Local hidden variable theorem.

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Abstract

Quantum mechanics does not predict the outcome of measurements with certainty. Does the statistical nature of quantum mechanics imply that quantum mechanics is incomplete or is the reality as such both, nondeterministic and deterministic? Is it possible at all to predict the outcome of each measurement with certainty? The question naturally arises, is there some deeper reality hidden beneath quantum mechanics? Are local hidden variables incompatible with observations? Is the hope for a so-called local hidden variable theory for quantum mechanics still alive? This publication will refute Bell's theorem by the proof that

there are local hidden variables.

Key words: Einstein–Podolsky–Rosen paradox, Bell's inequality, Realism, Nonlocality, Correlation, Causation.

1. Background

The assumption that particle attributes have definite values independent of the act of observation appears to be somehow reasonable. Physical processes occurring at one place should have no immediate effect on the elements of reality at another location. This is known as the principle of locality (Bohm, 1952). The desire for a local realist theory seems to be somehow a consequence of special relativity. The famous Einstein Podolsky Rosen paradox (EPR paradox) assumes local realism too. In recent years, however, doubt has been cast on local realist theories. In other words, it turns out that there is a serious challenge to local realism and thus on special relativity too. Roughly speaking, John S. Bell's (Bell, 1964) crucial attack on local realism has increased the tension between the locality of Relativity Theory and Quantum Nonlocality at a maximum. However, the book is not completely closed on Bell's theorem. Is there a experimental resolution of the conflict between Local Realistic Theories and Quantum Mechanics?

2. Material and Methods

John S. Bell, a former staff member of CERN (European Organisation for Nuclear Research) published his theorem in the year 1964. John S. Bell's theorem seems to be mathematically-technically correct. Thus, at this point, however, it is important to put some light on the background of Bell's theorem from a purely theoretical standpoint. At least two different questions are raised by reflection upon our investigations concerning Bell's theorem. First. First of all, per Bell's theorem, **either** local realism **or** quantum mechanics is wrong, both cannot be correct at the same (space) time. Upon assumption that quantum mechanics and local realism are equally correct, what conclusions can be drawn about Bell's theorem? In this case, Bell's theorem cannot be correct, although mathematically-technically it is correct. A variety of Bell test experiments suggest that Bell's inequality is violated. Is there a conclusion that is logically justified? Second. Can we rely on correlation. Does correlation imply causation? Is it possible to escape Bell's implications?

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Bell's thought experiment

"Two suitable particles, suitably prepared (in the 'singlet spin state') , are directed from a common source towards two widely separated magnets followed by detecting screens. Each time the experiment is performed each of the two particles is deflected either up or down at the corresponding magnet. Whether either particle separately goes up or down on a given occasion is quite unpredictable. But when one particle goes up the other always goes down and vice-versa. After a little experience it is enough to look at one side to know also about the other." (Bell 1981, p. C2-42).

Is there a cause for this behaviour, a local hidden variable? According to Bell, correlation can be used without any problem to proof for causation. In so far, many have overlooked the fact that **Bell jumps to a conclusion about causation** between random variables **which is based on a correlation** between events that occur simultaneously. Does correlation really imply causation? Surely not.

3. Results

Let us assume that the value of any physical quantity can be predicted with absolute certainty prior to performing a measurement or otherwise disturbing. In so far, let any quantum-level object have a definite and well defined state that determines the values of all other measurable properties. Let distant objects do not exchange information faster than the speed of light. This well defined properties are sometimes called *local hidden variables*.

Theorem 1. **There are local hidden variables I.**

Let

X_t	denote something existing independently of human mind and consciousness, f. e. a measurable random variable, a quantum mechanics object etc. at the (space) time t,
$(h)_t + (\text{not } h)_t = X_t$	denote that something that is existing independently of human mind and consciousness, f. e. a measurable random variable, a quantum mechanics object etc. at the (space) time t is determined by a local hidden and a local non-hidden part (variable), there is no third between the local hidden and a local non-hidden part, **tertium non datur**,
h_t	denote the local **hidden** (dark or secret) **part (variable)** of something existing independently of human mind and consciousness**,** f. e. of a random variable or of a quantum mechanics object X_t etc. at the (space) time t, the local hidden part of X_t,
$(\text{not } h)_t$	denote the local **not-hidden part (variable)** of something existing independently of human mind and consciousness**,** f. e. of a random variable or of a quantum mechanics object X_t etc. at the (space) time t, the local not-hidden of X_t,
$E(X_t)$	denote the expectation value of something existing independently of human mind and consciousness, f. e. a measurable random variable, a quantum mechanics object etc. at the (space) time t,
$\sigma(X_t)^2$	denote the variance of something existing independently of human mind and consciousness, f. e. a measurable random variable, a quantum mechanics object etc. at the (space) time t,
t	denote the (space) time,

then

$$\boldsymbol{\sigma(X_t)^2 = E(X_t^2) - E(X_t)^2 = 0.}$$

Proof by contradiction of the theorem 1.
Let us assume, that the opposite of our theorem above is true. Thus, let us assume **there are no local hidden variables**. Recall, we have defined that

$$\mathbf{h_t + (not\ h)_t = X_t.} \tag{1}$$

Our assumption is that **there are no local hidden variables**, we set $\mathbf{h_t = 0}$. We obtain the next equation.

$$(\mathbf{h_t = 0}) + (\text{not h})_t = X_t \tag{2}$$
$$\mathbf{0} + (\text{not h})_t = X_t \tag{3}$$
$$\mathbf{(not\ h)_t = X_t} \tag{4}$$

Our assumption is according to a proof by contradiction there are no local hidden variables. Thus, we obtained an **identity** of $\mathbf{(not\ h)_t}$, the part of $\mathbf{X_t}$ that is locally not hidden and measured and $\mathbf{X_t}$ itself. In other words, the locally not hidden or measured part of $\mathbf{X_t}$ is the whole $\mathbf{X_t}$ itself, there is nothing else, no locally hidden part. We cannot distinguish between $\mathbf{(not\ h)_t}$ and $\mathbf{X_t}$ both are identical and are the same. In so far, since $(\text{not h})_t = \mathbf{X_t}$ we obtain the next equation.

$$\mathbf{X_t = X_t .} \tag{5}$$
$$X_t * X_t = X_t * X_t . \tag{6}$$
$$X_t^{\,2} = X_t * X_t \tag{7}$$
$$E (X_t^{\,2}) = E (X_t * X_t) \tag{8}$$
$$E (X_t^{\,2}) = E (X_t) * E (X_t) \tag{9}$$
$$E (X_t^{\,2}) = E (X_t)^{2} \tag{10}$$
$$E (X_t^{\,2}) - E (X_t)^{2} = 0 \tag{11}$$
$$\mathbf{\sigma(X_t)^2 = E (X_t^{\,2}) - E (X_t)^{2} = 0.} \tag{12}$$

Q. e. d.

Consequently, if our assumption above is true that X_t has not a local hidden variable, then the variance of X_t must be equal to zero. In so far, if we perform some measurements on X_t and if we have found at the same time that $\mathbf{\sigma(X_t)^2 = 0}$ then we have equally found, that there is no local hidden variable inside (Barukčić 2006, p. 55-60) the investigated X_t. Otherwise, every time when $\mathbf{\sigma(X_t)^2 \neq 0}$ we found equally, that there is a local hidden variable inside X_t. According to the proof above, we must accept that there are indeed local hidden variables. In so far, Bell's theorem is refuted. But the proof above is not a proof, that quantum mechanics is incomplete or wrong, not at all. The proof above is only a proof, that every thing that exists independently of human mind and consciousness as such is inherently contradictory, it is the unity and the struggle between the local hidden and local not-hidden part within itself. The expression $\mathbf{X_t = X_t}$ is an existing contradiction. How can X_t be equal only to itself and nothing else? If X_t is equal only to itself and nothing else, if X_t is without any local hidden variable, if X_t is only **the pure** $\mathbf{X_t}$, then the variance of X_t must be equal to 0 or $\mathbf{\sigma(X_t)^2 = 0}$. In this case, X_t is no longer the unity of identity and difference, X_t doesn't change at all, X_t is and stay during all space and time just the same X_t . The theoretical question here is if X_t never changed, how was it possible for X_t to begin, how could it become that what it is, it is X_t, and this is something that is different from nothing. In so far, if it is only true that $X_t = X_t$, then it is impossible for X_t to begin, because if X_t is, X_t is not just beginning. On the other hand, in so far as X_t is not, then X_t does not begin. If X_t *is not* and if X_t would begin, then X_t must change at least from not X_t to X_t. Can X_t change as such although it is true that $\mathbf{\sigma(X_t)^2 = 0}$. It is obvious, that any alteration of X_t raises subtle problems. Thus, X_t or something else can change only is so far as it has incompatible properties within itself (a local hidden variable) and yet remains the same, if it is an existing contradiction. So, if X_t is only X_t and without a local hidden variable then there is no becoming, X_t just stays X_t , no changes, no movement, all is like it is, there is no development or **$\sigma(X_t)^2 = 0$**. It is impossible for X_t to change, in so far, as X_t changes, it is no longer X_t, it is something else. The changing of X_t implies that X_t does not remain X_t but passes into its other, into its local hidden variable and vice versa and may be much more then this. It is obvious, that this is an infinitely important proof. In other words, if there are no local hidden variables, if it is only true that **$X_t = X_t$, how can the variance of X_t** under this condition **be unequal to zero?**

Hypothetical syllogism

In propositional logic, a hypothetical syllogism expresses a rule of inference of the following form:

A → B. B → C. Therefore, **A → C.**

Example:

Driving a car (=A)	→	Traffic accident (=B).	(13)
Traffic accident (=B)	→	Deadly event (=C).	(14)
Therefore,			
Driving a car (=A)	→	Deadly event (=C).	(15)

Thus, set A as there is no local hidden variable or (**$h_t = 0$**) . Set B as $X_t = X_t$. Set C as $\sigma(X_t)^2 = 0$.

Theorem 2. There are local hidden variables II.

Proof based on hypothetical syllogism.

Premises.

($h_t = 0$)	→	($X_t = X_t$)	, which follows from (1),(2),(3),(4),(5).	(16)
($X_t = X_t$)	→	($\sigma(X_t)^2 = 0$)	, which follows from (5),(6),(7),(8),(9),(10),(11), (12).	(17)

Conclusio.

$$(h_t = 0) \rightarrow (\sigma(X_t)^2 = 0) \quad (18)$$

Q. e. d.

This is one of the most important proofs in physics, there are local hidden variables. The accuracy or the truth of our conclusion above depends on the soundness of the reasoning from the premises above to our conclusion and on the truth of our premises above. We assumed that there is no local hidden variable h_t or in other words, $h_t = 0$. In so far, our argument is valid and all of its premises are true. Therefore, it is a sound argument. To say it in broken English: **if X_t has not a local hidden variable, if X_t is only itself and nothing else, if X_t is only the pure X_t , if it is true that** $X_t = X_t$ **then the variance of X_t must be equal to zero or $\sigma(X_t)^2 = 0$**. Consequently, we are in great trouble, if we deny local hidden variables if $\sigma(X_t)^2 > 0$. In so far,

"**The variance in this sense is a measure of the inner contradictions of a random variable, of changes, of struggle within this random variable itself, or the greater $\sigma(X)^2$ of a random variable, the greater the inner contradictions of this random variable**" (Barukčić 2006, p.57).

Bell's theorem is refuted by our proof above, that there are local hidden variables in objective reality. Only, with our proof above, it is not proofed that the local hidden part of **X_t** stands in any relation to the local not-hidden part of **X_t**. In so far, the local hidden part of **X_t** must not have anything in common with the local not hidden part of **X_t** as such. What could this mean?

Theorem 3. The independence of the local hidden part and the local not hidden part of something.

X_t	denote something existing independently of human mind and consciousness, f. e. a measurable random variable, a quantum mechanics object etc. at the (space) time t,
$(h)_t + (\text{not } h)_t = X_t$	denote that something that is existing independently of human mind and consciousness, f. e. a measurable random variable, a quantum mechanics object etc. at the (space) time t is determined by a local hidden and a local non-hidden part (variable), there is no third between the local hidden and a local non-hidden part, **tertium non datur**,
h_t	denote the **local hidden** (dark or secret) **part (variable)** of something existing independently of human mind and consciousness**,** f. e. of a random variable or of a quantum mechanics object X_t etc. at the (space) time t, the local hidden part of X_t,
$(\text{not } h)_t$	denote the local **not-hidden part (variable)** of something existing independently of human mind and consciousness**,** f. e. of a random variable or of a quantum mechanics object X_t etc. at the (space) time t, the local not-hidden of X_t,
$E(h_t)$	denote the expectation value the local **hidden (**dark or secret) **part** of something existing independently of human mind and consciousness**,** f. e. of a random variable or of a quantum mechanics object X_t etc. at the (space) time t, the local hidden part of X_t,
$E(\text{not } h_t)$	denote the expectation value the local **not-hidden part** of something existing independently of human mind and consciousness**,** f. e. of a random variable or of a quantum mechanics object X_t etc. at the (space) time t, the local not-hidden part of X_t,
$\sigma((\text{not } h)_t, (h_t))$	denote the co-variance of the local hidden and the local not-hidden part of something existing independently of human mind and consciousness, f. e. of measurable random variables, of quantum mechanics objects etc. at the (space) time t,
t	denote the (space) time. Let $(\text{not } h)_t$ be independent from (h_t), let both have no influence on each other, let both not depend on each other,

then

$$\boldsymbol{\sigma((\text{not h})_t , (h_t)) = E((\text{not h})_t , (h_t)) - (E((\text{not h})_t)*E(h_t)) = 0 .}$$

Proof of the theorem 2.

Let us assume, that there is no relationship between $(\text{not } h)_t$ and its local hidden variable h_t . Thus, we have only the pure $(\text{not } h)_t$. We obtain the basic equation.

$$\boldsymbol{(\text{not h})_t = (\text{not h})_t} . \tag{19}$$

$$E((\text{not } h)_t) = E ((\text{not } h)_t) \tag{20}$$

This basic identity is not changed at all by the next operation. We obtain the next equation.

$$E((\text{not } h)_t)*(\quad \mathbf{1} \quad) = E ((\text{not } h)_t) \tag{21}$$

Our assumption is that there is a local hidden part (h_t) inside something that is different from 0. Only, this local hidden part (h_t) inside something has nothing to do with the local non-hidden part $(\text{not } h)_t$ of the same something X_t. In so far, let $\mathbf{E(h_t) \neq 0}$. Equally it is true that $\mathbf{E(h_t) / E(h_t) = 1}$. Thus, we obtain the next equation.

$$E((\text{not h})_t)*(E(h_t) / E(h_t)) = E ((\text{not h})_t) \quad (22)$$
$$E((\text{not h})_t)* E(h_t) = E ((\text{not h})_t) * E(h_t) \quad (23)$$
$$E((\text{not h})_t , (h_t)) = E ((\text{not h})_t) * E(h_t) \quad (24)$$
$$E((\text{not h})_t , (h_t)) - (E ((\text{not h})_t) * E(h_t)) = 0 \quad (25)$$
$$\boldsymbol{\sigma((\text{not h})_t , (h_t)) = E((\text{not h})_t , (h_t)) - (E((\text{not h})_t)*E(h_t)) = 0 .} \quad (26)$$

Q. e. d.

If something that is existing independently of human mind and consciousness possesses a local hidden part h_t that is absolutely independent from the local not hidden part $(\text{not h})_t$ of the same something, then it must hold true, that

$$\boldsymbol{\sigma((\text{not h})_t , (h_t)) = 0,}$$

otherwise, once again we are in trouble. On the other hand, if

$$\boldsymbol{\sigma((\text{not h})_t ,(h_t)) \neq 0}$$

then it is proofed, that the local hidden part h_t of something existing independently of human mind and consciousness and the local not-hidden part non-h_t of the same of something existing independently of human mind and consciousness are somehow depending on each other, are related to one an other, the one cannot without its other and vice versa.

4. Discussion

Bell is using correlation for his purposes, he is assuming that correlation implies causation. Bell prematurely claims without a proof that events which occur together (the measurement of Alice (A) is in causal relationship with the measurement of Bob (B)) are already caused by each other. In so far, that which had to be proofed is prematurely assumed as being correct before and without a proof as such. Bell has committed the typical cum hoc ergo propter hoc fallacy (Hackett, 1970) that is to say: A occurs in correlation to B, therefore, A causes B. Bell is observing only a correlation between A and B but making conclusion about causation. In other words, Bell has committed the correlation implies causation fallacy. "The EPRB correlations are such that the result of the experiment on one side immediately foretells that on the other, whenever the analyzers happen to be parallel. If we do not accept the intervention on one side as a causal influence on the other, we seem obliged to admit that the results on both sides are determined in advance anyway, independently of the intervention on the other side, by signals from the source and by the local magnet setting. But this has implications for non-parallel settings which conflict with those of quantum mechanics. So we cannot dismiss intervention on one side as a causal influence on the other." (Bell 1981, p. C2-52). Only, correlation has nothing to do with causation (Barukčić 2006, p. 46, p. 314, p. 341-343) this is already proofed and secured.

It is known, that the inequalities of Bell's theorem are violated. On the one hand, this does provide massive empirical evidence against correlation implies causation and thus against correlation analysis as such. On the other hand, this does not provide any positive empirical evidence in favour of Quantum Mechanics and equally this does not provide any empirical evidence against local realism.

Bell's theorem and a variety of Bell test experiments have definitely ended all dreams of those that had causality hopes for correlation. This is what Bell's theorem expresses and nothing more. Nobody can seriously believe that there is anything more in Bell's theorem.

Bell's theorem is based on the "cum hoc ergo propter hoc" logical fallacy, it is misleading as it is itself a logical fallacy. **Bell's theorem is the most profound logical fallacy of science**, it is the definite and best proof known, that correlation analysis contradicts Relativity Theory and Quantum mechanics and is thus a useless and dangerous statistical methodology.

Consequently, taking Bell's theorem for granted, or in other words, if we rely on correlation, then we must equally claim that the "spooky action at a distance" occurs (Einstein 1935) or according to Bell, telepathy is scientifically verified.

In so far, it's time to close the book on Bell's theorem, definitely.

This publication has proofed that the variance of something, of a random variable etc., is the best proof known, that the assumption of local realism and local hidden variables is correct. In accordance with Einstein et. al. we are "forced to conclude that the quantum-mechanical description of physical reality given by wave functions is not complete" (Einstein et. al. 1935, p. 780).

But contrary to expectation, our proof of the existence of local hidden variables is not a proof that quantum mechanics is incorrect. The correctness of quantum mechanics can be judged by the degree of agreement between quantum mechanics and the objective reality as such. While quantum mechanics is describing the objective reality the way the same is, in development, in change, quantum mechanics is because of this not an incomplete theory. The objective reality, independent of any theory, in development and change is as such if you will incomplete and full of contradictions.

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