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PM - Professor Lisa Randall talks of string theory

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Reporter: Mark Colvin

MARK COLVIN: A hundred years ago, in 1905, Albert Einstein released a series of scientific papers continuing some of his greatest work, including the Special Theory of Relativity.

Nowadays, everyone can tell you Einstein came up with E=mc2, even if they don't know exactly what it implies and many of us rely on systems like GPS navigation, which would be impossible without the Theory of Relativity.

But back then, it was impenetrable to all but a few of Einstein's peers in theoretical physics.

Is there an equivalent today? Some believe there is and it's something called string theory. It argues that there many extra dimensions that we can't see or measure, they may be curled up and unobservably small, or unfurled and vast, extending forever.

The Harvard University physicist, Professor Lisa Randall, is one of the world's leading scientists in the field, and the author of a book about it called *Warped Passages*.

I asked her about the Einstein comparison today.

LISA RANDALL: I don't know that there will have been a eureka moment for string theory in the same way, so that there will be a specific time, but it could well be that some of the ideas of string theory.

It might not be strictly speaking the way we're thinking about it now. I mean, we know string theory is a much broader theory than we originally had thought it was. It has other objects than strings in it. But some of the ideas from string theory are almost inevitably going to filter down I think in to the popular consciousness.

MARK COLVIN: Okay, well if there hadn't been an Einstein, on the upside we wouldn't have had the atom bomb, on the downside, we wouldn't have all those satellites in space. And that all depends on Einstein.

Can you, looking ahead, imagine where string theory would take us in the practical sphere?

LISA RANDALL: No, and I don't think Einstein could've said where his theories would take us in the practical sphere.

He did, however, know that his theories would be testable and string theory can't necessarily make that claim yet. There are ideas within string theory that might be tested, but… So he did realise it had some impact on the world in the sense that they can out and measure the bending of light. But in terms of the fact that the GPS system would rely on General Relativity I don't think he had envisioned technology advancing that far.

And so I have to admit I don't see practical applications of string theory at the moment. I think it is really important in terms of just understanding our world, understanding our place in the universe, understanding what the universe is.

MARK COLVIN: Reading about Einstein recently, one of the things that strikes me is that he wasn't necessarily the world's greatest mathematician, but what he was, was an amazing abstract thinker and that what he got was the concepts. Is it the same with string theory?

LISA RANDALL: There are actually a lot of misconceptions about Einstein and I think it really helps to go back and look at how Einstein thought about things.

When he was young he actually thought about things, that is to say physics, in very physical terms. He had… even if it wasn't necessarily a real experiment he had thought experiments and after all he was working in a patent office, he was thinking about concrete, physical problems.

Later on, when he extended his Special Theory of Relativity to General Relativity, the theory that really includes gravity itself, then he found that despite his best efforts he needed math to do it.

So a lot of people look back and say, "Look, Einstein came up with this theory because of math and it was purely theoretical reasoning," but it really came out of a struggle, a competition between the two.

I think string theory so far has primarily been approached from a mathematical point of view. I mean, what I find interesting about the work that I and others are doing now, is we're trying to take those ideas and approach them from a more physical point of view, see what are the physical implications.

And I really think that will be the route to progress in string theory, combining together ideas that are sort of motivated at least by more physical questions.

MARK COLVIN: You're a person that lives in three, maybe four dimensions that you can work in and yet you have to think about maybe up to 15 dimensions… how many dimensions?

LISA RANDALL: Well, we could think about any number that we want. String theory tells us to think about perhaps nine or 10 spatial dimensions, but the fact is that one thing we've learned from physics, especially in the last century, is that there's a lot that doesn't meet the eye very obviously.

When we could explore smaller scales we discovered quarks, that is to say, we as physicists. Certainly no one could go out and see that, it was really by indirect experiments that we found that out. When we could explore larger scales we learned about dark matter and dark energy. Again, things we don't directly perceive.

So a lot of what we learn about the universe we find out indirectly these days. So that means we can't just trust and say, "Well, I've only ever seen three dimensions, that means that's all there can be."

The question is, when we postulate the existence of more, is it consistent with what we've seen and could it actually have an impact on our world?

MARK COLVIN: Is the jury out on that? Have you proved it yet?

LISA RANDALL: Certainly the jury is out.

One thing that excites me though, is that in a couple of years, the large Hadron collider at CERN in Geneva, which is a high-energy accelerator that will smash together protons, will reach higher energies than we've ever studied before here on earth. And when we do that, we will learn some answers to these questions, hopefully.

Hopefully it will test some of these theories. Not all of these theories – it won't test the idea of extra dimensions quite generally, but it might actually discover evidence of extra dimensions or even rule out, unfortunately, some of the ideas that we've proposed.

MARK COLVIN: Can you, in a way, that a layperson would understand, how it would do that?

You've got this huge collider, which sends particles going around an enormous kind of donut-like object underground, how would it do what you're trying to do?

LISA RANDALL: It does sound indirect doesn't it?

What will happen will be… I think everyone knows Einstein's equation E=mc2 at this point… and what happens is the protons collide together, mass turns into energy and when you have that energy it can go back an in turn produce heavy particles. If you have a lot of energy you can produce heavier particles – E=mc2, where C is the speed of light. What that tells us is that we can look for heavier particles and there actually would be heavier particles if there are extra dimensions.

What would these particles be? Well, they're called Clusaclinemodes (phonetic)… Clusacline (phonetic) particles.

And what they are, are they're the analogue of particles that we know about, but they actually travel in the extra dimensions, and they actually can have energy and momentum associated with those extra dimensions. And if they do, they would be more massive.

So if there are extra dimensions, we expect to find massive particles that have the same charges as particles we know about, but heavier.

MARK COLVIN: The Harvard University physicist, Professor Lisa Randall, who is giving a lecture at the University of Technology, Sydney, this evening.