Applied Physics Research; Vol. 13, No. 1; 2021
ISSN 1916-9639 E-ISSN 1916-9647
Published by Canadian Center of Science and Education

Entanglement Interpreted as the Cooperation Between the Super-Elastic Double-Helix Photons and the Super-Elastic Double-Helix Gravitons. Quantum Cavendish Experiment. Intellectual Mastery of Nature (07.10.2020)

Jiří Stávek[1]

[1] Bazovského 1228, 163 00 Prague, Czech republic

Correspondence: Jiří Stávek, Bazovského 1228, 163 00 Prague, Czech republic. E-mail: stavek.jiri@seznam.cz

Received: October 7, 2020 Accepted: November 17, 2020 Online Published: April 7, 2021

doi:10.5539/apr.v13n1p1 URL: http://dx.doi.org/10.5539/apr.v13n1p1

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 haversin (2θ) = $\sin^2\theta$ and havercosin (2θ) = $\cos^2\theta$ 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, λ 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 ν1 and ν2 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 α and β. Alain Aspect unequivocally confirmed the predictions of the QM for the joint probabilities of measuring (+,+), (-,-), (+,-), and (-,+) events:

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

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

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".

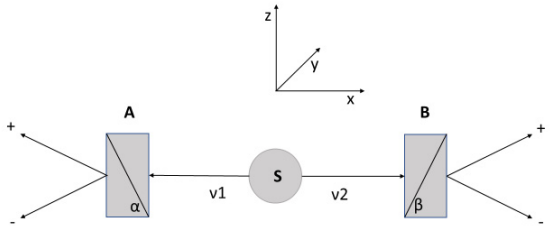

Figure 1. Schema of the Aspect´s Experiment confirming the predictions of the Quantum Mechanics

3. Bell´s Inequalities and the Bell´s Theorem

In 1964 J.S. Bell proposed to add to the two photons v1 and v2 a common property λ - a local hidden variable with the Bell´s locality condition: the result A (λ,α) of the measurement on photon v1 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.

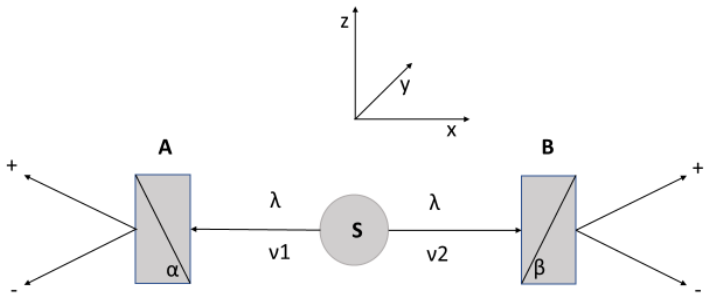

Figure 2. Bell´s Theorem - no local hidden variable λ can achieve the QM predictions at all polarizer settings

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.

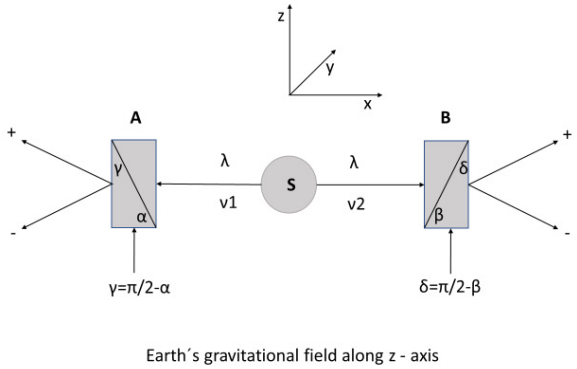

Figure 3. Earth´s gravitational field acting individually on photons at polarizers A (λ,α,γ) and B (λ,β,δ)

Gravitons at the polarizer A (λ,α,γ) act on that v1 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 v2 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):

$$\text{havercosin}\left(2\theta\right) = \frac{1+\cos\left(2\theta\right)}{2} = \cos^{2}\theta \tag{3}$$

$$\text{haversin}\left(2\theta\right) = \frac{1-\cos\left(2\theta\right)}{2} = \sin^{2}\theta \tag{4}$$

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

$$P_{++} = P_{--} = \frac{1}{2}\,\text{havercosin}\left[\left(\alpha-\gamma\right)-\left(\beta-\delta\right)\right] = \frac{1}{2}\,\text{havercosin}\left[\left(\alpha-\frac{\pi}{2}+\alpha\right)-\left(\beta-\frac{\pi}{2}+\beta\right)\right] =$$

$$= \frac{1}{2}\,\text{havercosin}\left(2\alpha-2\beta\right) = \frac{1}{2}\,\text{havercosin}\left(2\theta\right) = \frac{1}{2}\cos^{2}\theta$$

$$P_{+-} = P_{-+} = \frac{1}{2}\,\text{haversin}\left[\left(\alpha-\gamma\right)-\left(\beta-\delta\right)\right] = \frac{1}{2}\,\text{haversin}\left[\left(\alpha-\frac{\pi}{2}+\alpha\right)-\left(\beta-\frac{\pi}{2}+\beta\right)\right] =$$

$$= \frac{1}{2}\,\text{haversin}\left(2\alpha-2\beta\right) = \frac{1}{2}\,\text{haversin}\left(2\theta\right) = \frac{1}{2}\sin^{2}\theta$$

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.

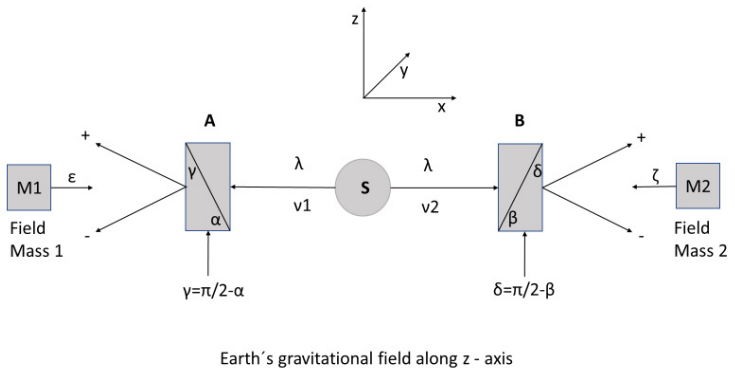

Figure 4. Quantum Cavendish Experiment

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 (λ,α,γ,ε) and B (λ,β,δ,ζ) governed by:

λ represents the super-elastic double-helix photon and graviton,

α the A polarizer setting,

β the B polarizer setting,

γ the Earth´s gravitational field at the polarizer A,

δ the Earth´s gravitational field at the polarizer B,

ε the field mass M1 in the vicinity of the polarizer A,

ζ the field mass M2 in the vicinity of the polarizer B.

We can manipulate with parameters: α, β, ε, ζ.

At this moment we do not know how to trigonometrically evaluate the parameters ε and ζ.

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 γ and δ - 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 γ and δ give the same predictions as the QM for all polarizer settings.

5. The proposed Quantum Cavendish Experiment can bring two new local hidden variables: ε and ζ that might be controlled by humans.

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

6. Nature might hide Her Beauty in plain sight protected by the mathematical camouflage.

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

Acknowledgments

This work was supported by the JP&FŠ Agency (Contract Number 25g/1963), by the VZ&MŠ Agency (Contract Number 16000/1989), by the GMS Agency (Contract Number 69110/1992), and by the FH&ES Agency (Contract Number 1502/2020). We were supported by the contract numbers 28101918/2018, 58287/2019. We have found the valuable support on the web site www.wolframalpha.com with the corrections of used formulae.

References

Al Balushi, A., Cong, W., & Mann, R. B. (2018). *An Optomechanical Quantum Cavendish Experiment*. Arxiv: 1806.06008v1. https://doi.org/10.1103/PhysRevA.98.043811

Anderson, P. R., & Brill, D. R. (1997). *Gravitational Geons Revisited*. Arxiv: gr-qc/9610074v2.

Aoki. (2018). *Massive Graviton Geons*. Arxiv: 1710.05606v2. https://doi.org/10.1103/PhysRevD.97.044005

Apollonius of Perga. *On the Cochlias*. In Proclus, On L. Euclid (Ed.), *Friedlein, 105*, 1-6.

Ashworth, R. A. (1998). *Confirmation of Helical Travel of Light through Microwave Waveguide Analysis*. *Physics Essays, 11*, 1-10. Retrieved from https://www.researchgate.net/publication/260829054_Confirmation_of_Helical_Travel_of_Light_through_Microwave_Waveguide_Analyses; https://doi.org/10.4006/1.3025308

Aspect, A. (2004). *Einstein-Podolsky-Rosen Correlations, Bell´s Theorem, and Quantum*. Retrieved from https://www.youtube.com/watch?v=_x-S98JQFyI

Aspect, A. (2013). From Einstein, Bohr, Schrödinger to Bell and Feynman: A New Quantum Revolution? *Séminaire Poincaré, XVII*, 99-123. Retrieved from http://www.bourbaphy.fr/aspect1.pdf

Aspect, A. (2015). *Closing the Door on Einstein and Bohr´s Quantum Debate, Physics, 8*, 123. Retrieved from https://physics.aps.org/articles/pdf/10.1103/Physics.8.123; https://doi.org/10.1103/Physics.8.123

Aspect, A. (2019). *The Future of Quantum Technologies: The Second Quantum Revolution*. Retrieved from https://www.youtube.com/watch?v=RBNzhVd_Yuw

Aspect, A. (n. d.). *Bell´s Theorem: The Naïve View of an Experimentalist*. Arxiv: quant-ph/0402001.

Aspect, A., Grangier, P., & Roger, G. (1982). Experimental Realization of Einstein-Podolsky-Rosen-Bohm Gedankenexperiment: A New Violation of Bell´s Inequalities. *Phys. Rev. Lett., 49*, 91-94. https://doi.org/10.1103/PhysRevLett.49.91

Aspect´s Experiment. (1982). Retrieved from https://en.wikipedia.org/wiki/Aspect%27s_experiment

Aspelmeyer, M. (2015). *The Past, Present and Future of Quantum Tests of (Quantum) Gravity*. Centenary Conference on the History of General Relativity, Berlin. Retrieved from https://www.mpiwg-berlin.mpg.de/sites/default/files/migrated/Aspelmeyer%20-%20Past%2C%20Present%20and%20Future%20of%20Quantum%20Tests%20of%20Gravity.pdf

Bacchiagaluppi, G., & Valentini, A. (2009). *Quantum Theory at the Crossroads: Reconsidering the 1927 Solvay Conference.* Cambridge University Press, Cambridge. https://doi.org/10.1017/CBO9781139194983

Bai, Ch., & Zeilinger, A. (2017). *Austrian and Chinese Academies of Sciences Successfully Conducted First Inter-Continental Quantum Video Call*. Retrieved from https://www.oeaw.ac.at/en/detail/news/austrian-and-chinese-academies-of-sciences-successfully-conducted-first-inter-continental-quantum-vi/

Bell, J. S. (1964). On the Einstein-Podolsky-Rosen Paradox. *Physics, 1*, 195-200. https://doi.org/10.1103/PhysicsPhysiqueFizika.1.195

Bell, J. S. (1987). *Speakable and Unspeakable in Quantum Mechanics*. Cambridge University Press, ISBN 0 521 33495 0.

Bell, J. S. (1992). Six Possible Worlds of Quantum Mechanics. *Foundations of Physics, 22*, 1201-1215. https://doi.org/10.1007/BF01889711

Billings, L. (2017). *China Shatters "Spooky Action at a Distance" Record, Preps for Quantum Internet*. Scientific American. Retrieved from https://www.scientificamerican.com/article/china-shatters-ldquo-spooky-action-at-a-distance-rdquo-record-preps-for-quantum-internet/¨

Blåsjö, V. (2018). Mathematicians Versus Philosophers in Recent Work on Mathematical Beauty. *Journal of Humanistic Mathematics, 8*, 414-431. Retrieved from https://scholarship.claremont.edu/cgi/viewcontent.cgi?referer=https://www.google.com/&httpsredir=1&article=1380&context=jhm; https://doi.org/10.5642/jhummath.201801.20

Boccaletti et al. (1970). *Conversion of Photons into Gravitons and Vice Versa in a Static Electromagnetic Field.* Il Nuovo Cimento, LXX, 129 - 146. https://doi.org/10.1007/BF02710177

Bohm, D. (1952). A Suggested Interpretation of the Quantum Theory in Terms of Hidden Variables, I. *Physical Review, 85*, 166-179. https://doi.org/10.1103/PhysRev.85.166

Bohm, D. (1989). *Quantum Theory*. Dover Publications, ISBN-10: 9780486659695.

Bohr, N. (1935). Can Quantum-Mechanical Description of Reality be Considered Complete? *Phys. Rev., 48*, 696-702. https://doi.org/10.1103/PhysRev.48.696

Bohr-Einstein Debate (1985). Retrieved from https://www.youtube.com/watch?v=SEjte11wPeI

Bohr-Einstein Debates. Retrieved from https://en.wikipedia.org/wiki/Bohr%E2%80%93Einstein_debates

Carlesso et al. (2017). *When Cavendish meets Feynman: A Quantum Torsion Balance for Testing the Quantumness of Gravity.* Arxiv: 1710.08695v1.

Carlesso et al. (2019). Testing the Gravitational Field by a Quantum Superposition. *New Journal of Physics, 21*, 093052. https://doi.org/10.1088/1367-2630/ab41c1

Chen et al. (2016). Sharp Contradiction for Local-Hidden-State-Model in Quantum Steering. *Sci. Rep., 6*, 32075. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5000011/; https://doi.org/10.1038/srep32075

Clauser, J. F., & Horne, M. A. (1974). Experimental Consequences of Objective Local Theories. *Phys. Rev., 10*, 526-535. https://doi.org/10.1103/PhysRevD.10.526

Cohen et al. (2019). *Realism and Causality I: Pilot Wave and Retrocausal Models as Possible Facilitators*. Arxiv: 1902.05108v2.

Cook, T. A. (1914). *The Curves of Life*. Constable and Company, London.

Cylindrical Helix. http://demonstrations.wolfram.com/SineAndCosineHelix/

Cylindrical Helix. http://mathworld.wolfram.com/Helix.html

Cylindrical Helix. https://en.wikipedia.org/wiki/Helix

Cylindrical Helix. https://www.mathcurve.com/courbes3d.gb/helicecirculaire/helicecirculaire.shtml

Dalton, B. J., Garraway, B. M., & Reid, M. D. (2020). *Tests for EPR Steering in Two-Mode Systems of Identical Massive Bosons.* Arxiv: 1611.09101v6. https://doi.org/10.1103/PhysRevA.101.012117

De Broglie - Bohm Theory. Retrieved from https://en.wikipedia.org/wiki/De_Broglie%E2%80%93Bohm_theory

De Broglie, L. (1927). *Electrons et Photons: Rapport et Discussions du Cinquième Conseil de Physique tenu à Bruxelles du 24 au 29 Octobre 1927*. Gauthier-Villars.

De Broglie, L. (1939). *Matter and light: The New Physics* (pp. 136-142). W.W: Norton CO., New York.

Del Santo, F. (2017). *Genesis of Karl Popper´s EPR-Like Experiment and its Resonance amongst the Physics Community in the 1980s*. Arxiv: 1701.09178. https://doi.org/10.1016/j.shpsb.2017.06.001

Duante, F. J. (2019). *Fundamentals of Quantum Entanglement*. IOP Publishing Ltd., ISBN-10: 0750322268.

Dürr, D., & Teufel, S. (2009). *Bohmian Mechanics: The Physics and Mathematics of Quantum Theory (Fundamental Theories of Physics.* Springer, ISBN 10-3540893431. https://doi.org/10.1007/b99978_12

Einstein, A., Podolsky, B., & Rosen, N. (1935). Can Quantum-Mechanical Description of Reality be Considered Complete? *Phys. Rev., 47*, 777-780. https://doi.org/10.1103/PhysRev.47.777

Einstein-Podolsky-Rosen Paradox: https://en.wikipedia.org/wiki/EPR_paradox

Feynman, R. (1964). Quantum Behavior. *Feynman Lectures, III*, Chapter 1. Retrieved from http://www.feynmanlectures.caltech.edu/III_01.html

Ford, K., & Wheeler, J. A. (2000). *Geons, Black Holes, and Quantum Foam: A Life in Physics*, W.W: Norton & Company, ISBN-10: 0393319911.

Freire, O. (2003). *Science and Exile: David Bohm, the Hot Times of the Cold War, and his Struggle for a New Interpretation of Quantum Mechanics*. Retrieved from https://arxiv.org/ftp/physics/papers/0508/0508184.pdf

Freire, O. (2015). *The Quantum Dissidents: Rebuilding the Foundations of Quantum Mechanics (1950-1990).* With a Forword by S.S. Schweber. Springer, ISBN-10: 9783662446614.

Fried, M., & Unguru, S. (2001). *Apollonius of Perga´s Conica: Text, Context, Subtext. Mnemosyne*, Bibliotheca Classic. ISBN-10: 9004119779. https://doi.org/10.1163/9789004350991

Gauthier, R. (2017). *Entangled Double-Helix Superluminal Composite Photon Model Defined by Fine Structure Constant.* Retrieved from https://www.researchgate.net/publication/320840733_Entangled_Double-Helix_Superluminal_Composite_Photon_Model_Defined_by_Fine_Structure_Constant

Geminus of Rhodes: Cylindrical Helix. https://www-history.mcs.st-and.ac.uk/Biographies/Geminus.html

Genovese, M. (2007). *Research on Hidden Variable Theories: A Review of Recent Progresses*. Arxiv: quant-ph/070107v1

Giustina et al. (2015). *Significant-Loophole-Free Test of Bell´s Theorem with Entangled Photons*. Arxiv: 1511.03190.

Hadot, P. (2008). *The Veil of Isis: An Essay on the History of the Idea of Nature*. Belknap Press. ISBN-10: 0674030494.

Han et al. (2019). *Polarization Design for Ground-to-Satellite Quantum Entanglement Distribution*. Arxiv: 1912.06318v1. https://doi.org/10.1364/OE.28.000369

Hardy, L. (1992). On the Existence of Empty Waves in Quantum Theory. *Physics Letters A, 167*, 11-16. https://doi.org/10.1016/0375-9601(92)90618-V

Heat, T. L. (2015). *Apollonius of Perga: Treatise on Conic Sections*. Carruthers Press. ISBN-10: 1446021262.

Helical Electromagnetic Waves, (2011). Retrieved from http://blackholeformulas.com/files/EnM.html

Heron. (1912). *Heronis Alexandrini opera quae supersunt omnia*. Teubner, Leipzig, Ed. And translated into German by J.L. Heiberg.

Hess, K. (2014). *Einstein was Right!* Jenny Stanford Publishing, ISBN-10: 9814463698. https://doi.org/10.1201/b16809

Huygens, Chr. (1678). *Traité de la Lumière*, Leyden, Van der Aa. (In Treatise on Light, London: McMillan, 1912).

Interpretations of Quantum Mechanics. Retrieved from https://en.wikipedia.org/wiki/Interpretations_of_quantum_mechanics

Jungnickel, C., & McCormmach, R. R. (1986). *Intellectual Mastery of Nature: The Now Mighty Theoretical Physics, 1870 - 1925 v. 2: Theoretical Physics from Ohm to Einstein.* University of Chicago Press, ISBN-10: 0226415848.

Kay, B.S. (2020). *The Matter-Gravity Entanglement Hypothesis*. Arxiv: 1802.03635v3.

Khrennikov, A. (2016). *After Bell*. Arxiv: 1603.08674v1.

Khrennikov, A. (2017). Bohr against Bell: Complementary versus Nonlocality. *Open Phys., 15*, 734-738. https://doi.org/10.1515/phys-2017-0086

Khrennikov, A. (2018). *Bell Argument: Locality or Realism? Time to make the Choice*. Arxiv: 1108.0001v3.

Khrennikov, A. (2020). Two Faced Janus of Quantum Nonlocality. *Entropy, 22*, 303. Arxiv: 2001.02977v1. https://doi.org/10.3390/e22030303

Kisak, P. F. (Ed.). (2016). *Quantum Entanglement! "…Spooky Action at a Distance…".* Create Space Independent Publishing Platform, ISBN-10:153029732X.

Kupczynski, M. (2017). Can we close the Bohr-Einstein Quantum Debate? *Phil. Trans. Royal Soc. A*, 375. Retrieved from https://royalsocietypublishing.org/doi/10.1098/rsta.2016.0392; https://doi.org/10.1098/rsta.2016.0392

Kupczynski, M. (2018). Closing the Door on Quantum Nonlocality. *Entropy, 20*, 877. Retrieved from https://www.mdpi.com/1099-4300/20/11/877/htm; https://doi.org/10.3390/e20110877

Kupczynski, M. (2020). Is the Moon There If Nobody Looks: Bell Inequalities and Physical Reality. *Frontiers of Physics, 8*, 273. Retrieved from https://www.frontiersin.org/articles/10.3389/fphy.2020.00273/full; https://doi.org/10.3389/fphy.2020.00273

Kvasz, L. (2012). *Galileo, Descartes, and Newton - Founders of the Language of Physics*. *Acta Physica Slovaca, 62*, 519-614. Retrieved from http://www.physics.sk/aps/pubs/2012/aps-12-06/aps-12-06.pdf

Kwiat et al. (1998). *Ultrabright Source of Polarization-Entangled Photons*. Arxiv: quant-ph/9810003.

Laloë, F. (2012). *Do we Really Understand Quantum Mechanics?* Cambridge University Press, Cambridge, ISBN 978-1-107-02501-1.

Landsman, N. P. (2005). *When champions meet: Rethinking the Bohr-Einstein Debate*. Retrieved from http://philsci-archive.pitt.edu/2503/1/EinsteinBohr.pdf; https://doi.org/10.1016/j.shpsb.2005.10.002

Lee, J. W., Kim, H. Ch., & Lee, J. (2015). *Gravity as a Quantum Entanglement Force*. Arxiv: 1002.4568v2.

Levitt, L. S. (1978). Is the Photon a Double Helix? *Lettere al Nuovo Cimento, 21*, 222-223. https://doi.org/10.1007/BF02822254

Lewis, P. J. (2007). Empty Waves in Bohmian Quantum Mechanics. *British Journal for the Philosophy of Science, 58*, 787-803. https://doi.org/10.1093/bjps/axm039

Li et al. (2018). *Testing Local Realism into the Past without Detection and Locality Loopholes*. Arxiv: 1808.07653v1.

Local Hidden Variable Theory. Retrieved from https://en.wikipedia.org/wiki/Local_hidden-variable_theory

Loopholes in Bell Test Experiments. Retrieved from https://en.wikipedia.org/wiki/Loopholes_in_Bell_test_experiments

Mancosu, P., & Arana, A. (2010). Descartes and the Cylindrical Helix. *Historia Mathematica, 37*, 403-427. Retrieved from https://www.sciencedirect.com/science/article/pii/S0315086009000949; https://doi.org/10.1016/j.hm.2009.10.006

Mermin, D. (1985). Is the Moon There when Nobody Looks? Reality and the Quantum Theory. *Physics Today*, 38-47. Retrieved from http://cs.westminstercollege.edu/~ccline/courses/phys301/PT_38(4)_p38.pdf; https://doi.org/10.1063/1.880968

Mermin, N. D. (1993). Hidden Variables and the Two Theorems of John Bell. *Rev. Mod. Phys., 65*, 803-815. https://doi.org/10.1103/RevModPhys.65.803

Miao et al. (2020). *Quantum Correlation of Light Mediated by Gravity*. Arxiv: 1901.05827v3.

Nauenberg, M. (2018). *Visiting Newton's Atelier before the Principia, 1679-1684*. Arxiv: 1805.06871v. https://doi.org/10.1080/00033790.2019.1566497

Newton, I. (1687). *The Principia. Mathematical Principles of Natural Philosophy*. Translated by I.B. Cohen and A. Whitman. University California Press, Berkeley. ISBN 978-0-520-08816-0.

Newton, I. (1704). *Optics: Or, a treatise of the reflections, refractions, inflexions, and colors of light. Also two treatises of the species and magnitude of curvilinear figures*. Palo Alto, Calif.: Octavo, ISBN 1-891788-04-3. https://doi.org/10.5479/sil.302475.39088000644674

Nordén, B. (2016). Quantum Entanglement: Facts and Fiction - How Wrong was Einstein after all? *Quarterly Reviews in Biophysics, 49*, 1-13. Retrieved from https://research.chalmers.se/publication/515475/file/515475_Fulltext.pdf; https://doi.org/10.1017/S0033583516000111

Paneru et al. (2020). Entanglement: Quantum or Classical? *Reports on Progress in Physics, 83*, 064001. https://doi.org/10.1088/1361-6633/ab85b9

Pascazio, S. (1985). Experimental Tests of Bell Inequalities. Are All Local Models Really Excluded? *Phys. Lett., 111*, 339-342. Retrieved from http://www.ba.infn.it/~pascazio/publications/pla85.pdf; https://doi.org/10.1016/0375-9601(85)90364-0

Perry, G. P., & Cooperstock, F. I. (1998). *Stability of Gravitational and Electromagnetic Geons*. Arxiv: gr-qc/9810045v1.

Pilot Wave Theory and Quantum Realism. (2016). *Space Time, PBS Digital Studios*. Retrieved from https://www.youtube.com/watch?v=RlXdsyctD50

Pilot Wave Theory. Retrieved from https://en.wikipedia.org/wiki/Pilot_wave_theory

Pladevall, X. O., & Mompart, J. (2019). *Applied Bohmian Mechanics: From Nanoscale Systems to Cosmology*. 2nd Ed., Jenny Stanford Publishing, ISBN 10-9814800104.

Planck, M., & Bohr, N. (2019). *Quantum Theory (Great Works that Shape Our World)*. Amazon, ISBN-10: 1787556824.

Power, E. A., & Wheeler, J. A. (1957). Thermal Geons. *Rev. Mod. Phys., 29*, 480. https://doi.org/10.1103/RevModPhys.29.480

Rothleitner, C., & S. Schlamminger, S. (2017). Invited Review Article: Measurements of the Newtonian Constant of Gravitation, G. *Rev. Sci. Instrum., 88*, 111101-1. https://doi.org/10.1063/1.4994619

Roveli, C. (2018). Physics Needs Philosophy. Philosophy Needs Physics. *Found. Phys., 48*, 481-491. Retrieved from https://arxiv.org/ftp/arxiv/papers/1805/1805.10602.pdf; https://doi.org/10.1007/s10701-018-0167-y

Schlamminger S. (2017). Quantifying the Quantum. *Nature Physics, 13*, 618. https://doi.org/10.1038/nphys4158

Schrödinger, E. (1936). Probability Relations between Separated Systems. *Mathematical Proceedings of the Cambridge Philosophical Society, 32*, 446-452. https://doi.org/10.1017/S0305004100019137

Schumacher, A. (1999). *Systematische Untersuchungen zur Messung der Newtonschen Gravitationskonstanten mit einem Pendelresonator*. PhD Thesis, University of Wuppertal, WUB-DIS-99-13.

Schwinger, J. (1976). Gravitons and Photons: *The Methodological Unification of Source Theory, General Relativity and Gravitation, 7*, 251-256. https://doi.org/10.1007/BF00768525

Selleri, F., & Tarozzi, G. (1981). Quantum Mechanics Reality and Separability. *La Rivista Del Nuovo Cemento, 4*, 1-53. https://doi.org/10.1007/BF02740737

Słomczyński, W., & Sczepanek, A. (2020). *Orthogonal Projections on Hyperplanes with Unitaries*. Arxiv: 2005.13658v1. Retrieved from https://arxiv.org/pdf/2005.13658.pdf

Stávek, J. (2013). On the Trigonometric Loophole. *Appl. Phys. Res., 5*, 48-58. https://doi.org/10.5539/apr.v5n6p48

Stávek, J. (2019). Super-Elastic Double-Helix Model of Photon. Huygens-de Broglie Particle on the Helical Path Guided by the Newton-Bohm Entangled Helical Evolute. Quantum of Magnetic Flux Based on the Mathematical Beauty of Newton, Lorentz, Einstein, Dirac, Gell-Mann, Schwinger, Polchinski and Witten (16.06.2019). *Appl. Phys. Res., 11*, 40-51. https://doi.org/10.5539/apr.v11n4p40

Stávek, J. (2020). How to Understand the Planck´s Oscillators? Wien Peaks, Planck Distribution Function and Its Decomposition, the Bohm Sheath Criterion, Plasma Coupling Constant, the Barrier of Determinacy, Hubble Cooling Constant (24.04.2020). *Applied Physics Research, 12*, 63-74. https://doi.org/10.5539/apr.v12n4p63

Stávek, J. (2020). Squeezing of the Super-Elastic Double-Helix Photon in the Gravitational Field (Hidden in Very Well- Known Old Formulae). Pound-Rebka-Snider Effect Studied by the Advanced LIGO Instrument, Pioneer Anomaly and CMB (Cosmic Microwave Background). (23.11.2019). *Applied Physics Research, 12*, 8-18. https://doi.org/10.5539/apr.v12n1p8

Stávek, J. (2020). Stretching of the Super-Elastic Double-Helix Geon. Wheeler´s Thermal Geons as Quanta of Heat and Momentum. Bohm´s Diffusion and the Heating of the Solar Corona and Heating of the Earth - Geon Engineering. Milgrom - Verlinde Constant. Mareš - Šesták Constant. *Applied Physics Research, 12*, 12-24. https://doi.org/10.5539/apr.v12n2p12

Stefanick, T. (2020). *The State of U.S.-China Quantum Data Security Competition*. Tech Stream. Retrieved from https://www.brookings.edu/techstream/the-state-of-u-s-china-quantum-data-security-competition/

Tanjung et al. (2020). Observable Quantum Entanglement due to Gravity. *Quantum Information, 6*. Retrieved from https://www.nature.com/articles/s41534-020-0243-y; https://doi.org/10.1038/s41534-020-0243-y

Tittel et al. (1997). *Experimental Demonstration of Quantum-Correlations over more than 10 Kilometers.* Arxiv: quant-ph/9707042. https://doi.org/10.1103/PhysRevA.57.3229

Van Raamsdonk, M. (2016*). Lectures on Gravity and Entanglement*. Arxiv: 1609.00026v1. https://doi.org/10.1142/9789813149441_0005

Verlinde, E. (2010). *On the Origin of Gravity and the Laws of Newton*. Arxiv: 1001.0785v1.

Versine (with some properties of *haversine* and *havercosine*). Retrieved from https://en.wikipedia.org/wiki/Versine

Vigier, J. P. (1982). *Non-Locality, Causality and Aether in Quantum Mechanics, 303*, 55-80. https://doi.org/10.1002/asna.2103030111

Villar et al. (2020). Entanglement Demonstration on Board a Nano-Satellite. *Optica, 7*, 734-737. Retrieved from https://arxiv.org/pdf/2006.14430.pdf; https://doi.org/10.1364/OPTICA.387306

Walleczek, J., Grossing, G., & Pylkkanen, P. (2019). *Emergent Quantum Mechanics: David Bohm Centennial Perspectives*. Mdpi AG, ISBN-10:3038976165. https://doi.org/10.3390/e21020113

Watson, J. D. (2001). *The Double Helix: A Personal Account of the Discovery of the Structure of DNA.* Touchstone, ISBN-10: 9780743216302.

Weihs et al. (1998). *Violation of Bell´s Inequality under Strict Einstein Locality Condition*. Arxiv: quant-ph/9810080. https://doi.org/10.1103/PhysRevLett.81.5039

Wheeler, J. A. (1955). Geons*. Physical Review, 97*, 511. https://doi.org/10.1103/PhysRev.97.511

Wheeler, J. A. (1957). On the Nature of Quantum Geometrodynamics. *Annals of Physics*, 604-614. https://doi.org/10.1016/0003-4916(57)90050-7

Whitaker, A. (2016). Richard Feynman and Bell´s Theorem. *Am. J. Phys., 84*, 493. Retrieved from https://aapt.scitation.org/doi/full/10.1119/1.4948268; https://doi.org/10.1119/1.4948268

Wilczek, F. (2016). Physics in 100 years. *Physics Today, 69*, 32-39. https://doi.org/10.1063/PT.3.3137

Williams, G. (2019). *Unravelling the Double Helix. The lost Heroes of DNA*. Weidenfeld & Nicholson, ISBN-10: 147460935X.

Wu et al. (2019). Progress in Precise Measurements of the Gravitational Constant. *Annalen der Physik (Berlin), 531*, 1900013. https://doi.org/10.1002/andp.201900013

Yin et al. (2017). Satellite-Based Entanglement Distribution over 1200 Kilometers. *Science, 356*, 1140-1144. Retrieved from https://science.sciencemag.org/content/356/6343/1140; https://doi.org/10.1126/science.aan3211

Yin et al. (2020). Entanglement-Based Secure Quantum Cryptography over 1,120 Kilometers. *Nature, 582*, 501-505. https://doi.org/10.1038/s41586-020-2401-y

Zeilinger, A. (1999). Experiment and the Foundations of Quantum Physics. *Review of Modern Physics, 71*, S288-S297. https://doi.org/10.1103/RevModPhys.71.S288

Zeilinger, A. (2014). *Quantum Information and Entanglement.* Retrieved from https://www.youtube.com/watch?v=TrsnMNh9W9U