Q&A on Physics and AI

Transcript (Auto only, and only for the second hour on physics with slides; no AI)

Terry Bollinger and participants
Presented at: Washington DC Quantum Computing Meetup (on OrionX YouTube)
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TB — Terry Bollinger
HM — Helen Ma (Team OrionX)
WS — William Slater
RS — Ron Schreiner
CP — Caetano Peng
JR — Joe Reddix

The second hour of video covered by this transcript covers only physics and the slides:

https://youtu.be/ssty6bs6w8Y?t=1h05m53s

The full 2-hour-plus video, starting with an hour of AI discussion, is available here:

https://youtu.be/ssty6bs6w8Y?t=00m00s

For all timestamps below, add **1:05:53** to get the correct video locations:

0:00	TB	Well, here, okay.
0:05		Helen, I hope you recorded that earlier conversation, because that was an interesting conversation. So.
0:11	HM	The conversation was live stream, so…
0:14	TB	Okay.
0:15		All right, let me see.
0:18		How does it always work? Share first, right?
0:23		Share my screen.
0:26		Share.
0:29		I think that's right, and then I…
0:36		Hello!
0:38		My mouse stopped working.
0:42		Well, what happened? Everything stopped working.
0:47		Can you folks still hear me?
0:52	HM	Yes, I can hear you.
0:54	TB	Okay, I… my screen completely locked, and I'm not sure what's…

1:00		I'm not sure what's going on.
1:02	WS	Terry, you're up.
1:04		Your camera may have gone off, too.
1:09	TB	Oh.
1:11	RS	Gary, it's the universe's way of telling you to get a Chromebook.
1:15	TB	Great.
1:21		Zoom is not responding. Oh, it wasn't me, so… Zoom actually crashed.
1:26	RS	You're sharing out.
1:27	TB	Yeah, well, I've never had that happen before.
1:31		Oh…
1:35		Alrighty. How are we doing now? Can folks see this?
1:39	HM	Yes.
1:40	TB	Okay.
1:41	WS	Terry, thanks for the warm up discussion. I thoroughly enjoyed it.
1:44	TB	Oh, I enjoy hearing, like, Caetano especially, I need pressure back. I need people to say, Terry, you're being stupid, because otherwise I'll just fall into my own little trap of saying, like, yeah, but there's so many smart, really smart people working on this stuff.
2:01		And there's going to be progress in this, and it's going to get better in some ways. It doesn't take me back from that thing about you don't want to make the fundamental mistake of mistaking tea leaves for intelligence. As long as you keep that in mind, it works okay.
2:15		Now, everybody, for a real switch in topics…
2:20		We're going to go to Albert Einstein and an interesting historical thing that he did, which is, what I… he doesn't have a name for it in his paper. He describes it in considerable detail.
2:35		But… by the way, can everybody see this? I'm sharing my screen, but I'm getting…
2:41		a black bar across the top that's covering the titles. Can people see my title or not?
2:47	WS	It's beautiful.
2:49	TB	That's a yes, you can see my title, right?
2:51	WS	Yes.
2:52	TB	Okay, so what I'm seeing is not what you guys are getting. It's a little bit different, okay

2:57 So, there's a paper that Einstein did in 1911,
3:03 And, it was a beautiful paper, and for reasons I've never been able to figure out, it had never been translated into English at the time when I first, encountered it.
3:14 And actually, there may be some reasons why nobody ever bothered. But the paper is striking because it is the one in which he predicted what we now call the twins paradox.
3:25 And you would think that that would get more attention just by that, because he used certain methods in the paper, they were unique, they were something he had not done before.
3:36 And he came up with a prediction that everybody, including himself, said, this is crazy.
3:41 You know, this can't be right. And yet he looked at it and goes like, well, it seems to work. And, you know, published the paper and did a talk on it. And it was right. And they found out that time dilation, as we see in muons and see in a number of things, was absolutely real.
4:00 What they had thought before that was a bit different. They didn't realize it was experimentally accessible.
4:06 So, the technique that he came up with in his paper, which he did not name, the name for it is my own name for it, it's a loading principle.
4:13 And it's worth looking at because if you apply it in more circumstances, wow, it really changes your perspective.
4:23 Not on the math itself, but on the applicability of the math in certain circumstances. And that's why it's important, because it puts certain additional constraints
4:34 Where the same exact mathematical model that you know works very, very well.
4:39 Suddenly has some additional dimensions for you to explore.
4:43 Okay, so,
4:46 This is the… essentially, I've already just given this part. It has, it was for the Twins Paradox.
4:52 It converts certain paradoxes into resolvable experimental situations with no paradox whatsoever.
5:00 And in fact, that was the most striking thing about the way he applied this principle, was that the reason he was able to predict real-time dilation was because he got rid of any paradoxical thinking. Instead, he wound up things where two objects touch, and at that point, they have an exact result.
5:17 And when they touch, that result is not lost. Whereas if you keep it always in the relative domain, where space and time are interchangeable, you can't do that. So what Einstein was doing with this.
5:29 Was he saying, like, well, that's frustrating, I want to actually get more specific, how do I do that?
5:34 And he came up with this loading idea, where he… and this is… this is an idea that fits well with modern thinking.
5:41 So I would say this is, again, one of those cases where Einstein was like a, you know, like a 50 years to a century or 50 years ahead, maybe a century ahead in terms of thinking like a computer person.

5:52	And I, you know, maybe that's unfair for, I don't know if it's, well, no, it's like, it's a computer type of way of thinking of things. He converted his mathematical framework into a data structure, and then he started loading it.
6:08	Now, he didn't have the terminology for it, but that's the way he worked it out. And once he did that, he was able to get rid of the paradox, and then move on to this new set of concepts with that.
6:19	And it's also interesting why, if this works so well, which it did experimentally.
6:24	Why do people still debate the twins paradox to this day?
6:28	his paper actually got rid of the twins paradox. He made the prediction, but the paper itself explains what's happening.
6:36	So, interesting little thing.
6:41	The paper in question.
6:43	which is called the Theory of Relativity, 1911. This was one of his last papers right before he went to general relativity, and that's important because
6:52	one of the things that happened was he went… once he went off to general relativity, he kind of just never went back. So, he had these ideas that he worked out here, but then he was intrigued, rightfully so.
7:05	By what he could do with general relativity, and went off on a different approach, different set of concepts that he was working with.
7:13	But nonetheless, the prediction he made in this paper, and you can see the original German paper.
7:18	It's… it's available online. You can see English translations. My own English translation, the one I have quoted here, is the one with the most information that I could add to it without changing the actual text. There's an English translation, which I've tried to keep very, very tight.
7:34	to the original. And interesting, there's an entire sentence was missing at one point in the original. I always found that fascinating. I don't know what happened during the editing, but there's a bridge system sentence that he refers back to, that you can figure out what the sentence was.
7:49	And it's there, so it's in square brackets inside the paper, so some little corrections that… that allow it to make a little… read a little more easily in that.
7:56	So, fascinating paper. You can see the original in German. You can get copies of the paper translated on my website, where it's just… just the translation. And then this version adds both figures that seem to reflect what he was trying… you know, I think it was a board talk.
8:11	They never captured it at all, except one of the pictures. So I put in pictures that at least capture some idea of what he was talking about that time. There's also an important appendix in which he derives the mathematics of frame translation. Very important little appendix.
8:26	That's also included in the paper for reference on that. So, it's a very detailed paper, gives you all the information that you need to dig into in detail if you want to.
8:35	Now, the actual statement, I'm not going to try to read this, I just want to put this here for reference. The method he gives to give event times a very specific meaning

8:45	One must apply the rule of setting clocks by assuming equal light propagation times in both directions. That's actually a little less important than the other part. Between two clocks to a large number of clocks that are all at rest relative to the coordinate system.
9:00	What he is describing here is exactly what we do with international clocks nowadays.
9:05	We have a single central clock. We then distribute that time to other nodes. We don't worry about the fact we're moving through space. That's what all that part about both directions is. To us, that just seems intuitive now, but we're so used to special relativity, we don't think much about it. For him, it was not that easy because there were competing theories at that time.
9:24	So he was pointing out that what you need to do is you have this master clock, you distribute the times outwards, you check, see what their times are, you get those clocks back, you do a couple cycles of this.
9:36	And you wind up setting those clocks so that you know from then on you will always get a time that matches the distance of the clock as opposed to the speed of light.
9:46	And of course… and we… this is so intuitive to us that we don't think about it. We think, yeah, of course you do. Every time you set your clock for, on a computer and you update it, it's doing a little cycle just like this.
9:58	But think of the time frame. Nobody was doing this back then. Not this way.
10:03	So Einstein was, you know, diving into some new territory that had not really been done before.
10:08	Then the second statement he makes is, oh, and by the way, since we know
10:14	that moving a system at a continuous velocity, unchanging velocity.
10:20	changes its definition of X, Y, Z, and T,
10:24	We can also do the same procedure on that new system.
10:28	Now, now notice what's going on here. You've got the original system, which you set all the clocks, it could be over some arbitrary space, you know, area of space, so you set all the clocks in that region of space, but then you have another one, and you have another coordinate system.
10:45	And by definition, this is going to be a new one. This is your one that you're driving, so there's going to be some subset of what you did before.
10:52	And you accelerate that.
10:54	and you come up with a second operation, you have to do it all over again. Why? Because when you accelerate things, it messes up time.
11:01	It just does. You know, even if you had everything synchronized before, they will not be synchronized over a large object after you accelerate that object. And Einstein knew this, so he's saying, like, you have to do this also procedure for a new system.
11:15	And that is where he began to get this whole thing to a point where it was experimentally verifiable.
11:22	So just to show the the steps. The 1st step was, you have a clock. You have your your golden standard clock.
11:29	And it has a time, so that's where the observer is.

11:32	Sometimes relativity sounds a lot like quantum theory, because it has observers, and those observers are important.
11:38	And that's one of the examples. So you have a gold standard clock. He's got a good clock
11:43	He's got copies of the clocks that he physically distributed to other locations, but they're not necessarily in sync. So the second step is you do this little interaction. There's different ways you can do it, different combinations. In fact, I'm sure there's a whole literature about that these days because GPS satellites, wow, you get all sorts of variations of this.
12:01	So, you synchronize those things, but in the end, the result is, you say, I have a volume of space.
12:08	I know how large a space is.
12:10	Objects are not moving relative to me, that's very, very important, because if you don't… if they're moving, you're not in the same frame, but if they're not moving relative to you, you're in the same frame. But they can also be very distant, they don't have to be close, they just have to not be moving relative to you.
12:25	So you do the synchronization procedure, you set the clocks, and you wind up with gold standard clocks everywhere.
12:32	Now, this is what… this is what…
12:34	if if you're really big on, you know, time is the most eternal of all abstractions. This is going to be offensive, because what Einstein did here was, he said, it's just a bunch of clocks. So
12:47	He wasn't following the standard line at all, but Einstein was always big on clocks. That's how he came up with special relativity. So he was always big on clocks. You got to have an actual cl
12:56	So, his point was that you have a volume of space.
12:59	How do I define the metric of time in that volume of space in such a fashion that a physicist can use it to make real measurements that mean something?
13:08	And that's what he was doing. He was saying, I have to go through this algorithmic procedure
13:12	in which you occupy some section of that space. You have the abstract space that's given by the mathematical equations, just simple XYZT,
13:21	All with apostrophes.
13:23	And you… so you have that, and then you, have to…
13:27	synchronize to… you have to load a certain part of that, but you can't do it for infinity. This takes time.
13:34	But you load those different pieces, those different clocks, with these other settings, you do a little procedure, and you wind up with a consistent set of this. Now, the thing I want to emphasize, and this is an important point, is the distinction between the data structure and the loading.
13:49	This is a finite process. This takes time. In fact, if it's a large area, it can take a lot of time.
13:56	So, in order to create a volume of space that has this consistent definition of time orthogonal to that space, using clocks, not using some abstract concept of time at all, but clocks.

14:08	You have to go through this procedure, and it will take some time.
14:12	Then once you have that defined, you can do the same thing for a smaller set. This is that K subset that Einstein talked about. So you have some smaller region that you're also doing the same kind of a definition with that.
14:23	So color that one green, just to distinguish that your green standard instead of your gold standard. Normally, this will be smaller.
14:30	And why do I say that? Well, think of a rocket ship.
14:33	When you launch a rocket ship, you're not launching the whole Earth, you're launching the rocket ship. Whose clocks are messed up? The clocks in the space ship. The clocks in the rocket ship.
14:43	those will be messed up. So you say, Oh, I have to do an Einstein loading of the clocks to reestablish my definition of time in a meaningful fashion.
14:55	So he still got the abstraction. The abstraction didn't go away. That's fine. But you have to load it for the particular context that you're in. And by making that distinction, Einstein was able to say things no one had said before.
15:08	Here's a large space. This is one
15:11	Nasa has discussed the possibility of doing this. I'm not sure what the status of that is right now. It certainly wouldn't go all the way out to, to Neptune. But it is,
15:25	For the area around the moon and the sun.
15:28	We would like to have a well-standardized definition of time, essentially the same kind of a process. Do you have a lot of complications? Oh, yeah, of course. You've got moving objects, you've got gravity. GPS folks deal with this stuff all the time, though. This is not new tech, and this is well-understood tech on how you create a centralized
15:48	clock standard. And think of it this way, you know, even a satellite, satellite's moving, it has relativistic time contraction, you can still just speed up the clock a little bit, and it'll tell you exactly what the time is on Earth.
16:00	So there's lots of little mechanical tricks you can do with this kind of definition of time, where you make sure that you have a consistent definition of time with all that. But it takes time. If you go out to Neptune, it's going to take you days to complete the looping process just to get those things set.
16:18	and make sure that they're all in sync with that. So, important distinction.
16:23	There's another case that happens. And this is this is actually astronomy in general. Obviously, we can't do that.
16:30	Uranus, I mean, Neptune, arguably, is somewhere we'd have trouble doing anything. We could possibly… Neptune, I put Neptune in both of these.
16:40	Because it's kind of a marginal case. But you really have a hard time looping time back and forth between those. On the other hand, come to think of it, when we sent a satellite to Pluto, which is this one over here on the right top, we were… they were doing clock synchronization cycles.
16:56	you had to. You know, if you're gonna… if you're gonna robot… run a robot out that far, you have to make sure that its time definition is the

same time definition that you're doing. So we've actually… I take that back, we've actually done synchronization of clocks all the way out beyond, Pluto.

17:11 So this is not as hypothetical as you might think, but the clock that represents that

17:16 back here is… this is a proxy, so it's a proxy loading in the sense that you don't have the actual clock out there. You say that, well, in the case of Pluto, we did, but in the case of, like, a galaxy, obviously we don't have a clock at Andromeda, but we can say, well

17:31 it behaves consistently, and if I go into the past I could set the clock. So there was some point that this is so many million years later in the future I can get an estimate of what it looked like now, so we can come up with this concept that there was a time. There was a space.

17:46 And we do that all the time. We tend to think reflexively that there's a single time for the entire universe, whether that's feasible or not.

17:55 It's part of this kind of model where we do a proxy definition of that.

18:01 Now, let's go back to the more specific case.

18:04 Where you have the rocket ship, and the rocket ship accelerates. As soon as it accelerates, you have to do a synchronization process, shown here on the left.

18:13 you get to their new green standard, not the gold standard, but the green standard for K prime.

18:19 And, at that point.

18:21 even if the spaceship is Lorentz contracted, somebody outside of it, and everything else, everything is identical to the physics you expect. That is the beauty of the special relativity principle, is you always have identical physics. You cannot do a test internal to that ship. Once you've synchronized the clocks.

18:39 that will tell you that you're moving. Now, before you synchronize the clocks, guess what? You can.

18:44 Because when you're in a state of flux, when you're still launching a ship, oh yeah, there's gonna be stresses that are gonna say that, oh, this clock's out of sync with this clock.

18:53 That's what I have to resolve. You can actually tell how much you accelerate by this synchronization process. It will give you some information about what did I just do? So history is important in this, but once you attain the final state, the history doesn't matter. You have this beautiful, identical nature of physics, no matter how you're moving.

19:13 So, what happens in a more realistic case? You have your gold standard time, it could be quite large, it could go all the way out to Pluto, in fact, it does. You have a spaceship that is accelerating, and then inside that spaceship.

19:27 You're gonna have a different set of time, and you're gonna have to resolve that set of time, and you have to do a synchronization process as soon as you've done the acceleration.

19:36 So what does that do when the two interact with each other?

19:39 This is where it gets interesting, and this is where Einstein really came up with the idea that, oh.

19:44 You know what? Those time dilations on the spaceship are detectable.

19:50 And by the way, and I don't know why this was lost.
19:53 Einstein did not say that they were detectable only after the ship returned, or only after it arrives, or only if you put him… he didn't do any of that.
20:03 What he said was, this ship will lose time.
20:07 Its clocks will go slower.
20:11 Relative to every single clock it touches as it travels.
20:15 In other words, there's nothing relative about it.
20:18 He's saying that as that ship is moving, this was how he made the argument.
20:22 It says, as that ship is moving, it encounters the clock that I've stated… that I created using the gold standard.
20:29 So, I've distributed, I've loaded the space that it's going through with that gold standard clock.
20:34 And when this spaceship encounters with this moving man, he uses a moving man actually on a rod, a rod and a observers, but it gets the observer moving with it. So same idea.
20:44 You've got an observer and a rod, or you've got a spaceship, take
20:48 So he moves it through there and says, how will that thing look to the clocks?
20:53 that I have already established inside of that space.
20:57 And his answer was, at every point.
21:01 At every clock tick, at every cycle, the spaceship loses time. So where's the time paradox?
21:07 Well, that's the beauty of it. He got rid of the time paradox. He just said, no
21:12 Now, if you're familiar with the idea I just said before, I said, but the physics is identical. You can see why you immediately go like, well, that can't be right.
21:21 Because the spaceship sees the same physics.
21:25 So it's gonna see motion from the outside universe as identical. You know what the missing point is?
21:31 The physics that he sees that's identical is inside of his new set… his new definition of time.
21:38 and a particle that comes inside of a spaceship and is measured by his clocks in his spaceship.
21:43 We'll always show time dilation.
21:45 But anything that's outside of that is going to show something that's connected to the older, previously existing framework.
21:53 So, you get your… Poincare invariance.
21:58 But it becomes hierarchical.
22:00 And the reasons for this, the figure I'm putting here, here's your spaceship.
22:05 Look at what happens when a spaceship accelerates. That's why you say it goes very close to the speed of light.
22:10 So, and this would be a huge velocity here. You get this, like, this wave effect, where you get this circle, where he keeps generating a new circle of contact here, but guess what? He can't get outside of the cone.

22:24	He can't get outside of the forward light cone. He's always contained inside that forward light cone.
22:30	And that makes a difference, because it means his definition, his loading of clocks.
22:35	His definition of time for his definition of time.
22:38	I'll say her definition of time. I get tired of talking about he for astronomers, astronauts. So her definition of time is
22:49	always going to be limited on how far she can set clocks to her standards. And again, the final reconciliation is always by when two clocks touch. There's no abstract concept of time here, there's only clocks touching each other.
23:03	And by that definition, the spaceship is very limited and cannot touch clocks that are outside of that domain. Anything inside that domain they can touch.
23:12	Now, what does that do? Here are the actual… this was the actual lengths that you get for 0.882C, which is a particular velocity that has to do with something I call binary rapidity, which is just rapidity using base 2 instead of base E.
23:29	Whatever, don't worry about it.
23:32	You get these actual paths through space. Here's the frame.
23:37	of the universe. Here's the frame that I showed in the solar system, with the gold bar and the blue bar. So there are lengths of time as you go outwards.
23:46	So the accelerated spaceship will get a new set of definitions. You can find these diagrams, by the way, in some of Feynman's work. He has these little interesting little kind of wedge-shaped diagrams, if you look in some of Feynman's work on this. So he gets these definitions that, in our space, look longer. They're stretched out.
24:04	And that's true for the time and for that, that they, you know, if you track this into where these things land in the first frame, that's where they, that's where they land. They follow this kind of a path.
24:14	Okay? And here comes the problem. This is not a problem. This is how you get this all away from all sorts of strange interpretations.
24:25	The spaceship cannot exceed the light cone.
24:30	It cannot go outside of it. The light cone is defined in this frame of references.
24:36	for the unmoving K frame of references. So what actually happens is no existing clock can go beyond this boundary in our time.
24:48	And no existing ruler can go beyond this boundary in this time.
24:52	What does that mean?
24:53	It means the entire spaceship is limited, both in terms of the distance it can travel.
24:59	and the time that it can consume, and it always stays inside of our universe. It never goes out. It does not create… it never… it can never fill the full abstraction of X', Y', Z', T'.
25:14	The T prime can only exist within this limited square here.
25:20	And that means that it can never interfere with the rest of the universe. When people talk about how you have to have a block… now, this is not Einstein, and I'm saying this, because Einstein did go with a block

universe. But when you… when you say this here, you don't get a block universe, because you cannot

25:36 You don't have the time to create it.

25:38 It just can't happen.

25:40 And these aren't hypothetical things. These are what actually happens with real particle experiments, real spaceships, real GPS satellites. All of them are absolutely subject to this limit.

25:51 So, again, this is not some hypothetical. If you have a larger frame.

25:55 You launch a smaller frame, you're embedded with that frame, you're one of these circles going here, you are not going to get the ability to just extend your perception of your framework to infinity. You have the mathematical framework still, it still works, you still have Poincaré asymmetry.

26:13 But the Poincaré symmetry, now you look and say, oh, whoops, oh, wow, it only works here. It only works within this very small, tiny area that's inside the spaceship. So I don't get the full effect with that.

26:27 So that suddenly puts a whole twist in this idea of, you know, all these mathematical frameworks.

26:33 It's in computer terminology: You're creating a data structure, a virtual data structure that is infinitely large, and then you ask the question, how do I load it with actual data?

26:43 That is what Einstein addressed. He said, how do I load it with actual clocks? How do I load it with actual synchronized clocks, so that my definition of time has actual meaning?

26:53 As opposed to being an abstraction.

26:56 And he came up with this idea that, oh, it's always slower. That means one twin is going to age more slowly. He actually used microbes, he didn't use twins.

27:06 So, loading principle. What happens if you take this idea?

27:10 Well, for one thing, And apply it to cosmology.

27:14 you can kiss the idea of a single uniform space-time goodbye, because that ain't what's happening. If you attach time

27:21 to matter in this fashion. Two clocks.

27:24 And again, it's weird because I'm emphasizing this was Einstein's idea. Yes, he went to the curve space-time later, but in 1911, this is the method that he used to drive a very real experimental prediction.

27:39 And that method that he derived leads to this. You get space-time that is attached to clocks, and you have all these different little circles that are going around there. The light cones can never be violated.

27:50 This is precious to to Einstein's. If you want to conserve the definition of speed of light.

27:59 You have to do this. You can't get the loading to exceed the speed of light

28:04 So you can never instantiate outside of your light cone. That's a very different way of looking at space-time. It literally is a fractal structure for space-time, with limitations attached to the clocks that you can instantiate it with.

28:18 The idea is that if you can't put a clock there, and it's just empty space, genuinely empt

28:24	There's no question. There's nothing you can measure at that point. You have to have energy of some sort in that space. You have flat space does not have energy.
28:32	You wind up with a universe that looks like this, and this is… is…
28:36	I find it intriguing. I think people should generally find it intriguing. It turns out there has to be a single universal
28:44	Definition of space-time that does count as a distinguished frame.
28:48	That would be the one at which everything started, the first universal bubble. I have a first.
28:54	Oh, I forget. I can't even see my own title up here because of this. I've got some interfering blocks here, but you have this initial.
29:02	Kind of day.
29:04	Cosmic microwave background is a very good approximation of it.
29:08	And that actually defines how fast you can change.
29:12	It says, you really do have a limit.
29:15	You can't get… just like I showed in that earlier diagram, where you can't get outside of that square, you can't get outside of this thing.
29:22	If you're a computer scientist, you will recognize this as virtual machines.
29:26	You have your actual computer down here.
29:30	And then you have virtual instantiations, which are a more limited set of the data structure.
29:36	In which you're filling up just a part of it, maybe a very huge part, an entire galaxy. But you fill that up, and you define it there, but it's still bound, rigidly.
29:46	by the constraints of the other one. The time here may seem slower, but it's not going to extend beyond that. The definitions of how things look in distant parts are going to be controlled by this block, not by that block.
30:00	And it goes all the way down to spaceship level, and actually it goes all the way down to the particle level, which is another way where it gets very interesting for particle physics.
30:09	One of the things I want to point out with this,
30:13	I just made the statement says that how often have you seen the statement that everything is relative? So everybody else is slower outside of a spaceship and everybody sees the spaceship as being slower.
30:26	Now, I'm just… there's no way to get around this. The statement is false.
30:31	Why? Because you have blue shift.
30:33	What is blue shift? Blue shift is light waves circulating faster than were before. Oops, that's a clock.
30:40	You, you can't have Blue Shift without having clocks.
30:45	And if you have the clocks at the front of the spaceship.
30:49	where they look like they're… the blue shift is saying that the clocks run faster. If you image an actual clock at the destination, not only will the light seem bluer, the clock will move faster!
31:00	You will not see time dilation in that clock. You will see that clock in this particular case 3.7 3 2 times faster than the clocks in your ship.
31:09	So anybody who tells you that everything is relative in all directions outside of a spaceship, it's just not what happens.

31:18 What actually happens is you get a gradient, so you get faster clocks here, you get slower clocks in behind, because you're running away from the light, so the frequency is slower, and you wind up seeing the clocks, observing those as being slower.
31:33 So, it's important to emphasize this, because this goes right back to the thing about how do you get rid of the twin paradox. The first step is to realize that when the guy in the spaceship looks towards Andromeda.
31:44 and he sees the clocks running 3.732 times faster, is that an illusion? No, it's not an illusion, that's what he actually sees when he gets there.
31:53 It is a real measurement of the real time.
31:56 that we will get when he actually touches the clocks at the far side. There's nothing unreal about it.
32:01 It's a very firm definition of where he's going.
32:04 So, important clarification, I know it's very popular to say, like.
32:09 Oh, yeah, yeah, no, everything is the same. No, it's not. And they… you can find the math that gets into this. It's out there, and it's been used in some of the astronomical paradoxes.
32:20 I remember, I drive this equation, the equation that's relevant to this, I drive it on my own, and I was very surprised to find out that it was used in the past on cosmic jets, because they were encountering the same problem.
32:31 So, it's interesting to see the connection.
32:34 Loading principle in quantum mechanics. If you're a multi-world person, you're not going to like this. Okay, light cones are wave boundaries.
32:46 So, kick the idea of a universal wave function out the door. I… yes, am I assuming physical reality means something? Yeah, it's because experimentally, I'm not sure what else to do. I mean, we're sitting here talking now, I can make myself an abstraction, so I'm not really talking here now, I'm… you know, you can go… just…
33:05 all sorts of Zen ways if you want to, but let's stick with the idea of what do we actually observe. First thing you observe is there is no such thing as a quantum wave function that is not bound by its light cone.
33:16 Every observed quantum wave function we've ever seen is observed by the origination of the light cone for that wave function.
33:24 So does it go to infinity? No, it does not Because, like it or not.
33:29 We don't see its wave function outside of that cone. You will not see the particle outside of that cone. You will not be influenced by the particle outside of that cone. Even entanglement! People think, well, what about entanglement? No, entanglement doesn't change anything at the remote site. It changes your result. Not the same thing.
33:46 So, this is a strict boundary right there. So, right there, anything that talks about a universal wave function is just not what we see experimentally, because when you have a classical observation, that particle ceases to exist in any other region.
34:02 Even if it's a photon that was covering half the universe before you looked at it, once you did that observation, it has no impact. It's gone. It is now part of the light cone.

34:13	So, what does this do on some parts of quantum mechanics? Like I say, if you're many worlds, sorry, this is… I always wonder, you say, why do I have such a reflexive
34:23	dismissal of many worlds, when so many people think it's beautiful mathematically, it's really quite simple, is Everett just thought that if you split a quantum event.
34:33	you immediately get two universes. Now, if you look back at what I just said, say, yeah, maybe… let's follow up on that. So you get a split of the universes. How long does it take the light cone
34:45	of the change you made to propagate to the rest of the universe. Everett never considered anything like that. He was so caught up in the abstraction, in the math.
34:54	They never even consider the fact that we never, ever observe
34:58	that kind of interaction which would violate the speed of light.
35:03	We don't see it experimentally, it doesn't happen. The light tone for the event, when it splits, just propagates like any other event.
35:11	So you get this split, you can talk about it being a split in universes, but even if you do, it's going to propagate out. So how long does it take? Well, it would… I did one calculation once, is…
35:23	So many times the length of the universe.
35:26	When you put everything together and consider the wave factors.
35:30	that it's just… it's a non-statement. It just doesn't go anywhere. So the basic premise in which Everett just glommed on to the Hilbert space definition
35:41	And paid no attention to the actual physics, which Hilbert spaces can tempt you to do that.
35:46	It doesn't work. Not if you embed it in actual…
35:51	Speed of light limited reality that we observe.
35:55	So you don't get universal wave functions. You get the same restrictions I made that. But more importantly, here's an interesting… to me, this is a fascinating impact. Hilbert spaces are a fantastic model for quantum state
36:09	Tracking.
36:11	So what happens if you apply this to it? What happens is the Hilbert space is no longer the most fundamental representation. And this is… here's complete heresy. The fundamental representation is the light cone. You have to go back to the Einsteinian universe, in which you can't propagate faster than the speed of light.
36:28	And when you do that, most of the Hilbert space gets discarded.
36:32	The helper space just simply doesn't apply. And this is the same mistake that Everett made. You're talking about states that cannot exist because they would take an infinite amount of time, or almost infinite amount of time, to create, because states have to have an origin also.
36:47	And if they have to have an origin, they have to have a light cone around them. If you have a light cone around them, you have finite limits on how fast they can propagate. So, in terms of math.
36:58	I don't view that as a negative, I view that as, like, wow, you could have a whole discipline of exploring Hilbert spaces from a constraint-based

relationship with the three-dimensional space light cone and the definition of times in those light cones, which can be multi-level.

37:15 So, far from discarding it, it just says, no, the Hilbert spaces have levels of complexity that we have not explored yet.

37:24 And that we really should try to explore them, and we'd probably get some very interesting results if we do.

37:30 Okay? And I end with quick comments on Llm technologies, which is, I think we've already covered. I think we've covered all of this, except that we are missing. And I think we've covered even that missing some bit of critical physics for how we do low

37:46 power cognition. Is it probably quantity related? Probably. But the point is that we just, we don't know it.

37:52 you can ask that question, and people say, like, I don't know how…

37:57 How that little jumping spider does so much computation so efficiently.

38:01 And it tells us something right there, that we don't really have a good grasp on it yet.

38:07 Summary.

38:08 Einstein's Loading Principle ended, and as I say, this

38:12 To me, it's just an opportunity. The way this man would think about things.

38:18 It's just amazing. Again, you have to factor in the time

38:22 The time, the error in which he did this, and the idea of making a distinction between the mathematical abstraction and the loading of that abstraction with actual clocks.

38:32 Was something he came up with that was way, way beyond that time.

38:37 That's an easier concept to talk about now, it's an easier concept to sort of talk about 50 years later, but really that kind of thinking was like a century ahead of time in terms of making a distinction between the mathematical structure, the data structure, and the loading of that data structure.

38:54 You…

39:00 So, I won't try to get into the LLM stuff, we've covered that plenty, except to make that final point again, is we need to understand this low-energy physics a lot better. And with that, I will wrap it up.

39:33 HM I see William has a question. Can you ask online?

39:39 WS Do you want me to type in the question or to just state the question verbally?

39:44 HM Or you can send the question online.

39:46 WS Okay, great.

39:51 Well, you have 2 quick questions. I'm not sure if people are aware right now, but there's actually a bill.

39:56 In Congress, and I'm not sure what really inspired this.

40:00 Certainly some out of the box thinking, but there's a bill in Congress.

40:05 to, freeze everything at

40:10 the current daylight-saving time and push this power to have daylight saving time out to the States individually.

40:18		So our world could start to get very complicated.
40:22		The next time we go back to,
40:25		We could be going back to daylight saving time. And the other comment I'll make,
40:31		is that I, I, I'm a person who's, who's been affected in life by.
40:37		seeing women get hurt, primarily my mother with my biological father, and it infuriated me at the age of 2.
40:48		And so I've always been a big defender of women.
40:51		And in his later years with biographies, detailed biographies about Einstein.
40:58		Did not paint a pretty picture of how he treated women, particularly the 2.
41:04		different women that he was married to, and he was kind of known as a male sex idol of his day. Women
41:14		Just flocked around him because he was so smart and everything, but
41:20		I take Einstein with a grain of salt. As a person, as a scientist and engineer myself, I admired his ideas, and I know that he changed the world.
41:31		But I'm not a big admirer of anybody that mistreats women.
41:37	TB	William, I would add to that Feynman, Feynman, if anything, was even wor
41:41		Although he did… he did balance out… I think he balanced out in his later years and, became a good father to his… he was… he apparently was a good father to his kids. And Einstein, I don't think, was ever…
41:53		Oh.
41:55		A good father to his kids, and he treated his wives terribly.
41:59		So, in both of those figures, anytime I make a comment about their minds on how they analyze physics.
42:05		I agree with you fully that there's an important qualifier. There's these guys.
42:10		were jerks on these issues, and we see plenty of that going on today. If we can start respecting people
42:18		For who they are as people.
42:21		And stop making gender distinctions between whether you're allowed to think or not is one of the stupidest ones imaginable, and yet still
42:30		carries over and is used as a self-propagating excuse. You say, well, you know, so we don't let women win Nobel Prizes usually, so obviously they're not good at winning Nobel Prizes.
42:42		Well, that's about as circular an argument as you can get.
42:45		and you look at the like the DNA store and the double helix, and how
42:50		A terrible crime that was done to the lady who actually did the work and really figured out, did the crystallography work.
42:59		It's… it's… There's been some improvements, but it's also been…
43:05		Tracking the back direction and I just hate this, I mean, it's just my daughter and my granddaughters, I got, I've got.
43:14		You know, a couple granddaughters that are just…
43:18		The idea of a world in which people can keep them from being what they want to do just infuriates me.

43:24		and fortunately got really good parents who were very good at
43:29		at seeing the potential. Their other grandmother is a CEO of a large company. I love that, and the smaller one takes after her grandmother, and I just, I think that's the greatest thing.
43:41		So, we need to stop doing this to each other. And we can admire the intellect. I admire Michael Jackson's… I like Michael Jackson's music.
43:50		I wouldn't… Ugh, you know, really?
43:54		You know, as a person,
43:57		Oh, gosh! There's so many examples. It's so unfortunate.
44:01		Maxwell, I believe, was a was a good dude.
44:04		So I'll try to give a counterexample. As far as I know from Maxwell, he was a good person. He died very young, and that's so unfortunate because he was a brilliant person.
44:14		So, yeah.
44:17		Good point.
44:21		Questions, anyone?
44:24		It is.
44:24	CP	Comment there, what?
44:26	TB	Caetano, I can.
44:29	CP	I said, just a short comment about what, what William just said. It's not excusing anybody, but
44:37		I've heard that the… Einstein, although not officially proven.
44:44		That had some people think that had some symptoms of autism or Asperger's.
44:52		And that can affect it.
44:55		is social behavior.
44:58		So, I'm… It is nature, you know, some of great scientists and people who have contributed.
45:07		For the humanity knowledge, they… they were autistic.
45:12		And, and, and the, the social.
45:16		Integrations was not as desired as we wished.
45:25	TB	Caetano, I can agree with the point that autism makes it more difficult to understand social relationships, but I will also point out autism does not affect your ability to make ethical choices.
45:35	TB	You know, if you're autistic.
45:37		You can still understand that I'm hurting someone, or I'm not hurting someone.
45:42		Except for an extremely severe case of autism, where they literally just disconnected from reality.
45:48		So, it makes it harder, I think.
45:51		But, a lot of his… a lot of Einstein's behavior is just what he chose to do.
45:57		He didn't have to make those choices. He didn't have to make some of those ch

46:01		And he may have not, I think he was sufficiently disconnected, he had trouble so…
46:08		seeing people as important. Maybe that would be a way. Maybe that's what you're getting at. If many forms of autism, it's hard to recognize the importance of other people. You just treat them as an abstraction. And yeah, that can lead to to damage.
46:22		That you didn't even intend.
46:25		But we all have to strive to do better, you know, and if we have handicaps and that.
46:31		So… We can do better. We can do better.
46:35		And especially in a world right now where so many people are just saying, hey, I'm going to do whatever I want to.
46:41		No, that doesn't work in the long run. That doesn't work for anybody, even those people who are doing that because they wind up constructing their own collapse.
46:51	CP	But back on the question, back on the question of AI and intelligence.
46:58		Sometimes, I wonder…
47:01		that we have problems, you know, as humans, in what we define certain concepts, like definition of consciousness, definition of intelligence. Sometimes I feel these concepts are kind of spectrum.
47:18		Rather than a single point definition.
47:21		So… so if we start thinking.
47:25		In terms of spectrum, in terms of range, like autism, autism, almost like we all are autistic to some extent within the spectrum.
47:33		Some more than others.
47:35		So when we're defining concepts like intelligence and the and and and the
47:40		And consciousness, consciousness may be within this, this spectrum range.
47:47		And, and also when we've been so critical about, about LLMs.
47:53		Because of the stochastic nature
47:56		But we also need to remember that our own brains, our neurons operate and the stochastic principles.
48:07		So, so it, it, the question of AI and intelligence, it can be more than stochastic, maybe also involving the, the way how we have incorporate logic.
48:20		Within the AI logic, the intuition, deductions, inductions, and the reduction add absurdum.
48:30		ways of thinking.
48:34		If in the future we'll incorporate this logical
48:38		Structures within AI may be that we to approach.
48:42		our kind of intelligence.
48:46	TB	Good points, good points.
48:48		Joe, you have your hand up.
48:50	JR	First of all, this is an outstanding discussion. I mean, Excellent.

48:55 My question is this. I'm watching what's going on with Elon Musk and how he's coordinating the.
49:02 various organizations, and I'm running the common block AR. Now, that could be a plug, and it could be a mile.
49:12 Well, I want to get your opinion, because
49:14 If we allow the integration of what we feel is an intelligent AI to be the ultimate intelligent AI, whether it integrates with a neural link and basics and stuff like that, that's a lot of integration.
49:28 But it's also a lot of control because it looks like that's what's starting to happen and it's more wealth.
49:36 Generated anything, which is not necessarily a good control point.
49:41 I like your thoughts and anybody else that they have something on it because I'm watching something that looks like collectively it's going to have an enormous impact on where AI, whether it's ABI or ESI or whatever goes. Any thoughts? Thanks.

49:59 TB Anybody else want to give an opinion first?
50:04 One comment I'll make, if you look at the history of Elon Musk.
50:08 especially after the last set of elections a couple of years ago.
50:13 Control, control.
50:16 Control, control, control, control.
50:20 There is no other theme.
50:22 This is a man who physically took over a building.
50:26 Illegally took over a building, it was later returned to them, trashed the building.
50:31 His people were smoking pot inside the building.
50:34 Apparently all because he didn't like the fact they had the word peace in their title.
50:39 It was just, but we're talking about, and with people, did you know that the entire CIA got fired?
50:46 Because he used Grok to send out emails to the entire CIA to fire them.
50:52 You don't hear about it much, because obviously they didn't fire them.
50:55 But that's the level of control freakiness that was going on at that time is everybody was being fired. It was being done through crock.
51:05 So, I think all of us have to really push for a democracy.
51:14 The belief in people, the belief that we're all important.
51:18 And that everybody should have an opportunity to get… I love the idea that people can get extremely rich, but I don't like the idea that they can use that to squash other people.
51:29 From… from what they're doing. So…
51:32 That would be my view on it.

51:37 JR Great question, thanks.

51:43 TB Other questions?

51:47 HM I got a question online.
51:50 From Emmett, were any experiments conducted on time dilation?

51:55 By Einstein, I had read about a heavily contained experiment which was closer to the theory.

52:04 TB I'm not sure if I caught every nuance in that, but Einstein himself, when he first predicted time dilation as a visible remark, one of the comments in that paper, which you can go and read the paper, was he didn't think it would ever be possible for people to witness time dilation personally.
52:21 And which is really funny because we do that all the time now. People fly around an airplane and if they've got a precise clock with them, atomic clocks, these experiments have been done. People actually see the time dilation.
52:34 as they travel. So Einstein did not expect to be able to see time dilation. I'm sure he realized later, by 1955 was when he passed.
52:46 I think by that time, they had enough… yeah, by that time, they had plenty of information to show there was a very real effect.
52:52 So I may be missing a nuance on the question about whether he had some other alternative experiment.
53:00 But I'm not familiar with that.
53:04 HM He means how fully keeping is permanent. Let me.

53:09 TB Householding which?

53:10 HM Hopefully keeping experiment.
53:16 It's on the chat.

53:18 TB Yeah, okay, let me look in the chat and see if I can…
53:28 Let's see.
53:29 And who is it? Who was asking this?
53:31 Oh, were any experiments… okay, I found it. Any experiments conducted on time dilation, I had…
53:38 or the Hafale Keating experiment, I'm just not familiar with it. I'm not familiar with that particular experiment. Sorry.
53:47 Now I'll have to look it up, though
53:54 Keep that as well.
53:58 Keep that as a note just to.
54:01 Keep track of it.
54:05 Any other questions.

54:08 HM Jordan has a question.
54:10 What are your thoughts on robotics and AI, especially activity-based intelligence for ROS and the rise of physical AI?

54:21 TB I think we need to be really unbelievably careful about that because.
54:26 The technology that we're using right now are insufficiently reliable
54:32 to create a safe space for extreme levels of integration of AI robotics.
54:40 at least with some of the technologies we're using right now. Again, robotics is one of the areas
54:46 One of our research challenges, for, for

54:49	Researchers, I remember at a meeting, it says make a robot so a team in an isolated situation and somebody is hurt, so the robot can actually help, because what was happening is people who had robots were actually risking their own life to protect the expensive piece of equipment.
55:05	And it's the exact opposite of what should be going on with that. So my goal has always been to see, and my hope has always been, that we can get robots that are genuinely helpful and can support people.
55:18	What worries me right now, is the same thing I've been talking about. There's insufficient recognition of the statistical
55:26	randomness that occurs when you reach the end of the training of an LLM.
55:32	There's some awareness of it.
55:34	But it's too casual right now. So, the same thing happens that the LLM casually deletes your database.
55:43	Well, put that into a robot, and the robot may casually delete your head.
55:48	So, you don't want unverified systems doing this kind of stuff.
55:53	And the level of LLM technology for robotics just terrifies me. These things should… are not ready… they're not ready for guiding robots in real time.
56:03	Now, that said, are they being used? I assume, I hope they're being used properly in some circumstances. I gave the example yesterday from my old friend from high school who had a marvelous experience driving a Tesla.
56:16	that they were able to go, you know, halfway across the East Coast.
56:20	with no problems at all. So, this can be done! This can be done, it can be done well.
56:25	But specifically for LLMs.
56:29	Just look at all the problems that we keep popping up with, and we need to be very, very careful.
56:35	About letting that particular technology get in charge of any kind of dangerous equipment.
56:41	Or a system.
56:44	Oh, good question.
56:46	But physical AI, I haven't…
56:48	I'm not against robots. I help get funding to develop robots. I see a lot of areas, oh gosh, firefighting situations on naval ships. That was one of the areas we specifically looked at. Tom McKinnon was one of those who pointed that out.
57:07	You know, those things are built for humans, so a human-formed robot that can go in and do firefighting duty
57:13	Man, that would be great!
57:15	That would be excellent. There's many places in in, you know, the Fukajima Fukajima reactor. Same thing. The robots weren't up to it. So if we can get the robots moving.
57:26	I think there's fantastic potential
57:29	And I just go back to my hesitation being that not with this tech, not yet. We need to go back to some of the more traditional ideas and yeah, they're cumbersome.

57:39		But hopefully we can… if these things don't have a good model, they shouldn't be going out into the real world. That's maybe a simpler way to put it. Most LLMs don't have any world models to speak of at all.
57:50		So, look at somebody like Yann LeCun, who's looking at model building.
57:55		Those are technologies that might give a much more…
57:59		verifiable connection between robotics and AI.
58:04		So again, good question, thanks.
58:09	HM	Oh, I have a question myself.
58:11		Do you think LLM will eventually become an expert system?
58:16	TB	Oh… You know, it's funny, one of the reasons why
58:20		This phase is so interesting for me, it's because I was really into expert systems.
58:25		You know, I was the advocate of expert systems. I helped put a… I don't know if it ever actually flew, but we developed a load shedding system for the space station, for NASA.
58:36		And, Prolog helped us in that one. Boy, Prolog did better than some of the Expert Systems. So, Expert Systems, I think…
58:45		have a very good use. We use them in certain areas, but the incompleteness, they're skimming the cream off of what's good.
58:54		One of the things I think was safer about the expert systems is that they acknowledged that they were just skimming the cream off of what they were doing. They didn't hallucinate as much.
59:04		Although when you put in statistical fuzzy logic, some of them could hallucinate there too.
59:11		So I I would like to see us have more.
59:15		Of, a lot more automation of some of the
59:20		The knowledge that we have, so they could help people.
59:23		And my beef is always about how we're doing it.
59:27		So I look at certain trends, and if the tree, if it doesn't have somebody coming in now, that's late.
59:34		If it doesn't have an understanding, comprehension, and ability to see what the world is.
59:42		as opposed to just statistically answering, based on what other answers were.
59:47		Then… then… We need to be careful about that version of expertise.
59:53		can still be useful, but it's it's tends to be rattier. We want solid answers.
59:59		Go France and go Argentina. I haven't been tracking.
1:00:05		Yeah, RAG does get you closer to an expert system. Yes, yes, Ron, that's a good point.
1:00:15		Other questions.
1:00:21		Bill, thank you, too.
1:00:24	RS	I just had one final comment,
1:00:29		we were way back earlier in the discussion, we were talking about, how many qubits you need for this, that, and the other thing. You know, gate-based qubits are only one kind of quantum computer.

1:00:44	TB	Yep.
1:00:44	RS	So there are, I've worked with neutral atom machines, which, which was the, you know, the Q era, Aquila,
1:00:55		They didn't actually operate their qubits in full cable.
1:01:04	TB	By the way, anybody who's not familiar with Ron,
1:01:07		Schreiner and his work, if you go back and look at one of the earlier videos a couple weeks ago, be sure to go back and look at
1:01:14		Ron's work, some great work in quantum computing there, and I'm.
1:01:19	RS	Yeah, I.
1:01:19	TB	I'm hopeful. I'm hopeful about where you're going I…
1:01:23	RS	That would… that would be… that would be me, Terry.
1:01:26	TB	Yes, yes, no, no, I was talking to the other people.
1:01:28	RS	Okay.
1:01:29	TB	No, I wouldn't pitch you or you.
1:01:32	RS	Alright.
1:01:32	TB	But.
1:01:34	RS	No.
1:01:34	TB	I'm telling other people to… I'm giving you a plug, Ron. I'm giving.
1:01:38	RS	Thank you, thank you.
1:01:39	TB	Everybody was… Although, if you need to consult yourself, you probably should. That's funny.
1:01:45	RS	Oh, but basically, they, they, they exhibit this phenomena where, because you can move the atoms around in whatever pattern you want in the, in the vacuum.
1:01:58		the whole system seems to have this understanding of the distance between atoms, and they… that can be leveraged for all sorts of algorithms, so maybe that might be the scenario in which, instead of using gate-based qubits, we use analog qubits.
1:02:15		To see if we can actually model a neuron, so I just wanted to throw that out there.
1:02:20	TB	That's, which was that work again? Because that is interesting work. I think anywhere where it gets more analog is… has the potential to access a lot.

1:02:29 RS Dude.

1:02:29 TB Compensation.

1:02:30 RS Neutral atom machines, like the Aquila, which is a 256 qubit machine, but again, they don't operate in gate-based mode.
1:02:41 They operate in what they call analog mode, although they claim their work, they've been working on gate-based mode. They'll get that solved at some point, but…

1:02:51 RS The fact that that type of quantum cubit can hopefully be operated in either mode gives it much more range, so…

1:03:02 TB Oh, that's… yeah, that's interesting.

1:03:04 RS Yeah, maybe the analog mode would be more… more appropriate for modeling neurons. I gotta think about this.

1:03:11 TB I think the trouble with the analog mode is our brains just aren't wired to understand that well, and I think we just reflexively kind of veer away from it, because it makes us uncomfortable. But I also think there's just… I really do think there's a lot of potential
1:03:28 In coming out with computational results that coalesce much, much faster.
1:03:33 with heavily analog as opposed to heavily digital. Heavily digital, again, is the Aristotelian bias. We want everything to be a precise decision, and then we just let a little bit of quantum leak through. So…
1:03:46 You know, if you're modeling very complex situations with very complex models, why not let the entire model kind of analog-style
1:03:55 fit together like our enzymes and proteins do, because they sure do a good job of it. They figure out how to navigate this stuff. So maybe we ought to be taking some lessons from those. But that's interesting work. I'm intrigued to see where that goes.

1:04:11 RS Yeah, well, until a newer on fires, it's basically… Operating in an airlock mode.
1:04:18 Oops.
1:04:20 you know, accumulated…

1:04:21 TB Can't quite hear you, Ron.

1:04:23 RS Until a neuron fires, it's basically operating in analog mode until…
1:04:30 Once it fires, it kinda, like, transitions to a digital.
1:04:34 The threshold, and then it goes back to accumulating data.
1:04:38 Probably more… more sensibly in the… in…
1:04:41 What you could understand is analog mode, so…
1:04:44 TB Okay.

1:04:45 RS Could be very interesting to think about.

1:04:47	TB	One of the things that intrigues me about enzymic biomolecules, which again I think are the experts at doing this stuff efficiently, is they
1:04:56		They come to a final result, but
1:04:58		it's not so much a binary result as the result itself is very complex. You know, so you get two molecules, the enzymes, they fit together in a very complicated way, so they have an analog processing with a result that does wind up being a specific result.
1:05:12		But it's not so much a decision as a reconciliation of a whole bunch of different things into one final package.
1:05:19		And, boy, every time I look at how cells work, it's just…
1:05:23		It just boggles my mind. How are they doing all that?
1:05:27		How… seriously, how are they doing all that? Watch one of the animations sometime.
1:05:32		About the synthesis of proteins and all the steps and all the corrections, this is what Hopfield addressed some in his 1974 papers.
1:05:42		How do they do this?
1:05:44		Because we see it, and we pretend we understand it, but we really don't.
1:05:49		You know, so…
1:05:50	RS	It's still the miracle of life.
1:05:52	TB	Still the miracle of life. And I think there's potential research potential there that we just have not fully explored yet.
1:06:00		So, it's funny, quantum computing, I've gone from, from highly enthusiastic to, like, I'm very disappointed, mostly because of the Deutsch model, that's a many worlds model.
1:06:09		It just kind of like, doc, that just didn't… it just didn't work, and then people pretended it was something else. But then I went back, and now I'm just the opposite direction. I'm going like, I think there's a lot of potential in this. I think the world's trying to teach us something. It's just, let's get away from the many worlds Deutsch model.
1:06:26		Because they tried it, they tried it for decades, it didn't really go much of anywhere, so let's stop pretending there are other universes throwing in computers just for our benefit. I don't think that's experimentally beneficial. Let's stick with our universe.
1:06:43		And see, how is it doing that? You know, how is it getting all those things together?
1:06:48		So so we'll see it. Fascinating area.
1:06:54		Any other questions.
1:07:04		going once.
1:07:05	HM	By the way, are you interested to talk about expert systems?
1:07:10	TB	In in which one?
1:07:11	HM	Expert systems.
1:07:13		That's my favorite.
1:07:15		Are you interested to present something about expert systems?
1:07:19		In the future?

1:07:19 TB Questions?
1:07:20 I could present... it's kind of a dated technology at this point.
1:07:26 Let me think on that one a little bit, because it's sufficiently out of
1:07:29 I'd have to think about it a little bit, but

1:07:33 HM Really? You think Express Systems are out of date?

1:07:37 TB Well, for me they are. It's it's it's a been there, done that thing.
1:07:46 Oh.
1:07:51 Let me think on that a little bit. Let me think on that a little bit.

1:07:54 HM Sure is my favorite.

1:07:57 TB Oh, so well.
1:07:59 Let's talk about that. I think there's a good chance I'll do it, but I'd like to talk a little more.

1:08:05 HM Thank you.

1:08:06 TB Okay, great.
1:08:10 Anyone else?
1:08:15 Say, Ron said, Ron, you meant that about expert systems, right?

1:08:20 RS Edit.

1:08:25 TB Okay.
1:08:27 Yeah, at some point, Helen, I wouldn't mind diving back into that. I'd love to see where that technology is going, because, like I say, that was my world for a while.
1:08:36 So, yeah, we'll do one on an expert system. That'd be an interesting topic, so...

1:08:41 HM Yeah, it seems that people talk about LLM more than expert systems, but I just checked or not, they're two different things.

1:08:48 TB Well, and expert systems cover a surprising amount of the same turf, but at much lower cost.
1:08:56 It's interesting to see that interaction between them. And it might be interesting to see what you could do. Oh, boy. I'm not sure what you could do with an expert system technology applied with modern databases and modern computational power.
1:09:14 That might be really interesting, because hardware limitations absolutely were a factor back when I was, you know.
1:09:21 Thoroughly embedded in that world.
1:09:24 Oh gosh, so just trying to find an engine that didn't totally destroy our computers was a problem, which is why I went to a version of Prolog that ironically turned out to be faster than the supposedly expert system shells.

1:09:39		So, yeah, okay, that would be a fun topic.
1:09:42		We'll do that.
1:09:45		Anything else?
1:09:49		Helen is best, as always. Yes, Helen, thank you for these presentations.
1:09:56	HM	If we can talk about expert systems or some other AI subjects, that'd be great. How about robotics, automated reasoning?
1:10:07	TB	Those could… those could be topics, those could be topics, too. Yeah, robotics, for yeah.
1:10:16		Robotics and, all of these are interesting topics with,
1:10:23		I've lost track of where the latest in some of the robotics was. I used to be right on top of that, but it's been a while. I intentionally avoided the area for some years.
1:10:33		So.
1:10:37		Any other questions? If not, maybe we're about at a wrap here.
1:10:41	HM	Yeah, sure. The last comment is awesome discussion today from Ron.
1:10:45	TB	Oh, thank you, Ron.
1:10:46	HM	Yes.
1:10:47	TB	And thank you again for that presentation. I really liked your presentation a couple weeks ago, which is why I was plugging it. So that's good stuff.
1:10:53		So, well, thanks, everybody, and it's good to see everybody again.