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RESTATEMENT OF THE HEISENBERG UNCERTAINTY PRINCIPLE FOR THE CONDITION OF SUPERPOSITION

Thomas E. Bearden

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This report presents a discussion of the Heisenberg uncertainty principle for the condition of superposition. In that changed form, the principle becomes causal and rigidly quantized, but applies to unperceived reality (probability), consistent with Bohr's interpretation that probability waves are causally propagated in time. The connection between the two statements

Abstract (Continued)

Abstract (Concluded)

of uncertainty/certainty provide a basis for the transfer function that describes the operation of perception itself.

It is important to realize that physics has nothing to say about a possible real world lying behind experience [1]. The term "physical world" must not be assumed to be identical to "real world" [2]. The experential nature of physics, one may say, is based on observation, and observation is based on experiment and measurement.

Experiment has three distinguishing features:

1) From total experience, a localized domain is abstracted (separated, differentiated) for special attention and investigation.

2) Answers are sought to certain questions in the mind of the investigator; the questions are the result of, or are intended to validate, certain concepts formulated by the investigator about the localized domain.

3) The experiment has a well-defined operational character [3].

Experimental measurement eventually or essentially reduces to comparison, either of the coincidence of a pointer with a mark on some scale, or of sets of such coincidences, etc [4]. Since mathematics is simply the game of "observation" or perception in an abstracted form [5], the experimental observation may be expressed in mathematical terms involving number (quantity).

The "localization" portion of the nature of experimental observation may be further abstracted by defining it as a differentiation (separation) of total experience, and immediately proceeding to examine the smallest possible differential. In this way we are led to the idea of quantized change, and the necessity to examine the Heisenberg uncertainty principle.

Abstract a fundamental particle of mass and call it a perceptron — which can be viewed as a physical gadget which detects change (perceives) by itself changing. The holographic view is used, i.e., a detector detects only changes internal to itself, and thus the "external world" of a perceptron actually consists of internal changes to that perceptron. That is, a mass particle is regarded as a holographic closure of the macroscopic universe inside itself.

It is reasoned that all observed change is comprised of differentials (quanta) of change, and experiment bears this out. Now, examine the smallest possible differential of perceived change. For the perceptron to output this differential of change or operational pieces of it, it follows that it has no smaller differential of perceived change on which to operate. Therefore, it can only have operated on undifferentiated "change" (i.e., "changeless change") per se. That is, it can only have operated on "changeness", the "unchanging stuff of which changes are merely little bits." Thus there emerges a model of perception whereby the perceptron operates on (differentiates) unperceived (undifferentiated) reality to create or produce perceived, differentiated reality [6]. The perceptron is modeled as a physical mass (such as a fundamental particle), that performs a process. The perceptron perception process is considered to have input and output. "Input" is merely a statement that perceptron operation has not occurred; "output" is merely a statement that perceptron operation has occurred. Aggregates of outputs constitute what is called physical phenomena or physical reality.

Perceived physical phenomena are thus first derivatives of a more fundamental, unperceived reality.

A statement of major importance has been made at this point. That statement is that "reality" does not have to be "perceived reality." Thus there are two kinds of reality, perceived and unperceived. This directly supports the many-worlds interpretation of quantum mechanics [7] and defines possible as real, though unperceived. That is, possible reality simply is unperceived reality.

Thus a most peculiar quandary is encountered. The only manner in which we can conceive the "unperceived" is as if it were perceived, and then deny that it has been outputted by perception. Thus the unperceived can only be conceived in a perceived fashion! The "absence of perception" calls first for the creation or invoking of perception, then the invoking of an operation on that perception to "remove" it. That is, in fact, the "zero" operator, the absenting operator. The entire mental psycho-logical operation and makeup is structured in this fashion, for this is the fashion in which we "view the world." To conceive of the absence of a thing is to call it into existence and "remove it across or beyond a boundary." Thus, e.g., one easily forms the concept of a "virtual photon"; i.e., one which is "nonobservable." In the same manner, "virtual energy" is energy which is not observed. The decisive boundary, the "threshold," in each case is the perception process; i.e., whether or not it operates.

Mathematical probability is based on just such an idea. The most fundamental idea involved in the structuring of the concept of "probability" is that it represents an unobserved observable (observed) event. Again, one comes face to face with the principle of the boundary identity of exact opposites; in this case, the exact opposites are the observed and the unobserved, whose direct identity yields the concept of probability.

Born's interpretation of wave functions directly reveals the truth of conceiving the unobserved as the observed. To quote Born: "We describe the instantaneous state of the system by a quantity ψ, which satisfies a differential equation, and therefore changes with time in a way which is completely determined by its form at a time $t = 0$, so that its behavior is rigorously causal. Since, however, physical significance is confined to the quantity $\psi^*\psi$, and to other similarly constructed quadratic expressions, which only partially define ψ, it follows that, even when the physically determinable quantities are completely known at time $t = 0$, the initial value of the ψ-function is necessarily not completely definable. This view of the matter is equivalent to the assertion that events happen indeed in a strictly causal way, but that we do not know the initial state exactly. In this sense the law of causation is therefore empty; physics is in the nature of the case indeterminate, and therefore the affair of statistics."

Again to quote Born: "The motion of particles conforms to the laws of probability, but the probability itself is propagated in accordance with the law of causality."

Thus, the concept of ψ is essentially the "unobserved observed," while a quadratic expression such as $\psi^*\psi$ is "unobserved observed unobserved observed." These expressions are very similar to products involving +1 and -1, where +1 replaces "observed," and -1 replaces "unobserved." Thus it is readily seen that the quadratic expression constitutes an observable, having "physical significance," while the linear expression does not. Since DeBroglie waves are conceived in a similar "operation upon an observable (mass) to give a nonobservable (wave)," then the connection (relation) of DeBroglie waves (unperceived operations) to probability waves (unperceived perceived operations) follows immediately [8].

Now, note that the idea of probability involves the idea of multiple possibilities; i.e., probability defines a (usually) multiple path <u>per se</u>. There is nothing magical about the multiple path; it is involved in the idea of probability <u>a priori</u>. And the idea of determination (perception) involves the idea of monocular selection <u>a priori</u>. That is, the past is determined (selected), the future is probabilistic (indeterminate, unselected, unperceived). Again, that is the only way the future can be conceived, as if it had been selected (perceived). Again the "unperceived perceived." The connection with probability (to the future) follows, as does the fact that physical reality is merely a monocular path through multipath possible reality, or through what is called "probability" or "probable realities." It also follows that these probable realities are causally connected, i.e., time-ordered, because that is the only way we can conceive them.

So it can be concluded that all probables are reals, though not perceived (objective, physical) reals. Once a statistical operation has occurred, the "probability" of the outcome is said to be "one," i.e., it is determined. But "one" is the basic perception operational output. Only the past, then, is determined: perception is determination; i.e., it is the production (selection) of the determined (occurred) from the undetermined (probable). It is the creation of the certain from the uncertain. Perceptron operation, i.e., fundamental quantum perception, is thus the interface (operational boundary) between the certain and the uncertain, the determined and the probable, the perceived and the unperceived. It is impossible to comprehend the nature of this boundary operation without a change to one of the laws of logic, and the comprehension of the principle of the boundary identity of exact opposites [9]. Only by means of this principle is it possible to obtain a thing from its exact opposite; i.e., a corpuscle from a wave, length from lengthless points, thing from no-thing, determined from possible, perceived from unperceived, presence from absence, matter from void, etc.

Note, in passing, that the simplest conceived operation to operate on the unperceived and convert it to the perceived is superposition. This concept merely envisions gathering or collecting the pieces of the unperceived perceived together until a certain unperceived perceived amount is reached. This amount constitutes the threshold of perceptron operation, and a switch occurs, the "collected unperceived perceived" simply switches into the "uncollected (singular) perceived." That is, the perception process is activated when the input reaches this threshold amount, and that amount is outputted.

Thus, a transfer function is needed to describe the operation of the fundamental quantum perceptron operation. Given such a transfer function, the most fundamental quantum observations of physics may simply be "transferred in reverse" to create a model of the unperceived reality, regardless of how strange a model emerges.

It is well known from physical observation that physical change occurs in quantized action changes, where action has the dimensions ML^2/T [10]. However, ultimately action itself is unperceivable; specifically, only ΔL and ΔT are perceived. That is, perception is differentiation; differentiation is separation; there are only two basic separations, ΔL and Δt. Thus these totally constitute fundamental perception per se. That being true, comparative operation can only be obtained by switching one into the other and vice versa, and this determines the characteristic of the perceptron's operation. The ratio of ΔL to Δt involved in this interswitching process is called velocity. The perceptron, being finite, has a limiting rate of operation; this limitation on switching rate (for normal operation) is c, the velocity of light. For that reason the velocity of light is the same for every observer; i.e., every perceptron has the same limit for maximum switching rate.

The Heisenberg uncertainty principle in one sense is a statement that "It is absolutely certain that everything is absolutely uncertain." Note that by classical logic, the principle contradicts itself. In our view, however, it is simply one way to state the boundary identity of exact opposites. That is, the principle is perfectly comprehensible, but only on the operational boundary between certainty and uncertainty. Thus, to be correctly and most precisely stated, the principle must be absolutely deterministic on one side of the boundary and absolutely indeterminate on the opposite side of the boundary. The principle is not so stated in its presently recognized form.

The major reason for this dilemma is that the particular instrumental complex (perceptron assemblage) used in experimental measurement inevitably determines that an indication can be measured only after a conglomerate collection of action quanta occur. That is, the system's response is far less sensitive than the theoretically most basic, fundamental perceptron. It is the real system response (monocular perception determined from an assemblage of perceptrons) that the uncertainty principle has been applied to; the principle is therefore expressed in terms of standard deviation, and standard deviation by definition applies only to a "collection" of events and not to one single causal event of the statistical collection. Thus in using standard deviation, one is working statistically. This is necessary because the instruments with which one works are conglomerates and collective; it is not possible to work with a real, "single quantum minimum perceptron."

The present philosophical interpretation of quantum physics is therefore in somewhat of a turmoil, to say the least. The prevailing interpretation is the Copenhagen interpretation of Bohr and Heisenberg. Heisenberg makes it clear that quantum physics is statistical, but not in the sense that statistical conclusions are being drawn from exact data (i.e., not in the classical sense). To quote Heisenberg: "In the formulation of the causal law, namely, 'If we know the present exactly, we can predict the future,' it is not the conclusion, but rather the premis which is false. We cannot know, as a matter of principle, the present in all its details." This is certainly true as long as our instrumental perceptron assemblages are large in relation to $h/4\pi$. For example, even an electron has a rest mass of 9.109×10^{-31} kg; since one kilogram represents 17.053×10^{50} perceptron operations per second, then one electron requires 1.553×10^{21} basic perceptron operations per second merely to passively exist. Even for a measurement in 10^{-12} seconds, a very large number of perceptron operations would have been experienced by an electron, and the causal premis obviously fails for such a situation.

However, Louis de Broglie points out that, while the probabilistic formulas of quantum physics are completely justified, there appears to be no justification at all for the extrapolated assertion that the uncertain and incomplete observational knowledge that present experimental technology gives about microphysical events is a result of real indeterminacy of the physical states and their evolution. Here it must indeed be said that de Broglie has a point. It is true that the Copenhagen interpretation rejects the notion of a hidden objective world ruled by causality, behind our perception; however, it most certainly incorporates completely the notion of a hidden "nonobjective" world ruled by causality, behind our perception (unperceived). Thus the Copenhagen interpretation merely shifts the causality from the observed to the unobserved; that is, the structure is the "unperceived causal perceived." The nature of the concept of probability does not eliminate causality, it merely shifts it to the unperceived (input) side of the perceptron. The principle of the boundary identity of exact opposites makes it evident why this approach is valid.

Thus it is the opinion of this author that the interpretation of quantum physics is in a classic "five blind men and the elephant" situation; each interpretation is correct insofar as it goes, but neither is totally correct. De Broglie is correct in pointing out the fallacy of the extrapolation from present instrumental limitations, but still has not digested the fact that the unperceived, being causal, is therefore superposable to switch into its opposite, the perceived non-causal (statistical), which, when further collected, becomes quite causal again (patterned).

There is nothing fundamentally wrong with abstracting the concept of the "single quantum minimum perceptron" and analyzing it; however, in so doing, one should point out that this is working with hidden variables and also without them, in the orthodox point of view. Rather than become involved in the controversy over the validity or nonvalidity of the "hidden variable" approach, one may proceed to take the minimum perceptron hidden variable approach and, at the conclusion, point out that it is possible for both views (that the world is totally nondeterministic and also totally deterministic) to be valid. In fact, with the imposition of the adjective "totally" on deterministic and nondeterministic, the terms become synonymous by the principle of the boundary identity of exact opposites.

With the preceding reservations, we will proceed to examine the Heisenberg uncertainty principle from the hidden variables approach, and will remove all restrictions normally attached to it because of its association with standard deviation of a statistical number of changes. We will further,apply it to possibility itself; i.e., insist on the validity of possible superpositions consistent with the principle itself, whether or not the perceived change is much greater than each superposed possibility [11]. That is, if a change even hypothetically could occur, A to B to C to D, but in the actual experimental gadgetry the change occurs A to D, then insist that A to D must not violate the sense of A to B to C to D. Thus, we are rigorously applying the principle to the domain of total uncertainty, i.e., to unperceived reality. That is, to the unperceived perceived, which by definition must include all "possible perceived."

These assumptive arguments force the Heisenberg uncertainty principle to be restated in a form appropriate to the most elemental perceptron's operation, and this then provides the basic transfer function for the most elemental change possible, as well as for any perceived change in terms of superposed unperceived possible changes.

The Heisenberg uncertainty principle may be stated as:

$$\Delta E \, \Delta t \geqq \frac{h}{4\pi} \quad , \qquad (1)$$

where E is energy, t is time, and h is Planck's constant. The product of energy and time is a quantity called "action," and the units of action A are

$$A = \frac{ML^2}{T} \quad . \tag{2}$$

The units of angular momentum are also the same as the units of action, and an alternate statement of the Heisenberg uncertainty principle is

$$\Delta p \Delta L \geq \frac{h}{4\pi} \quad , \tag{3}$$

where p is momentum and L is length. The uncertainty principle is most often applied to a microscopic change, and is usually interpreted as stating the physical limit of accuracy of observing the change.

We now consider the application of the uncertainty principle to an observable change which, by definition, is derived from superposition of two or more other possible changes. In this case, the uncertainty statement must apply to each possible change entering into the superposition, as well as to the final observable change resulting from the superposition.

Since ΔE may be either positive or negative, we may state (1) as

$$\Delta A = \frac{nh}{4\pi} \qquad |n| \geq 1 \quad . \tag{4}$$

The two changes are arbitrarily selected

$$\Delta A > 0, \; n = 1 \tag{5}$$

and

$$\Delta A < 0, \; -1 > n > -2 \tag{6}$$

as two supposedly possible changes to be superimposed. Each of these changes individually obeys the uncertainty principle statement (4), but their superposition would give

$$|\Delta A| < \frac{h}{4\pi} \quad , \tag{7}$$

which violates the uncertainty principle statement (4). Similarly, by suitable selection of supposedly possible changes for superposition, the uncertainty principle statement (4) can be forced to contradict itself for all except possible changes that involve integral (or zero) values of n. Accordingly, the corrected uncertainty statement for possible changes which are superimposed is

$$\Delta A = n \frac{h}{4\pi} \quad , \quad n = 0, \pm 1, \pm 2, \ldots \quad , \qquad (8)$$

which is a precisely quantized (certain) statement. But, since any admissable possible change can be considered as an acceptable candidate for superposition with any other admissable possible change for superpositional switching from possible (unperceived, uncertain) reality to determined (perceived, certain) reality, then Equation (8) represents a fundamental and necessary restatement of the Heisenberg uncertainty principle itself for the unperceived world of possible change. When applied to the reality of total uncertainty, the Heisenberg principle reduces to a form directly analogous to Planck's basic hypothesis.

But that totally uncertain (undetermined) reality by definition constitutes the input "world" of the fundamental perceptron. Thus (8) is the basis of the transfer function for the differentiation of the "unperceived action continuum" by the fundamental perceptron. That is, (8) rigidly specifies the input to the perceptron. In fact, since the perceptron operation is rigidly monocular, it operates one individual time for each and for only each

$$\Delta A = \frac{nh}{4\pi} \quad , \quad n = \pm 1 \quad . \qquad (9)$$

The major significance of this statement of the uncertainty principle can now be pointed out: the unperceived input to a perceptron occurs in quite rigidly fixed quanta of action. The perceptron operates precisely each time a single quantum is inputted, be it additive or subtractive in nature. That is, the unperceived "possible" or "probable" (uncertain) input world is rigidly quantized, specifically because of our conceptual limitations which determine how we can even conceive "unperceived" entities in the first place. The question then arises, whence comes the "measurement uncertainty" involved in the conventional statements (1) and (3)?

The uncertainty in determination (measurement uncertainty) of perception output arises because action is unperceived, and only a derivative of action can be perceived at one time. That is, the perceptron is a pure differentiator (separator), so each quantum of action processed by the perceptron is simply split in two. Comparison by a differentiator occurs of one variable with respect to another, so only one of the variables can be absolutely determined (certain), in which case the other is absolutely undetermined. If one uses a ruled length (fixed value of length) to measure or compare another length, one cannot tell what the value of the ruler is, but only that the length being "ruled" is "so many rulers in length." We can "spread the uncertainty" over both variables by taking a statistical admixture of measurements where the "independent variable" is taken to be now one, now the other, but we cannot escape the basic minimum of indeterminancy that is there. Thus, because the perceptron is a monocular differentiator/comparator, statements (1) and (3) are correct for measurement (perceptron output) *per se*. Even so, statements (8) and (9) are rigorously true for perceptron input, i.e., "possible" or "probable" reality.

It can now be pointed out that it is consistent to assert that (8) and (9) constitute the most elementary nature of the actual unperceived action change(s) inputted to perceptron operation, while (1) and (3) still apply to the perception of (knowledge of) individual action derivatives, from quantum changes composed of one or more quanta, which are unavoidably involved in any physical measurement technique.

Using this approach, the fundamental perceptron may be modelled, thus directly connecting the perceived to the unperceived, the physical to the nonphysical, and physics to metaphysics [6].

NOTES AND REFERENCES

1. Lindsay, Robert Bruce and Margenau, Henry, Foundations of Physics, Dover Publications Inc., New York, New York, 1963, p. 30.

2. Lindsay and Margenau, Ibid., p. 3.

3. Lindsay and Margenau, Ibid., p. 5.

4. Lindsay and Margenau, Ibid.

5. Essentially mathematics may be taken as founded upon set theory. But the concept of "set" involves the concept of perceived object; i.e., a perceived "one." The connection or relationships of the sets of perceived objects thus constitutes the game of perception itself.

6. From the standard, e.g., two-slit experiment, an electron cannot be considered either a corpuscle only, or a wave only, until after the observational selection of one or the other. Before selection, it must be considered as some sort of unperceived blend of the two. See Thomas E. Bearden, Quiton/Perceptron Physics: A Theory of Existence, Perception, and Physical Phenomena, March 1973, (available through the Defense Documentation Center, AD 763210), for the beginning of an elementary theory of the perceptron and a fundamental model of it.

7. The Many-Worlds Interpretation of Quantum Mechanics, A Fundamental Exposition by Hugh Everett, III, with papers by J. A. Wheeler, B. S. DeWitt, L. N. Cooper, and D. Van Vechten, and N. Graham; eds. Bryce S. DeWitt and Neill Graham, Princeton Series in Physics, Princeton University Press, Princeton, New Jersey, 1973.

8. For a particularly clear summary exposition of Born's interpretation of wave functions, see Robert Eisberg and Robert Resnick, Quantum Physics of Atoms, Molecules, Solids, Nuclei, and Particles, John Wiley & Sons, New York, New York, 1974, pp. 146-152. The same reference contains a very clear exposition of matter waves, duality, the uncertainty principle, and the philosophy of quantum physics (pp. 63-88).

9. Bearden, Thomas E., The Boundary Identity of Exact Opposites: A Simple Solution to the Age-Old Philosophical Problem of Change, 8 October 1975 (Defense Documentation System).

10. From the perceptron viewpoint, there is only one fundamental "input" dimension, that of LT, spacetime. There is only one fundamental output dimension, separation itself. This may be taken to be either T or L or both; the two are considered synonymous except for a constant of proportionality.

11. Note that there is a subtle change here from the accepted frequency approach to probability. That is, in the orthodox view of the frequency approach, an experiment may be conducted repeatedly for a large number of trials. The number of times a certain outcome occurs is then divided by the total number of trials to give the "probability" of that outcome. That is, the "relative frequency" of occurrence is taken as the empirical probability. In this orthodox approach, one has a "perceived frequency" definition of probability. However, the approach being taken by this author constitutes the assignment of a "possible frequency" definition of probability even for possibilities that do not perceivably occur; i.e., that are never determined. Zero probabilities exist (zero is real) and must also be allowed for in the scheme of application. Probable can be exactly defined as unperceived perceived. That is, we first conceive multiple causal paths of perception to a "one event" which has "multiple outcomes" (usually one per each conceived causal path). For example, multiple paths are conceived to the "throw of a die so that one side is up." Six paths are conceived, each to a single "side up," so that it constitutes "one side of six sides, up." Thus we have unconsciously known that the unperceived is causally perceived; i.e., probability is the "unperceived perceived."