

# Is There Room for God in the Cosmos?

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Part 1: **Recent Data and New Forms for Big Questions.**

Part 2: **Manifold Physics and Possible Worlds.**

Part 3: **Which World Do We Live In?**

# Quotation by Lisa Randall, 2006

- So does your science leave space for untestable faith? Do you believe in God?
- There's room there, and it could go either way. Faith just doesn't have anything to do with what I'm doing as a scientist. It's nice if you can believe in God, because then you see more of a purpose in things. Even if you don't, though, it doesn't mean that there's no purpose. It doesn't mean that there's no goodness. I think that there's a virtue in being good in and of itself. I think that one can work with the world we have. So I probably don't believe in God. I think it's a problem that people are considered immoral if they're not religious. That's just not true. This might earn me some enemies, but in some ways they may be even more moral. If you do something for a religious reason, you do it because you'll be rewarded in an afterlife or in this world. That's not quite as good as something you do for purely generous reasons.

# Randall's Technical Work: Is Space Higher-Dimensional? **Is it Roomy?** Same interview:

- Will physics ever be able to tackle the biggest questions for instance, why does the universe even bother to exist?
- Science is not religion. We're not going to be able to answer the "why" questions. But when you put together all of what we know about the universe, it fits together amazingly well. The fact that **inflationary theory** [the current model of the Big Bang] can be **tested** by looking at the **cosmic microwave background** is remarkable to me. That's not to say we can't go further. I'd like to ask: Do we live in a **pocket** of three-dimensional space and time? We're asking how this universe began, but maybe we should be asking how a larger, **10-dimensional universe** began and how we got here from there.

# Transcendence and Immanence

- **Transcendent** means not bound by space and time, standing apart from the cosmos.
- **Immanent** means manifest inside space and time, everywhere.
- God is said to be both. A self-contradiction?
- With respect to the **rational numbers**, the **irrational real numbers** are both.
- Same in math with the *completion* of any incomplete metric space.

# Why should Believers Care?

- Know and appreciate God's creation.
- God communicates *through* His creation.
  - General Revelation
  - Prayer and personal leading
  - Incarnation / Communion / John 1.
- The Big Questions embody *sanctity*.
  - Examine one's life, "Know Thyself" (Socrates)
  - Profound respect for each other (Rom. 12:10 JB)
- Training to see things beyond oneself.
- Childlike awe and wonder...

# Not to Try to 'Prove the Existence of God'

- Proof < Truth even in simple math (Gödel)
- Knowledge---Three Kinds:
  - K1: Reproducible Knowledge (“hard science”)
  - K2: Experiential Knowledge (→“Induction”)
  - K3: Modeling (→*Occam's Razor*; K3 = our topic here)
- Faith = trust in another
- Intuition = trust in oneself

Luther: *sola fide* / Fideism

No-proof, no-K1 partial fideism: merely orthodox?

# Lisa Randall Again, same interview

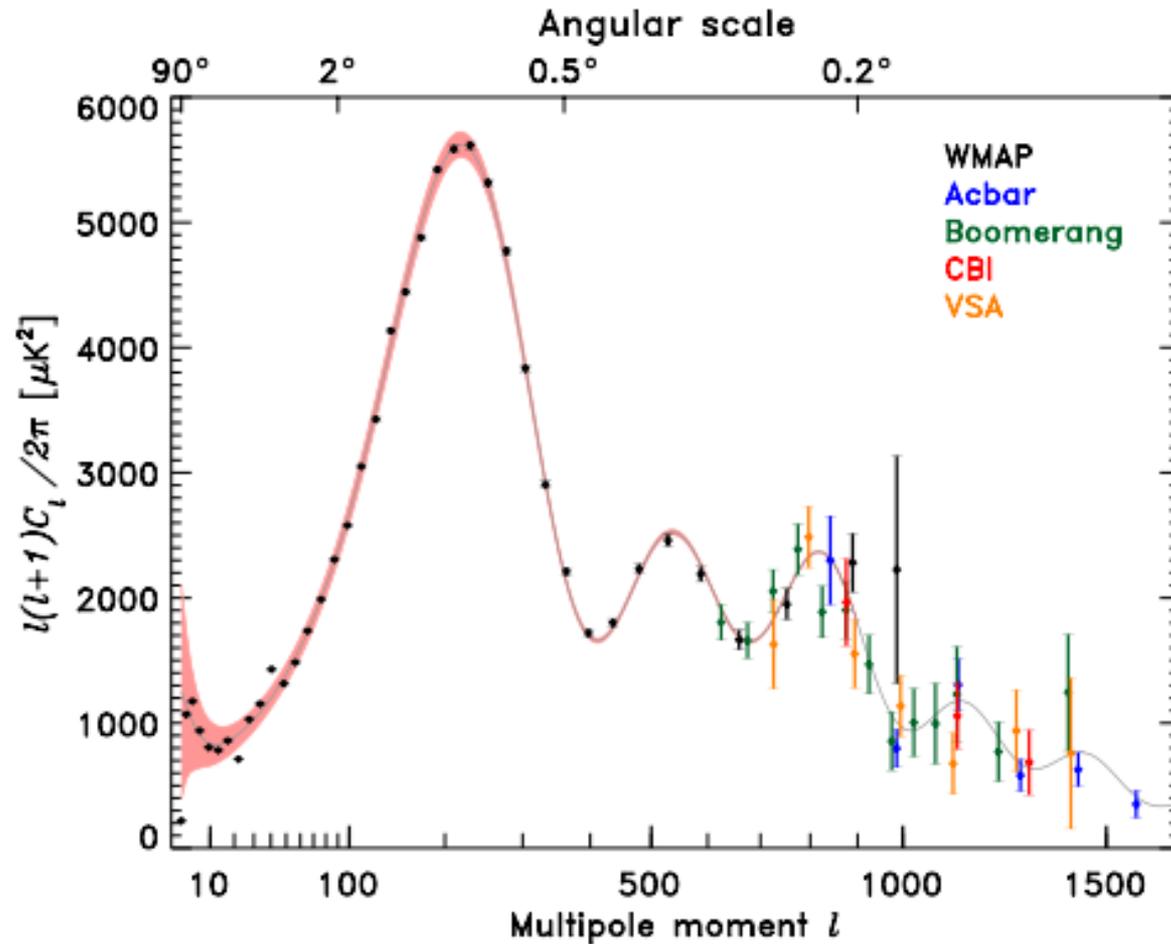
- This sounds like your formula for keeping science and religion from fighting with each other.
- A lot of scientists take the **Stephen Jay Gould** approach: **Religion** asks questions about **morals**, whereas **science** just asks questions about the **natural world**. But when people try to use religion to address the natural world, **science pushes back on it**, and religion has to accommodate the results. Beliefs can be permanent, but beliefs can also be flexible. Personally, if I find out my belief is wrong, I change my mind. I think that's a good way to live.
- My own approach: “to do science faithfully.”
- ASA calls ~ this “Whole-Person Education.”



# Facts? Death, Taxes, and Inflation

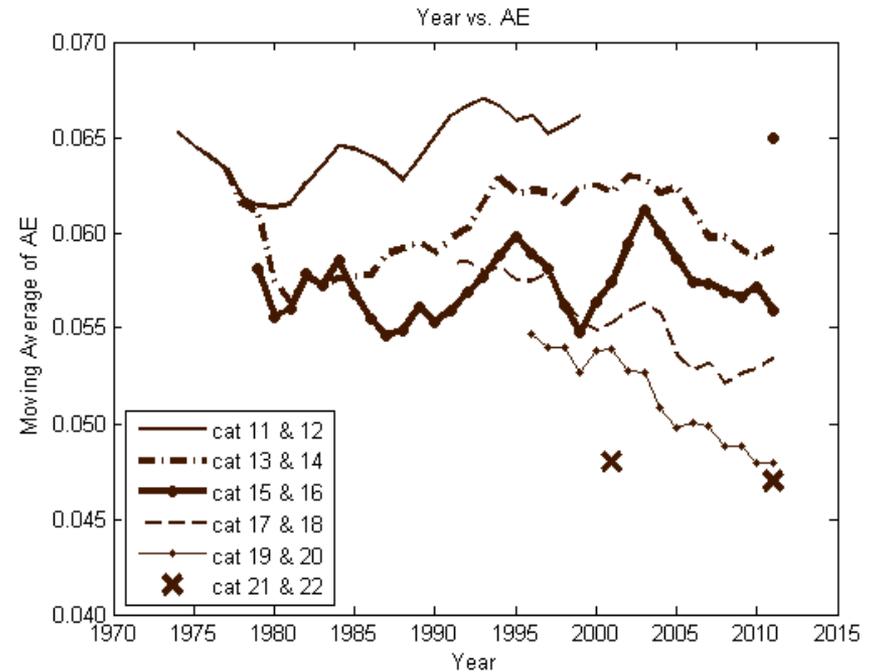
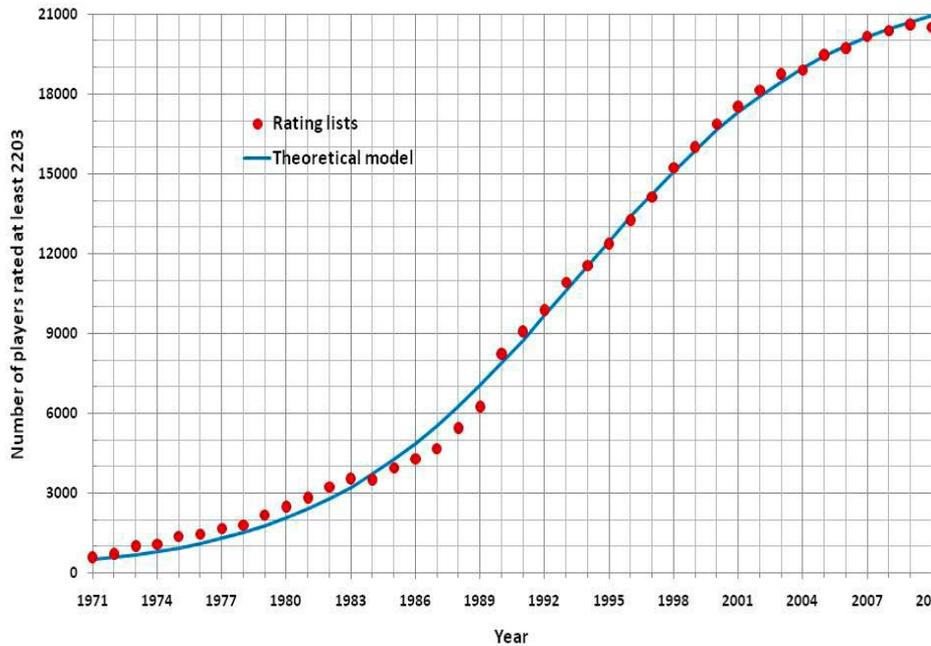
- Original Big Bang Theory has 3 big flaws:
  - Stuff in space is more homogeneous than it “should be”---as if it equilibrated each other.
  - Critical flatness of space arises “by accident.”
  - Objects we’ve never seen would probably exist.
- Solution: **Inflation** in pocket’s first moments:
  - Space driven apart violently faster than  $c$  for the first few Planck time units.
  - Accentuates back-effect of prior contact.
  - Hugely flattens out the relativistic metric.
- 2004+: **Prediction** for Cosmic MB borne out

# Proof of Inflation? WMAP Et Al.



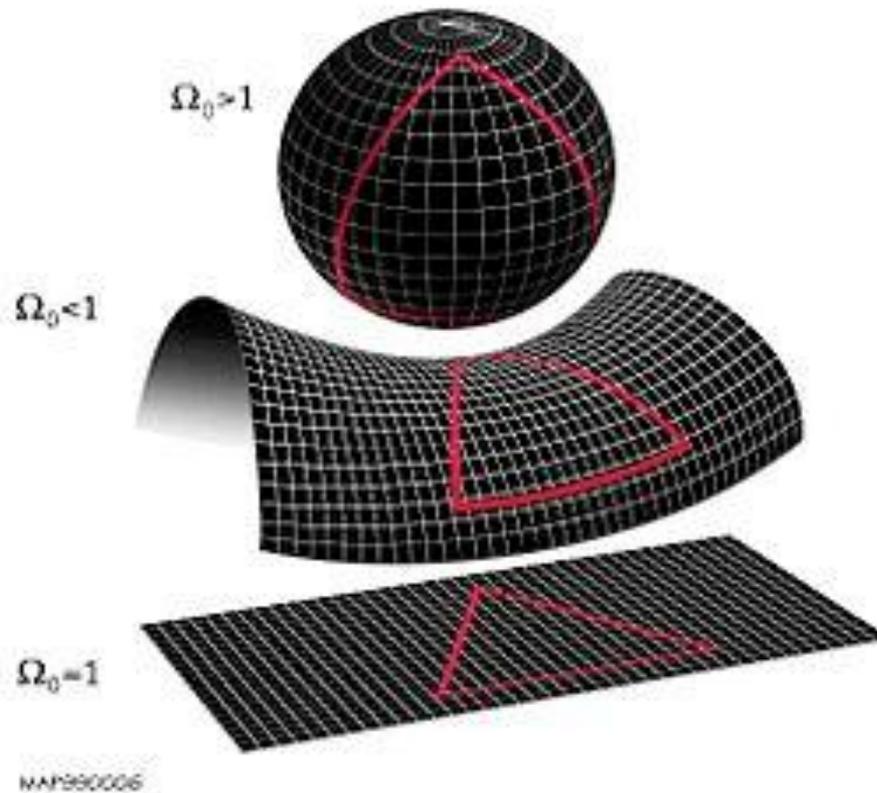
# Proofs of No Inflation? (aside)

Figure 1: Growth of number of players rated at least 2203 since 1971



Regan-Haworth-Macieja 10/2011, showing chess ratings fit a simple population model *without inflation*. Graph by Maciejaja, Year vs. Avg. Error plot by student assistant Tamal Biswas.





The local geometry of the universe is determined by whether the relative density  $\Omega$  is less than, equal to or greater than 1. From top to bottom: a [spherical](#) universe with greater than critical density ( $\Omega > 1$ ,  $k > 0$ ); a [hyperbolic](#), underdense universe ( $\Omega < 1$ ,  $k < 0$ ); and a flat universe with exactly the critical density ( $\Omega = 1$ ,  $k = 0$ ). Our universe, unlike the diagrams, is three-dimensional.

# Inflation Springs Eternal?

- The simplest models of inflation make it an eternally occurring process.
- → Our Big Bang was just a “bubble nucleation” event in a larger cosmos.
- → Our space is under tension, like the inside of a bubble, → dark energy,  $\Lambda$
- Overall expansion still implies a single origin (“Vilenkin’s Theorem”) under GR.
- Aligns with the “String Theory Landscape”

# Follow The Math

- Old goal of physics: explain it uniquely.
- But the math hints that values of nature's fundamental constants are Plug & Play.
- The “Standard Model” of particle physics has 19 settable parameters, one of mass (squared) and 18 dimensionless.
- String Theory was purposed to explain them (and to marry GR and quantum theory), but may have over 100 parameters of its own.

# Particles

- Matter is molecules made from atoms, plus...?
- Atoms have protons, neutrons, and electrons. Neutrinos are an example of non-atomic matter.
- Electrons are indivisible, and all identical.
- Protons and neutrons are made from *quarks*.
- Quarks are *confined* by the **strong force** and exchange *gluons*.
- *String Theory* claims that all indivisibles are tiny (or huge) **strings** in various vibrational modes.

# What is String Theory?

- No longer just strings---2D mem"branes", 3D, 4D... included too. **Math Incarnate?**
- Strings interact most easily---by joining, splitting, winding, sticking (or not) to branes.
- Strings *vibrate*, according to linear algebra: eigenvalues. (Tacoma Narrows Bridge.)
- The math gives a string with eigenvalue +2, which acts as a **quantum of gravity**.
- Vibrations cohere only in  $3+1+6+1 = 11$  dimensional space, or some larger combos.

# Two Ways to Hide Dimensions

1. Make 'em have tiny extent: a few *Planck units* wide and no more. OR
2. Make 'em huge---but *confine* us to a 3-brane. *Either way, space is roomy.*

Parallel branes can collide, producing Big Bang effects. “Ekpyrotic Theories”.

The “Casimir Effect”, aka. *stiction*, shows up at *moderate* distances---believed because wavelength of dark energy is big. Bernard Haisch, *The God Theory*: seen as ministry.

# Strings Make Me Tense

- The 6 *taut* dimensions must obey the equations of a **Calabi-Yau manifold**.
- But there are many such manifolds, and strings can tangle on their “horns” many ways, each putting different tension on space.
- Different tension → different physical values  
→ different worlds.
- “Landscape” Versus Uniqueness.
- Intelligent Design? Anthropic Principle?

# Universe and Mind

- Many scientists--nonbelievers and believers alike--have felt the Universe has-a/is-a Mind.
- Can this universal mind communicate?
- Unless said mind is **metrically immanent**, this must be **faster-than-light communication**.
- **Personal prayer** seems to require **super-c**.
- If super-c is possible, surely organisms would evolve to use it?
  - Such an agency behaves like a *personal* deity.

# “Scale” and “View”

- **Micro Scale**: within atoms, “femto-tech.”
- **Macro Scale**: ordinary human experience.
- **Cosmo Scale**.
- Theory of Micro Scale: Quantum Mechanics (QM), using Discrete Math.
- Theory of Macro & Cosmo Scales: General Relativity (GR), Continuous Math.
- Can GR & QM be “unified”?

# View (nomenclature by Max Tegmark)

- “Frog’s-Eye View”: from within a process, at one of its steps.
- “Bird’s-Eye View”: from outside a process, viewing its completion.



# Three fundamental questions...

1. Is the Universe [in?] a co-ordinate system?
2. Does Time have an arrow at all scales?
3. Is everything that is consistent with the laws of physics *actual*?

# Related questions...

- “Did God have a choice?” (Einstein)
- “What breathes fire into one set of equations, and not another?” (Hawking)
- (Of the “superfluous” muon particle)  
“*Who ordered that?*” (Isidor Rabi)
- [Muons are now seen as important source of mutations in evolution, a mechanism that works only because relativistic effects extend their lifetimes after creation in cosmic rays.]
- “Does God play dice?” (Einstein)

# Bigger Questions...Change...

- ~~Why is there something rather than nothing?  
(Answered by “Math Exists”, IMHO)~~
- (Why) Is there something rather than everything? (Robert Mann, U. Waterloo)
- ~~Is there life after death?~~
- Is There More of Me?
- ~~Do we have free will?~~
- What Kind of World Do We Live In?

# Four Possible Worlds

(the frog's eye view of ordinary life physics is **not** one of them!)

1. **Newton/Einstein**: **Absoluteness** of 3+1 dimensional **manifold**, deterministic.
  1. Might be “nudged” by higher dimensions.
2. **Quantum Nondeterminism**: de Broglie-Bohm **realization** of Copenhagen view.
3. **Many Worlds**: determinism at a “Power Set” birds-eye view (Hawking now).
4. **The Matrix** (seriously considered by Nick Bostrom, David Chalmers).

# On 4: The Simulation Argument

- *SimCity*, *SecondLife*, etc. may be harbingers of “truly realistic” simulations, especially if quantum computers are realizable.
- If consciousness reduces to information processing, could we tell the difference?
- Ye who so love full-scale simulations would create so many that a “typical” person by numbers would be a simulated one. Thus us?
- David Chalmers: such “ye” may as well be God.

Though Chalmers is #48 at <http://brainz.org/50-most-brilliant-atheists-all-time/>, he told a few including me at UB in 2008 that *The Matrix* might make him believe in God.

# 0: The “Cartesian Box”



$$V_b = V_t + V_g$$

The Universe sits in a 3-dimensional flat space,  
and Time is a separate consideration.

# Relativity---frog's eye view

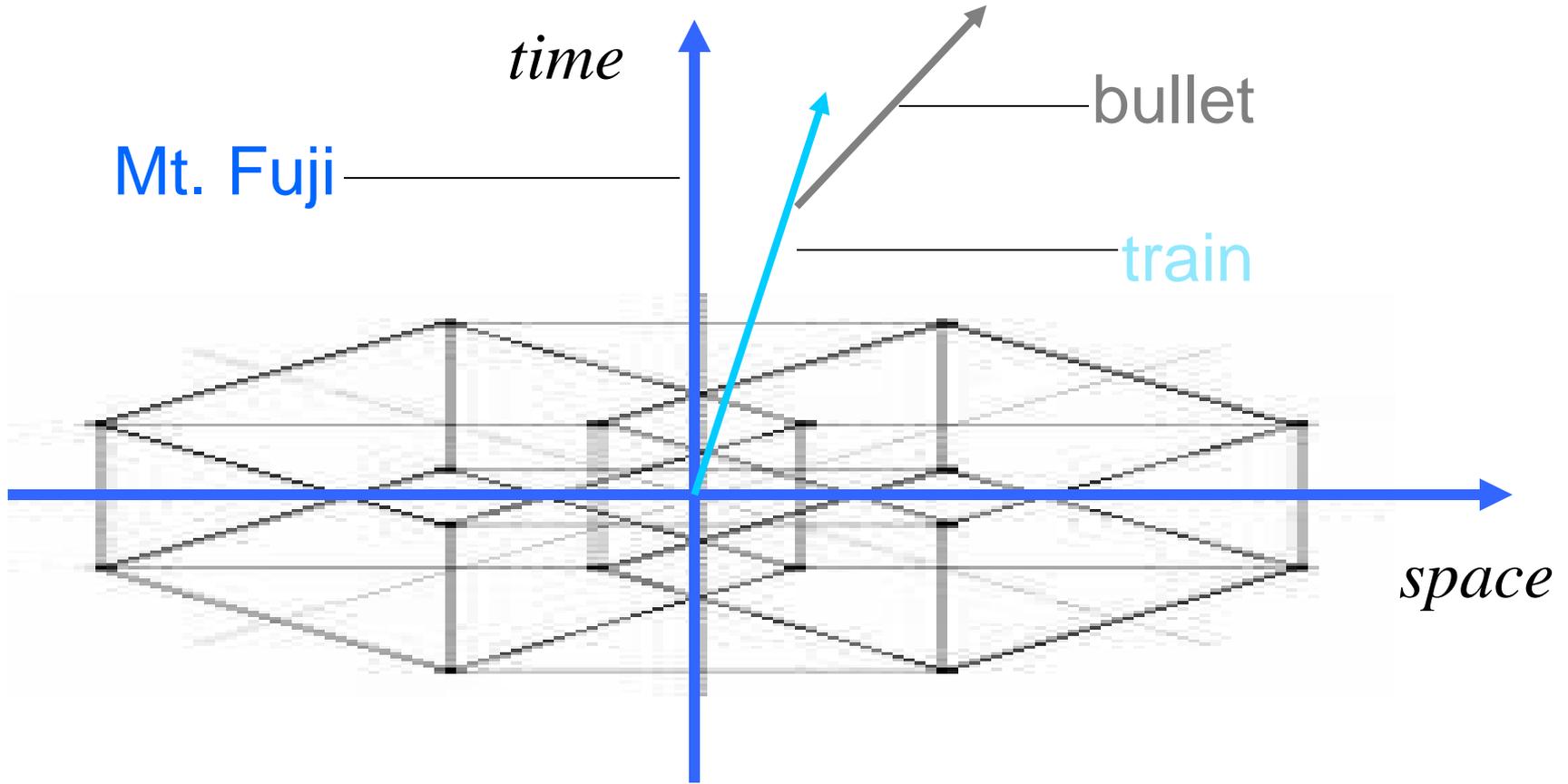


$$V_b = V_t + \\ V_g(1 - (v_t/c)^2)^{1/2}$$

Length “contraction”, Time “dilation”...

Inertial mass is related to energy by  $M = E / c^2$

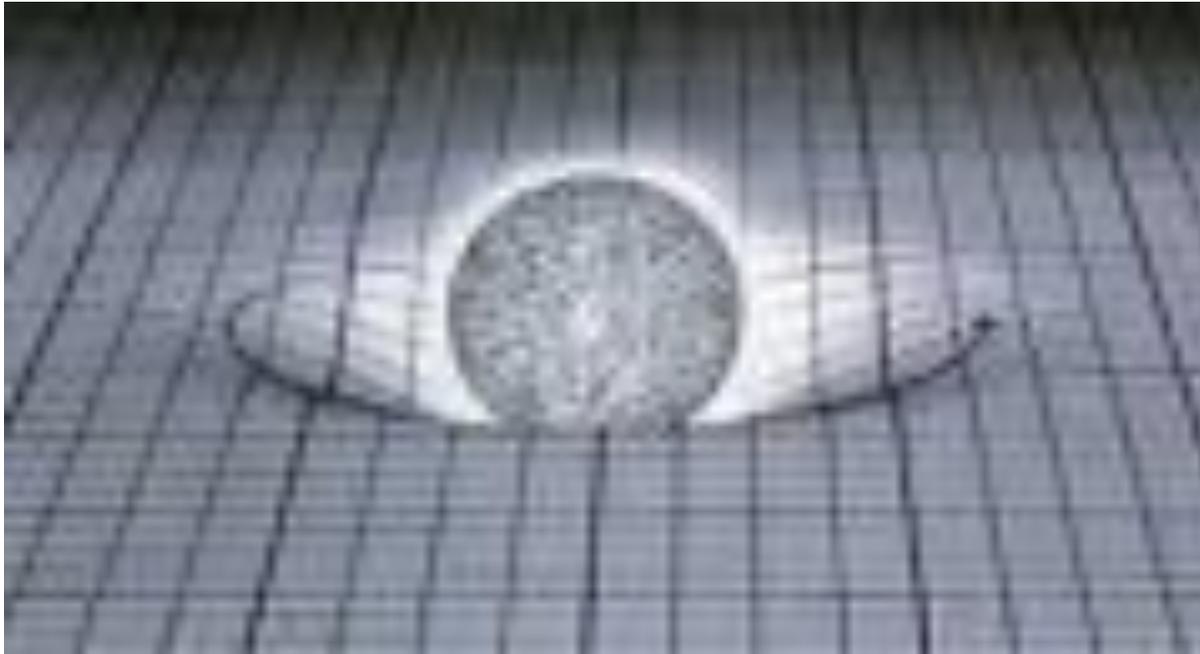
# 1: Relativity---bird's-eye view



Trigonometry in 4D, not simple addition

$$c = 1, \text{ so } M = E$$

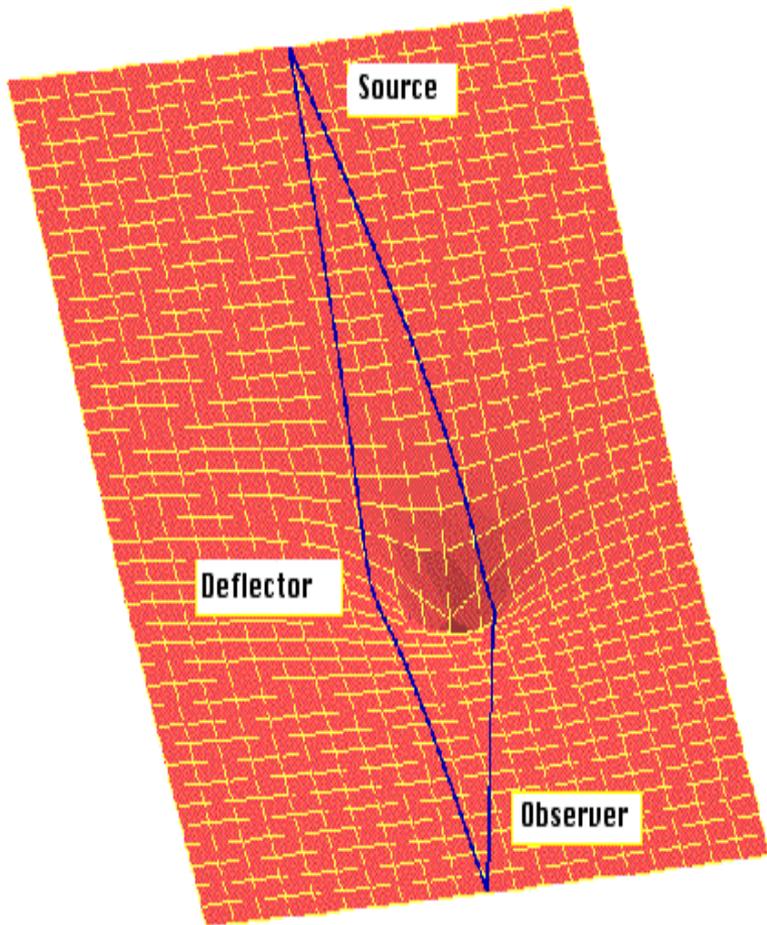
# From Special to General Relativity



“Matter tells spacetime how to curve, and curved space tells matter how to move.” (John A. Wheeler, 1911-2010)

Physical processes must be compatible with the math of the 4D Riemannian manifold defined by Einstein's equations. This geometrical constraint itself yields predictions.

# Gravitational Lensing



# GR on your Dashboard

THE EINSTEIN FIELD EQUATION

$$G_{\mu\nu} = 8\pi T_{\mu\nu}$$



GPS satellites

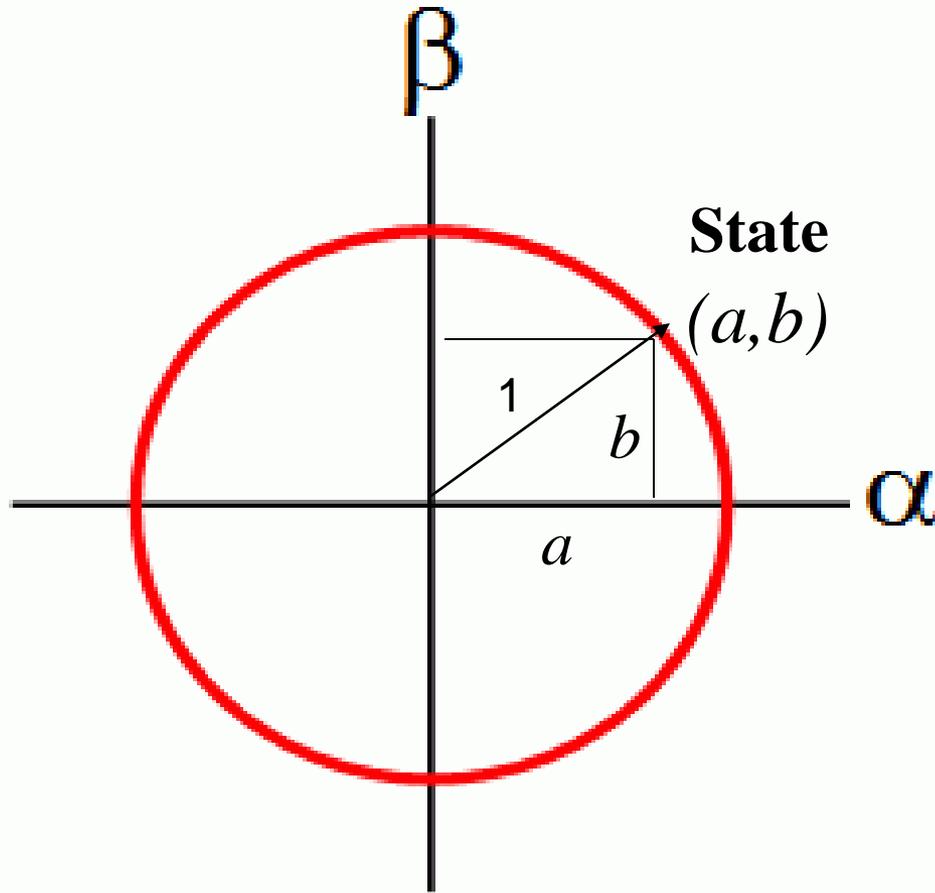
Basically says Gravity goes hand-in-hand with Acceleration

Calculation is actually done in the “Cartesian Box” after first jimmying the satellites’ clocks to run slightly more slowly, so that latitude & longitude are functions of “adjusted” time. Else, the drift would be 10km per day!

# 2 & 3: Quantum Mechanics

- Basic entities of physics have indivisible units called *quanta*.
  - Electric charge (electron, positron)  
 $1.602 \times 10^{-19}$  coulomb
  - Light and other EM radiation (photon)
  - *Gluons, W & Z bosons* for other forces.
  - Gravity? (graviton?)
- Space and time may also be quantized, e.g. into the *Planck units*:  $1.616 \times 10^{-35}$  meters,  $5.391 \times 10^{-44}$  seconds. **Pixelated!**

# Quantum Bits, e.g. spins.



Probability of observing  
Alpha is  $a$ -squared,  
Beta is  $b$ -squared. By  
Pythagoras, these add to 1.

# Observables (without observers)

- An **observable**  $O$  is a physical entity plus a roster of possible values for it, e.g.:
  - Particle, positions A,B,C,...
  - Particle, velocities  $v_1, v_2, v_3, \dots$
- A roster value (RV) of  $(0,0,\dots,0,1,0,\dots,0)$  means  $O$  has the value corresponding to where the **1** is. “**Pinpoint value**”
- Applying the ***Fourier transform*** to RVs defines the RVs of the **complementary** observable  $O'$ . *When  $O'$  is “real”, watch out!*

# Heisenberg's Uncertainty Principle

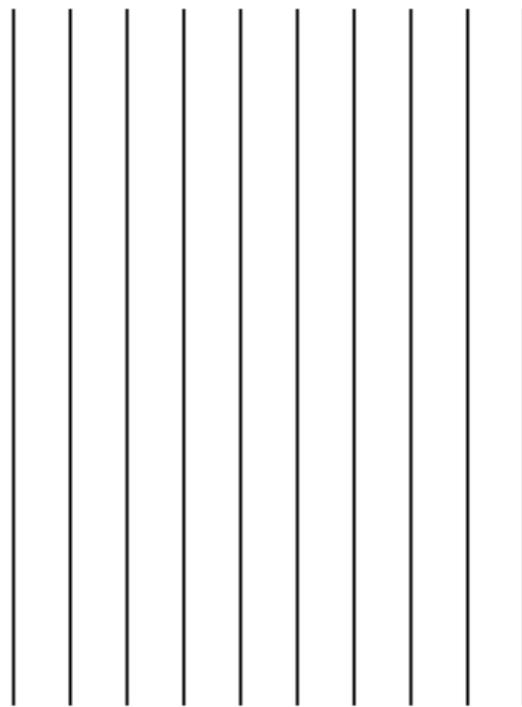
- Position and *momentum* (= mass x velocity) are complementary, when measured in Planck units with  $E = mc^2$  used as conversion.
- So are electron “spins” Up/Down and L/R.
- **Theorem:** An RV  $r$  and its Fourier transform  $r'$  can't both have pinpoint values.
- “Non-pinpoint” is **interpreted** as *uncertainty of knowledge from observation*. (“random variable”)
- Magnitude of non-pinpointness governed by *Planck's constant*  $h$  (value related to  $\Lambda$ ??).

# Wave/Particle Duality

- Fourier transforms have been used for centuries to decode definite information (“harmonics”) from mixed signals (chords).
- “Definite” = *particle*, “mixed” = *wave*.
- Light shows both natures!
- *Bose-Einstein condensate*---certain chilled matter can become wavy.
- Space cannot be totally empty---it must produce *virtual particles, in pairs*. The Casimir force is direct evidence of this.
- Duality of interpretation, but not nature?

# The “Two-Slit” Experiment...

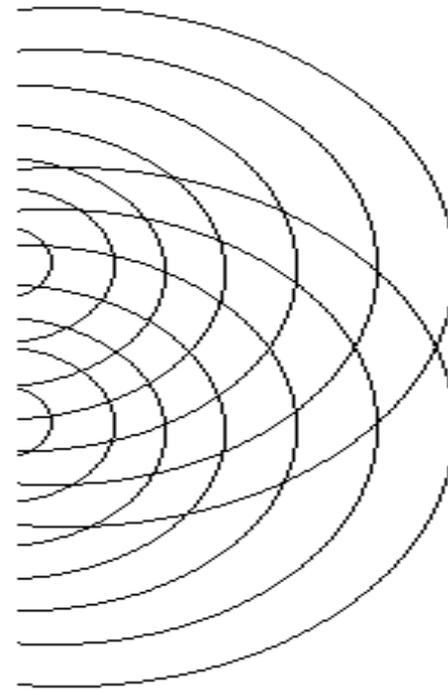
Interference



light waves

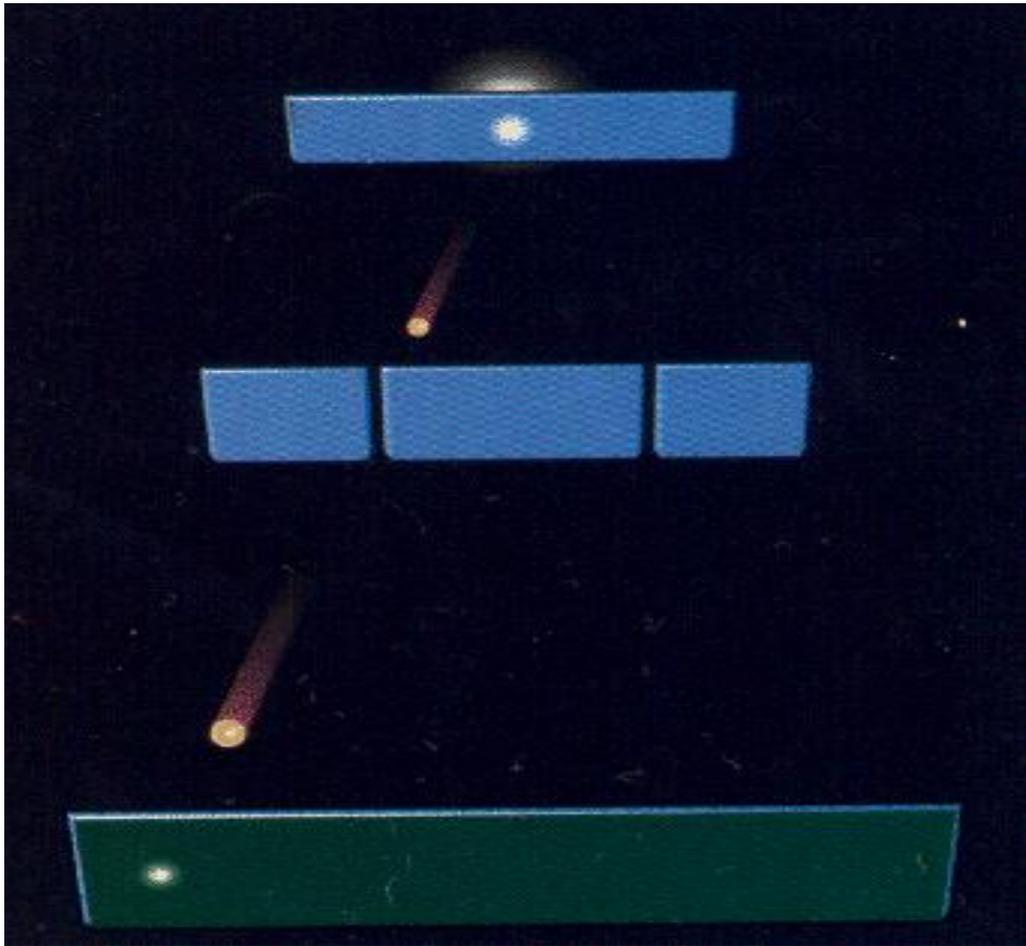


barrier



interference pattern

# ...works even when photons go singly!



*Many-Worlds Interpretation* (MWI): we experience just one of what are really two (or more) photons in separate universes that interfere with each other. **OR** (D. Deutsch) they are imprints of one **multiversal** object in two (or more) universes, one of which is ours.

Yogi Berra: “When you come to a fork in the road, take it!”

Ensures no destruction of information in physics.

“Hawking’s 2005 Lost Bet”

# Hawking and Many Worlds

- *A Brief History of Time*: on quantum scale, Time has no arrow---equally valid backwards.
- *The Grand Design* (with L. Mlodinow, 2010): all possible histories are as valid as all possible future paths. Implies MWI.
  - If it is possible that the Earth was created 6000 years ago with fossils intact (YEC!), then that is an equally-actual reality. [Thus the world's signature scientist cannot oppose creationists.]
- Deutsch: YEC and **Boltzmann Brains** etc. are actual but not *preponderant*.

# Boltzmann Brains and the “Measure Problem”

- New York Times Science Section, Jan 15, 2008: **“Big Brain Theory: Have Cosmologists Lost Theirs?”**
- It could be the weirdest and most embarrassing prediction in the history of cosmology, if not science.
- If true, it would mean that you yourself reading this article are more likely to be some momentary fluctuation in a field of matter and energy out in space than a person with a real past born through billions of years of evolution in an orderly star-spangled cosmos. Your memories and the world you think you see around you are illusions.
- This bizarre picture is the outcome of a recent series of calculations that take some of the bedrock theories and discoveries of modern cosmology to the limit...

# The New Riddle of Existence

- *Does everything that can exist, exist?*
  - Carnivorous alien wombats? (**Yes**: C. Seife)
  - Copies of you? (**Yes**: M. Tegmark, B. Greene...)
  - A planet just like Earth except that Richard Dawkins is the Pope? (*Porquoi pas?*)
  - A being with your entire life memories that is recognizably you? (Go back to prev slide...)
- In an **Unrestricted Multiverse**, everything that can happen, happens.
- Opposing standpoint: *Creation Is Particular.*

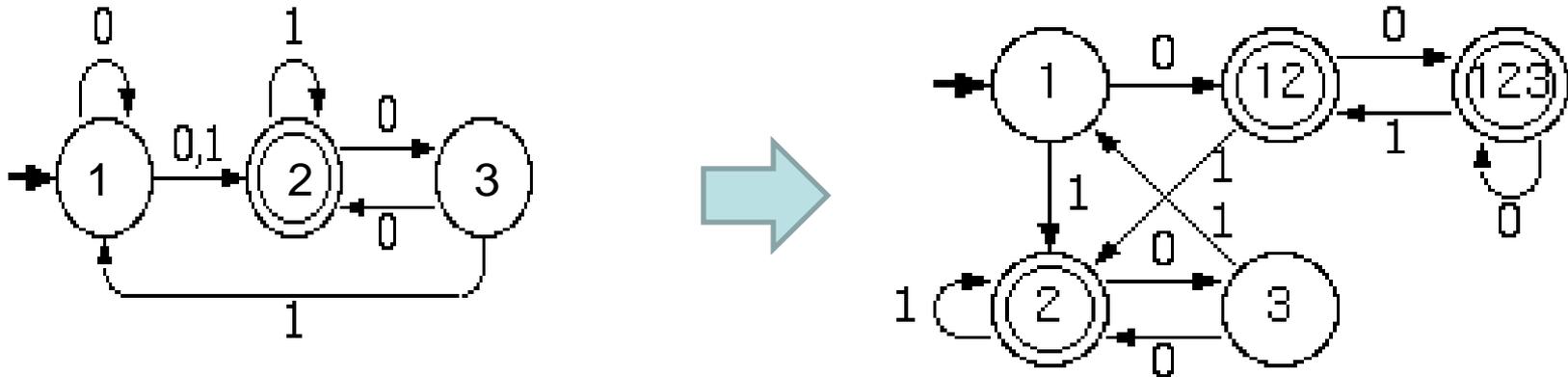
# Love and Particularity

- If there is an Unrestricted Multiverse with infinitely many copies of us doing every possible thing, then our actions are arbitrary. Hence meaningless?
  - Deutsch: we can be moral both locally and preponderantly.
- Charles Seife: Right now **you** are being devoured by a giant alien wombat!
- Is there **Love** in being forced into its cave by sheer weight of numbers?

# Challenge to Any Doppelgänger

- Is your copy *you*?
- **If it is not you**, then what about you is different from your material makeup?
  - By definition, this is Soul Matter.
- **If it is you**, then you have a communion of your being across spacelike intervals (which requires super-c communication) or across multiversal boundaries.
  - Does this require a personal God? Einstein feared so...

# The Two Views From My Field

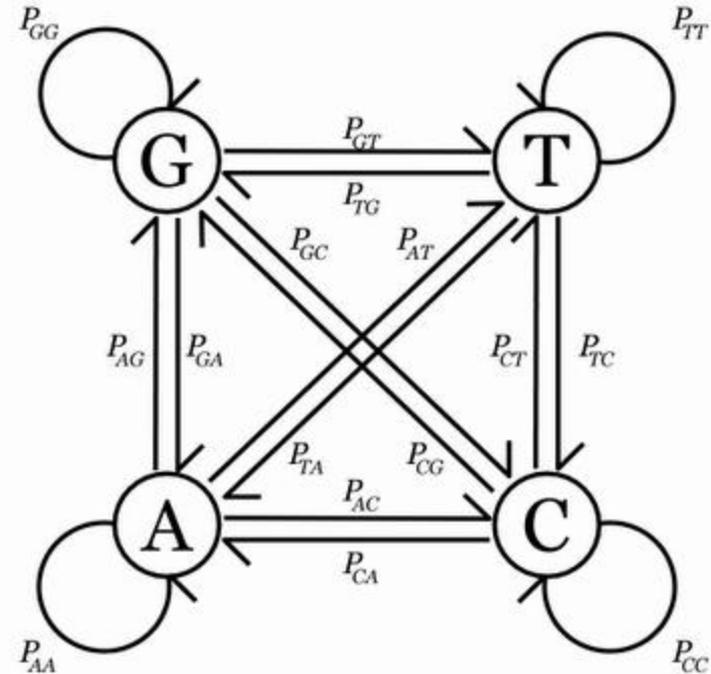
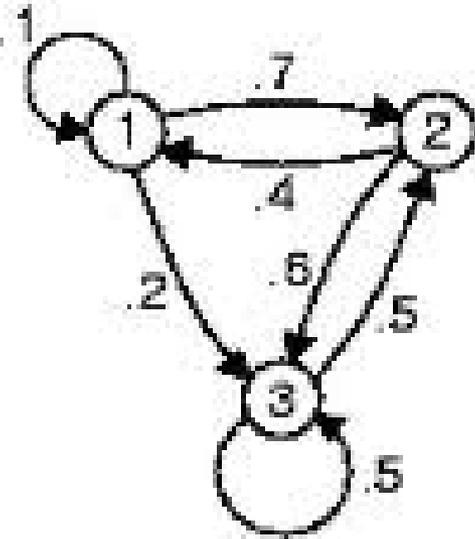


Every **N**ondeterministic **F**inite **A**utomaton **N** can be converted into an equivalent **D**eterministic **F**inite **A**utomaton **M**. Every single state of **M** is a set of possible active states of **N**.

Problem: **M** is often **exponentially bigger** than **N**.

Which, NFA or DFA, is more fundamental? Is either **immanent**?

# Reality as a Markov Chain



Markov Chain  
= NFA with probabilities  
= frog's-eye view.

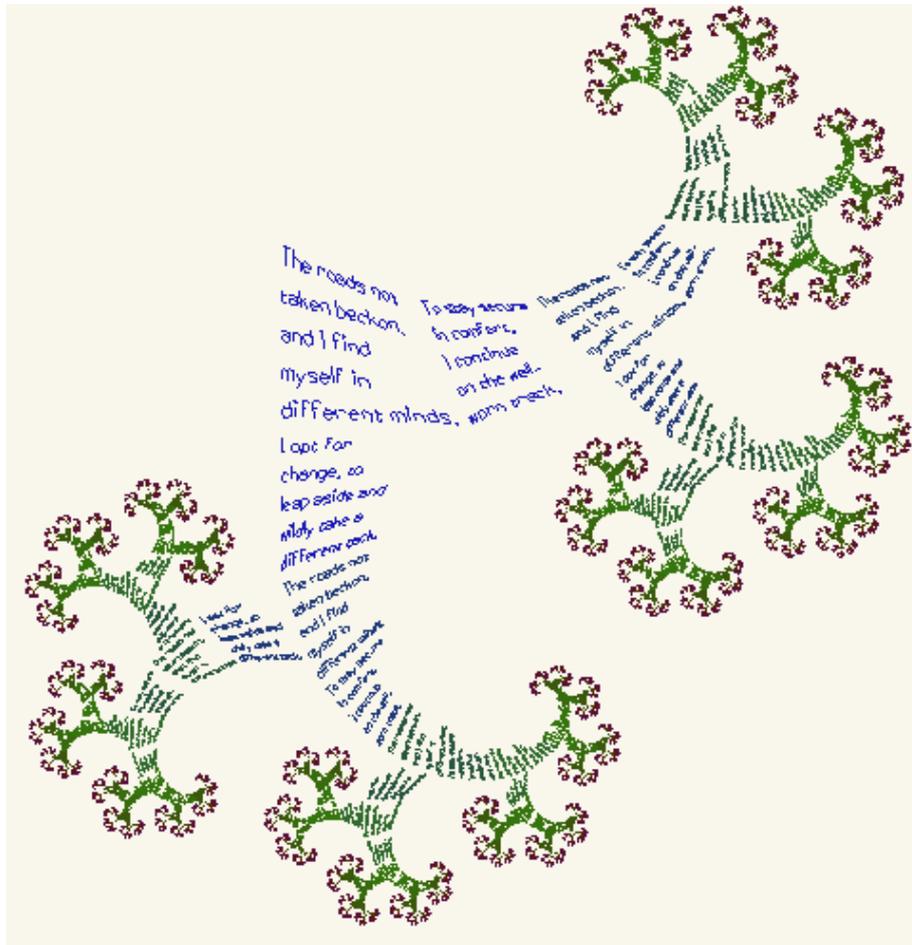
Not all transitions need to be immediately possible.

(e.g. 3 to 1 in first diagram)

# Dueling Interpretations of QM

1. **Copenhagen**: an observation is the product of a projection of an object's wave function, called a "collapse".
  - Fundamentally Nondeterministic. "SUAC"
2. **Many Worlds**: no collapse, just different "versal" windows on multiversal objects.
  - Bird's-Eye View Determinism, like DFA.
3. **De Broglie-Bohm Theory**, "MWI in Disguise"  
Math of MWI, but Pilot Wave not "collapse".
  - Frog's-Eye View: One actuated path.

# The Garden of Forking Paths



DeBroglie-Bohm: As in a chess game, there are many possibilities but only one Principal Variation. Only one move gets played.

To what extent is this game **participatory** for us?

# The Ultimate Gap?

- All petitionary prayer is prayer over paths.
- What selects a path? **Who?**
- How often? Every Planck time unit?
- Do we participate?
  - Do we have free will to do so?
- In the past, it has been an unworthy mistake in both science and reverence to leave the **gaps** in our knowledge to “God’s agency.”
- Is this model worthy? Is it ultimate?

# The Worthy Throne Room?

The agency of choosing the path of creation is

- Transcendant: bird's-eye not frog's-eye.
- Immanent: connected to every point of existence, active at every Planck unit of time. Personal.
- Nondeterministic: not fully predictable by us.
- Participatory: if it influences us, then at least by time-symmetry, we influence it.
- Thus compatible with free will (in manner similar to Roger Penrose's *The Emperor's New Mind*).
- Humble for created beings, with no expectation that God could or would alter this agency by fiat.

# Regarding “The God Hypothesis”

- Atheists rail that GH is not K1, refute “logical proofs.”
- Martin Gardner: not K2 either, not K3 except that modeling *possibilities* to aid understanding is OK.
- K2 evidence?: Miracles, “synchronicity” (Jung).
- Intelligent Design (ID): said to be deduction (Paley, 1804), but IMHO it’s really K3 with Ockham’s Razor.
- Argument from Reason (cf. C.S. Lewis) is K3.
- Partial fideism excludes “Proof” and K1 but allows full K2 and K3, including ID (at level of cosmology).
- What I have offered here is K3. It does not exclude K2, and does not try to stand in front of the Gospels.
- Room for personal God & life in Christ as received.