AA

https://www.youtube.com/watch?v=xNsjuZPVje8

"The Most Significant Idea" Roger Penrose Ever Had...

„Nejvýznamnější nápad“, jaký kdy Roger Penrose dostal...

Curt Jaimungal

456 tis. odběratelů

14 844 zhlédnutí >25. 4. 2025< #science

Main episode with Roger Penrose: _ • The 21st Century’s Greatest Living Sc... As a listener of TOE you can get a special 20% off discount to The Economist and all it has to offer! Visit https://www.economist.com/toe Join My New Substack (Personal Writings): https://curtjaimungal.substack.com Listen on Spotify: https://tinyurl.com/SpotifyTOE

0:00
(01)- The occasion that I'm talking about here was a particular occasion, which was maybe, in a sense, the most significant thought which I had, which was, well, there was an event, you see, a very unfortunate event, when Kennedy was assassinated. This was in 1963, and it was in Dallas. And my Dallas colleagues, including Wolfgang Rindler, and Ivor Robinson, and other people there, Schuchart, Pitch Oshvart was there, and they were at a dinner, and Kennedy was supposed to go and give a talk at this dinner. And he was awfully late, and they sort of joked, well, maybe somebody shot him. Somebody had shot him. And they came, and it was a way of, so much as they came, it was just about a week later, I think, when we decided to go to southern Texas,
1:06
to go to a nice place where there was a beach, and people could relax and try and recover from this awful occasion. And do someOshvart. Now, the thing about Pitch to Oshvart, he was a Hungarian who did speak English, but he didn't like to speak, even in Hungarian, I think. He didn't like speaking. He was a silent person. Okay, so he was the Hungarian direct. Yes, but he was definitely, he could speak English, but with a strong Hungarian accent, of course. And he
2:00
was the driver of the car when I came. And so this was very nice for me, because I didn't have to make up conversation to speak to him. He preferred not to have conversation. So I think to myself, I knew about this Robinson Congrensus race, which sort of describe a light ray, but which has been displaced in this way. And I said, the thing to do is to count, and I thought I didn't say anything, to count the number of degrees of freedom this configuration has. How much freedom does it have? And I counted them, and it has six degrees of freedom. And that's significant because? Yes, this is very significant, because light rays themselves have five degrees of freedom. So it's only one. You make your light ray complex in a sense, and you only drop your dimensionality by one. It's not really what you do if you're complex.

We have five complex dimensions. No, no. This only gives it, drops it by one. Why is that so important to me? Because this gives me a picture. The light rays
3:01
themselves are represented by points on this bound three, sorry, this five-dimensional boundary. And the Robinson Congrensus, as I call them, these twisting Congrensus of light rays, represent the points. If they go right-handed, they're one side, and if they go left-handed, they're the other side. This is the splitting of the space into two halves, just what I was looking for. Only it does it globally for the whole of space-time. Don't think of points, think of light rays. And then the complex ones, in this strange contorted sense, are only one more dimension. So that was the origin of twistor theory. I went back, got him back much earlier than anybody else, because they were still gossiping, I guess. And I went to the, I had a blackboard there, and I worked it out in terms of two-component spinors. And it worked beautifully. And this was twistors.
4:01
You take two two-component spinors, the way you can think of it. See, a two-component spinor ordinarily points along the light cone. It's like a light, it has a null vector associated with it. And that null vector points along the light cone. In addition, there's a little flag plane. And the flag plane tells you its phase. So the length of the, not the length, but the sort of extent of the light ray, or the extent of the null vector gives you one scale, and the other scale is the phase, which is the little flag plane. So you have this nice geometrical way, apart from the sign, which you have to add in addition, you've got the nice way of describing two-component spinors. I was well familiar with that. So the thing about the twistors, as you can think of the light ray, where does it hit the light cone of the origin? Some point. And then you look at the light ray going up, it hits that point. That's a thing I called omega. I didn't call it omega at the time, but it's to do with angular momentum, really. It's the moment of the light ray about the
5:03
origin. And the other is pi, that's the momentum of the photon. So you've got the momentum and the moment. And the two two-component spinors, they give you a four-dimensional entity. This was a twistor. So that was the origin of twistor theory. I tried to talk about it to my colleagues there, none of them were interested. Engelbert was. He was the only one that was at all interested in what I'd done. So it was a little bit of a... Why weren't they interested? Because it wasn't general relativity. I didn't know how to do general relativity with twistors. Took me decades to find out how to do general relativity with twistors. Do you think twistors will be an ingredient in a theory of everything? So something that combines the standard
…………………………………………………………………………………………………..

(01)- The occasion that I'm talking about here was a specific event that was perhaps in a way the most significant thought that came to my mind, which was that there was an event, you know, a very unfortunate event, when Kennedy was assassinated. It was in 1963 in Dallas. And my colleagues from Dallas, including Wolfgang Rindler and Ivor Robinson and other people, Schuchart, Pitch Oshvart were there, and they were at a dinner and Kennedy was supposed to go to this dinner and give a speech there. And he was terribly late and they were kind of joking that maybe someone had shot him. Someone had shot him. And they came, and it was a way, however they came, it was about a week later, I think, when we decided to go to South Texas,
1:06

to go to a nice place where there was a beach, and people could relax and try to recover from this terrible event. And do something like Oshvart. And now the thing with Pitch to Oshvart, he was a Hungarian who spoke English, but he didn't like to speak, I don't think he even liked to speak Hungarian. He didn't like to speak. He was a quiet person. Okay, so he was the Hungarian direct. Yes, but he definitely knew English, but of course with a strong Hungarian accent. And he

2:00

was driving the car when I arrived. And that was really nice for me, because I didn't have to make up a conversation to talk to him. He preferred not to speak. So I'm thinking, I knew about this Robinson Congrensus race, which kind of describes a light beam, but which was shifted in this way. And I thought I needed to count, and I thought I hadn't said anything, the number of degrees of freedom that this configuration has. How many degrees of freedom does it have? And I counted them and it has **six degrees** of freedom. And that's significant because? Yes, that's very significant because light beams themselves have **five degrees** of freedom. So it's just one. A light ray is complex in a sense, and its dimensionality is only reduced by one. That's not exactly what you do when you're complex. We have five complex dimensions. No, no. This gives it, it reduces it by one. Why is this so important to me? Because it gives me a picture. Light Rays

3:01

themselves are represented by points on this bounded three-dimensional, sorry, five-dimensional boundary. And the Robinson Congrensus, as I call them, these twisted Congrensus of light rays, represent points. If they go right, they're on one side, and if they go left, they're on the other side. This is a division of space into two halves, exactly what I was looking for. It just does it globally for the whole of spacetime. Don't think of points, think of light rays. And then the complex ones, in this weird distorted sense, are just another dimension. **So that was the origin of twistor theory.** I went back, I got it back much earlier than anyone else, because they were probably still talking. And I went to the board and I calculated this ??, what?, in terms of two-component spinors. And it worked beautifully. And this ??, what this? were twistors.

4:01

You take two two-component spinors, as you can imagine. A two-component spinor usually points along the light cone. ?? It's like light, it has a zero vector associated with it. And this zero vector points along the light cone. Plus, there's a little flag plane. And the flag plane tells you its phase. So the length, not the length, but the kind of range of the light beam or the range of the zero vector gives you one scale, and the other scale is the phase, which is the little flag plane.(?) So you have this nice geometric way, except for the sign that you have to add, you have a nice way of describing two-component spinors. I was very familiar with that. So the twistor thing, how do you imagine a light beam where it hits the light cone of the origin? At some point. And then you look at the light beam going up, it hits this point. That's something I called omega. I didn't call it omega at the time, but it's actually related to angular momentum. It's the momentum of the light beam relative to the origin. And the second one is pi, which is the momentum of the photon. So you have momentum and momentum. And two two-component spinors, that gives you a four-dimensional entity. That was a twistor. ??? So that was the origin of twistor theory. I tried to talk to my colleagues about it, but none of them were interested. **Engelbert, yes**. He was the only one who was interested in what I did. So it was a bit... Why weren't they interested? Because it wasn't general relativity. I didn't know how to do general relativity with twistors. **It took me decades to figure out how to do general relativity with twistors**. Do you think twistors will be part of the theory of everything? So something that combines standard...

…………………………………………………………………………………………………

(02)- model? It certainly should have a much broader application. But you see, what you have to do is take another step, which I sort of made a couple of years ago, made it in a slightly different way. Well, it was a couple of years ago.

6:04

Yeah. But it was in a slightly different way about six years ago. I wrote an article then, which wasn't published too much later. But the article I wrote more recently was in honor of C.N. Yang, the great physicist, one of the people who got a Nobel Prize for weak interactions and their chirality, right? Light ref, right? And it's quite curious because of that too. You see, you have the chirality. The twistor has a chirality to it automatically, which is the way it's just described. If you reflect it, it really goes into something else. It goes into a dual twistor. So you have a twistor, which is a four complex dimensional space, vector space, if you like. The dual of that space is the opposite twist. So you have a twistor and a dual twistor, and they twist

7:00

the opposite way, roughly speaking. But this was all to do with... I was trying to do positive and negative helicity. I learned not too long after this that you can describe momentum and angular momentum in terms of twistors very nicely. And the null ones, if you're talking about light rays, this is just a twistor, basically. It's a twistor and a dual twistor together. But the nice thing, you can describe the angular momentum. This is the notation I use later to call the moment an angular momentum thing. That's the omega. And the momentum is the other one, which is the pi part. And that's just the splitting which gives you these two interpretations. They're the two parts. These have two components and they give you these two parts. It's also conformally invariant. The conformal transformations work beautifully. Conformal invariance. It got more mixed up with positive and negative helicity. You see, what you really see is that the twistor, the positive and negative,

8:09

you have the space which is split into two halves. The space, incidentally, is a well-known space to geometers. It's a complex projective three-space. So it's a six real dimensional space, which is really complex three-dimensional space. So it's nice to visualize because you just think of it as three dimensions and you say, well, it's really complex too. So you can visualize lots of things in there. And it's really six real dimensions, and the five dimensions go either up or down, depending upon what is it that's positive or negative. Well, you look at, it took a lot of time to analyze this, but when you really see its connection with angular momentum and so on, it really is the helicity. So the photon is rotating right-handed, if that's right-handed or left-handed. So twistors are inherently chiral. They're inherently chiral. So this was where it

9:01

was. I talked about helicity. That's what it was at that time, whereas the intention was this should be positive-negative frequency. So the whole subject kind of got mired, in my view, with this confusion. And it got particularly so when one started to talk about general relativity, and there were some ideas which came from Ted Newman, who was a close colleague of mine, and he was interested in making space-time a little complex, and looking at angular

momentums, things which come from your displacement into the complex. It was a very deep insight that he had there. And I realized that that was the sort of thing I was doing. And one of his ideas, I won't go into the details, I realized you could take this and talk about them in twistor terms. And this described a kind of twistor, a twistor which actually referred to a curved space-time. Okay, wait. When you say
10:00
you talked about them in twistor terms, what do you mean? The complex space-time in twistor terms? Yes. It is a complex space-time. And you see, Ted Newman didn't mind about his space-time not being directly physical. I don't know whether he minded or not. He called it H-space. He had a space construction which involved making space-time complex, and looking at it in this particular way that he did. So why was that interesting to you? Because when we've talked off-air, if I mention the word supersymmetry, there's a grimace on your face. If I mention string theory, because it has extra dimensions and maybe some other flavors, there's an even worse grimace. I can tell you where the grimace comes from. See, all these things are adding extra dimensions to space-time. Now what I was doing was absolutely, crucially tied to the space-time having three space and one time dimension. If you change that, you wreck the theory. So some people see
11:00
a theory that works in n dimensions, especially mathematicians, that's a feature that it can
…………………………………………………………………………………………………..

(02)- model? It should certainly have much broader application. But you see, what you have to do is take the next step, which I kind of did a few years ago, I did it a little differently. Well, it was a few years ago.
6:04
Yes. But it was a little differently about six years ago. I wrote a paper back then that wasn't published until much later. But the paper that I wrote recently was in honor of C.N. Yang, a great physicist, one of the people who got the Nobel Prize for weak interactions and their chirality, right? Light ref, right? And that's what makes it quite special too. You see, you have chirality. A twistor has **chirality** automatically, which is the way it's just described. If you reflect it, it actually goes into something else. It goes into the dual twistor. So you have a twistor, which is a four-complex dimensional space, a vector space, if you will. The dual of this space is the opposite twist. So you have a twistor and a dual twistor and they twist
7:00
inversely, roughly speaking. But all of this was related to... I was trying to describe positive and negative helicity. I learned not long after that that momentum and angular momentum can be described very nicely by twistors. And the zero ones, if we're talking about light rays, it's basically just a twistor. It's a twistor and a dual twistor put together. But the nice thing is that you can describe angular momentum. This is the notation that I later use to refer to momentum as angular momentum. That's omega. And momentum is the other one, which is part of pi. And that's just a partition that gives you these two interpretations. It's two parts. These have two components and they give you these two parts. It's also conformally invariant. Conformal transformations work beautifully. Conformal invariance. It got more mixed up with positive and negative helicity. You see, what you're actually seeing is a twistor, positive and negative,
8:09

space that's divided into two halves. By the way, this space is well known to geometrist. It's a complex projective three-dimensional space. So it's a six-dimensional space, which is a really complex three-dimensional space. https://www.hypothesis-of-universe.com/docs/eb/eb_007.pdf ; So it's nice to imagine it because you just imagine it as three dimensions and you say it's really complex too. So you can imagine a lot of things there. And it's actually six real dimensions, and those five dimensions go either up or down, depending on what's positive or negative. Well, you look at it, it took a lot of time to analyze, but when you actually see its connection with angular momentum and so on, it's really helicity. So the photon is spinning to the right, whether it's to the right or to the left. So twistors are inherently chiral. They're inherently chiral. So here it was

9:01

I was talking about helicity. That's exactly what it was then, whereas the intention was for it to be a positive-negative frequency. So the whole subject got a little bit tangled up in this confusion, I think. And it happened particularly when you started talking about general relativity, and there were ideas from Ted Newman, a close colleague of mine, who was interested in how to complicate spacetime a little bit and look at angular momentum, things that arise by shifting into the complex. It was a very profound insight of his. And I realized that this is exactly what I was doing. And one of his ideas, I won't go into detail, I realized that you could talk about them in terms of twistors. And that described a kind of twistor, a twistor that actually related to curved spacetime. Okay, wait. When you say you talked about them in terms of twistors, what do you mean? Complex spacetime in terms of twistors? Yes. It's a complex space-time. And you see, Ted Newman didn't mind that his space-time wasn't exactly physical. I don't know if he did or not. He called it H-space. He had a spatial construct that involved complexing space-time, and his view of it was this particular way. So why did you care? Because when we were talking off-air, when I mentioned the word supersymmetry, you get a grimace on your face. When I mentioned string theory, because it has extra dimensions and maybe some other variations, you get an even worse grimace. I can tell you where that grimace comes from. Look, all ""these things"" which "these"??, add extra dimensions to space-time. If I have a pot (spacetime) with jam and I keep adding ““**these things**“”” , will I have more jam in the pot?? What I did was absolutely and crucially connected with the fact that **spacetime has three spatial and one time dimensions**.But it doesn't have 3+1, but it has 3+3 dimensions, three length and three time (!) What if it is proven??!! If tha what “that” is supposed to change?, you change it, you destroy the theory. Which one?, twistor? So some people, especially mathematicians, see a theory that works ||in n-dimensions||, as a //*property*// that can... that works in any dimension. When something “works in dimension<<<<”, that is a pretty stupid formulation…,“in” dimension there is nothing. ; Formulation: “Something works using dimensions”, I would understand that; the theory in dimensions works as a property, you say, uh…, that is also a very strange formulation. My hypothesis/theory builds matter from dimensions, from 3+3 dimensions of space-time by >>packaging<<, and then these formations of entangled, crumpled dimensions according to topology and geometry carry properties, properties are determined by the shapes of curvatures + the number of dimensions of two kinds. With you, the theory works as a property in “n” dimensions, in any dimension, that… that is a strange formulation of reality…
………………………………………………………………………………………..

(03)- work in any dimension. And if you say my theory only works in four dimension, some people see that as a weakness. You see that as, no, that's a strength. Absolutely. That is absolutely the point. I'm seeing it as a strength. Because you're not looking at mathematics. Okay, mathematicians pick up on twistor theory and they generalize it to higher dimensions and all sorts of things. Fine, that's good. That's good stuff. But it's pure mathematics. I'm interested here in specifically the mathematics which applies to the physical world. Now that, whether you can generalize that to 17 dimensions is of no particular interest to me. And if people do string theory, initially when I heard about string theory, I thought it was a beautiful idea. And then when it went and said, oh no, it only works in, I think, 26 dimensions originally. I thought, okay, that's not, okay, you can work on that. I'm not going to work on that. It's not physics anymore. New update. Started a
12:02
Substack. Writings on there are currently about language and ill-defined concepts as well as some other mathematical details. Much more being written there. This is content that isn't anywhere else. It's not on Theories of Everything. It's not on Patreon. Also, full transcripts will be placed there at some point in the future. Several people ask me, hey Curt, you've spoken to so many people in the fields of theoretical physics, philosophy, and consciousness. What are your thoughts? While I remain impartial in interviews, this Substack is a way to peer
12:32
into my present deliberations on these topics. Also, thank you to our partner, The Economist.
……………………………………………………………………………………………………

(03)- works in any dimension. And if you say that my theory only works in four dimensions, some people see that as a weakness. I "cannot" comment on that. Precisely because I build a theory "of" dimensions (of 3+3 physical dimensions and n+m mathematical dimensions). You see it as, no, that's a force. Absolutely. That's exactly the point. I see it as a force. Because you don't look at the mathematics. Okay, mathematicians will take twistor theory and generalize it to higher dimensions um…"my" mathematicians will take 3+3 physical dimensions and build all, all elementary particles from them, and then physicists will join these 'mathematicians' and build physics, chemistry, and biology from those elementary particles (dimensional) → https://www.hypothesis-of-universe.com/docs/eb/eb_002.pdf ; https://www.hypothesis-of-universe.com/docs/aa/aa_030.jpg ; https://www.hypothesis-of-universe.com/docs/aa/aa_037.pdf ; etc., etc., and all sorts of things. And all sorts of things. O.K. Okay, that's good. That's a good thing. But it's pure mathematics. Not in my HDV. Mathematics is to build all elementary particles from dimensions https://www.hypothesis-of-universe.com/index.php?nav=ea ; and physics is then → to use these two-character formulas and build the physical reality of Being from them, + to build laws, principles, rules + a chemist uses physics and builds inanimate nature from it "with his sign language", a biologist builds living nature. All this from so-called signs = physical quantities. I am specifically interested in mathematics that applies to the physical world. Whether it can be generalized to 17 dimensions does not particularly interest me. :-) And if people are interested in string theory, at first, when I heard about string theory, I thought it was a beautiful idea. Maybe it is, but theorists have to change the vision that strings are "from Nothing" to the vision that strings are from the dimensions of two quantities Length and Time. And then when it happened and they said it only works in, I think, 26 dimensions initially, I thought, that's not

good, okay, you can work on that. I'm not going to work on that. It's not physics anymore. New update. Started
12:02
Substack. The articles on it are currently about language and vaguely defined concepts, as well as some other mathematical details. There's a lot more written there. This content isn't anywhere else. It's not on Theories of Everything. It's not on Patreon. There will also be full transcripts there in the future. A few people ask me, "Hey Curt, you've been talking to so many people in theoretical physics, philosophy, and consciousness. What do you think about it? While I remain impartial in my interviews, this Substack is a way to get a glimpse
12:32
of my current thoughts on these topics. Thanks also to our partner, The Economist. That was a nice conversation, except that I didn't learn "what Twisters are made of."

…………………………………………………………………………………………………….

JN, 05.05.2025