$$e^{i\pi} + 1 = 0$$

$$\frac{4}{\sqrt{\Phi}} \approx \pi$$

Quantum Theory and Consciousness

Master: *By what light do you see?*
Disciple: *The sun by day, the lamp by night.*
M: *By what light do you see these lights?*
D: *The eye.*
M: *By what light do you see the eye?*
D: *The mind.*
M: *By what light do you know the mind?*
D: *My Self.*
M: *You then are the Light of Lights.*
D: *Yes, That I am.*
EKASLOKI, BY SHANKARACHARYA

$$\sum_{n=1}^{\infty} n = -\frac{1}{12}$$

$$\phi^2 - \phi = 1$$

$$F_n = \frac{2}{\sqrt{5}}(-i)^{n-1}\sin\left[n\left(\frac{\pi}{2} - i\ln\phi\right)\right]$$

20th Century Paradigma Revolution

20th century:

- Theory of Relativity: Albert Einstein undermined Newton's mechanics, absolute space and time.

- Quantum Mechanics: Rutherford, Planck, Bohr, Dirac, Heisenberg undermined Newton and Einstein.

- Incompleteness theorem: Kurt Friedrich Gödel (1930) limits of mathematical logic.

21st century:

- String Theory – Holographic Universe

- Artificial Intelligence

20th Century Paradigma Revolution

20th century:

- Theory of Relativity: Albert Einstein undermined Newton's mechanics, absolute space and time.

- Quantum Mechanics: Rutherford, Planck, Bohr, Dirac, Heisenberg undermined Newton and Einstein.

- Incompleteness theorem: Kurt Friedrich Gödel (1930) limits of mathematical logic.

21st century:

- String Theory – Holographic Universe
- Artificial Intelligence

Physics in 21st century

- **Special Theory of Relativity (STR)** mechanics

  Time dilation $t = \tau \cdot \gamma$
  Length Contraction $L = L_0/\gamma$ $\left.\vphantom{\begin{array}{c}a\\b\end{array}}\right\}$ $\gamma = \dfrac{1}{\sqrt{1 - \frac{v^2}{c^2}}}$

- **General Theory of Relativity (GTR)** gravity

- **Quantum mechanics (QM)** structure of matter
  - Relativistic QM - Quantum Field Theory (QFT)
    - Quantum ElectroDynamics (QED) -weak and elmag force
    - Quantum ChromoDynamics (QCD) - strong force
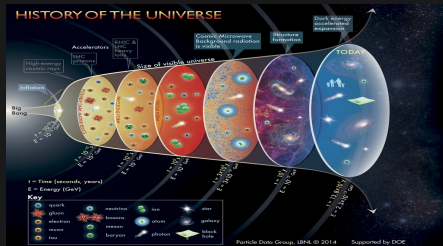
Gravity neglected in all QFT's.

Cosmology

GTR Eqs governing the Universe evolution.

- Big Bang Theory - Einstein's General Relativity[*]
- Dark Universe 96% dark matter+energy, and only 4% ordinary matter. No antimatter?
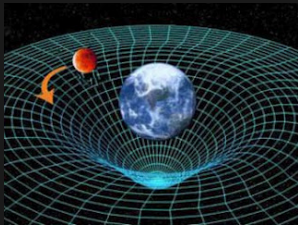
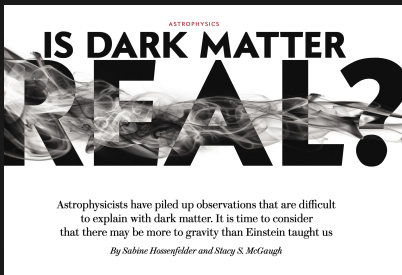$$G_{\mu\nu} + \lambda g_{\mu\nu} = \frac{8\pi G}{c^4} T_{\mu\nu}$$

---

[*]Annalen der Physik. 354 (7): 769.

Crumbling something Sci. Am, 2018

Local Realism and Objectivism

Our culture stems from a fundamental believe:
REALITY = MATTER:

- Matter is primordial (Big Bang Theory).
- Mind is a byproduct of Matter self–organization.

However, no one can really say **HOW** does
Consciousness arise from Matter.
This question, known as

> The Fundamental Problem of Consciousness

remains a mystery.

Is Materialism Irrational?

Local Realism and Objectivism

More rational view:

"The Ultimate Reality, the playground for the apparent mind–matter duality is CONSCIOUSNESS. Ignoring of this basic fact creates all unpleasant feelings of an existential threat and leads to conflicts between communities and nations."

RUPERT SPIRA

Consciousness is the only WHAT IS – Void without form "I". Movement creates "AM" – the Mind. What we can study, talk about, experience is only "AM". "I" remains the Ultimate Reality which cannot be recognized by "AM".

Quantum Physics - How Real is a REALITY?

Even the materialistic hard core is puzzled by the fact that the Universe is suspiciously Mathematical.
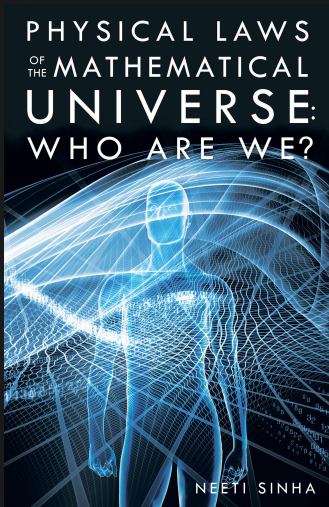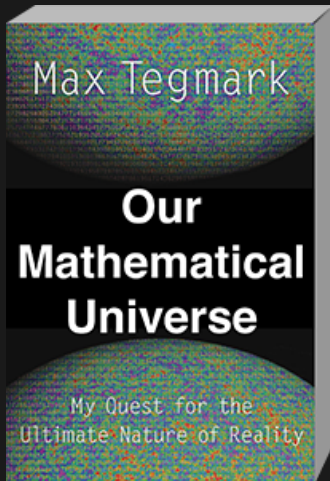
Quantum Physics - How Real is a REALITY?

Eugene Wigner THE UNREASONABLE EFFECTIVENSS OF MATHEMATICS IN THE NATURAL SCIENCES[‡]

Famous story: Discussion between a regular guy and a statistician.

$$population(x) \approx \exp\left[-\frac{(x-x_0)^2}{2\pi\sigma^2}\right]$$

"How can you know that?" was his query. "And what is this symbol here?" "Oh," said the statistician, "this is pi." "What is that?" "The ratio of the circumference of the circle to its diameter." "Well, now you are pushing your joke too far," said the classmate, "surely the population has nothing to do with the circumference of the circle."

Is it all just a mental construct, or collective "dream"?

QM: Very gentle introduction

Quantum Mechanics $\rightarrow$ introduction of Imaginary numbers!

We have just replaced classical unity "1" by $i = \sqrt{-1}$

Let's multiply LS and RS of classical expression for system energy

$$H = \frac{\mathbf{p}^2}{2m} + V(\mathbf{q})$$

by unity: $\Psi = 1 = e^{i \cdot \phi} = e^{i\mathbf{p} \cdot \mathbf{q}/\hbar}$, where $\hbar$ Planck constant[†].

$$H\Psi(\mathbf{p}, \mathbf{q}) = \left[\frac{\mathbf{p}^2}{2m} + V(\mathbf{q}) \right] \Psi(\mathbf{p}, \mathbf{q})$$

and Schrödinger equation follows:

$$\left[-\frac{\hbar}{2m}\nabla^2 + V(\mathbf{r}, t) \right] \Psi(\mathbf{r}, t) = H\Psi(\mathbf{r}, t) = i\hbar \frac{\partial}{\partial t} \Psi(\mathbf{r}, t)$$

***

[†]Actually reduced Planck constant $\hbar = h/2\pi$

Very gentle introduction

Let's evaluate a derivative $\nabla = (\partial/\partial q_i)$.

$$\nabla\Psi = \nabla e^{i\mathbf{p}\cdot\mathbf{q}/\hbar} = \frac{i}{\hbar}\mathbf{p}e^{i\mathbf{p}\cdot\mathbf{q}/\hbar} \Rightarrow \mathbf{p}\Psi = -i\hbar\nabla\Psi$$

Classical $\rightarrow$ Quantum
$\Psi(\mathbf{q}) = \Psi(\mathbf{r}, t)$ represent the state of the system

State quantities turn from single valued numbers
$(\mathbf{p}(\mathbf{r_0}, t_0) = 42.0$ kg.m/s) to

Operators:

$$\mathbf{p}\Psi(\mathbf{r}, t) = -i\hbar\nabla\Psi(\mathbf{r}, t)$$

$$E\Psi(\mathbf{r}, t) = i\hbar\frac{\partial}{\partial t}\Psi(\mathbf{r}, t)$$
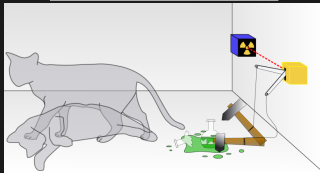
How sustainable the Local Realism is?

E.g. Ervin Schrödinger 1958

One of the main founders of Quantum Physics.

Schrödinger Cut

Schrödinger equation

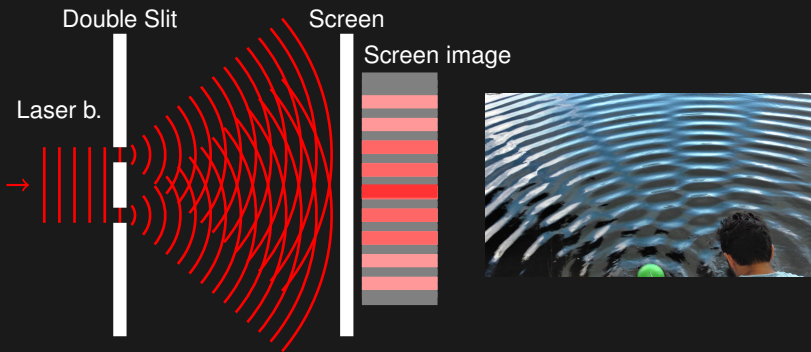$$[\frac{-\hbar}{2m}\nabla^2 + V]\psi = -i\hbar\frac{\partial}{\partial t}\psi$$

"*Mark the last of a generation that lived with the mysticism controversy*"

Particles or Waves? Double slit Experiment.

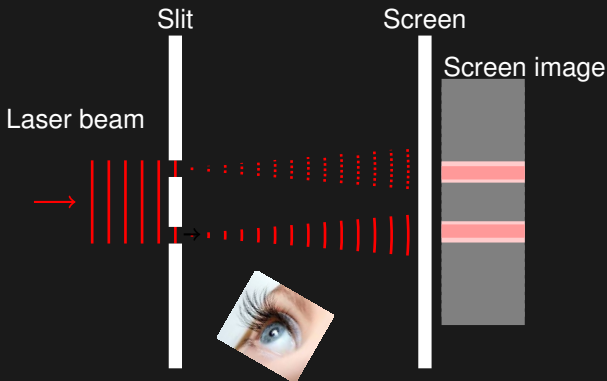1801, the English physicist and physician Thomas Young double slit experiment. Laser beam through two slits quantum interference
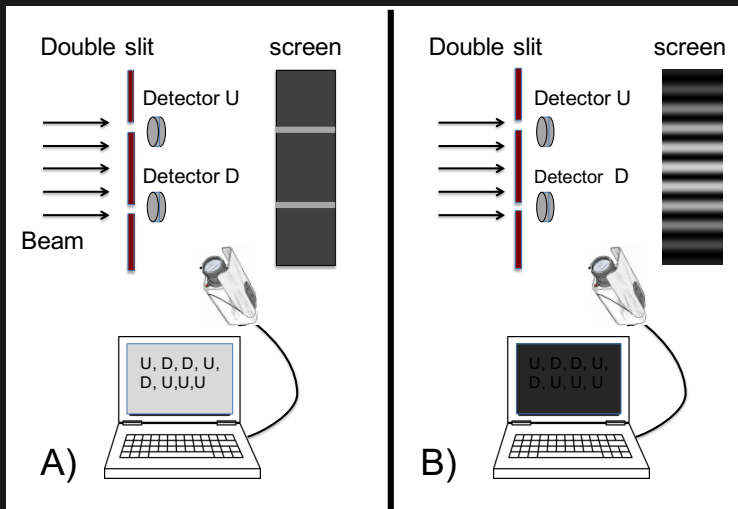
Particles or Waves?

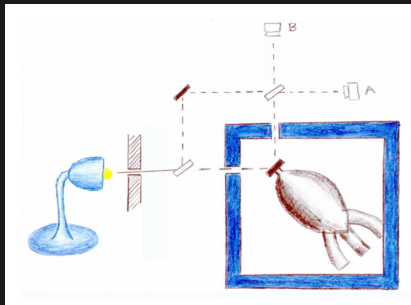Beam through DOUBLE slit and with which-way info

Existence of which-way information changes the reality!!
Questions the Subject (observer) – Object (Reality) concept.
What is consciousness?

How sustainable the Local Realism is?

Quantum Weirdness

1. Interaction Free Measurement

- 1993 Avshalom Elitzur and Lev Vaidman (visited us in 2016)[†]
- My second best candidate for any of "Skeptics Challenge ". To guess what is in the closed safe.

[†]Elitzur, Avshalom C.; Lev Vaidman (1993). "Quantum mechanical interaction-free measurements"

Why are physicist baffled by QP?

Consciousness is the most fundamental to what Reality is.

Let us consider the

Quantum Zeno effect

   A system cannot change while you are watching it!

A simple intuitive analog:

- Imagine a person A is sleepy and person B is asking A every 30 sec whether he is asleep. Obviously, every times A replies "No".
- State "sleepy" is unstable state. Observing this state prevent him from the transition to more stable state.

How sustainable the Local Realism is?

3. Quantum Zeno effect is the suppression of transitions between quantum states by frequent measurements.

Time/Aging can be stopped.

How sustainable the Local Realism is?

Quantum Zeno Effect

Let me remind you Schrödinger equation:

$$\left[-\frac{\hbar}{2m}\nabla^2 + V(\mathbf{r},t) \right] \Psi(\mathbf{r},t) = i\hbar\frac{\partial}{\partial t}\Psi(\mathbf{r},t)$$

Let us denote an unstable quantum state as $\Psi(\mathbf{r},0) \equiv |\phi(0)\rangle$. The evolution of the system is described by Hamiltonian H

$$|\phi(t)\rangle = \exp(-iHt)\,|\phi(0)\rangle$$

The point is: whenever the $|\phi(0)\rangle$ exists, one has to start the evolution from scratch. H doesn't change.

Quantum Zeno Effect

More mathematically: Survival probability P after small time interval δt

$$P = \langle \phi(0) | \phi(\delta t) \rangle = \exp(-iH\delta t) \langle \phi(0) | \phi(0) \rangle$$

Term $\exp(-iH\delta t)$ could be expanded by use of Tylor expansion and for larger interval $\Delta t = N \cdot \delta t$ where N is the number of measurements we'll get

$$P = 1 - \frac{\Delta t^2 \cdot \hat{H}^2}{2N^2} \to 1 \text{ for } N \to \infty$$

If you observe frequently $N \to \infty$ P tends to 1, survival probability is certainty.

Quantum Zeno Effect

Many experimental verifications.

MIT Technology Review

The Nobel Prize–winning physicist Eugene Wigner
"Wigner's Friend" thought experiment

> **A quantum experiment suggests there's no such thing as objective reality**
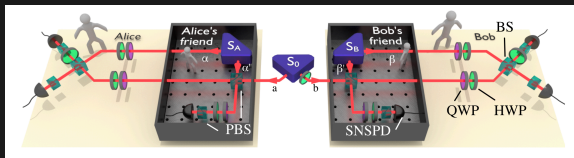
The two realities are at odds with each other. *"This calls into question the objective status of the facts established by the two observers"*[†]

[†]"Experimental test of local observer-independence"
M/ Proietti, et al; 2019; DOI: `10.1126/sciadv.aaw9832`

How sustainable the Local Realism is?

2. Wheeler Delay Choice exp. - Time flows backwards
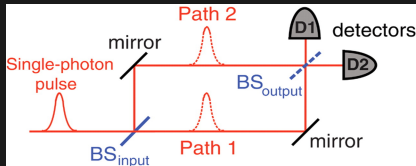
Observer has a freedom to leave / remove the last mirror before the waves arrive at detectors D1 or D2. When mirror removed, the wave must collapse **BACKWARD in TIME** into a particle, which has traveled Path1 or Path2.

Maybe TIME is some kind of illusion?

How sustainable the Local Realism is?
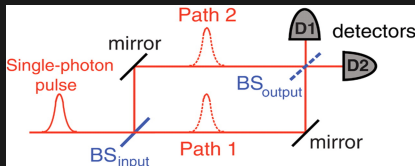
- Time flows backwards

Observer has a freedom to leave / remove the last mirror before the waves arrive at detectors D1 or D2. When mirror removed, the wave must collapse **BACKWARD in TIME** into a particle, which has traveled Path1 or Path2.

Maybe TIME is some kind of illusion?

Local observer-independence

- "Facts of the world" can only be established by a privileged observer – e.g., one that would have access to the "global wavefunction" in the many worlds interpretation.

- Bohmian mechanics.

- Give up observer independence completely by considering facts only relative to observers. This choice, however, requires us to embrace the possibility that different observers irreconcilably disagree about what happened in an experiment.

"The scientific method relies on facts, established through repeated measurements and agreed upon universally, independently of who observed them." Right ???

The root cause of all pain and suffering is ignorance.

Anil Seth. TED talk

In fact, we're all hallucinating all the time, including right now.
It is just that when we agree about our hallucinations
*we call that **Reality.***

Douglas Adams

Time is an illusion.
Lunchtime doubly so.

---

§Avidyā (Buddhism)