STEPHEN HAWKING SET TO INSPIRE SCIENCE GLITTERATI AT TIFR MEET

World's leading physicists unravel secrets of space and time at 'Strings 2001'

By Vithal C. Nadkarni

MUMBAI: Which is the newest feather that British physicist Stephen Hawking has added to his much-decorated cap? The celebrated theorist and best-selling author of *A Brief History of Time*, who is confined to a wheel chair mounted with a computer and voice synthesiser—the result of being ravaged by the nerve-crippling, muscle-wasting Lou Gehring's disease—is among the first three recipients of the Sarojini Damodaran fellowship awarded by the Tata Institute of Fundamental Research (TIFR).

The fellowship, which has been set up under the aegis of a Bangalore-based charitable trust headed by S.D. Shibulal of Infosys Technologies, has enabled Mr Hawking to attend 'Strings 2001', an international conference on String theory which begins on Friday at TIFR.

String theory is widely regarded as the most promising candidate for unifying all the fundamental particles and forces which underlie physical phenomena. At the heart of the theory are little entities—strings—which represent a paradigm shift from an older model that viewed elementary particles, such as electrons and protons, as point-like objects. The newer model looks upon these elementary particles as different vibrational modes of a single fundamental entity called String.

"The six-day 'Strings 2001' is a veritable Who's Who of a theory which is one of the greatest revolutions wrought by the human mind," says Spenta Wadia of TIFR, one of the co-ordinators of the conference. "We have a galaxy of 300 physicists, including pioneers like John Schwarz, Michael Green, David Gross and Ed Witten, at the conference, which has been jointly organised by TIFR, the Abdus Salam International Centre for Theoretical Physics in Trieste and the Clay Mathematics Institute in Cambridge, Massachusetts, along with several other institutions in India," he adds.

Mr Hawking is the Lucasian professor of mathematics at Cambridge University in the UK, a chair once held by legendary stalwarts such as Sir Isaac Newton and Paul Dirac. He is best known for his work on black holes and quantum gravity.

The KBC-ishtyle question being asked around in Mumbai is: What's a black hole specialist like Mr Hawking doing at a conference devoted to exotic entities like Strings in this city?

Indeed, until String theory came to the rescue, Mr Hawking had spent a lot of time in trying to unite two seemingly incompatible partners—subatomic quantum mechanics and Einstein's theory of relativity. Both form the bedrock of modern physics.

"Conventional efforts at unification did yield a menage a trois, a union of the three basic forces, the weak, the strong and electro-magnetic interactions. But the fourth force, gravity, remained the odd-man out," says Sunil Mukhi, another TIFR co-ordinator.

Enter String theory. "Originally devised to describe the physics of strong interactions in the 1960s, string theory ended up by providing a consistent theory of gravity," says pioneering Caltech physicist John Schwarz. "Suddenly, you had this theory with a predictive potential that electrified the physics community."

Gravity is no longer an inconvenient add-on in the new framework. "Unlike standard quantum theories which make gravity impossible, String theory not only allows gravity but requires it," says Edward Witten of the Institute for Advanced Study, Princeton. A winner of the Fields Medal, regarded as the equivalent of a Nobel Prize in mathematics, Mr Witten is widely viewed as one of the brightest minds in the world. "I regard this fact as one of the greatest insights ever made in science," he adds.

Says Trieste Centre director Miguel Virasoro, himself a distinguished String theorist, "India richly deserves this conference. It's a tribute to the vital contributions made to the theory by physicists in your country."

"The conference is part of an annual series and is being held for the first time outside of the United States and Western Europe—not even the UK and France have had the privilege so far," says Atish Dabholkar, another TIFR co-ordinator.

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MUMBAI: The *creme de la creme* of the international physics community is flocking to the six-day international conference on String theory which begins on Friday, January 5, at the Tata Institute of Fundamental Research (TIFR) at Colaba.

String theory promises to realise Albert Einstein's dream of a unified theory of all forces in nature by providing a mathematically consistent formalism which joins the two pillars of modern physics, quantum theory and the General Theory of Relativity.

In String theory, the universe is no longer made up of elementary particles, as formerly held, but of tiny strings that wriggle about in 11 dimensions. Depending on how the strings are vibrating and rotating they can represent any of the known particles of matter ranging from electrons to quarks. If String theory is verified, it will revolutionise the concepts of space and time, understanding of questions relating to the nature of black holes and the origin and fate of the universe.

"Consider the analogy of a vibrating sitar string," say Sunil Mukhi, a conference co-ordinator from TIFR. "Just as in music, different vibrations of the instrumental strings give rise to different musical notes, similarly elementary particles can be thought of as manifestations of the vibrations of a fundamental string."

"Moreover," adds David Gross, director of the Institute for Theoretical Physics at the University of California, Santa Barbara, "String theory not only makes gravity compatible with quantum mechanics, it also provides a nearly realistic picture of low-energy elementary particle physics.

"Even more exciting," he continues, "for the first time, we have a real possibility of verifying some of the predictions of the theory in experiments at the large hadron collider 'atom-smasher' that's coming up at the CERN labs in Geneva."

Says Ashoke Sen of the Harish-Chandra Research Institute, Allahabad, "Apart from the prospect of direct experimental verification, String theory provides tantalising glimpses of the deep structures beneath the fabric of 'reality'."

Adds Atish Dabholkar of TIFR, "What draws some of the best young talent to String theory is the sheer beauty and power of its evolving mathematical structures."

Among the most important spin-offs of the theory is a novel understanding of why basic building blocks of protons and neutrons called quarks do not come out and are, in fact, impossible to separate.

Another reason why String theory has caught the fancy of physicists of the stature of Stephen Hawking, who is attending the conference, is the breakthrough on the 'Information Puzzle' of black holes, experts say.

Black holes are exotic astrophysical objects whose gravitational pull is so strong that not even light can escape from inside them. However, quantum effects make black holes glow. This was Mr Hawking's landmark discovery — black holes emit Hawking radiation.

"Ironically, thanks to String theory, it now appears that the seemingly exotic Hawking radiation is actually similar to radiation given off by a piece of glowing charcoal," says TIFR's Spenta Wadia. That's what makes String theory one of the hottest pieces of physics in the new millennium.