continuous transitions between stationary states. All the theories of Quantism are so inconsistent with physical reality that always discontinuous changes according to certain probabilities are postulated. Realism is necessary to restore causality, continuity and determinism.

27.- *Other physical consequences of Realism?*
a.- The stability of the fundamental state (with the minimum energy) is immediate: The evolution is way down the energy gradient and no other state has lesser energy.
b.- Einstein relation

$$E = hc/\lambda$$

is for Realism a corollary, instead of being as in Quantism a postulate. Furthermore Realism provides a novel understanding of this fundamental relation. In particular it can be inferred that a photon is an electromagnetic soliton; the detailed structure of this soliton becomes a real possibility.
c.- Realism suggests that the difference between a fermion and a boson lies in whether or not there exists, for the particle as a wave in ordinary three dimensional space, rotationally invariant stationary configurations.
Additionally there are several additional interesting conjectures and many will be raised –some more sound than others– as Realism develops and replaces Quantism.

Sociology of Realism

28.- *Why everybody embraces Quantism while Realism is unknown?*
Quantists have had so far the upper hand and succeeded propagating their errors. This is because the mathematical details that for everybody unlock the doors of Realism were missing. While familiarity with these details spreads out Quantism will start looking as the bizarre theory it is and will be replaced by Realism. Once this process is complete there will no longer be talking about Realism or Quantism. The correct description of natural phenomena will simply be called Physics.

29.- *If Realism were such an advantageous theory, would not it be immediately adopted?*
It would be. If people were perfect entities instead of human beings.
Most career physicists involved in these matters have been intensively trained in quantist ideology. For the sake of Quantism they sat in courses and heard the persuasive arguments of their teachers. They spent hundreds or even thousands of hours with textbooks on the subject. They solved so many exercises and felt the reward of reaching the 'correct' solution.
The purity of their learning was tested and guaranteed by written and oral examinations. By providing smart explanations in interrogations and seminars. By repeating the expected formulas in front of their advisers.
They belong to learned societies that dedicate sustained efforts to the dissemination of the Physics of the day, that is, of Quantism.
They participate in conferences where their colleagues confirm the truth of their assumptions and conclusions.
But their most compromising deed is to teach Quantism. They have passed the quantum beliefs to others and are now responsible for having done that.
Many will take the stand against Realism because they have to defend their past and present actions.
It is too heavy a burden to face the professional, academic and psychological consequences of a change of paradigm.
Without any doubt a strong defense of Quantism will initially arise. However, Quantism be defeated and Realism will eventually prevail.

30.- *If for many physicists Quantism is already the Truth of Choice, who is going to prefer Realism over Quantism?*
The illustrated public has an immense reservoir of common sense. This includes the large number of educators that, not being fanatics of Quantism and anxious because of its obscurities and incoherences, have to struggle each year in order to explain the imposible Quantism. They did not say much while the minority of Physicists opposing Quantism lacked an adequate formal theory. But as the real evolution equation becomes known the situation changes and they will prefer reasonableness.
Similarly, with Realism now available students will ask questions and will demand explanations. They will not passively accept Quantism.
Regardless of their doctrine quantists are not fools. In other areas of their daily lives they have been successfully applying the same common sense than everyone else. Most will rethink their position and will make the effort required to adopt Realism. They will discover that their previous experience with the calculations of Schrödinger operator together with the naturality of Realism greatly simplifies Physics. The need to reformulate Physics in terms of Realism will provide them with ample opportunity to make lasting contributions to Science. Many quantists of today are the satisfied physicists of tomorrow.

31.- *What are the challenges faced by Realism?*
To discover that the Earth was not the center of the Universe and that planet orbits are elliptical was a first step but, at the time, many more had still to be taken in order to develop a coherent Celestial Mechanics.
Similarly today, with the emergence of Realism all the areas presently dominated by Quantism –and this includes a very large part of Theoretical Physics– have to be reworked. Reinterpreting many experimental results is an unavoidable job.
Later on an important task will be reforming textbooks as well as the contents of the Science and Physics courses at all levels.

32.- *Why this FAQ denounces Quantism in such unrelenting manner?*
The Gordian knot was too complicated and was impossible to untie: It had to be cut. Quantism is too complicated.

History of Realism
33.- *Is Realism something new?*
Not at all. The list of founding fathers of Realism includes Max Planck, Albert Einstein, Louis De Broglie and Erwin Schrödinger. They had the right

physical ideas but strangely –and unfortunately– missed the mathematical details that are now the foundations of of Realism.

34.- *But are not these rather the founding fathers of Quantism?*
Quantists claim that these great physicists created Quantism. Nothing can be farther from truth. Their efforts were in fact attempts to develop Realism. They all made fundamental contributions to the Realism discussed in this document. They publicly rejected Quantism because it negated the general principles of causality, continuity and determinism. Never they recanted their opposition to Quantism.

35.- *If Realism correctly reflects Nature, why was it not glimpsed before, even beyond Physics?*
Of course it was glimpsed. It was seen initially by its founding fathers. Afterwards, revealing evidence surfaced.
a.- In Theoretical Physics versions of dissipative Quantum Mechanics point in the right direction. But these efforts have been insufficient because they are perceived as a sort of Quantism with corrective terms. They preserve too much of the old quantum order and are assimilated or ignored by orthodox Quantism.
b.- In Chemistry and during many years, theoreticians have been intentionally avoiding complex wave functions and have successfully modeled chemical reactions as evolution way down the energy gradient.
c.- In Numerical Calculus stationary states and energies are obtained using a variety of gradient descent methods.

36.- *In the history of Physics there is an outstanding quotation: 'I don't believe God plays dice'. What can be said now?*
It is not a real dice game because the world is causal and deterministic. But it seems one because there is sensitive dependency on initial conditions, which in practice we do not know nor can control.
For us, imperfect hard core gamblers, God plays dice, but He knows in advance the winning number.

Purpose of Realism

37.- *What is Realism main goal?*
To be developed, to be applied, and to claim all territory currently occupied by Quantism.
Additionally a big educational effort at all levels in contemporary society is required to expel the belief in Quantism and establish once and for all that

causeless, random and discontinuous quantum jumps are imaginary phenomena invented by Quantists.

Publications

38.- *Where can publications on Realism be found?*
In the already mentioned http://euler.ciens.ucv.ve/~dcrespin/Pub
and also bundled with the freeware *Real vs Quantism.exe*

Oteyeva, Caracas, on September 23, 2006.