# A Proposed Physical Basis for Quantum Uncertainty Effects.

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**Abstract**:
Quantum scale "uncertainty" effects limiting measurement accuracy appear to reflect the actual properties of quantum particles as has been well substantiated in numerous experimental examples. However, the concept of uncertainty appears to lack any clear physical basis and stands as an effects descriptor, not as a causal description of actual particulate physical properties. The famous EPR paradox is examined, assessed and placed into current perspective then new theory is presented defining the functional causal basis of observed uncertainty effects. Lastly, experimental evidence will be presented in support of this new model.

"When we see probability we do not see causality, we see the limits placed upon our ability to observe overcome by way of an ingenious guess at the result. In this clever approach where cause is neglected *for the prediction of outcome*, we must not forget it is we who can not see. *Physical systems are not guessing at themselves."*
—R.N.

## Introduction.

To many the whole notion of uncertainty, as discussed in quantum mechanics, comes as something of anathema; the whole idea seems to contradict commonsense. It would appear, therefore, sensible to examine this apparent basis for much of modern physics again and in some detail. At the same time it would seem appropriate to examine other uncertainty relations which come into modern physics. Amongst these must be the idea of uncertainty relations in thermodynamics and it is an examination of these which could lead to an understanding of the entire issue, including possibly a further consideration of the question of the completeness of quantum mechanics as a theory and, therefore, of the validity of the claims of Einstein, Podolsky and Rosen[1]. There are no uncertainty relations in classical thermodynamics where, almost by definition, all physical quantities are taken to have quite definite values. However, for example when systems composed of a large number of particles are to be investigated, statistical methods have to be employed since it is impossible, at least at present, to evaluate exactly the behavior of each and every individual particle. Hence, the subject 'statistical mechanics' came into being. By its reliance on statistical methods and, therefore, the idea of probability, the outcome of investigations becomes less definite and uncertainties creep in. This is the source of the so-called thermodynamic uncertainty relations which are considered in many texts[2]. Note though that these uncertainty relations arise out of the introduction of uncertainty into the theory by investigators; they do not appear purely as a result of the physical situation being discussed. Hence, such relations and any deductions made using them must be viewed with a degree of skepticism and treated accordingly since it is not at all obvious that any such deductions are physically realistic. It might be wondered if the same could be true of the uncertainty relations of quantum mechanics. In his seminal book[3], Heisenberg first introduces his relations via a quite simple but definitely approximate method using a wave picture. He then proceeds to derive them also without explicit use of the wave picture but then obtains from them *the mathematical scheme of quantum theory and its physical interpretation.* However, at the basis of much of the mathematics associated with quantum theory is the wave equation with the so-called wave function associated with a probability. Once probability comes into things, uncertainties in measured quantities must necessarily follow. Hence, the question must be raised as to whether, or not, the uncertainties associated with quantum theory are real physical uncertainties or uncertainties introduced surreptitiously by theoreticians, just as occurs in statistical thermodynamics?

All the work that follows is really an extension of earlier work which appeared in the Hadronic Journal and is available online[4]. Any reader of the current work is encouraged to read the full work mentioned here first in order to grasp more easily that which follows.

**Some Preliminaries.**

To begin with, the original paper by Einstein, Podolsky and Rosen[1] should be examined. It may be noted that several important points concerning the thought experiment are proposed:

" ...every element of the physical reality must have a counterpart in the physical theory."

"The elements of the physical reality cannot be determined by a priori philosophical considerations, but must be found by an appeal to results of experiments and measurements."

"More generally, it is shown in quantum mechanics that, if the operators corresponding to two physical quantities, say A and B, do not commute, that is, if AB≠BA, then the precise knowledge of one of them precludes such a knowledge of the other. Furthermore, any attempt to determine the latter experimentally will alter the state of the system in such a way as to destroy the knowledge of the first. From this follows that either (1) the quantum mechanical description of reality given by the wave function is not complete or (2) when the operators corresponding to two physical quantities do not commute the two quantities cannot have simultaneous reality. For if both of them had simultaneous reality-and thus definite values-these values would enter into the complete description, according to the condition of completeness."

"Thus, by measuring either A or B we are in a position to predict with certainty, and without in any way disturbing the second system, either the value of the quantity P (that is $p_k$) or the value of the quantity Q (that is $q_r$)."

"Previously we proved that either (1) the quantum-mechanical description of reality given by the wave function is not complete or (2) when the operators corresponding to two physical quantities do not commute the two quantities cannot have simultaneous reality. Starting then with the assumption that the wave function does give a complete description of the physical reality, we arrived at the conclusion that two physical quantities, with noncommuting operators, can have simultaneous reality. Thus the negation of (1) leads to the negation of the only other alternative (2). We are thus forced to conclude that the quantum-mechanical description of physical reality given by wave functions is not complete."

Two primary elements of the EPR argument may now be noted separately:

1. It is possible to define both position and momentum of two previously interacting quantum particles/systems.
2. Measurement may not (non locally) disturb system two if system one is measured, unless a hidden variable not yet defined within the context of *wave function* is identified.

Point two is clearly implied from the last sentence in the paper:

"We believe, however, that such a theory is possible."

and the aforementioned sentence:

"...every element of the physical reality must have a counterpart in the physical theory."

It is important to note at this juncture, the concerns of Heisenberg regarding such fanciful methods of deduction and exploration as thought experiment and human imagining alone, which appear to closely parallel Einstein's views of the same, as already noted above.

From Heisenberg's book[3], p. 15, concerning the reality of uncertainty as per his equations in physical systems, he states that

"*In this connection one should particularly remember that the human language permits the construction of sentences which do not involve any consequence and which therefore have no content at all—in spite of the fact that these sentences produce some kind of picture in our imagination*."

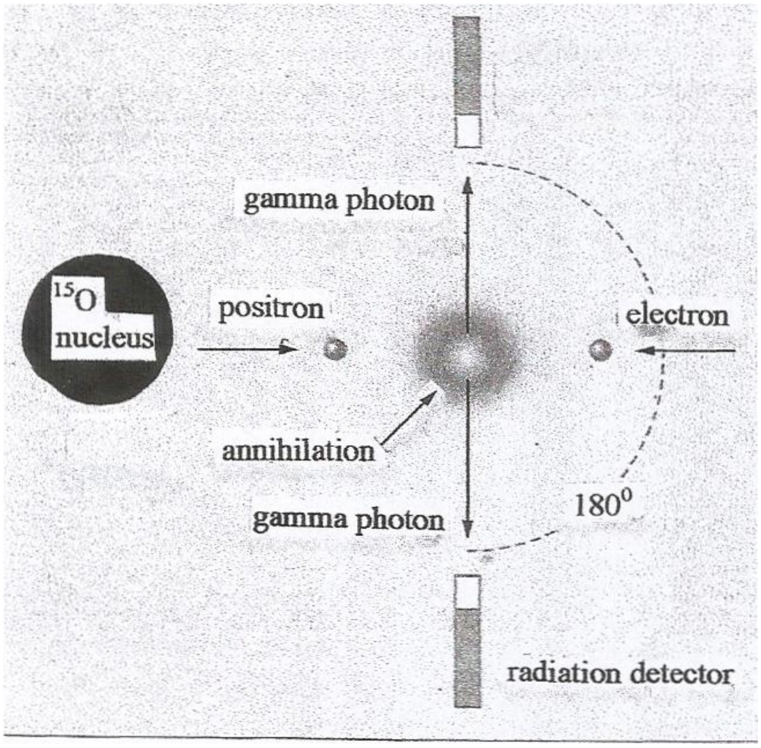
The reader of this present article should note this point as it is important in what follows.

**Analysis of EPR feasibility**.

If the notion of the EPR argument is sound, one would expect the scheme to be used in some sort of demonstrable way. If the idea is good and leads to accurate measurement, some practical usage must have been made of it after all these years. Entangled science aside, is the basic notion in point one above actually demonstrable?

Let us bring forward the usual interpretations of the EPR ideas, and imagine two quantum particles which have interacted, and are now moving directly away from each other at a 180 degree relation. This is the interpretation most used, that akin to the thinking of Kumar[5] which defines the EPR idea as "two particles, A and B, [that] interact briefly and then move off in opposite directions."

Is this scheme actually able to measure anything, and is it used? Seemingly yes. Positron Emission Tomography scanning (the PET scan) appears to use this idea to measure biological processes and define the locations thereof. A PET scanner is essentially a gamma ray detector. In PET scans, Blood Oxygenation Level-Dependent relations indicative of tissue oxygen metabolism are detected through positron/electron annihilations created by way of an injected radioactive oxygen tracer such as $^{15}O$, which has a half life of 123 seconds. As the unstable nucleus of a $^{15}O$ atom decays having been absorbed by dynamic oxygen using tissues such as neurons, it emits a positron. The positron annihilates when brought in contact with an electron, emitting 2 (gamma) annihilation photons which travel in exactly opposite directions, a 180 degree relation of two quantum particles moving at a constant mutual speed, allowing accurate measurement of the location of the source interaction in space, and also, inference could easily be drawn from one particle measurement to the values of the other.



PET scan schematic representation.

It may be concluded that the basic notion is in fact quite functional as a system of measurement when used in a general way. It is clear also that scientific observers could easily infer the position and momentum of one particle from measurement of the other, which travels in mirror opposite, both at a known speed.

It seems the EPR scheme does allow actual measurement as it should in reality, and is not just a fanciful idea one may draw up to form a picture in one's head, and so, answers in this one aspect at least, Heisenberg's and also Einstein's standards of a workable theory as represented in good science.

Next, we move to the nonlocal aspects of the EPR theory and assess the outcome of experiments. Local realism insists that measurement of one separated system part could not ever superluminally affect the other separated parts of the system (presumably unless some missing, hidden variable is in play). Recall that, in the Copenhagen interpretation of QM, the wave function is entirely a probabilistic entity! However, it is found that nonlocal measurement effects moving well in excess of light speed are evidenced and those results then repeated in experiments involving entanglement.

In an article by Yin, et al.[6], it may be read

> "In the well-known EPR paper, Einstein et al. called the nonlocal correlation in quantum entanglement as `spooky action at a distance'. If the spooky action does exist, what is its speed? All previous experiments along this direction have locality and freedom-of-choice loopholes. Here, we strictly closed the loopholes by observing a 12-hour continuous violation of Bell inequality and concluded that the lower bound speed of `spooky action' was four orders of magnitude of the speed of light if the Earth's speed in any inertial reference frame was less than $10^{-3}$ times of the speed of light."

Here, the new theories come good and the matter may be resolved in favor of a hidden variable: the scalar wave within the aether. See reference 4. Of course, in any modern discussion of the EPR paradox, it must never be forgotten that a resolution was presented in 1998 by Ruggero Santilli[7] and this has, as far as is known, never been discredited. Hence, it appears that, when the whole question of the EPR paradox comes under discussion, reference should be made to this work.

**Cause of quantum uncertainty effects.**

Again the reader should remember of the cautionary words of Heisenberg:

> "In this connection one should particularly remember that the human language permits the construction of sentences which do not involve any consequence and which therefore have no content at all—in spite of the fact that these sentences produce some kind of picture in our imagination."

It might be postulated that the notion of "uncertainty" itself is exactly such an error as Heisenberg himself cautions against! This property is particulate anthropomorphism...we assign a human quality, *uncertainty*, a kind of affective and logical confusion, to a physical particle. Yes; humans can form this idea, an idea of a particle which is somehow confused as they are, but that is a human idea, not a physical idea. Although it may be pictured, it has no actual physical content.

What could actually be causing the observed measurement results of quantum experiments? If not uncertainty, what is the physical cause of the measurement problem and seeming duality between particle and wave? Duality is always the mark of confused thinking, as are most if not all paradoxes. What could be causing the plainly available "uncertain" experimental effects. It must be a real physical object, and not some confused human imagining!

In truth, Heisenberg's uncertainty relation

$$\Delta x \Delta p_x \geq h$$

describes effects, not causes. There seems to be no physics in this! What actual object could cause these measurement and other "uncertain" quantum effects?

There is a hidden variable; that is, the aether and the longitudinal pressure waves (scalar waves) which form up "force carrier," entangled and gravitational effects. See reference 4.

Now recall boundary layer theory as applied to the aether; that is, the boundary between the aether itself and any body passing through it or over which it passes. Details of the theory of the boundary layer, due initially to Prandtl[8], may be found in most books on fluid mechanics such as that by Cole[9].

Imagine an aetherial boundary layer around a particle. The original uncertainty equation is missing the basis - there is no basis to the physics - it describes only effects. The boundary layer as a *particle-surrounding scalar wave* accounts for the causal mechanism of uncertainty effects, (as well as, possibly, nuclear decay and fusion as will be discussed in future work) - the measurement uncertainty is then caused by an actual wave surrounding the actual particle; not a wave-like particle duality. Physics has left out the aether and, hence, the wave around each quantum particle. The "uncertain" momentum and *x* component of velocity in the Heisenberg equations are themselves caused by this wave obscuring those aspects of the particle. The overall change as diffusion then refers to the heat within the scalar wave and hence its initial (quantum) size, *delta in the Heisenberg equations then referring to the amount of change in temperature above absolute zero*, in a causal analysis and proper treatment[3]. That wave is the source of "diffusion" effects. Note how in the paper, *Entropy in a column of gas under gravity*[10], heat first added to the system creates gravitational potential (in part) and not only increase in temperature. That gravitational potential is, by our present theories, the creation of the scalar waves which create a gravitational field. See reference 4.

If this is so, and our theory correct, a violation of measurement "uncertainty" should be observed in experiments if the scalar waves around the particles are deprived of heat. Indeed, this is exactly what is seen in experiments. The back action limit, the quantum limit on measurement precision bounded by uncertainty, is violated, and now, just as might be expected, absolute zero may be approached *arbitrarily close* to deprive the actual source of uncertainty effects of the heat needed to create them. As Clark and colleagues have pointed out recently[11]:

> "Here we propose and experimentally demonstrate that squeezed light can be used to cool the motion of a macroscopic mechanical object below the quantum backaction limit. We first cool a microwave cavity optomechanical system using a coherent state of light to within 15 per cent of this limit. We then cool the system to more than two decibels below the quantum backaction limit using a squeezed microwave field generated by a Josephson parametric amplifier."

Uncertainty is experimentally demonstrable as a function of heat instantiated within the boundary scalar wave surrounding the particle. It appears likely that, as heat is further reduced as absolute zero is approached more closely, *the cause of quantum uncertainty and fluctuation which is the omnidirectional motion of aether particles within the particle boundary scalar wave* is then reduced, perhaps by way of energy reduction of the aether particle itself and/or alignment of said omnidirectional particle motions, leading to the absence of any wave-forming particulate energy value at absolute zero temperature.

*Quantum fluctuation effects and related uncertainty are caused by omnidirectional aether particle motion. Uncertainty itself within quantum particulate measurement dynamics is actually caused by the boundary wave, surrounding a quantum particle as a function of heat.*

*Uncertainty effects emerge as a function of quantum scale, as the aether particle size is more closely approached.*

Lastly, new experiments are seen where, as might be expected, heat is reduced to permit the proliferation of related condensate and EPR effects to emerge. Note, for example the paper by Fadel, et al[12] in which it is stated that

> "While spin-squeezed and other nonclassical states of atomic ensembles were used to enhance measurement precision in quantum metrology, the notion of entanglement in these systems remained controversial because the correlations between the indistinguishable atoms were witnessed by collective measurements only. Here we use highresolution imaging to directly measure the spin correlations between spatially separated parts of a spin-squeezed Bose-Einstein condensate. We observe entanglement that is strong enough for Einstein-Podolsky-Rosen steering: we can predict measurement outcomes for non-commuting observables in one spatial region based on a corresponding measurement in another region with an inferred uncertainty product below the Heisenberg relation."

**Uncertainty within internal and external dynamical systems.**

Clearly the ideas within this brief work refer only to uncertainty effects within the external dynamical problem, that of particulate interactions and not to the internal dynamical problem of hadronic construction which is that of non-potential contact interactions, meaning non-Hamiltonian systems (that is, variationally nonself-adjoint systems not representable with a Hamiltonian). Those hadronic and other like systems then, may be rightly understood without erroneous reference to uncertainty by way of the mathematics of Santilli.

These topics are discussed in detail at:
http://www.galileoprincipia.org/santilli-confirmation-of-the-epr-argument.php

Briefly, as derived from the web reference above:
Extended and hyperdense protons and neutrons in conditions of partial mutual penetration as occurring in a nuclear structure demonstrate

nonHamiltonian forces. The assumption of the exact validity of Heisenberg's uncertainty in the interior of a nucleus is non-scientific. The hadronic isomomentum is uniquely defined by

$$p' * \psi'(t', r') = - i \partial' \psi'(t', r') = - i U \partial \psi'(t', r') \qquad (1)$$

It is then plain that isolinear momenta isocommute on isospace over isofields by therefore confirming the principle of isotopies

$$[p'_i, p'_j]' = p'_i * p'_j - p'_j * p'_i = 0 \qquad (2)$$

This occurs because the isotopic element T of the isoproduct "*" , cancels out with its inverse, the isounit U =1/T. However, isomomenta no longer commute in our spacetime

$$[p'_i, p'_j] = p'_i p'_j - p'_j p'_i \neq 0 \qquad (3)$$

because, in the absence of the isotopic product, the derivative does act non-trivially on the isounit U due to its general dependence on local coordinates, and this eliminates Heisenberg's uncertainty principle for the study of interior problems and actually replaces it with a much more general principle.

**Some Final Thoughts on the Aether.**

Before concluding, it might be appropriate to reflect on the demise of the aether theories over the last hundred years and more. In the intervening time, several people have doggedly pursued investigations into theories involving the aether concept, often at personal cost. Among those was Kenneth Thornhill and it might benefit many to read his work which is readily available on the internet.[13] In the cited article, he starts by showing that Planck’s energy distribution for a black body radiation field may be derived for a gas-like aether with Maxwellian statistics. The gas consists of an infinite variety of particles whose masses are integral multiples of the mass of the unit particle. Also the frequency of electromagnetic waves correlates with the energy per unit mass of the particles, not with their energy, thus differing from Planck’s quantum hypothesis. Identifying the special wave-speed, usually called the speed of light, with the wave-speed in the $2.7^0$K background radiation field, leads to a mass of $0.5 \times 10^{-39}$kg for the unit aether particle. Interestingly, in this article he also shows that the speed of light should vary with the square root of the background temperature. It is not without interest to note that this suggestion by Thornhill would obviate any need for introducing theories of inflation to protect the Big Bang notion. More may be found on the whole question of the constancy, or otherwise, of the speed of light in the article by Farrell and Dunning-Davies[14].

Also, before ending this section, attention should be drawn to a companion paper by Thornhill[15] in which he discusses in detail the fact that, in a gas-like aether, the duality between the oscillating electric and magnetic fields, which are transverse to the direction of propagation of electromagnetic waves, becomes a triality with the longitudinal oscillations of the motion of the aether if electric field, magnetic field and motion are coexistent and mutually perpendicular. He points out that it must be shown that, if electromagnetic waves also comprise longitudinal condensational oscillations of a gas-like aether, analogous to sound waves in a material gas, then all three aspects of such waves must propagate together along identical wave fronts. This he shows to be the case. Further he finds that the equations governing the motion and the electric and magnetic field strengths in such an aether, together with their common characteristic hyperconoid, are all invariant under Galilean transformation.

**Conclusion**.

The notion of "uncertainty" within physical systems is only an anthropomorphic effects descriptor, not a causal description of physics. Fluctuation effects in quantum systems and uncertain measurement effects are in fact caused by a real object and not probability: the aether and the scalar waves within it. Quantum mechanics as interpreted by the Copenhagen interpretation is in point of fact: incomplete. The wave function must be augmented in its interpretation to represent aetherial and scalar wave dynamics, at which point the adjusted theory would in fact satisfy Einstein's highest standards as a physical theory.

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