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Roger Penrose on Spacetime, Quantum Theory, and General Relativity (Part 2) | Closer To Truth Chats

Closer To Truth

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Sir Roger Penrose talks about the work that earned him a Nobel prize in physics, developing mathematics to analyze spacetime, his 1965 paper "Gravitational Collapse and Space-Time Singularities", Cosmic Censorship Hypothesis, Conformal Cyclic Cosmology, and his thoughts on Quantum Mechanics and General Relativity.

My comments and opinions are inserted into the text in red font 14/12/2023

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(01)- The outrageous idea is that our big bang is the conformal continuation of somebody else's remote future because what was it Eon prior to ours and its remote future became our big bang now you need some equations to describe that sort of thing and I also for quite a long time thought well I can go on lecturing about this forever because nobody will ever prove me wrong and then I thought I've got an idea I could prove myself wrong welcome to closer to truth I'm speaking with sir Roger Penrose on physics cosmology and black holes Raja is a distinguished pure mathematician mathematical physicist and Nobel Laureate in physics the Emeritus Rouse ball professor of mathematics at the University of Oxford Penrose has distinct views on the philosophy of science physics cosmology and mind which we explore closer to truth is presenting this three-part mini-series with sir Roger Penrose this is part two penrose's unique approach to fundamental physics cosmology and black holes Roger welcome let's start with your Nobel Prize for as the committee said for the discovery that black hole formations is a robust prediction of the general theory of relativity please describe how this discovery came about well it was the story is a bit longer than just that event you see I think it was when I was in Cambridge as a research fellow um and this was I think in my second year when my friends and colleagues Dennis Sharma from whom I learned in the North Water physics um I think told me that there was a lecture being given at King's College London by David Finkelstein and he thought I would be interested so I went with Dennis to this lecture and this lecture was describing how but you see there was this watch out solution known from way back it's the first solution to Einstein's equations it was ever discovered of a flat space and this solution describes a spherically symmetrical body but if you imagine that body being squashed down smaller and smaller to a certain scale something crazy happens and it because what people thought it becomes Singularity the equations just go crazy and this Singularity was referred to as the Swatch of singularity now in this talk given by David Finkelstein we described it wasn't a singularity at all that you could choose appropriate coordinates which extend the picture beyond that and you could imagine material falling right through this Horizon than having their existence inside now um I remember talking to David afterwards and we he claims that we sort of swapped subjects because he became interested in sort of discrete physics which I'd been interested in and I became interested in general and sympathy and we did sort of swap subjects but I picked up on his arguments there and began to wonder to myself you've got rid of this so-called Singularity at the spot Shield Horizon maybe not called The Horizon which is what we call the Horizon of a black hole now but that diameter and uh but yet you still have this singularity in the Middle where the curvatures seem to go to infinity and you can't do anything about it so I did wonder whether there might be a general theorem in mathematics which told you if you have an irregular situation not a completely symmetrical collapse because this was all talking about spherical symmetry everything is the same all the way around and it's a very special situation so in a general collapse you'd expect something complicated going in and do you still have a theorem which tells you there's a singularity I don't know why I thought that at the time but what I did think was I wonder if there's a theorem and if there is one why doesn't why don't they know it because I would have heard about it not David would have explained it to me or something he just said there's this theorem so I realized there wasn't one so I thought well I wonder whether I could prove something like that and then I thought well what do I know about general relativity that other people might not know pretty well nothing that's because I was not an expert in the subject but what I did know was dirac's lectures on two component Spinners which I've been to and they were very revealing to me I won't go into the why I was interested in this sort of thing but it was an opening of a new way of looking at things and when I applied these ideas to general relativity the things sort of opened up in a way which was quite different from other ways of looking at the subject so I mentioned all this because it's background it wasn't what actually uh led to the actual theorem and the proof of it which came many years later you see this this I think it was 1958. when I were in Davidson I gave a talk and uh it was much later when people were starting to see these radio

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(01)- The outrageous idea is that our big bang is a conformal continuation of someone else's distant future, because what was an Eon before ours and its distant future became our big bang, now you need some equations to describe such things and so am I thought for quite a while that I could lecture on this forever because no one would ever prove me wrong, and then I thought I had an idea that I could prove. I'm wrong, welcome to the truth. ((I'm talking to Sir Roger Penrose about physical cosmology and black holes. Raja is a distinguished pure mathematician, mathematical physicist and Nobel laureate in physics, Rouse Professor Emeritus of Mathematics at Oxford University. Penrose has different views on the philosophy of scientific physics, cosmology and mind , which we will explore further. Pravda presents this three-part miniseries with Sir Roger Penrose, this is the second part. Penrose's unique approach to fundamental physics, cosmology and black holes Roger welcome let's start with your Nobel Prize because the committee said for the discovery that the formation of black holes is a robust prediction of general relativity, please describe how this discovery came about, it was a bit longer than just the event you see.)) I think it was when I was at Cambridge as a research fellow, and that was i think in my sophomore year when my friends and colleagues Dennis Sharma, from whom I studied in the physics of water in the north, told me that there was a lecture.

David Finkelstein was giving a lecture at King's College London and he thought I would be interested, so I went to this lecture with Dennis, and this lecture described how to do it, but you see there is this solution for observing known since ancient times past, it is the first solution to Einstein's equations. Flat space was ever discovered, and this solution describes a spherically symmetric body, but if you imagine that body is compressed smaller and smaller to a certain scale, something crazy, it happens because what people thought would become a singularity , the equations just went crazy and this singularity was referred to as the pattern singularity, now we described in this David Finkelstein talk >that it wasn't a singularity at all< so you can pick the appropriate coordinates that expand the picture beyond that and you can imagine the material falling right across that horizon rather than existing inside the um now I remember talking to David afterwards and we said we had a bit of a change of subject because he became interested in a kind of discrete physics that I was interested in and started I'm interested in generality and sympathy and we exchanged topics a little, but there I caught his arguments and began to think that you got rid of the so-called Singularity at the place of Shield Horizon, maybe it's not called Horizon, which is what we call it now The black hole horizon, but the diameter and uh, but still you have this singularity in the middle where the curvatures seem to go to infinity and you can't do anything about it, so I was wondering if there might be a general theorem that tells you that if you have an irregular situation, not quite a symmetric collapse because that's all been talked about spherical symmetry everything is the same all the way around and it's a very strange situation so in a general collapse you'd expect something complicated to get in and you still have a theorem that tells you, that there is a singularity? I don't know why I thought that at the time, but what I thought was that I wonder if there is a theorem, and if there is, why don't they know it, why don't they know it, because I would have heard of it, but David wouldn't explain it to me or something I just said there is this theorem so I realized there isn't one so I thought well I wonder if I could prove something like that and then I thought well what I know about general relativity that other people may not know very well because I wasn't an expert on the subject, but what I did know was Dirac's lectures on two-component Spinners, which I attended and were very revealing for me. I won't go into why I was interested in this species. But it was opening up a new way of looking at things, and when I applied these ideas to general relativity, things opened up in a way that was quite different from other ways of looking at things, so I mentioned all this because it's background, it wasn't that's what actually led to the actual theorem and the proof of it that came many years later, you see, I think it was 1958. when I was at Davidson I was speaking and it was much later when people began to see these radios

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(02)- signals from what became known as quasars these were extremely energetic entities very very puzzling entities because from the redshift they seem to be receding from us at a very very great speed and the normal explanation for that would be oh well they're very very distant universe is expanding so these objects which we now call quasars sources of these very strong radio signals must be very very distant because of this redshift and if they're that distant they must be extremely powerful if they're that powerful they must be involving a large amount of mass considerable proportion of the mass in the Galaxy or something like that yet they couldn't be that big because the variation in these signals indicate that they couldn't be bigger than the solar system that have really small in the solar system but you have something which looks like a body of the nature or you would get if you could collapse something down to the structured radius now so I got interested in this I think it was John Wheeler who was particularly interested in this question and at that time there was a paper written by two Russians Licious and kalatnikov who seemed to have proved that in the general situation you didn't get Singularity if there were some complicated swishing around as the thing collapses inwards and they become swirling out again in some way like that I had a look at the paper I didn't really I didn't notice the mistake there was actually a serious error in the paper which I think was discovered by belinski later who then collaborated with the Russians but at the time there was it was nothing was wrong with the paper as far as people knew I just wasn't totally convinced by the methods that they use so I started just thinking thinking about this problem and we're using other kinds of techniques which for other problems I'd been thinking about before which was a general arguments about surfaces and future regions of surfaces and what is the boundary of a future look like whether its properties and then you get light rays on the boundary and they start crossing over and producing horrible caustics and Crossing regions and things like that but I could realize how you could circumvent all these problems originally for quite a different reason but then I thought of applying these ideas to the black hole we didn't call them black holes in those days that was really John Wheeler I think largely who used that term but we they would just collapse collapsing objects there was known from 1939 a paper by James Robert Oppenheimer and a student of Snyder but they'd only considered a completely severely symmetrical cloud of dust dust means no pressure it's focusymmetrical means that everything is falling directly to the center so the fact that you get the singularity at the center wouldn't surprise anybody because there's nothing to stop the matter there's no pressure there's nothing and so you get to sing your life very artificial in general you don't expect it they will swish around and do something else I'm swirling out that seemed to be the normal view but I've gone thinking about it using the kinds of methods I'd been worrying about at the time and I thought of this concept of a tracked surface which is a way of characterizing when a collapse had reached the point of no return in a certain sense and that's something I tell the story of how that came to me when I was crossing the street there was a I was being visited by Ivor Robinson who was a an Englishman who was working in Dallas Texas but he had a wonderful way with words that the Americans absolutely loved he certainly had a wonderful word with words and he was talking about something I have no idea what we came to this road where we crossed the road conversation stopped we got to the other end and when he left I remember having this strange feeling inhalation what am I feeling elated about I had no idea I went through the things that happened to me during the day what did I have for breakfast what am I walking through the woods or and all these things which happened part of the usual thing no no not that not bad crossing the street when the silence came and Ivor stopped talking I had this idea that I was able to resurrect the idea fortunately of how to characterize without using any symmetry ideas of a collapse that had gone too far and then I knew from the kinds of arguments I'd been playing with without a lot of things what boundaries of Futures look like and once you have this track surface condition a nice sketched out an argument which showed that

you had to have a singularity it was not I didn't have the best argument in fact the argument I use in the paper I always feel embarrassed about this because it wasn't I had a really clumsy argument at one point and Charlie misner with whom I shared and it's uh with my years as a research fellow at Prince a prince and under John Wheeler
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(02)- signals from what became known as quasars, they were extremely energetic entities, very mysterious entities because from the redshift they appear to be moving away from us at a very high speed and the normal explanation for that would be that they are very very the distant universe is expanding so these objects that we now call quasars the source of these very strong radio signals must be very very far away because of this redshift and if they are that far away they must be extremely powerful, if they are that powerful they must include a large amount of matter, a significant fraction of the matter in the Galaxy, or something like that, but they couldn't be that big because the variations in these signals suggest that they can't be bigger than the solar system, which is really small. The solar system, but you have something that looks like a body of nature, or you would get if you could collapse something into a structured radius now, so I was interested. John Wheeler was particularly interested in this question and at the time there was a paper written by two Russians **Licious and Chalatnikov** who seemed to prove that in the general situation you didn't get the Singularity if there was **some complicated flicking** leap change of state from pre-big-bang to big-bang, as I describe and explain the emergence of "this" universe of ours with matter from the state of the Universe before the Bang, when there was a state of space-time without matter and it was flat, uncurved, infinite, without the passage of time and without expansion. The **curvature** of dimensions is then (then after the Bang) the **PRINCIPLE of the structure of matter and physical fields** and...and even together with the **PRINCIPLE of alternating symmetries with asymmetries**, they are a "generating universe" in which time flows, length dimensions unfold even temporal, and even laws, new laws must be created, what can we arrange in a sequence, a list of laws, rules and "mandatory systems"... like a thing collapses inward and somehow stirs outward again. In other words: infinite flat 3+3D space-time (before big-bang = before ***instant change***), without matter, without time passage, without expansion, without laws, will "collapse" *with a "swish whip"*, in the style of "distortion of dimensions" to the **"final** locality" and from this state a new genesis of the Universe occurs already with matter, with the flow-flow of time, with the unfolding of space, interactions of the elements of matter, etc. -Attention, **I'll correct myself** : The final location of crooked dimensions (= our Universe...what started with the pseudo-singularity)), then that location, after creation, **floats** still in that original flat infinite 3+3D space-time. The original Universe did not die, did not disappear. The pre-big-bang universe, i.e. that state of flat 3+3D space-time, is still everywhere, it is "between us" and there is a basic grid, warp, grid, network of non-curved 3+3 dimensions, in which localities with crooked dimensions. (ie elementary particles, interactions, up to complex DNA, galaxies, stars, all 4 fields).

I was looking at the paper, I didn't really notice it, I didn't notice the error, in fact there was a serious error in the paper that I think was discovered by **Belinski** later who were then working with the Russians, but it wasn't with the paper when they existed nothing bad if people knew that I wasn't entirely convinced of the methods they were using, so I started just thinking about this problem and we're using other kinds of techniques that I had thought about before for other problems, which were general arguments about surfaces and future regions of surfaces and about what is the boundary of the future appearance of its property and then you get light rays at the boundary and they start to cross and produce terrible corrosives and Crossing regions and things like that, but I understood how you could work around all these problems originally from quite a different reason, but then I thought of applying these ideas to a black hole, we didn't call them black holes at the time, it was really John Wheeler, I think for the most part who used the term, but we would just collapse the collapsing objects there I know from 1939 a paper by James Robert Oppenheimer and a student of Snyder, but they only considered a completely strongly symmetric dust cloud, that means no pressure, it's focal symmetric, that means everything falls right into the center, so the fact that you get a singularity in Wednesday, wouldn't surprise anyone because there's nothing to stop it, there's no pressure, there's nothing, and so you sing your life very artificially, you generally don't expect it. I'm going to swing around and do something else, I'm swirling out, which seemed like a normal view, but I was thinking about it using the kinds of methods I was concerned with at the time, and I came up with this concept of tracking the surface, which is a way of characterizing , when the collapse in a sense reached the point of no return, and that's something I tell the story of how it came to me when I was crossing the street where I was visited by Ivor Robinson who was an Englishman who worked in Dallas in Texas, but he had a wonderful way with words that Americans absolutely loved, he sure had a wonderful way with words and he was talking about something I have no idea what we came to this road where we crossed the road, the conversation stopped, we got to the other end and when he left i remember i had this strange feeling inhaling that makes me feel uplifted i had no idea i went through the things that happened to me during the day i had a break walking through the woods or and all these things that have become part of the usual things no no it's not bad to cross the street when there was silence and Ivor stopped talking I had an idea that fortunately I managed to resurrect this idea how to characterize the ideas of collapse without using any symmetry that went too far, and then I knew from the kinds of arguments that I played with without a lot of stuff, what the boundaries of the future looked like, and once you had that track surface condition a nice sketchy argument that showed that you had to have exceptionality, it wasn't I didn't have the best argument actually the argument I use in the paper, I'm always ashamed of it because it wasn't, I had a really awkward argument at one point and **Charlie Misner** who I shared it with and is that with my years as a researcher at Prince and Prince and under **John Wheeler**

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(03)- and I learned a lot of physics from China business and he told me a better word he thought he'd already told me this better way and I knew it already for some stupid reason I had thought of using it in the argument but when I described the argument that's why I always use the death away but anyway that that was the origin of this paper what reaction do people have I think quite typical I well I remember visiting Princeton a little while later than this and Bob Dickey who is a very distinguished physicist and he came up to me slapped me on the back and said you've done it you've shown gender relativity is wrong and I think this was a common do that people had because you got these singularities and I have a suspicion that if Einstein had been alive at that time and I'd sort of had the chance to explain this to Einstein he would have had a similar view but that tells you the general relativity is wrong you shouldn't get singularities it wasn't quite the viewer I had my own View okay well something else has to replace general relativity when curvature has become so strong that you have to bring in quantum gravity that's probably true but it doesn't help you very much in this this kind of situation but um that was sort of the origin of the paper in fact I gave talks at the conferences there were these Texas conferences that initially were held every year I think and I usually gave a talk about what Nick came to be known as black holes was that your 1965 paper gravitational collapse and space-time singularities yes indeed that was that paper yes okay great um what kind of mathematics did you use in that paper in your developmental work uh that analyze the properties of space-time because many give you credit for bringing new mathematics to uh um to assess and evaluate the nature of space-time yes we see that sort of town there were two approaches people would have to do this kind of problem or general relativity in general one of them would be defined Exact Solutions and the short shell solution was one very famous one and the cursed solution another famous example which describes black holes rotating black holes um when they settle down but you see that's not very good when you're looking at the collapse because it's going to be something very complicated so Exact Solutions aren't much help the other kind of techniques that people would have used would would be in computers methods you put the thing on a computer and you chug away well the computer methods were not very Advanced at that time you wouldn't have been able to get very far at all even now to know whether you're actually getting a singularity or is it just that you've overloaded something on the computer I mean is it that the computers can't handle curvatures which get so big or something like that um is it really a singularity it doesn't quite answer the question I suppose that's probably the way people would have gone without these kinds of techniques but I developed quite different techniques which were had to do some people call them topology they're partly topological that means you're looking at properties of spaces where you're not not interested in distances and things like that isn't quite that once looking at a um you see it's a kind of geometry which hadn't been much studied mathematically you see general relativity uses what people would say Romanian geometry now it's not quite right because Romanian geometry it certainly is they're using the formalism that **Riemann** had introduced initially and then the Italian German shepherchief return people like that had developed these techniques unfortunately the techniques were there so when Einstein developed his theory he could well through his his colleague was able to um to access this body of understandable now this body of mathematical understanding was what we now refer to as Romanian geometry now Romanian geometry isn't really quite the kind of geometry which is used in general relativity and let me try and explain this in a certain way it's really what you call minkowsky in Geometry except the word mccaskill is misleading it is due to **Minkowski** put it like that there was this mathematician who got a way of understanding relativity now when I say relativity now I mean special relativity that was the relativity Theory before gravity is brought into the picture you have speed of light and how things behave when you get to the speed of light when you approach the speed of light and people even Einstein tended to talk about this in terms of transforming from one set of observers to another and the name relativity even comes about because you're thinking of it in that kind of way different observers measure different things and they're all relative to each other and the concepts become relative which is a bit misleading what minkowski did was to

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(03)- and I learned a lot of physics from Chinese business and he told me a better word, he thought he already told me better, and I already knew it for some stupid reason, I thought of using it in an argument but when I was describing an argument, that's why I always use death gone, but anyway that was the origin of this paper, what kind of reactions do people have, I think pretty typical, I well remember visiting Princeton a little while later and **Bob Dickey**, who is a very well-respected physicist, and he came up to me, slapped behind my back and said you've done it you've shown that gender relativity is wrong and I think that was a common thing for people to do because you have these singularities and I suspect that if Einstein was in that time alive and I would have a chance to explain it to Einstein, he would have a similar opinion, but that tells you that general relativity is wrong, you shouldn't get singularities, that wasn't quite a spectator I had my own View ok ok, something another has to replace general relativity when the curvature got so strong that you have to introduce quantum gravity, which is probably true, but it won't help you much in this situation, but um, that was kind of the origin of that article, actually I was speaking at conferences, it was the Texas conferences that were held every year at first, I think, and I usually talked about what Nick called black holes. Was it that your 1965 Gravitational Collapse and Spacetime Singularities paper yes indeed that was the paper yes ok great what kind of mathematics did you use in this paper in your development work uh that analyzes the properties of spacetime because many of you attribute new mathematicians to assess and evaluate the nature of space-time yes, we see that in the city there were two approaches that people would have to solve this kind of problem or general relativity in general, one of them would be defined exact solutions and a short shell solution was one very famous and cursed solutions another famous example that describes black holes rotating black holes when they settle down but you can see it's not very good when you look at the collapse because it's going to be something very complicated so Exact solutions don't help much different kind of the techniques that people would use would be in computer methods, you put the thing in the computer and you get rid of it well, computer methods weren't very advanced at the time, you wouldn't have them. He was able to get very far, even now, to know if you're actually getting a singularity or if it's just that you've overloaded something on the computer. I mean computers can't handle curvatures that get bigger or something like that erm, it's really a singularity doesn't quite answer the question. I suppose that's probably the way people would go without these techniques, but I developed quite different techniques that they had to do, some people call them topologies. It's partially topological, which means hat you're looking at properties of spaces where you don't care about distances and things like that aren't quite the same once you look at um,
you see it's a kind of geometry that hasn't been studied much mathematically you see general relativity uses what people would say, **Romanian geometry** (and Bulgarian constants) now it's not quite ok because Romanian geometry it certainly is that they use the formalism originally introduced by Riemann and then the Italian German Shepherd

who developed these techniques unfortunately there were techniques so when Einstein developed his theory he could through his colleagues well get to this set of comprehensible now this set of mathematical understanding was what we now call Romanian geometry now Romanian geometry is not really quite the kind of geometry that is used in general relativity and let me try and explain that in a way, it's really what you call a **Minkowski** in geometry, except that the word **Mccaskill** is misleading, it's **because of Minkowski**, he said that there was a mathematician who got a way of understanding relativity now when I say relativity, I mean special relativity| which was the theory of relativity before gravity was brought into the picture, you have the speed of light and how things behave when you get to the speed of light, when you get close to the speed of light and people, even even Einstein, tended to talk about it in terms of a transformation from one set of observers to another (!) comment and the name >relativity< even came about because you think about it in that way, different observers measure different things and they are all relative. To each other and concepts become relative, which is a bit misleading what Minkowski did
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(04)- show no it's kind of geometry it's like euclidean geometry but instead of having more pluses you see in the plethian geometry if you want to know the distance between two points in unit coordinates you put the square root of the sum of the squares of all the coordinates and that's the sort of thing you do to talk about ordinary you can geometry and coordinates now what Michelle Costa showed is if you change a sign you have squares of sums of squares no you don't you put some minus signs in then you get what we refer to as minkoff's geometry Einstein when he first saw it I thought it was mathematical sophistry and not very important but you realize later no that's the way to look at it all these ideas are special relativity they're just a form of geometry it's a different kind of form of geometry where you have space and time they're on a certain equal footing but there's a sign Difference A Plus and a minus so you use a minus sign rather than the plus sign in some way I won't go into the details of that but there's time directions have a different sign from the space dimensions once you've got that idea it's not hard to see how to adopt that kind of geometry to this minkowski and kind of geometry now the term minkaskian now is a little bit confusing to me here because the term means the flat space that you costly actually introduced when you go beyond that and that was Einstein's huge Revolution was to understand you take Minkowski in Geometry is the flat space version and you now bend it so you have a curved space time so you're using the ideas of Riemann the love achievement there in these other Italian geometers and you combine them with the idea of nikosuke and it's that combining which people didn't take on really it was confusing to people if you don't realize it's not really Romanian geometry because you've got a difference in the sign and it's really a different subject and it's that subject this is the answer to your question somewhat complicated the answer I'm afraid the answer your question is is this subject of when you take the geometry that's in the um Romanian geometry which is curved space time but you use the notion of distance where the distance is really a time and you have these pluses and minuses and which aren't all the same sign and once you've got used to that the kind of geometry you're using or the kind of topology the kind of geometry when I said topology I mean you're not actually looking at Exact Solutions most of the time you're looking at General features which these Solutions have to have and you get a feeling for that kind of geometry and that's what I suppose I wasn't actually quite the first person to do this there were a few people but they hadn't got very far and I was able to use theorems in this kind of geometry which hadn't been really explored before in any deep way to show how you can prove these Singularity theorems in general relativity and it was really a subject which took off from there um then a few years later I think uh maybe 1969-ish you began an association with Stephen Hawking um in further developing what happens when all black matter collapses into a a singularity this geometric point in space where mass is theoretically compressed to an infinite a density and zero volume which sounds you know very difficult to conceive of how did that process begin and what what was what was the additive feature perhaps I should clarify the history a little bit um according to the movie he said I gave a talk at King's College on this collapse theorem which I just described for black holes and uh according to the movie Stephen Hawking was there with spots coming out of his head or something being inspired by the talking he wasn't actually there he was not present I was very proud of the occasion because John Singh was there who was a an Irish relatively relativists who had two books which were written from a geometrical point of view and so I really liked his books and I felt very pleased that he was there but Dennis Sharma heard about my talk Dennis Sharma was in Cambridge and had his group there and asked um whether I would give a repeat of my talk at King's College in Cambridge and Stephen Hawking was there and not only that but I gave a private session after the talk that I gave to Stephen and George Ellis possibly Brandon Carter I don't think he's not sure he was there but certainly George Ellis was there and he and Stephen had been working on certain theorems but they realized that these techniques that I'd been using were something that could go off in a different attack altogether Stephen very quickly picked up on the arguments I was using and applied them to a cosmological situation in a rather limited sense but it was a good argument and he then sort of took on it took off on his own and developed these techniques at that time I was interested in other things I kept in contact with Stephen but I didn't uh do much with

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(04)- show no, it's a kind of geometry, it's like euclidean geometry, but instead of having the multiple pluses you see in ||plethian geometry||, if you want to know the distance between two points in unit coordinates, you take the square root of the sum of squares of all coordinates and that's the kind of thing you do when you talk about ordinary geometry and coordinates. Now what **Michelle Costa** showed is that if you change the sign, you have squares of sums of squares no, you don't put some minus in them then you get what we call Minkoff geometry. Einstein, when he first saw it, I thought it was mathematical sophistry and it's not very important, but later you realize that's not the way to look at it. All these ideas are special relativity, **they're just a form of geometry**, it's a different kind of geometry where you have space and time, they're on the same level, but there's a "difference" sign, and a "plus" and a "minus", so **in some way** you use a minus sign instead of a plus sign. Don't go into details, but there are time directions that have a different sign than spatial dimensions, once you get the idea, it's not hard to see how to take this kind of geometry to Minkowski. And the kind of

geometry, now the term Minkaskian now it's a little confusing to me because this term means flat space that you **actually expensively introduced** when you go beyond that, and that was a huge Einstein revolution of understanding that you take Minkowski in Geometry is a version of flat space and now you bend it (!) the object's motion trajectory rotates, the motion geometry copies the curvature of the spacetime mesh so you have curved spacetime, O.K. so you're using Riemann's ideas, love success there in these other Italian geometers and you combine them with the idea of **Nikosuke**, (who is that?) and it was the combination that people didn't accept that was really confusing. Folks, if you don't realize that it's not actually Romanian geometry because you have a sign difference and it's really a different subject and it's the subject, this is a somewhat complicated answer to your question. I'm afraid that the answer to your question is whether this topic is when you take geometry, which is in um Romanian geometry, which is curved space-time, but you use the concept of distance, where distance is actually time and you have these pluses and minuses and which are not all the same sign. And once you get used to it, the kind of geometry you're using or the kind of topology the kind of geometry, when I said topology I mean most of the time you're not looking at Exact Solutions. If you look at the General properties that these solutions must have, you get a feel for this kind of geometry and that's what I suppose I wasn't really the first to do this, there were a few people, but they didn't get very far. And I was able to use theorems in this kind of geometry that hadn't been explored in any deep way before to show how you could prove these singularity theorems in general relativity and it was really a theme that developed from there.
A few years later, I think, maybe |in 1969, you started working with Stephen Hawking to further develop what happens when all the black matter collapses into the singularity of this geometric point in space where the matter is theoretically compressed to an infinite density and zero volume| which sounds, you know it's very hard to imagine how this process started and what was the additive feature, maybe I should clarify the history of um a bit according to the film he said I gave a lecture at King's College about this collapse theorem which I just described black holes and according to the movie Stephen Hawking was there and there were spots coming out of his head or something inspired by the way he was talking, he wasn't really there I wasn't very proud of this opportunity because **John Singh** was an Irish relatively relativist who had two books that were written from a geometric point of view, so I really liked his books and I was very glad he was there, but Dennis Sharma heard about my lecture. Dennis Sharma was in Cambridge and he had his group there and he asked um if I would repeat my lecture at King's College Cambridge and Stephen Hawking was there and not only that, but after the talk I gave to Stephen and **George Ellis**, maybe **To Brandon**, I had a private session. Carter I don't think he's not sure he was there but there certainly was George Ellis and he and Stephen were working on certain theorems but they realized that these techniques I was using were something that could be triggered another attack. Stephen was pretty quick to pick up on the arguments I was using and apply them to a cosmological situation in a somewhat limited sense, but it was a good argument and then he kind of took it off, took off on his own, you can see (and feel) that Roger angry, he blames Stephen for taking something from him and at that time he developed these techniques. I was interested in other things that I kept in touch with Stephen, but I didn't do much with them
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(05)- him except towards the end there was a series of talks that I gave in Seattle they were John Wheeler and Cecile DeWitt had organized a series of talks there and I had to give a series of 12 lectures they got a lot of collection of mathematicians and physicists together these were called the Battelle ROM contra and I remember wasting a lot of time on one area and I'd only left three lectures for my theorems and and talking about the singularities and black holes in the song so the first talk I actually talked about the trial Shield Singularity case then the second talk so these are the three talks for the end I gave I think it was I think 12 lectures I can't even remember whether it was 12 or 24 quite a lot of lectures and uh only right at the end did I leave myself enough time to give these three talks one was on the short-term solution one was on my Singularity theorem which I've just talked about and the final one was all on on Stephen's theorem she's had several different films published articles in the world society and I had to get this talk the next day and I hadn't left myself and not enough time
so what on Earth do I do so I spent most of the night trying to work out one theorem which encompassed all the results that Stephen had which I finally did I gave this talk and when I got back to England I phoned up Stephen I said look I've got this new theorem which I could and he said yes so have I so he's actually found it independently and then we wrote a paper together which was the two papers with one for the gravity prize which we've got second prize the other one was we wrote for the Royal Society we wrote a long detailed paper so that was the only real collaboration we had Roger Looking Back Now from the perspective of 2022 a couple years after you're a Nobel for this uh how has the argument uh stood up uh and what kind of nuances or improvements do you see in our understanding after so many years yes well as as I said Stephen picked up on the cosmology end of the arguments showing that the singularities were generic also in that situation however I was always very troubled by the although you see the singularity in the Big Bang is in the past and the ones in the gravitational collapse the black holes is in the future and you just have one way or the other but when you look at the details of these things it's extremely different that is to say the singularities in black holes were utterly different from the one in the Big Bang and I don't think people have really even now faced up to this it was a thing that troubled me very greatly it's all Hub tied up with the second law of thermodynamics but it almost is the second law of Thermodynamics and I remember giving a talk in Caltech where um I think Feynman was there and I described this big puzzle you see when you see the earliest what's the earliest evidence we see of the Big Bang there's this thing called the microwave background you see this radiation coming from the the big bang it's the clearest evidence that there was a big bang is the micro background but this microwave background one of the most uh the earliest observation of this thing was that it had this called a plank Spectrum what that means is that you're looking at the very most random thing you possibly could so you're looking at photons coming from this very very early stage and it is random as it possibly could be now what does the second law of Thermodynamics tell you it says things get more and more random as time goes on so when you go to see the earliest thing you've ever seen and you find it's the most random thing you've ever seen how can it get more random to me this was a great great puzzle um fundamental difficulty about the whole situation you're seeing the most random thing in the universe people say oh well the universe is expanding it but you think about

it at the door that's not the answer it certainly isn't the answer what is the answer the answer is that what you're seeing in the microwave background is basically photons and matter in its most random state there is something else that you're seeing that is its uniformity over the sky now it's uniformity over the sky you might say that's also random as far as matter and radiation is concerned yes it is but how about gravity gravity behaves in a very different way you can think of this in terms of stars and galaxies and they sort of pump together and they perform black holes and the entropy is going up and up and up and up so as the thing entropy goes up as far as gravity is concerned the thing is getting much less uniform so the uniformity in the sky is telling you that gravity the gravitational degrees of freedom were simply not activated so in the very early Universe you have this extraordinary puzzle that whereas everything else is as random as it could be seemingly gravity was not it was not taking part in this Randomness it was aloof from it all it's very different you have to have a theory which ……………………………………………………………………………………………………..

(05)- he except that towards the end there was a series of lectures that I gave in Seattle, it was **John Wheeler and Cecile DeWitt** they organized a series of lectures there and I had to give a series of 12 lectures that got a lot of mathematicians and physicists together they were called counter Battelle ROM and I remember wasting a lot of time in one area and only left three lectures on my sentences and talking about singularities and black holes in a song so **first** lecture I actually talked about the Singularity Shield court case, then I talked about the **second** so these are the **three lectures** at the end that I gave I think it was I think 12 lectures I can't even remember if it was 12 or 24 quite a lot of lectures and uh , only at the end I left enough time to give these three lectures, one was on the short-term solution, one was on my singularity theorem that I was just talking about, and the last one was all about Stephen's theorem which had several different movies published articles in the world society and I had to get this lecture the other day and I didn't let myself and I didn't have enough time so what on earth should I do so I spent most of the night trying to come up with one sentence that included all the results that Stephen had, which I ended up doing, I gave this talk and when I got back to England I called Stephen I said look I have this new sentence that I could and he said yes so it found independently, and then we wrote a paper together, which was two papers, one was for the gravity prize, which won second prize, the other was one that we wrote for the Royal Society, we wrote a long detailed paper, so that was the only real the collaboration we've had **Roger Looking Back Now** from the perspective of 2022 a few years after you've won the Nobel Prize for it, how the uh up argument has held up, and what nuances or improvements do you see in our understanding after so many years yes, as I said, Stephen has taken up the cosmological end of the argument showing that singularities were also common in this situation, but I've always been very concerned that although you see the singularity in the Big Bang is in the past and those in gravitational collapse, black holes are in the future and you just have one way or the other but **when you look at the details of these things, it's extremely different, that is, the singularities in black holes were completely different from those in the Big Bang** **The unfortunate Hubble and its unfortunate singularity … quote from another blog** :

If we have the exact value of H_0, we can rewind the history of the universe to the singularity and calculate when the big bang happened. But that's it, the gigantic model error//. Because the expansion will end up in that unfortunate "point" singularity with zero volume, infinite density and all sorts of bad things. Whereas ***unpacking*** *means the unwrapping of 3+3 dimensional space-time (which emerged after the big bang as an extremely curved foam, boiling cauldron, plasma) and not from singularity, but* ***unwrapping from vacuum****, from Planck scales 10^{-40} m, 10^{-32} sec . , and anywhere, that is, the universe is unfolding all around us, on the sidewalk, in the forest, in the gold mines, in the void between the galaxies and even still, at any time, all the time, not just once in the singularity. In the boiling vacuum, in the foam of dimensions, virtuan pairs of particles are born (they are born and immediately annihilate), and apparently dark energy "from Nothing" is also recruited there, and it has the property that it is born so much that the density of this dark energy was constant in time, that is, the crazy, crazy accelerated expansion of the Universe disappears.*

EXPANSION NO ; UNPACKED YES.

http://www.hypothesis-of-universe.com/docs/c/c_053.jpg

...and I don't think people face it even now, it was a thing that worried me a lot, it's all tied up by Hubble **??** with the second law of thermodynamics, but it's almost the second law of thermodynamics, and I remember that I gave a talk at Caltech where, um, I think Feynman **was there** and I described this big puzzle that you see when you see first what is the earliest evidence that we see of the Big Bang is this thing called the microwave background, you see this the radiation coming from the big bang it's the clearest evidence that the big bang happened is the micro background but this microwave background was one of the earliest observations of this thing was it was called the **Plank Spectrum** which means you're looking at the absolutely the most random thing you could, so you're looking at photons coming from this very early stage and it's as random as it could be now. What the second law of thermodynamics tells you is that things get more and more random as time goes on so when you go look at the earliest thing you've ever seen and you find it's the most random thing you've ever seen. It felt more random this was a great big puzzle um the fundamental difficulty of the whole situation you see the most random thing in the universe people say ok the universe is expanding but you think about it at the door that's not the answer it's definitely not the answer what is answer the answer is that what you see in the microwave background is essentially photons and matter in its most random state there is something else you see is its uniformity over the sky now it is uniformity over the sky you could say , that it is also random when it comes to matter and radiation, yes it is, but what about gravity? Gravity behaves in a very different way, you can think of it in terms of stars and galaxies and they kind of pump together and make black holes and the entropy goes up and up and up and up, so as the entropy of things goes up in terms of gravity, matter is much less uniform, so the uniformity in the sky tells you that the gravitational degrees of freedom of gravity just haven't been activated, so in the very early universe you have this extraordinary puzzle that while everything else is as random as it can seem, gravity she did not participate in this randomness, she was far away from it all, very different..,, you must have a theory, yes, gravity is a non-linear state of continuum, from a global point of view, (if we consider the whole universe, it does not have an arbitrary location without gravitational curvature), (gravity is the same "kind of curvature of dimensions" no matter how big the universe is in a given position), whereas the microscopic states of curvature of dimensions are so "swirling, chaotic, foamy" that they demonstrate the state of space-time, i.e. the state of dimensions in a symmetrical linear representation...so even more precisely: the microworld behaves according to the Principle of alternating symmetries with asymmetries, which

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(06)- explains why gravity is so different from everything else in the beginning and my initial reaction to this was okay everything is sort of quantum gravity at the beginning or something like that but it's got to be a very very peculiar kind of quantum gravity in which it's very time asymmetrical with the gravitational degrees of it I used to call it the what I call the vial curvature hypothesis Val w e y l is a great mathematician who understood the general relativity extremely well and the fact that the curvature which describes gravity is a particular kind of curvature it's What's called the conformal curvature or the vile curvature and what you see is that kind of curvature was not activated in the early universe and why was that if it was just quantum gravity why isn't that a symmetrical theory in time so I had this view for quite a long time which is okay yeah it's quantum gravity but it's a very very peculiar kind of quantum gravity it's nothing like any kind of quantum mechanics we've ever seen and if you're just trying to quantize gravity you're not going to get it so that was a view I had I still sort of hold that view but it's not the answer which I would describe I think in the uh maybe in a different way so you you in essence are are challenging the standard model of Lambda cold Arc model for the origin of the universe uh um and you propose a different uh solution conformal cyclic cosmology um how does that work go what are the fundamental differences between the two and what kind of evidence do you believe supports conformal cyclic cosmology it's rather ironic in a way that the term Lambda code dark matter and ⋯CDM called dark matter I'm agreeing with both of those things they're just as a man that is there in the form of a cosmological constant that would imagine about that there is this thing called the cosmological constant which seems to be what's causing the exponential expansion we see for the very very distant things in the universe sure I think that's right Lambda I agree with code Dark Matter sure that's there too but I'm not complaining about the elements of that theory it's just it seems to take people in what I regard as the wrong direction quite understandably because the point of view that I maintain is outrageous and in fact when I used to give talks about it I always do support outrageous apparently as a defense against other people calling it outrageous no no I've already said that you see well as as we say in Consciousness as we say in cosmology the question is not whether it's outrageous the question is is that is it at outrageous enough exactly is that right yes well the argument so yeah the argument is that the Big Bang was not the beginning but you have to take a view which isn't the usual view that people have in general relativity it's not diff the view is a question of emphasis but in some sense the like columns or the null cones are more fundamental than the metric this means that if you like the geometry determined by massless objects or photons things which don't have any Mass is more basic than the geometry where you have distances and times my tends to think of distances and times as the metrical structure but think of that as a secondary notion and it's quite a useful way of thinking about it because the metric is a quantity which has 10 numbers to Define it per point so at every point of space-time we have four dimensions of space-time at every point you have four number which tells you what the metric is that's the use of the young expression which says the S squared equals and it's that's the metric and it has 10 numbers to Define now nine of those numbers Define the just where the light cone is and when sn9 I really mean the independent ratios of those 10 numbers the independent ratios I don't I'm not interested in overall scaling I'm just interested in independent ratios of those 10 numbers which are nine independent ratios that tells you the like current or the null cone it tells you how photons go so you they in space time you have this current thing and you have a history of a photon it goes along with these cones it's the way life behaves if you have anything else which had no Mass it would just respect those cones it would not be interested in anything else when I say anything else what's the tenth component the tenth component is determined by Mass and that is to the two most fundamental equations of 20th century physics one of them just crept into the 20th century one of them of course is Einstein's E equals MC squared C is just a constant so it tells you energy that's the E and M that's the M energy and mass are equivalent and in Mass are equivalent that's E equals m z squared so you just tells you the relationship between the two

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(06)- explains why gravity is at the beginning so different from everything else after the big bang, the state of space-time is foamy, i.e. all dimensions are in the "foamy" curvature (and this is how the state of np is in equilibrium). "Simultaneously, concurrently" coexists with this "foamy" (chaotic) state and "the state of such other curvatures of dimensions", which will have the >nature< that we call *gravity*. So the state of gravity is a non-chaotic curvature, a mild curvature that "floats" on a "foamy" state of dimensions. So we have here >two states< of specific curvature. But the universe builds the "third state of curvature" in such a way that in the foam of dimensions, the boiling foam, it will pack, roll dimensions into "packages" so that they will "grow into each other" ||I don't know how to say it by choosing even better words| | and these packages will be elementary particles with "matter-like" properties and behavior. So : The universe after the big bang "original 3+3 space-time" warps (foam = plasma). And this foam will

a) unwrap (into the curvature of gravity) a

b) pack into the curvatures of the three states of behavior = physical field, a

c) package in the third type of "packing-packing": balls, they will be packages of dimensions... a set of elements - particles for interaction behavior will be created and that will be matter. Space-time in this Being, "portioned into states" will not be "alone". There will be a second sequence of something that will be called: laws, rules, orders, principles, etc.** and my initial reaction to that was fine, in the beginning everything is -something like- quantum gravity or something like that, but it must be a very special

kind of quantum gravity in which it is very asymmetric in time with its gravity degrees. I don't like "quantized" gravity. Quantization of dimensions that are already curved before starting to cut with the machete, so that with the machete we make "on dimension = from dimension" corners (intervals of length + intervals of time) and then put these intervals together so that the result is a linear straight line, the dimension is not curved..., like that the intention of the physicists I don't know what good it is. I was saying what I call **Val Weyli's** bottle curvature hypothesis, he is a great mathematician who understood general relativity extremely well and the fact that the curvature that describes gravity is a special kind of curvature O.K. According to me it is a parabola... it is What is called conformal curvature or nasty curvature and what you see is that this kind of curvature was not activated in the early universe and why was it when it was just quantum gravity why is it not a symmetric theory because the parabola is not linear in time so I've had this view for quite a long time, which is fine, yes, it's quantum gravity, but it's a very special kind of quantum gravity, it's nothing like any kind of quantum mechanics we've ever seen, and if you're just trying to quantize gravity, cut a parabola into infinitesimal line segments ...(!?) I don't get it, (!?) , so that was the view I had, **still i hold this view** but it's not the answer i would describe http://www.hypothesis-of-universe.com/index.php?nav=f i think uh maybe in a different way so you basically you question the standard cold arc model Lambda model for the origin of the universe into the state, **a)** into a variant of the global macrostructure with a small curvature parabolic...and **b)** into the second state of the microuniverse with "boiling linearity of the dimensional structure " - I hope you understand what I mean.
hm hm and you propose another solution ||conformal cyclic cosmology|| hm how does it work what are the basic differences between the two and what evidence do you think supports conformal cyclic cosmology it is rather ironic that the term Lambda code dark matter and ···CDM called dark matter. I agree with both of those things, they are just like a person who is there in the form of a cosmological constant that would imagine about it there is this thing called a cosmological constant that seems to cause **exponential expansion**, I'm against ! that we see in very very distant things in space. I definitely think it's right Lambda I agree with the Dark Matter code, sure it's there too, but I'm not complaining As for the elements of that theory, it seems to be leading people in what I think is the wrong direction, quite understandably, because the opinion I hold is outrageous and sometimes leads to a mental hospital and in fact when I've talked about it I always openly support outrageous as a defense against other people calling it outrageous no no no more i said you see well, as we say in Consciousness, as we say in cosmology, the question is not whether it's outrageous, the question is whether it's outrageous enough exactly that right: yes ok argument so yes the argument is that the big bang was not the beginning, it was not the beginning of all Being, but it was the beginning of **"our universe**, our state of spacetime" after the big-bang but you have to take a view that is not the usual view that people have in general relativity, there is no difference, perspective is a matter of emphasis, but in some sense similar columns or zero cones are more fundamental than metrics, that is, if you like geometry determined by massless objects or photons, things that have no mass are more fundamental than geometry where you have distances and times. Well, um... I tend to think of distances and times as a metric structure, but I think of it as a secondary concept, and it's a pretty

useful way to think about it because a metric is a quantity that has 10 of numbers that define it per point, so at each point in spacetime we have four dimensions of spacetime well, um… at each point you have four numbers that tell you what the metric is, that's to use a young expression that says , that S squared equals and that's a metric and has 10 numbers to define now nine of those numbers. Define where the light cone is and when sn9 I really mean the independent ratios of these 10 numbers independent ratios I don't care about the overall scaling I only care about the independent ratios of those 10 numbers which is nine independent ratios **???** which will tell you similar the current or the null cone tells you how the photons move so you they in spacetime have this current thing and you have the history of the photon it goes along with these cones is how life behaves if you had anything else that didn't have mass it would just respect those cones, he wouldn't care about anything else if I say anything else, what is the tenth component, the tenth component is determined by the mass and that's the two most basic equations of physics 20. century one of them just crept into the 20th century one of them is of course Einstein's E is equal to MC squared C is just a constant so it tells you energy which is E and M which is M energy and mass are equivalent and in Mass they're equivalent, that's E is equal to m z squared, so it just tells you the relationship between the two

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(07)- what did Max Planck tell us earlier than Einstein he told us E equals H Nu or HF people Nu or F is a frequency H is a just a constant like it's like C what's the time energy and frequency are equivalent energy and frequency okay put the two together energy and mass equivalent engine frequency equivalent mass and frequency are equivalent so if you have a massive body it is a clock it has a tick ratio just by virtue of its mass it's a very high frequency so you can't directly use the mass of a particle as a clock but in a sense people do they turn this sort of gear it down by tricky ways of doing it and you gear it down and you make Atomic or nuclear clocks so that's the origin of a very robust nature of these Atomic and nuclear clocks but it comes down to the fact that Mass is where you get the one extra thing the scale comes from Mass okay we turn this around what happens in the very remote future I'll simplify the picture a bit to say well it's pretty well just photons most of the particles running around our photons if it was just photons you wouldn't have any Mass photons don't have mass they don't even know anything parts of the light cones so you have what's called conformal geometry you don't have the full 10 components you have nine you have the nine which tell you where the null currents are what about the Big Bang the story is even actually clearer there when you get the further into the big bang you get the hotter and hotter the more the possibles are racing around the rich light speeds they have a mass but the mass contribution is almost entirely through their motion the mass the rest mass of those particles when you get right into the Big Bang it is pretty well irrelevant they are pretty well massless so their masses for a different reason but at the two ends of the universe the big bang and the remote future you have the geometry of conformal geometry it's the geometry where scale has got lost and so it's not so outrageous to say and this is where I am being outrageous but it's not so outrageous to say that the Big Bang stretches out the remote future squash it down when I say stretch and squash are not

affecting the conformal geometry it's very useful to have those Azure pictures so-called Circle limits and you can see these fish or these angels and Devils as they get close to the boundary they get seemed to get smaller and smaller but as far as they're concerned they're the same size as the ones in the middle so you can represent infinity Infinity can be represented as a nice boundary that's one trick the other trick is stretching out the big bang that again can be represented in a nice boundary it was my then student Paul Todd who rather suggested rather than saying the vial curvature is zero which is meant as I said which isn't very useful so the Big Bang is stretchable out and it can can be continued okay that's a big constraint on the Big Bang what happens he doesn't say it has anything it's just a beginning but stretched I'm saying it's the same as a remote future of a previous Eon so I'm saying that our Eon began with our big bang stretched out so it's a nice smooth surface when you stretch it out now all the physics gets nice and conformal because temperature gets so big and you can stretch it out and if it makes sense the remote future you squash it down and that makes sense and the outrageous idea is that our big bang is the conformal continuation of somebody else's remote because it was an eon prior to ours and its remote future became our big bang now you need some equations to describe that sort of thing and I also for quite a long time thought well I can go on lecturing about this forever because nobody will ever prove me wrong I got an idea I could prove myself wrong which was signals of certain type can get crossed the main important signals which could get across would be gravitational wave signals so gravitational waves could in principle get across from one Eon to the next do we see any evidence for such things well I did a long story there because I there were various people who started to look for these things and then they got discouraged my Armenian colleague um we got more serious into this some Polish colleagues also headed by Christophe Meisner um Pavel nurovski and then later on Daniel and got involved and independently we and they analyze signals in the microwave background which seemed to indicate the presence of black hole collisions so this would be super massive black holes you're thinking about Galactic clusters and we know in our galaxy we have a supermassive black hole as it time goes on it will swallow more and more stars in the galaxy I guess different galaxies will
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(07)- what Max Planck told us before Einstein told us E equals H Nu or HF. people Nu or F is frequency H is just a constant like C what is time energy and frequency are equivalent energy and frequency ok put the two together energy equivalent and motor mass frequency equivalent mass and frequency are equivalent so if you have a massive body, it's a clock that has a ticking ratio just because of its mass, it's a very high frequency, so you can't directly use the mass of a particle as a clock, ?? strange talk… but in a sense people reduce this kind of transmission in complex ways and you reduce it and make an atomic or nuclear clock, so that's the origin of the very robust nature of these atomic and nuclear clocks, but the point is that mass is where you get the only extra thing, the scale comes from mass okay, let's turn it around what happens in the very distant future, I'm going to simplify the picture a bit to say well, it's pretty good, just photons, most particles orbiting our photons, if it was just photons you would have no mass; photons have no mass, they don't even know anything about the parts of light cones, photons are perhaps the only particle that has no mass, i.e. non-zero mass so you

have what is called conformal geometry you don't have the full 10 components, you have nine, you have nine, which tell you where the zero currents are, what about the big bang, the story is actually even clearer as you get further into the big bang, the hotter and hotter the more possible they are hurtling around at rich light speeds that have mass but post of matter is almost entirely through their motion the mass of the rest of the mass of these particles when you get right into the big bang is pretty irrelevant they are pretty well massless so their mass for another reason but at the two ends of the universe the big bang and the distant future , you have the geometry of conformal geometry, it's a geometry where the scale is lost so it's not so outrageous to say and this is where I'm outrageous but it's not so outrageous to say that the big bang stretches the far future, squeeze it when I say , that stretching and squashing don't affect the conformal geometry, it's very useful to have those cyan images, the so-called Circle limits, and you can see these fish or these angels and devils as they approach the limit they get, they seemed to get smaller and smaller, but as for them, they are the same size as the ones in the middle, so you can represent them ad infinitum. Infinity can be represented as a nice boundary, which is one trick, the other trick is to stretch the big bang, which again can be represented in a nice boundary, it was my student at the time, Paul Todd, who suggested rather than saying that the curvature of the bottle is zero, which is i meant like i said which is not very helpful so big bang is expandable and can be continued well that's a big limitation of big bang what happens it doesn't say it has something it's just a start but stretched out I'm saying it's the same as the far future of the previous Eon so I'm saying our Eon started with our big bang stretched out so it's a pretty smooth surface, when
you stretch it, now all physics becomes nicer and conformal because the temperature increases so big and you can stretch it and if it makes sense in the far future, squeeze it and it makes sense and the outrageous idea is that our big bang is a conformal continuation distant from someone else because it was an eon before ours and its distant future became our big bang now you need some equations to describe such things and for quite a while I thought I could go on and on about this too, because no one will ever prove me wrong. I have an idea that I could prove. I was badly mistaken, which were signals of a certain type that could be crossed with major important signals that could propagate, would be gravitational wave signals so gravitational waves could in principle get across from one Eon to another we see some evidence for such things well i made a long story because there were different people who started looking for those things and then it discouraged them, my Armenian colleague hm, we started to deal with it more seriously some Polish colleagues also led by **Christoph Meisner** um **Pavle Nurovski** and later **Daniel** and got involved and independently we and they analyze blah-blah signals in the microwave background that seemed to indicate the presence of black hole collisions so they would be supermassive black holes, you think about galactic clusters and we know we have a supermassive black hole in our galaxy . Blah-blah Time goes on, it will absorb more and more stars in the galaxy, I think there will be different galaxies

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(08)- collide their black holes with congeal yeah Andromeda one is much bigger than ours it'll swallows out from in one belt take a few thousand million years while we would do it but never mind uh one dog but when it does this there will be a great burst of gravitational waves going out those gravitational waves go out and out and out and out they will meet the crossover surface go through it and produce a signal on the other side which you might possibly see the argument is that we see them and this is very controversial many people believe that you can't possibly see these things it must be a mistake very good we've had this going on forever the latest paper we have in the monthly notices of the Royal Astronomical studies on a different effect this is what we call Hawking points and we see them with a very very strong signal describe the Hawking points well what happens to a galactic cluster you see our Galactic plastic and there's not a very large number of galaxies they run into each other their black holes will congeal and they'll settle down with one black hole stacked up and down stars and most of the cluster will get swallowed in one super duper black hole there are a lot bigger clusters around and they will produce black holes now what happens to those black holes according to Stephen Hawking and I agree with him these black holes will radiate energy they won't that won't happen for an awful long time because the temperature of the universe as a whole is much bigger than the temperature of the Hawking evaporation you have to wait till the radiation goes down and down and down and down you have to wait something like 10 to 100 years the blue goal years one followed by 100 zeros another three years something of that sort of order before the black holes start to radiate away the temperature of the universe gets low enough that the black holes have become the hottest things around then they evaporate away all that evaporation and you look at the conformal picture and you see what happens here it gets you think it may be spread out for ages and ages over the universe but in the conformal picture you think of the Escher annual levels they get squashed into a tiny little point that tiny little Point comes through and you can bear our theorems which tell you that all the energy in that Galactic cluster does not get lost it has to be there in the next eon so what happens though the energy has to be there it pours through in one tiny little point what happens to that time is it a point it spreads out for 380 000 years the the photons can't get out they just scatter us they scatter scatter scatter until 380 000 years it gets cold enough that the photons get out and then you see them and you see spots in the sky which would have a radius of something like well there's some little bit of argument about this about five to eight times the damage of the moon what we actually see is eight times the diameter of the Moon and those we claim are these spots walking points or walking spots the points are there is little individual points as they come through the spots are what you see which are eight times the diary of the Moon they are seen with a confidence level of 99.98 so this very strong signal where are they exactly well you can see pick out the strongest ones the five Strongest Ones in the for the satellite that we mainly use is the Planck satellite you go back to the older satellite the W map satellite and you find those five points are also there at exactly the same places in that other satellite data there's a sixth one in the W map data go back look at the plant data it's there too so I would say those six points are probably genuine Hawking points those are at a very challenging position you've said it and it's certainly very controversial not a lot of people agree with the data analysis but it's it's there for everybody to to evaluate what I'd like to understand though is in that transition where uh the end of one Epoch or a aeon then conformally looks the same with with a with a scale change to to go to the big bang of the next what what is the trigger point for that is there a is is it a critical mass of something or what what is the the the event that causes that transition to be made well you see it's not really an event because it's Infinity if you like and then Infinity isn't much of an event you see it's it's it's it becomes the physics becomes a I mean I think particle physics also has to be accommodated in some way to make it more conformal I I I'm not a part of confidence physicist so I can't really argue on this when things get extremely cold there are certain things which it's like to look rather like when it's extremely hot and there are things like conformal theories which start to address these issues I think particle physics has to be developed to accommodate this it's not right to cause an event I think because it's it's just that

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(08)- they will collide their black holes solidify yes andromeda one is much bigger than ours it will swallow it from one belt it will take several thousand million years while we would but never mind uh one dog but when it does there will be a big explosion of gravitational waves coming out, those gravitational waves come out and come out and come out and come out, meet the crossing surface, go through it and create a signal on the other side, which you can see the argument is that we see them and this is very controversial, many people believe that you can't see these things it must be a bug very well we have it forever the latest paper we have in the monthly notices of the Royal Astronomical Studies about another effect we call hawking points and we see them with a very strong signal well describe the hawking points what happens to the galactic cluster you see our Galactic Plastic and there aren't very many galaxies that collide with each other this passage of crap is uninteresting to my new vision of the universe… their black holes solidify and settle with one black hole stacked up and down with stars and most of the cluster will be absorbed by one super duper black hole there are much bigger clumps around and they will produce black holes what will happen to those black holes according to Stephen Hawking and I agree with him these black holes will emit energy they won't happen for a terribly long time because the temperature of the universe as a whole is much greater than the hawking evaporation temperature you have to wait for the radiation to go down and down and down and down you have to wait something like 10 to 100 years blue target year one followed by 100 zeros another three years something like that before the black holes start
radiate away the temperature of the universe cools down enough that the black holes became the hottest things around, then all that evaporation evaporates away and you look at the conformal picture and you see what's going on here, you think it might be spread out for eons and ages over the universe, but in a conformal picture, as you think of Escher's annual levels, they get squeezed into a tiny tiny point that a tiny tiny point goes through, and you can bear our theorems that tell you that all the energy in this galaxy cluster doesn't get out. Lost, it has to be there in the next aeon, so what happens, even if the energy has to be there, it flows through in one tiny little point, this passage of crap is uninteresting to my new vision of the universe… what happens to that time , it's a point that expands to 380,000 years, erm..err…I don't like points that "give birth" to more points that photons can't fall out, they just scatter us scatter scatter scatter up to 380,000 years will cool enough for the photons to get out and then you'll see them and you'll see spots in the sky that would have a radius of something like well there's a bit of an argument about that about five to eight times the damage to the moon what we're

actually seeing is eight times larger than the diameter of the moon and those that we claim are these points walking points or walking points the points are small individual points when they pass through the spots are what you see which is eight times larger than the log of the moon are seen with a confidence level of 99 .98, so this very strong signal, where they are exactly well, you can see pick the strongest, the five strongest in for the satellite that we mainly use the Planck satellite, you go back to the older satellite satellite on the W map and you find that
the five points are also in the exact same places in other satellite data the sixth is in the W map data go back look at the race data it is there too so I would say this passage is uninteresting to my new vision of the universe… that those six points are probably the real hawking points, which are in a very challenging position, as you said, and it's certainly very controversial, few people agree with the analysis of the data, but it's there for everyone to evaluate, what I would like to understand, it's in that transition where the end of one epoch or aeon then conformably looks the same with and with the scaling to go to the big bang the next what what is the trigger point for that is there and it's a critical mass of something or what is that event that causes that that transition is well done you see it's not really an event because it's infinity if you will and then it's infinity It's not much of an event you see it's what becomes of physics I think I think that particle physics must also be accommodated in some way, that **how** is the universe supposed to accommodate human inventions ??? to be more conformal. "I'm not part of the self-confident physicist, so I can". I don't really argue that when things get extremely cold, there are certain things that it looks like when it gets extremely hot, and there are things like conformal theory that start to address these issues. I think particle physics must be developed to accommodate this. ?? I don't think it's right to cause an event because it just is.. this passage of crap is uninteresting to my new vision of the universe…
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(09)- it sort of merges into the other and the physics becomes not interested in in the scale anymore it becomes interested in conformal structure so what I'm looking for is is is what makes that transition where the physics is not interested in the scale that that's the key phrase what causes that transition well I think it's two different things one in the remote future one in in the remote well here's a big bang the remote future has got to be something like Mass Fade Out you see I can't say this without being a little technical but you see they are in in particle physics there's the first thing you ever do which is to look for the Casimir operators of the pancre group now that's technical jargon but the thing is that when you have a cosmological constant this is this Lambda term that in Einstein introduced for the wrong reason he wanted a static universe but it seems to be there it seems to be what's causing this exponential expansion I mean there may be some other reason for that which people argue for I go for the Einstein cosmological constant but when you have that your physics really changes and it's not the conquerade group anymore it's the decita group now this makes subtle differences which people totally ignore when they look at particle physics but when you see this Lambda term is in there it changes what the fundamental things are in physics and mass Fades out as being one of the fundamental things it's a more subtle thing and so that mass is allowed not to be a constant now when this becomes important in the remote future there probably is a time and probably something like 10 to 100 years or something I don't even know

there's probably an earlier time where it's important where the dark matter you see there's a question about dark matter dark matter has to be present in this scheme but we haven't emphasized that much but the equations don't work unless you have a dark material which basically is what holds the universe together and I claim this is the what dark matter is and it's a it's a scalar material and it has to Decay after a certain length of time probably about 10 to the 11 years which is a little bit longer than the whole length of time up to now so it's about 10 times as long as that so in that kind of length of time this dark matter will have started well that that's a sort of Half-Life that's when half of it will have gone so it's already started to Decay so there's less of it now than there would have been in the very earliest observations of dark matter so there are lots of observational seat features which I think people should explore do we see evidence for Dark Matter fading out it could relate to these curious discrepancies between the measurements of the Hubble constant there are two quite different values that people come through in the expansion rate of the universe this could be the result of a change in the dark matter content it's anyway I I love your challenging of current belief uh that that's terrific even if it's not right it it forces us to think hard about what what our data is and what and what the theories are Roger I'd like to conclude with your interpretation of the relationship between quantum mechanics and general relativity the Quest for quantum gravity which in today's world has some very um organized schools and string theory Loop quantum gravity Etc uh I think you take an orthogonal approach to to all of it and have have a very different way of thinking yes now I take a very different View you see when people talk about quantum gravity they tend to mean what happens is very very very tiny distances and very very huge Energies now that's a reasonable question and when you're talking about the singularities in black holes that's sort of where you're driven say okay the curvatures get bigger and bigger which means the radius of curvature gets smaller and smaller and when it comes that comes down to something like whatever it is 20 orders the magnitude smaller than the radius of a proton I don't know figures but when you're looking at something like that do we not have to change our physics and to have a quantum gravity Theory very likely I'm not complaining about that well I'm complaining about it it's the wrong place to look when I say it's the wrong place to look it's because there's a much better place to look than that place that place to look is not a place where we see any positive indication of experimental well I mean maybe there's some wild ideas that people have but you you people tend to talk in terms of accelerators we're so they're so enormous that they'd have to be the size of the solar system or something like that you can't have it with present-day accelerated to get anything like the energy that you would need here okay that may be true Maybe whatever but it's not interesting and that's where all the string
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(09)- it kind of merges into the other and physics stops caring about scale, it becomes concerned about conformal structure, so what I'm looking for is what makes that transition where physics doesn't care about scales, that's the key phrase, what causes that transition. Well I think they're two different things one in the far future one in the far well here's a big bang the far future must be something like Mass Fade Out see I can't say it without being a little technical but you see they're in particle physics, the first thing you ever do is look for Casimir operators of the pancreas group, that's technical jargon, but the thing is, when you have a cosmological constant this is this lambda term that Einstein introduced for the wrong reason, he wanted a static universe, but it seems that there is, it seems, that's what's causing this exponential expansion, I don't think so. There is no justification for exponential expansion..., what should it be? I think there may be some other reason for it, yes, well, a different reason than what is being argued "for" today **for** which people they argue. Einstein's cosmological constant, but when you have that your physics is really changing and it's no longer a conqueror group, it's a decita group, now it makes subtle differences that people completely ignore when they look at particle physics, but when you see this term Lambda , there it changes what the basic things in physics and matter are, it fades out as one of the basic things, it's a subtler thing, and so matter is allowed to not be constant, ?? Again, there is the problem of Penrose not distinguishing **mass from mass**. I wonder : should mass or weight be constant? what did Roger mean ??? http://www.hypothesis-of-universe.com/docs/c/c_076.jpg ; when it becomes important in the distant future, probably there is a time and probably something like 10 to 100 years or something i don't even know, there is probably an earlier time that matters where the dark matter you see, but you see the butt in this scheme there has to be dark matter present, no...but we didn't emphasize that much, but the equations don't work unless you have dark matter that basically holds the universe together, and I'm arguing that this is dark matter and it's scalar material and after a certain length time has to decay. What is this term? What does "time decay" mean?? After all, time can NEVER disintegrate, because it is a universe-creating quantity. Time, of course, as the passage of time, the passage of time, i.e. the continuous cutting of intervals on the time dimension, that is something else..., distinguish between the "quantity" TIME and >time< as the passage of intervals on the dimension probably about 10 to 11 years, which is a little bit longer than the whole time so far, so it's about 10 times as long, so for such a time, yes, "time" makes sense as a "sum of intervals" which is compared in another time as another sum of time intervals. Damn, when will this stewing of terms stop... http://www.hypothesis-of-universe.com/docs/c/c_041.jpg ; http://www.hypothesis-of-universe.com/docs/c/c_052.jpg this dark matter started well, it's kind of a half-life where half of it goes away, so it's already started to decay, so there's less of it now than there would have been in the earliest observations of dark matter, so there are many features of the observations that i think we humans should investigate we will see evidence that dark matter is disappearing it could be related to these strange discrepancies between the measurements of the Hubble constant there are two completely different values that humans are going through in the expansion rate of the universe it could be a result of a change in dark matter content is anyway. I love your challenge of the current belief uh that's amazing even if it's not right it makes us think hard about what our data is and what and what are the theories Roger. I would like to conclude with your interpretation of the relationship between quantum mechanics and general relativity ||Search **quantum gravity** which has several very organized schools in the world today and **string theory, Loop quantum gravity** etc, uh I think you approach it all orthogonally and have a very different way of thinking yeah I have a very different view now which you see when people talk about quantum gravity they tend to mean what happens is very very very small distances and very very huge energy, so :

$E/x = m \cdot c^2 / x$ ..., □/0 = □ . 1/0 , ??. now that's a reasonable question and when you're talking about singularities in black holes that are somehow controlled, say well, the curvatures of the dimensions get bigger and bigger, which means the radius of curvature of the length dimension gets smaller and smaller, I get that, but I don't understand "what is it about"?.., about the singularity ?..?, in which 10^{56} kg of matter-mass "settled" ???, ahem and when it comes to something similar, ? ?? it's 20 orders of magnitude smaller than the radius of a proton, I don't know the numbers, but when you're looking at something like that, we don't need to change our physics and have quantum gravity. Theory very likely I'm not complaining about it well complaining about it it's a bad place to look when I say it's a bad place to look it's because there's a much better place ***to look***
, than the place, ***where to look***,
not where we see any positive signs of an experimental well, i mean maybe people have some wild ideas, but you people tend to talk about accelerators, we are, so they're so huge they'd have to be the size of the solar system or something, what is being solved in accelerators today?? We already have the Higgs boson, fusion is not solved in accelerators, so what are physicists doing at CERN???, what are they looking for? A source of new energy? Basically how? They put more energy into the "gadget" than they then get out of it...yeah ?? you can't have that with acceleration now to gain something like the energy you would need here, well that might be true. Maybe anything, but it's not interesting and that's the place
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(10)- theorists are going and so on a light string theory when I first heard about it because I thought the idea was a pretty one what I didn't like is when people then got driven off to consider first of all 26 dimensional space time and then 10 and then 26 and 10 at the same time or 11 and various things like that which all seemed to me going in the wrong direction we've got four dimensions and we have to understand those four dimensions yeah to curl them up into tiny little balls is not an answer and it has a lot of problems and I don't think any of these problems have been faced up too properly so therefore what what direction would you have people look at it's really the very opposite direction it's not the effects of the quantum mechanics might indeed have on the structure of gender relativity or instructive space-time but what affects general relativity it might have on the structure of quantum mechanics now the trouble here is that people turn a blind eye to the real problem in quantum mechanics quantum mechanics as it exists at the moment isn't self-inconsistent Theory now most of the big physicists who complained about quantum mechanics like Einstein and schroding earned and Iraq surprisingly enough weren't so rude as I'm being they say it's incomplete okay that's a nicer way of saying it quantum mechanics is incomplete it's not just as inconsistent but schroding was well aware of this that's why he introduced his cat I mean he introduced this idea you could imagine an experiment where you could put a cat into a state where it was dead in line at the same time shirting was not saying okay well we could make a sure a cat which is then alive at the same time maybe somebody will do this one day what he was saying is look this is ridiculous and that's the point of view he was making Einstein picked up on that view very much himself both of them held that same view also Dirac rather surprisingly he very rarely actually said what he really thought you could have to find the right place for the right quote but you see direct said quantum mechanics is a provisional Theory and it's for this reason the collapse of the you see let me put it in there more direct terms you see the Schrodinger equation tells you how the quantum State evolves the there is a thing called the quantum State it's what in quantum mechanics how you describe a system there are lots of different ways of doing it but you can do it trading this way and it's like saying you've got a wave function okay that's the quantum State now Schrodinger's equation tells you how that Quantum State evolves with time if there's this equation that tells you d by d t equals something very clear thing that state chabs along and does something however it doesn't because when it gets too big or too something something else happens the wave function collapses usually you talk about making a measurement on the system you say that the schroding is state only tells you the results of measurements what are the measurements well you say you wheel out of the cupboard this the measuring machine this measuring machine measures something doesn't there's a dial or a blip or a ping or something or other it does something that you hear it's measured it reel it back into the cupboard and forget about it that measuring device was made out of the same stuff of everything else why does it not evolve according to the Schrodinger equation it doesn't say ping or not ping it says ping and not ping at the same time the schroding his cat dead and alive or not at the same time that's what this Schrodinger equation tells you Schrodinger when he's describing his cat he's saying my equation is telling you a lot of nonsense it's telling you that you can have cats that are dead and alive at the same time something else is involved in quantum mechanics now you see that huge bodies of theorists philosophers physicists goodness what all over the world having different views about how to get around this problem very few of them actually say you've got to change quantum mechanics I'm one of those very few very few of those say you've got to change it because when you bring it because it's bringing gravity into the picture that's not that's even still a minority with a minority I'm part of that Minority within a minority I'm saying yes it's when you bring gravity in that's where you've got to change the theory there's even a minority within the minority of that Minority which is which ways we do it but let's not very into that but I'm happy talking to my other minority friends who who have views of this sort but the view is that there is a conflict and I this is a series it's not just a view it's a calculation you can see there is a conflict between the two basic principles one of general relativity and the other of quantum mechanics the basic principle of quantum mechanics I'm talking about is the superposition principle that's the Iraq and the speaker tour you can have a

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(10)- The theorists go and so on, light string theory when I first heard about it because I thought the idea was nice, but I didn't like it when people then let themselves think primarily about 26 dimensional space time and then 10 and then 26 and 10 at the same time or 11 and various similar things, thought interesting, vision and reasoning wrong. Above all, it is - in my opinion - wrong that physicists do not investigate the multidimensionality of time. Why? Why shouldn't it exist, why.? In my opinion, what is needed is to understand n+m dimensional spacetime, at least to explore >why< three length dimensions and three time dimensions they "make up" physical reality and other superstructure dimensions of n-length and m-time are unphysical, ((**I started on the Internet in 2000 and immediately threw myself into layman's debates on the definitions**

of physical terms in 2003 http://www.hypothesis-of-universe.com/docs/aa/aa_006.pdf ; http://www.hypothesis-of-universe.com/docs/aa/aa_019.pdf ; **that is the point from which is to begin the understanding of the world**)),
that is, mathematical dimensions, mathematical entities for building "packages" of matter. I built 25 elementary particles by "wrapping, warping, twisting dimensions", from only 10 length dimensions and 11 time dimensions. Here, for example, a table of all baryons http://www.hypothesis-of-universe.com/docs/ea/ea_006.pdf the formulas do not include indices for types of dimensions, for simplicity. Or another table http://www.hypothesis-of-universe.com/docs/ea/ea_008.pdf ; the reader just has to find it for themselves, http://www.hypothesis-of-universe.com/index.php?nav=e . Then more and more complex matter is just a kind of abstract packaging of elements, for example http://www.hypothesis-of-universe.com/docs/eb/eb_002.pdf ; http://www.hypothesis-of-universe.com/docs/eb/eb_004.pdf and here it is already possible to """"transform"""" the two-variable recording technique into the common contemporary recording technique as we know it with use all the letters **a)** of the Latin alphabet, **b)** of the Arabic alphabet, **c)** of the Greek alphabet and perhaps even a few characters that are not in them. And with the help of these letters it is possible to expres, describe the entire universe, all matter from atoms, through molecules, compounds of chemistry, biology to DNA. The reality and signs of the abstract writing technique, that's it. Reality can also be written using the two characters "**x**" and "**t**". UNDERSTAND IT!!!!! http://www.hypothesis-of-universe.com/index.php?nav=e !!! Every physicist knows and knows what a "binary system" is and can imagine notations of physics and chemistry and biology using this technique, it is complicated but computers can handle it. It is similar with the abstract notation technique that uses n+m dimensions, i.e. n-length and m-time. Only it is difficult for the brain to understand that the 3 dimensions of length are physical and the 3 dimensions of time as well... and that the other dimensions no longer """belong to physics""", i.e. they belong to the reality of Existence for the construction of matter. Why not ?, Why not ?, Why not ?, Why not ?, Why not ? Genesis http://www.hypothesis-of-universe.com/docs/aa/aa_037.pdf ; five realized writing techniques to describe Jsoucna http://www.hypothesis-of-universe.com/docs/aa/aa_112.pdf ; http://www.hypothesis-of-universe.com/docs/c/c_051.jpg which all seemed to go in the wrong direction to me, **we have four dimensions and we need to understand those four dimensions**, **Yes, that's the point !!!** yeah, to curl them into a tiny little ball is not the answer you're wrong and they have a lot of problems and I don't think any of those problems have been solved very well so what direction should people look here for example http://www.hypothesis-of-universe.com/docs /f/f_024.pdf it's really the other way around, it's not that the effects of quantum mechanics could really have on the structure of gender relativity or instructive spacetime, but what effects general relativity could have on the structure of quantum mechanics, the problem is that people turn a blind eye to the real problem in quantum mechanics. Quantum mechanics as it currently exists is not inherently inconsistent. The theory now most of the great physicists who complained about quantum mechanics like Einstein and Schroeding earned and Iraq surprisingly wasn't as rude as I say they say it's incomplete well that's a nicer way to say it quantum mechanics is incomplete isn't it equally inconsistent, but Schroding was well aware of this, so he introduced his cat. the problem is maybe in understanding the

principle of alternating symmetries with asymmetries and also that I mean he presented this idea, you can imagine an experiment where you could put a cat in a state where it was dead in a queue at the same the time the shirt didn't say well well we could provide a cat that is then alive at the same time maybe someone will do it one day what he said is look it's ridiculous and that's the point of view that made Einstein this point of view very well grabbed himself both held the same opinion also dirac quite surprisingly very rarely actually said what he really thought you could find the right place for the right quote but you see the direct said quantum mechanics is a provisional theory
and it's because of this the collapse of what you see let me put it in more direct terms you see the Schrodinger equation tells you how a quantum state evolves there is a thing called a quantum state that's what you describe in quantum mechanics a system , there are many different ways to do it, but you can do it by trading this way and it's like saying you have a wave function, okay, that's a quantum state, now the Schrodinger equation tells you how that quantum state evolves with time , if there's this equation that tells you that ddt is equal to something very clear that the state is bragging and doing something but it doesn't because when it's too big or too much something else happens, the wave function collapses, you're usually talking about taking a measurement on the system you say schroding is a state only it will tell you the results of the measurement what are the measurements well you say you will come out of the cabinet this measuring machine this measuring machine is measuring something there is no dial or vibration or ping or anything else it does something you hear is it measured wind it back in the cabinet and forget the measuring device was made of the same material everything else why doesn't it evolve according to schrodinger the equation doesn't say ping or not ping says ping and not ping at the same time schroding its cat dead and alive or not at the same time it is what this Schrodinger equation tells you Schrodinger when he describes his cat he says my equation tells you a lot of nonsense he tells you that you can have cats that are dead and alive at the same time something else is involved in quantum mechanics now you see that huge bodies of theorists philosophers physicists goodness what have different opinions around the world about how to get around this problem very few of them actually say you have to change quantum mechanics I'm one of the very few very few of them say that you have to change that because if you bring it because it brings gravity to an image that isn't, it's even still a minority with a minority. I am part of that minority within a minority. I say yes, it's when you bring gravity into it, that's where you have to change the theory, inside there's even a minority a minority of that minority, which is how we do it, but we won't go into it too much, but **I like to chat with my other friends of the minority who hold opinions** of this kind, eg. by Heisenberger's uncertainty principle. I think physics lacks a deeper understanding of that indeterminacy ...here was one attempt http://www.hypothesis-of-universe.com/docs/f/f_035.pdf but the opinion is that there is a conflict and I this is a series it's not just a look, it's a calculation, you can see that there is a conflict between two fundamental principles, one from general relativity and the other from quantum mechanics, the fundamental principle of quantum mechanics that I'm talking about is the principle of superposition, which is Iraq and the tour speaker You can have

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(11)- particle here particle here then it could be here and here at the same time any state there could be one thing could be that state then you have states which involve both of them at once that's the principle of superposition very fundamental requirements the principle that's fundamental to general relativity is Galileo's principle of equivalence when I say Galileo he described you know imagine you a big rock and a little drop dropping from the leading Tower Pisa or whatever it might be he knew if you had air resistance it would make a difference says yes you have to get rid of the air resistancy with well aware of that fact when the air resistance is reduced to zero they would drop together we know that this astronaut dropped a feather in Iraq I think wasn't it and they dropped plunk like that sure we know that happens that's the principle underlying Einstein's general theory of relativity what I'm saying is that those two principles are incompatible with each other you could do a little calculation which shows that the two don't stand comfortably with each other something's got to go wrong what it is that goes wrong I don't know it does give you a time scale for how long it takes therefore it to go wrong this time scale was really the same as the ocean one of the people who have a theory of that quantum mechanics has to be modified by doing gravity and this is the ocean he has a an equation for how long it would take for the collapse to take place I didn't know of his theory at that time I produced the same formula so sometimes people call it the dealership Penrose as well he he actually was way before me I think about five years or so way before me I didn't know his formula but then we go off on somewhat different directions with regarding what you do with this formula so so that's an interesting issue but the idea is that you can actually work out if you have a body in the superposition of two places at once how long would it take for it to become one or the other and this equation tells you that it's just that no experiment has actually reached that level as yet so if that could have occur what's the implication of that if that were true that there's a period of time in which they would it would resolve the superposition yes a generalization or a generalization yeah the development of quantum mechanics in which the collapse of the wave function is a real phenomenon I call this objective reduction the collapse is sometimes more political reduction of the quantum State collapse of the wave function or the reduction of the quantum State Center but then I like to use it oh our objectives that objective means objective o r means reduction o r says or it means one or the other you don't get a superposition but in a certain time scale one or the other happens now that would be a physical process that is a perfect transition because next in part three of closer to truth three-part interview with sir Roger Penrose we discuss his unique approach the Consciousness and the new physics including quantum mechanics you can watch more than 20 of Roger's videos on closer truth.com and they're closer to truth YouTube channel thank you Roger thanks everyone for watching my pleasure thank you thank you for watching if you like this video please like and comment below you can support closer to Truth by
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time this is the principle of superposition very fundamental requirements the principle that underlies general relativity is galileo's principle equivalence when I say Galileo described you know imagine a big rock and a small drop falling from the front tower of Pisa or whatever it might be he knew if you had air resistance it would make a difference he says yes you have to get rid of of air resistance well aware of the fact that when air resistance is reduced to zero they would fall together we know this astronaut dropped a feather in Iraq I think it didn't and they fell like this we know for sure it will happen that's the principle which is the basis of Einstein's general theory of relativity what I'm saying is that these two principles are mutually incompatible you can do a little calculation that shows that the two don't sit comfortably together something must go wrong what went wrong I don't know gives you that time scale, how long does it take, so to go wrong that time scale was really the same as the ocean, one of the people who have the theory that quantum mechanics must be adjusted by gravity and this is the ocean, he has an equation for how long it would take for would the collapse happen I didn't know his theory at the time I made the same formula so sometimes people call it the Penrose dealership and he was actually way ahead of me I think about five years ahead of me I didn't know his formula but then we set out in somewhat different directions about what you do with the pattern, so that's an interesting problem, but the idea is that you can actually find out, if you have a body in a superposition of two places at once, how long it would take for it to become one or the other, and this equation tells you that it's just that no experiment has actually reached that level yet, so if it could happen, what does that mean, if it were true, that there's a period of time in which it would resolve superposition yes generalization or generalization yes the development of quantum mechanics in which the collapse of the wave function is a real phenomenon This is what I call objective reduction collapse is sometimes more political reduction of quantum State collapse of wave function or reduction of quantum State Center but then I like to use oh our goals that the goal means target or means reduction or says or it means one or the other, you don't get a superposition, but on some time scale one or the other happens now, which would be a physical process that is a perfect transition because next in the third part of a three-part conversation closer to the truth with sir by Roger Penrose discussing his unique approach to Consciousness and new physics including quantum mechanics you can watch more than 20 of Roger's videos at closer to truth.com and they are closer to the truth youtube channel thank you roger thank you all for watching my pleasure thank you thank you for watching if you like this video please like and comment below you can support closer to the truth by 57:13 subscription
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JN, 14/12/2023 ...opinions...visions... are imperfect, unfinished, and they are there just for thinking, for inspiration on how to improve them and use the improved ones...