Bionoetics, vol. 12, no. 2, 2016

A CHALLENGE TO QUANTUM ENTANGLEMENT BY EXPERIMENT AND THEORY

Eric Stanley Reiter[1*]

ABSTRACT: It is argued on both experimental and theoretical grounds that quantum entanglement, which has been taken to explain consciousness, is an illusion.

KEYWORDS: Quantum Entanglement; Photons; Wave Particle Duality; Threshold Model; Consciousness.

Scientists intrigued by daunting phenomena such as consciousness have been turning to quantum mechanical (QM) entanglement. I call for fixing our fundamental physics before applying it to other fields. It is well known that Einstein and Schrödinger argued against QM. Schrödinger's scepticism is well documented:

> "Let me say at the outset, that in this discourse, I am opposing not a few special statements of quantum mechanics held today, I am opposing as it were the whole of it, I am opposing its basic views that have been shaped 25 years ago, when Max Born put forward his probability interpretation, which was accepted by almost everybody" **[1**, his 1952 Dublin Seminar**]**.

Schrödinger's works coining entanglement **[2]** and his cat **[3]** followed the so-called EPR paper **[4]**, and followed his discussion with Einstein on that paper. Therefore papers **[2, 3]** can be understood to say that the world-view delivered by QM is far too incomprehensible to take seriously. Arguments have raged. Most famously, entanglement is said to be upheld by so-called two-"particle" experiments performed by Aspect and team **[5]**. In such a test, a probabilistic wave-function spreads from a central point, then detectors on opposite sides can click in either of two states as read

---

[1*] eric@thresholdmodel.com, www.thresholdmodel.com. October 2016.

by a coincidence circuit. When clicks happen in coincidence the wave function is thought to collapse, and state correlations are recognized. However, a much simpler single-"particle" test will address this issue of wave-function collapse. Either test, the single or two-"particle" test, is usually done with visible light, and use what they call singly emitted "photons" **[6]**. Our examination of these fundamentals calls for careful language. There is a "give-away:" when you see a paper written in terms of photons, even if it is intended to show if photons exist, the result will always lead to photons. There is a way to avoid the photon model, yet embrace an $h\nu$ in our equations, and that is what this essay is about. We need a new word. I use $h\nu$, pronounced *h-new*, in honour of Planck's $E = h\nu$. We will see that an $h\nu$ is a threshold-quantity of energy, not like a held-together light-particle.

Wave-particle duality is about wave-function collapse, and that is about entanglement. It is all about quantum mechanics. Showing how entanglement is an illusion, is what this essay is about.

Here is the experiment: A radiation source is tested to see that it emits only one $h\nu$ at a time, except by chance. This is called a *true-coincidence* test. Then with that source, we do a beam-split coincidence test. Here we see how our emitted $h\nu$ of energy behaves in a wave-front like split toward two detectors. The coincidence circuit tests to see if one detection excludes the other detector from clicking, except by chance. These "clicks" are microsecond pulses we see on an oscilloscope. The coincidence circuit will reveal: (1) if light holds itself together by the photon model to avoid coincident clicks accept by chance, or (2) if light can spread classically to deliver a coincident click rate exceeding chance. Such beam-split-coincidence tests performed in the past **[5]** have upheld result (1) predicted by QM. Literature asserts, if this one-way-or-another property of quantum particles were to be refuted, it would call for a major revision of QM [**6** Brannen & Ferguson]. Previous to my work, no one performed this test with gamma-rays, perhaps because gamma-rays are thought to be the most particle-like form of light. Here we report that a gamma-ray beam-split-coincidence test can refute quantum mechanical chance. When the chance rate is exceeded, we call it the unquantum effect.

Our true-coincidence test uses the same circuit and detectors as the beam-split coincidence test, except the geometry is different. A true-coincidence test for gamma-rays will sandwich an isotope between two detectors to see if it emits two $h\nu$ in a single decay **[7]**. Similarly these tests can be performed upon other… phenomena. For other "phenomena" we are tempted to say "particles." This linguistics problem is part of our 100 year-old physics problem.

Nuclear physicists have a long history of deciphering decay schemes by comparing to chance rates. But for safe keeping, this true-coincidence test has been performed in-house on our isotopes sources: ^{109}Cd and ^{57}Co. It is well known that these isotopes emit only one gamma-ray at a time. They also emit an x-ray in coincidence, but we filter those out.

One might expect we are seeing two half-photons, or a Compton effect split. We use pulse-height filters to count only full-height pulses, in a manner that delivers a two-for-one effect. We use the same filter and coincidence circuit to confirm we emit one-at-a-time, then we change only the geometry to resemble a beam-splitter, then we see two-at-a-time: two-for-one. When we know a pulse-height, it is the same as saying we know an electromagnetic frequency, except by a small fraction due to the detection process. Physicists know from prior tests that pulse-height from these gamma-ray detectors is proportional to electromagnetic frequency.

Many tests performed at our laboratory since 2001 show that this unquantum effect is not an artefact, not a special case, and not an experimental error. Also, the *why* of when it works, and not-works, is revealed in our test variants. Details of one gamma-ray unquantum test are in **Appendix I [8, 9]**. That test exceeded QM chance by 35.

To refute QM for just light is not good enough, because matter-phenomena also display wave-particle duality. With much effort, we have substantiated our unquantum effect for alpha-rays. In a similar beam-split coincidence test with alpha-rays, we have measured that the helium-nuclear-matter-wave can split. The binding-energy of helium is 7 MeV per nucleon, so it would take 14 MeV to split the alpha. We used ^{241}Am, that emits an alpha at only 5.5 MeV, so we are not able to split alphas into two deuterons. When these alphas confront a gold foil, some will reflect to a detector, and some will transmit through to another detector. When measured in coincidence, we conclude the alpha splits like a wave. Most of these coincident pulses are half-height, and this has been repeatedly measured at up to 100 times the chance rate. When measuring full-height pulses we still see an incredible 4 times chance. That is a two-for-one effect with matter-waves! Many variants of this alpha unquantum effect have been tested. Details of an alpha-ray unquantum test are in **Appendix II [8, 10]**.

These tests compel us to re-interpret past experiments. Experiments can have several interpretations. The goal is to find a way to interpret all experiments by a single non-dualistic model.

Now thinking of the gamma-ray unquantum effect, it being two-for-one implies energy had to be pre-loaded in either the detector or scatterer preceding the detection event, otherwise we violate energy conservation. We uphold energy conservation. Therefore we are forced to consider an accumulation hypothesis. The accumulation reaches a threshold, so here we call it the Threshold Model. We say we are violating particle-energy conservation. This is similar to the Bohr-Kramers-Slater **[11]** idea whereby energy conservation did not require particle-per-particle accounting. See **[9** or **12]** for how prior arguments on this issue were blundered. The accumulation idea is old and had several variants **[13, 14, 15]**. Most importantly, the idea of a pre-loaded state has been routinely ignored. In much search, I have not seen any writing treating a pre-loaded state since Millikan's book of 1947 **[16]**. A way to visualize the threshold model is by **figure 1**.

A few definitions are overdue. First, *particle* and *wave*. The important property of a particle is that a particle holds itself together. A particle can be anything from a dimensionless point to a galaxy. A wave does not hold itself together, and it spreads. That one distinction is all we need. For the definition of the photon, N Bohr paraphrases Einstein:

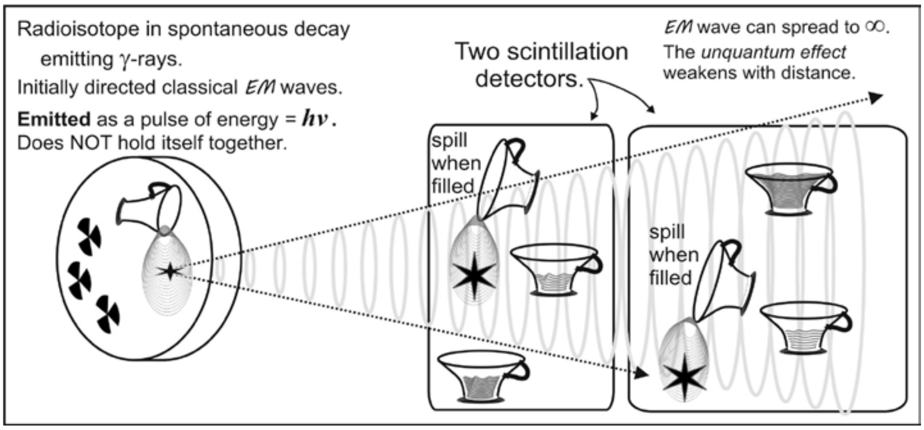


Figure 1. A way to visualize the threshold model in the gamma-ray test.

> "If a semireflecting mirror is placed in the way of a photon, leaving two possibilities for its direction of propagation, the photon would be recorded on one, and only one, of the two photographic plates situated at great distances in the two directions in question, or else we may, by replacing the plates by mirrors, observe these effects exhibiting an interference between the two reflected wave-trains **[17]**."

This model combines classical wave and particle ideas. Classical-wave and classical-particle models are mutually exclusive. Therefore a *quantum mechanical particle* is an incomprehensible model, not a thing. A photon has never been a thing, and it should not be spoken of that way.

From many experiments and the beauty of biochemical structure we know we still have particles. However for the sake of explaining our wave effects and new experiments let us say "not always" and propose a two state solution. Consider that a particle can hold itself together, but can also "lose-it." Please examine the equations famous for "particle-wave" experiments in **Table 1**. These equations have ratios of *e*, *h* and *m*. Let us look at electron mass *m*. If we think of *m* as the mass of a particle, we will forever be stuck in wave-particle duality. Observe that these equations have ratios like *e/m*. Consider our constants in terms of thresholds; consider that our constants are maxima. Consider an arbitrarily small cubic volume of a charge-wave. Imagine the charge (or action or mass) in this cube to be some sub-threshold value of *e* (and similarly for action and mass). The simplest relationship would be linear, and that the *e/m* ratio in this cube can be conserved; similarly for the *h/m* and *e/h* ratios. In this scenario our experiments could not make the distinction between our threshold model and QM. The way to tell the difference between those models is our beam-split coincidence test.

	Quantum Mechanics	Threshold Model
Matter wavelength	$\lambda_{\text{phase}} = \frac{h}{m\upsilon}$	$\lambda_{\text{group}} = \frac{Q_{h/m}}{\upsilon_{\text{group}}}$
Photoelectric	$h\nu_L - h\nu_0 = \frac{m\upsilon^2}{2} = eV_0$	$Q_{h/m}(\nu - \nu_0) = \frac{\upsilon_{\text{group}}^2}{2} = Q_{e/m}V_0$
Compton	$\Delta\lambda = \frac{h(1-\cos\theta)}{mc}$	$\Delta\lambda_{\text{group}} = Q_{h/m}\frac{1-\cos\theta}{c}$
Lorentz force	$F = ma = e(\upsilon \times \boldsymbol{B})$	$a = Q_{e/m}(\upsilon_{\text{group}} \times \boldsymbol{B})$
Aharonov-Bohm	$\Delta x = \frac{eL\lambda Bw}{h}$	$\Delta x = Q_{e/h}L\lambda_{\text{group}}Bw$

Table 1. Equations of wave-like experiments expressed by quantum mechanics and the threshold model.

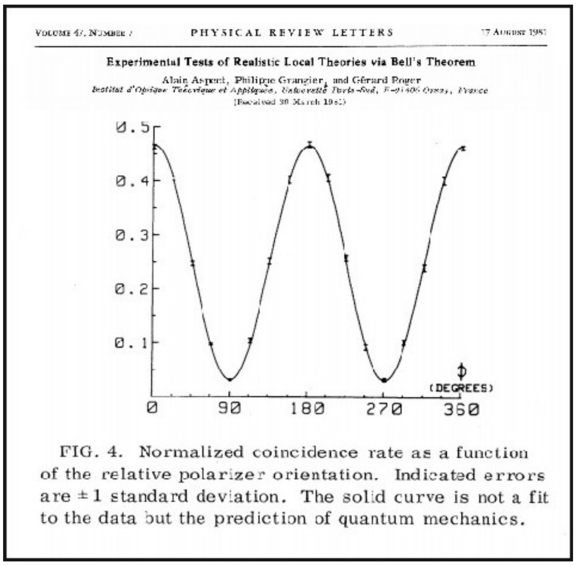
What about experiments reporting quantized charge? Measurements of *e* are performed upon ensembles of many atoms, such as in Millikan's oil drop experiment (and earlier by J. J. Thompson). Quantization as seen in an ensemble does not necessarily imply that free charge is quantized. From evidence of charge diffraction alone, it is a false assumption to think charge is always quantized at e. In our new model, if charge were to spread like a wave, maintain a fixed e/m ratio for any unit of volume, load-up upon absorption, and be detected at threshold e, it would remain consistent with conventional observation. An electron's worth of charge need not be spatially small. Chemists performing Electron Spin Resonance (ESR) measurements often model an electron as large as a benzene ring. A point-like electron would predict a smeared-out ESR spectrum. Carver Mead argued for an extended electron **[18]**.

The threshold model, supported by the unquantum effect, easily resolves the enigma of the double-slit experiment. A light-wave (or matter-wave) would load up, and show itself upon reaching a threshold with a click. The only conceptually difficult aspect of this theory is that there must be sufficient detail in a spreading matter-wave to encode for an identifiable element to load up upon absorption. This is not too difficult to imagine for elemental-waves (atoms), but we predict that complicated molecules will not load-up. Our alpha-ray test demonstrates how our threshold model applies to historical interference and diffraction tests with charge-waves (electrons), neutron matter-waves (neutrons), and elemental matter-waves (atoms) **[19, 20]**. Consistent with our threshold model is a recent helium diffraction experiment that revealed both particle and wave signatures in its diffraction pattern **[21]**. The matter-wave reads like a soliton that can either hold itself together in a particle state or spread like a wave. This is subtly different from complementarity, whereby the state depends on how one looks at the experiment.

RECENT EXPERIMENTS OF OTHERS

To challenge entanglement is to show that its key experiments are flawed. We examine two examples, two well known tests, one using light and one using matter.

Recall the popular work by Aspect and team **[5]** that convinced mainstream publishers that the world is ruled by spooky entanglement. They used an atomic beam stimulated by a laser to emit pairs of "photons." Clicks behind polarizers are reported



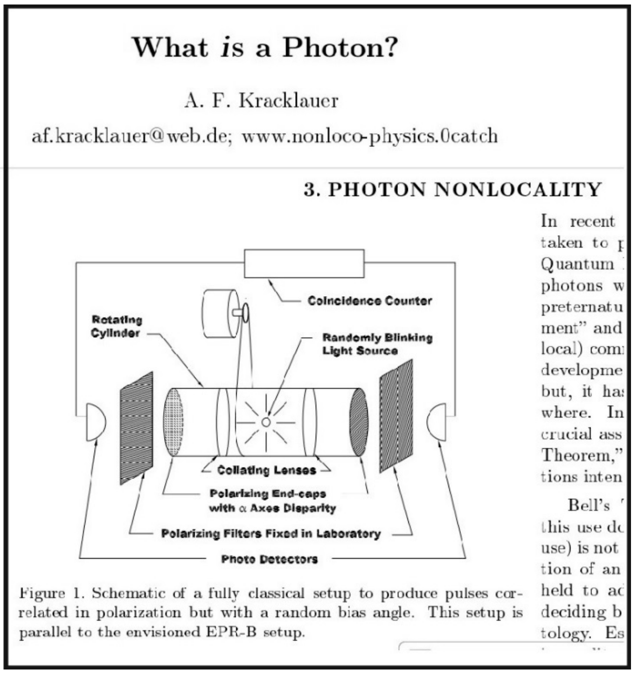
Volume 47, Number 7 PHYSICAL REVIEW LETTERS 17 August 1981

Experimental Tests of Realistic Local Theories via Bell's Theorem

Alain Aspect, Philippe Grangier, and Gérard Roger
Institut d'Optique Théorique et Appliquée, Université Paris-Sud, F-91406 Orsay, France
(Received 30 March 1981)

FIG. 4. Normalized coincidence rate as a function of the relative polarizer orientation. Indicated errors are ±1 standard deviation. The solid curve is not a fit to the data but the prediction of quantum mechanics.

Figure 2. Data from **[5]** PRL 47, pg 460 (1981), Aspect, "Experimental Tests of Realistic Local Theories via Bell's Theorem."



What *is* a Photon?

A. F. Kracklauer
af.kracklauer@web.de; www.nonloco-physics.0catch

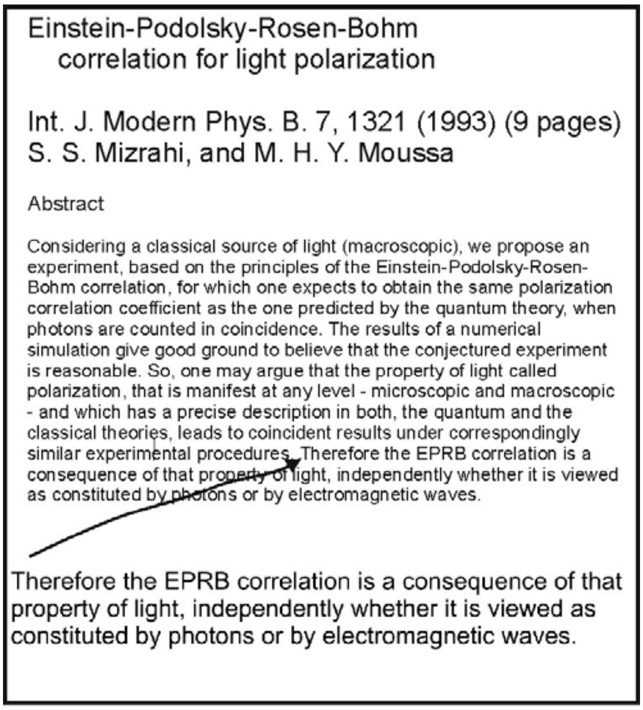
3. PHOTON NONLOCALITY

Figure 1. Schematic of a fully classical setup to produce pulses correlated in polarization but with a random bias angle. This setup is parallel to the envisioned EPR-B setup.

In recent
taken to
Quantum
photons w
preternatu
ment" and
local) com
developme
but, it ha
where. In
crucial ass
Theorem,"
tions inten

Bell's
this use d
use) is not
tion of an
held to ac
deciding b
tology. Es

Figure 3. Excerpt from Kracklauer, SPIE paper [22].



Einstein-Podolsky-Rosen-Bohm
correlation for light polarization

Int. J. Modern Phys. B. 7, 1321 (1993) (9 pages)
S. S. Mizrahi, and M. H. Y. Moussa

Abstract

Considering a classical source of light (macroscopic), we propose an experiment, based on the principles of the Einstein-Podolsky-Rosen-Bohm correlation, for which one expects to obtain the same polarization correlation coefficient as the one predicted by the quantum theory, when photons are counted in coincidence. The results of a numerical simulation give good ground to believe that the conjectured experiment is reasonable. So, one may argue that the property of light called polarization, that is manifest at any level - microscopic and macroscopic - and which has a precise description in both, the quantum and the classical theories, leads to coincident results under correspondingly similar experimental procedures. Therefore the EPRB correlation is a consequence of that property of light, independently whether it is viewed as constituted by photons or by electromagnetic waves.

Therefore the EPRB correlation is a consequence of that property of light, independently whether it is viewed as constituted by photons or by electromagnetic waves.

Figure 4. The experiment quoted in Kracklauer [23].

to correlate in a way that defies classical interpretation. They did not tell you that their laser delivers polarized light. The atoms in the beam are known to emit in a two-$h\nu$ cascade. Therefore, we expect emission to be in polarization-correlated $h\nu$ pairs. We claim our $h\nu$ is emitted in an initially-quantized directed burst, but thereafter this energy will spread classically. Their data is in **figure 2**. This graph is expected from Malus's law and classical polarized light as a function of angle (nothing weird here). Indeed, other authors agree, see **figures 3 and 4**.

An article in Nature received much attention for claiming that giant molecules, emitted one-at-a-time, will add up to a diffraction pattern **[24]**. It is a far stretch to imagine how such a thing can be true, by either QM or TM. We acknowledge that their diffraction roughly fits the de Broglie equation ($\lambda = d \sin \theta = h/mv$). It is more reasonable to expect these molecules are casting mere shadow patterns that are magnified by static electric fields. Electric field effects, the most obvious source of artefact, were not addressed. We have identified and posted four striking anomalies (see **Appendix III**) that require explanation: (1) there is insufficient velocity resolution in their model to prevent their fringe widths from being blurred-out to twice as wide, (2) fringe orders have the wrong relative intensities, (3) there is a large mismatch upon applying $d = ½ g t^2$ = (dist of particle fall) = ½(acceleration of gravity)(distance particle travels/velocity)^2 to their data, and (4) their movie-data shows a sharp-edge fringe intensity profile that is characteristic of a shadow pattern. Crucial control tests addressing electric fields are required before taking their message seriously. A graphic from this Nature article and detailed calculations in a letter to its author are shown.

CONCLUSION

Entanglement is an illusion of the threshold and ratio properties of charge, action and mass. Much elaboration upon experiment and theory outlined here has been developed; please see http://www.thresholdmodel.com. Visitors are welcome to my laboratory in Pacifica CA to witness or adjust an experiment.

APPENDIX I, THE GAMMA-RAY UNQUANTUM EXPERIMENT **[8, 9]**

After spontaneous decay by electron capture, ^{109}Cd becomes stable ^{109}Ag. ^{109}Cd also emits an x-ray, far below the lower level of our discriminator (LL). Chance is immediately recognized by a flat band of noise on a time-difference histogram (Δt), and its rate can be measured by **[7]**

$$R_C = R_1 R_2 \tau ,$$

where R_1 and R_2 are the singles rates from each detector, and τ is the chosen time window within which coincident events are counted from the Δt histogram. Later we will compare this to the experimental chance rate R_e to see how they differ.

To assure that the unquantum effect was not generated by background, several all-night and all-day tests with and without the source were examined. Recent tests were performed with two detectors, each consisting of a NaI(Tℓ) scintillator crystal coupled to a PMT. Detector #1 was a custom-made thin detector, at 4 mm thick, and is shown in **figure 5**. Behind the thin detector was thick detector #2, a 1.5" Bicron. We call this thin-thick detector arrangement, tandem geometry. The thin detector serves to tap away a component of an emitted gamma-ray, similar to a beam-split geometry. Two 10 μCi check-sources of ^{109}Cd were inside a Pb box of 1/4” walls with a 1/4” diameter hole and a 1/8” square tungsten aperture. The aperture was designed to optimize how the cone of emitted gamma fits the larger detector #2.

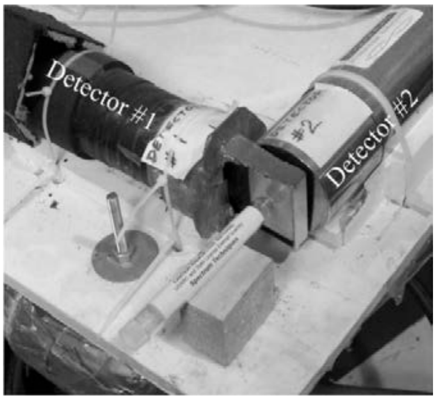


Figure 5. Two sodium iodide gamma-ray detectors in tandem geometry. Detector #1 is a custom-made 4 mm thick slab.

Poor collimator design has often delivered *chance*. The test was performed inside a lead shield lined with tin and copper; this lowered our singles background rate to 1/31. The coincidence background rate remained a significant fraction that must be subtracted.

Referring to **figure 6**, components for each of the two detector channels are an Ortec 471 amplifier, an Ortec 551 SCA, and an HP 5334 counter for singles rates (not shown). A four channel LeCroy LT264 digital storage oscilloscope (DSO) with histogram software, monitored the analog pulses from each amplifier on DSO channels (1) and (2). DSO also monitored SCA timing pulses at channels (3) and (4). The stored image of each triggered pulse shows well-behaved pulses to assure that noise and pulse-overlap were not a factor. This DSO can update pulse-heights, (A)(B), and time-difference Δt (C) histograms after each "qualified"-triggered sweep. To assure exceeding *particle-energy conservation*, LL on each SCA window was set to at least 2/3 of the ^{109}Cd 88 keV gamma characteristic pulse-height.

A coincidence background test with no source present had 304 counts/49.4ks = 0.00615/s, a rate to be subtracted. Within the same time-window τ, taken as 200 ns, the chance rate from Eq. 1 was R_c = (8.21/s)(269/s)(200 ns) = 0.000442/s. The experimental coincidence rate within τ was R_e = (101/4.59ks) – (0.00615/s) = 0.0158/s. The unquantum effect was R_e/R_c = 0.0158/0.000442 = 35.7 times greater than chance.

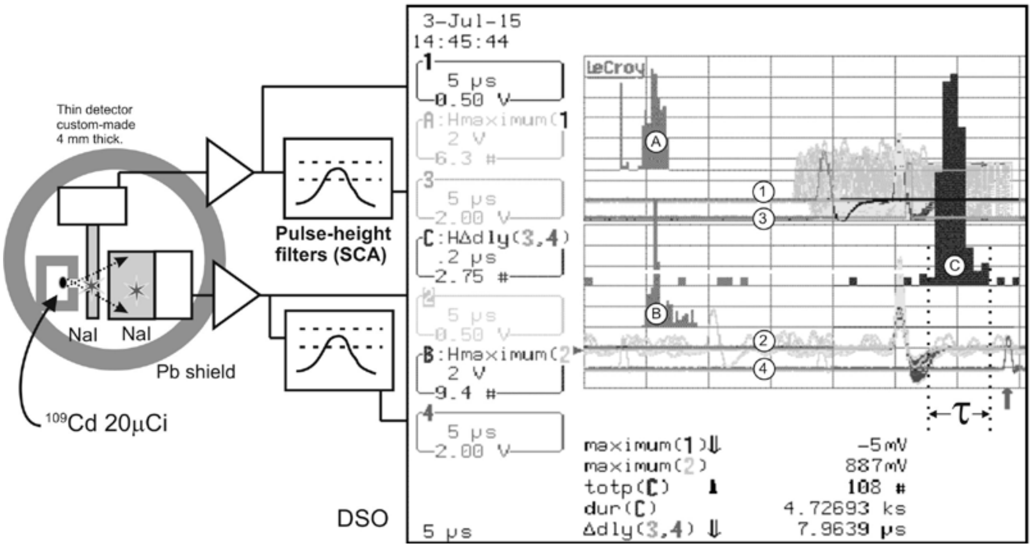


Figure 6. Gamma-ray experiment in tandem geometry using ^{109}Cd. Counters and computer interfaces are not shown. DSO screen is annotated.

APPENDIX II. THE ALPHA-RAY UNQUANTUM EXPERIMENT [8, 10]

Americium-241 in spontaneous decay emits a single 5.5 MeV alpha-ray and a 59.6 keV gamma. An alpha is known as a helium nucleus. Two silicon Ortec surface barrier detectors with adequate pulse-height resolution were employed in a circuit nearly identical to that used in **figure 6**. **Figure 7** shows the detectors and pre-amplifiers in a vacuum chamber. These tests were performed under computer (CPU) control by a program written in QUICKBASIC to interact with the DSO through a GPIB interface. Here, both SCA LL settings were set to only 1/3 the characteristic pulse-height because it was found that an alpha-split usually, but not always, maintains particle-energy conservation. By this, we mean that the "energy" read from the two detectors in coincidence usually adds to the emitted 5.5 MeV. The coincidence time-window was τ = 100 ns. The Δt histograms of **figure 8** were from DSO screen captures.

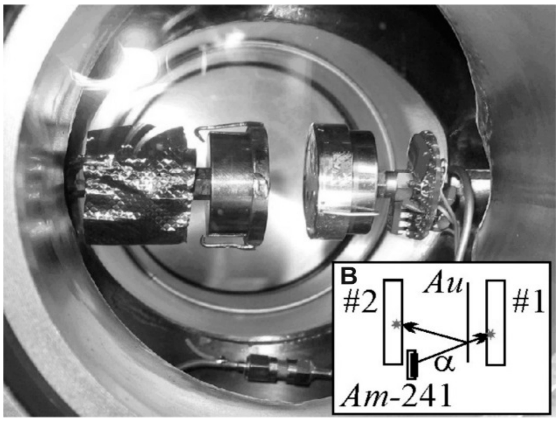


Figure 7. Alpha-ray experiment.

Data of **figure 8-a** was a two-hour true-coincidence control test with the two detectors at right angles to each other and with the ^{241}Am centrally located. Only the chance rate was measured, assuring that only one alpha was emitted at a time. 4π solid angle capture was not attempted because it requires a specially made thin source. However, the right angle arrangement is adequate, and it is well known how ^{241}Am decays. Any sign of a peak is a quick way to see if chance is exceeded. A background coincidence test of 48 hours with no source present gave a zero count.

Data of **figure 8-b** taken Nov. 13, 2006 was from the arrangement of **figure 7**

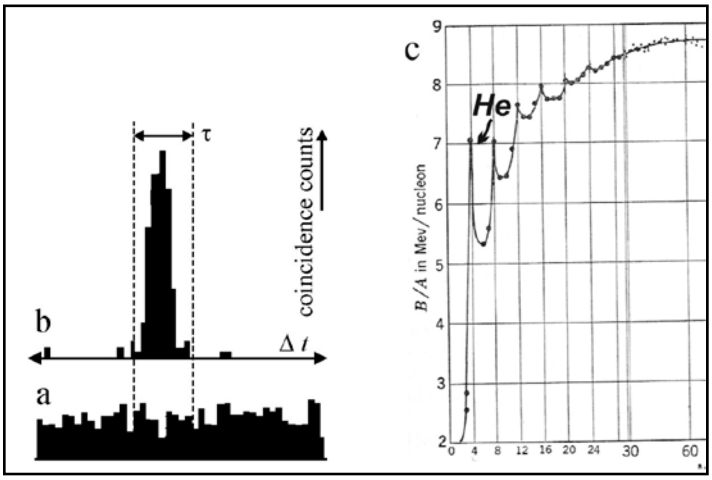


Figure 8. **a**: true-coincidence histogram. **b**: beam-split coincidence histogram. **c**: binding-energy per nucleon **[25]**.

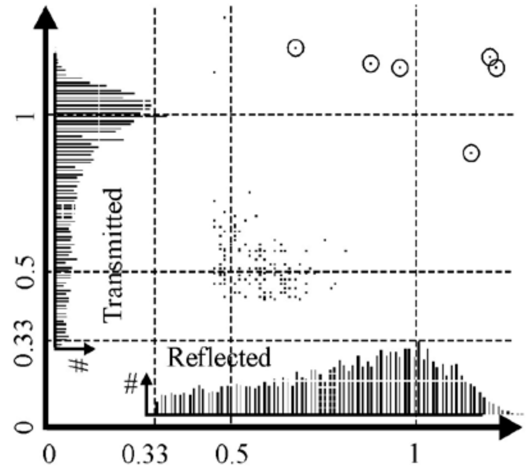


Figure 9. The computer controlled experiment of **figure 8** with pulse-height pairs of each detector plotted X-Y.

using two layers of 24 carat gold leaf suspended over the front of detector #1. Mounted at the rim of detector #2 were six 1μCi ^{241}Am sources facing detector #1 and shaded from detector #2. Every coincident pulse-pair was perfectly shaped. $R_C = 9.8 \times 10^{-6}$/s, and $R_e/R_C = 105$ times greater than chance.

From the CPU program and data used in the test of **figure 8-b**, data is re-plotted in **figure 9**. **Figure 9** depicts each pulse-height as a dot on a two dimensional graph to show coincident pulse-heights from both detectors. The transmitted and reflected pulse-height singles spectra were carefully pasted into the figure. We can see that most of the alpha pulses (dots) are near the half-height marks, demonstrating particle-energy conservation. However, the six dots circled clearly exceed particle-energy conservation. Counting just these 6, we still exceed chance: $R_e/R_C = 3.97$. This is a sensational contradiction of QM because it circumvents the argument that a particle-like split, such as splitting into two deuterons, is somehow still at play. Several other materials were tested in transmission and reflection geometries to reveal the usefulness of this matter-wave unquantum effect in material science. It is not necessary to use gold to exceed chance. However, many materials tested just delivered a chance rate.

APPENDIX III

On, 22.05.2012, 01:54, Eric Reiter wrote:

Dear Dr Juffmann

Regarding your recent article, “Real-time single-molecule imaging of quantum interference,” I have performed calculations on your data that do not make sense to me.

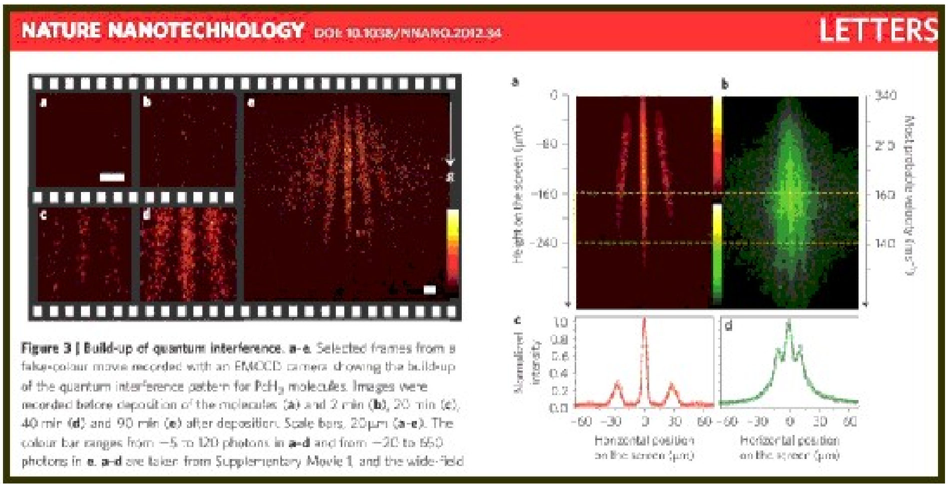
1) Let’s calculate the fall of a particle. We can use (1/2)gt^2, where t = time = distance/velocity. For a fast particle Hfast = (9.8/2)(2m/340m/s)^2 = 169×10^-6 meters. For a slow particle Hslow = (9.8/2)(2m/140m/s)^2= 1×10^-3 meters. Hslow – Hfast = 830 micrometers. But you show only 240 micrometers. Therefore the difference in falls should be 3.4 times larger than you show.

2) I used a multiple slit diffraction simulation tool to test what the intensity profiles should be. I found your first order fringes were a few times brighter than they should be for the given wavelength/slit-width and wavelength/slit-spacing ratios. The tool I used is http://wyant.optics.arizona.edu/multipleSlits/multipleSlits.htm.

Though this tool has fewer slits than yours, I found this did not change the intensity ratios.

3) Given the dimensions of your instrument, the velocity resolution should cover 0.43 of the sensor plane by the following calculation: The slit height is 100 micrometers, and the projection to the sensor plane should make this 2/(2 – 0.56) larger, that is 138 micrometers at the sensor plane. But the sensor plane is 320 micrometers high. Since 138/320 = 0.43, a particle of any given velocity could land anywhere in a vertical segment of height that is 0.43 of the screen height. So the first order fringes should have been very noticeably widened as the fringes descend, by this apparently poor velocity resolution.

4) In the published movies of the detector plane, the intensity profiles of the fringes have edges that seem to rise and fall too abruptly. Also, the intensity profile of each fringe, especially the central fringe, in the movie looks flat. Fringes should have peak-like



NATURE NANOTECHNOLOGY DOI: 10.1038/NNANO.2012.34 **LETTERS**

Figure 3 | Build-up of quantum interference. a–e, Selected frames from a false-colour movie recorded with an EMCCD camera showing the build-up of the quantum interference pattern for PcH$_2$ molecules. Images were recorded before deposition of the molecules (**a**) and 2 min (**b**), 20 min (**c**), 40 min (**d**) and 90 min (**e**) after deposition. Scale bars, 20µm (**a–e**). The colour bar ranges from −5 to 120 photons in **a–d** and from −20 to 650 photons in **e**. **a–d** are taken from Supplementary Movie 1, and the wide-field profiles.

Unless I have made several silly errors, there is something going on other than quantum interference. Please consider a control test to eliminate the possibility that you are looking at a shadow pattern that has been magnified by a charge deflection effect at the slits. It would be very easy for the slits to become charged to deflect dye particles in a manner similar to a cylindrical lens. A simple test would be to introduce a voltage control wire to the slits. An even simpler test would be to shade half of the slit array to see if a half side of the fringe pattern disappears. Whether or not a focus effect was like a positive or negative lens, half of the fringe pattern would disappear. A focused shadow would explain the anomalies I point out.

Thank you for your consideration and I hope to hear from you.

Eric S Reiter.

REFERENCES

[1] Schrödinger E, [The Interpretation of Quantum Mechanics] Ox Bow Press,Woodbridge, CN (1995).

[2] Schrödinger E, “Discussion of Probability Relations between Separated Systems,” Mathematical Proceedings of the Cambridge Philosophical Society, Volume 31, Issue 04, October 1935, pp 555-563.

[3] Schrödinger E., “The Present Situation in Quantum Mechanics” (Schrödinger's cat paper), Proceedings of the American Philosophical Society, 124, 323-338 (1980).

[4] Einstein, Podolsky Rosen, “Can Quantum Mechanical Description of Reality be Considered Complete?” Phys Rev 47, 777-780 (1935).

[5] Aspect A., “Experimental Tests of Realistic Local Theories via Bell's Theorm,” Physical Review Letters 47 pg 460-463 (1981).

[6] Brannen E., Ferguson H., “The question of correlation between photons in coherent light rays,” Nature, 4531, 481- 482 (1956).

Clauser J. F., “Experimental distinction between the quantum and classical field theoretic predictions for the photoelectric effect,” Physical Review, D9, 853-860 (1974).

Grainger P., Roger G., Aspect A., “A new light on single photon interferences.“ Annals of the New York Academy of Sciences, 480, 98-107 (1986).

Givens M.P., “An experimental study of the quantum nature of x-rays,” Philosophical Magazine, 37, 335-346 (1946). This test was done with x-rays.

[7] Knoll G., [Radiation Detection and Measurement], (1979). Also, for the chance equation see Melissinos, [Experiments in Modern Physics] (1966) Pg 407.

[8] Reiter, E., "New Experiments call for a Continuous Absorption Alternative to the Photon Model," Proceedings of the SPIE 2015 What are Photons?, available on http://www.thresholdmodel.com.

[9] Reiter, E., "Photon Violation Spectroscopy," available on http://www.thresholdmodel.com.

[10] Reiter, E., "Particle Violation Spectroscopy," available on http://www.thresholdmodel.com.

[11] N. Bohr, H. A. Kramers, J. C. Slater, "The Quantum Theory of Radiation", in Sources of Quantum Mechanics, B. L. Van Der Waerden, ed. (Dover, New York, 1967); Phil. Mag. 47, 785 (1924); Zeits. f. Phys. 24, 69 (1924).

[12] Reiter, E, "An Understanding of the Particle-Like Property of Light and Charge," available on http://www.thresholdmodel.com.

[13] Kuhn T. S., [Black-Body Theory and the Quantum Discontinuity 1894–1912], Oxford University Press, 235-264 (1978).

[14] Whittaker E., [History of Theories of Aether and Electricity 1900-1926], 103 (1953).

[15] Wheaton B. R., [The Tiger and the Shark] (1983).

[16] Millikan R.A., [Electrons (+ and –) Protons Photons Neutrons Mesotrons and Cosmic Rays], University of Chicago Press, revised edition, 253 (1947).

[17] Bohr N., [Atomic Physics and Human Knowledge], John Wiley and Sons Inc, New York, pg 50-51 (1958).

[18] Carver Mead SPIE keynote talk 2013, http://natureoflight.org/?mpage=conf&spage=conf-2013#keynote

[19] Estermann I., Frisch R., Stern O., "Monochromasierung der de Broglie-Wellen von Molekularstrahlen," Zeitschrift fur Physik, A73, 348-365 (1932).

[20] Berman P. R., [Atom Interferometry], Academic Press (1997).

[21] Doak R. et al, "Towards realization of an atomic de Broglie microscope: helium atom focusing using Fresnel zone plates," Phys. Rev. Letters, 83 (21), 4229-4232 (1999).

[22] Kracklauer A. F., "What are Photons," Proc. of SPIE vol 9570 (2015). Available at www.nonloco.com

[23] Mizrahi S. S, Moussa H. Y., "Einstein-Rosen-Pedolsky-Bohm Correlation for Light Polarization," Intl J Modern Physics B, pg 1321 (1993).

[24] Juffmann T., "Real-time single-molecule imaging of quantum interference," Nature Nanotechnology, 7, pg 297-300 (2012).
[25] Evans R., [The Atomic Nucleus], 717 (1955).