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Interview: The final frontier

18 June 2005

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Is there anything in what your president at Harvard, Lawrence Summers, said about the inherent differences in ability between men and women?

I'm a scientist so I can't help but look at it from a scientist's perspective. The literature clearly shows that Summers hadn't done his homework back in January. There are lots of social factors that influence performance so it's impossible at this point to isolate innate differences in intelligence. You can only say something reliable about innate differences in scientific ability if the differences are so big they cannot be explained by social factors. And so far as we can tell, they are not. Given the large social influences, the only thing you can reliably establish is that innate differences are small. Liz Spelke, a Harvard professor who's done research on this topic, says that what's remarkable is how similar boys and girls are, not how different. In the absence of reliable evidence, why make the hypotheses that he made?

I get the feeling you're fed up with this subject.

It is kind of weird how people like this topic. I am so bored with it. Why do people think this is so exciting?

So your passions lie more in physics than sociology, in finding hidden extra dimensions of space, for example. Do you believe these dimensions really exist?

I do believe it. But I'm not going to stop questioning my belief until we have some experimental proof: a lot of the things we're talking about are speculative, and may or may not turn out to be true. But I really don't see any reason why these extra dimensions should not exist. At the moment we see things over a very limited range of distance and energy. Every time we have looked beyond the boundaries of what we could see before, we have found new phenomena. Plus if you believe in string theory you have very good reason to think that they are there.

You have been quoted recently as saying that string theory is in a bind, that we need a new insight to help us explain the universe. Is physics stuck?

We'll be in a much better position when we have some data from the Large Hadron Collider. Physics is always better when you have some facts available. But that doesn't mean this is wasted time. There were a whole lot of ideas out there that hadn't been put together, a whole lot of questions that hadn't been asked - ones that I'm not sure I would have been asking if we'd had more data available. We have now had some time to think about deep questions and develop ideas we might never have arrived at if we hadn't had this chance to absorb the potential implications of abstract ideas such as extra dimensions and string theory for the observable world.

What made you want to take time away from research to write your new book?

I wanted to show why physicists think about things like extra dimensions, and how they might tie into "real" observable phenomena. Another reason is that we have these big particle accelerators and people should know why they are there. We are asking for funding for these things and it's only fair that people should know what the questions are that we're trying to answer with them. I think it is really important to pay back, to explain to people what's going on.

So everyone should "own" a little bit of the particle accelerators?

Yes. I think everyone should have the opportunity to learn what they would like to know about the physical theories that we will soon explore. How can you ask people to fund an accelerator without explaining why it is going to be a great thing? That's why my book gives a great deal of background, discussing particle physics, quantum mechanics, relativity, string theory, and newer ideas about extra dimensions of space.

But is answering the "big" questions becoming too expensive to

"Some of the important issues in

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**justify** are too difficult to get at with limited space [in newspapers]...you really require a book"

Physics has definitely become expensive, but it's like asking how much a college education is worth. In the US, college is very expensive, yet it's nonetheless clear that the value exceeds the cost. Part of what makes humans special is that we want to learn more about the world we live in. To put the cost in a different perspective, when the Superconducting Super

Collider was cancelled [in 1993], the savings and loan crisis cost the US government \$175 billion to bail out 500 banking institutions. Compare that to the advances we would have obtained from the SSC. Some brilliant new insights into the world, ones that you just couldn't get any other way, and for a fraction of the cost of bailing out savings and loan. And look at the money we are spending on the Iraq war - what are we going to have at the end of that?

**It sounds like you think there is a lot wrong with US spending priorities.**

American foreign policy at the moment is a disaster, and it doesn't show any signs of improving. We just keep making policy decisions that antagonise the world. There are lots of worrisome things in the US right now. When you look at the effect religion is having on science in the US, it's shocking, unbelievable. The extent to which rationality seems to be receding into the background is a pretty surprising thing.

**Have you ever wanted to fight on these fronts?**

When I was younger I wanted to be a lawyer. I liked the logic and I like engaging in arguments. But would I be a person who could solve those problems? I don't know the answer to that. Sometimes I look at the problems in the world and think how frustrating it must be to be trying to solve them: the pace of progress is so slow. I prefer to think of problems I can tackle and solve. It's a small thing, but one of the advantages of being a woman in theoretical physics is that you are making a difference just by being who you are.

**So you did have issues of gender and science in mind when you wrote the book?**

One reason I wrote it is that there aren't a lot of books about physics by women. I think it is important to let others know there are different kinds of people doing science. The goal was to engage people in a scientific way of thinking by explaining what the problems are, and how to go about solving them - what it means to actually do the research. It is certainly not written for any particular gender, but if we can broaden the audience, I'm all for that.

**What can be done to broaden the audience? Physics doesn't seem to enter into popular culture much.**

It's true that there's now a disconnect. I don't know why, but I'm hoping that it's not from lack of interest. I hope it is merely because people don't know how to access this stuff. If you read the science sections of the newspapers, a lot of it is health or the more accessible biology issues. But some of the important issues in physics are just too difficult to get at with only limited space. To explain some recent work, you really require a book because you need to delve into many different aspects of physics: quantum mechanics, relativity, particle physics, string theory, and so on.

**Do you think it's being involved in all these areas that made you the world's most widely cited theoretical physicist?**

It's true that one of the reasons my work got cited so widely is that it's not just particle physics, it's not just string theory, it's not just cosmology - these ideas branch out into many different areas of physics.

**Princeton's Ed Witten was the last recipient of the "most-cited" tag that I heard about and it seemed to give him enormous stature. Has it done the same for you?**

Actually, no one has made a big deal of it. But citations are only one measure of success. Most of us aren't just sitting there counting citations. I only found out when somebody told me about it.

**Even so, it is quite an achievement in a field where women reportedly find it more difficult to get to the top. Did you - or do you - ever feel excluded from physics as a woman?**

No. In many ways, my career has gone fine for me, personally. That doesn't mean I think problems don't exist, and I would like to make it easier for other women in the future. In writing this book, I wanted to send the message out that you don't have to be a guy, you can be yourself, you can be creative and imaginative while also doing the math. Women have these abilities as much as men. I wanted to say: "This is really interesting stuff, why cheat yourself? Why exclude yourself from it?" Maybe we just have to tell them they don't have to give up everything else to be a physicist, though you do have to give up a lot.

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