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Abstract
In our approach we have combined knowledge of Old Masters (working in this field before the year 1905), New Masters (working in this field after the year 1905) and Dissidents under the guidance of Albert Einstein (EPR Paradox). Two free-will partners A (Alice) and B (Bob) share each a photon from a photon pair emitted from the source and measure the correlations among those entangled photons. Based on the great work of the smartest theorists and experimentalists the interpretation of that entanglement correlations goes unequivocally for the supporters of Niels Bohr: the quantum mechanics (QM) is complete and cannot be modified in any possible way. J.S. Bell stated that all local hidden variable theories are excluded forever, and this is now the dominant statement in the “entanglement community”. Is there any chance to contribute anything reasonable in favor of Albert Einstein’s statement that the QM is incomplete? In our approach we have inserted two new local hidden variables γ and δ (gravitons emitted by the Earth towards individual polarizers = GAIA Effect) into the old trigonometric functions haversine (2θ) = sin²θ and havercosin (2θ) = cos²θ where haversine and havercosine represent orthogonal projections on hyperplanes. These new local hidden variables might contribute to the creation of the entanglement among the separated photons as it is described by the QM. In order to falsify the QM correlation predictions (in the spirit of Karl Popper), we can locally bring to the vicinity of the polarizers two field masses (emanating additional gravitons towards the used polarizers = RHEA Effect, Plato connected the word with ρέω = rheo = flow, RHEA - the daughter of GAIA). The first local hidden variables γ and δ - GAIA Effect - at this moment cannot be controlled by humans, however, the second local hidden variables ε and ζ - RHEA Effect - can be controlled by humans (e.g., the experiment of Henry Cavendish in 1797). This concept might document the Intellectual Mastery of our Nature to hide Her secrets using the mathematical camouflage. We want to pass this scenario into the hands of the big G researchers and the “entanglement community” to evaluate if really our “Nature loves to hide.”

Keywords: Entanglement, EPR Paradox, Einstein - Bohr Debate, J.S. Bell, A. Aspect, Exclusion of all Local Hidden Variables Forever, GAIA Effect, RHEA Effect, the Mathematical Camouflage, Haversine, Havercosine, the Falsification of the QM, “Nature Loves to Hide”

1. Introduction
There was the Great Debate on the completeness of the Quantum Mechanics (QM) among Albert Einstein and Niels Bohr in 1935. Since that time the Einstein-Podolsky-Rosen Paradox passed through hands of all Great New Masters in Physics. (Only few references from many thousands of valuable papers could be cited in the Reference Section).

E.g., J.S. Bell in 1964 stated in his Bell’s Theorem that no local hidden variable theory can describe the correlation events as the QM predicts. Alain Aspect in 1982 published his Great Experimental Paper that was lately improved by many Great New Masters - the “entanglement community” unanimously stated that all local hidden theories are excluded forever.

It seems that we have achieved “the loophole-free-stage” of the Bell’s Theorem and that there is no hope to return back to any possible local hidden variable to achieve the same description of the correlation events as the QM and even to experimentally falsify the most successful physical theory - the QM.
We were inspired by Heraclitus quote “Nature loves to hide” and tried to find behind the Nature curtain a perfectly hidden local variable that might act on photons at individual polarizers on the surface of our Earth. We know from the literature that the gravitational field acts on photons. E.g., Johann Georg von Soldner and Albert Einstein predicted the bending of light, Pound-Rebka experiment described the gravitational redshift and blueshift predicted by Albert Einstein. What could be the effect of the Earth’s gravitational field on the photon passing through the polarizer close to the surface of the Earth?

Our working hypothesis represents a possible modification of correlation events among two entangled photons in the vicinity of the polarizers by gravitons emitted from the Earth towards the individually adjusted polarizers. We propose to call this local hidden variable as the GAIA Effect - this first local hidden variable is present in all Laboratories on the Earth and cannot be manipulated by humans. We can insert this GAIA Effect into the old trigonometric functions haversin \((2\theta) = \sin^2 \theta\) and havercosin \((2\theta) = \cos^2 \theta\) and thus obtain the identical trigonometric functions for the correlation events as it is predicted by the QM. The trigonometric functions haversine and havercosine describe the orthogonal projections on hyperplanes and might be used for the description of quantum-mechanical events (Jiří Stávek in 2013 and the Great Paper of Wojciech Słomczyński and Anna Sczepanek in 2020).

In order to falsify the QM predictions (in the spirit of Karl Popper) we can bring to the vicinity of individual polarizers a field mass as an additional source of gravitons flowing towards the given polarizer. We propose to call this second local hidden variable as the RHEA Effect (emanating additional gravitons towards the used polarizers = RHEA Effect, Plato connected the word with ρέω = rheo = flow, RHEA - the daughter of GAIA). This RHEA Effect can be manipulated by humans as it was demonstrated by Henry Cavendish in 1797. This technique is very well known to the big G researchers, however, in this case the field mass could be significantly bigger in compare with the test mass \(m\) of an observed photon \((m = h/\lambda c, h\) is the Planck constant, \(\lambda\) is the wavelength, \(c\) is the light speed). If this hypothesis describes the real events in Nature then we might obtain some new “tailor-made” correlations among the entangled photons.

(We are aware of the words of J.S. Bell to Alain Aspect in 1975: “Quantum Mechanics has been vindicated by such a large amount of work by the smartest theorists and experimentalists, how can you hope to find anything with such a simple scheme, in optics, a science of the XIXth century?”).

2. Aspect’s Experiment Confirming the Predictions of the Quantum Mechanics

In the very famous Aspect’s experiment two photons \(v_1\) and \(v_2\) are emitted simultaneously from the source \(S\) as it is shown in Figure 1. These two photons are then measured using two polarizers \(A\) and \(B\), each with a configurable measuring angle \(\alpha\) and \(\beta\). Alain Aspect unequivocally confirmed the predictions of the QM for the joint probabilities of measuring \((+,-), (-,+), (+,+),\) and \((-,-)\) events:

\[
P_{++}(\alpha, \beta) = P_{--}(\alpha, \beta) = \frac{1}{2} \cos^2 (\alpha - \beta) = \frac{1}{2} \cos^2 \theta
\]

\[
P_{+-}(\alpha, \beta) = P_{-+}(\alpha, \beta) = \frac{1}{2} \sin^2 (\alpha - \beta) = \frac{1}{2} \sin^2 \theta
\]

This experiment was repeated by many Great New Experimentalists under different conditions in order to close all possible loopholes - see References in the Reference list - and all of them confirmed the predictions of the QM. Based on these experimental data we can accept the Niels Bohr quote: “QM is complete and you cannot add anything to it”.

Figure 1. Schema of the Aspect’s Experiment confirming the predictions of the Quantum Mechanics
3. Bell’s Inequalities and the Bell´s Theorem

In 1964 J.S. Bell proposed to add to the two photons ν1 and ν2 a common property λ - a local hidden variable with the Bell´s locality condition: the result A (λ,α) of the measurement on photon ν1 by the A polarizer does not depend on the orientation β of the distant polarizer B (λ,β) and vice versa.

Bell found that there is no local hidden variable (in the spirit of Einstein´s ideas) to formulate a model agreeing with the QM predictions for all polarizer settings. Based on these Bell´s inequalities the Einstein local realism is untenable.

This situation is given by Figure 2 - a local hidden variable λ cannot achieve the QM predictions of correlation events for some polarizer adjustment (e.g., θ = π/4).

Based on the experimental data the Bell’s Theorem the most accepted interpretation of the QM excluded all local hidden variables forever.

![Figure 2. Bell’s Theorem - no local hidden variable λ can achieve the QM predictions at all polarizer settings](image)

4. Can Gravitons Cooperate with Photons to Achieve the QM Predictions at all Polarizer Settings?

We propose to estimate an action of two new local hidden variables γ and δ - representing the Earth´s gravitational field at individual polarizers A (λ,α,γ) and B (λ,β,δ). This situation is depicted by Figure 3.

![Figure 3. Earth´s gravitational field acting individually on photons at polarizers A (λ,α,γ) and B (λ,β,δ)](image)

Gravitons at the polarizer A (λ,α,γ) act on that ν1 photon in dependence on the setting of the polarizer A as: γ = π/2 - α.

On the other side, gravitons at the polarizer B (λ,β,δ) act on that ν2 photon in dependence on the setting of the polarizer B as: δ = π/2 - β.

In order to describe those events among gravitons and photons in the vicinity of both polarizers A and B, we propose to apply two old trigonometric functions - havercosine and haversine that describe the orthogonal projections on hyperplanes and might be used for the description of quantum-mechanical events (Jiří Stávek in 2013 and the Great Paper of Wojciech Słomczyński and Anna Sczepanek in 2020):
\begin{align*}
\text{havercosin}(2\theta) &= \frac{1 + \cos(2\theta)}{2} = \cos^2 \theta \\
\text{haversin}(2\theta) &= \frac{1 - \cos(2\theta)}{2} = \sin^2 \theta
\end{align*}

For the joint probabilities of photons ν1 and ν2 at polarizers A and B we can write Equations 5 and 6 as:

\begin{align*}
P_{++} &= P_{--} = \frac{1}{2} \text{havercosin}\left[(\alpha - \gamma) - (\beta - \delta)\right] = \frac{1}{2} \text{havercosin}\left[\left(\alpha - \frac{\pi}{2} + \alpha\right) - \left(\beta - \frac{\pi}{2} + \beta\right)\right] = \\
&= \frac{1}{2} \text{havercosin}(2\alpha - 2\beta) = \frac{1}{2} \text{havercosin}(2\theta) = \frac{1}{2} \cos^2 \theta
\end{align*}

\begin{align*}
P_{+-} &= P_{-+} = \frac{1}{2} \text{haversin}\left[(\alpha - \gamma) - (\beta - \delta)\right] = \frac{1}{2} \text{haversin}\left[\left(\alpha - \frac{\pi}{2} + \alpha\right) - \left(\beta - \frac{\pi}{2} + \beta\right)\right] = \\
&= \frac{1}{2} \text{haversin}(2\alpha - 2\beta) = \frac{1}{2} \text{haversin}(2\theta) = \frac{1}{2} \sin^2 \theta
\end{align*}

In this scenario, the joint cooperation of photons and gravitons at individual polarizers leads to the same quantitative predictions for all polarizer settings as the QM.

These new local hidden variables γ and δ are present only in the trigonometric functions havercosine and haversine and are invisible in the mathematical formulae derived by the QM.

Did we achieve the Einstein’s elements of reality missing in the QM? Is the QM complete or incomplete?

5. Quantum Cavendish Experiment

In order to falsify the QM correlation predictions (in the spirit of Karl Popper) we can locally bring to the vicinity of the polarizers A and B field masses M1 and M2 emanating additional gravitons towards the polarizers A and B. In this modification we create two additional hidden local variables ε and ζ.

Figure 4 shows the Quantum Cavendish Experiment inspired by Henry Cavendish’ big G measurement. In this case the field masses M1 and M2 might modify the correlation events among two entangled photons.

![Figure 4. Quantum Cavendish Experiment](image)

If the hypothesis with the action of the gravitational field on the entangled photon correlation probabilities is valid
than we might observe “tailor made” correlations violating the predictions of the QM.

In the Quantum Cavendish Experiment we have two separated events at A (\(\lambda,\alpha,\gamma,\epsilon\)) and B (\(\lambda,\beta,\delta,\zeta\)) governed by:

- \(\lambda\) represents the super-elastic double-helix photon and graviton,
- \(\alpha\) the A polarizer setting,
- \(\beta\) the B polarizer setting,
- \(\gamma\) the Earth’s gravitational field at the polarizer A,
- \(\delta\) the Earth’s gravitational field at the polarizer B,
- \(\epsilon\) the field mass \(M_1\) in the vicinity of the polarizer A,
- \(\zeta\) the field mass \(M_2\) in the vicinity of the polarizer B.

We can manipulate with parameters: \(\alpha, \beta, \epsilon, \zeta\).

At this moment we do not know how to trigonometrically evaluate the parameters \(\epsilon\) and \(\zeta\).

We want to pass this model into the hands of the big G researchers and the “entanglement” community to estimate the realization of the Quantum Cavendish Experiment.

6. Conclusions

1. We have combined knowledge of Old Masters, New Masters, and Dissidents in order to newly formulate events with the entangled photons.

2. We have introduced two new local hidden variables \(\gamma\) and \(\delta\) - the Earth’s gravitational field acting locally on photons based on each polarizer setting. These two local hidden variables cannot be manipulated by humans.

3. We have newly used the old trigonometric functions - havercosine and haversine for the description of correlation events at both polarizers. Havercosine and haversine describe the orthogonal projections on hyperplanes and might be used for the description of quantum-mechanical events.

4. Havercosine and haversine with the new local hidden variables \(\gamma\) and \(\delta\) give the same predictions as the QM for all polarizer settings.

5. The proposed Quantum Cavendish Experiment can bring two new local hidden variables: \(\epsilon\) and \(\zeta\) that might be controlled by humans.

5. Quantum Cavendish Experiment might create “tailor-made” correlations different than the QM prediction.


7. We want to pass this model into hands of Readers of this Journal better educated in Trigonometry and Quantum-Mechanical Events.

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