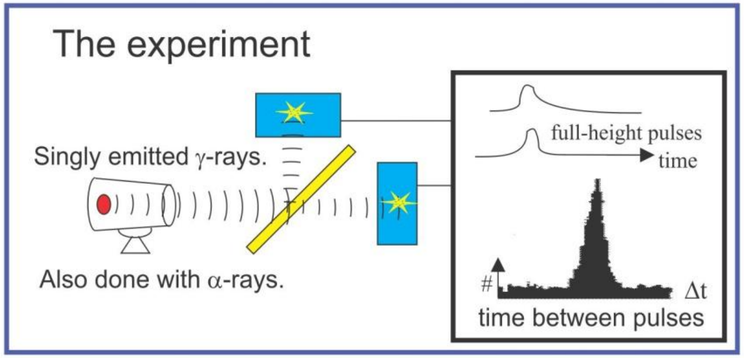
A Serious Challenge to Quantum Mechanics, Theory, Part 3. History, experiments, and applications are here also.

Washington Quantum Computing Meetup, November 16, 2024, 10 AM PST

Eric Stanley Reiter

Please download and read this PDF for best understanding.



Serious Challenge to QM, Experiments Part 1
Click for slides PDF.

Lecture video

Serious Challenge to QM, History, Part 2
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Lecture video

Serious Challenge to QM, Theory, Part 3
Click for slides PDF.

Everything from *ER* is at website:

https://www.thresholdmodel.com

Please note slide number for question session.

ratios beats thresholds

Theory preview.

These properties of the matter wave,
thresholds beats ratios , were identified from past experiments.

We applied these properties to our constants,

$$e,\ \ h,\ \ m,$$

and fundamental equations,

$$E = h\nu = eV \text{ and } p = h/\lambda.$$

The model predicted new experiments that worked and contradicted QM.

We call it *Threshold Model*.

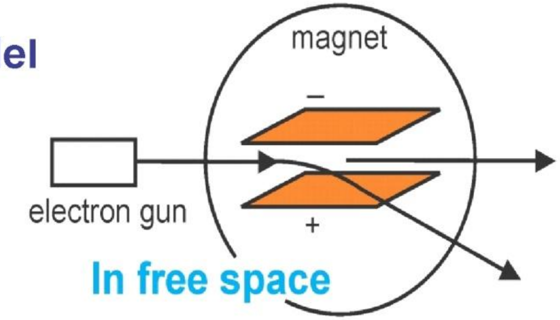
Before wave effects were discovered, a particle/field model worked fine.

1897 JJ Thomson **assumed a particle model** in experiment and theory to reveal

e/m ratio

by Lorentz force.

Best reference is *The Electron*, Millikan 1917.

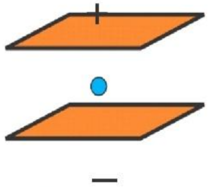


In free space

1898 Townsend and JJ balanced Liquid drops to reveal the charge constant

e

balance liquid drops against gravity



In bulk matter

Our threshold model will explain these great experiments with wave properties.

Spoiler alert: e <u>looks</u> quantized by an ensemble effect. e, and m are constants that express thresholds of charge and mass. The message of the e/m experiment is the ratio, not that it is a particle of e and m going across space.

1900 Planck

Contrary to popular accounts, the energy of Planck’s resonators was in matter,

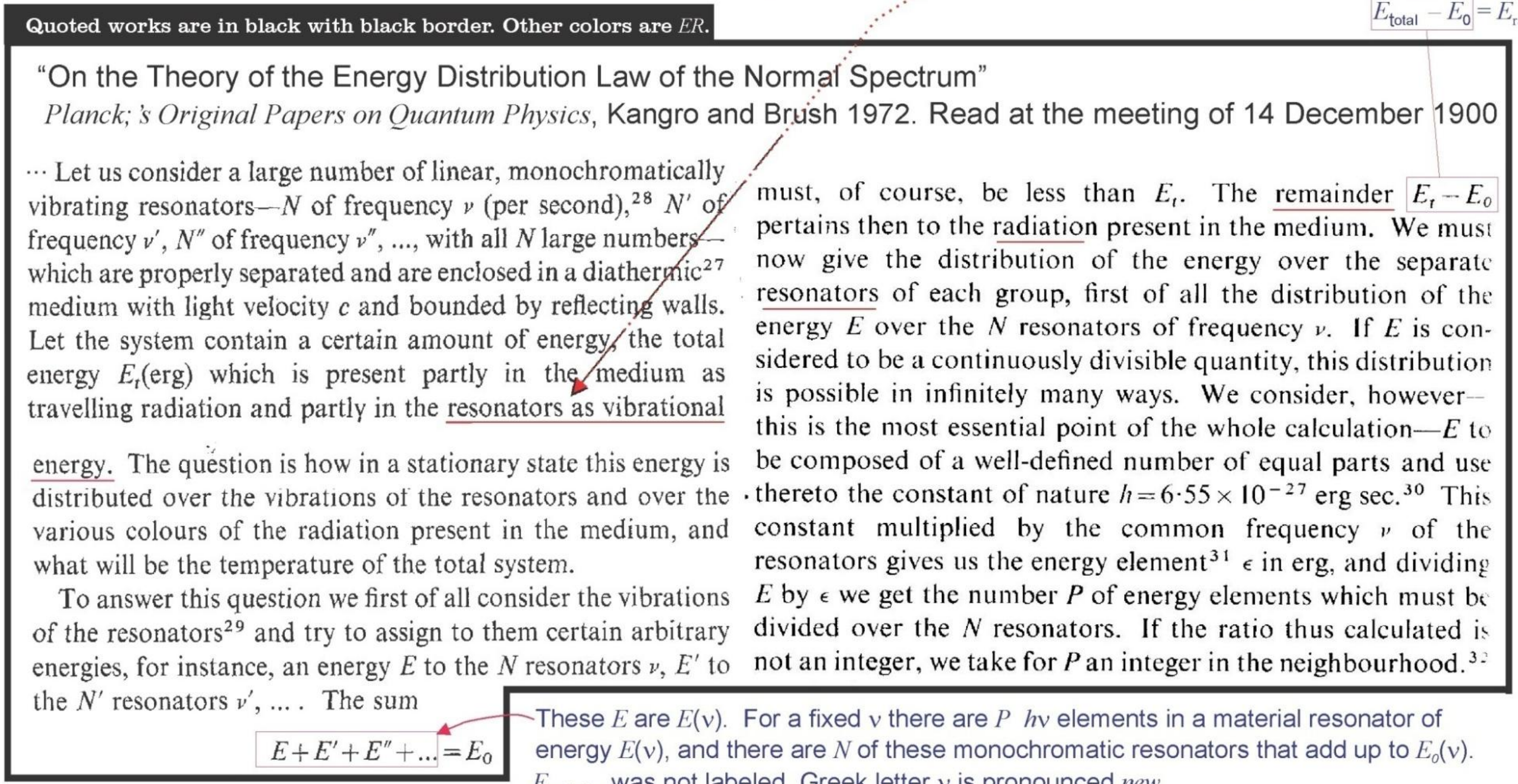
not light,
not energy itself,
not energy exchange.

He identified energy resonators with a light component $E_{\text{radiation}}$ and a matter component E_0. He discarded the light component. The remaining matter component was used to find energy elements $\epsilon = h\nu$.

Therefore, quantized action at h was a property of matter, not light, in this highly quoted paper.

Quoted works are in black with black border. Other colors are *ER*.

$E_{\text{total}} - E_0 = E_{\text{radiation}}$



“On the Theory of the Energy Distribution Law of the Normal Spectrum”
Planck; 's Original Papers on Quantum Physics, Kangro and Brush 1972. Read at the meeting of 14 December 1900

··· Let us consider a large number of linear, monochromatically vibrating resonators—N of frequency ν (per second),[28] N' of frequency ν', N'' of frequency ν'', ..., with all N large numbers—which are properly separated and are enclosed in a diathermic[27] medium with light velocity c and bounded by reflecting walls. Let the system contain a certain amount of energy, the total energy E_t(erg) which is present partly in the medium as travelling radiation and partly in the resonators as vibrational energy. The question is how in a stationary state this energy is distributed over the vibrations of the resonators and over the various colours of the radiation present in the medium, and what will be the temperature of the total system.

To answer this question we first of all consider the vibrations of the resonators[29] and try to assign to them certain arbitrary energies, for instance, an energy E to the N resonators ν, E' to the N' resonators ν', ... The sum

$$E + E' + E'' + \ldots = E_0$$

must, of course, be less than E_t. The remainder $E_t - E_0$ pertains then to the radiation present in the medium. We must now give the distribution of the energy over the separate resonators of each group, first of all the distribution of the energy E over the N resonators of frequency ν. If E is considered to be a continuously divisible quantity, this distribution is possible in infinitely many ways. We consider, however—this is the most essential point of the whole calculation—E to be composed of a well-defined number of equal parts and use thereto the constant of nature $h = 6{\cdot}55 \times 10^{-27}$ erg sec.[30] This constant multiplied by the common frequency ν of the resonators gives us the energy element[31] ϵ in erg, and dividing E by ϵ we get the number P of energy elements which must be divided over the N resonators. If the ratio thus calculated is not an integer, we take for P an integer in the neighbourhood.[32]

resonators
in matter

These E are $E(\nu)$. For a fixed ν there are P $h\nu$ elements in a material resonator of energy $E(\nu)$, and there are N of these monochromatic resonators that add up to $E_0(\nu)$. $E_{\text{radiation}}$ was not labeled. Greek letter ν is pronounced *new*.

He derived and quantified his constant in an earlier 1900 paper but it was not labeled h. “Uber irreversible Strahlungsvortrange” Ann d Phys (4) S, 69-122, see paragraph 25, in Physikalische vol 1, pg 665.

1905 Einstein hypothesized energy quantization.

A. Einstein, *Ann. Phys*. 17, 132 1905 “Concerning an Heuristic Point of View Toward the Emission and Transformation of Light” 17 March 1905. Translated in *American Journal of Physics*, v. 33, n. 5, May 1965.

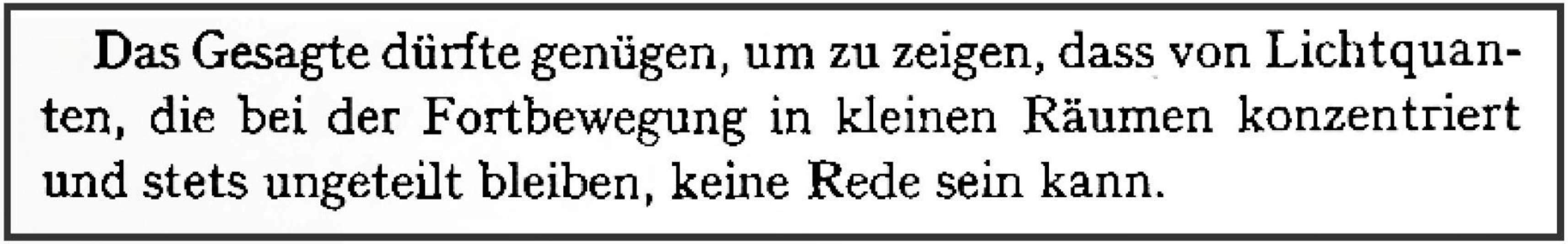
It seems to me that the observations associated with blackbody radiation, fluorescence, the production of cathode rays by ultraviolet light, and other related phenomena connected with the emission or transformation of light are more readily understood if one assumes that the energy of light is discontinuously distributed in space. In accordance with the assumption to be considered here, the energy of a light ray spreading out from a point source is not continuously distributed over an increasing space but consists of a finite number of energy quanta which are localized at points in space, which move without dividing, and which can only be produced and absorbed as complete units.

threshold model uses only this part

He quoted Planck 1900, but derived $E = h\nu$ his own way to quantize energy itself. His notation was different but simplifies to $E = h\nu$.
He quoted the experiment of Lenard 1902.
He then used his $E = h\nu$ and the particle model to write a photoelectric effect equation.
Others tested the photoelectric effect equation and found it correct. Many objected to energy quantization.

1910 Lorentz
“Die Hypothese der lichtquanten”

P. Zeit. 1910 page 349.



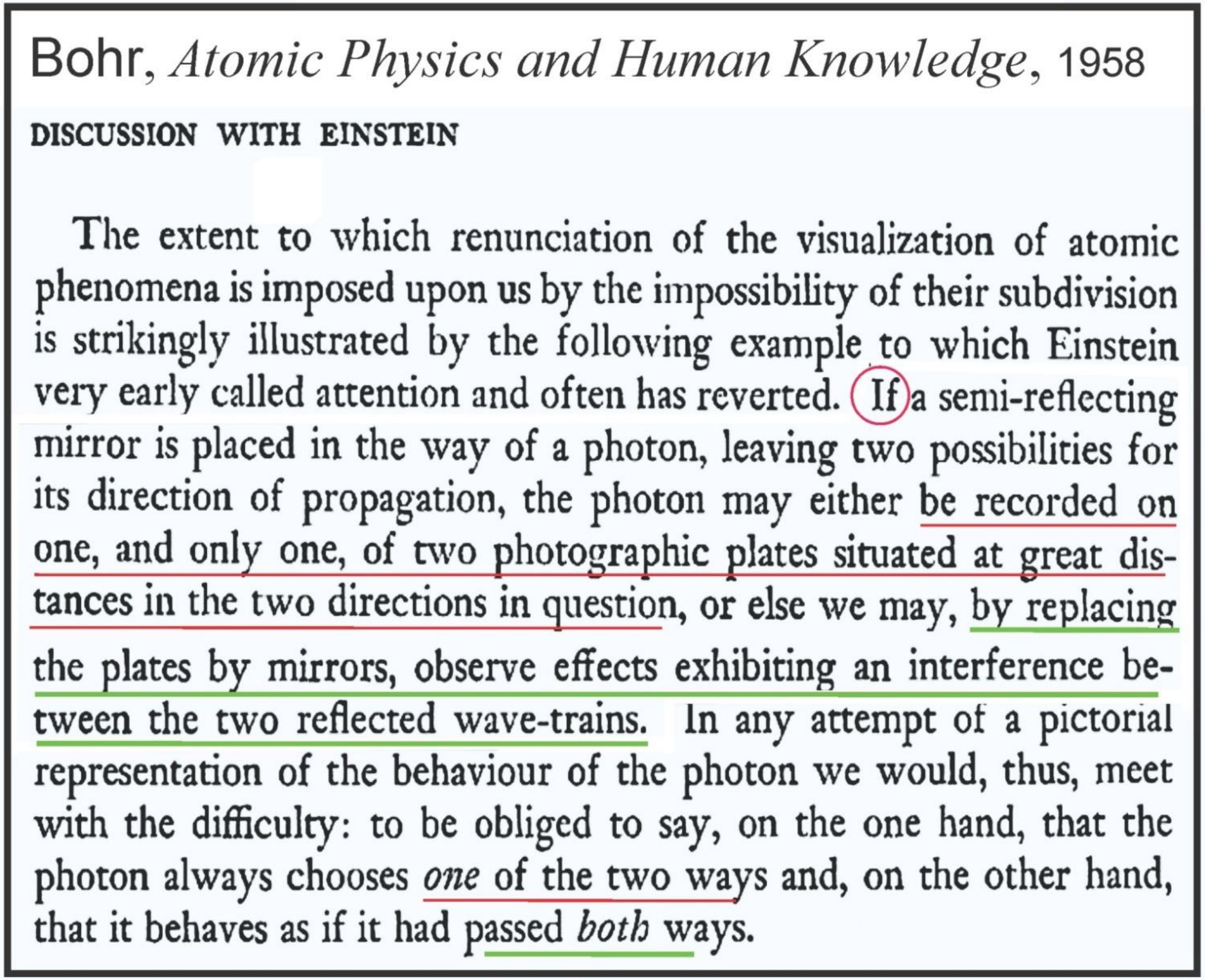
Das Gesagte dürfte genügen, um zu zeigen, dass von Lichtquanten, die bei der Fortbewegung in kleinen Räumen konzentriert und stets ungeteilt bleiben, keine Rede sein kann.

"The preceding discussion should suffice to show that one cannot speak of a light quantum that remains undivided and spatially concentrated."

Similar opinions were expressed by
Planck, JJ Thomson, OW Richardson, Sommerfeld, Debye, and Millikan.

Photon model has two parts.

QM uses this model for all "QM particles."



Bohr, *Atomic Physics and Human Knowledge*, 1958

DISCUSSION WITH EINSTEIN

The extent to which renunciation of the visualization of atomic phenomena is imposed upon us by the impossibility of their subdivision is strikingly illustrated by the following example to which Einstein very early called attention and often has reverted. If a semi-reflecting mirror is placed in the way of a photon, leaving two possibilities for its direction of propagation, the photon may either be recorded on one, and only one, of two photographic plates situated at great distances in the two directions in question, or else we may, by replacing the plates by mirrors, observe effects exhibiting an interference between the two reflected wave-trains. In any attempt of a pictorial representation of the behaviour of the photon we would, thus, meet with the difficulty: to be obliged to say, on the one hand, that the photon always chooses *one* of the two ways and, on the other hand, that it behaves as if it had passed *both* ways.

impossible to visualize

quantum mechanics
in one sentence

the particle part

the wave part

the particle part

the wave part

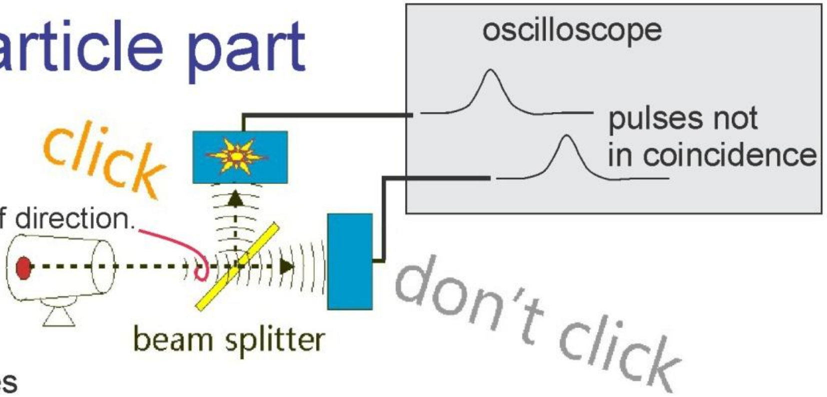
Consequently, confusion is avoided by: "photon" is a model, not a thing.

Many experiments employ this model, assuming it to be true.

Einstein’s photon model has two parts

Experimental depiction of the model. Described in books by Bohr, Heisenberg, and de Broglie.

the particle part



Probability of direction.
Not a path.

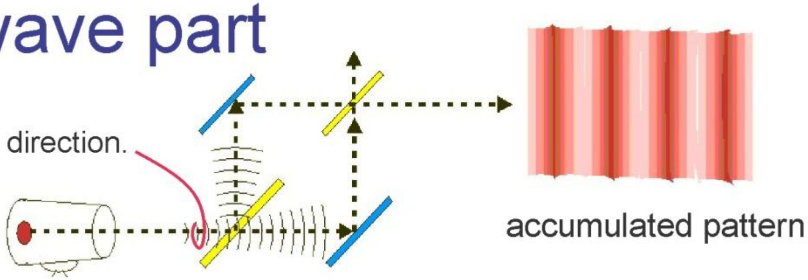
Single $h\nu$
light sources
were attempted
by attenuation, atomic beam,
triple coincidence, and parametric down conversion.

All $h\nu$ detectors make pulses.
They say a photon made the pulse.

If energy is quantized,
one $h\nu$ emitted should land at
only one detector.

A beam-split coincidence test.

the wave part



Probability of direction.
Not a path.

same source

An interference pattern
indicates that wave energy
traveled **both** paths, even
from a singly emitting $h\nu$
source.

QM applies this model to both matter and light.

We will show how the particle part of the photon model fails.

1930 Heisenberg, *Quantum Theory*.

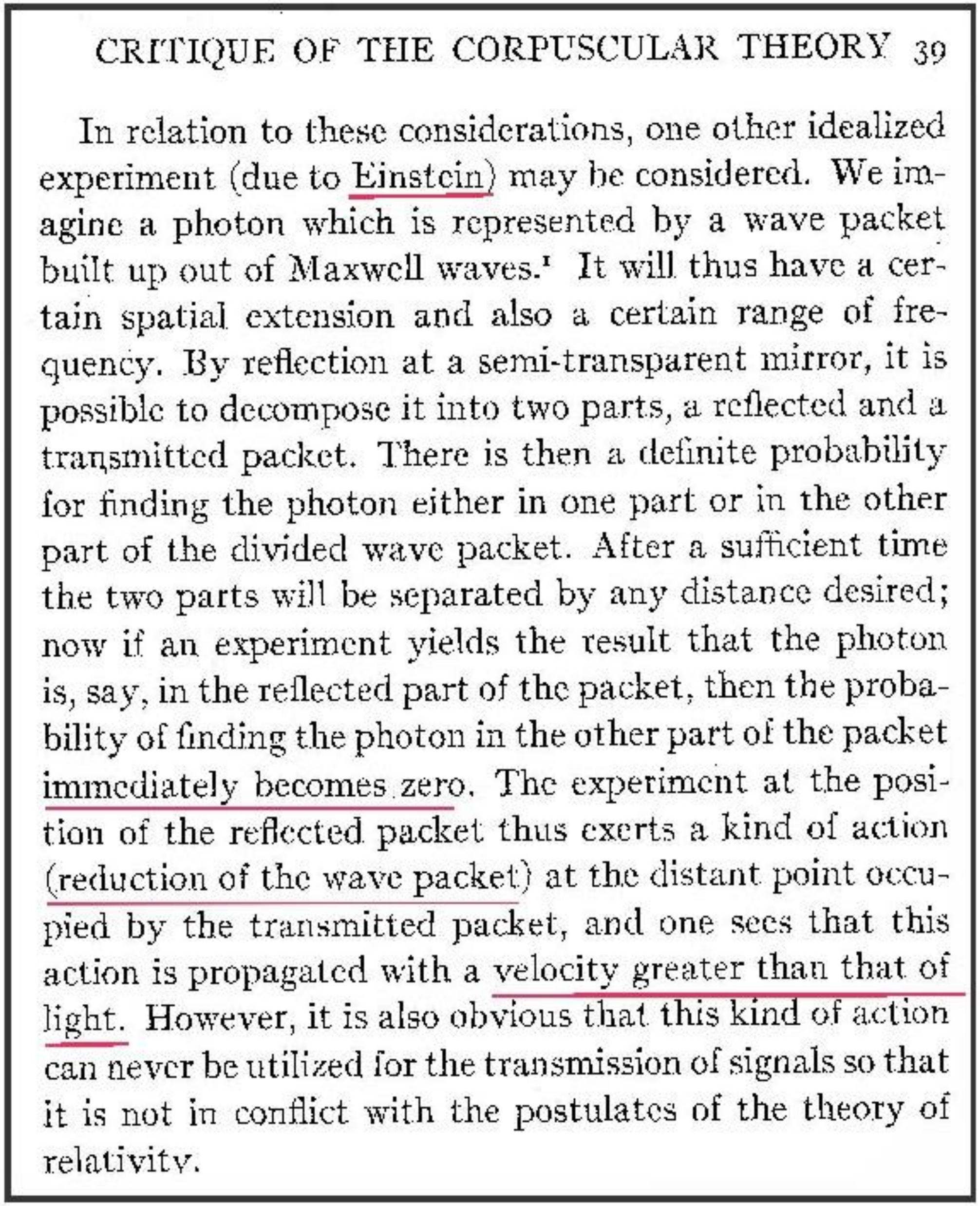
Einstein's photon model implies:

- Wave-function collapse,
- wave-particle duality,
- entanglement,
- measurement problem,
- superposition,
- non-physical probability wave,
- quantum weirdness, and
- quantum mechanics itself.

We hear desperate interpretations like these:

- pilot waves,
- many worlds,
- holographic universe,
- superdeterminism,
- we are in a computer simulation,
- all connected by strings,
- retrocausality,
- denial of realism,
- shut-up and calculate.

Click to see "Heisenberg's Introduction of the 'Collapse of the Wavepacket' into Quantum Mechanics"
Raymond Y. Chiao and Paul G. Kwiat. *Fortschr. Phys.* 50 (2002) 5—7, 614 — 623
https://sci-hub.se/10.1002/1521-3978(200205)50:5/7%3C614::AID-PROP614%3E3.0.CO;2-R
These physicists performed beam-split coincidence tests with visible light, similar to others shown below.



CRITIQUE OF THE CORPUSCULAR THEORY 39

In relation to these considerations, one other idealized experiment (due to Einstein) may be considered. We imagine a photon which is represented by a wave packet built up out of Maxwell waves.[1] It will thus have a certain spatial extension and also a certain range of frequency. By reflection at a semi-transparent mirror, it is possible to decompose it into two parts, a reflected and a transmitted packet. There is then a definite probability for finding the photon either in one part or in the other part of the divided wave packet. After a sufficient time the two parts will be separated by any distance desired; now if an experiment yields the result that the photon is, say, in the reflected part of the packet, then the probability of finding the photon in the other part of the packet immediately becomes zero. The experiment at the position of the reflected packet thus exerts a kind of action (reduction of the wave packet) at the distant point occupied by the transmitted packet, and one sees that this action is propagated with a velocity greater than that of light. However, it is also obvious that this kind of action can never be utilized for the transmission of signals so that it is not in conflict with the postulates of the theory of relativity.

1911 Planck I build upon Planck's second theory*

Described in Dover Book *Theory of Heat Radiation*, 1959 page 161.
Original papers from 1911 and 1912.

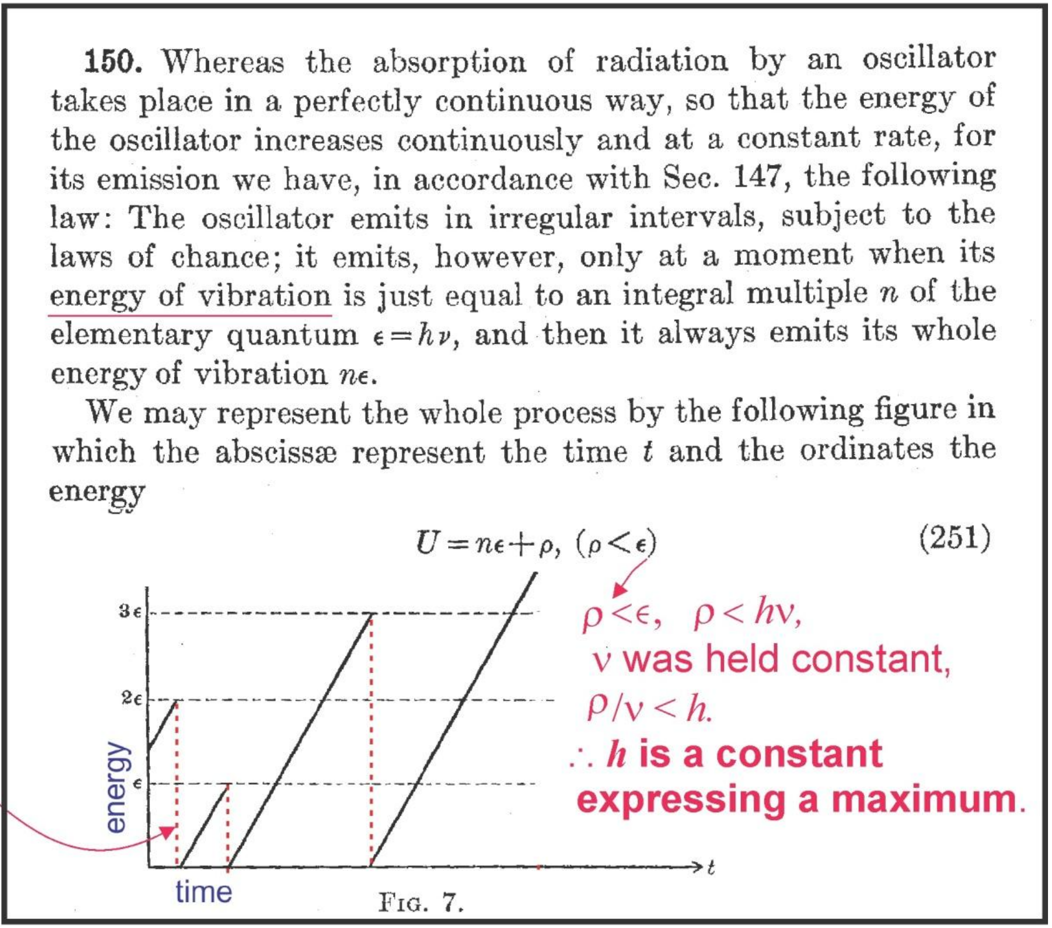
Here:

h is a threshold,
not a quantization.

h is a property of matter,
not light.

QM recognizes only those discontinuities.

An important **zero-point energy term** *hν*/2 resulted in the normal spectrum with this model. This is the average energy in a pre-loaded state. **My experimental sub-quantum effect reveals that hidden energy.**



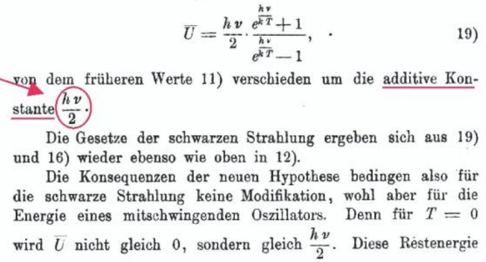
150. Whereas the absorption of radiation by an oscillator takes place in a perfectly continuous way, so that the energy of the oscillator increases continuously and at a constant rate, for its emission we have, in accordance with Sec. 147, the following law: The oscillator emits in irregular intervals, subject to the laws of chance; it emits, however, only at a moment when its energy of vibration is just equal to an integral multiple n of the elementary quantum $\epsilon = h\nu$, and then it always emits its whole energy of vibration $n\epsilon$.

We may represent the whole process by the following figure in which the abscissæ represent the time t and the ordinates the energy

$$U = n\epsilon + \rho, \quad (\rho < \epsilon) \tag{251}$$

$\rho < \epsilon, \quad \rho < h\nu,$
ν was held constant,
$\rho / \nu < h.$
$\therefore$ ***h* is a constant expressing a maximum.**

FIG. 7.



$$\overline{U} = \frac{h\nu}{2} \cdot \frac{e^{\frac{h\nu}{kT}} + 1}{e^{\frac{h\nu}{kT}} - 1}, \quad \cdot \tag{19)}$$

von dem früheren Werte 11) verschieden um die additive Konstante $\frac{h\nu}{2}$.

Die Gesetze der schwarzen Strahlung ergeben sich aus 19) und 16) wieder ebenso wie oben in 12).

Die Konsequenzen der neuen Hypothese bedingen also für die schwarze Strahlung keine Modifikation, wohl aber für die Energie eines mitschwingenden Oszillators. Denn für $T = 0$ wird $\overline{U}$ nicht gleich 0, sondern gleich $\frac{h\nu}{2}$. Diese Restenergie

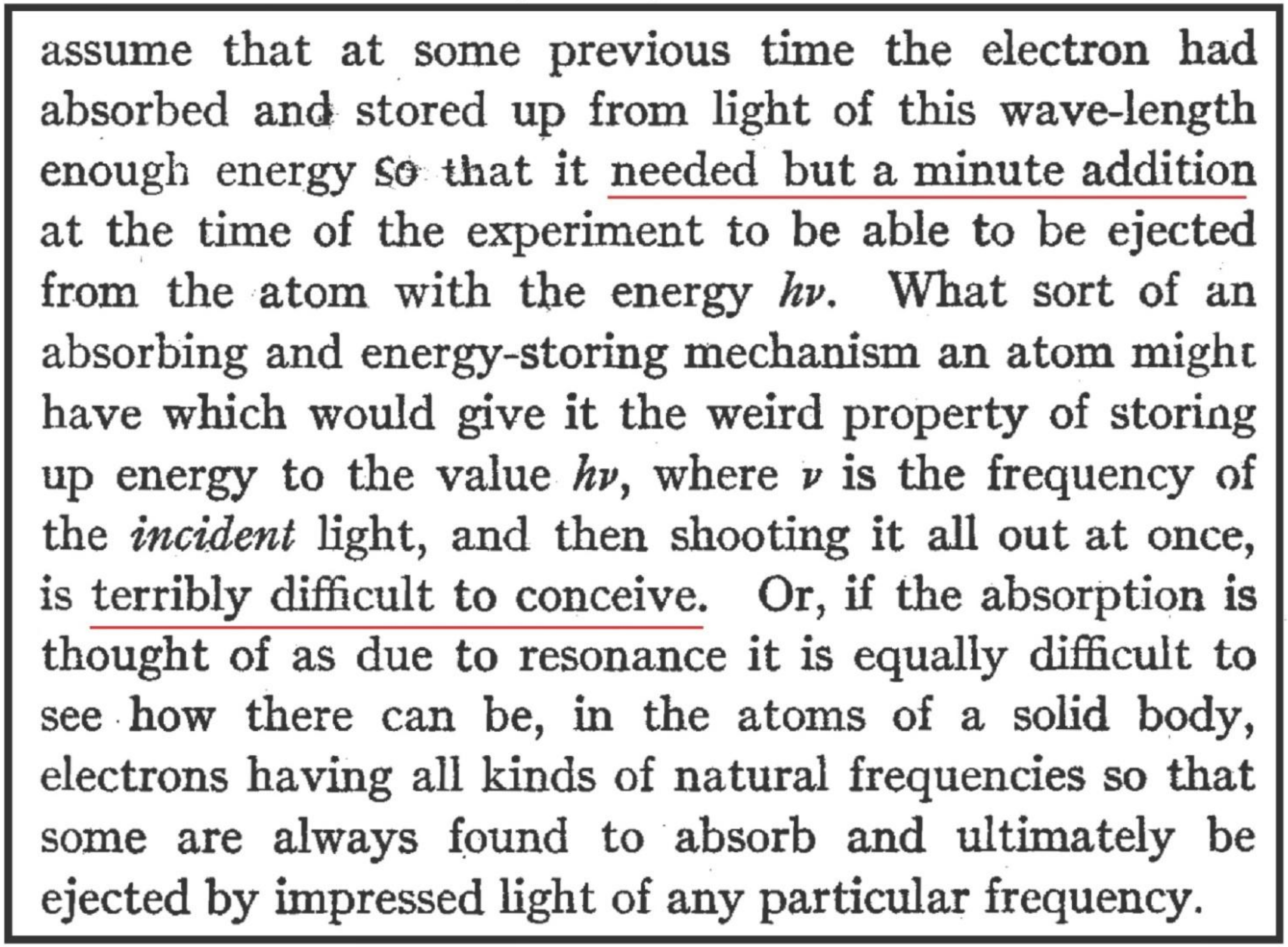
Here in Planck's 1911 paper the average of the pre-loaded state of energy appears for the first time. Although eq 19 is for a spectrum of light, *h* is a property of matter. Eq 19 reduces to the familiar form with *hν*/2 added. "Eine neue Strahlungshypothese," *Physikalische*...pg 256.

* Phrase coined by Kuhn in book *Black Body Theory and the Quantum Discontinuity.* Textbooks call this loading idea an accumulation hypothesis.

thresholds

Millikan considered a workable loading theory but *gave it up*.

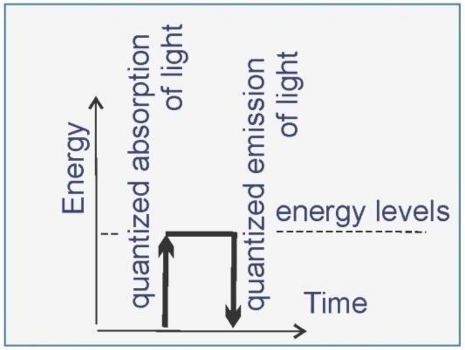
1935 Millikan. *Electrons (+and–)*… excerpt from second edition 1947, page 253. Every experimentalist should read this book.



assume that at some previous time the electron had absorbed and stored up from light of this wave-length enough energy so that it needed but a minute addition at the time of the experiment to be able to be ejected from the atom with the energy *hν*. What sort of an absorbing and energy-storing mechanism an atom might have which would give it the weird property of storing up energy to the value *hν*, where *ν* is the frequency of the *incident* light, and then shooting it all out at once, is terribly difficult to conceive. Or, if the absorption is thought of as due to resonance it is equally difficult to see how there can be, in the atoms of a solid body, electrons having all kinds of natural frequencies so that some are always found to absorb and ultimately be ejected by impressed light of any particular frequency.

The “minute addition” idea is not so difficult to conceive. Off-tuned frequencies can converge. Even a classical oscillator can maintain its frequency at a sub-threshold amplitude, absorb some energy, grow beyond a stable energy, then become unstable. This “minute addition” idea is the last consideration of a workable loading theory in all of our literature. Only a continuous non-workable loading theory was considered in response-time tests.

Models of absorption and emission of light



Einstein's **quantized energy**. Also, Planck's first theory is often interpreted this way.

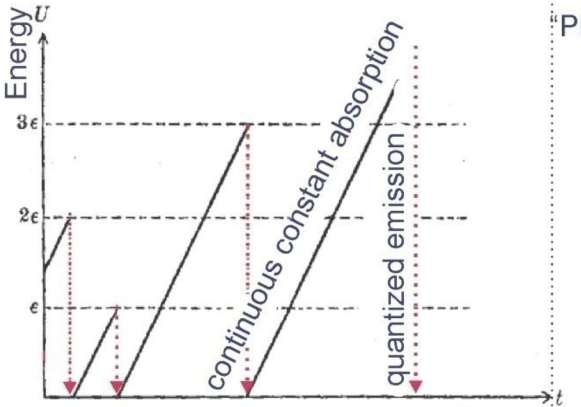
Action quantized at h. Energy quantized at $h\nu$. Quantum jumps.

No loading.

Embraced by mainstream because Planck 1911 did not work and Millikan's "minute addition" was given up.

Explains particle effects. Ignores most wave effects.

thresholds



Planck's drawing

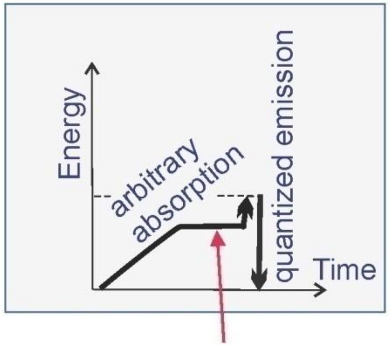
"Planck's second theory of 1911" and a theory of Sommerfeld and Debye.

Action and energy are thresholded. h is a maximum.

Loading is <u>only</u> continuous, and at a constant rate.
A pre-quanum state was not described.

Response-time tests have compared to this model and argued QM must be correct. In that context, we identify this as a non-workable loading theory.

Explains normal spectrum and predicts zero point energy.



pre-quantum state
as described by Millikan

Millikan's "minute addition" idea of 1917. Developed by ER 2000.

Action and energy are thresholded. h is a maximum.

Loading rate is arbitrary. Embraces a pre-quantum state.

Indistinguishable from QM in response-time tests.

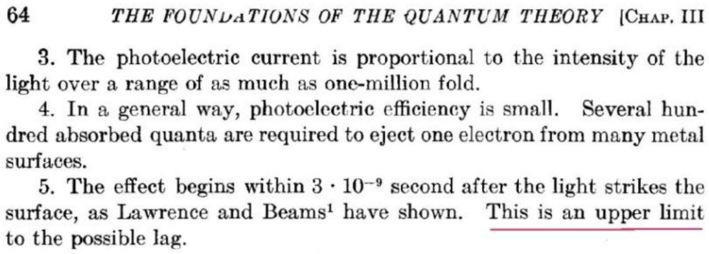
Can explain particle and wave effects.

We call this workable loading theory the **Threshold model.**

Photoelectric response-time arguments

Everyone compared to the continuous constant unworkable loading theory of Planck 1911.

1930 Ruark and Urey,
Atoms Molecules and Quanta.



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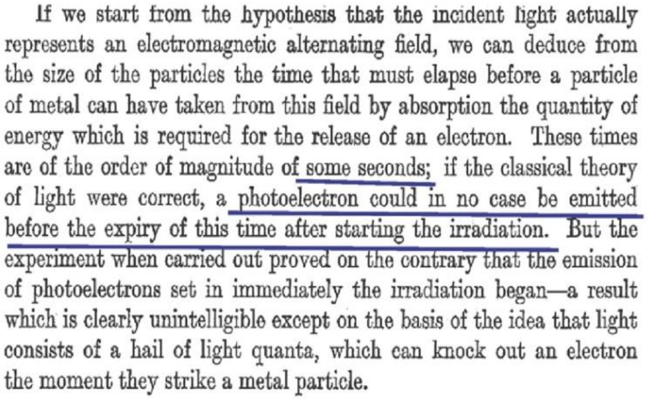
3. The photoelectric current is proportional to the intensity of the light over a range of as much as one-million fold.

4. In a general way, photoelectric efficiency is small. Several hundred absorbed quanta are required to eject one electron from many metal surfaces.

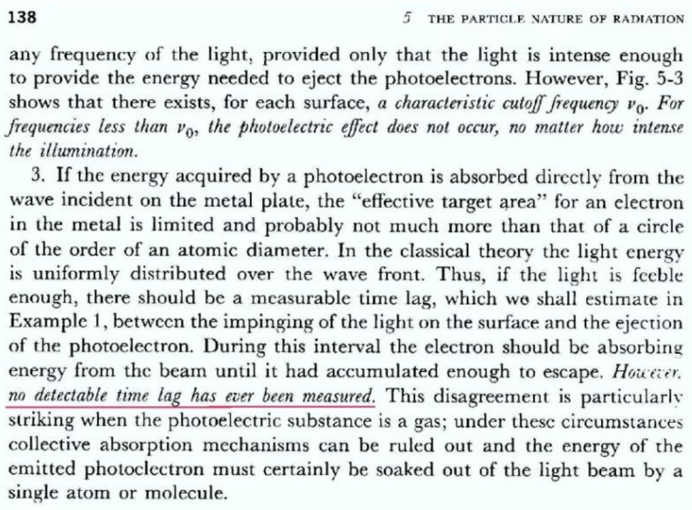
5. The effect begins within $3 \cdot 10^{-9}$ second after the light strikes the surface, as Lawrence and Beams[1] have shown. This is an upper limit to the possible lag.

1935 Max Born,
Atomic physics, 5th edition, 1951, pg 82.



If we start from the hypothesis that the incident light actually represents an electromagnetic alternating field, we can deduce from the size of the particles the time that must elapse before a particle of metal can have taken from this field by absorption the quantity of energy which is required for the release of an electron. These times are of the order of magnitude of some seconds; if the classical theory of light were correct, a photoelectron could in no case be emitted before the expiry of this time after starting the irradiation. But the experiment when carried out proved on the contrary that the emission of photoelectrons set in immediately the irradiation began—a result which is clearly unintelligible except on the basis of the idea that light consists of a hail of light quanta, which can knock out an electron the moment they strike a metal particle.

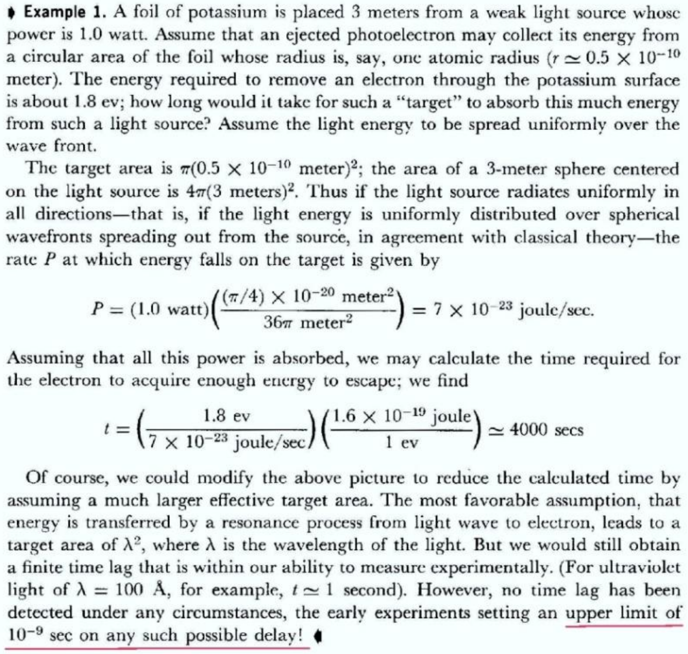
1972 R. Resnick,
Basic Concepts in Relativity and Early Quantum Theory



138 5 THE PARTICLE NATURE OF RADIATION

any frequency of the light, provided only that the light is intense enough to provide the energy needed to eject the photoelectrons. However, Fig. 5-3 shows that there exists, for each surface, *a characteristic cutoff frequency* ν_0. *For frequencies less than* ν_0, *the photoelectric effect does not occur, no matter how intense the illumination.*

3. If the energy acquired by a photoelectron is absorbed directly from the wave incident on the metal plate, the "effective target area" for an electron in the metal is limited and probably not much more than that of a circle of the order of an atomic diameter. In the classical theory the light energy is uniformly distributed over the wave front. Thus, if the light is feeble enough, there should be a measurable time lag, which we shall estimate in Example 1, between the impinging of the light on the surface and the ejection of the photoelectron. During this interval the electron should be absorbing energy from the beam until it had accumulated enough to escape. *However, no detectable time lag has ever been measured.* This disagreement is particularly striking when the photoelectric substance is a gas; under these circumstances collective absorption mechanisms can be ruled out and the energy of the emitted photoelectron must certainly be soaked out of the light beam by a single atom or molecule.



◆ **Example 1.** A foil of potassium is placed 3 meters from a weak light source whose power is 1.0 watt. Assume that an ejected photoelectron may collect its energy from a circular area of the foil whose radius is, say, one atomic radius ($r \simeq 0.5 \times 10^{-10}$ meter). The energy required to remove an electron through the potassium surface is about 1.8 ev; how long would it take for such a "target" to absorb this much energy from such a light source? Assume the light energy to be spread uniformly over the wave front.

The target area is $\pi(0.5 \times 10^{-10}\text{ meter})^2$; the area of a 3-meter sphere centered on the light source is $4\pi(3\text{ meters})^2$. Thus if the light source radiates uniformly in all directions—that is, if the light energy is uniformly distributed over spherical wavefronts spreading out from the source, in agreement with classical theory—the rate P at which energy falls on the target is given by

$$P = (1.0\text{ watt})\left(\frac{(\pi/4) \times 10^{-20}\text{ meter}^2}{36\pi\text{ meter}^2}\right) = 7 \times 10^{-23}\text{ joule/sec.}$$

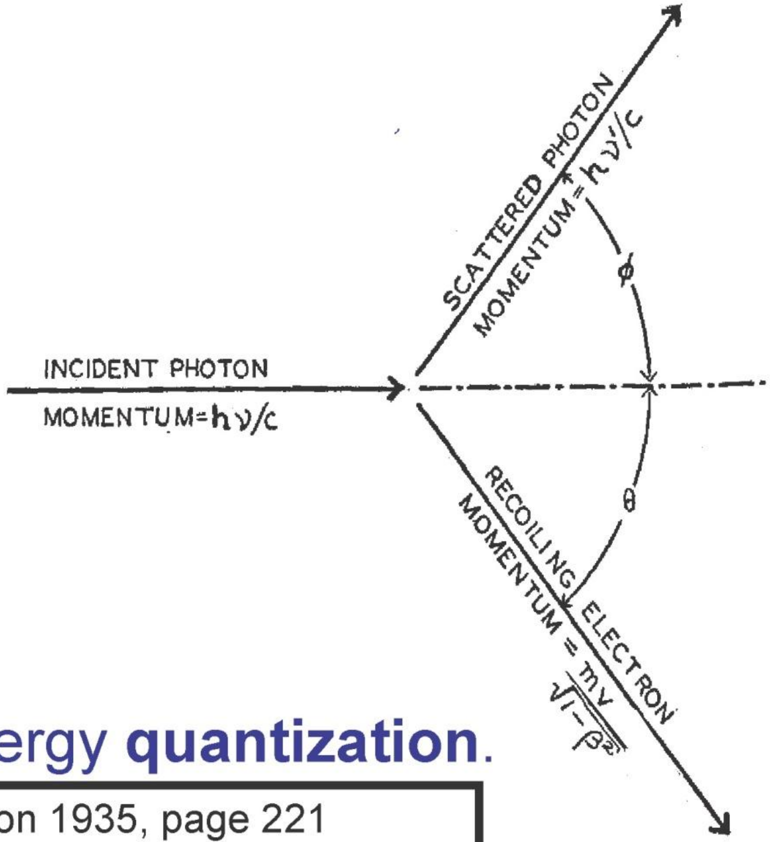
Assuming that all this power is absorbed, we may calculate the time required for the electron to acquire enough energy to escape; we find

$$t = \left(\frac{1.8\text{ ev}}{7 \times 10^{-23}\text{ joule/sec}}\right)\left(\frac{1.6 \times 10^{-19}\text{ joule}}{1\text{ ev}}\right) \simeq 4000\text{ secs}$$

Of course, we could modify the above picture to reduce the calculated time by assuming a much larger effective target area. The most favorable assumption, that energy is transferred by a resonance process from light wave to electron, leads to a target area of λ^2, where λ is the wavelength of the light. But we would still obtain a finite time lag that is within our ability to measure experimentally. (For ultraviolet light of $\lambda = 100$ Å, for example, $t \simeq 1$ second). However, no time lag has been detected under any circumstances, the early experiments setting an upper limit of 10^{-9} sec on any such possible delay! ◆

1923 Compton. "A Quantum Theory of the Scattering of X-rays by Light elements"

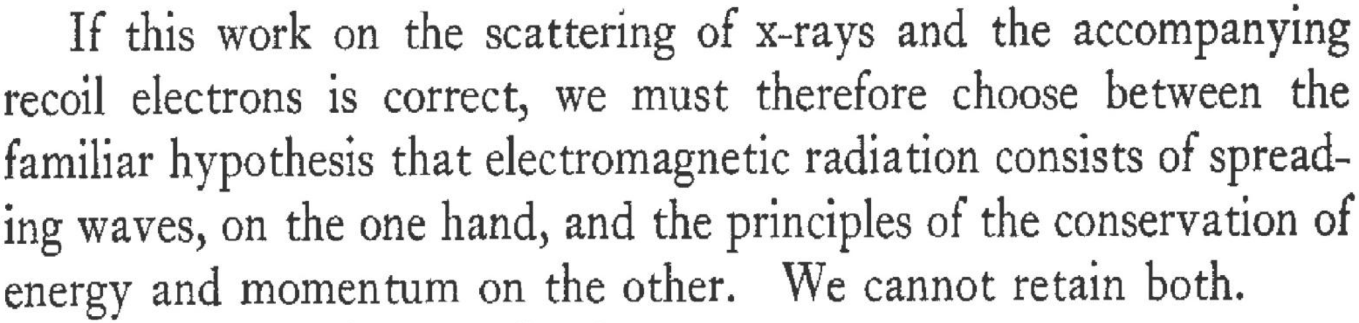
Phys Rev V21 #5 p483.



Compton's experiment and particle-oriented derivation was upheld as additional evidence of energy quantization.

That idea was used to argue that energy **conservation** requires energy **quantization**.

X-Rays in Theory and Experiment, Compton and Allison 1935, page 221

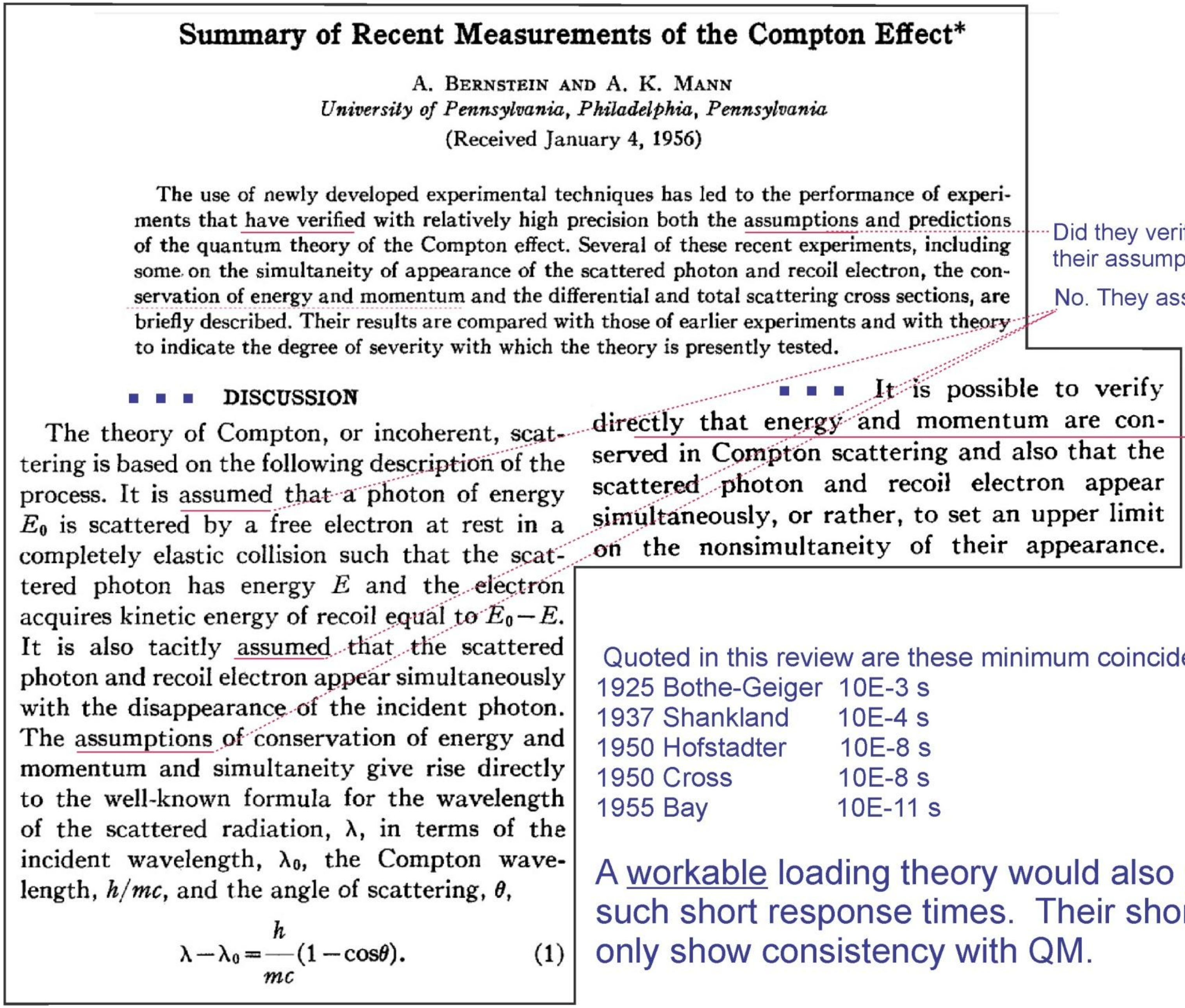


> If this work on the scattering of x-rays and the accompanying recoil electrons is correct, we must therefore choose between the familiar hypothesis that electromagnetic radiation consists of spreading waves, on the one hand, and the principles of the conservation of energy and momentum on the other. We cannot retain both.

To paraphrase: one must choose between unquanized waves and energy conservation.

Compton effect response-time arguments

1956. *American Journal of Physics*, 24, 445



Summary of Recent Measurements of the Compton Effect*

A. Bernstein and A. K. Mann
University of Pennsylvania, Philadelphia, Pennsylvania
(Received January 4, 1956)

The use of newly developed experimental techniques has led to the performance of experiments that have verified with relatively high precision both the assumptions and predictions of the quantum theory of the Compton effect. Several of these recent experiments, including some on the simultaneity of appearance of the scattered photon and recoil electron, the conservation of energy and momentum and the differential and total scattering cross sections, are briefly described. Their results are compared with those of earlier experiments and with theory to indicate the degree of severity with which the theory is presently tested.

■ ■ ■ DISCUSSION

The theory of Compton, or incoherent, scattering is based on the following description of the process. It is assumed that a photon of energy E_0 is scattered by a free electron at rest in a completely elastic collision such that the scattered photon has energy E and the electron acquires kinetic energy of recoil equal to E_0-E. It is also tacitly assumed that the scattered photon and recoil electron appear simultaneously with the disappearance of the incident photon. The assumptions of conservation of energy and momentum and simultaneity give rise directly to the well-known formula for the wavelength of the scattered radiation, λ, in terms of the incident wavelength, λ_0, the Compton wavelength, h/mc, and the angle of scattering, θ,

$$\lambda-\lambda_0=\frac{h}{mc}(1-\cos\theta). \tag{1}$$

■ ■ ■ It is possible to verify directly that energy and momentum are conserved in Compton scattering and also that the scattered photon and recoil electron appear simultaneously, or rather, to set an upper limit on the nonsimultaneity of their appearance.

Did they verify their assumptions?

No. They assumed.

They thought conservation requires quantization.

Quoted in this review are these minimum coincidence times:

1925 Bothe-Geiger	10E-3 s
1937 Shankland	10E-4 s
1950 Hofstadter	10E-8 s
1950 Cross	10E-8 s
1955 Bay	10E-11 s

A <u>workable</u> loading theory would also predict such short response times. Their short times only show consistency with QM.

1924 de Broglie dissertation

$\lambda = h/p$ fits experiments, but his derivation has two problems:

λ = wavelength, h = Planck's constant, $p = mv$ = momentum, ν = frequency, m = mass, E = energy, c = light speed.

1. $E = h\nu$ and $E = mc^2$ were equated to make

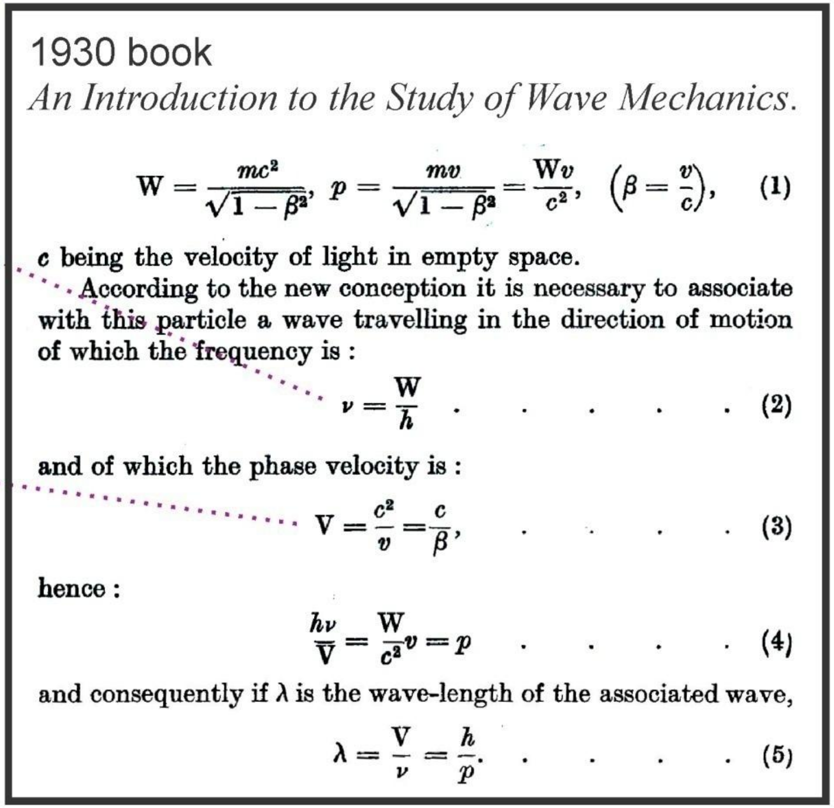
$$h\nu = mc^2$$

Nuclear experiments use $h\nu = \Delta mc^2$. Pair creation/annihilation also use this equation. However, electron diffraction tests reveal ν as a function of velocity. Therefore this step does not help to understand the resulting wavelength eq where it is most useful.

2. That c^2 equation just *appears* this way here. It may be obtained by an improper extraction from the Lorentz transformation of time. A stationary group velocity v implies an infinite phase velocity V. V exceeding c in eq 2 implies probability waves and entanglement.

Insert problem **2** into problem **1** yielding $h\nu/m = v\mathrm{V}$.
Use $\nu = \mathrm{V}/\lambda$ to obtain de Broglie's famous wavelength equation $\lambda = h/mv$.

The threshold model overcomes these problems.



1930 book
An Introduction to the Study of Wave Mechanics.

$$\mathrm{W} = \frac{mc^2}{\sqrt{1-\beta^2}}, \quad p = \frac{mv}{\sqrt{1-\beta^2}} = \frac{\mathrm{W}v}{c^2}, \quad \left(\beta = \frac{v}{c}\right), \qquad (1)$$

c being the velocity of light in empty space.

According to the new conception it is necessary to associate with this particle a wave travelling in the direction of motion of which the frequency is :

$$\nu = \frac{\mathrm{W}}{h} \quad . \quad . \quad . \quad . \quad . \quad (2)$$

and of which the phase velocity is :

$$\mathrm{V} = \frac{c^2}{v} = \frac{c}{\beta}, \quad . \quad . \quad . \quad . \quad (3)$$

hence :

$$\frac{h\nu}{\mathrm{V}} = \frac{\mathrm{W}}{c^2}v = p \quad . \quad . \quad . \quad . \quad . \quad (4)$$

and consequently if λ is the wave-length of the associated wave,

$$\lambda = \frac{\mathrm{V}}{\nu} = \frac{h}{p}. \quad . \quad . \quad . \quad . \quad . \quad (5)$$

1926 Schrödinger "Quantization as a Problem of Proper Values" *Annalen der Physik* (4) vol 79 In book *Collected Papers on Wave Mechanics.*

He used de Broglie's wavelength equation before it was experimentally substantiated. He did not use its derivation.

1927 GP Thomson* and Davisson & Germer** discover charge diffraction.

By confirming the de Broglie equation, people considered its derivation.

The Wave Mechanics of Free Electrons* (1930); **ghost waves pg 12. ***Nature* 119, 558 (1927).

beats

1926 Schrödinger

"Quantization as a Problem of Proper Values"
Annalen der Physik (4) vol 79
In book *Collected Papers on Wave Mechanics.*

He used de Broglie's wavelength equation before it was experimentally substantiated. He did not use its derivation.

deep difference tones

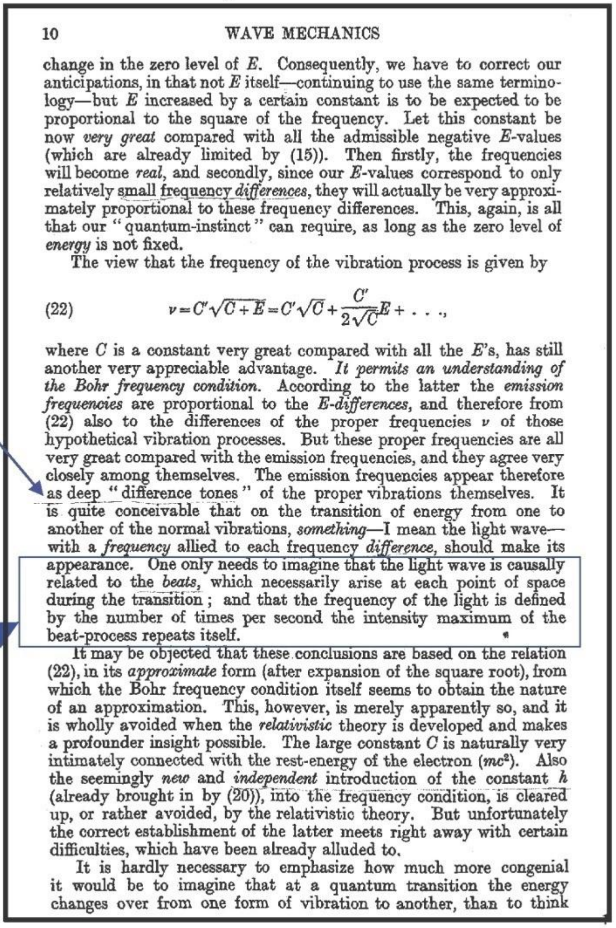
Recall Bohr's equation of the hydrogen spectrum. Adjust h to the right side to see h^3 in the denominator. **The structure of the equation can emphasize beat frequencies instead of photons**.

$$\nu_{\text{beat freq}} = (\text{some constant})(1/n^2 - 1/m^2)/h^3$$

freq of beats = difference freq of inner waves

He understood that light interacts with beats of his Ψ-wave.

That h^3 is a big clue favoring this charge-beat model. It appears in my derivation of Planck's normal spectrum. I use Bose's h^3 construct for the matter-wave instead of for light.



10 WAVE MECHANICS

change in the zero level of E. Consequently, we have to correct our anticipations, in that not E itself—continuing to use the same terminology—but E increased by a certain constant is to be expected to be proportional to the square of the frequency. Let this constant be now *very great* compared with all the admissible negative E-values (which are already limited by (15)). Then firstly, the frequencies will become *real*, and secondly, since our E-values correspond to only relatively small frequency *differences*, they will actually be very approximately proportional to these frequency differences. This, again, is all that our "quantum-instinct" can require, as long as the zero level of *energy* is not fixed.

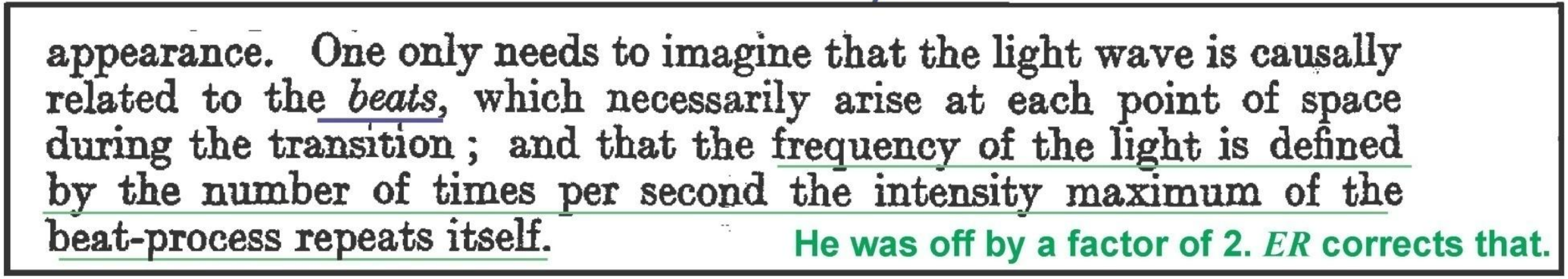
The view that the frequency of the vibration process is given by

$$\nu = C'\sqrt{C+E} = C'\sqrt{C} + \frac{C'}{2\sqrt{C}}E + \ldots, \tag{22}$$

where C is a constant very great compared with all the E's, has still another very appreciable advantage. *It permits an understanding of the Bohr frequency condition.* According to the latter the *emission frequencies* are proportional to the *E-differences*, and therefore from (22) also to the differences of the proper frequencies ν of those hypothetical vibration processes. But these proper frequencies are all very great compared with the emission frequencies, and they agree very closely among themselves. The emission frequencies appear therefore as deep "difference tones" of the proper vibrations themselves. It is quite conceivable that on the transition of energy from one to another of the normal vibrations, *something*—I mean the light wave—with a *frequency* allied to each frequency *difference*, should make its appearance. One only needs to imagine that the light wave is causally related to the *beats*, which necessarily arise at each point of space during the transition; and that the frequency of the light is defined by the number of times per second the intensity maximum of the beat-process repeats itself.

It may be objected that these conclusions are based on the relation (22), in its *approximate* form (after expansion of the square root), from which the Bohr frequency condition itself seems to obtain the nature of an approximation. This, however, is merely apparently so, and it is wholly avoided when the *relativistic* theory is developed and makes a profounder insight possible. The large constant C is naturally very intimately connected with the rest-energy of the electron (mc^2). Also the seemingly *new* and *independent* introduction of the constant h (already brought in by (20)), into the frequency condition, is cleared up, or rather avoided, by the relativistic theory. But unfortunately the correct establishment of the latter meets right away with certain difficulties, which have been already alluded to.

It is hardly necessary to emphasize how much more congenial it would be to imagine that at a quantum transition the energy changes over from one form of vibration to another, than to think



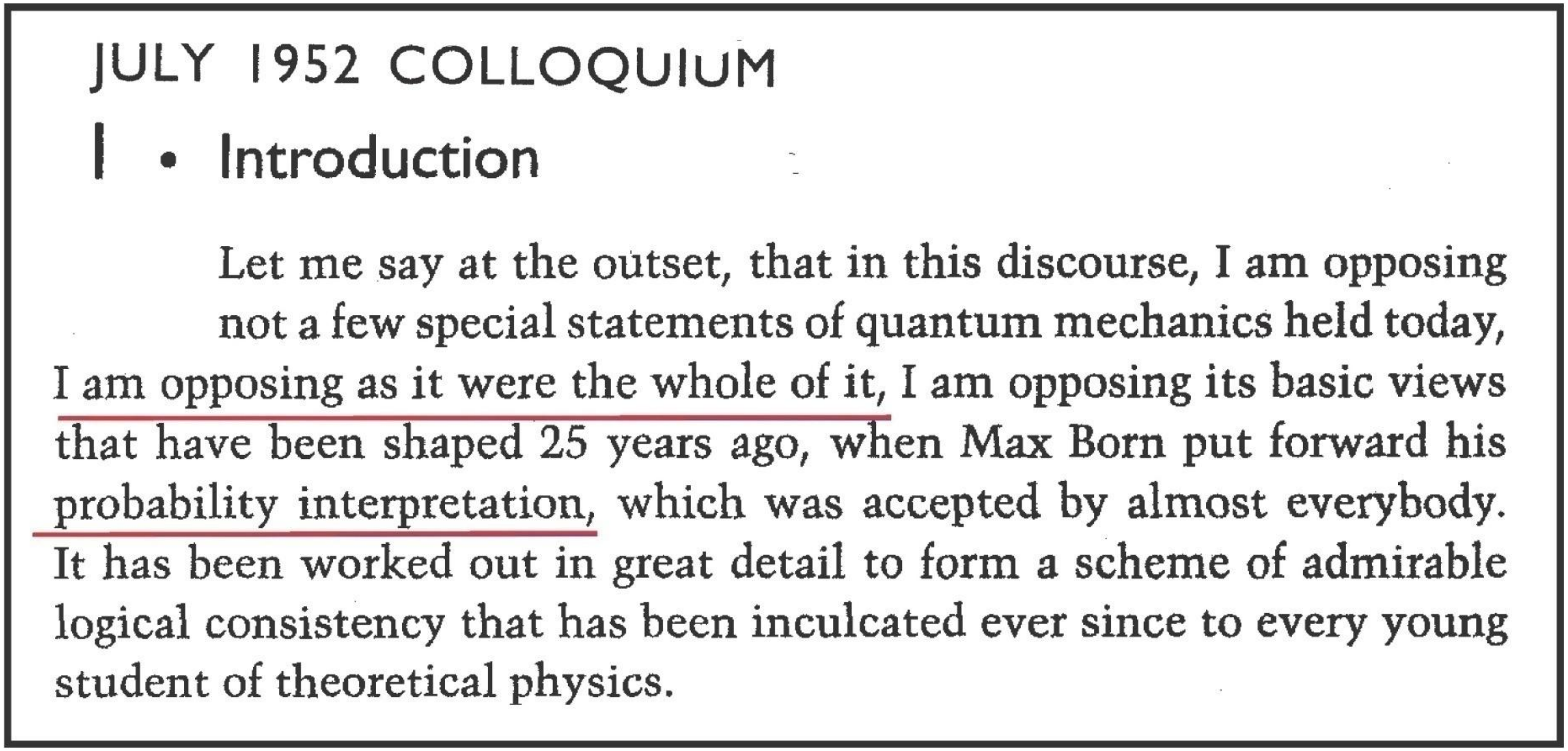
appearance. One only needs to imagine that the light wave is causally related to the *beats*, which necessarily arise at each point of space during the transition; and that the frequency of the light is defined by the number of times per second the intensity maximum of the beat-process repeats itself.

He was off by a factor of 2. *ER* corrects that.

Soon, Born introduced the probability interpretation of $\Psi^*\Psi$, and Schrödinger hated it.

Schrödinger opposed quantum mechanics

From book *The Interpretation of Quantum Mechanics,*
Dublin Lectures 1995.

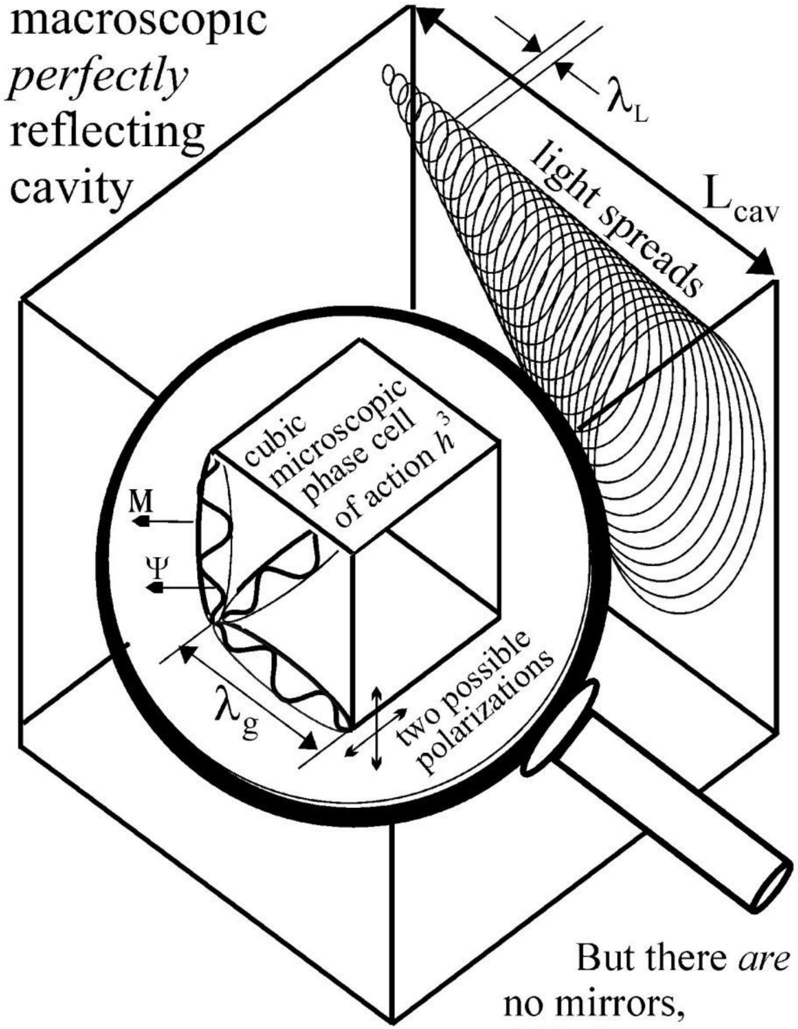


JULY 1952 COLLOQUIUM

I • Introduction

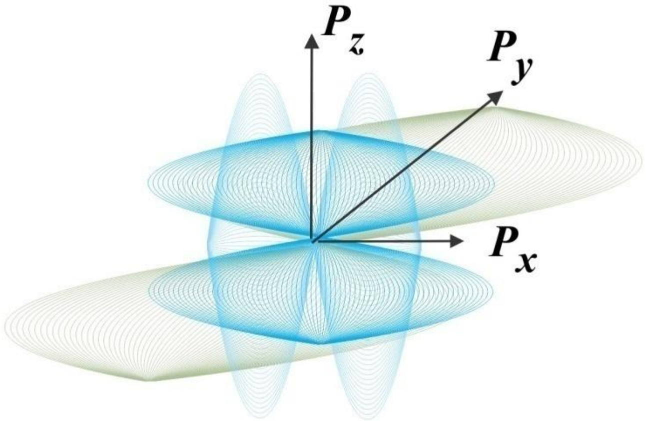
Let me say at the outset, that in this discourse, I am opposing not a few special statements of quantum mechanics held today, I am opposing as it were the whole of it, I am opposing its basic views that have been shaped 25 years ago, when Max Born put forward his probability interpretation, which was accepted by almost everybody. It has been worked out in great detail to form a scheme of admirable logical consistency that has been inculcated ever since to every young student of theoretical physics.

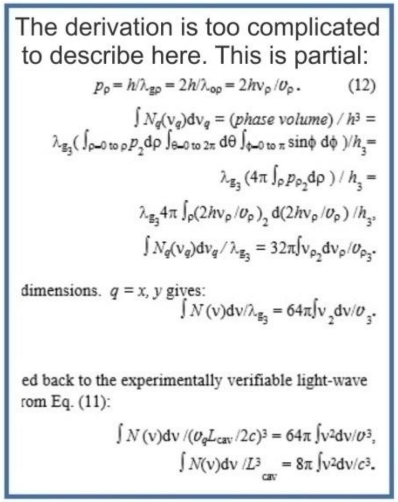
Black body spectrum can be derived using Bose's h^3 construct in matter instead of light (by *ER*).



But there *are*
no mirrors,
especially in outer space.

In matter, Ψ beats are shown here superimposed in three dimensions of space.





The derivation is too complicated to describe here. This is partial:

$$p_\rho = h/\lambda_{g\rho} = 2h/\lambda_{o\rho} = 2h\nu_\rho/\upsilon_\rho . \qquad (12)$$

$$\int N_q(\nu_q)d\nu_q = (\textit{phase volume})\,/\,h^3 =$$
$$\lambda_{g_3}(\int_{\rho=0\text{ to }\rho} p_2 d\rho \int_{\theta=0\text{ to }2\pi} d\theta \int_{\phi=0\text{ to }\pi} \sin\phi\, d\phi\,)/h_3 =$$
$$\lambda_{g_3}(4\pi \int_\rho p_{\rho_2} d\rho\,)\,/\,h_3 =$$
$$\lambda_{g_3} 4\pi \int_\rho (2h\nu_\rho/\upsilon_\rho)_2\, d(2h\nu_\rho/\upsilon_\rho)\,/h_3,$$
$$\int N_q(\nu_q)d\nu_q\,/\,\lambda_{g_3} = 32\pi \int \nu_{\rho_2} d\nu_\rho/\upsilon_{\rho_3}.$$

dimensions. $q = x, y$ gives:

$$\int N(\nu)d\nu/\lambda_{g_3} = 64\pi\int \nu_2 d\nu/\upsilon_3.$$

ed back to the experimentally verifiable light-wave
rom Eq. (11):

$$\int N(\nu)d\nu\,/(\upsilon_q L_{cav}/2c)^3 = 64\pi \int \nu^2 d\nu/\upsilon^3,$$
$$\int N(\nu)d\nu\,/L^3_{cav} = 8\pi \int \nu^2 d\nu/c^3.$$

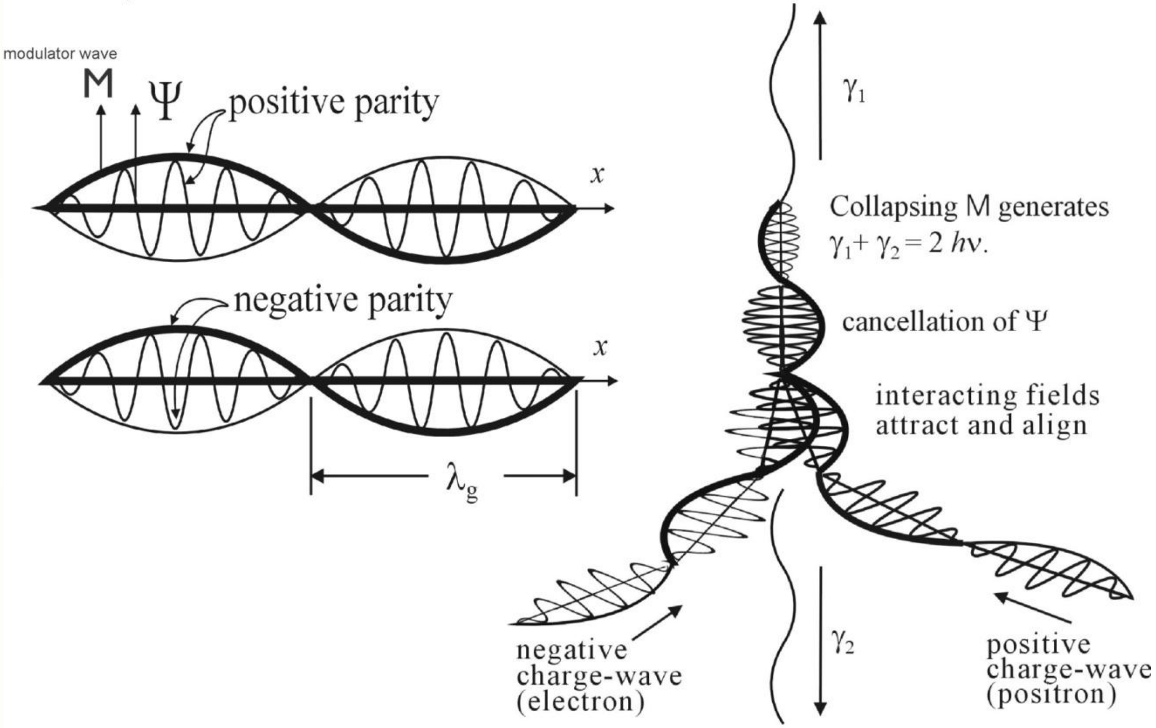
click for
Theory paper
An Understanding of the Particle-Like Property of Light and Charge.

beats

thresholds

beat model hypothesis of antimatter

The inner wave cancels leaving the electromagnetic modulator component to collapse and radiate.

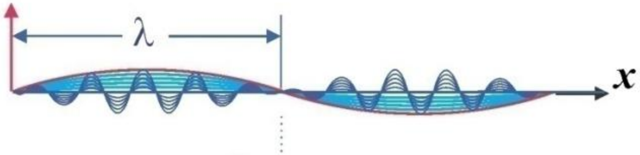


click for
Theory paper

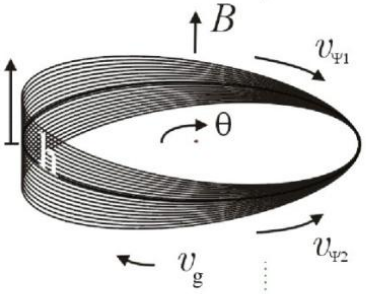
An Understanding of the Particle-Like Property of Light and Charge.

Beats reach a threshold at area *h*.

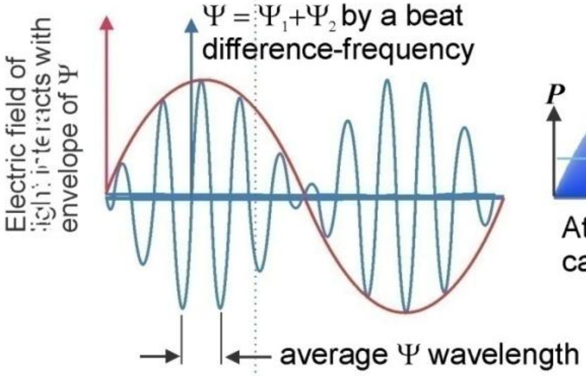
This concept is similar to Sommerfeld's $\int pdq = h$, but graphed in only one of three dimensions. Wrapping the beat in a circle makes a particle. The other two dimensions are for forces. Admittedly, this needs work, but it is a way to visualize Planck's constant, beats, and thresholds.



Charge is the envelope of Ψ. λ is the length of a beat. Here is a sub-*h* state of charge.



Under nuclear influence, the beat wraps in a circle for the particle state. Here the two inner Ψ waves are counter-rotating to make a standing wave. When not in a circle, the Ψ wave is in its wave state.



This is a graph. Momentum goes this way.

At threshold *h*, an envelope of charge can be released in the photoelectric effect.

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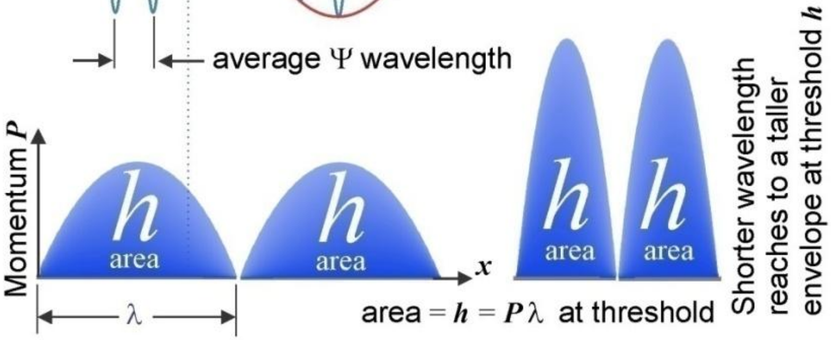
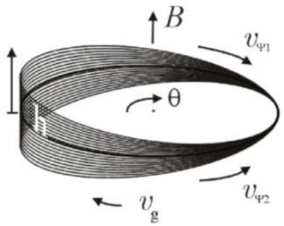
An Understanding of the Particle-Like Property of Light and Charge.



Planck's constant describes a shaping function of Ψ-beats.

Beat model of atom

These are graphs. It does not *look* like this. Ψ is graphed as a function of θ. Shown is only one dimension of Ψ. My black body derivation reveals two more dimensions.

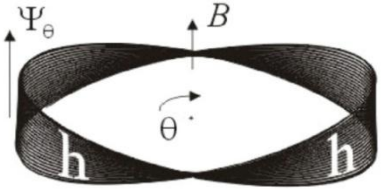


Hydrogen

Ψ is depicted only as function of θ at a fixed radius.

Counter rotating Ψ waves describe nature of spin.

My spin theory derives the Bohr magneton from the energy lost upon entering a Stern-Gerlach magnet. The derivation employed the counter-rotating Ψ beats and diagrams shown here. See “An Understanding of the Particle-like Nature of Light and Charge.”



Helium

Two electron charges in a two beat standing Ψ wave (allowed).

Helium

Two similar standing Ψ pairs on one orbital with action > h (not allowed).

Helium

Two different standing Ψ pairs, inner beat is at n = 1, outer beat is at n = 2 (allowed). Inner Ψ waves are counter rotating.

click for
Theory paper

An Understanding of the Particle-Like Property of Light and Charge.

beats

thresholds

ratios

Derivation of the wavelength equation without ghost waves

ν_L = light frequency, m_e = electron mass, υ_g= group velocity, V = electric potential.

Starting with the photoelectric effect, it delivers a conserved ratio $Q_{h/e} = V/\nu$. Respecting our constants, we can write $h/e = V/\nu$ and can convert to kinetic energy with electron mass, giving $h\nu = m\upsilon^2/2$.

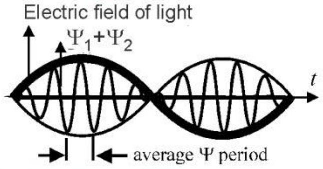
Supported by Schrödinger's beat discussion, we recognize the velocity of a Ψ beat, υ_g:

$$h\nu_L = m_e\upsilon_g^2/2.$$

A trig identity confirms that a modulator light wave can fit over two beats of an inner Ψ wave.

$$\nu_L = \upsilon_g/2\,\lambda_g$$

$$\nu_L = \nu_g/2$$



giving $h\nu_g/2 = m_e\upsilon_g^2/2.$

Recognizing periodicity of beats by $\nu_g= \upsilon_g/\lambda_g$

gets $h\upsilon_g/2\lambda_g = m_e\upsilon_g^2/2,$

$h = m_e\upsilon_g\lambda_g$. This looks like the de Broglie equation. However...

we still have those h, e and m that spell particles. If our constants describe quanta, we will remain forever in ghosts. The solution is to apply Planck's threshold-h concept to make e and m thresholds also. Here, we write h/m as Q_{hm}.

$Q_{h/m}= \upsilon_g\lambda_g$ the non-dualistic wavelength equation.

The constants are thresholds. The ratios are quantized.

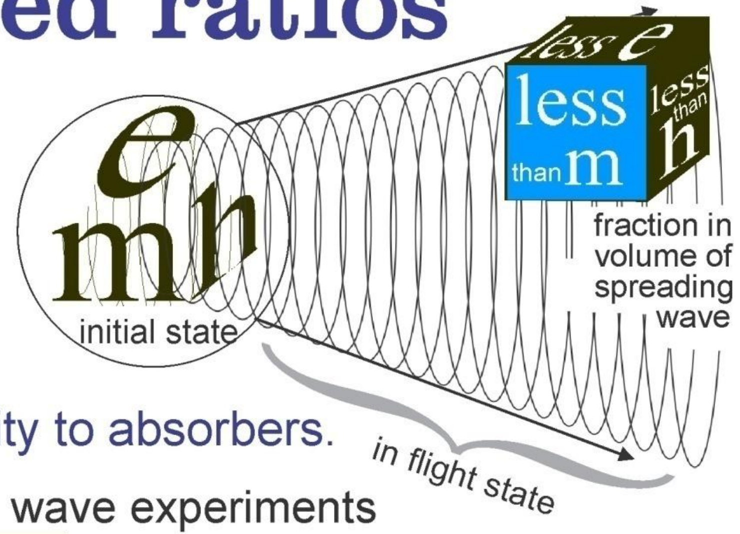
Principle of conserved ratios

The message from experiments relating to wave-particle duality reveals simple **ratios:** ***h*/*m*, *e*/*m*, *e*/*h*.** Therefore we can make *e* and *m* maxima, the way Planck did for *h*.

The constants are thresholds.

The ratios are quantized.

In this way, a matter-wave can transmit its identity to absorbers.



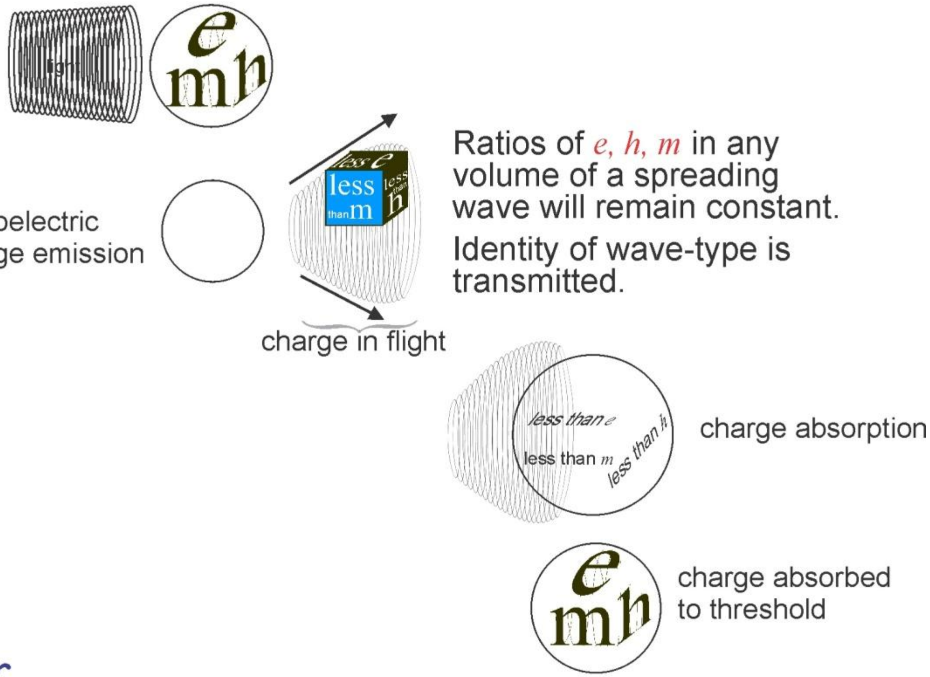
	Quantum Mechanics	Message from wave experiments
Matter wavelength	$\lambda_{\text{phase}} = \frac{h}{m\sigma}$	$\lambda_{\text{group}} = \frac{Q_{h/m}}{\sigma_{\text{group}}}$
Photoelectric	$h\nu_L - h\nu_0 = \frac{m\sigma^2}{2} = eV_0$	$Q_{h/m}(\nu - \nu_0) = \frac{\sigma_{\text{group}}^2}{2} = Q_{e/m}V_0$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

Equations with odd ratios of these constants are not about spreading waves. The Millikan oil drop test reads quantized charge in an ensemble effect. Also consider *h*/*k* as a conserved ratio.

Photoelectric effect need not emit particle electrons

The experiment only delivers $Q_{h/e} = V/\nu$ (and a work function term). In experiments revealing wave properties with equations containing $e\ h\ m$, those constants can be denoting maxima instead of quantizations.

We contend that enormous surface charges on a microscopic drop will rally an ensemble effect to deliver the illusion of charge quantization.



Ratios of e, h, m in any volume of a spreading wave will remain constant.

Identity of wave-type is transmitted.

This idea calls for evidence of

sub-quantized charge,

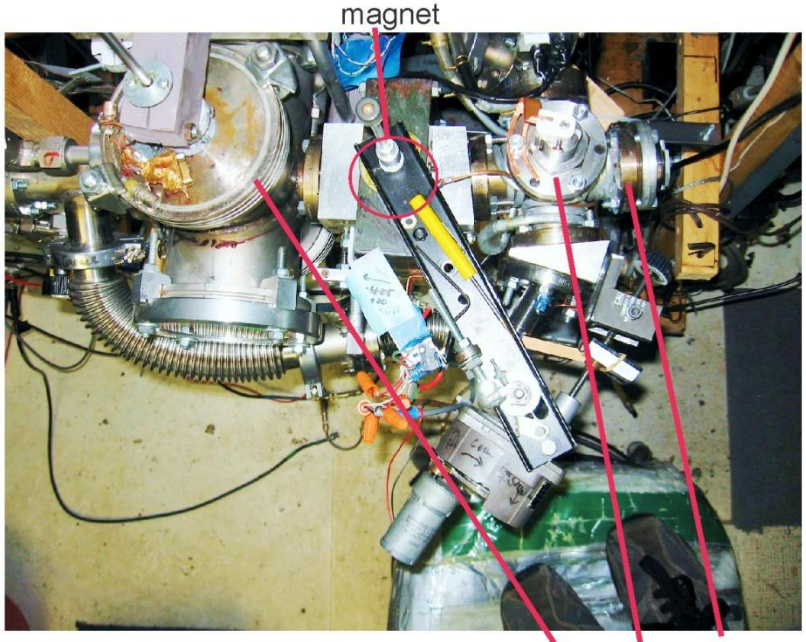
sub-quantized energy, or

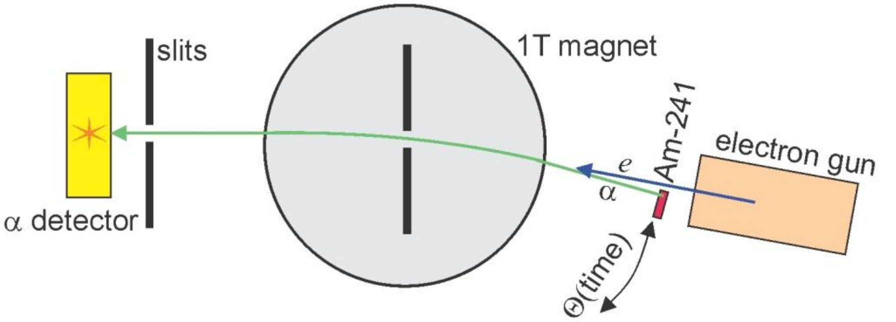
sub-quantized mass.

My work uncovered good evidence.

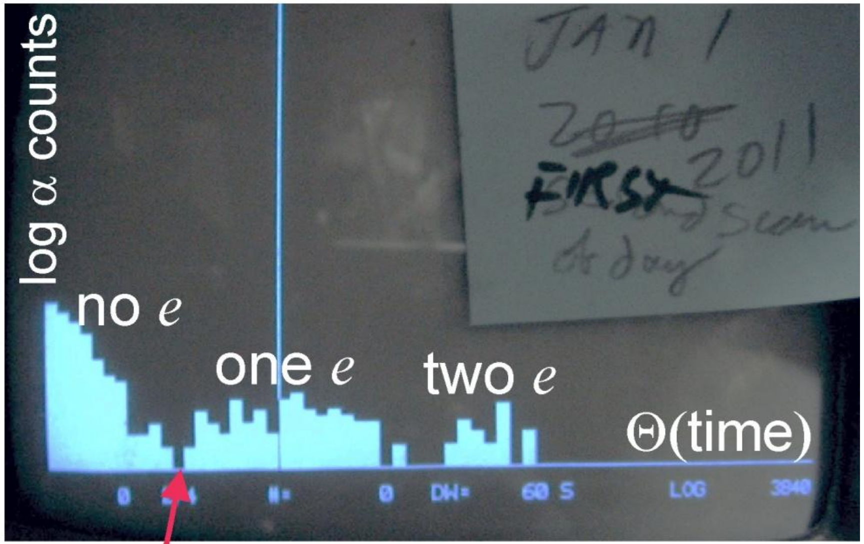
A threshold model predicts sub-quanta charge. This is unfinished work.

This α-ray mass spectrometer revealed all 3 charge states of helium. My strategy called for a velocity resonance of an electron upon the alpha-wave. 700 Volt electrons would create a gentle loading. Such an electron gun is difficult to build or get. I made several electron guns that never worked correctly. I offer apparatus and assistance to an enthusiastic follower.





one of several geometries attempted



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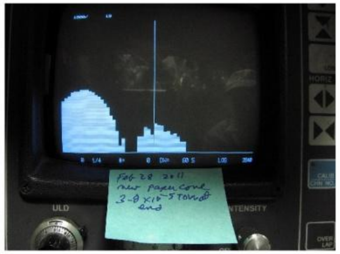


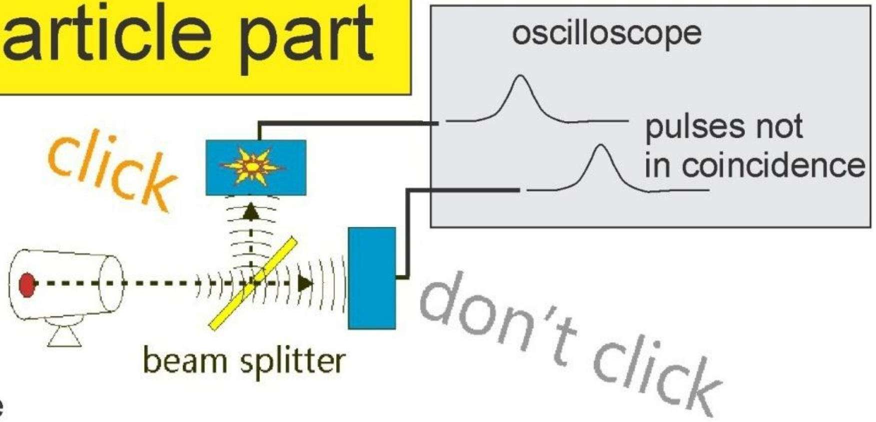
A better spectrum

The goal was to make this dip disappear.

Recent reports of fractional charge are fractions like 1/3, and their effect is in solids. My theory and experimental strategy is to show that charge in individual atoms can have arbitrary values below a threshold, but are difficult to detect.

To test if energy is quantized, everyone performs

the particle part



Single $h\nu$
light source
has been attempted
by attenuation, atomic beam,
triple coincidence, and parametric down conversion.

These detectors make pulses.
They say a photon hit there.

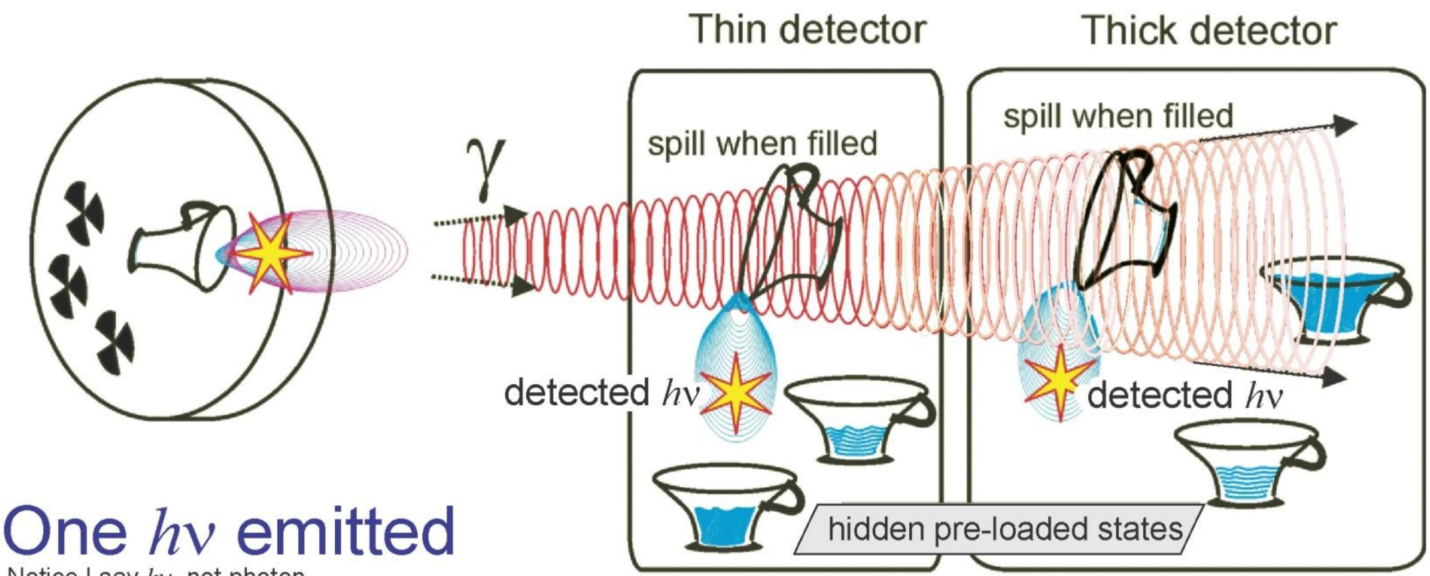
If energy is quantized,
one $h\nu$ emitted should land at
only one detector.

A beam-split coincidence test.

of the photon model and compares to chance.

A threshold model predicts *two-for-one*

It is like cups that spill only after being filled. There are hidden pre-loaded states.
We take advantage of a near-field electromagnetic shock-wave from gamma emission.



One $h\nu$ emitted

Notice I say $h\nu$, not photon.

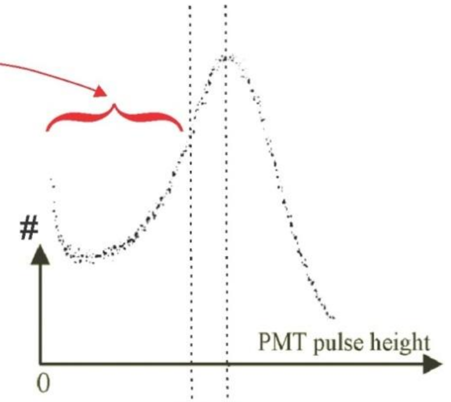
can cause two $h\nu$ detected

This argument requires
- timing resolution,
- energy resolution, and
- assurance of single emission.

Pulse-detector properties

visible light

Monochromatic visible light
on Photomultiplier Tube
From Philips *Photomultiplier Tubes* databook.



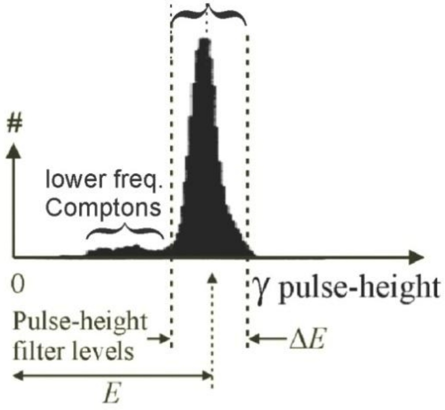
To exclude these pulses would favor QM;
To include them would favor TM.

No QM test reports where they
set the low-level of their discriminator (I looked hard and could not find).

No visible light detector has improved pulse-height resolution (APD, cooling...)

gamma-rays

Cd-109 Gamma-ray photopeak at 88 keV from NaI scintillator



pulse height ∝ frequency ∝ $h\nu$ energy of detection

A *two-for-one* photon violation argument **can** be made. We do not read half-height pulses.

The pulses we throw away are of low detection-energy, that should be discarded.

Pulse-height to frequency relationship was determined from crystal diffraction tests.

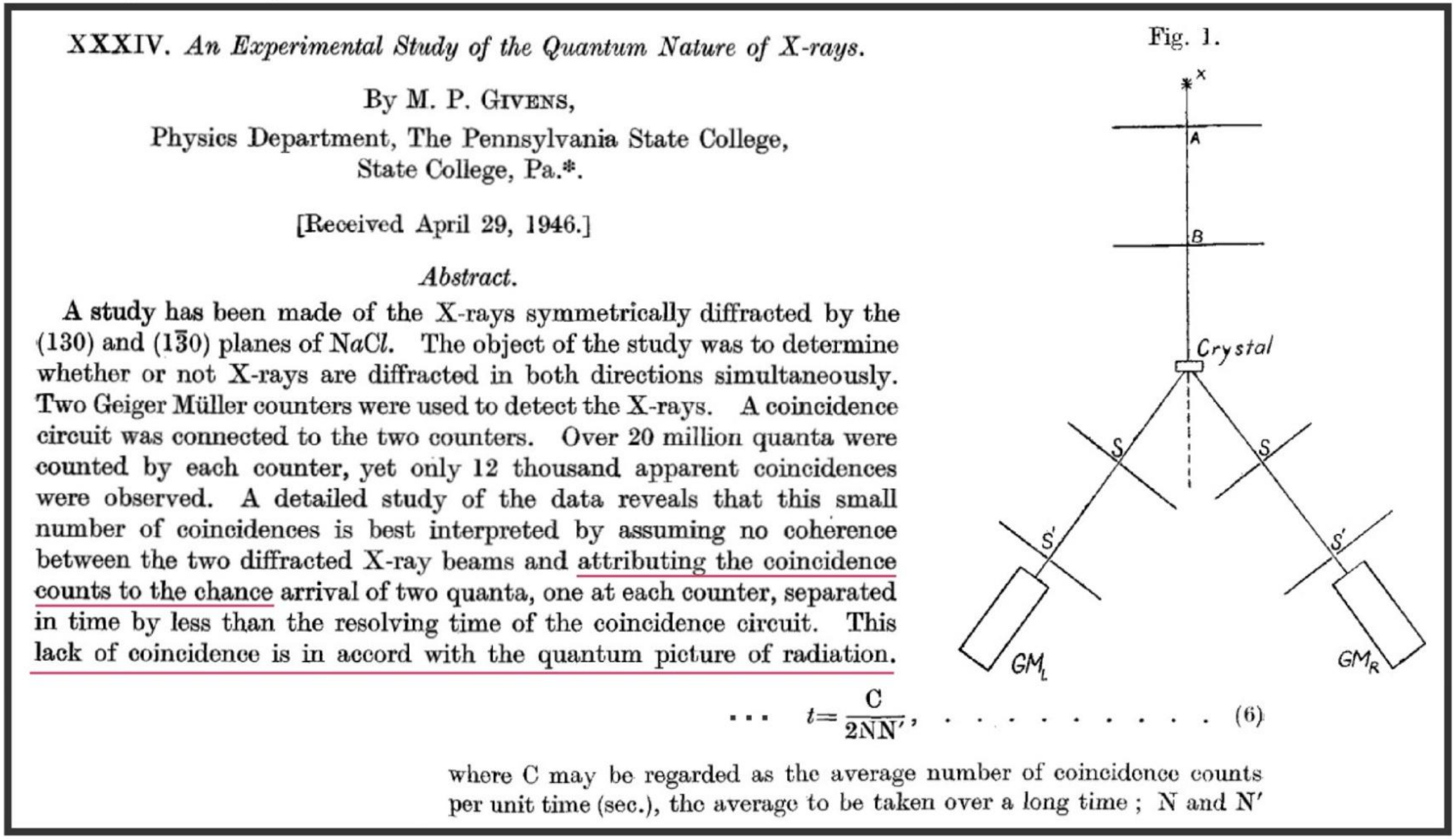
γ-rays afford detection-energy resolution.

γ-rays afford a <u>much better</u> test to determine one-at-a-time emission.

1946 The first beam-split coincidence test of Einstein's photon model.

The London, Edinburgh, and Dublin
Philosophical Magazine and Journal of Science

This tested the first part of the model.



XXXIV. *An Experimental Study of the Quantum Nature of X-rays.*

By M. P. Givens,
Physics Department, The Pennsylvania State College,
State College, Pa.*.

[Received April 29, 1946.]

Abstract.

A study has been made of the X-rays symmetrically diffracted by the (130) and ($1\bar{3}0$) planes of Na*Cl*. The object of the study was to determine whether or not X-rays are diffracted in both directions simultaneously. Two Geiger Müller counters were used to detect the X-rays. A coincidence circuit was connected to the two counters. Over 20 million quanta were counted by each counter, yet only 12 thousand apparent coincidences were observed. A detailed study of the data reveals that this small number of coincidences is best interpreted by assuming no coherence between the two diffracted X-ray beams and attributing the coincidence counts to the chance arrival of two quanta, one at each counter, separated in time by less than the resolving time of the coincidence circuit. This lack of coincidence is in accord with the quantum picture of radiation.

Fig. 1.

$$t=\frac{C}{2NN'}, \qquad (6)$$

where C may be regarded as the average number of coincidence counts per unit time (sec.), the average to be taken over a long time ; N and N′

x-ray source

NaCl scatterer

Geiger detectors

The chance equation
is foundational in
nuclear physics.

Good: They do the beam-split coincidence test and correctly compare to chance, like this:

(click rate in det 1)(click rate in det 2)(time window) = *(chance rate).*

$$\textit{(experimental coincidence rate in same time window)} \,/\, \textit{(chance rate)} = \frac{R_{\text{experiment}}}{R_1\, R_2\, \tau} \cong 1 \text{ for QM.}$$

They saw 1.

Bad: No detector pulse-height resolution. x-ray tubes do not deliver "one-at-a-time."

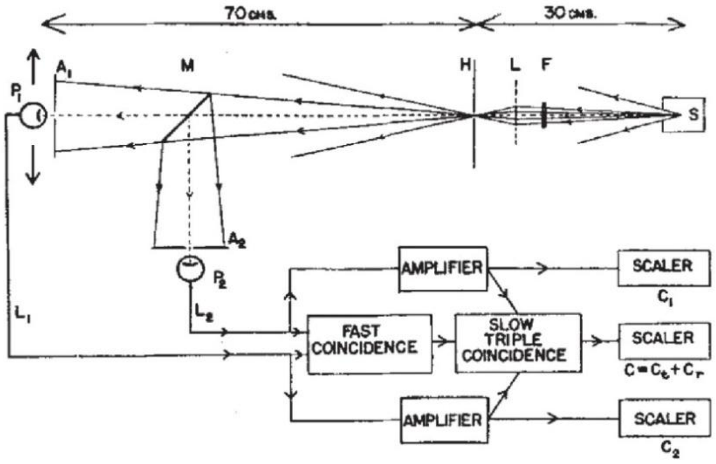
"One-at-a-time" is determined by a true coincidence test to be explained later.
The factor of 2 in Givens' chance equation is due to the method of overlapping square waves.

NATURE September 1, 1956 VOL. 178

By PROF. ERIC BRANNEN and H. I. S. FERGUSON
Department of Physics, University of Western Ontario, London, Canada

“The Question of Correlation Between Photons in Coherent Light Rays”

Beam-split coincidence test



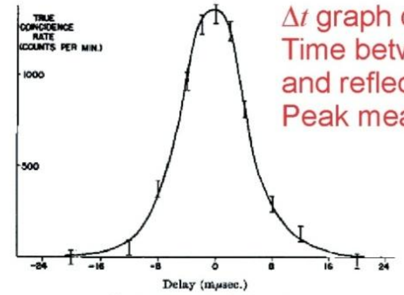


Fig. 5. Prompt resolution curve

Δt graph control test. Time between transmitted and reflected clicks. Peak means > chance.

Δt graph result. No peak means chance.

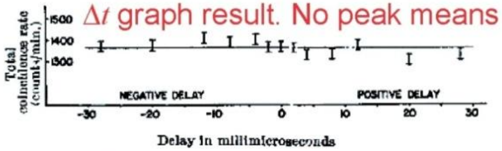


Fig. 8. Total coincidence rate versus delay, 'photocathodes not superimposed'

. . . The coincidence rate C was proportional to the product C_1C_2 consistent with the coincidence rate being pure random⁵ (random rate $\boxed{C_r = 2\tau C_1C_2}$).

The chance equation

Note added in proof. It would appear to the authors, and also to Prof. Jánossy (private communication), that if such a correlation did exist, it would call for a major revision of some fundamental concepts in quantum mechanics. This was, of course, the reason why these experiments were performed.

Good: They do the beam-split coincidence test, compare to chance, and use Δt graph.

Bad: No detector pulse-height resolution (PMT); light source does not deliver *one-at-a-time*.

1974 Clauser Test of particle part of Einstein's photon model

PHYSICAL REVIEW D VOLUME 9, NUMBER 4 15 FEBRUARY 1974

Experimental distinction between the quantum and classical field-theoretic predictions for the photoelectric effect*

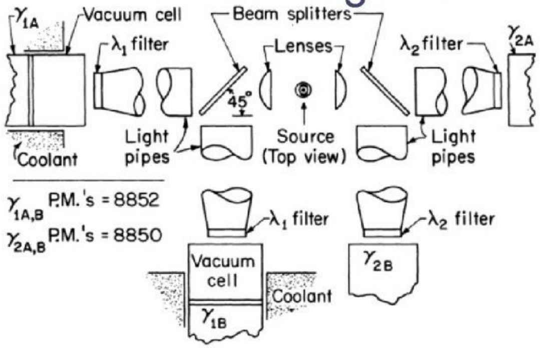
John F. Clauser

Department of Physics and Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720

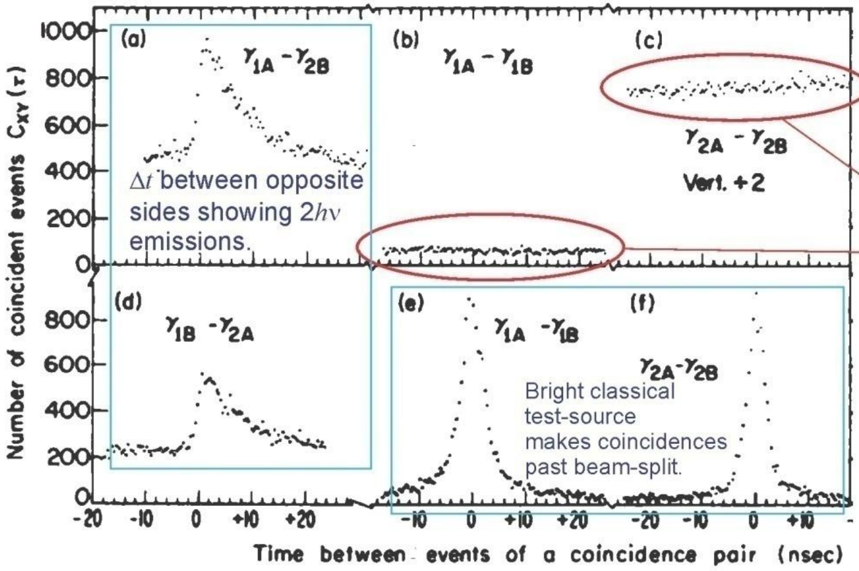
(Received 30 October 1973)

We have measured various coincidence rates between four photomultiplier tubes viewing cascade photons on opposite sides of dielectric beam splitters. This experimental configuration, we show, is sensitive to differences between the classical and quantum field-theoretic predictions for the photoelectric effect. The results, to a high degree of statistical accuracy, contradict the predictions by any classical or semiclassical theory in which the probability of photoemission is proportional to the classical intensity.

A beam-split at each side.
Two $h\nu$ emitted together.



. . . lenses (aspheric, $f \approx 1$), and fell on TiO_2-coated glass beam splitters (transmission ≈ 63% and 35% for opposite linear polarizations, inclined at 45° to the incident beams).



Δt between opposite sides showing $2h\nu$ emissions.

Bright classical test-source makes coincidences past beam-split.

Polarized light upon polarizing optics can give a 'photon-look.'

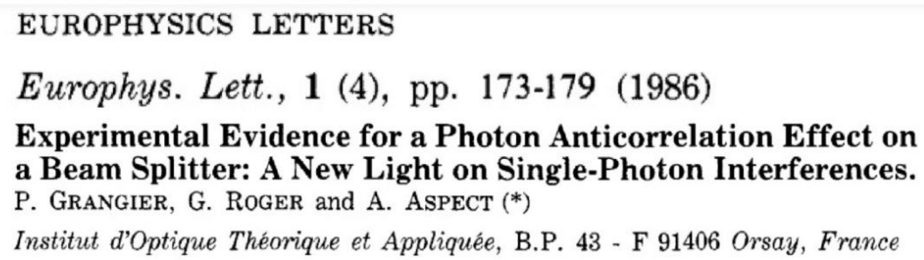
These are Δt between clicks from the pair of detectors past the beam splitter. This flat band of noise is taken as strong evidence for QM.

Strategy comparison. Their strategy is to first test that the source delivers *two-at-a-time*. These are only occasionally detected when in opposite directions. They then look at beam-split clicks to see if there are *two-at-a-time*.
My strategy is the opposite: I use γ-rays, which provide an energy budget. I ensure that the source delivers to opposite detectors, only *one-at-a-time*, and then look at beam-split clicks to see if there are *two-at-a-time* (I see two).

Good: Used Δt graph.

Bad: An energy budget is not possible with visible light. Pulse-height filter settings were not reported. Singles rates were not reported. Polarized light would be routed by a polarized beam-splitter.

The most famous test of Einstein’s photon model



EUROPHYSICS LETTERS

Europhys. Lett., **1** (4), pp. 173-179 (1986)

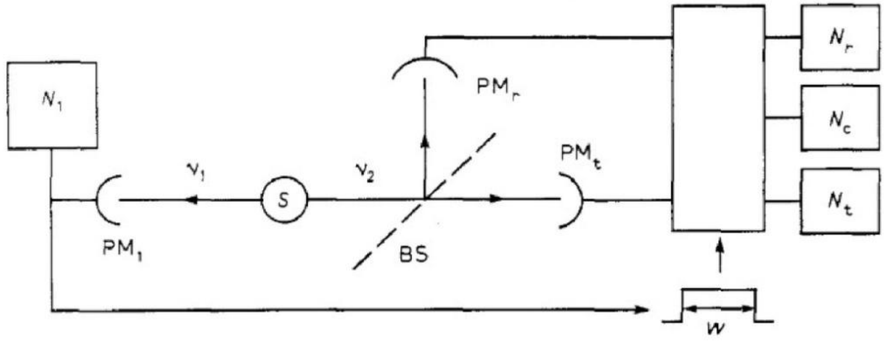
Experimental Evidence for a Photon Anticorrelation Effect on a Beam Splitter: A New Light on Single-Photon Interferences.

P. GRANGIER, G. ROGER and A. ASPECT (*)

Institut d’Optique Théorique et Appliquée, B.P. 43 - F 91406 *Orsay*, *France*

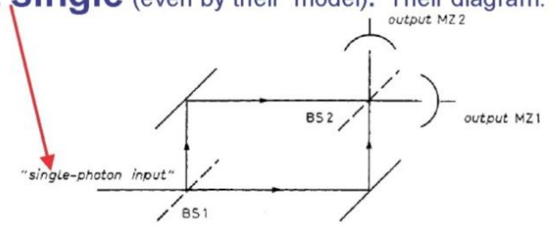
Nearly the same paper is in *Hyperfine Interactions* 37 (1987) 3-18.

The ***particle part*** of the photon model says *one way or another*. Not both ways.

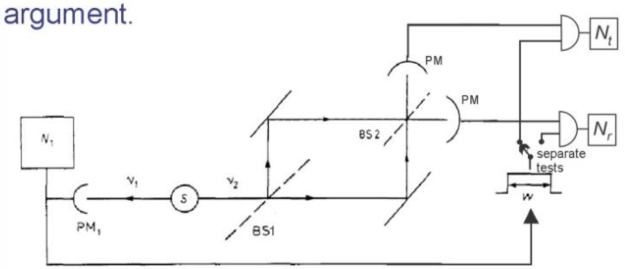


The ***wave part*** of the photon model says *both ways* (I always expect interference).

Light entering the interferometer is **not single** (even by their model). Their diagram.



Authors did not show the full schematic of this wave part. This is my diagram, interpreted from their text. They are triggering one of the PM on the right side by the PM on the left, for their “single photon” argument.

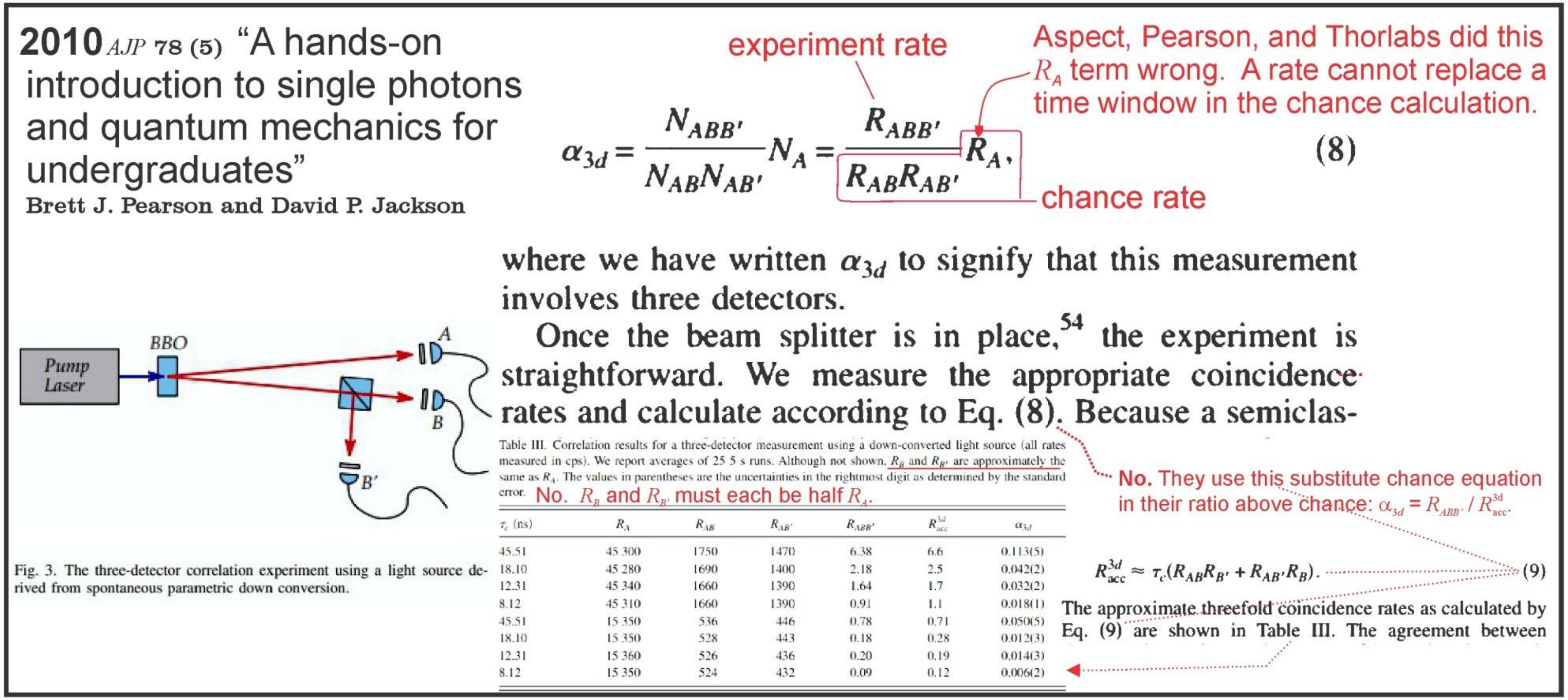


Good: They attempted both *parts* of the photon model.

Bad: This is a triple coincidence test, but they **did not use the correct triple coincidence chance equation**, which is very respected in nuclear physics. Pulse-height filter settings were not reported. Use of visible light leads to eliminating many coincident pairs. If they did not test for this, their use of a polarizing beam splitter ("multidielectric coatings") will route $h\nu$ light one-way or the other. Their *wave part* illustration is terribly misleading; see my correction above.

They now teach photons with this triple coincidence method.

How many assumptions did they make to conclude photons?



2010 *AJP* **78 (5)** "A hands-on introduction to single photons and quantum mechanics for undergraduates"

Brett J. Pearson and David P. Jackson

experiment rate

Aspect, Pearson, and Thorlabs did this R_A term wrong. A rate cannot replace a time window in the chance calculation.

$$\alpha_{3d} = \frac{N_{ABB'}}{N_{AB}N_{AB'}}N_A = \frac{R_{ABB'}}{R_{AB}R_{AB'}}R_A, \qquad (8)$$

chance rate

where we have written α_{3d} to signify that this measurement involves three detectors.

Once the beam splitter is in place,[54] the experiment is straightforward. We measure the appropriate coincidence rates and calculate according to Eq. (8). Because a semiclas-

Fig. 3. The three-detector correlation experiment using a light source derived from spontaneous parametric down conversion.

Table III. Correlation results for a three-detector measurement using a down-converted light source (all rates measured in cps). We report averages of 25 5 s runs. Although not shown, R_B and $R_{B'}$ are approximately the same as R_A. The values in parentheses are the uncertainties in the rightmost digit as determined by the standard error. No. R_B and $R_{B'}$ must each be half R_A.

τ_c (ns)	R_A	R_{AB}	$R_{AB'}$	$R_{ABB'}$	R^{3d}_{acc}	α_{3d}
45.51	45 300	1750	1470	6.38	6.6	0.113(5)
18.10	45 280	1690	1400	2.18	2.5	0.042(2)
12.31	45 340	1660	1390	1.64	1.7	0.032(2)
8.12	45 310	1660	1390	0.91	1.1	0.018(1)
45.51	15 350	536	446	0.78	0.71	0.050(5)
18.10	15 350	528	443	0.18	0.28	0.012(3)
12.31	15 360	526	436	0.20	0.19	0.014(3)
8.12	15 350	524	432	0.09	0.12	0.006(2)

No. They use this substitute chance equation in their ratio above chance: $\alpha_{3d} = R_{ABB'} / R^{3d}_{acc}$.

$$R^{3d}_{acc} \approx \tau_c(R_{AB}R_{B'} + R_{AB'}R_B). \qquad (9)$$

The approximate threefold coincidence rates as calculated by Eq. (9) are shown in Table III. The agreement between

This method is similarly described in the *Thorlabs Quantum Optics Kit User Guide*.

Their table gives τ and all needed rates. They correctly cite but do not use the triple coincidence chance equation* $R_{\text{chance}} = 3\tau^2 R_A R_B R_{B'}$ which is well respected in nuclear physics. My calculation with their data $\alpha_{3d} = R_{ABB'}/R_{\text{chance}}$ = [6.6/s] **/** **[**3(45ns)^2(45300)(45300/2)(45300/2) = 141E–3 sec**]** = 47 x chance**.** This should have indicated they were doing something wrong! They want to see less than chance to claim photons, so they discard the respected R_{chance} and use their linear eq 9.

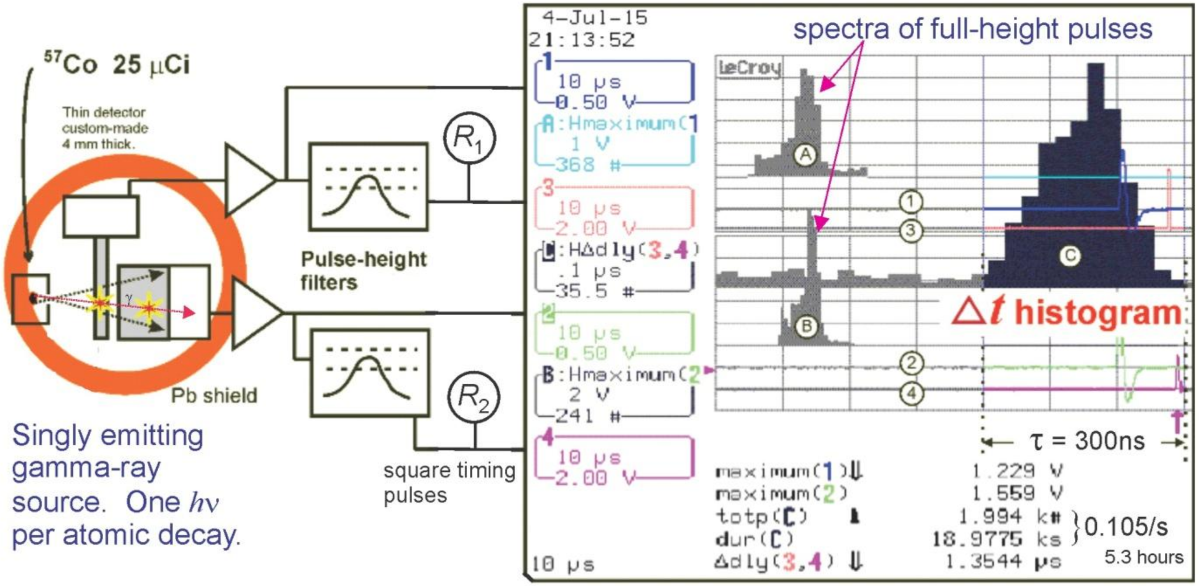
Their high rate above chance for *AB* can be explained by classical fluctuations, as reported by HBT, Rebka & Pound, and Morgan & Mandel. Their low rate below chance for *ABB'* is explained by using the wrong chance equation.

*"Accidental coincidences in counter circuits" Eckart and Shonka, *Physical Review* 53 pg 752 (1938).

My Beam-split coincidence test is with gamma-rays

Evidence that energy is not quantized. Start with one, end with two, implies pre-quantum loading.

2015. Reiter, E. S. "New experiments call for a continuous absorption alternative to the photon model." *SPIE Conference, The Nature of Light: What Are Photons? VI.* **doi:10.1117/12.2186071 /12.2186071**



Singly emitting gamma-ray source. One *hν* per atomic decay.

Any peak refutes QM: the sub-quantum effect.

17 min video of the γ-ray experiment.
https://youtu.be/GLKHb3K48sM
22 x chance

Background coinc rate = 0.0142/s Jul 5, 2015

Experimental coinc rate = R_e=1994/18977s = 0.105/s

Corrected R_e= 0.105/s – 0.0142/s = 0.0907/s

Chance rate =$\boxed{R_c=R_1R_2\tau}$=(616/s)(82.9/s)(300ns) =0.0153/s

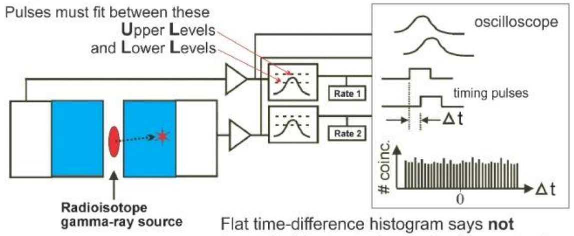
R_e/R_c = 6 times chance

Similar to prior art tests:
- Test of particle part of photon model.
- Δ time histogram.
- Chance equation comparison.

Better because:
- Gamma source was tested to be singly emitting (*one-at-a-time*).
- Pulse height resolution afforded an energy budget.
- Done with different geometries, radioisotopes, detectors, splitters.
- Effect also seen in single detector, and in triple coincidence.
- Performed hundreds of times.

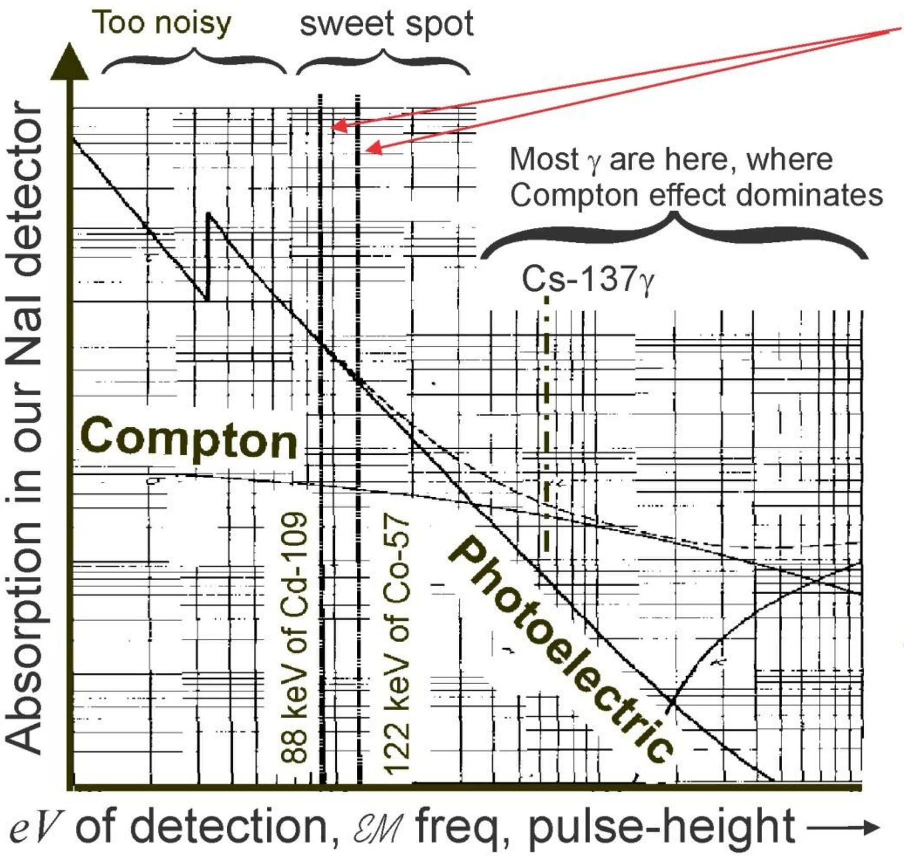
One-at-a-time emission test

Formally called a true coincidence test. Standard procedure in nuclear physics.



Flat time-difference histogram says **not** true coincidence, and emission is *one-at-a-time.*

Why was this effect not previously noticed?



Graph found in Evans, *The Atomic Nucleus.*

There are only two isotopes that:

- emit only one gamma per decay,
- decay to stable,
- have a reasonable half-life and
- have high photoelectric effect efficiency for sources with the above properties.

The photoelectric effect must dominate over the Compton effect to see the unquantum effect. Most sources emit high *eV* γ where the Compton effect dominates. In spectroscopy with NaI and HpGe detectors, the unquantum effect is only visible in two isotopes, Cd-109 and Co-57. High resolution HpGe detectors have photoelectric nearly equal to Compton, making the unquantum effect harder to see. The unquantum effect is *about* the photoelectric effect.

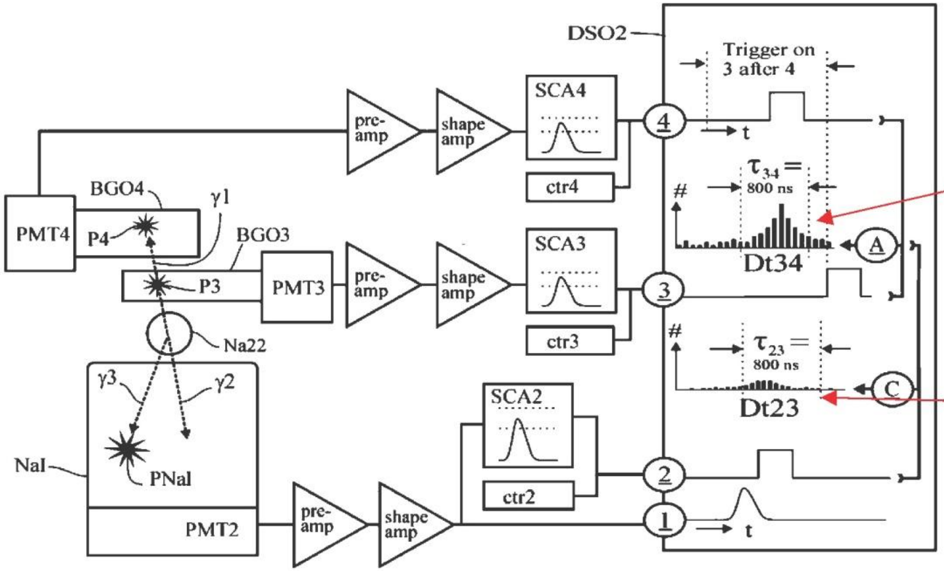
There is a particle biased mindset.

- Describing an experiment in terms of photons will result in photons.
- Short response times in the photoelectric and Compton effects were taken as evidence against ANY loading theory.
- Who would expect the most particle-like light could show that light is not particles?

The sub-quantum effect is about the photoelectric effect.

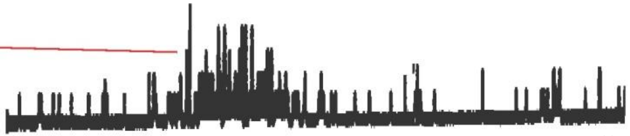
Eric's triple coincidence test with gamma rays

Decay of Na-22 emits a positron and a hotter γ. The positron meets an electron and annihilates into two γ. The hot γ is used as a trigger. One annihilation γ can be caught by a pair of Bismuth Germinate scintillators in tandem. Discriminators pass the proper pulse heights. The Lecroy scope can trigger and record a time-difference histogram for when all three pulses overlap within preset time windows. Using the well known triple chance equation*: $R_{chance} = 3R_2R_4R_3\tau_{12}\tau_{32}$, the ratio $R_{experiment}/R_{chance}$ = ~ 500 x chance.



This is documented in *Particle Violation Spectroscopy* (2008).

This is two detectors reading coincident clicks from one emitted annihilation γ. The discriminator eliminates the hot gamma click. This shows sub-quantum, but I do even better with the trigger method.



Any hint of a peak in this graph reveals the triple coincidence rate exceeding chance. Quantum mechanics fails.

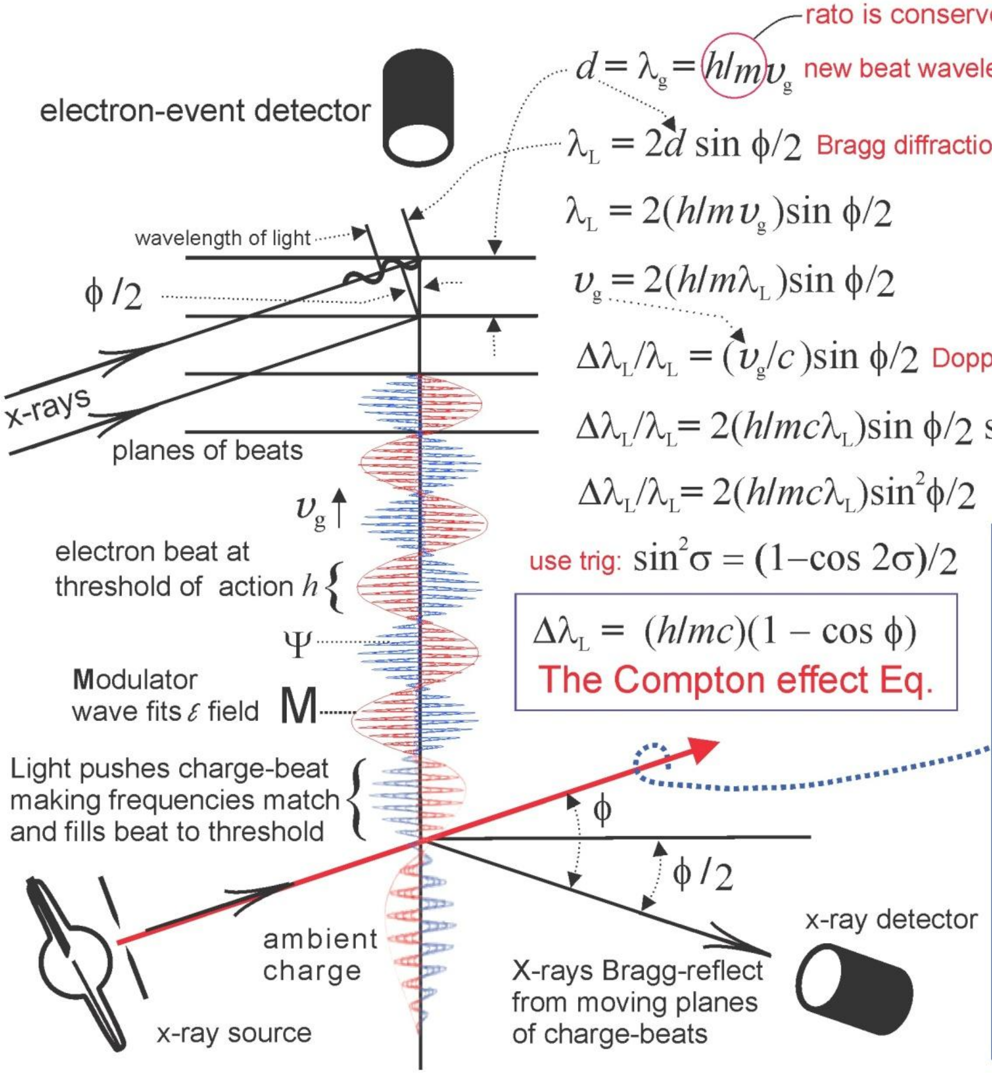
This is my most convincing test. Use of annihilation radiation and a trigger γ eliminates the idea of photon bunching. There are no photons.

---

* "Accidental Coincidences in Counter Circuits" *Physical Review* vol 53 pg 752 (1938) Eckart and Shonka

Compton effect equation by a beat-wave model

In Compton and Allison's book, *X-Rays in Theory and Experiment* **1935**, they derived by the same wave equations shown here. *ER* adjusted it to this beat model. Their derivation was clumsy from assuming that counter propagating de Broglie waves could create beats. Here we recognize Ψ beats as fundamental to charge (as Schrödinger said). Subscripts: g is for group/beat, L is for light.



rato is conserved throughout.

$$d = \lambda_g = (h/m)\upsilon_g$$ new beat wavelength eq.

$$\lambda_L = 2d \sin \phi/2$$ Bragg diffraction Eq.

$$\lambda_L = 2(h/m\upsilon_g)\sin \phi/2$$

$$\upsilon_g = 2(h/m\lambda_L)\sin \phi/2$$

$$\Delta\lambda_L/\lambda_L = (\upsilon_g/c)\sin \phi/2$$ Doppler shift Eq.

$$\Delta\lambda_L/\lambda_L = 2(h/mc\lambda_L)\sin \phi/2 \sin \phi/2$$

$$\Delta\lambda_L/\lambda_L = 2(h/mc\lambda_L)\sin^2\phi/2$$

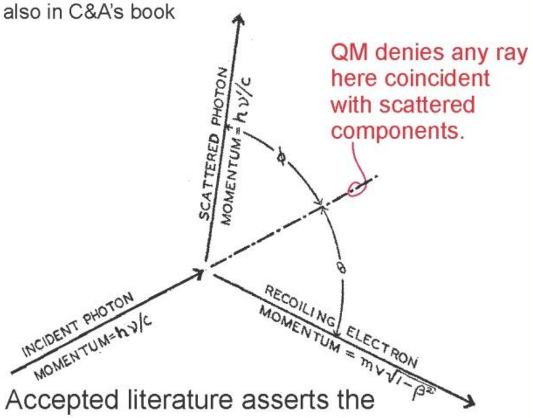
use trig: $\sin^2\sigma = (1-\cos 2\sigma)/2$

$$\boxed{\Delta\lambda_L = (h/mc)(1 - \cos \phi)}$$

The Compton effect Eq.

QM model of Compton effect

also in C&A's book

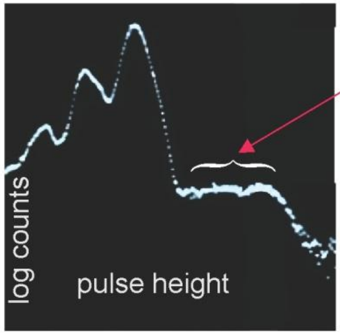


QM denies any ray here coincident with scattered components.

Accepted literature asserts the effect **must** be described this way. It comes from thinking energy conservation requires energy quantization.

QM denies this ray.

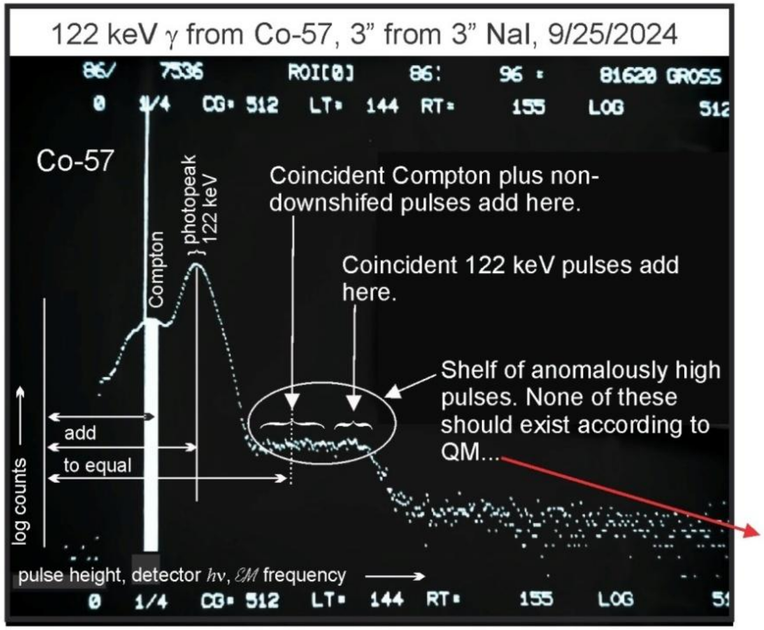
We observe it by a coincidence effect with the down-shifted ray.



In our model, a fraction an incident $h\nu$ can continue undeflected at the original frequency. This explains an anomalous shelf of pile-up in Co-57 γ-ray spectra. This isotope emits one $h\nu$ per atomic decay. Compton-scattered **plus** pulses normally in the photopeak can add within the scintillator to create large pulse-heights that can exceed those normally caused by an incident $h\nu$ by about 1.6. This happens far more often than by chance. QM denies such coincident undeflected rays.

Evidence of non-deflected ray in Compton effect

Non-deflected component in the Compton effect makes non-downshifted pulses that add in coincidence with Compton shifted components.


122 keV γ from Co-57, 3" from 3" NaI, 9/25/2024

Compton light-pulses within the scintillator will add to the 122 keV (usually in photopeak) pulses to create large pulses in a shelf region. Each of the large shelf-region pulses react to singly emitted 122 keV $h\nu$ from Co-57 γ decay. In the shelf region, one decay $h\nu$ can be detected to exceed 1.7 of that original $h\nu$. This is not energy from nothing. It indicates a pre-loaded state, the **sub-quantum effect**. The pre-loaded energy is from previous γ and noise. All rates are in 10 bins.

photopeak 530917/144s = 3687/s = $R_{\text{photopeak}}$

Compton 81620/144s = 567 = R_{compton}

shelf 1072/144s = 7.44/s = R_{shelf}

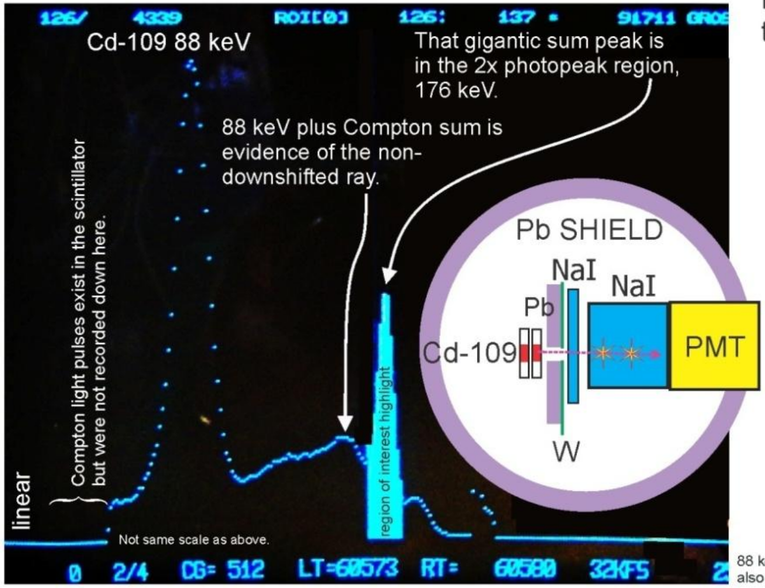
Background at shelf 60/325s = 0.185/s = R_{back}

Time constant τ is much shorter than from scope. τ = 300ns

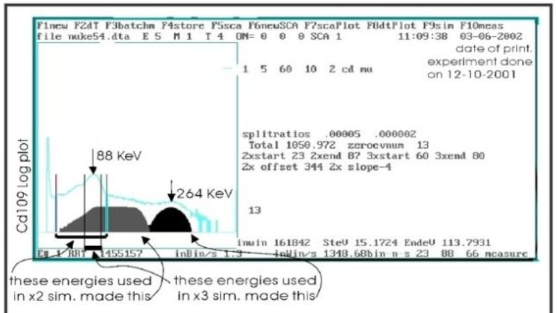
R_{chance} in 10 bins = $2R_{\text{Compton}}R_{\text{photopeak}}\tau$ = 2(567/s)(3687/s)(300ns) = 1.25/s

$(R_{\text{shelf}} - R_{\text{back}})/R_{\text{chance}}$ = (7.44 – 0.185)/1.25 = **5.8 times chance.**

They are not in the spectrum of HPGe detectors, it is not by chance, not in background, not an instrumentation artifact, and not due to high count rate overlap. The scintillator sum method is an easy way to see coincident pulses. Past experimentallists have embraced quantized energy conservation, and therefore did not look for this non-downshifted ray.



88 keV γ passed through a 4mm NaI slab and were detected by a 1.5" NaI. This effect was also true without the thin NaI, with 1.5" NaI, with 3" NaI, 750V and 900V. 6/27-28/2015.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F1new F2dT F3batchm F4store F5sca F6newSCA F7scaPlot F8dtPlot F9sim F10meas
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                                      1  5  60  10  2 cd mu

                                      splitratios  .00005  .000002
                                       Total 1050.972  zerocvnum  13
                                      2xstart 23 2xend 87 3xstart 60 3xend 80
                                      2x offset 344 2x slope-4

                                       13

                                      inwin 161842  SteV 15.1724 EndeV 113.7931
Em 1 RRT 1455157     inBin/s 1.3     inWin/s 1348.68bin-n-s 23  88  66 measure
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Fig. 4. Simulation of sum-peaks from Cd109 spectrum using author's home built swept single channel analyzer and software.

I have studied this anomalous shelf effect in response to γ from Co-57 and Cd-109 in many tests. The shape can vary greatly among different test setups. NaI detectors are required to exceed chance.

I performed a computer simulation in 2002 in an attempt to understand variables in this scintillator sum effect. The details of spectra shape are functions of many variables and call for more study.

Photon Violation Spectroscopy

Practical application and physical insight. These effects require salt-state Cd-109. Patent application of 2005.

Two liquid nitrogen cooled high purity germanium (HPGe) detectors in lead shield. This specific setup was used for the cooled beam splitter test.

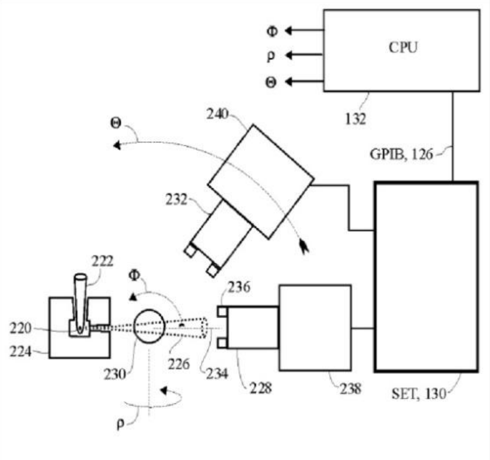
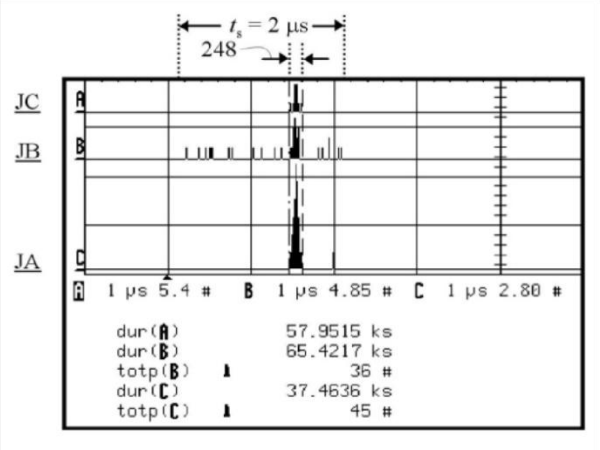


Fig. 12

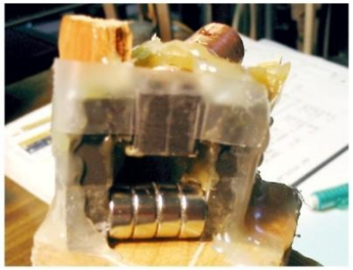


```
A  1 µs 5.4 #    B  1 µs 4.85 #    C  1 µs 2.80 #

dur(A)            57.9515 ks
dur(B)            65.4217 ks
totp(B)    ▲           36 #
dur(C)            37.4636 ks
totp(C)    ▲           45 #
```

Fig. 13 Figure numbers relate to patent application.

Crystallography of atomic bonds. Ratio above chance was enhanced ~44 times after adjusting the angle of silicon wafers. Effect is from electronic Bragg layers, not atomic layers.



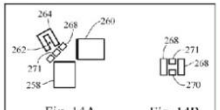


Fig. 14A Fig. 14B

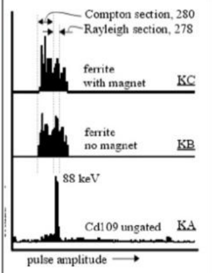


Fig. 15

magnetic effect

Ratio of sub-quantum to Compton effects revealed how a ferromagnetic scatterer had a stiff bond, and a diamagnetic scatterer had flexible bond, as expected.

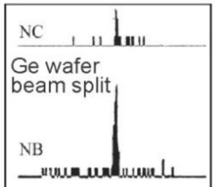


Fig. 19

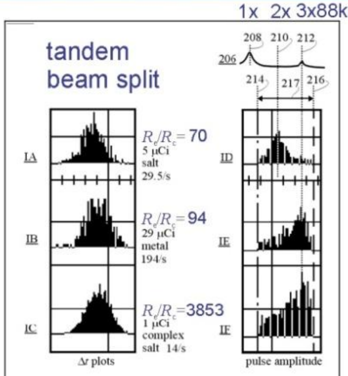


Fig. 11A Fig. 11B

Cd-109 was electroplated to compare metal/crystal states.
Chemical-nuclear influence discovered.
5x increase over metal with salt Cd-109 to Ge beam split.

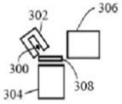
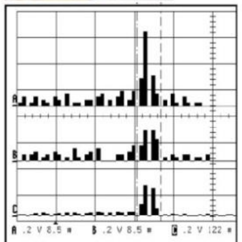


Fig. 17



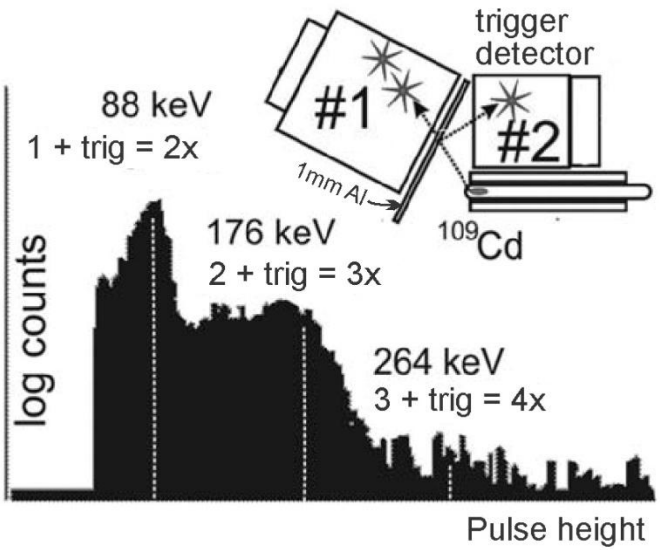
```
A .2 V 8.5 #    B .2 V 8.5 #    C .2 V 122 #

dur(A)             7.20117 ks
totp(A)    ▲            47 #
dur(B)             7.54552 ks
totp(B)    ▲            32 #
points(B)                6
```

Cooling the beam-splitter doubled the sub-quantum effect.

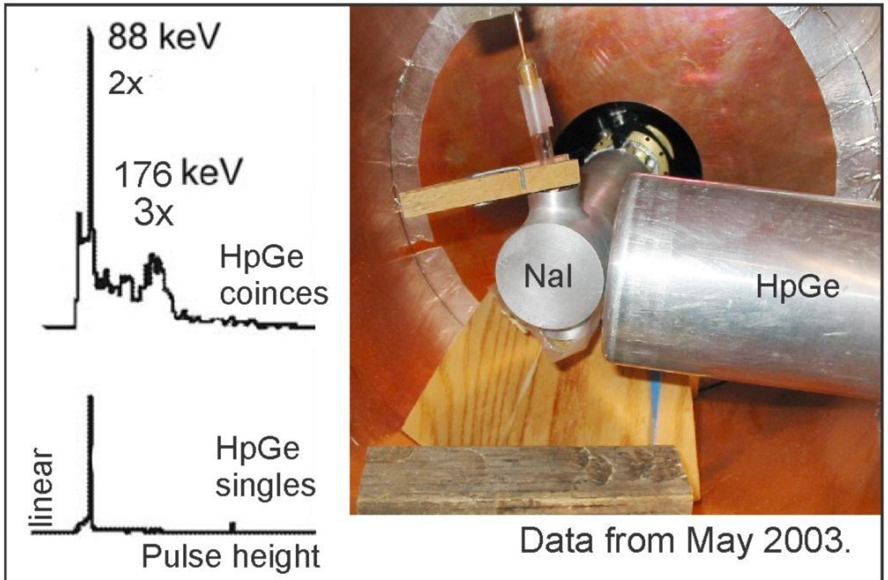
If we see *two-for-one*, we should see 3x, 4x ... We do.

These are coincidence-triggered pulse-height spectra of 88 keV γ from Cd-109. Overlapping coincident pulses within the detector make bigger detection pulses.



Spectrum of #1, triggered by #2. Beam-split using two NaI detectors. 3x split.

Data from 7/26/2002.



Data from May 2003.

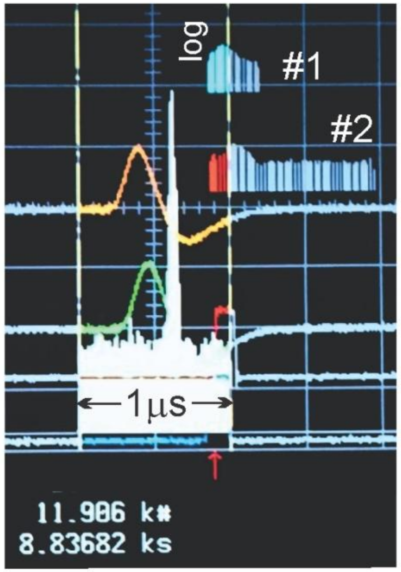
Spectrum of HPGe detector triggered by hollow NaI detector. 3x split. 7 x chance. Pile-ups become larger in a beam-split.

Source to detector distance resonance

Co-57, 100 ns τ window, photopeak only of #1 and including pile-ups of #2

9-Apr-24 12:48:35

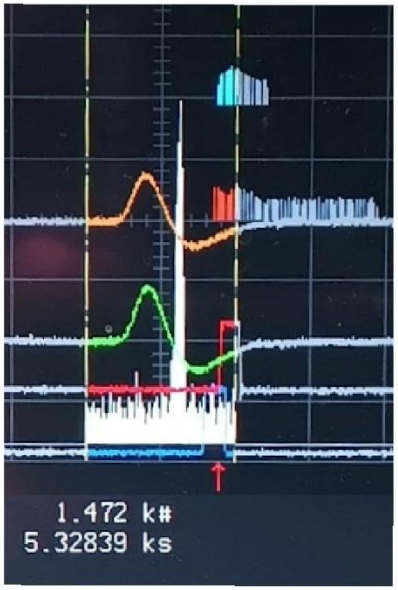
1.875”



2.6 x chance

9-Apr-24 15:36:54

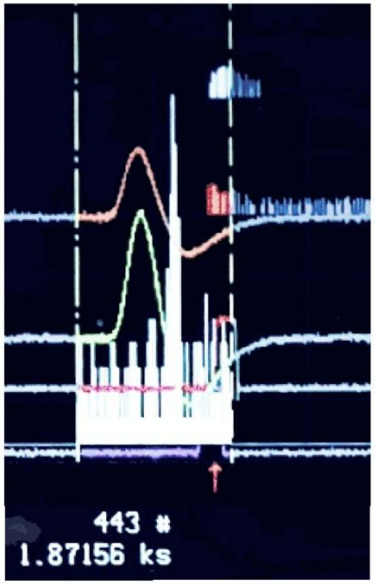
2.25”



5.5 x chance, **Best**.

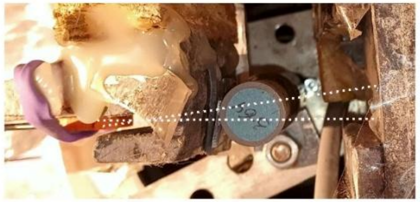
9-Apr-24 19:33:18

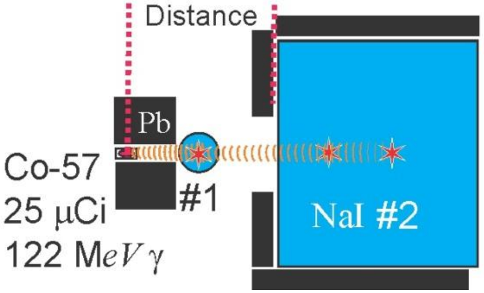
2.5”

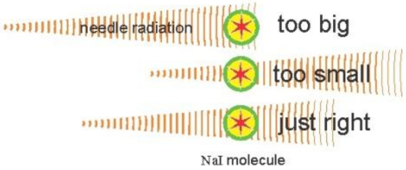


4.4 x chance

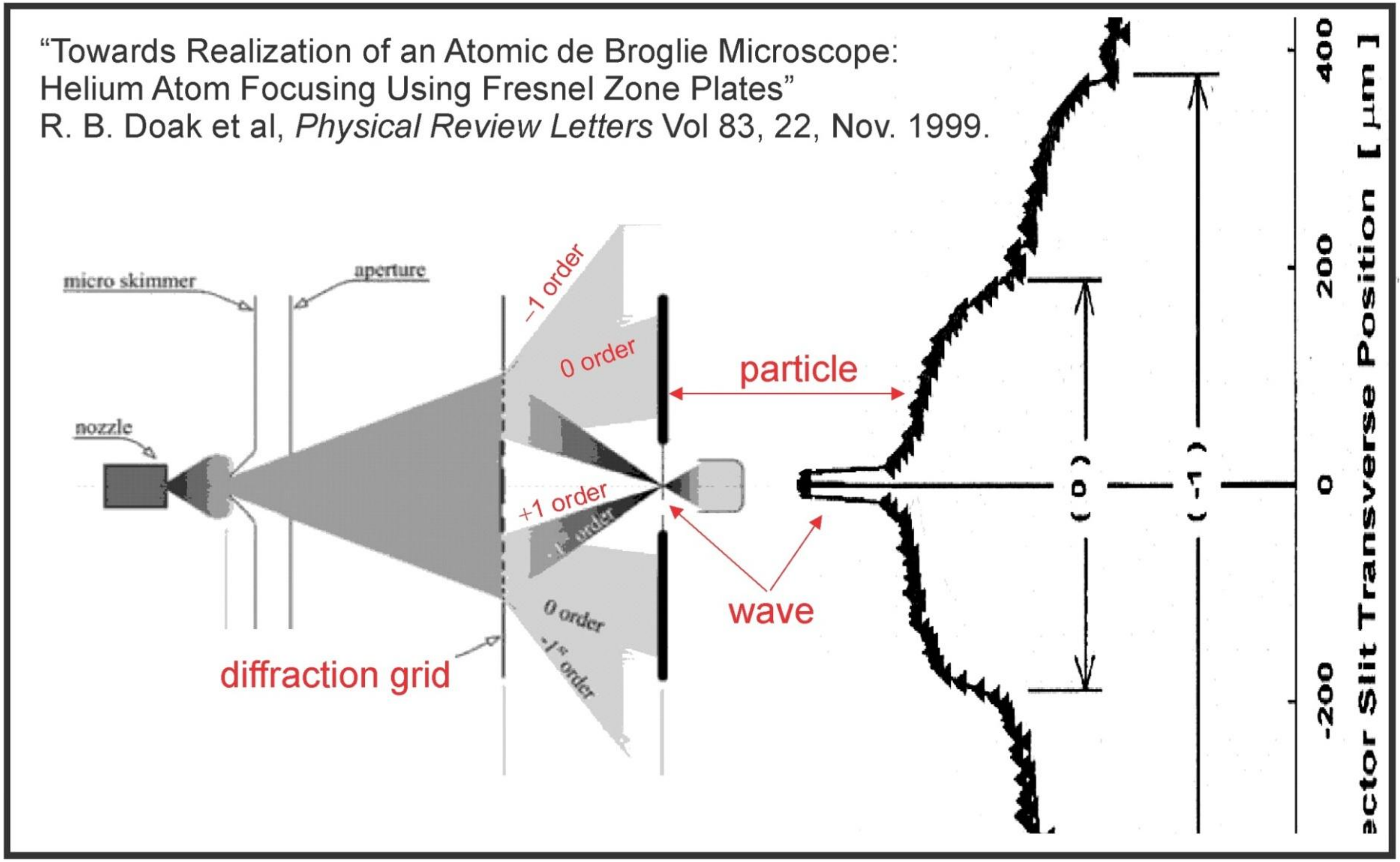
One would think that closer would enhance, but it inhibited the unquantum effect. This suggests a match between the transverse spread of the classical gamma and the molecular absorber size.







What about rest mass?



"Towards Realization of an Atomic de Broglie Microscope: Helium Atom Focusing Using Fresnel Zone Plates"
R. B. Doak et al, *Physical Review Letters* Vol 83, 22, Nov. 1999.

Particle-path and matter-wave (de Broglie) signatures reveal that helium has **two states**, like solitons. The authors admit these two signatures.

Can QM probability-waves explain such dual states?

Click for video from our Oct 2023 Meetup.
Dr Vedral asks for this all-important test. He did not know of my α−split test, stating no one did any such test of the matter-wave.
https://drive.google.com/file/d/1YjATQiTNCfIKkmqYfQlNRDCWguidYK72/view?usp=sharing The entire lecture: https://www.youtube.com/watch?v=VDH3vvKGveQ

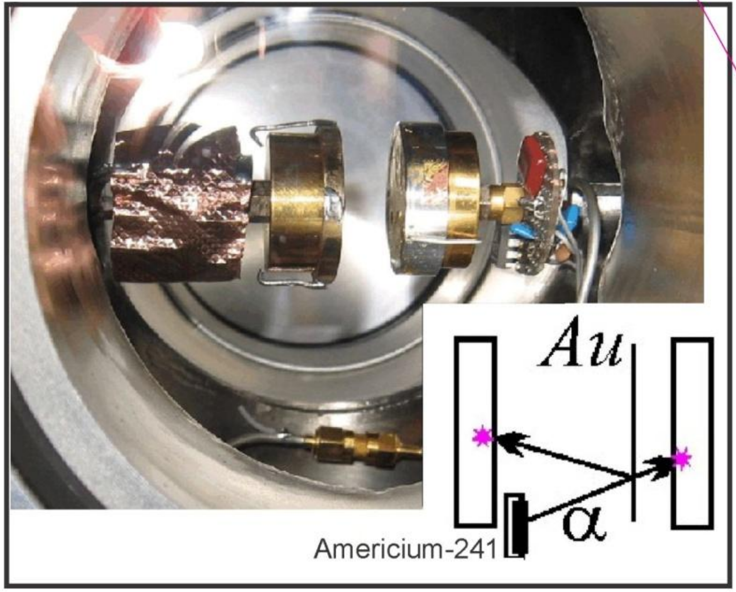
Beam-split test with alpha-rays

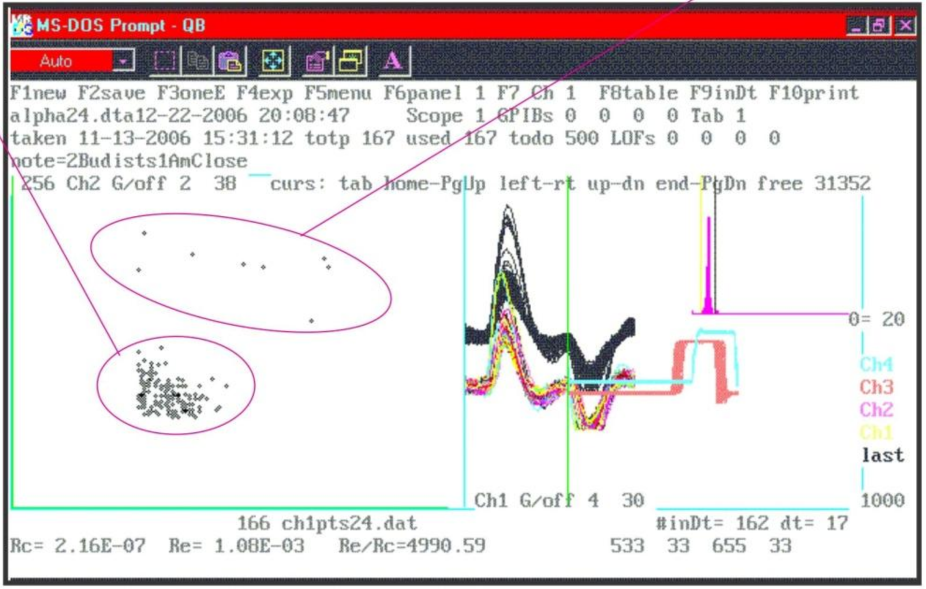
Singly emitted alpha-rays from Am-241. Gold leaf beam-splitter.

Matter-waves are not probability-waves. Mass and charge are thresholds.

102 x chance for half-height pairs.
*K*inetic *E*nergy is too low to split into deuterons. Can be interpreted as lowered *KE* at detectors, with $Q_{\text{charge/mass}}$ of α.

4 x chance for full-height pairs.
This is elemental two-for-one!



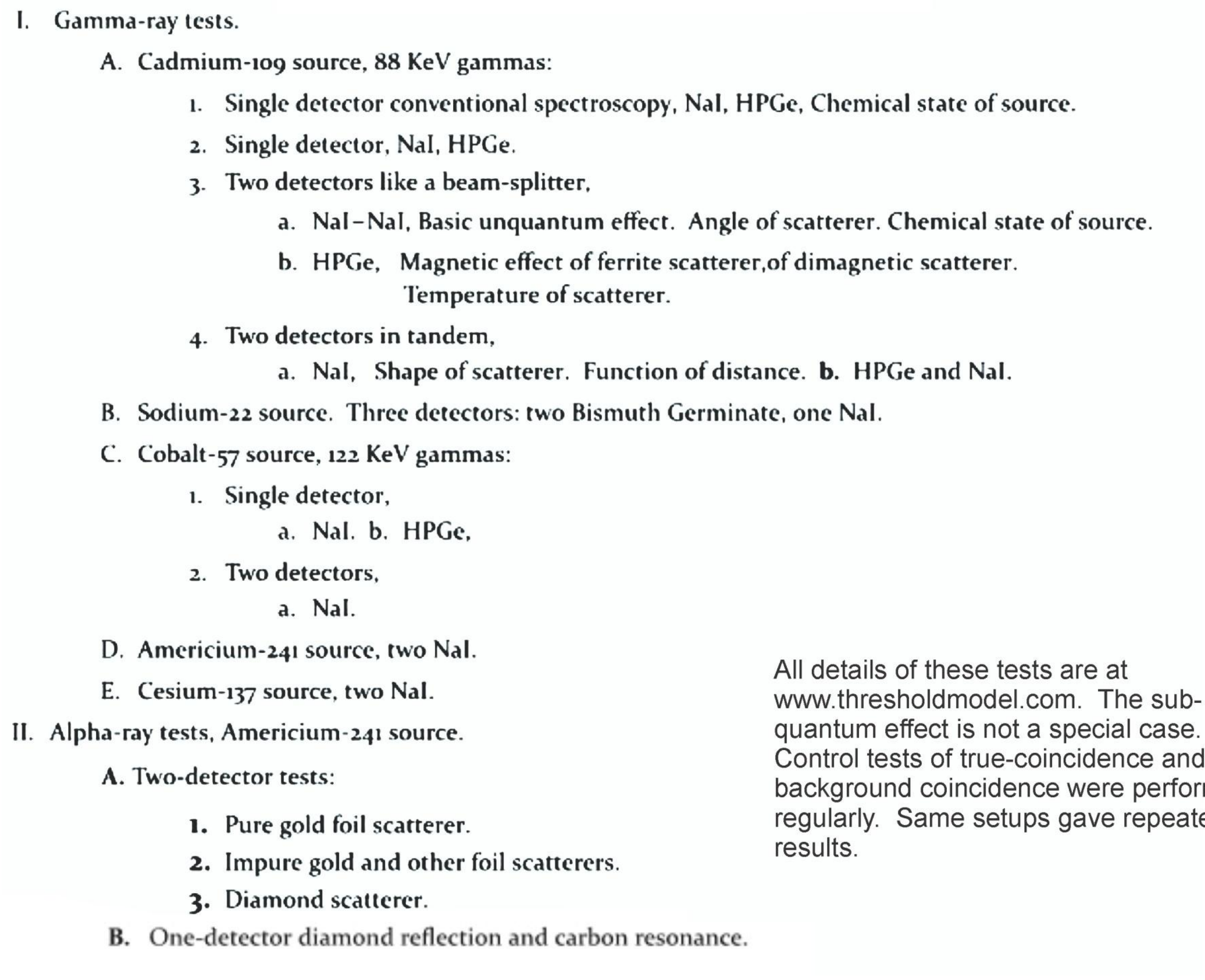


```
F1new F2save F3oneE F4exp F5menu F6panel 1 F7 Ch 1  F8table F9inDt F10print
alpha24.dta12-22-2006 20:08:47      Scope 1 GPIBs 0  0  0  0 Tab 1
taken 11-13-2006 15:31:12 totp 167 used 167 todo 500 LOFs 0  0  0  0
note=2Budists1AmClose
 256 Ch2 G/off 2  38   curs: tab home-PgUp left-rt up-dn end-PgDn free 31352
                                                            0= 20
                                                            Ch4
                                                            Ch3
                                                            Ch2
                                                            Ch1
                                                            last
                                    Ch1 G/off 4  30         1000
               166 ch1pts24.dat                   #inDt= 162 dt= 17
Rc= 2.16E-07  Re= 1.08E-03   Re/Rc=4990.59          533  33  655  33
```

The experiment was automated to see pulse-heights for each coincident pair. X=Ch1, Y=Ch2. Am-241 5.5 MeV α, 895 min, 2 cm dia Ortec detectors 9 mm apart, 2 layers 24 k gold leaf, background = 1 count/3 days, Nov 8-13, 2006, all perfect pulses, a true coincidence test revealed no trues.

References. **2015** Reiter, E. S. "New experiments call for a continuous absorption alternative to the photon model," *The Nature of Light: What Are Photons? VI conference*. doi:10.1117/12.2186071 /12.2186071. "Particle Violation Spectroscopy," US patent application filed January 9, **2008**. https://patents.google.com/patent/US20080173825. See link from website https://www.thresholdmodel.com

Index of successful sub-quantum effect tests



I. Gamma-ray tests.
  A. Cadmium-109 source, 88 KeV gammas:
    1. Single detector conventional spectroscopy, NaI, HPGe, Chemical state of source.
    2. Single detector, NaI, HPGe.
    3. Two detectors like a beam-splitter,
      a. NaI – NaI, Basic unquantum effect. Angle of scatterer. Chemical state of source.
      b. HPGe, Magnetic effect of ferrite scatterer,of dimagnetic scatterer.
        Temperature of scatterer.
    4. Two detectors in tandem,
      a. NaI, Shape of scatterer. Function of distance. **b.** HPGe and NaI.
  B. Sodium-22 source. Three detectors: two Bismuth Germinate, one NaI.
  C. Cobalt-57 source, 122 KeV gammas:
    1. Single detector,
      a. NaI. b. HPGe,
    2. Two detectors,
      a. NaI.
  D. Americium-241 source, two NaI.
  E. Cesium-137 source, two NaI.

II. Alpha-ray tests, Americium-241 source.
  A. Two-detector tests:
    1. Pure gold foil scatterer.
    2. Impure gold and other foil scatterers.
    3. Diamond scatterer.
  B. One-detector diamond reflection and carbon resonance.

All details of these tests are at www.thresholdmodel.com. The sub-quantum effect is not a special case. Control tests of true-coincidence and background coincidence were performed regularly. Same setups gave repeated results.

The action constant h is a threshold and a property of matter, not light.

The mass constants like m_{electron}, m_{proton}... are thresholds.

The ratios are quantized. The constants are thresholds.

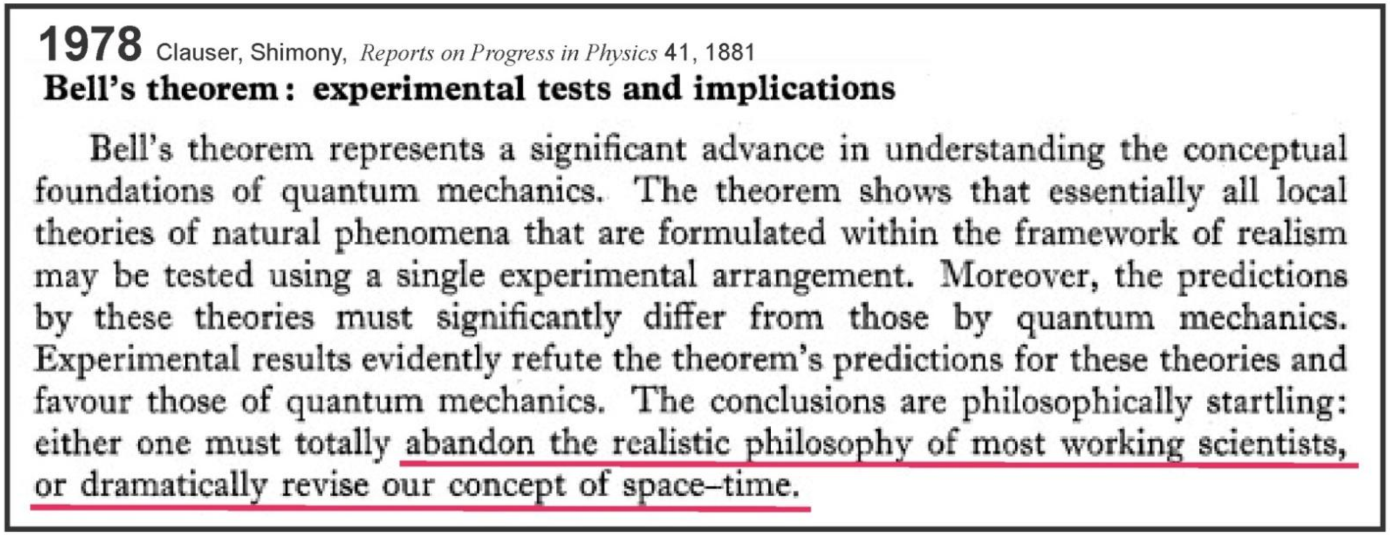
Matter has two states, like a soliton.

There is no macroscopic entanglement.

“Photon” is a false model.

The sub-quantum state is the hidden variable that Bell theory overlooked.

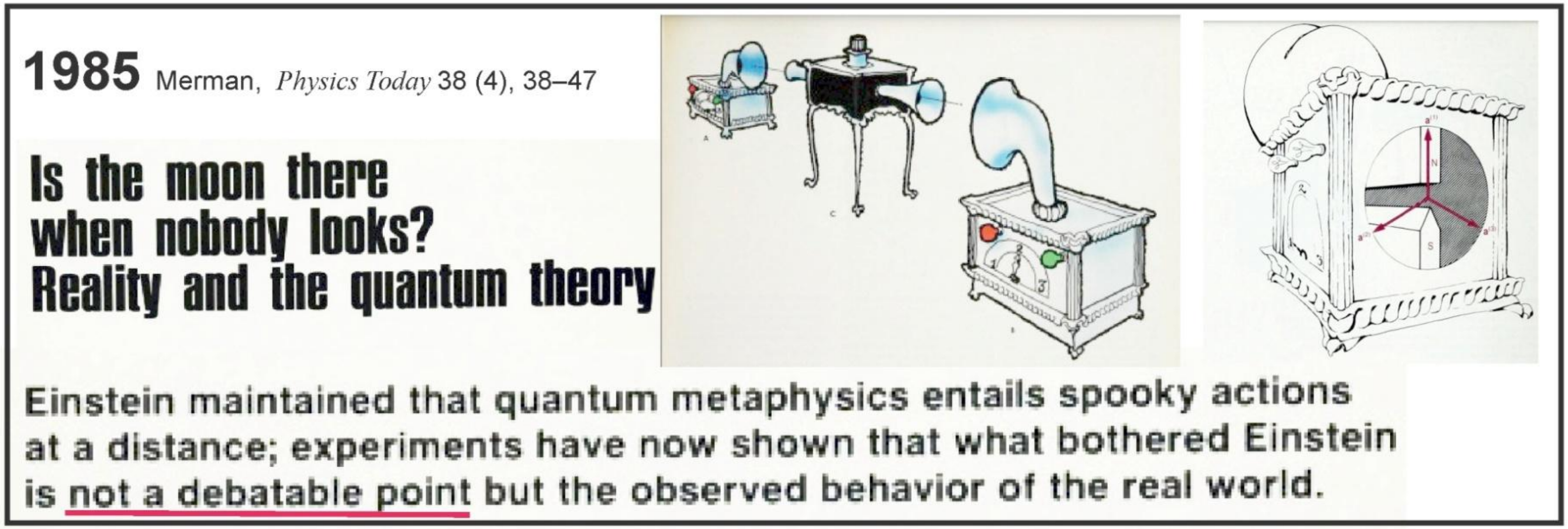
They really mean it.



1978 Clauser, Shimony, *Reports on Progress in Physics* 41, 1881

Bell's theorem: experimental tests and implications

Bell's theorem represents a significant advance in understanding the conceptual foundations of quantum mechanics. The theorem shows that essentially all local theories of natural phenomena that are formulated within the framework of realism may be tested using a single experimental arrangement. Moreover, the predictions by these theories must significantly differ from those by quantum mechanics. Experimental results evidently refute the theorem's predictions for these theories and favour those of quantum mechanics. The conclusions are philosophically startling: either one must totally abandon the realistic philosophy of most working scientists, or dramatically revise our concept of space–time.



1985 Merman, *Physics Today* 38 (4), 38–47

Is the moon there when nobody looks? Reality and the quantum theory

Einstein maintained that quantum metaphysics entails spooky actions at a distance; experiments have now shown that what bothered Einstein is not a debatable point but the observed behavior of the real world.

By Bell, detection only considers hidden variables within an arriving particle. There was no consideration of a hidden sub-quantized energy state within the detector. Therefore my discovery shows that Bell and QM are both wrong.

We encourage describing an experiment in **terms** of the experiment.

Models	**electromagnetic**		**matter, rest mass**		
classical wave	light, ray, wave		water wave, sound wave		
classical particle			molecule, planet		
experiment oriented	wave state	detection state	wave state	particle state	detection state
	light, ray, wave	click, event, *hν*	charge wave, proton wave, ...	electron, proton, ...	electron event, proton event, ...
QM terminology	photon; not a thing	*hν*, photon	probability.		electron proton, atom...
Threshold Model	**light, ray, wave**	**click, event, *hν***	**charge wave, proton wave, ...**	atom	**electron event, proton event, ...**
	light is never a particle		rest mass has two states		

...because QM has no visualizable model.

The photon has always been a model, not a thing. Consider changing the definition of the word, whereby a “photon energy” term is expressed <u>only</u> at a detector click.

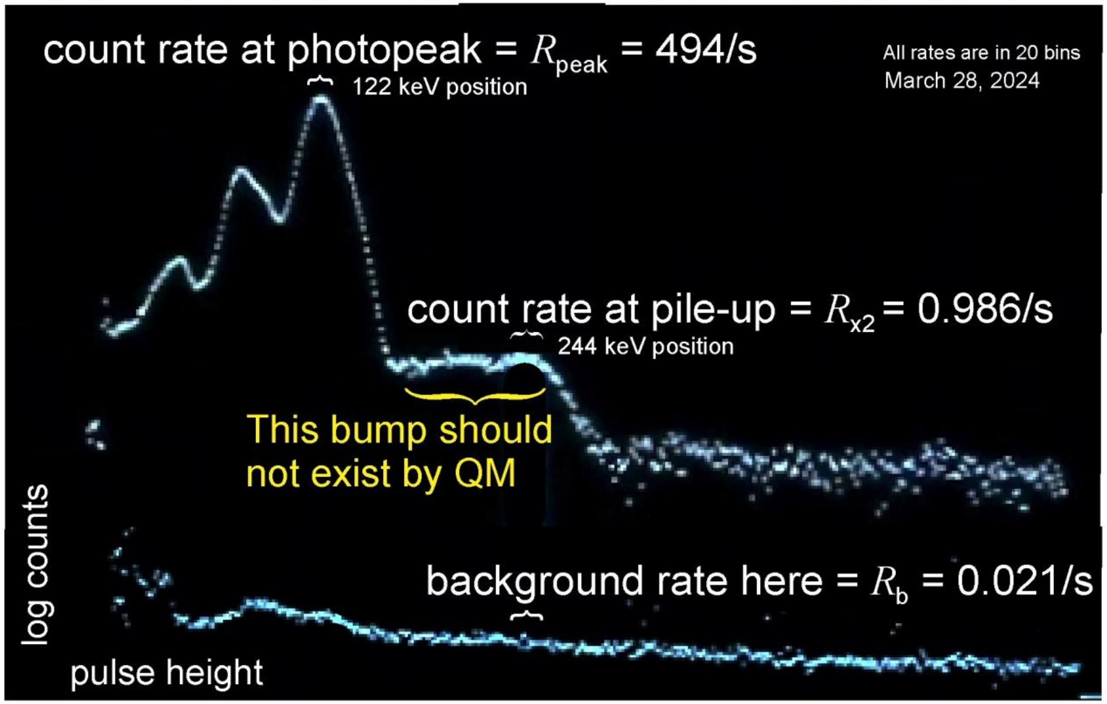
Better yet, call a detection energy by a new name, *hν* (pronounced *h-new*) in honor of Planck.

If you have any doubt, do this easy test.

Sub-quantum effect is readily seen in a simple γ-ray spectra
Scintillator light pulses add to make a twice-high sum-peak.
Calculation shows coincidence rate exceeds chance.

Atlantic Nuclear sells the 25 µCi Co-57 check source. Most undergraduate physics departments will have the gamma spectrometer.

25 µCi Co-57, 2” from 3” dia. NaI detector. Large detector required.



count rate at photopeak = R_{peak} = 494/s

122 keV position

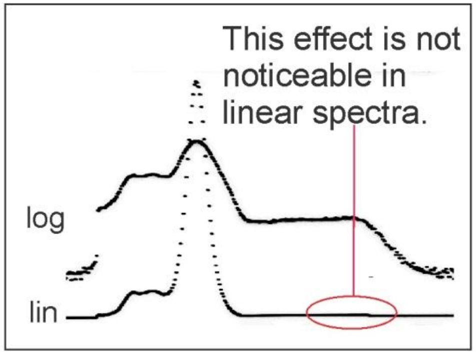
All rates are in 20 bins
March 28, 2024

count rate at pile-up = R_{x2} = 0.986/s

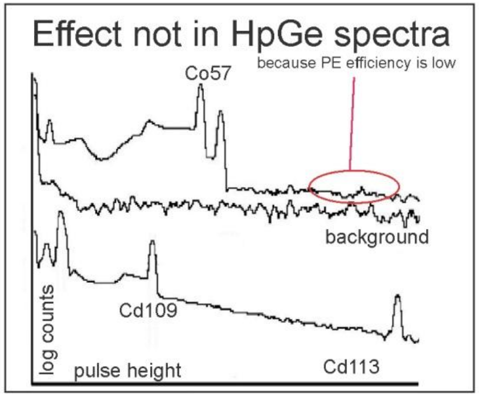
244 keV position

This bump should not exist by QM

background rate here = R_b = 0.021/s



This effect is not noticeable in linear spectra.

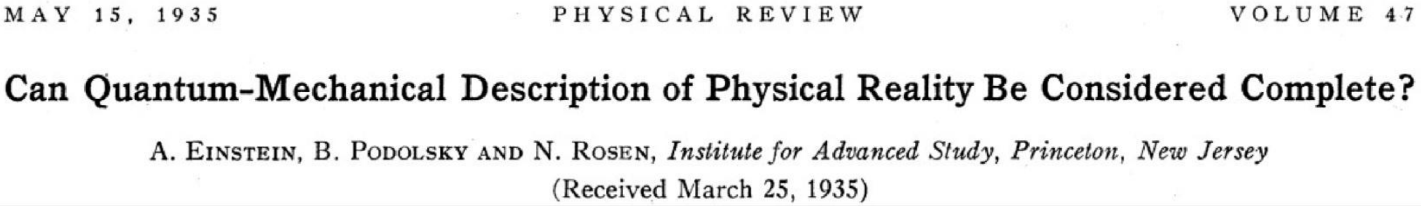


Effect not in HpGe spectra

because PE efficiency is low

The time constant for NaI scintillations is within τ = 300ns. Subtracting background at pile-up, R_{x2} = 0.947/s.

Chance rate at pile-up = $\boxed{R_{\text{chance}} = 2(R_{\text{peak}})^2\tau}$ = 2(494/s)^2(300ns) = 0.146/s. R_{x2}/R_{chance} = **6 x chance.**

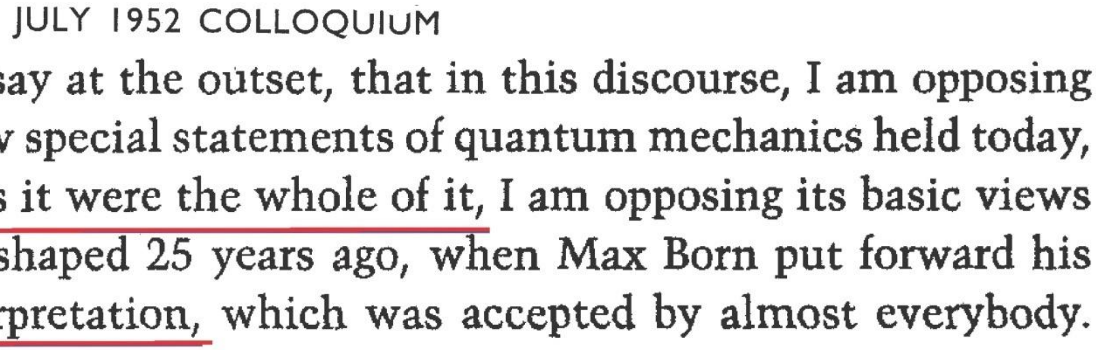


MAY 15, 1935 PHYSICAL REVIEW VOLUME 47

Can Quantum-Mechanical Description of Physical Reality Be Considered Complete?

A. EINSTEIN, B. PODOLSKY AND N. ROSEN, *Institute for Advanced Study, Princeton, New Jersey*
(Received March 25, 1935)

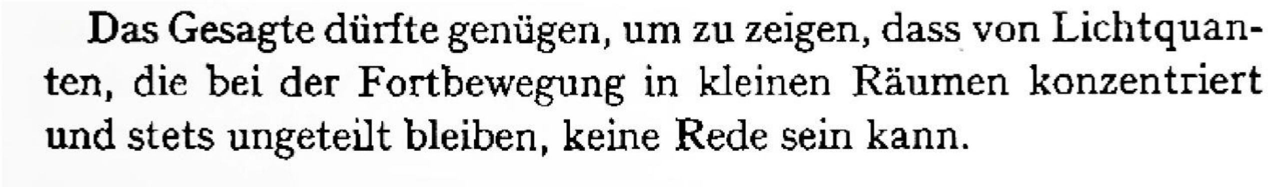
Schrodinger



JULY 1952 COLLOQUIUM

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.

1910 Lorentz “Die Hypothese der lichtquanten” *P. Zeit*. 1910 page 349.



Das Gesagte dürfte genügen, um zu zeigen, dass von Lichtquanten, die bei der Fortbewegung in kleinen Räumen konzentriert und stets ungeteilt bleiben, keine Rede sein kann.

“The preceding discussion should suffice to show that one cannot speak of a light quantum that remains undivided and spatially concentrated."

I stand with Einstein, Schrödinger, and Lorentz.

Please write me: esreiter2024@thresholdmodel.com