Experimental Quantum Mechanics

August 2025

Dear Fellow Researchers,

I have been working to understand the particle wave duality in physics. If anyone wants to actually discuss the mathematics, just let me know and we can do a Meetup, Zoom or Whatsapp, or if you still live in Minnesnowta - Live and in Person!

I finally can derive the single photon wave equation on a single plane, in a vacuum from Maxwell's Equations, and am drudging along following Zbigniew Ficek's Quantum Physics text book. It appears that Maxwell's Equations are the key to understanding the photon and electro-magnetic waves. It's apparent that there is no real photon, but disturbance in the medium that causes the wave.

What this disturbance is , we shall find out.

Photons have no mass according to Einstein E=MC^2

Objects with mass , like quarks and electrons only makes up 1-5% of total mass. Different papers cite different numbers but they all add up to a very small percentage of things we call mass.

What is the 98% else made up of?

Quarks are held together by Energy and its my understanding that when we speak of mass, M=E/C^2 , we really are speaking of Energy divided by C^2. NO MASS, just Energy/C^2 Now about the 1-5% quarks and electrons, where do they get their mass?

Well , thanks to ChatGPT:

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The relationship between quarks, electrons, and the Higgs field lies in how these fundamental particles
acquire mass.

  1. The Higgs Field:
     The Higgs field is an invisible quantum field that permeates all of space. According to the
Standard Model of particle physics, particles acquire mass through their interaction with this field.
     The stronger a particle interacts with the Higgs field, the more mass it has.
     This mechanism is called the Higgs mechanism.

  2. Quarks and Electrons in the Higgs Field:
     Both quarks (which make up protons and neutrons) and electrons are fermions (matter particles),
and they interact with the Higgs field to acquire mass.

The Process:
  Each fermion type couples to the Higgs field via a Yukawa coupling (a type of interaction).
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I was reading about Physicist David Bohm's work on electron/photon trajectories. He apparently came up with a description of particles going through the two slit experiment now called The Bohmian Trajectories and what we now call

Broglie-Bohm Theory or Bohmian Mechanics

David Bohm's work on hidden variables led to the John Bell's work on the Bell Inequality theorem

Here is a short description about Bell and links to his two published papers

physics.aps.org/articles/v18/53

John Bell's second paper was what got him the Nobel Prize in Physics 2022

Bell took a philosophical experimental concept and mathematically proved the idea of no hidden variables and brought forth the concepts of quantum entanglement, locality, non-locality and causality to the forefront of modern quantum physics.

This next link is a bit larger read , but does bring in a new topic (#8) which makes it the more interesting, because it brings forth some philosophical concepts.

plato.stanford.edu/entries/bell-theorem/

"The correlations between a pair of entangled particles — how often both were polarized vertically — could be used to differentiate local hidden-variable theories from quantum mechanics."

So, the experiment, which by the way , has been proven and published in many prominent journals and which we were planning on conducting

John Bell's work disproved the EPR (Einstein, Podesky, Rosen) thought experiment in which they claimed that Quantum Theory was incomplete due to paradoxes found in the theory.

Einstein even called non-locality "Spooky Action at a distance"

EPR were Classical Theorists with a new concept of Relativity, so not necessarily on board with Quantum concepts.

Here is the archived description about EPR thought experiment

Anyhow, David Bohm helped with the idea of proprioception

Which in turn , the idea of Holonomic brain theory

Which describes how consciousness is formed by quantum effects.

It differs from traditional neuroscience, what some of you study.

What are your thoughts on electric oscillations in the brains dendritic webs instead of axons and synapses?

Ciao,

CJM de Carreon

References:

- Experimental loophhole-free violation of a Bell inequality using entangled electron spins separated by 1.3km

Web Links:

- GitHub - dmidem/bell-test: Simulation of a quantum experiment with entangled particles to check Bell's theorem javascript
- Double-slit experiment that proved the wave nature of light explored in time
- 20 Quantum Physics Books for Free! - PDF

YouTube links

- Double Slit Experiment 02 youtube vid randomVids
- Quantum Entanglement lab youtube link Scientific American
- Zeilingers experiment with entangled photons (U1-11-03)

local notes:

- Notes on experiments: notes.txt
- Sept 2024 email on quantum mechanics
- Sept 2024 email on equipment required

pdf's

- Bells Inequality Theoretical framework :
- Update bases for starting :

Math Science Local Links

- r-quantum.sh www/quantum.md
- r-physics.sh www/physics.md
- r-calculus.sh www/calculus.md
- r-math.sh www/math.md
- Math Directory

Explore Online Computations

- wolframalpha
- online MATLAB - FREE 20 hours/month
- www.physicsforums.com/ dunnowhat2say Kr3@to8386 alumni.umn.edu
- www.physicsforums.com/insights/

Experimental Quantum Mechanics

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The Nobel Prize in Physics 2022 was awarded jointly to Alain Aspect, John F. Clauser and Anton
Zeilinger "for experiments with entangled photons, establishing the violation of Bell inequalities and
pioneering quantum information science"
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Quantum Entanglement

- wiki definition phenomenon where the quantum state of each particle in a group cannot be described independently of the state of the others, even when the particles are separated by a large distance.

Light Properties

- wiki Einstein - Podolsky - Rosen Paradox - physical reality is incomplete - proven wrong
- wiki David Bohn - implicate and explicate order brain at cell level works w/ quantum effects

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David Joseph Bohm - thought and distortion of perception
Thought proceeds as if it is merely reporting objectively, but in fact, it is often coloring and
distorting perception in unexpected ways. What is required in order to correct the distortions
introduced by thought, according to Bohm, is a form of proprioception, or self-awareness. Neural
receptors throughout the body inform us directly of our physical position and movement, but there is no
corresponding awareness of the activity of thought.
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- Concept of ProPrioperception - sense of self movement, force and body position
- Holonomic brain theory

online PDF's
some are downloaded

- Problems and Solutions on Quantum Mechanics compiled list
- Solved Problms and Quantum mechanics in one dimension

- Solved Quantum Mechanics : 500 problems with solutions

Symbols and Proofs

- check Obsidian -> MATH -> Proofs
- Ali the Dazzling - equations Maxwells Equations
- Ali the Dazzling - explains equations Maxwells Equations
- Divergence and curl : Maxwells equations 3Blue1Brown
- what is a partial derivative - symbols explained
- cleo math proofs integrals solved my unknown
- math symbols
- math symbols glossary
- proof symbols used in math
- free proof math books
- Excellent Proof writing book for beginners : JAY Cummings Proofs - A long-form mathematics textbook
- amazon long form proofs $20
- answers to longform proofs from amazon
- real analysis Jay Cummings
- "Book Of Proof" - Best Math Text
- Wohlgemuth's Introduction to proofs does a better job of clarifying the use of inferences.
- Wohlgemuth also emphasizes formal stepwise writing skills early in the text.

Quantum Mechanics

Sabine Hossenfelder

- sabine hossenfelder - Quantum Mechanics playlist
- Understanding Quantum Mechanics: Schrödinger's Cat Experiments
- Understanding Quantum Mechanics #1 it's not discrete
- Understanding Quantum Mechanics #2 superposition
- Understanding Quantum Mechanics #3 non-locality
- Understanding Quantum Mechanics #4 bra-ket Dirac notation
- Understanding Quantum Mechanics #5 decoherence
- Understanding Quantum Mechanics #6 non-locality
- Understanding Quantum Mechanics #7 atomic energy levels
- Understanding Quantum Mechanics #8 the tunnel effect

Physics forums articles

- 7 basic rules of quantum mechanics

What is a photon?

- Photons illuminated: a gentle intro to quantum optics
- why no one has measured the speed of light

Quantum Mechanics random links

- Bell's Theorem - The Quantum Venn Diagram Paradox
- loop quantum gravity

- search pbsspacetime
- great video on quantum entanglement lab -Scientific American
- domainofscience :quantum wavefunction explained
- what is a field quantum fields: the real building blocks of the Universe
- ww.reddit.com/r/quantum
- Quantum 101 from Perimeter Institute of Theoretical Physics - playlist
- what is Schrodinger Equation? basic intro to Quantum mechanics
- arvin ash physics : entanglement theory may reveal a reality we can't handle
- quantum entanglement links
- The secrets of Einstein's unknown equation with Sean Carroll
- Veratasium - Math / Physics channel
- Eric Weinstein - on the collapse of string theory
- Eric Weinstein - the real physics questions we're ignoring - Eric Weinstein
- what if space and time are not real
- top theories on reality
- quantum consciousness debate
- trillion dollar equation - Black Scholes formula - stock market / physicists
- ww.reddit.com/r/quantum
- Quantum 101 from Perimeter Institute of Theoretical Physics - playlist
- Bell's Inequality: The weirdest theorem in the world | Nobel Prize 2022
- Bell's Inequality: | quantum entanglement with bbo crystal animated
- what is Schrodinger Equation? basic intro to Quantum mechanics
- arvin ash physics : entanglement theory may reveal a reality we can't handle
- Leonard Susskind - Quantum origins of gravity holographic universe
- soviet era math
- how to self study math
- decoding alien message
- mind blowing math facts
- Great new channel Braver new math

Physics explanations

- double slit experiment explained
- Ali_the_Dazzling The Wave Equation Simplified
- Ali_the_Dazzling You don't understand Maxwell's equations
- need partial derivatives and integral calculus : 4 Maxwell equations easy to understand
- math required to study theoretical physics
- integrals explained
- domainofscience :schrodinger equation explained in 60 seconds
- parth G : Schrodinger equation explained
- schrodengers equation explained in symbols
- parth G : Why Lagrangian Mechanics is BETTER than Newtonian Mechanics F=ma | Euler-Lagrange Equation

Quantum Optics and quantum field theory

- 1. There are no particles, there are only fields
- 2. Essential Quantum Optics
- 3. Quantum Field Theory, as Simply as Possible
- 4. Tales of the Quantum Understanding Physics' Most Fundamental Theory
- 5. Demonstration of the Casimir Force
- 6. Quantum Vaccum - intro to quantum electrodynamics
- detectors for vacuum states - balanced homodyne detectors in QFT

random quantum papers, requirements etc

- https://www.quantumvisions.net/en/
- bell's theorem : The quantum venn diagram paradox
- Quantum 101 from Perimeter Institute of Theoretical Physics - playlist
- Bell's Inequality: The weirdest theorem in the world | Nobel Prize 2022
- what is Schrodinger Equation? basic intro to Quantum mechanics
- arvin ash physics : entanglement theory may reveal a reality we can't handle
- Leonard Susskind - Quantum origins of gravity holographic universe
- Zeiingers experiment with entangled photons (U1-11-03 youtube
- bells theorum: The quantum venn diagram paradox : minutephysics **
- proving quantum entanglement is real
- how do you create quantum entanglement? downloaded)
- random quantum physics books
- list of free pdf books on quantum mechanics
- crystal requirements for BBO crystal
- crystal requirements for BBO crystal tiny.cc/k565
- laser requirements ebay
- quantum entanglement with Barium borate crystal bing.com search
- spontaneous parametric down coversion
- Bing search term: "clausen's paper on detecting bell's inequalities pdf"
- Proof of Bells Theorem : Lorenzo Maccone AJOP

Quantum Experiments Youtube

- looking glass universe: Indian girl - what is a wavefunction
- quantum entanglement magic trick - splitting UV photons in half - short
- parametric downconversion :this crystal can split light particles - BBO crystal
- how to produce entanglement
- qr theory no one wants to talk about
- quantum entanglement by scientific american
- time travel in quantum entanglement
- Zellingers experiment with entangles photons

random links

- Evidence of Van der Waals adhesion in gecko setae - quantum adhesion (molecular bonding) of gecko
- Observing gain induced group delay multi photo pulses generated in spontaneous down-conversion

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Optical experiments
beta barium borate crystal  ebay $40 https://www.ebay.com/itm/265761835586
uvlaser pointer https://www.ebay.com/itm/355891096029

Transparency: BBO crystals have a wide transparency range, from the ultraviolet (185 nm) to the near
infrared (3.5 µm).
Phase matching: BBO crystals have a broad phase-matching range.
Nonlinear coefficient: BBO crystals have a large nonlinear coefficient.
Damage threshold: BBO crystals have a high damage threshold.
Thermal acceptance bandwidth: BBO crystals have a wide thermal acceptance bandwidth.
Wavefront distortion: BBO crystals have low wavefront distortion.
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Materials list for Zellingers Technique

- YCOB Yttrium Calcium Oxy borate - free sample
- Specs on YCOB crystal from crylink.com pdf
- CRYLINK.com manufacturing process and specs
- ebay crystal $40

References

- Investigation on nonlinear characteristic, weak absorption and damage of Tm doped YCOB
- Amir Yacoby - Theoretical Physicist
- spacial configuration determination on YCOB crystal ~