A Dual-Universe Model of Reality

Presented by: Terry Bollinger (Apabistia Press)
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Overview

Part I.
# What is Dualism, Anyway?

Dualism Just Means "Two Things"

➢ Historically, dualism exists in almost every religion and philosophy

➢ Given the presence of so many naturally occurring, easily identified pairings of contrasting quantities, the presence of dualities in both religion and philosophy is almost inevitable, e.g., to address:

    ➢ Day and night

    ➢ Two genders in humans and most (but by no means all) animals and plants

    ➢ Good and evil (as defined by a particular group)

➢ Ironically, modern life relies heavily on an extreme dualism

➢ We call this new dualism "bits" and use it to build "software"

An Unusually Complex Historical Dualism

➢ **Yin-yang** is a Chinese philosophical-religious duality framework with roots dating back at least three thousand years

➢ The idea, roughly speaking, is that a "primordial chaos" called *qi* (roughly, "breath of life") transforms into cycles of yin-and-yang that in turn generate geometry and matter

➢ The yin-yang framework holds that this dichotomy exists in some form in all natural things, and in the patterns of change, difference, and transformation of the universe.

➢ The visual inspiration for the yin-yang figure is the sun shining on a hill

➢ **Yin** on the right represents the hill's shadowed northern side, and includes retractive, passive, contractive, or receptive concepts

➢ **Yang** on the left represents the hill's well-lit southern exposure, and includes repelling, active, expansive, and repulsive concepts

➢ The dots represent the inseparable inclusion of each concept within the other, e.g., a well at the top and a mound at the bottom

An Early Exploration of Bit-Like Dualism
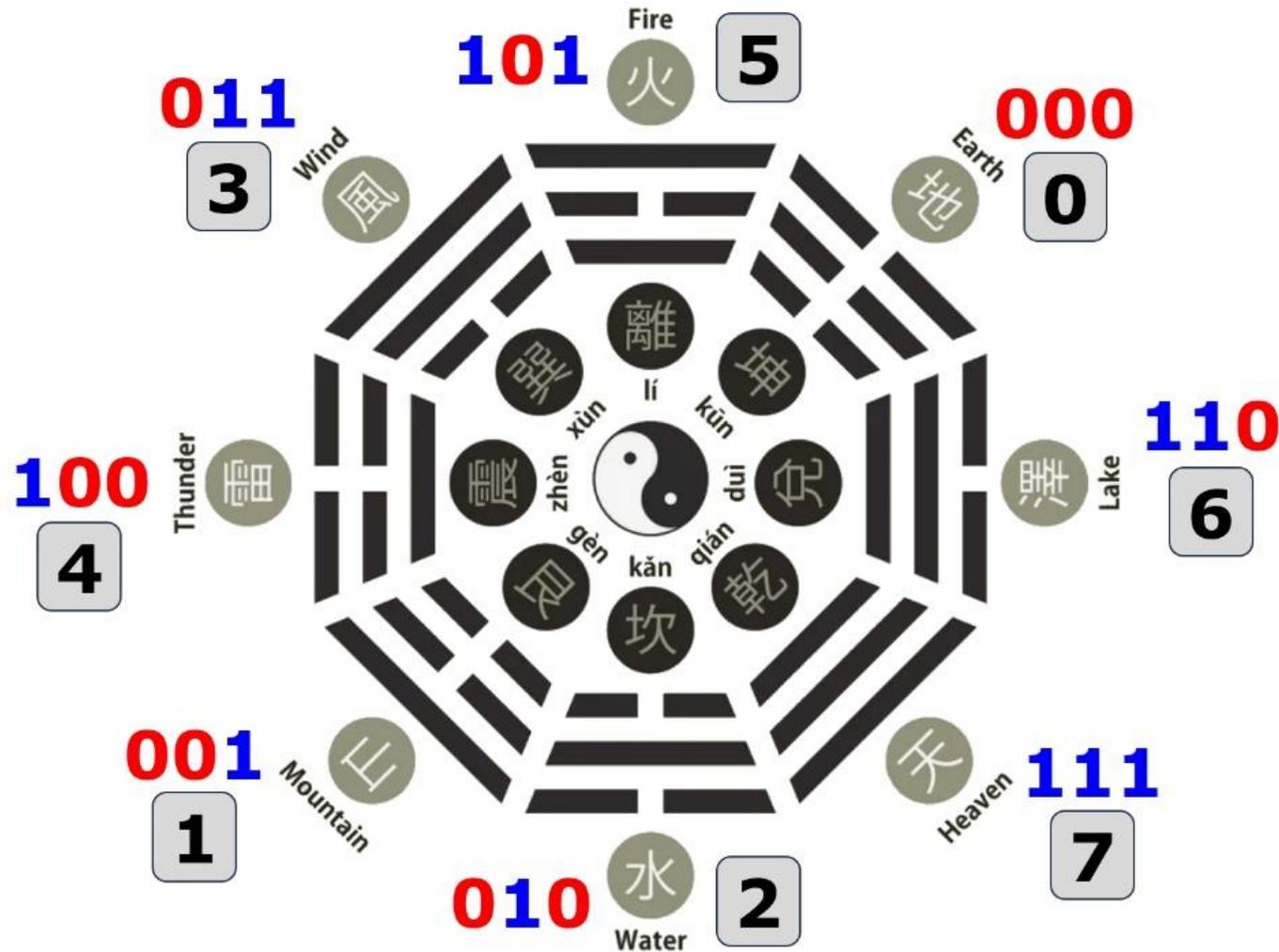
➢ Computer scientists were not the first to push binary dualism to represent more complex structures

➢ Some schools of yin-yang interpretation classify the world using three-bit binary integer equivalents, with earth as 0, heaven as 7

➢ While lakes are nice, making them 6, adjacent to heaven's 7, emphasizes this is not based on modern science

Dualisms in Science and Mathematics

➤ Most of the dualisms of science revolve around the existence of experimentally verified **mathematical dualisms**

➤ Mathematical dualisms exist when different formalisms capture the same concept or data, sometimes without obvious reasons

➤ In quantum mechanics, a surprising dualism was the equivalence of Born's matrix mechanics to Schrödinger's wave mechanics

➤ Two interesting dimensions of dualisms are:

  ➤ Embedded vs. separate: Does nature mix the two forms?

  ➤ Exact vs. broken: Does the dualism look identical from both sides?

➤ An unexpected dualism can open up powerful new insights
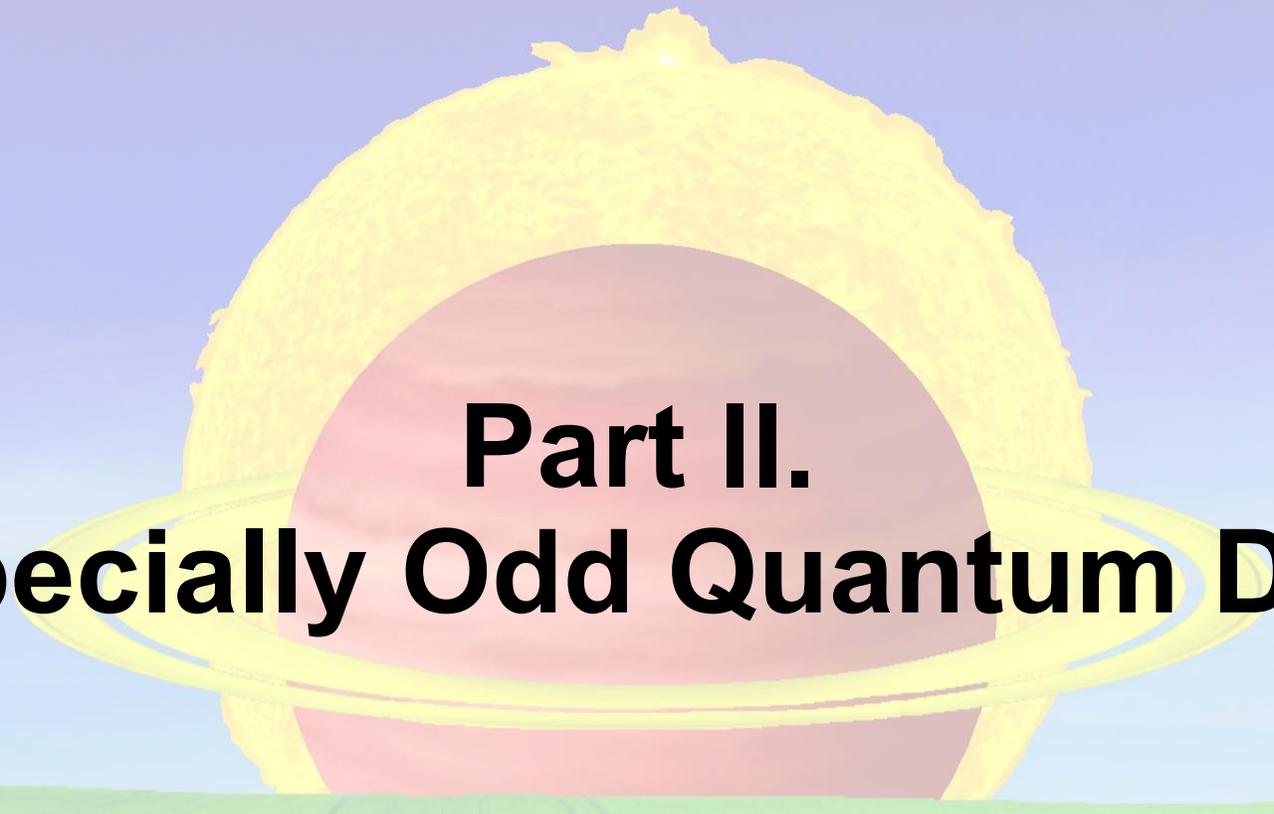
Part II.
An Especially Odd Quantum Dualism

The Original 1920s Dual-Holographic Universe

➢ One of the oddest dualisms found in early quantum mechanics was that the universe supports *two* equivalent four-dimensional spaces:

  ➢ A **location-time** coordinate system that all of us use every day, and

  ➢ A **momentum-energy** coordinate system that uses coordinates that are not at all intuitive, yet are powerful *and equivalent* to location-time

  ➢ These two are equivalent to each other through a delightful bit of math called the **Fourier transform** (and its almost-identical inverse)

➢ An interesting bit of trivia: The Fourier transform is what makes holograms produce images when you shine light on them

➢ Thus, these two dual spaces are literally **holograms of each other**

Matter Can Reside "Mostly" in Momentum Space

➢ The matter we see in everyday life lives "mostly" in location space

➢ When matter resides "mostly" in momentum space, very odd things happen

➢ The illustration (By Hinkeldörnchen, CC BY-SA 4.0) shows what happens to copper conduction electrons that "live" mostly in momentum space

➢ Superconductors and Bose condensates are also examples
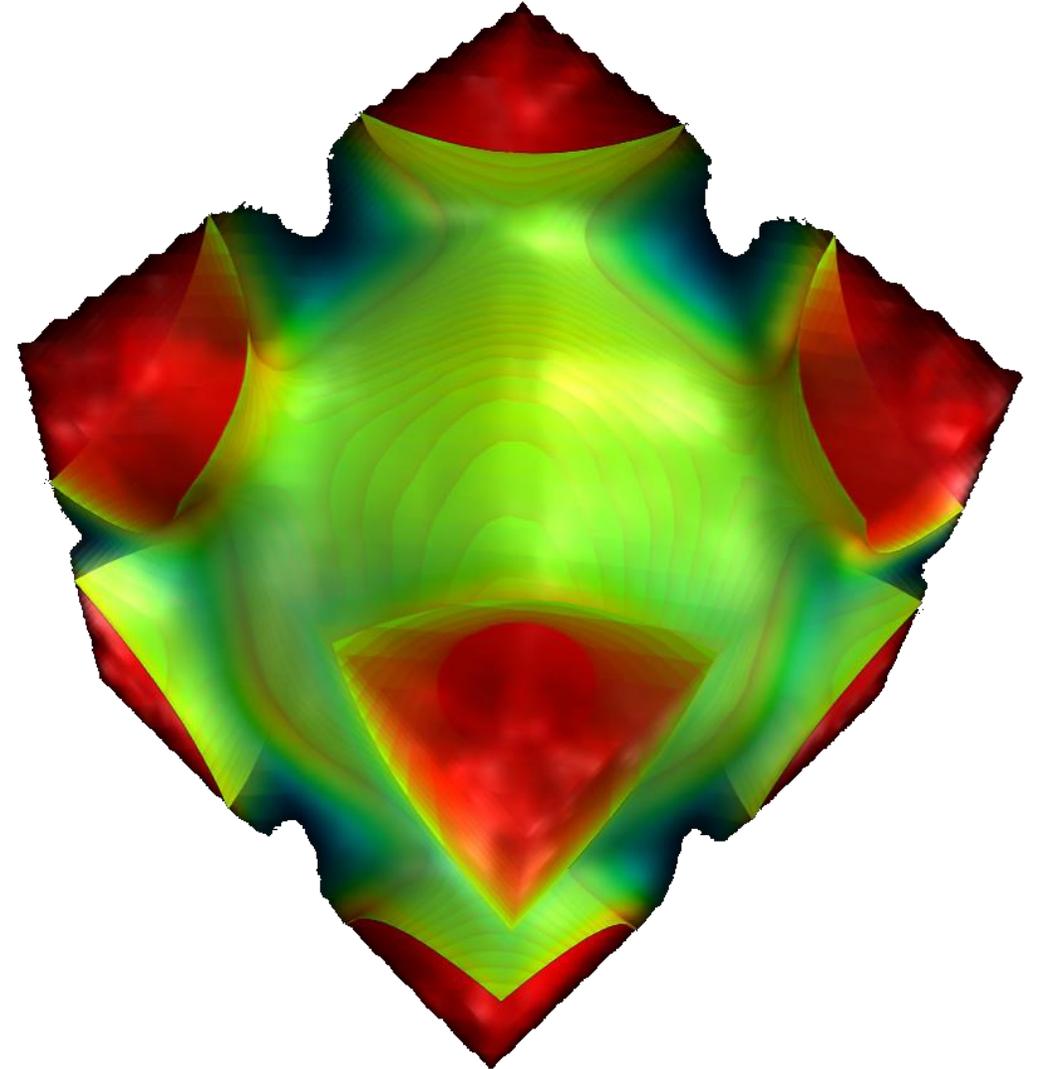
Photons Live Mostly in Momentum Space

Because photons exist *mostly* in momentum-energy space, they lack simple locations in space and time, leading to baffling phenomena

A Foot-Thick "No-Glare" Glass Plate "Loses" Photons in Time for 2 Nanoseconds

1 foot (0.33 m) of "no-glare for that frequency" glass

100% pass through

100% never reflect

individual photons of a precise frequency

~1 nanosecond (one billionth of a second)

Photon "sees itself" ~2 ns later

~1 nanosecond (one billionth of a second)

Two nanoseconds *after* the photon hits the glass front, its reflection from the far side of the glass cancels the existence of the reflection
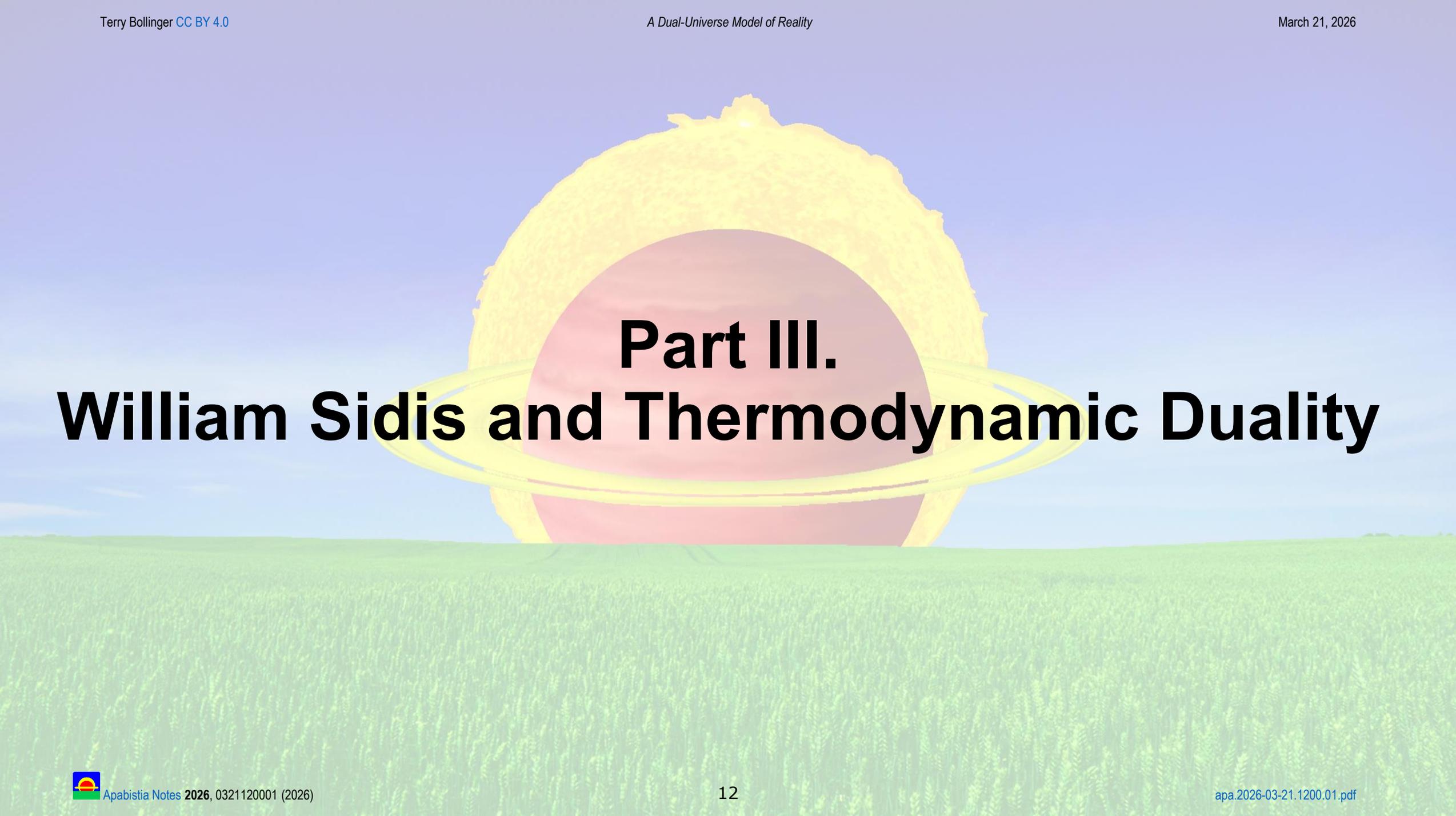
Part III.
William Sidis and Thermodynamic Duality

The Curious Case of William Sidis

➢ Sidis is often claimed to be one of the smartest people who ever lived, but he dropped out of academic society early in his life

➢ He did write (but did not promote) one interesting book:

W. J. Sidis, *The Animate and the Inanimate*. The Gorham Press, 1925. https://archive.org/details/TheAnimateAndTheInanimate.W.J.Sidis/mode/2up

➢ In the book, Sidis proposes two "co-mingled" universes:

     ➢ The first universe, the one we notice most, follows thermodynamics

     ➢ His second universe consists of a process that *reverses* entropy

     ➢ He proposes that only living organisms can access this entropy reduction

     ➢ He explicitly invokes the old (Lord Kelvin) belief that life defies entropy

➢ Worth noting: If reinterpreted as "probability bending," Sidis' second universe resembles behaviors seen only in momentum space

Sidis Quotes

The Animate and Inanimate, Preface, p. 3:

"[My] … theory … is based on the … reversibility of everything in time; that is, that every type of process has … a corresponding process which is its exact reverse with respect to time. [We already know this to be true] for all physical laws but one: the second law of thermodynamics. … We suppose that reversals of the second law are a regular phenomenon, and identify them with what is generally known as life."

➢ Rephrasing the idea: Can living organisms bend probabilities?

    ➢ When asked this way: Yes, of course they can

    ➢ An example: Photosynthesis uses quantum mechanics to transfer photon energy reliably

Probability Bending in Photosynthesis

➢ An example of biochemical probability bending:

G. S. Engel, *Quantum coherence in photosynthesis*. Procedia Chemistry 3 (1), 222–231 (2011). https://www.sciencedirect.com/science/article/pii/S1876619611000684

p. 229: "… Superposition states … 'coarse-grain' the energetic landscape, permitting the [photon energy] excitation to avoid narrow traps. In the same way that [a larger soccer ball rolls easily down the hill while] a small marble … [becomes] stuck on each blade of grass, these superposition states permit [faster] sampling of the … landscape. … [Otherwise,] the excitation would rattle around such a … landscape forever."

➢ Like photons that get "lost in time," being located mostly in momentum space keeps photon energy-transfer packets ("excitons") from "seeing" the small, noisy details of proteins

Nobel Laureate Hopfield on Probability Bending

J. J. Hopfield, *Electron Transfer Between Biological Molecules by Thermally Activated Tunneling*. Proceedings of the National Academy of Sciences 71 (9), 3640–3644 [Sep.] (1974). https://www.pnas.org/doi/abs/10.1073/pnas.71.9.3640

p. 3640: "The overall effectiveness of … photosynthesis … depends both on there being a large electron transfer rate for desired transfers, and a small rate for inappropriate transfers. … The simplest … coupling of electronic states to molecular thermal motions … to calculate the temperature-dependent electron transfer rate … involves tunneling. [p. 3644] … The tunneling matrix element is generally not appreciably temperature dependent."

J. J. Hopfield, *Kinetic Proofreading: A New Mechanism for Reducing Errors in Biosynthetic Processes Requiring High Specificity*. Proceedings of the National Academy of Sciences, 71 (10), 4135–4139 [Oct.] (1974). https://www.pnas.org/doi/abs/10.1073/pnas.71.10.4135

Abstract, p. 4135: "The specificity with which the genetic code is read in protein synthesis … can be increased … by a process defined here as kinetic proofreading. … Known reactions which … appear … useless or deleterious … are … essential to the proofreading function."

Can Ambiguous Time Improve Probabilities?

➢ Definitely! See examples on the previous two slides, where it can:

    ➢ Help direct energy by making moving energy packets "self-interfere"

    ➢ Reduce the odds of deleterious chemical reactions even in chaotic settings

➢ A specific example: If you send a photon out randomly and nominally in any direction, then, classically speaking, it should be almost impossible to recover

➢ But what if you use a quantum device better known as an *ordinary lens* to improve odds?

➢ Notable: The photosynthesis method used exciton lensing
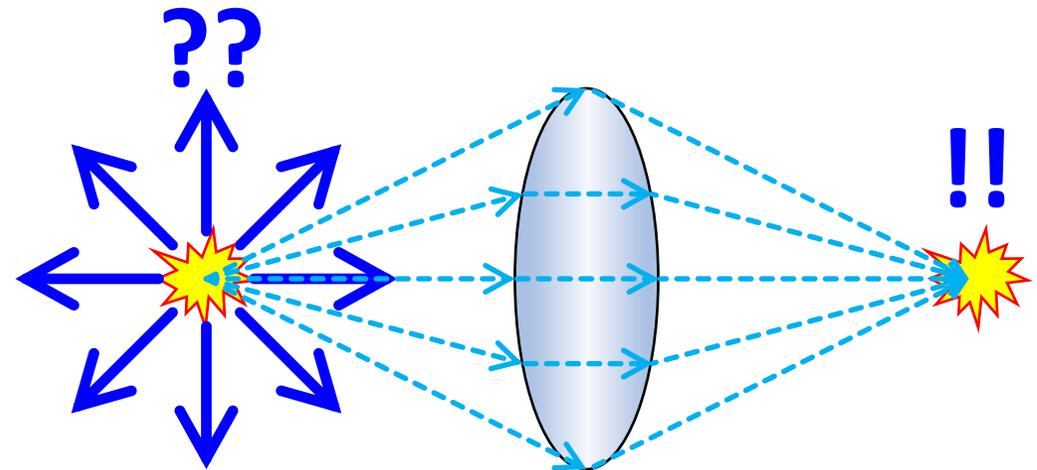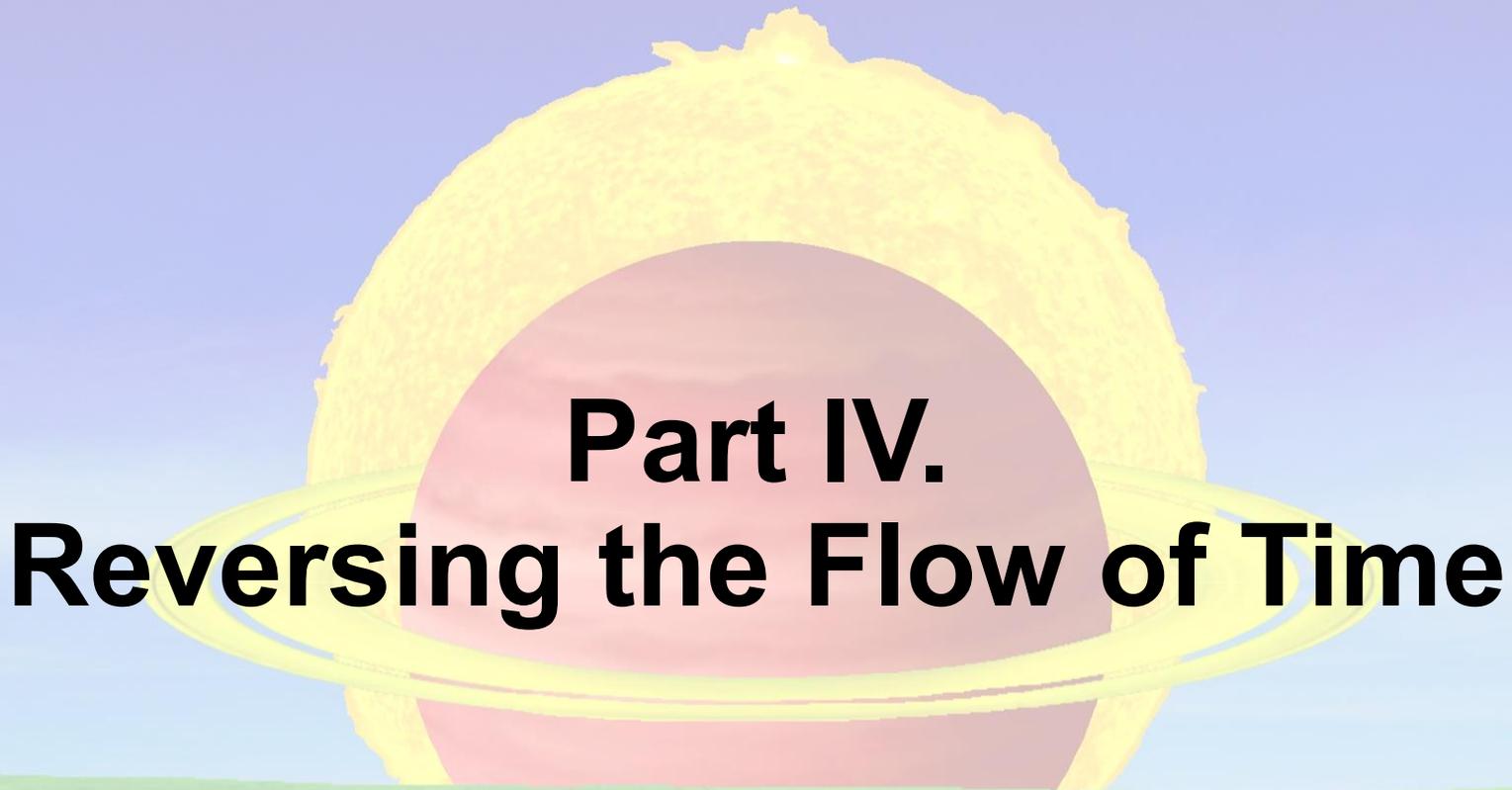
Part IV.
Reversing the Flow of Time

Dirac Predicts The Backward-Moving Positron

P. A. M. Dirac, *A Theory of Electrons and Protons*. Proceedings of the Royal Society of London. Series A, Containing papers of a mathematical and physical character **126** (801), 360–365 (1930). https://royalsocietypublishing.org/doi/pdf/10.1098/rspa.1930.0013

p. 361: "Let us examine [a] negative energy [electron state] more closely. … [Its] trajectory [in a given electromagnetic field will be the same as] … an ordinary electron with [charge -e and] positive energy. [However, it will] move in [a] reversed [direction within that trajectory]. [Notice, though, that this reversed movement is equivalent to a new kind of] electron of charge +e and positive energy moving in the [same reversed direction in the] electromagnetic field. Thus, an electron with negative energy moves in an external field as though it carries a positive charge."

Wheeler Takes Reversed Time Farther

At his Nobel Prize Lecture, Richard Feynman recalled how, in the Spring of 1940, John Wheeler called him with a truly wild idea:

> I received a telephone call one day at the graduate college at Princeton from Professor Wheeler, in which he said, "Feynman, I know why all electrons have the same charge and the same mass" "Why?" "Because, they are all the same electron!" (...) I did not take the idea that all the electrons were the same one from [Wheeler] as seriously as I took the observation that positrons could simply be represented as electrons going from the future to the past in a back section of their world lines. That, I stole![2]

➢ Wheeler had Dirac's positron idea to a whole new level, postulating an entirely new antimatter universe residing "somewhere" in ours

➢ This idea was very much testable, but proved not to be true

Wheeler's One-Electron Cyclic Universe
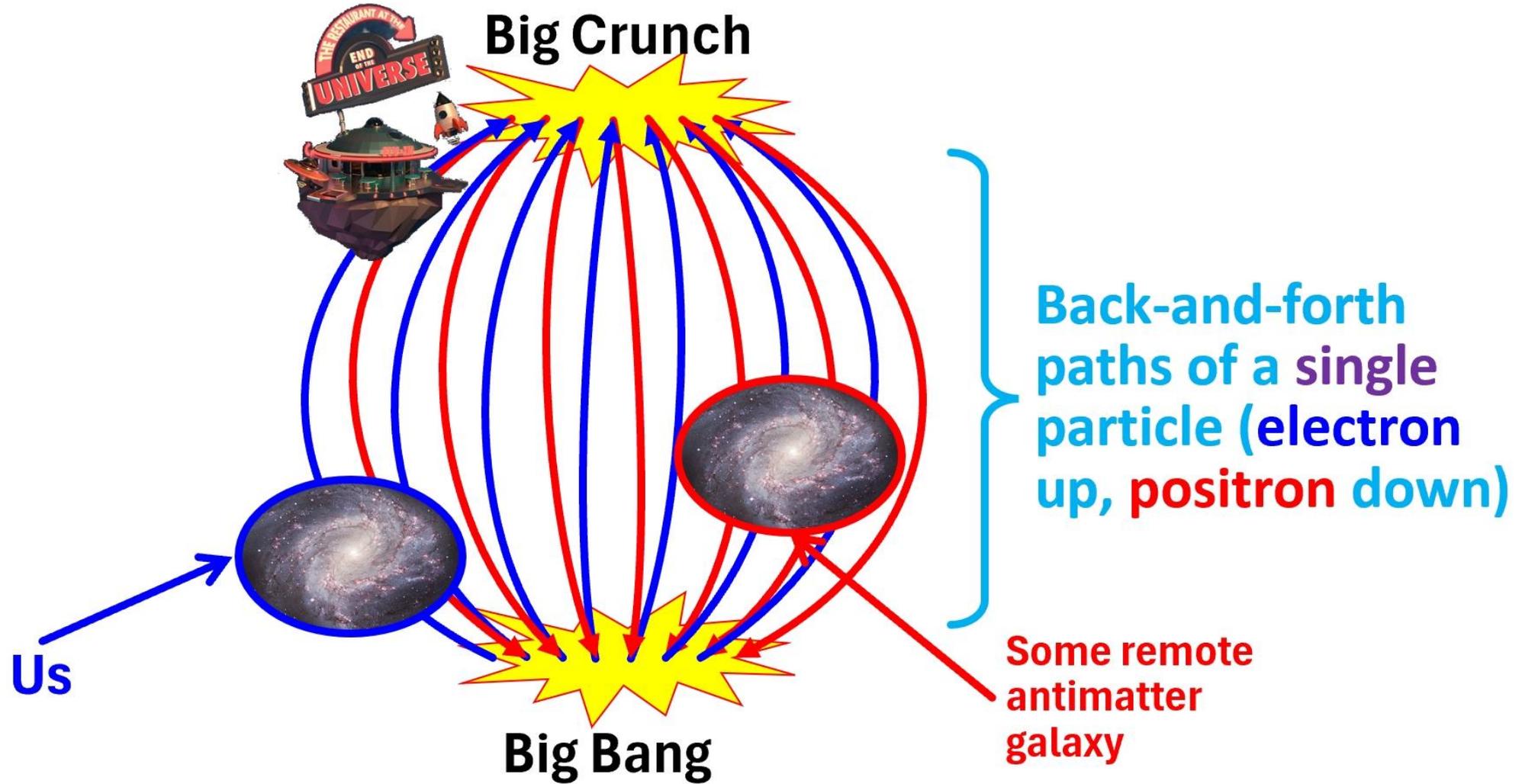
Feynman's Smaller-Scale Dual Time Concept

R. P. Feynman, *The Theory of Positrons*, Physical Review **76** (6), 749–759 (1949).
https://authors.library.caltech.edu/records/vysv7-c2b63

"It is as though a bombardier flying low over a road suddenly sees three roads, and it is only when two of them come together and disappear again that he realizes that he has simply passed over a long switchback in a single road."
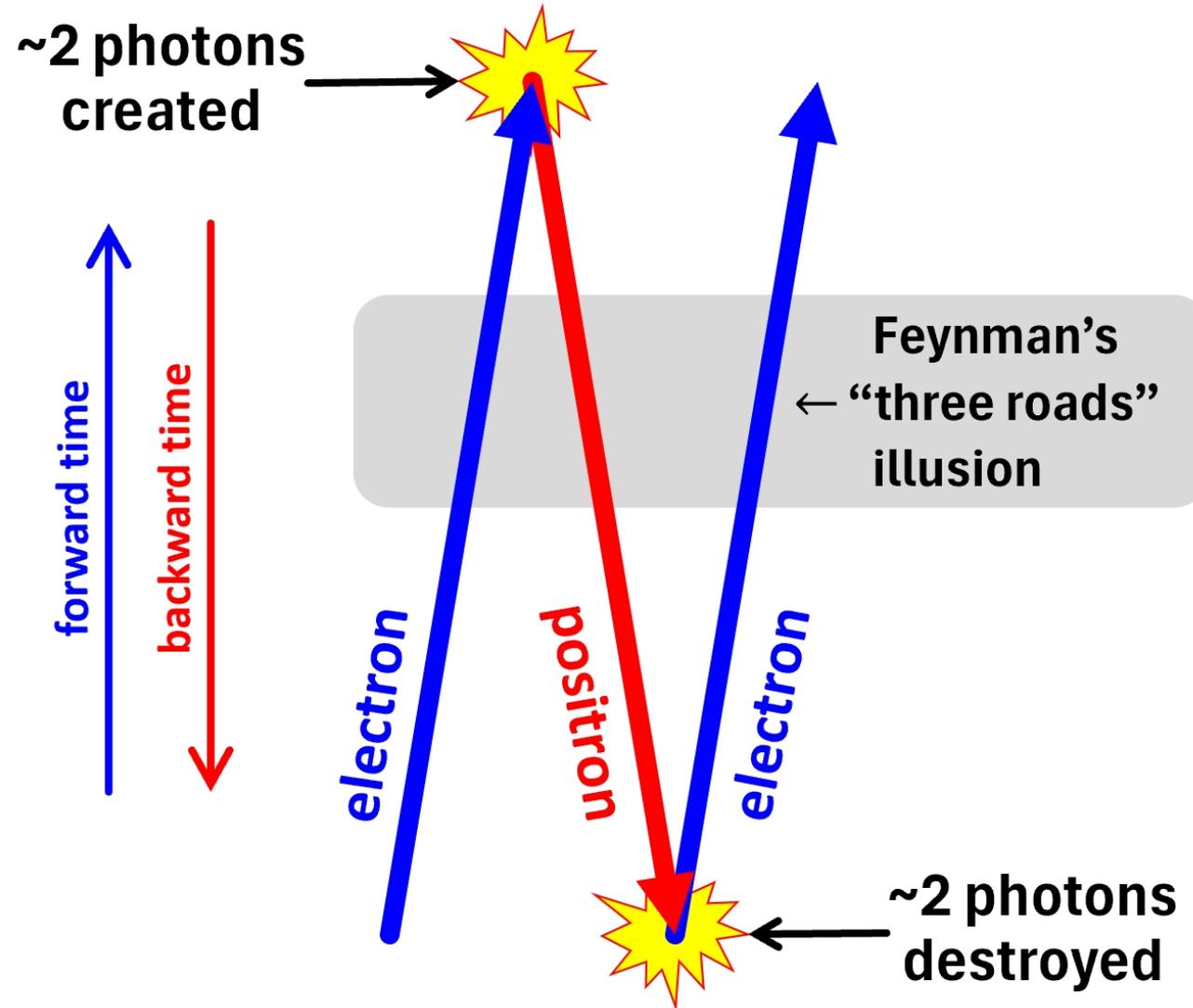
Sidenote: Beware of Chatbots for Research

➢ Every few months, I try reading one of the "AI Summaries" that Google will not allow me to turn off

➢ Every attempt contained some level of egregious error. In this case, it confidently assigned a quote from John Bell to Feynman:

WRONG
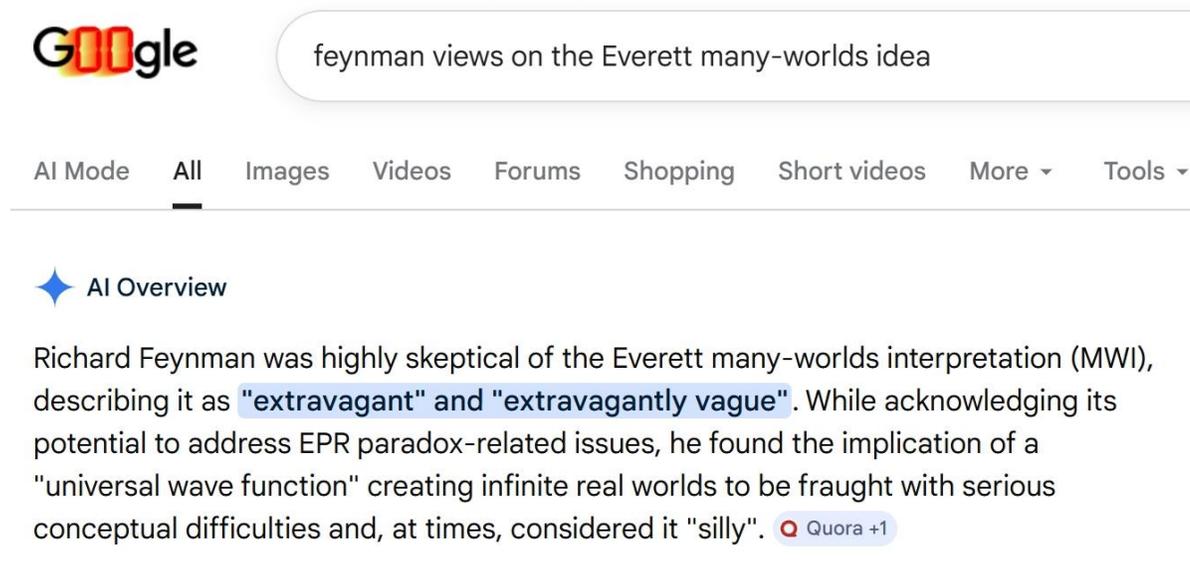
Google

> feynman views on the Everett many-worlds idea

AI Mode | **All** | Images | Videos | Forums | Shopping | Short videos | More ▾ | Tools ▾

✦ AI Overview

Richard Feynman was highly skeptical of the Everett many-worlds interpretation (MWI), describing it as "extravagant" and "extravagantly vague". While acknowledging its potential to address EPR paradox-related issues, he found the implication of a "universal wave function" creating infinite real worlds to be fraught with serious conceptual difficulties and, at times, considered it "silly". Ⓠ Quora +1

RIGHT

The power of the interpretation began to be appreciated even by people reluctant to endorse it fully. John Bell noted that "persons of course multiply with the world, and those in any particular branch would experience only what happens in that branch," and grudgingly admitted that there might be something in it:

The "many worlds interpretation" seems to me an extravagant, and above all an extravagantly vague, hypothesis. I could almost dismiss it as silly. And yet ... It may have something distinctive to say in connection with the "Einstein Podolsky Rosen puzzle," and it would be worthwhile, I think, to formulate some precise version of it to see if this is really so. And the existence of all possible worlds may make us more comfortable about the existence of our own world ... which seems to be in some ways a highly improbable one.
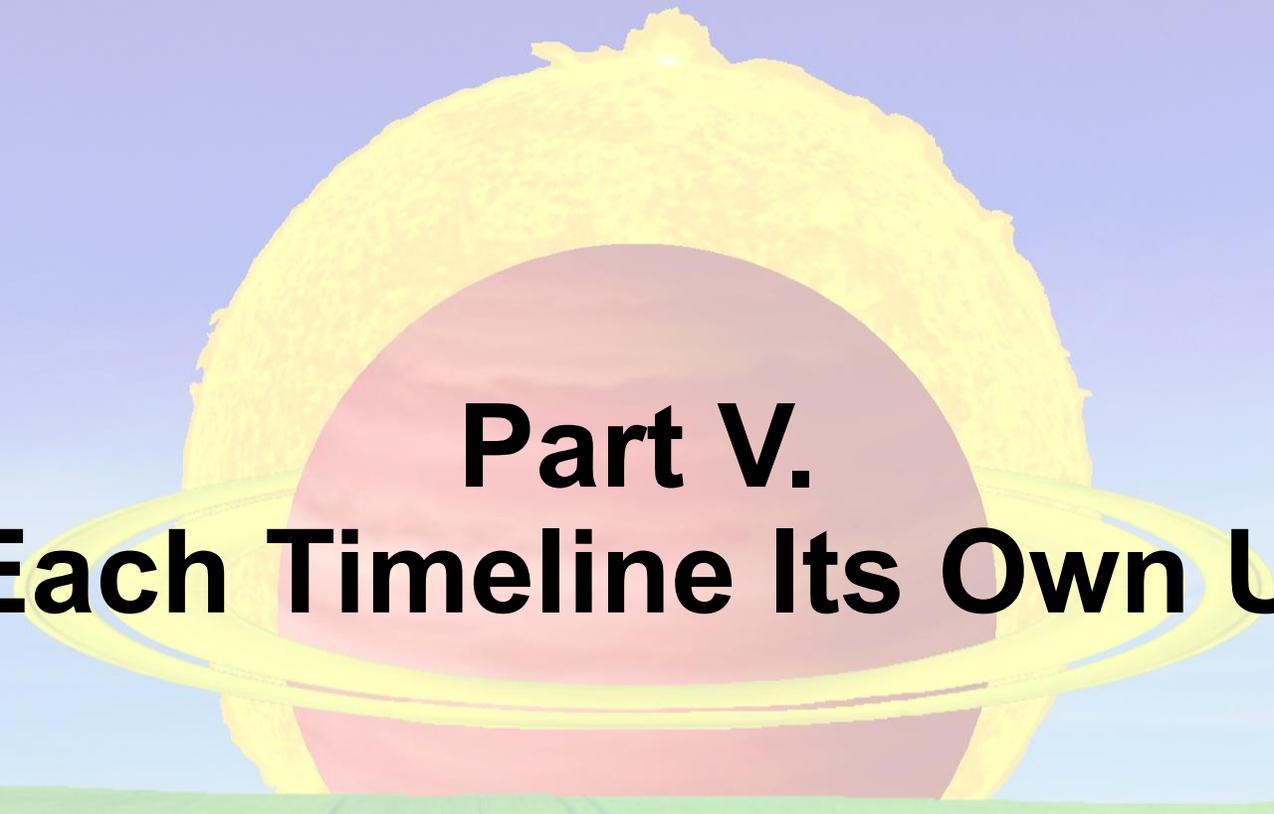
Part V.
Giving Each Timeline Its Own Universe

The Jennifer Chen and Sean Carroll Dual Universe

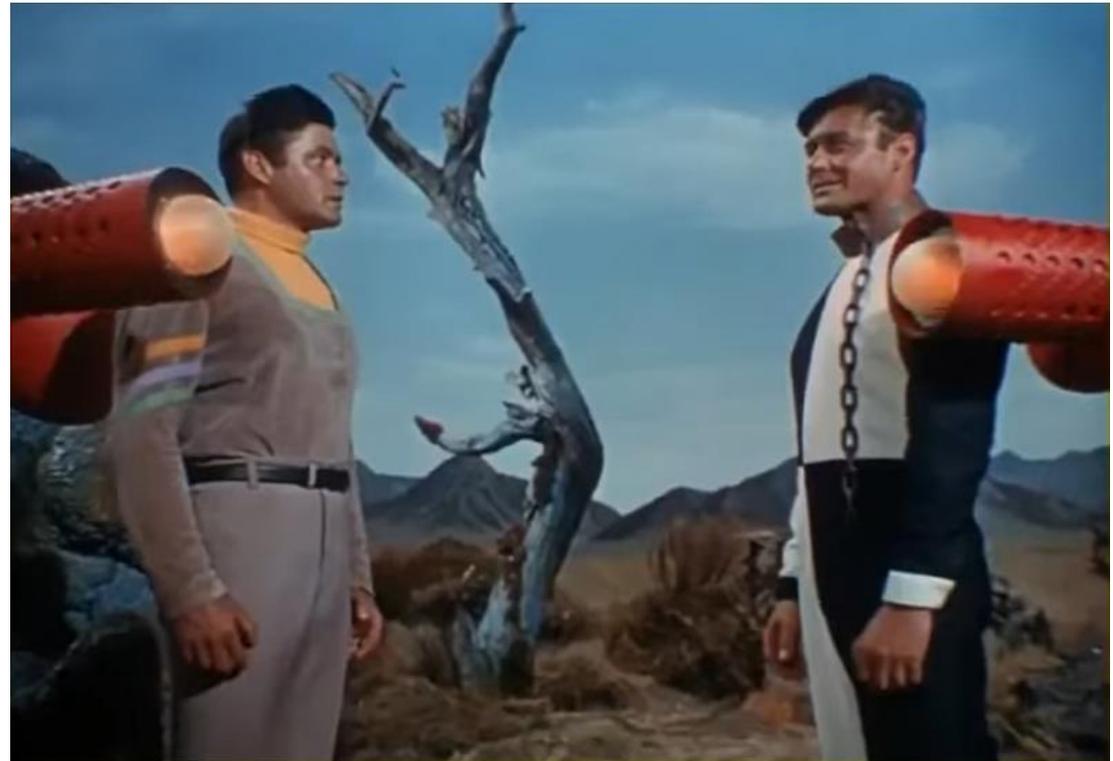Sean M. Carroll and Jennifer Chen, *Spontaneous Inflation and the Origin of the Arrow of Time*, arXiv preprint hep-th/0410270 [Oct. 27] (2004). https://arxiv.org/abs/hep-th/0410270

Figure 9: The ultra-large-scale structure of the universe. Starting from a generic state, it can be evolved both forward and backward in time, as it approaches an empty de Sitter configuration. Eventually, fluctuations lead to the onset of inflation in the far past and far future of the starting slice. The arrow of time is reversed in these two regimes.
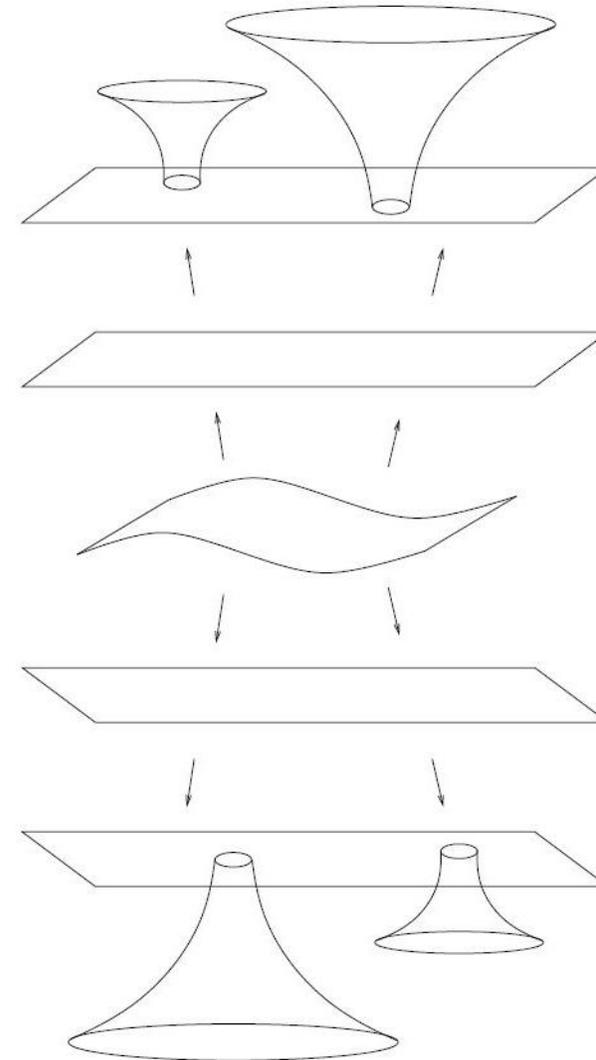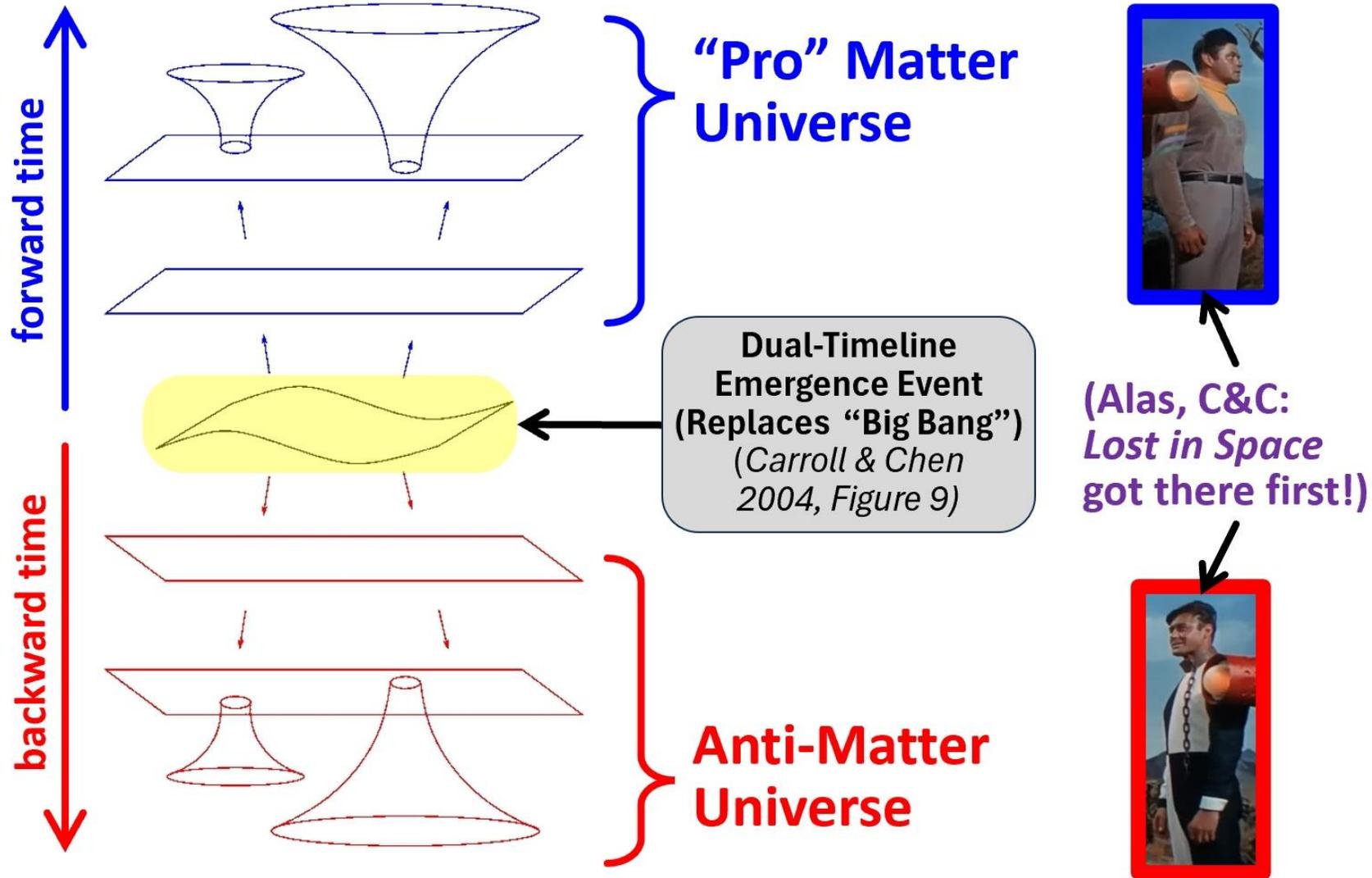
Alas, The Idea Was Not Entirely New By Then

Left: *Star Trek,* Oct. 6, 1967 (S2 E4): **Mirror Mirror**

Right: *Lost in Space*, Dec. 27, 1967 (S3 E15): **The Anti-Matter Man**

# Time Arrows in the Chen-Carroll Dual Universe

"Pro" Matter Universe

Dual-Timeline Emergence Event (Replaces "Big Bang") (*Carroll & Chen 2004, Figure 9*)

Anti-Matter Universe

forward time

backward time

(Alas, C&C: *Lost in Space* got there first!)

CPT and the Chen-Carroll Dual Universe

➤ Because their argument depended entirely on de Sitter (asymptotically empty) solutions to General Relativity, it gave no attention to a critical particle physics issue: **CPT Symmetry**

➤ CPT Symmetry means Charge, Parity, Time symmetry.

  ➤ **Charge** is just particle charge (plus for minus, for example)

  ➤ **Parity** refers to taking a mirror image, which affects issues like spin

  ➤ **Time** is just that: The direction of the timeline, as first noted by Dirac

➤ The paper seems never to have been published in a journal

➤ Antimatter violates CPT symmetry, so the Chen-Carroll dual universe is not entirely self-consistent

Julian Barbour and The Janus Point

➢ The "Janus" in this 2020 dual-universe book refers to the idea of the two-faced god Janus looking outwards at two universes with opposite timelines.

➢ The book began with this paper:

J. Barbour, T. Koslowski, and F. Mercati, *Identification of a gravitational arrow of time*, Physical Review Letters **113** (18), 181101 (2014). https://journals.aps.org/prl/abstract/10.1103/PhysRevLett.113.181101

➢ The unique premise of the paper and book is that the formation of two universes comes from gravitational interactions
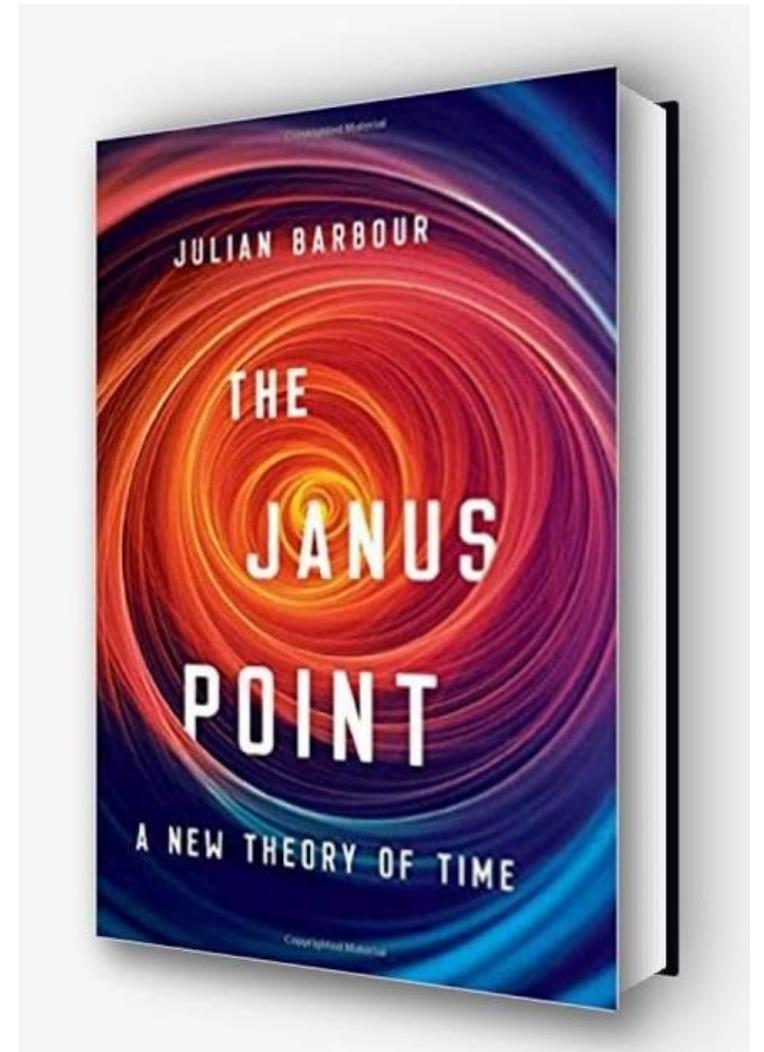
A Serious Problem with the Janus Premise

> *The model.*—The Newtonian N-body problem with vanishing total energy $E_{tot} = 0$, momentum $\mathbf{P}_{tot} = \mathbf{0}$, and angular momentum $\mathbf{J}_{tot} = \mathbf{0}$ is a useful model of the Universe in many respects [3]. As we show below,

➢ The difficulty with this sentence from the first paragraph of the paper is extraordinarily simple: There is no such thing as vanishing total energy in Newtonian physics — or in relativistic physics, for that matter. It implies the existence of negative energy in Newtonian physics, but without explicitly saying so.

➢ The reference given is bogus for this; it only addresses momentum.

The Latham Boyle and Neil Turok Dual Universe

The Big Bang, CPT, and neutrino dark matter

Latham Boyle[1], Kieran Finn[1,2] and Neil Turok[1]

[1] *Perimeter Institute for Theoretical Physics,*
Waterloo, Ontario, Canada, N2L 2Y5
[2] *School of Physics and Astronomy, University of Manchester*
Manchester, UK, M13 9PL

ABSTRACT: We investigate the idea that the universe before the Big Bang is the *CPT* reflection of the universe after the bang, so that the state of the universe does *not* spontaneously violate *CPT*. The universe before the bang and the universe after the bang may be viewed as a universe/anti-universe pair, created from nothing. The early universe is radiation dominated and inflationary energy is not required. We show how *CPT* selects a preferred vacuum state for quantum fields on such a cosmological spacetime. This, in turn, leads to a new view of the cosmological matter/anti-matter asymmetry, and a novel and economical explanation of the dark matter abundance. If we assume that the matter fields in the universe are described by the standard model of particle physics (including right-handed neutrinos), it is natural for one of the heavy neutrinos to be stable, and we show that in order to match the observed dark matter density, its mass must be 4.8×10^8 GeV. We also obtain further predictions, including: (i) that the three light neutrinos are majorana; (ii) that the lightest of these is exactly massless; and (iii) that there are no primordial, long-wavelength gravitational waves.

Cancelling the vacuum energy and Weyl anomaly in the standard model with dimension-zero scalar fields

Latham Boyle[1] and Neil Turok[1,2]
[1] *Perimeter Institute for Theoretical Physics, Waterloo, Ontario, Canada, N2L 2Y5*
[2] *Higgs Centre for Theoretical Physics, University of Edinburgh, Edinburgh, Scotland, EH8 9YL*
(Dated: October 2022)

The standard model is a remarkably consistent and complete quantum field theory but its coupling to gravity and the Higgs field remain problematic, as reflected in the cosmological constant problem, the Weyl anomaly, and the hierarchy puzzle. We point out that 36 conformally-coupled dimension-zero scalar fields can simultaneously cancel the vacuum energy and both terms in the Weyl anomaly, if the Higgs field is emergent. The cancellation is highly non-trivial: given the standard model gauge group $SU(3) \times SU(2) \times U(1)$, it requires precisely 48 Weyl fermions, *i.e.*, three generations of standard model fermions, including right-handed neutrinos. Due to a large additional gauge symmetry, the new scalars contribute no new local degrees of freedom or particle states. Their only physical state is their vacuum state, in which they possess a scale invariant power spectrum extending to long wavelengths. This suggests a new explanation for the primordial scalar perturbations in cosmology, not requiring inflation. We also discuss how the Higgs field might emerge as a composite object.

> The many Boyle and Turok papers on dual universes are easily the best available. They even include numeric predictions, e.g., for 36 dimension-zero scalar fields. (My best guess: Quark time axes.)
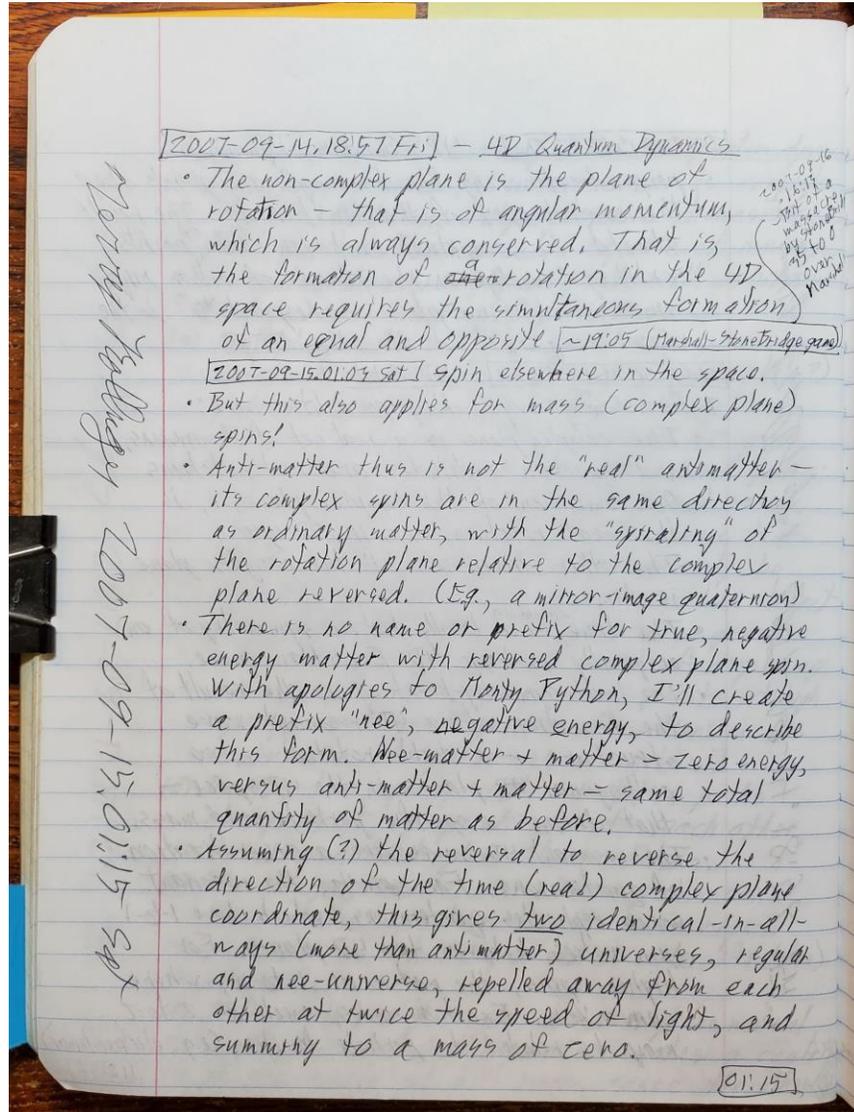
Part VI.
Bollinger Dual Universe Quick View

Sometimes, Simple Arguments End Up Interesting

➢ Quaternions are the four-dimensional version of complex numbers

➢ The quaternion properties relevant to dual universes are:

    ➢ They contain two **independent** spin planes, one complex, one imaginary

    ➢ Looking at the possible combinations of spins and axes gives a dual-cube structure that maps into the Glashow Cube representation of fermions

    ➢ Chirality becomes the direction of spin of the complex plane, with a simple conservation analogy with angular momentum arguing that half of the known set of chiral fermions — the "weak blind" half — have *negative rest mass*. This is a serious violation of expectations, but also testable.

        ➢ Both universes contain both types, but each has a slight excess of its type

➢ This idea matches well with the concept of bottom-up spacetime

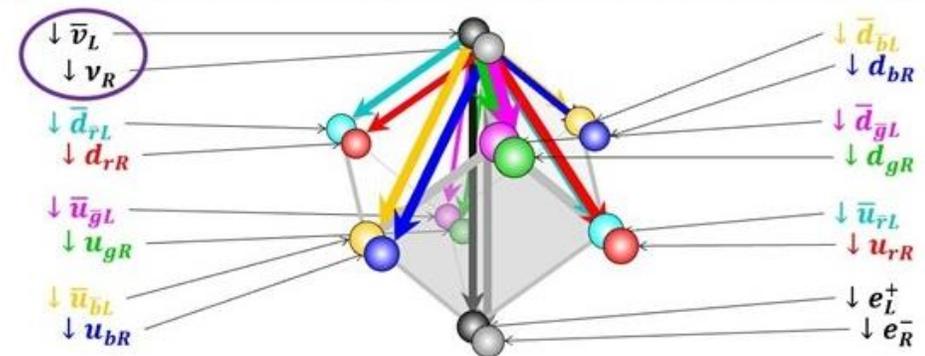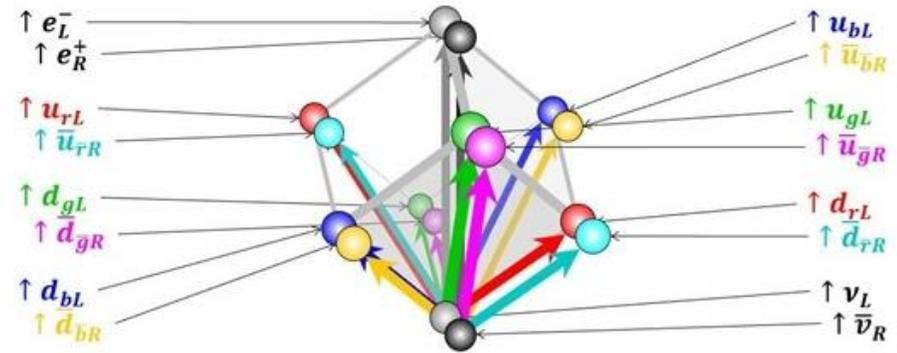# Original Notes Entry and Fermion Duals By Universe

Part VII.
Summary: What's Next

Summary: What's Next

➢ Integration with bottom-up fractal spacetime

➢ Experimental tests definition (looking for negative rest masses in weak-blind chiral fermions)

➢ More comprehensive math models, but *only* bottom-up

  ➢ Follow the Feynman principle of looking for the simplest possible steps

  ➢ Have smoothness emerge from simple steps (also a Feynman principle)

➢ Explore the timeless-ness issue more closely

  ➢ Feynman disagreed with the idea of a universal (Everett) wave function

  ➢ Feynman's "playing with time" may lead to better quantum computing