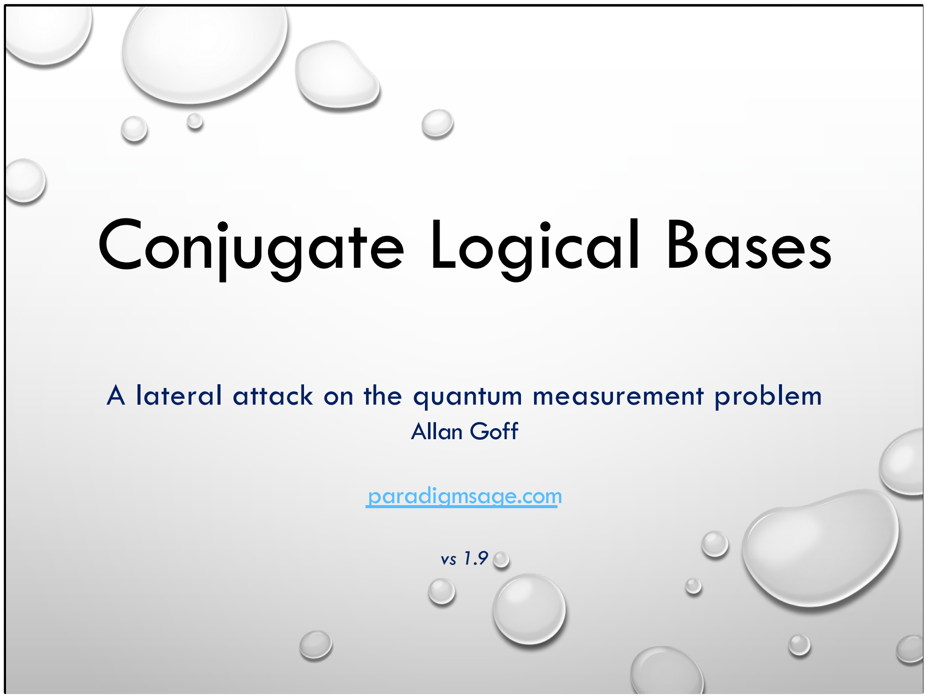
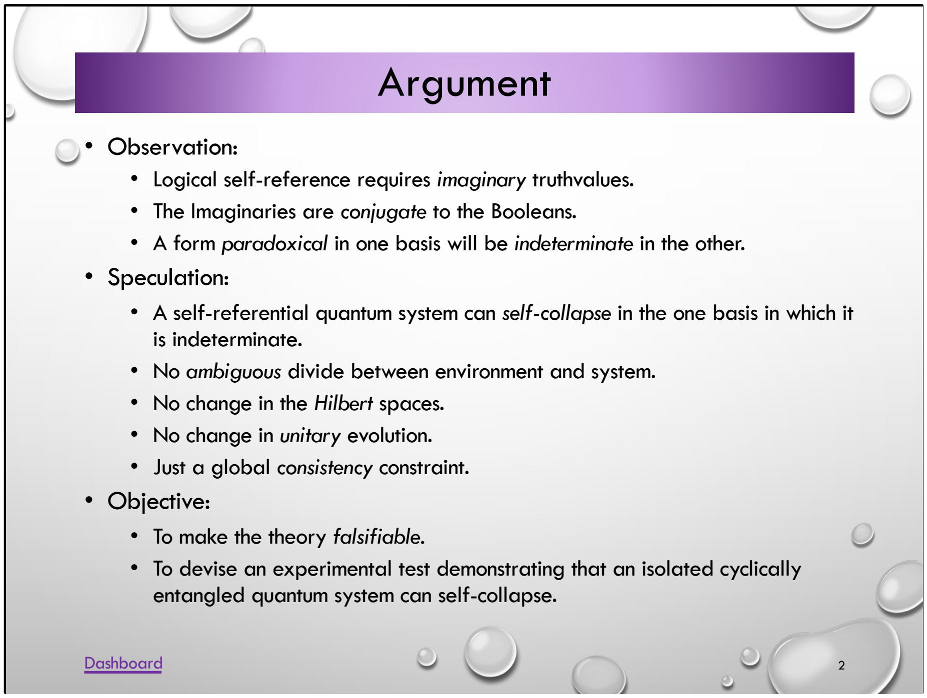


Presented at the LOF2026 conference at Cambridge University, UK, 8/12/2026.



This presentation is a stepwise argument from math to physics ending in an experimental test.

Its inspiration is the unavoidability of self-reference in complex systems building upon the seminal work of G. Spencer-Brown in *Laws of Form*.

The introduction of imaginary truthvalues leads to the epiphany that Imaginary truthvalues form a conjugate basis to the Boolean truthvalues.

Thus, the speculation: will an isolated cyclically entangled closed loop in spacetime self-collapse?

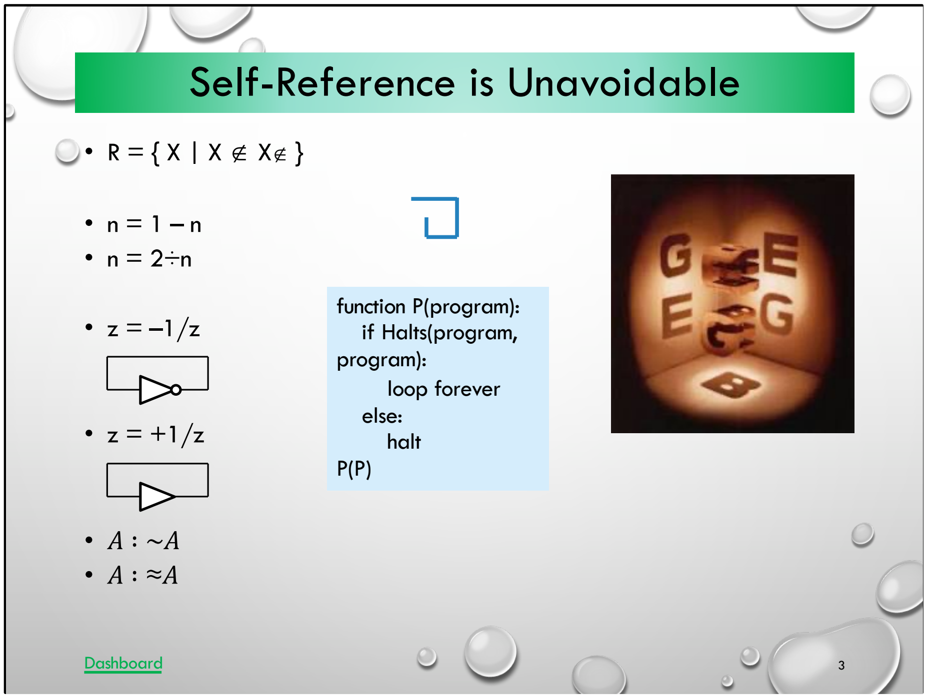
Supposition: if there is one and only one basis in which the loop is self-consistent.

No ambiguous divide between the environment (treated at the classical level) and the system (treated at the quantum level).

Just one level – quantum all the way up.

A global consistency constraint is built upon the foundation of Hilbert spaces and unitary evolution.

QM is not wrong, relativity is not wrong, but both were incomplete, each containing part of the solution.



Russell

Gödel

Use/Mention

Liar's Paradox

Ontological Indeterminism

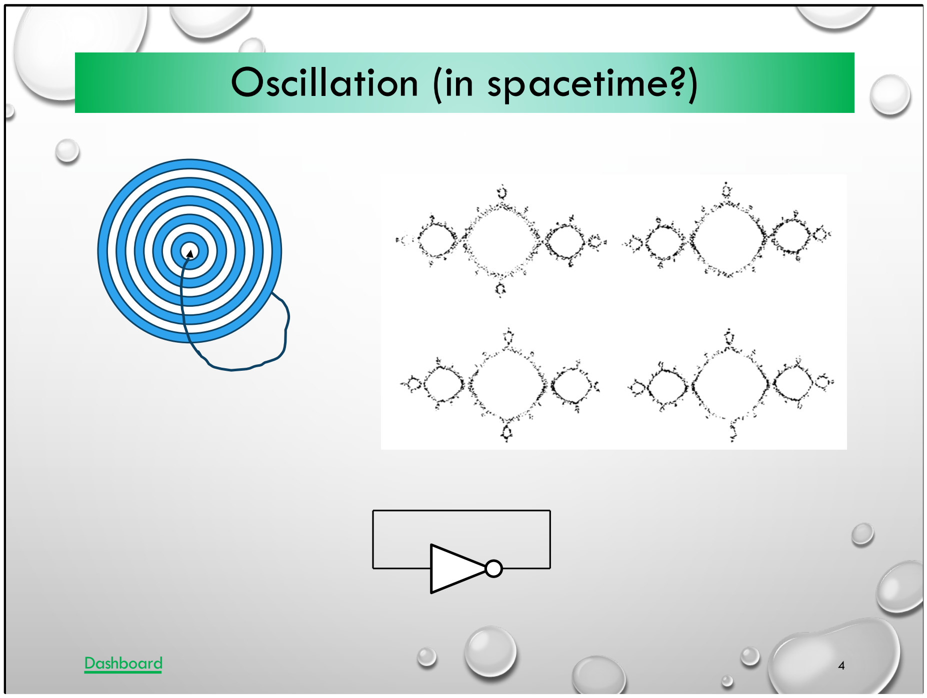
Sequential circuits

Halting problem

Spencer-Brown

Self-reference breaks closure.

It has been at the heart of all the major limit theorems of the last century.



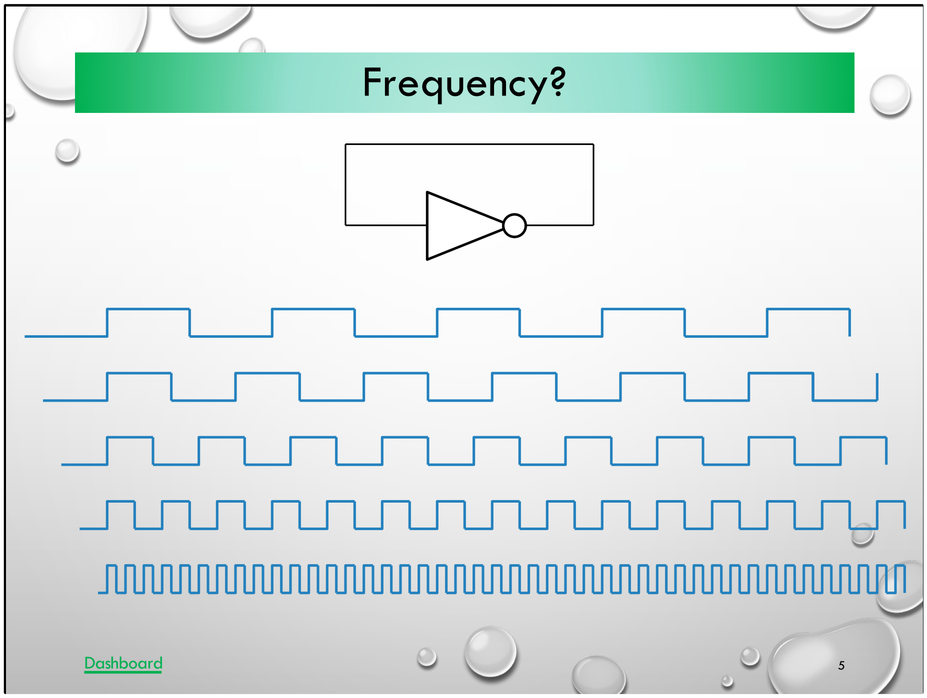
Spencer-Brown was ambiguous whether reentrance was in space or time – pick your distinction.

Kauffman has deeply explored reentrance in space.

Reentrance in time is arguably easier

Hellerstein's Diamond logic, Bricken, Shoup, Goff.

The notation of digital schematics makes it trivial to recognize the symmetry between the Liar's Paradox and the Circular Argument.



If we model SR as an oscillation in time, then the question is whether there is an upper limit to its frequency.

If so, call it the **paradox frequency**.

This can be modeled with clocked gates.

A NOT gate feeding back on itself has a paradox frequency half the clock frequency.

Its phase determines is imaginary truthvalue.

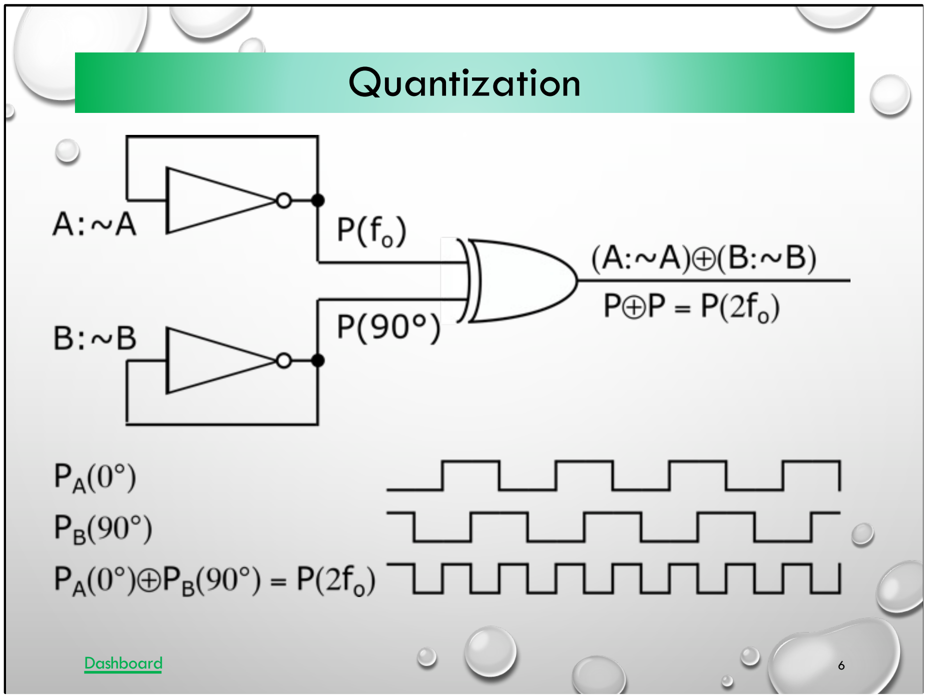
Its arbitrary which phase is mapped to which truthvalue.

Does that rankle?

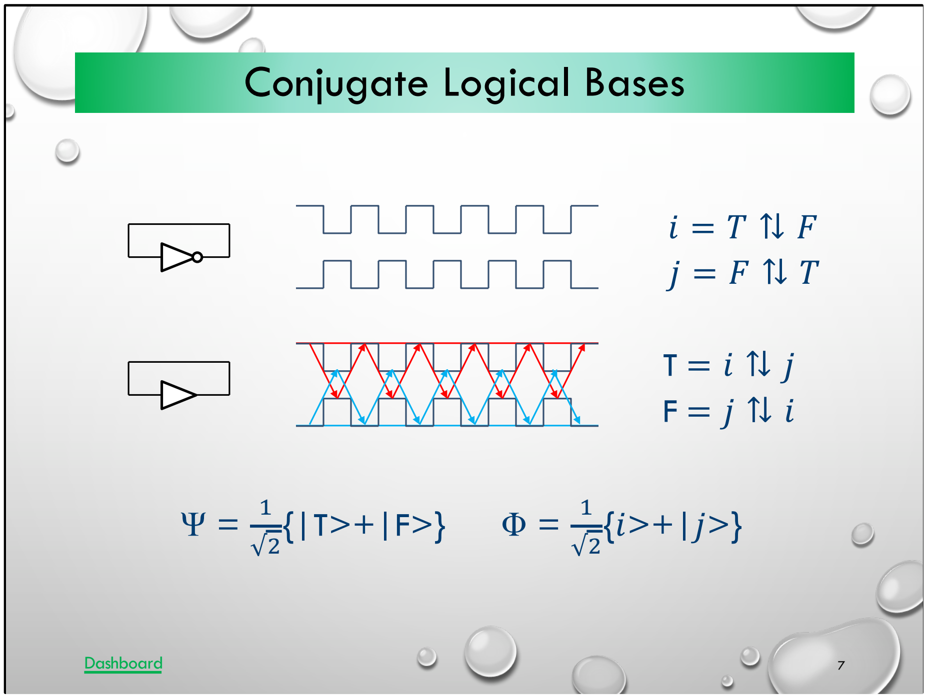
We forget that Boolean truthvalues are also arbitrary.

Does zero map to T or to F?

A standard must be picked.



Assume a maximum frequency, call it the paradox frequency.
Let two paradoxes feed an XOR gate but with a 90° phase shift.
Out comes an oscillation at *twice* the paradox frequency, assumption invalidated.
Thus, either there is no upper limit, or the phase must be quantized.
Thus, there are two imaginary truthvalues, call the imaginary true and imaginary false, and label them 'i' and 'j'.
Portent #1: A maximum allowed frequency (the Planck frequency, the paradox frequency).
Portent #2: Quantization (allowed phases: 0° and 180°).



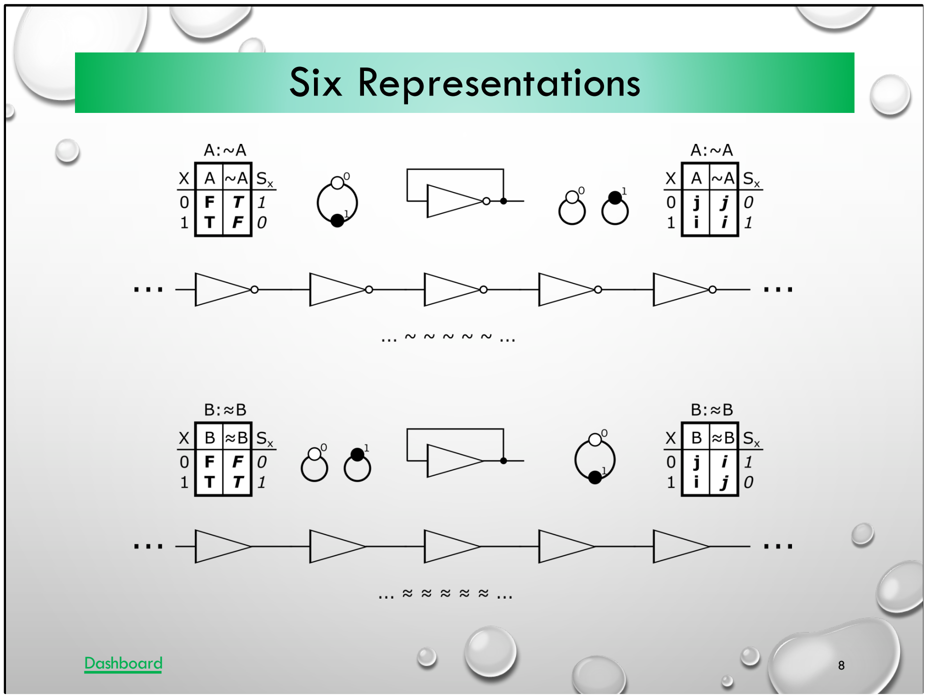
The Imaginary truthvalues can be represented as alternating Boolean truthvalues.

In perfect symmetry, the Boolean truthvalues can be represented as alternating Imaginary truthvalues.

They form a pair of *conjugate bases* for truthvalues.

Echoes (portent) of quantum physics.

Portent #3: Conjugate Bases



Six representations

- Typographic
- Truth tables
- Successor vector
- Attractor structures
- Digital circuits
- Infinite expansion

Hypothetical: a self-referential form is never paradoxical in all bases.

There is always at least one in which it is indeterminate.

Consider a unary gate whose output feeds back to its input.

It is fully self-referential, no inputs at all.

If it is a NOT gate, the circuit is paradoxical in the Boolean basis but indeterminate in the Imaginary basis.

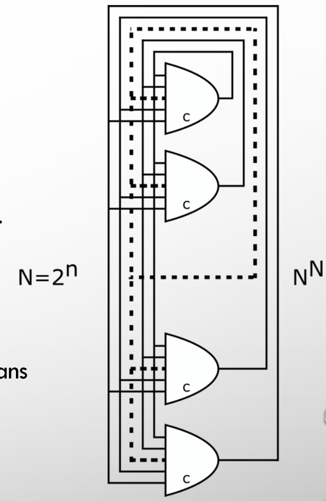
If it is a BUF gate, the circuit is paradoxical in the Imaginary basis but indeterminate in the Boolean basis.

There are two theoretical branches here:

- Keep the indeterminacy throughout some ‘proof’.
- Randomly pick one value and use it throughout the ’proof’.

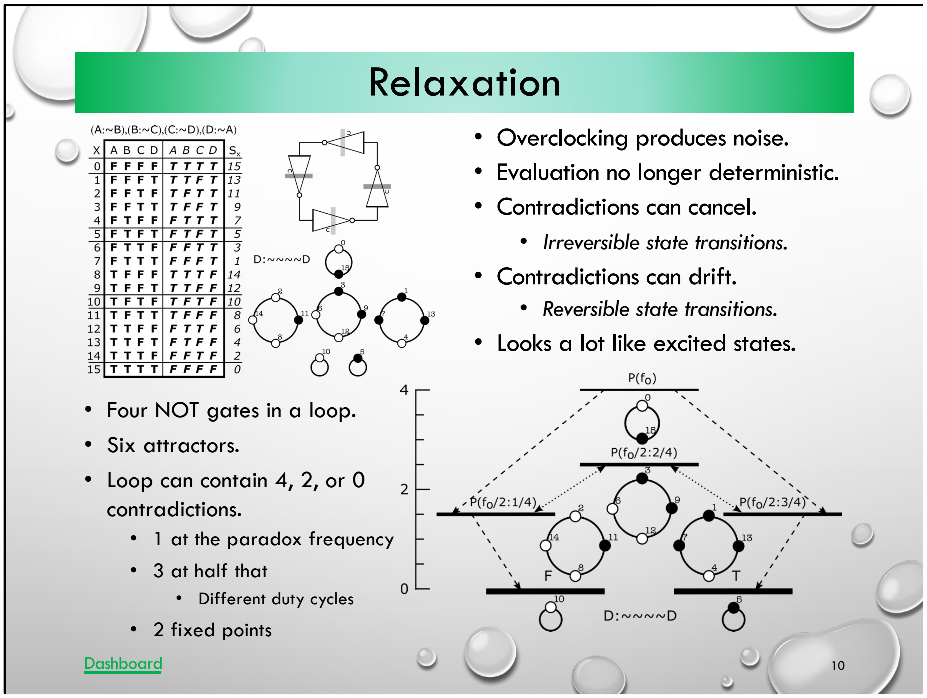
Scaling Law

- There are n gate complexes:
  - Each with n inputs.
  - Every output is an input.
  - Every complex is clocked.
  - Each implements a truth table.
    - Each has 2^n rows.
    - There are 2^(2^n) possible output columns.
    - Thus, (2^(2^n))^n sequential circuits.
  - Thus, N^N sequential circuits.
    - $N = 2^n$.
  - Only N! combinatorial circuits.
- Avoiding self-reference has denied logicians access to most logical forms, N! versus N^N.



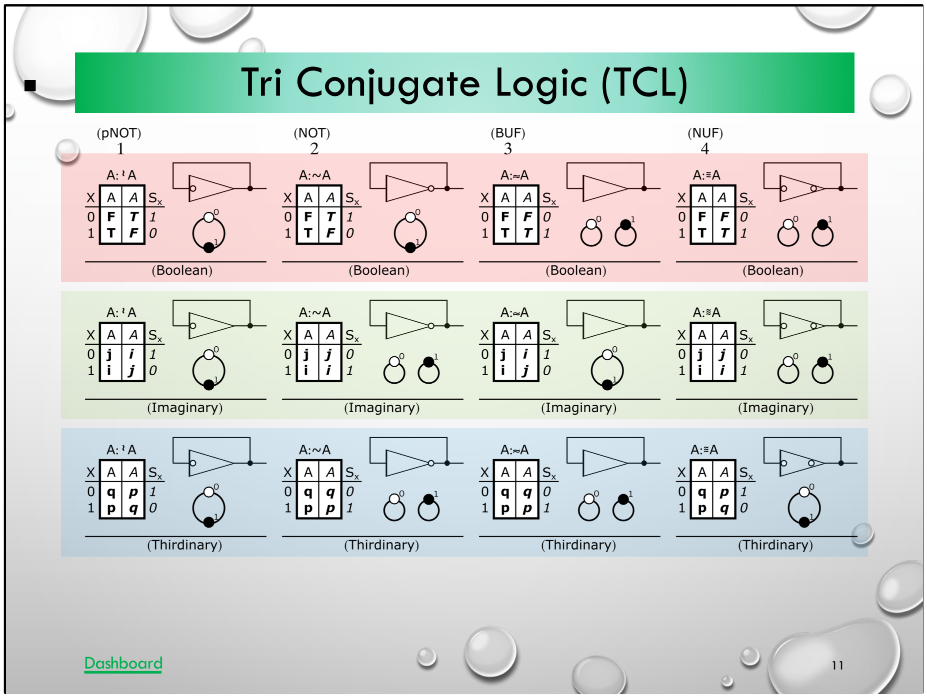
Dashboard

Combinatorial circuits (linear forms) only scale as N!.
Sequential circuits (nonlinear forms) scale as N^N.
Logicians in their misguided attempt to prevent self-reference have cut themselves off from the vast majority of logical forms.
The conventional interpretations of Gödel’s theorems may be off base.
Perhaps they do not prove that truth supersedes proof, but merely that some truths cannot be reached without going through imaginary truthvalues.
The ancient Euclidean ideal of neatly stepping from truth to truth as the ultimate recipe to uncover all truths may not be possible.
Perhaps that ideal should be given a name, the Euclidean Proof Paradigm (EPP).
It has reigned supreme as the core of human reasoning for more than 2,000 years – perhaps self-reference reveals its limits.
Like imaginary numbers in math, some proofs require them.



In a sequential form, any contradictions propagate around the loops.
Here we have a simple 4 stage loop of NOT gates.
The attractor structure has 6 pure attractors, no stems (no transient states).
All the representational forms are evident here.
The attractor structure makes it clear that this form is indeterminate between Boolean and Imaginary bases, and at least one other basis conjugate to both.
If evaluation is strictly generational, then the truth table is predictive, and the form is stuck in whatever attractor it starts in.
The contradictions stately advance around the loop.
However, if a signal arrives early or late, or a logical computation rushes or gets delayed, then the contradictions can shift relative positions.
Overclocking does just this in real circuits.
A simple shift is just a phase shift, a reversible transition between similar attractors.
But if two contradictions meet, they cancel, and the system can transition, irreversibly, between attractors.
Thus the ‘values’ of this form can be organized into a contradiction diagram (energy diagram) with various excited states and, significantly, a ground state.
Portent #4: Excited states.

Take a page out of Dirac.
If scalars don’t work, try vectors, if vectors don’t work try matrices – viola, antimatter.



Deeper analysis has been slow – could this be a dead end?
Why should there be only *two* mutually conjugate logical bases?
Could there be three?
Now we add two more 'imaginary' truthvalues, call them p & q.
(If there is room for three standards, there is certainly room for four.)

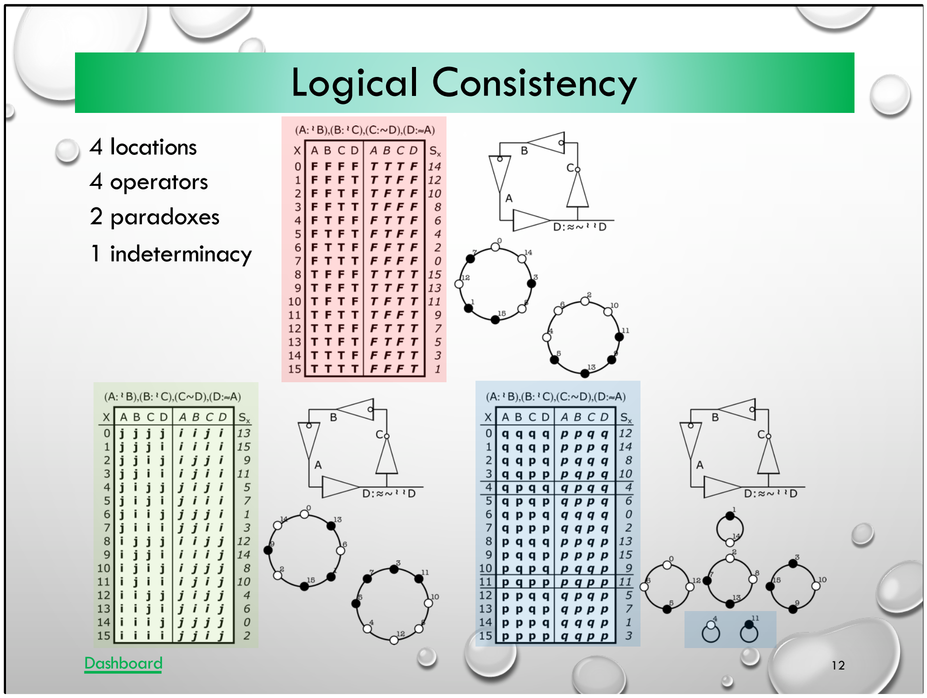
Three bases:

- Boolean (T/F)
- Imaginary (i/j)
- Thirdinary (p/q)

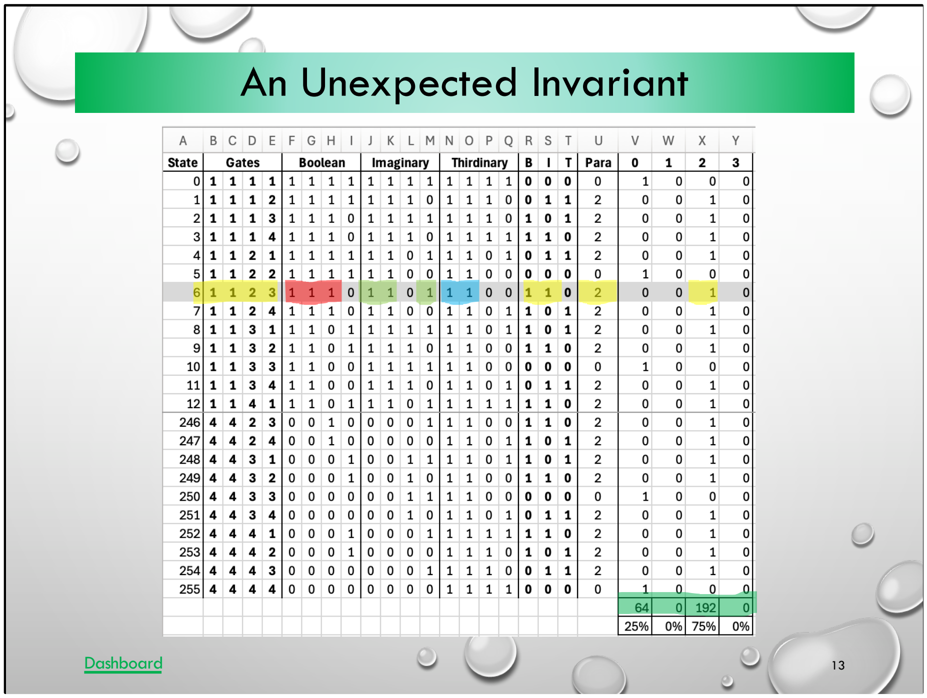
Four unary operators:

- pNOT
- NOT
- BUF
- NUF

Try Conjugate Logic, (TCL – *tickle*).



In a sequential form, any contradictions propagate around the loops.
Here we have a simple 4 stage loop of unary gates – pNOT, pNOT, NOT, BUF.
The attractor structure is basis dependent.
This form is inconsistent in the Boolean and Imaginary bases but has a fixed-point ground state in the Thirdinary basis.



An Unexpected Invariant

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y
State	Gates				Boolean				Imaginary				Thirdinary				B	I	T	Para	0	1	2	3
0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	1	0	0	0
1	1	1	1	2	1	1	1	1	1	1	1	0	1	1	1	0	0	1	1	2	0	0	1	0
2	1	1	1	3	1	1	1	0	1	1	1	1	1	1	1	0	1	0	1	2	0	0	1	0
3	1	1	1	4	1	1	1	0	1	1	1	0	1	1	1	1	1	1	0	2	0	0	1	0
4	1	1	2	1	1	1	1	1	1	1	0	1	1	1	0	1	0	1	1	2	0	0	1	0
5	1	1	2	2	1	1	1	1	1	1	0	0	1	1	0	0	0	0	0	0	1	0	0	0
6	1	1	2	3	1	1	1	0	1	1	0	1	1	1	0	0	1	1	0	2	0	0	1	0
7	1	1	2	4	1	1	1	0	1	1	0	0	1	1	0	1	1	0	1	2	0	0	1	0
8	1	1	3	1	1	1	0	1	1	1	1	1	1	1	0	1	1	0	1	2	0	0	1	0
9	1	1	3	2	1	1	0	1	1	1	1	0	1	1	0	0	1	1	0	2	0	0	1	0
10	1	1	3	3	1	1	0	0	1	1	1	1	1	1	0	0	0	0	0	0	1	0	0	0
11	1	1	3	4	1	1	0	0	1	1	1	0	1	1	0	1	0	1	1	2	0	0	1	0
12	1	1	4	1	1	1	0	1	1	1	0	1	1	1	1	1	1	1	0	2	0	0	1	0
246	4	4	2	3	0	0	1	0	0	0	0	1	1	1	0	0	1	1	0	2	0	0	1	0
247	4	4	2	4	0	0	1	0	0	0	0	0	1	1	0	1	1	0	1	2	0	0	1	0
248	4	4	3	1	0	0	0	1	0	0	1	1	1	1	0	1	1	0	1	2	0	0	1	0
249	4	4	3	2	0	0	0	1	0	0	1	0	1	1	0	0	1	1	0	2	0	0	1	0
250	4	4	3	3	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	1	0	0	0
251	4	4	3	4	0	0	0	0	0	0	1	0	1	1	0	1	0	1	1	2	0	0	1	0
252	4	4	4	1	0	0	0	1	0	0	0	1	1	1	1	1	1	1	0	2	0	0	1	0
253	4	4	4	2	0	0	0	1	0	0	0	0	1	1	1	0	1	0	1	2	0	0	1	0
254	4	4	4	3	0	0	0	0	0	0	0	1	1	1	1	0	0	1	1	2	0	0	1	0
255	4	4	4	4	0	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0	1	0	0	0
																					64	0	192	0
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Dashboard

13

Four possible operators, four possible locations.
256 permutations - shown is the partial spreadsheet, middle rows suppressed.
The number of phase inversions for each gate is computed.
Odd number is a paradox, even number is an indeterminacy.
Tallied by basis, then summed for the entire table.
Permutation 6 is highlighted as an example – pNOT, pNOT, NOT, BUF.
In no case is there a permutation where only one basis is paradoxical, and none where every basis is paradoxical.
In 192 cases the loop is paradoxical in exactly two bases and *indeterminate in precisely one*.
in 64 cases, the loop is indeterminate in all three bases.

The Bell States in Three Bases

State	L	O	R	Statistics
1	$\psi_- = \frac{1}{\sqrt{2}}\{\lvert H\rangle\lvert V\rangle - \lvert V\rangle\lvert H\rangle\}$	$\psi_- = \frac{1}{\sqrt{2}}\{\lvert D\rangle\lvert S\rangle - \lvert S\rangle\lvert D\rangle\}$	$\psi_- = \frac{1}{\sqrt{2}}\{\lvert R\rangle\lvert L\rangle - \lvert R\rangle\lvert L\rangle\}$	Fermionic
2	$\psi_+ = \frac{1}{\sqrt{2}}\{\lvert H\rangle\lvert V\rangle + \lvert V\rangle\lvert H\rangle\}$	$\phi_+ = \frac{1}{\sqrt{2}}\{\lvert D\rangle\lvert D\rangle + \lvert S\rangle\lvert S\rangle\}$	$\phi_- = \frac{1}{\sqrt{2}}\{\lvert L\rangle\lvert L\rangle - \lvert R\rangle\lvert R\rangle\}$	Bosonic
3	$\phi_- = \frac{1}{\sqrt{2}}\{\lvert H\rangle\lvert H\rangle - \lvert V\rangle\lvert V\rangle\}$	$\psi_+ = \frac{1}{\sqrt{2}}\{\lvert D\rangle\lvert S\rangle + \lvert S\rangle\lvert D\rangle\}$	$\phi_+ = \frac{1}{\sqrt{2}}\{\lvert L\rangle\lvert L\rangle + \lvert R\rangle\lvert R\rangle\}$	
4	$\phi_+ = \frac{1}{\sqrt{2}}\{\lvert H\rangle\lvert H\rangle + \lvert V\rangle\lvert V\rangle\}$	$\phi_- = \frac{1}{\sqrt{2}}\{\lvert D\rangle\lvert D\rangle - \lvert S\rangle\lvert S\rangle\}$	$\psi_+ = \frac{1}{\sqrt{2}}\{\lvert L\rangle\lvert R\rangle + \lvert R\rangle\lvert L\rangle\}$	

- The Bell states have the same structure as the operators of TCL.

Now for the transition from logic to physics.

Consider the Bell states but represent them in all three mutually independent bases.

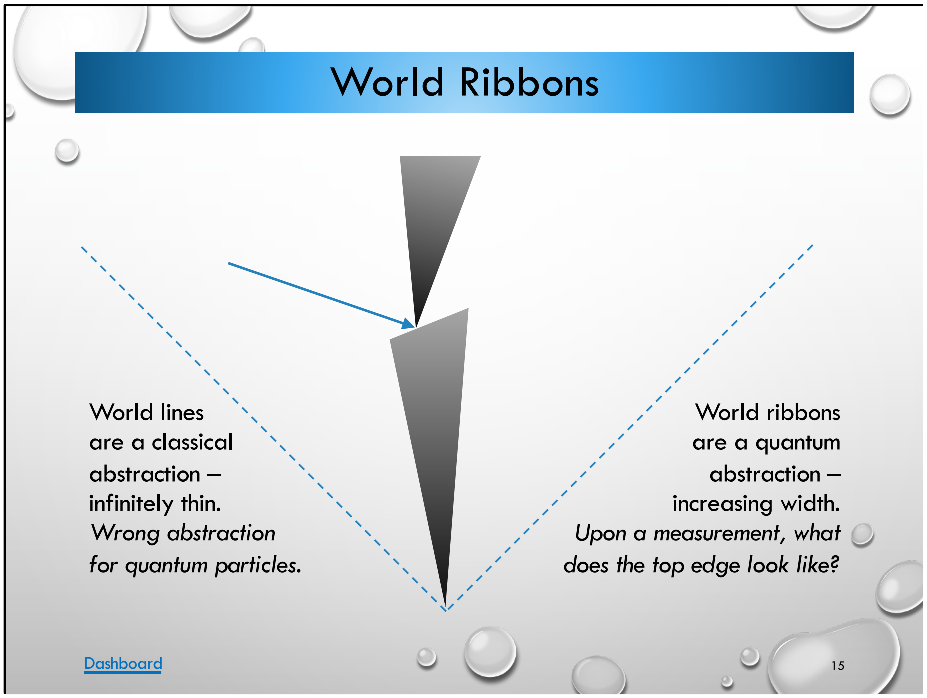
Four states, each represented in each of the three basis.

The antisymmetric state (state 1, ψ_-) has the same mathematical form in every basis, the rest do not.

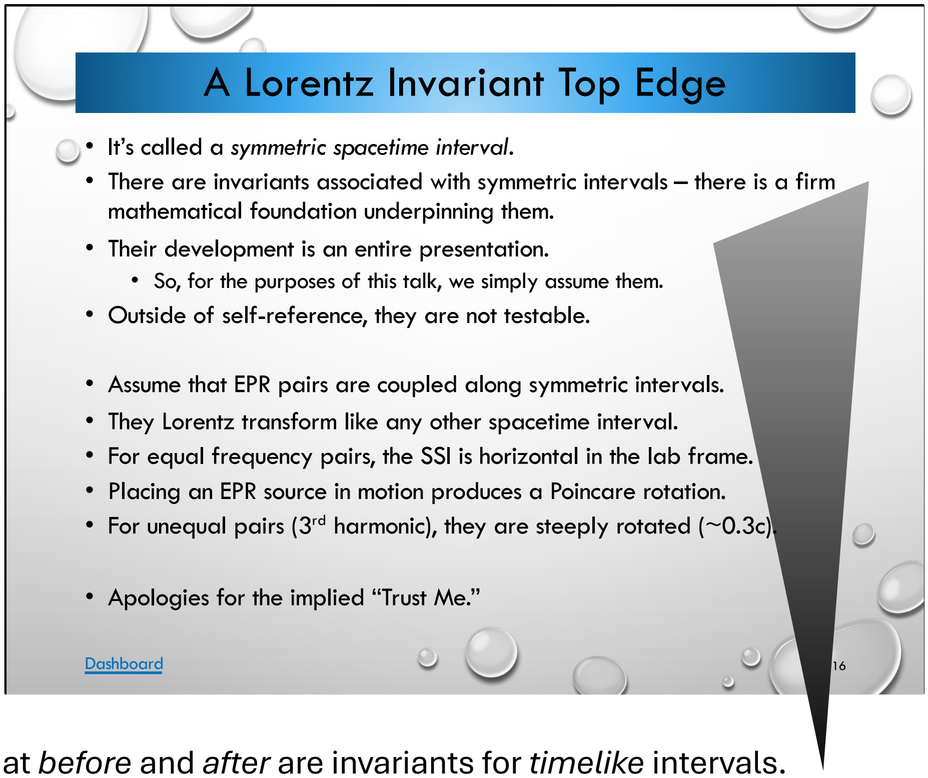
This asymmetry is going to have consequences.

It is exactly the same structure as in TCL.

Do the consequences follow?



The uncertainty principle is at odds with the concept of a world line.
A particle does not follow an infinitely thin trajectory.
Its path into the future has breadth, which generally increases.
Call this a *world ribbon*.
Collapse of the wave function is envisioned as something that happens instantaneously.
But instantaneous is not a relativistic invariant – it is a classical abstraction.
Collapse cannot be instantaneous in all reference frames, only in one.
Thus, the question – when collapse happens, what is the shape of the top edge of a world ribbon?
If objective collapse is relativistically meaningful, the collapse hypersurface should itself be spacelike.



Recall that *before* and *after* are invariants for *timelike* intervals.

Recall that *left* and *right* are invariants for *spacelike* intervals.

That symmetry is crucial; before and after are frame independent for timelike intervals, left and right are frame independent for spacelike intervals.

If there is any frame in which it can be decided the slope of the collapse edge (spacelike), then all observers will agree.

Nature gifted us an arrow of time, we get before and after for free.

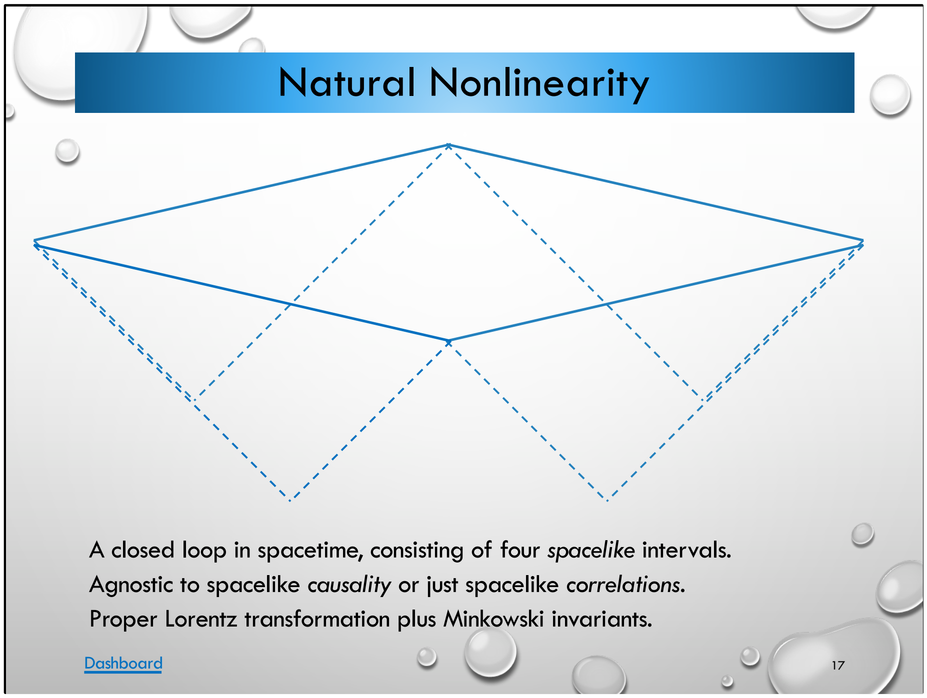
For spacelike intervals we shall have to dig a little deeper.

Quantum teleportation via entanglement provides another hint – half the information arrives from the quantum channel.

Claiming this is "instantaneous" is not consistent with relativity, but a Lorentz invariant spacelike interval would be.

The symmetric interval provides a specification for the top edge of a world ribbon, but some other specification might be the case.

See the references for a detailed derivation.



Consider four EPR pairs, 8 particles in all.

Assume the photons in each pair are connected by symmetric intervals.

Place each EPR source be placed in relative motion which imposes Poincare rotations.

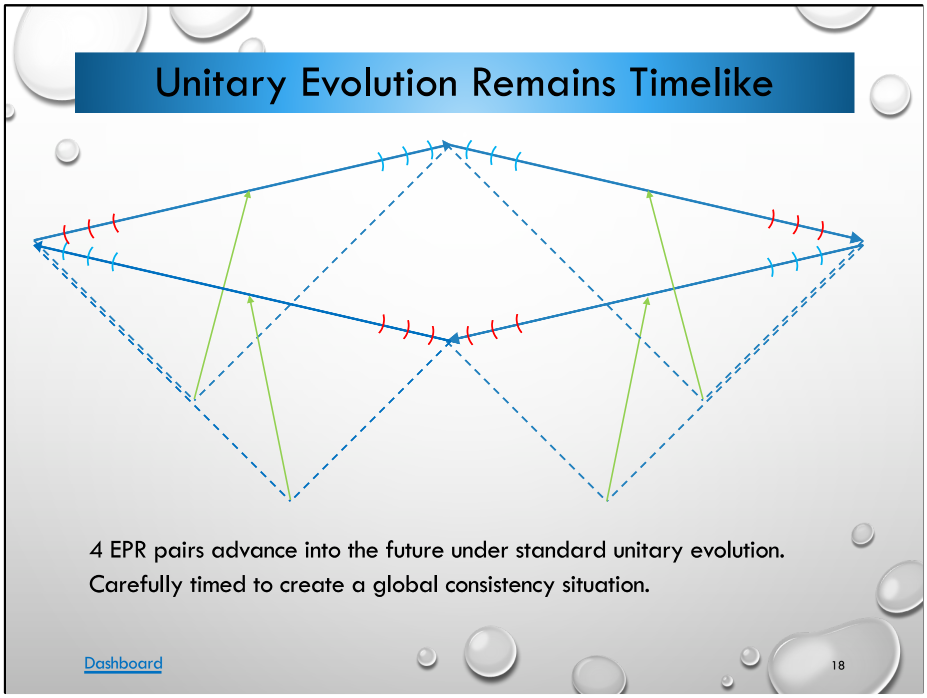
Let the direction, timing, and Poincare rotations be chosen with such care that the symmetric intervals form a closed loop in space time, in this example, a simple diamond.

We have a closed loop in spacetime, the EPR pairs are correlated by the Bell states, the cross pairs are correlated by becoming indistinguishable and thus must have the same polarization.

The presumption has long been that solving the quantum measurement problem requires introducing nonlinearity into quantum mechanics.

Existing collapse models introduce new nonlinear physics.

Self-reference offers a possible source of nonlinearity without introducing a new universal constant.



No changes to the evolution of the wave function are required.

Hilbert spaces still work, the Schrodinger equation still applies.

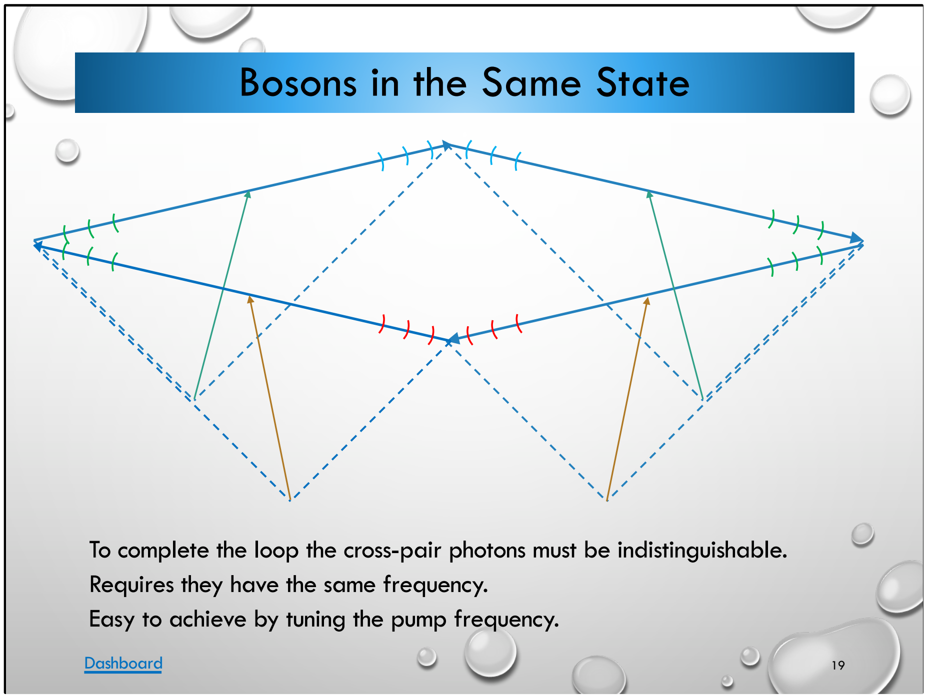
The EPR photons follow their lightlike world lines.

Entanglement remains spacelike.

Poincare rotations are achieved by simply placing the EPR sources in motion.

But that means the entangled photon pairs no longer have the same frequencies.

How do you convince a pair of photons to behave like bosons, to be in the same state, if their frequencies are different?



The pump photons must be in different frequencies.

Indistinguishability of the cross-pair photons complete the loop.

This creates a global consistency constraint – the polarizations of the photons must be consistent around the loop.

Turns out that this constraint is NOT basis agnostic.

An Unexpected Invariant

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y
State	Pair States				Lab				O				R				L	O	R	Para	0	1	2	3
0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	1	0	0	0
1	1	1	1	2	1	1	1	1	1	1	1	0	1	1	1	0	0	1	1	2	0	0	1	0
2	1	1	1	3	1	1	1	0	1	1	1	1	1	1	1	0	1	0	1	2	0	0	1	0
3	1	1	1	4	1	1	1	0	1	1	1	0	1	1	1	1	1	1	0	2	0	0	1	0
4	1	1	2	1	1	1	1	1	1	1	0	1	1	1	0	1	0	1	1	2	0	0	1	0
5	1	1	2	2	1	1	1	1	1	1	0	0	1	1	0	0	0	0	0	0	1	0	0	0
6	1	1	2	3	1	1	1	0	1	1	0	1	1	1	0	0	1	1	0	2	0	0	1	0
7	1	1	2	4	1	1	1	0	1	1	0	0	1	1	0	1	1	0	1	2	0	0	1	0
8	1	1	3	1	1	1	0	1	1	1	1	1	1	1	0	1	1	0	1	2	0	0	1	0
9	1	1	3	2	1	1	0	1	1	1	1	0	1	1	0	0	1	1	0	2	0	0	1	0
10	1	1	3	3	1	1	0	0	1	1	1	1	1	1	0	0	0	0	0	0	1	0	0	0
11	1	1	3	4	1	1	0	0	1	1	1	0	1	1	0	1	0	1	1	2	0	0	1	0
12	1	1	4	1	1	1	0	1	1	1	0	1	1	1	1	1	1	1	0	2	0	0	1	0
246	4	4	2	3	0	0	1	0	0	0	0	1	1	1	0	0	1	1	0	2	0	0	1	0
247	4	4	2	4	0	0	1	0	0	0	0	0	1	1	0	1	1	0	1	2	0	0	1	0
248	4	4	3	1	0	0	0	1	0	0	1	1	1	1	0	1	1	0	1	2	0	0	1	0
249	4	4	3	2	0	0	0	1	0	0	1	0	1	1	0	0	1	1	0	2	0	0	1	0
250	4	4	3	3	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	1	0	0	0
251	4	4	3	4	0	0	0	0	0	0	1	0	1	1	0	1	0	1	1	2	0	0	1	0
252	4	4	4	1	0	0	0	1	0	0	0	1	1	1	1	1	1	1	0	2	0	0	1	0
253	4	4	4	2	0	0	0	1	0	0	0	0	1	1	1	0	1	0	1	2	0	0	1	0
254	4	4	4	3	0	0	0	0	0	0	0	1	1	1	1	0	0	1	1	2	0	0	1	0
255	4	4	4	4	0	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0	1	0	0	0
																					64	0	192	0
																					25%	0%	75%	0%

Dashboard

20

4 sides to the diamond loop, 4 Bell states => 256 possible cyclic entanglements.

Each Bell state can be represented in each of the three Dirac bases.

Which cycles are self-consistent when represented in each of the three Dirac bases.

- 64 are paradoxical in none of the bases, they are indeterminate in all three.
- 0 are paradoxical in one basis.
- 192 are paradoxical in two bases, but indeterminate in the third.
- 0 are paradoxical in all three bases.

The observation motivates the conjecture that recursive entanglement possesses a topological consistency invariant.

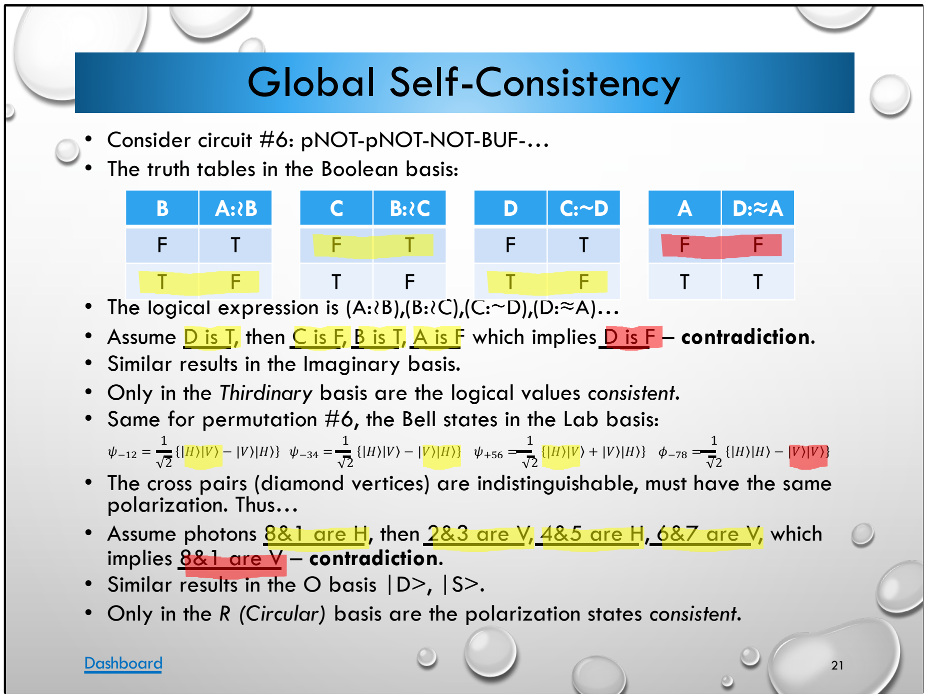
This may turn out to be merely a finite combinatorial curiosity—or it may reflect a deeper property of recursively entangled systems.

The Bell-state basis transformations exhibit the same combinatorial classification as TCL.

Speculation: an isolated quantum system which becomes cyclically entangled, will be paradoxical in all bases except one.

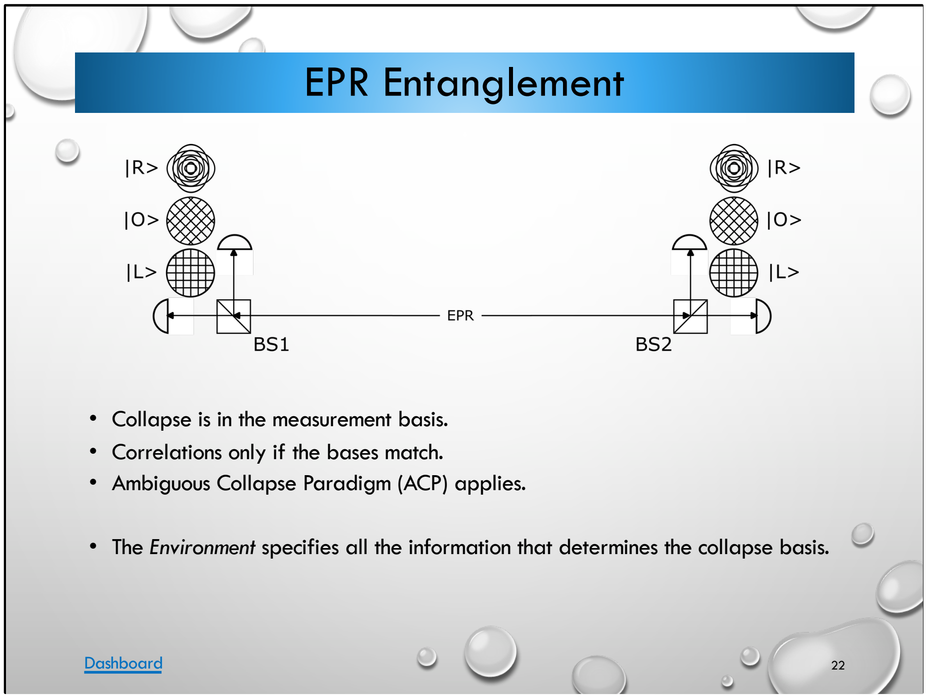
In that one unique basis, the quantum state is indeterminate.

The conjecture is that the unique indeterminate basis is the attractor selected by global consistency – self-collapse w/o an external observer.



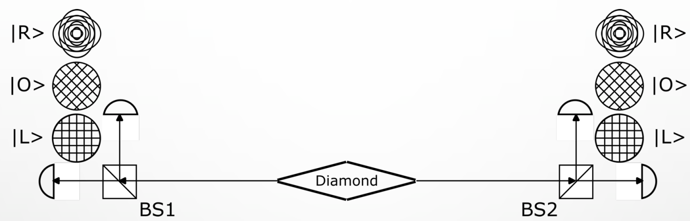
The bits around a self-referential form must be consistent.
Logical reasoning in combinatorial circuits is basis agnostic.
But in sequential circuits (self-reference), they are not basis agnostic.
The re-entrance constrains the globally self-consistent basis.

The polarization states around a self-referential form must be consistent.
Unitary evolution is basis agnostic.
But a closed loop in spacetime is not basis agnostic.
The re-entrance constrains the globally self-consistent basis.



ACP: current dogma about nonlocal collapse should be given a name.
Given two spacelike separated observers, Alice and Bob, which measurement is the ‘cause’ of the collapse is ambiguous.
Each is free to assume that it is their measurement which collapses the wave function from entangled in a single Hilbert space into two separated Hilbert spaces,
where each beliefs (claims) the other observer’s measurement merely reveals which eigenvector was the result of the random collapse.

Diamond Paradox



- Either collapse is open or occurred in the self-collapse basis.
- If collapse is open, correlations whenever the bases match.
- If self-collapse, correlations only if the bases match the self-collapse basis.

- The *quantum system* specifies all the information that determines the collapse basis.

Dashboard

Experimental Predictions

Collapse Measurement	Uncollapsed 25%	Lab (|H>, |V>)	Ortho (|D>, |S>)	Circular (|L>, |R>)
Lab (|H>, |V>)	Correlated	Correlated	Random	Random
Ortho (|D>, |S>)	Correlated	Random	Correlated	Random
Circular (|L>, |R>)	Correlated	Random	Random	Correlated

Falsifiable

- A speculative hypothesis deserves a good name.
- Quantum Temporal Paradox (QTP).

Dashboard

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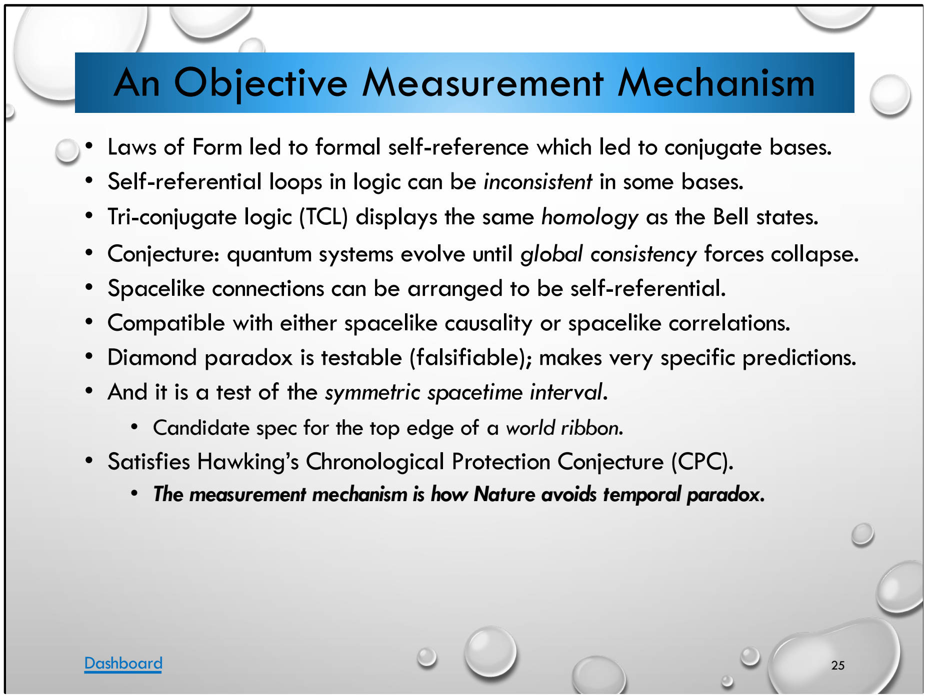
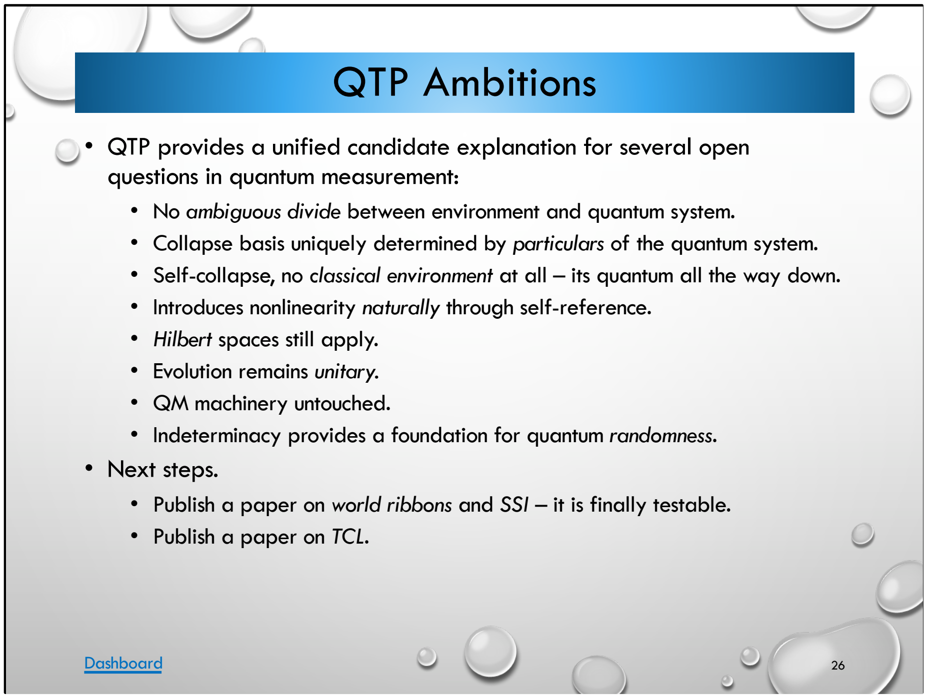
Measure opposite ends of a diamond paradox in any of the three bases.
If it has not collapsed, the results will be correlated in every basis.
If it has collapsed, the results will be correlated only when measured in the collapse basis.
Quantum Temporal Paradox (QTP) makes very specific predictions.
It is falsifiable.
“I know, I know, Quantum Temporal Indeterminacy (QTI) would be more accurate, but no scientist in his right mind is going to propose a speculative theory that would be pronounced ‘cutie’, I’d never hear the end of it.”



The challenge for World Ribbons is specifying the top edge when a measurement occurs.
The Symmetric Spacetime Interval (SSI) was a good answer for light but was not testable.
The Diamond Paradox provides a test which current tech is, or is close to, being able to resolve.



QTP may, of course, turn out to be wrong, but the logic behind it is well grounded. It should provide impetus to consider self-reference as a viable avenue from which to attack the quantum measurement problem.

As a tease, should spacelike causality be allowed by Nature within the guardrails of self-collapse…

Prediction is *forecasting* the future using data, laws, and computation.
Postdiction is *knowing* the future, having witnessed it.

Q&A

Dashboard

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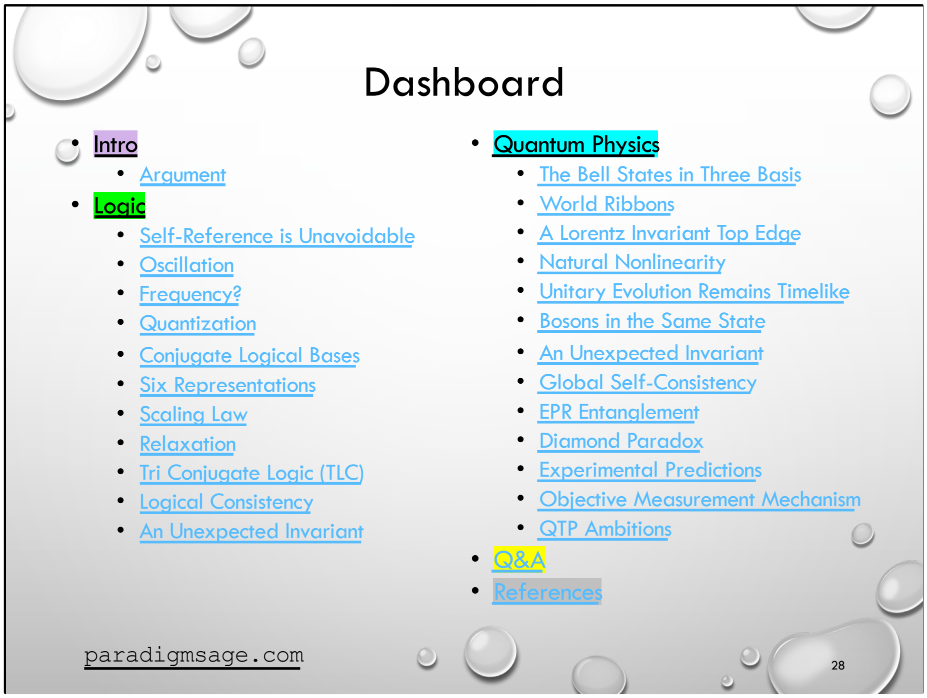

Links to sections and individual slides.

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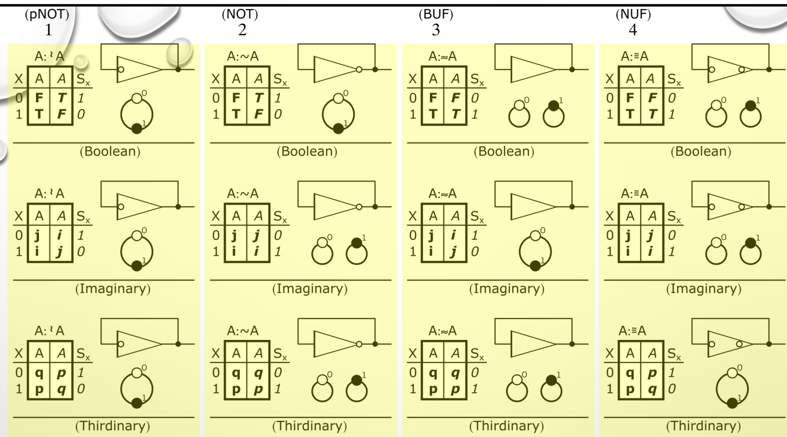

State	L	O	R	Statistics
1	$\psi_- = \frac{1}{\sqrt{2}}\{\lvert H\rangle\lvert V\rangle - \lvert V\rangle\lvert H\rangle\}$	$\psi_- = \frac{1}{\sqrt{2}}\{\lvert D\rangle\lvert S\rangle - \lvert S\rangle\lvert D\rangle\}$	$\psi_- = \frac{1}{\sqrt{2}}\{\lvert R\rangle\lvert L\rangle - \lvert R\rangle\lvert L\rangle\}$	Fermionic
2	$\psi_+ = \frac{1}{\sqrt{2}}\{\lvert H\rangle\lvert V\rangle + \lvert V\rangle\lvert H\rangle\}$	$\phi_+ = \frac{1}{\sqrt{2}}\{\lvert D\rangle\lvert D\rangle + \lvert S\rangle\lvert S\rangle\}$	$\phi_- = \frac{1}{\sqrt{2}}\{\lvert L\rangle\lvert L\rangle - \lvert R\rangle\lvert R\rangle\}$	Bosonic
3	$\phi_- = \frac{1}{\sqrt{2}}\{\lvert H\rangle\lvert H\rangle - \lvert V\rangle\lvert V\rangle\}$	$\psi_+ = \frac{1}{\sqrt{2}}\{\lvert D\rangle\lvert S\rangle + \lvert S\rangle\lvert D\rangle\}$	$\phi_+ = \frac{1}{\sqrt{2}}\{\lvert L\rangle\lvert L\rangle + \lvert R\rangle\lvert R\rangle\}$	
4	$\phi_+ = \frac{1}{\sqrt{2}}\{\lvert H\rangle\lvert H\rangle + \lvert V\rangle\lvert V\rangle\}$	$\phi_- = \frac{1}{\sqrt{2}}\{\lvert D\rangle\lvert D\rangle - \lvert S\rangle\lvert S\rangle\}$	$\psi_+ = \frac{1}{\sqrt{2}}\{\lvert L\rangle\lvert R\rangle + \lvert R\rangle\lvert L\rangle\}$	

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Side by side comparison of the homology of TCL and the Bell states.

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Books.

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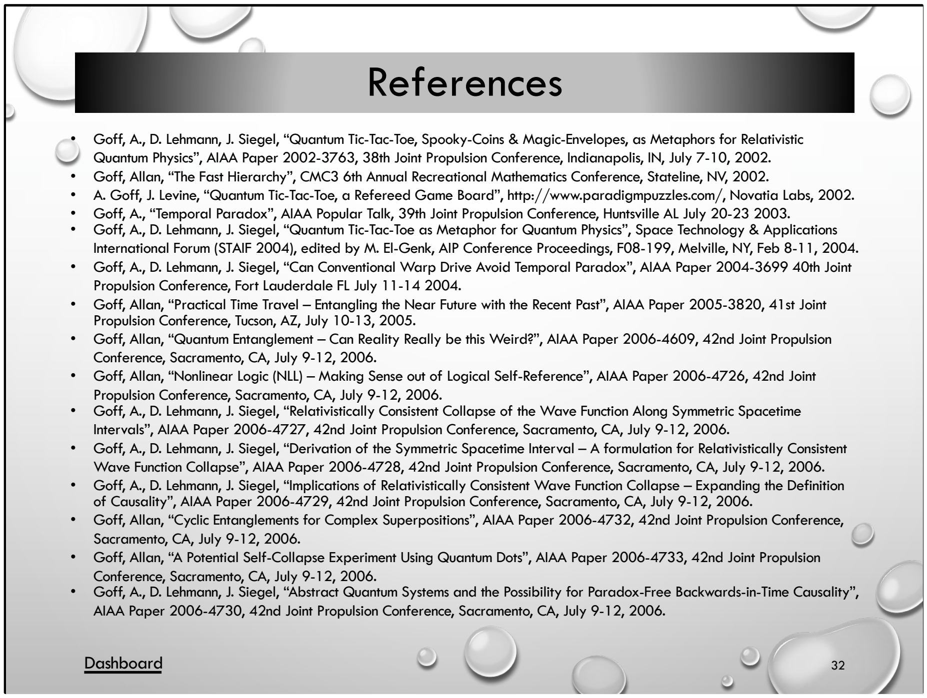
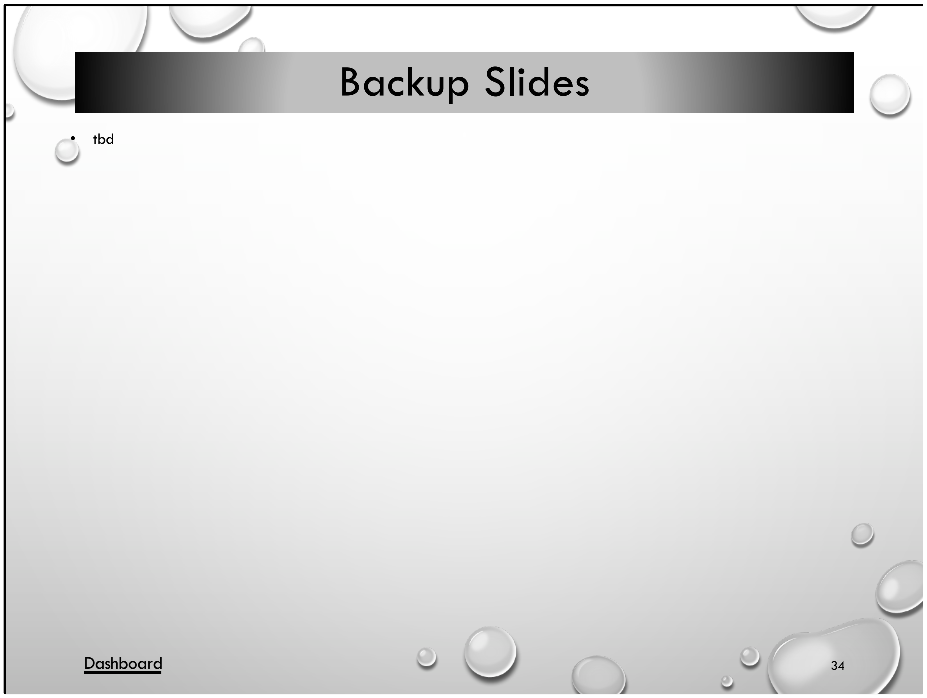
Papers.



Curriculum Vitae.

Bio – Allan Goff

- Allan Goff served as a nuclear officer in the US Air Force. He has taught 50 university classes, presented 18 papers at international propulsion conferences, is the author of *Quantum Tic-Tac-Toe* and *Discovering the Rules to 3D Chess: an Unexpected Excursion into the Quantum Realm.* As an entrepreneur, he ran a placement agency for software engineers and won a two-year contract with the state of California removing 11 megawatts of demand off the electric grid. His day jobs have included software engineering and project management gigs in government, business, and academia. He is married with two children, two grandchildren…and counting.



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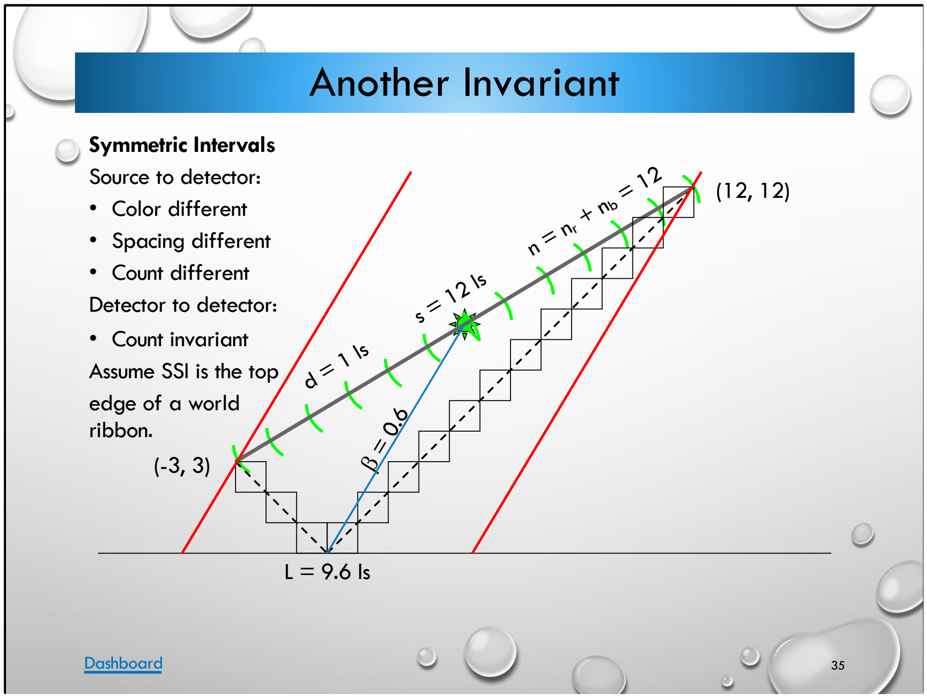

Spacelike causes are verboten in physics because of the specter of temporal paradox.

Spacelike causality is more than just FTL it is also time travel.

But if conjugate bases remove that objection, then the challenge of spacelike causality becomes much simpler.

Recall that left and right are invariants in spacelike causes.

In timelike causes it is before and after that are the invariants.

That symmetry is crucial; before and after are frame dependent in spacelike causes, left and right are frame dependent in timelike causes.

If there is any frame in which it can be decided whether it is the left event of the right event that is the cause, then all observers will agree.

Nature gifted us an arrow of time, we get before and after for free.

For spacelike causality we shall have to dig a little deeper.

We already have a hint that spacelike causality is in fact allowed in physics, entanglement supported teleportation. Half the information travels by the quantum channel.

If the symmetric interval idea is correct, then we have a specification for the top edge of a world ribbon.

Global Self-Consistency - TCL

- Consider circuit #6: pNOT-pNOT-NOT-BUF-…
- The truth tables in the Boolean basis:

B	A:≀B
F	T
T	F

C	B:≀C
F	T
T	F

D	C:~D
F	T
T	F

A	D:≈A
F	F
T	T

- The logical expression is (A:≀B),(B:≀C),(C:~D),(D:≈A)…
- Assume D is T, then C is F, B is T, A is F which implies D is F – **contradiction.**
- Similar results in the Imaginary basis.
- Only in the Thirdinary basis are the logical values consistent.

Dashboard

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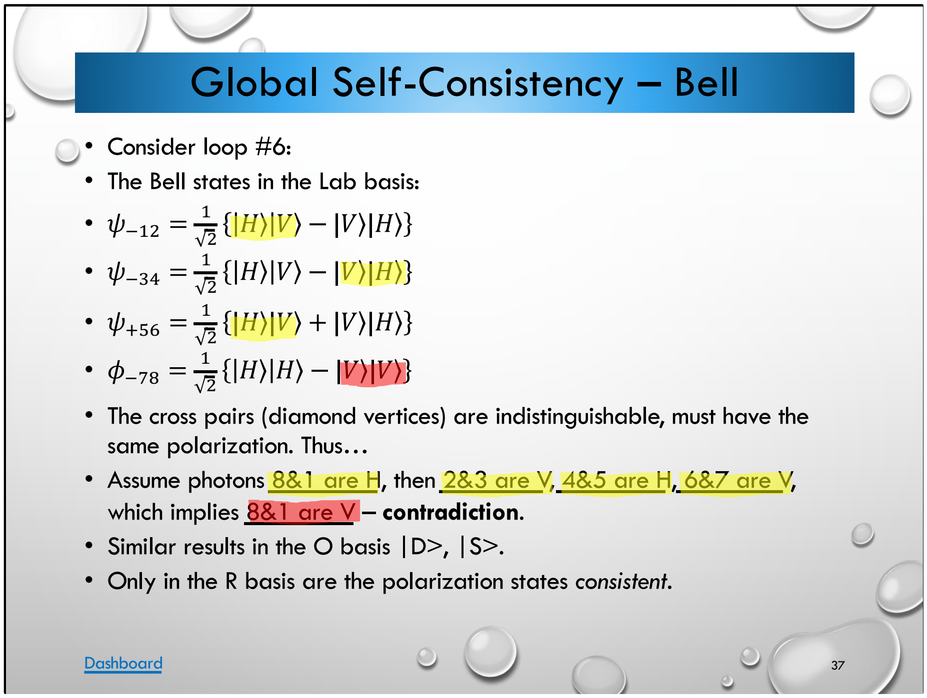
The bits around a self-referential form must be consistent.
Logical reasoning in combinatorial circuits is basis agnostic.
But in sequential circuits (self-reference), they are not basis agnostic.
The re-entrance forces a global consistency condition which selects a preferred basis.



The polarization states around a self-referential form must be consistent.
Unitary evolution is basis agnostic.
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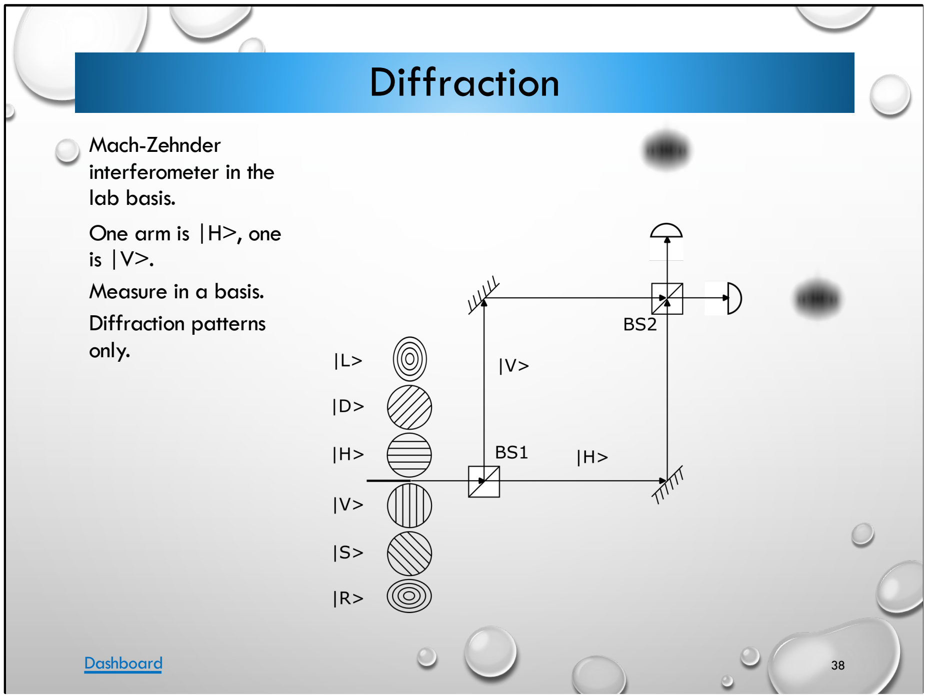
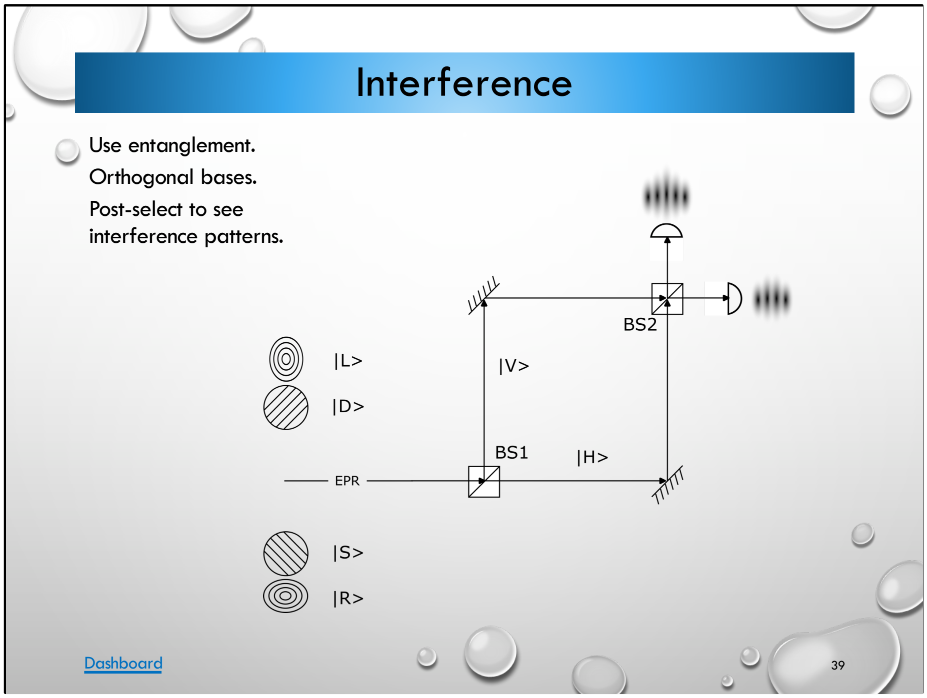
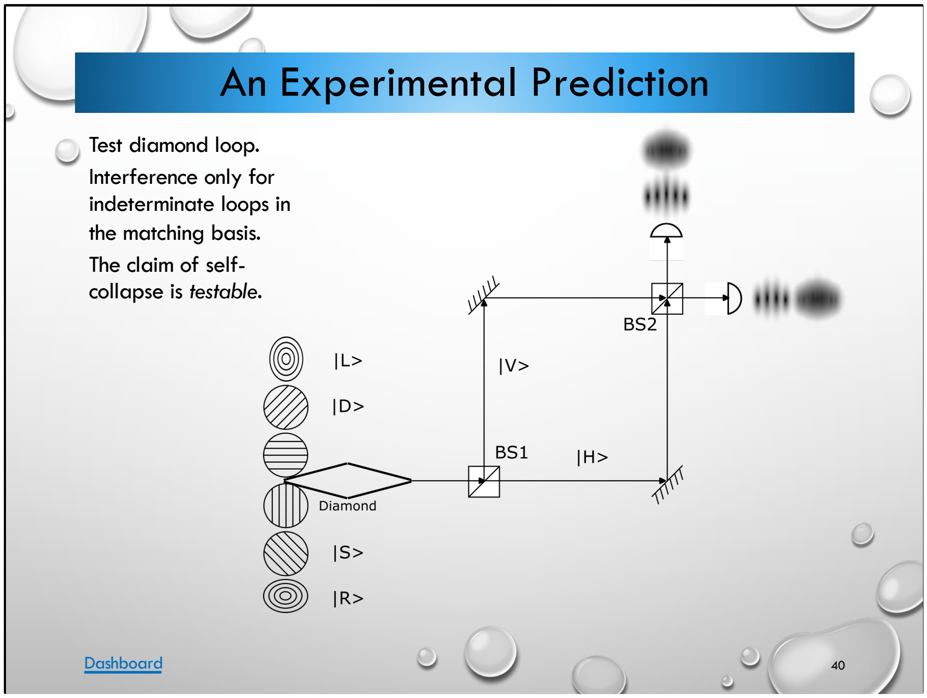


Consider a Mach-Zehnder interferometer with the polarizing beam splitters set up so horizontally polarized photons go down one arm, while vertically polarized photons go down the other.
Random insertion of photons will reveal only diffraction patterns.
In the lab basis, every photon travels along only one arm.
In the bases conjugate to the lab bases, the interference patterns for each eigenvector are phase inverted, so their sum is still just a diffraction pattern.
Without post-selection, single-photon detections produce only the diffraction distributions associated with each arm.
There are three bases: the lab basis (|H>, |V>), the linear basis orthogonal to it (|D>, |S>), and the circular basis (|L>, |R>).



Entanglement can be used to tease out the interference patterns by post-selecting events in the bases conjugate to the laboratory basis.
This is basically quantum erasure.



Replace the EPR source with the diamond loop.
There are 256 possible loops.
Quantum Temporal Paradox (QTP) is the hypothesis that this loop has a very specific collapse profile, depending on which Bell state each EPR arm of the diamond is in.
One quarter of cyclic configurations are predicted to remain uncollapsed.
In the other cases, 25% will collapse in the lab basis, 25% in the ortho basis, and 25% in the circular basis.
This global consistency constraint, that an isolated quantum system may self-collapse into a specific basis, is falsifiable.

Experimental Permutations

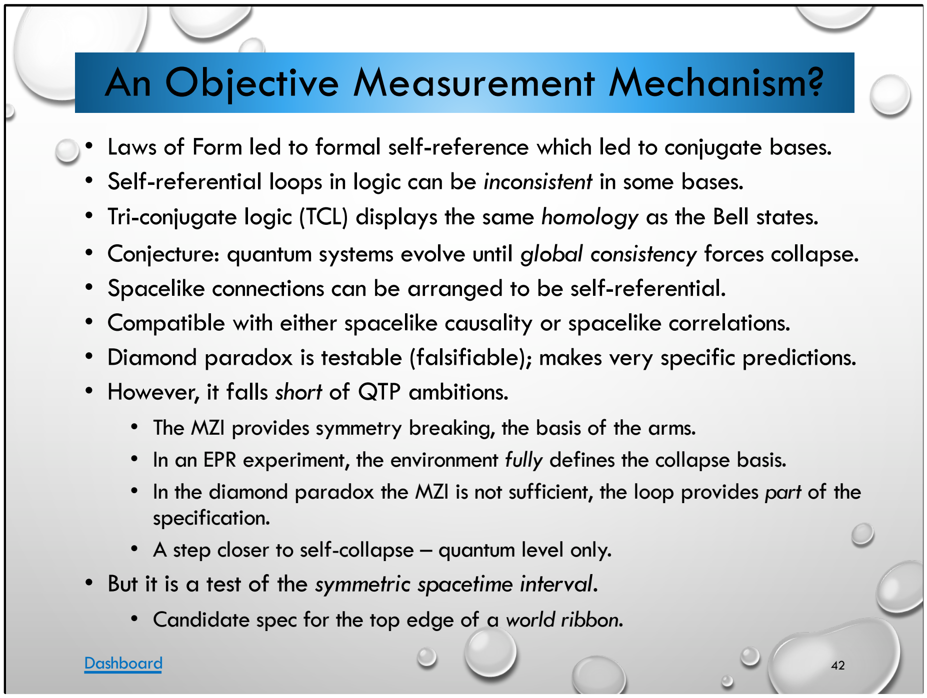
Collapse / Measurement	Uncollapsed 25%	Lab (|H>, |V>)	Ortho (|D>, |S>)	Circular (|L>, |R>)
Lab (|H>, |V>)	Diffraction	Diffraction	Diffraction	Diffraction
Ortho (|D>, |S>)	Interference	Diffraction	Interference	Diffraction
Circular (|L>, |R>)	Interference	Diffraction	Diffraction	Interference

Falsifiable

- QTP creates tension with our classical notion of linear time.
  - The present as an infinitely thin interface between past and future.
- The diamond loop is a static structure in spacetime.
- Any photon prior to encountering the loop is indeterminate.
- After a collapsed loop, every photon's state is fixed.
- Have entangled the near future with the recent past into an expanded present.
- Within this window around *now*, past, present, and future become ambiguous.
- The present has a *thickness* – call it a *chronoblock*.

Dashboard

If the loop is in a configuration that does not collapse, any measurement in a basis orthogonal to the lab basis can be used to post select, revealing interference patterns.
If the loop self-collapses into the lab basis, every photon goes down only one arm of the interferometer, diffraction patterns only.
If the measurement of the left pair of photons in the diamond loop is in the lab basis, again every photon goes down only one arm of the interferometer, diffraction patterns only.
However, if the diamond loop self-collapses in a basis conjugate to the lab basis, then a measurement in that basis can be used to post select, revealing interference patterns.
The signature of this theory is the quad of yellow/green cells – no self-collapse, all green; self-collapse, two green, two yellow.



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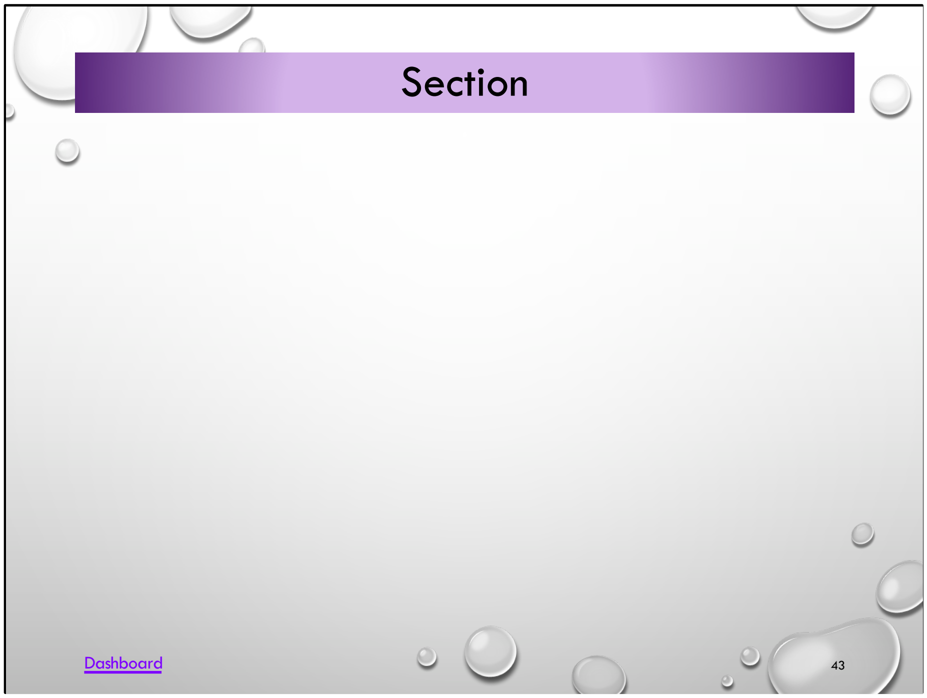

If retro-causal information is physically possible, thermodynamics must be reformulated in terms of causal order rather than temporal order.

Section

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Dashboard

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