

When Physics is Fun—and Funny

Yale physicist and IIT Madras alumnus R Shankar teaches physics combined with a liberal dose of humour, writes Hari Pulakkat

As he starts his year-long course on the fundamentals of physics, Yale University professor R Shankar gives his students a quick synopsis.

"I don't know what your major is. I don't know what you are going to do later, so I picked the topics that all of us in physics find fascinating. Some may or may not be useful, but you just don't know." When Shankar, who is the John Randolph Huffman Professor of Physics & Applied Physics, starts a lecture in this way, with a smile on his face and a glint in his eye, his older students know it is a set-up.

"Some of you are probably going to be doctors," he continues, "and you don't know why I'm going to do special relativity or quantum mechanics...If you're a doctor and you've got a patient who's running away from you at the speed of light, you'll know what to do. Or, if you're a paediatrician with a really small patient who will not sit still, it's because the laws of quantum mechanics don't allow an object to have a definite position and momentum."

Shankar is only a minute into the lecture, but his students already know what to expect: some serious physics from the age of Newton up to its great 20th century revolutions. They will also discover that it's very different from any physics course they've encountered. Physics is deep and fun to do. When Shankar teaches it, it is also deeply funny.

Such physics with a touch of humour was available only to select Yale students at one time, but is now watched by students all over the world. Yale videotaped and put his course online free in 2007 and 2011. Shankar's lectures were among the first that Yale University put online as part of an experiment.

"The introductory courses in physics are quite serious," Shankar told ET last week when he came to the Indian Institute of Technology Madras to receive his distinguished alumnus award. "They are taken by non-physics people...The intro is to tell everybody what the subject is like."

Shankar finished his electrical engineering from IIT Madras in 1969 and switched to physics for his Ph.D. in the US as he was fascinated by the subject after reading *The Feynman Lectures on Physics*, a textbook based on lectures by Nobel laureate Richard P Feynman.

After his Ph.D. in theoretical physics from the University of California at Berkeley, Shankar became a Junior Fellow at Harvard, then only the second Indian to be awarded this fellowship, after Nobel Prize winner S Chandrasekhar. He moved to Yale three years later, remain-

ing there ever since. He has won prizes for his research, but is primarily known as a teacher par excellence.

In the last decade, some well-known physicists have put their courses online. The earliest among them was Walter Lewin of the Massachusetts Institute of Technology. Lewin quickly became an Internet celebrity as much for his acrobatic physics experiments as for his passion for communicating physics.

Shankar taught at roughly the same level as Lewin. He did no experiments in class, except comb his thin hair once to attract bits of paper with the comb. But he instilled in his students, with his characteristic humour, a deep appreciation for the subtlety of physical laws.

"This is a big day in your life," he announces in one of his master classes on Newton's laws.

Then he goes on to tell the students they haven't understood Newton's laws as deeply they should have, although the laws are taught in school.

For example, Newton's famous second law of motion, $f=ma$, is useless if you don't know how to measure each term independently. It turned out that most students were not able to come up with good ways of measuring mass and force. Measuring things accurately is important to doing physics well.

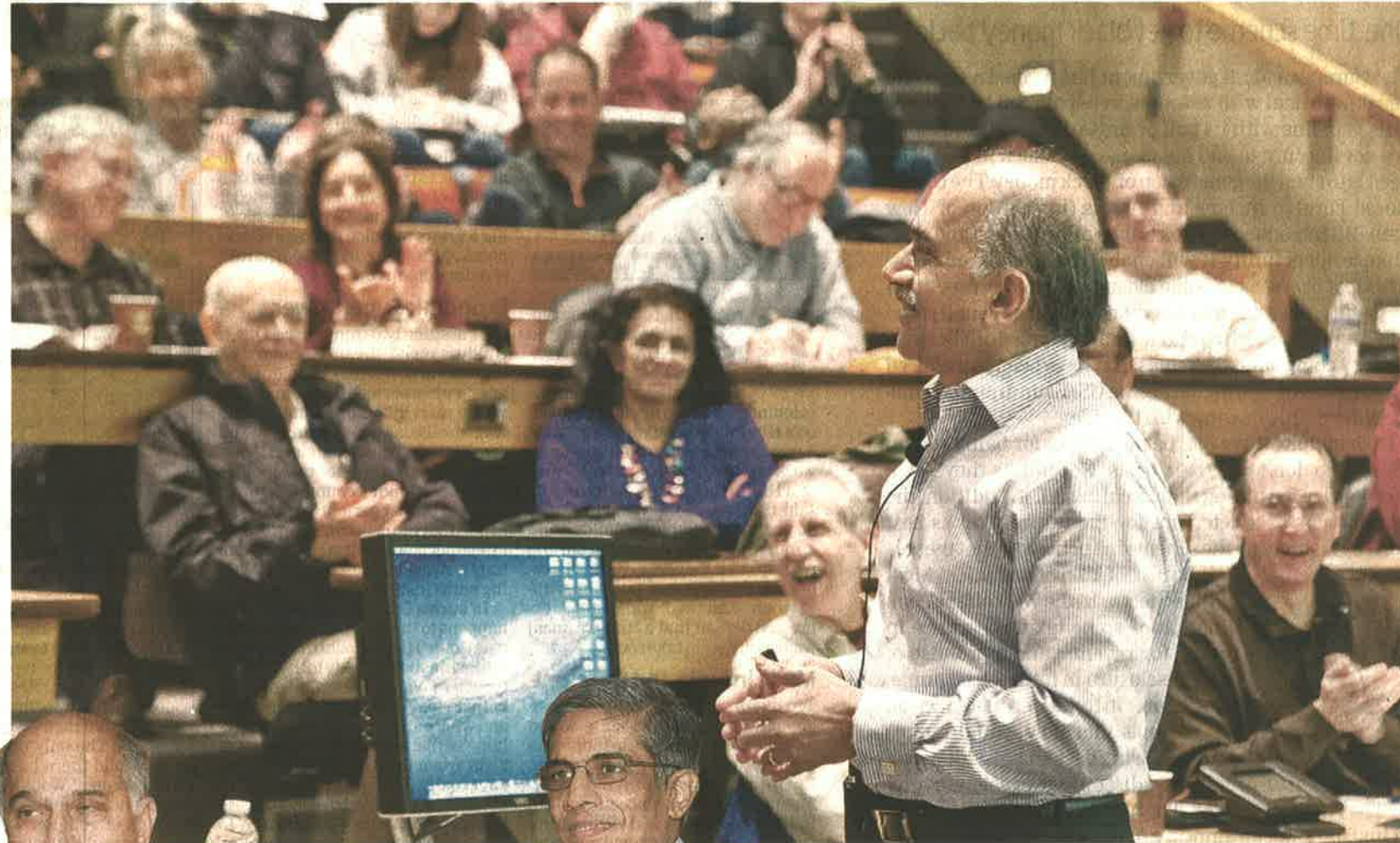
"It has to do with some of my training at IIT as an engineer," he tells ET. "Engineers do not talk about anything they cannot measure. They are not interested in any formalism, no matter how beautiful, if it doesn't have a purpose."

It turns out that he got his sense of humour, too, from IIT. He was a good debater at IIT and this training helped him to think on his feet.

His jokes are sometimes spontaneous and sometimes practiced, but they are almost always relevant. Over time, they have got a life of their own, as his students have collected and put them online.

"I've got bad news and good news," he says as he begins a lecture on quantum mechanics. "The bad news is that it's a subject that's kind of hard to follow intuitively and the good news is that nobody can follow it intuitively."

Feynman once famously said that no one understands quantum mechanics. "Here is my goal," continues



Not all physicists need to practice physics. They can be helpful in other areas

Prof Bhaskar Ramamurti (right), director IIT-M, presents the Distinguished Alumni Awards to Dr R Shankar

Shankar, now 67, wants to spend more time lecturing and writing. And he wants to lecture to the public

Shankar. "Right now, I'm the only one who doesn't understand quantum mechanics.

In about seven days, all of you will be unable to understand quantum mechanics. Then you can go back and spread your ignorance everywhere else."

Shankar, now 67, wants to spend more time lecturing and writing. His talks are coming out in the form of a book. His earlier book on quantum mechanics is used in many advanced courses around the world. And he wants to lecture to the public, too, and bring to them the excitement of physics.

Why bother to teach physics to non-physicists? Because you

learn skills that are useful later.

"You have actually done some problems, you know what it means to have a theory, what it means to have predictions. You know what it means to estimate something, to quantify something and approximate something. These are skills that are useful no matter what you do."

"Many of the students in my class may go and work for government," says Shankar. Like Ashton Carter, the current US defence secretary. He first learned humanities at Yale and then finished with a double major in physics and medieval history. He went to Oxford to do a Ph.D. in theoretical physics and taught physics at Harvard.

"Not all physicists need to practice physics. They can be helpful in other areas. That is what we want to do at Yale, train people in many things. They can then select (their speciality) later," Shankar says.