Mathematical Sciences 2009

"I think this Prize (Infosys Prize) will go a long way in attracting young talent to science and that's what we need to build a strong country...Whatever I've done is built on the work of many others and my work should really be thought of as a tiny piece of a vast effort that is going on, in trying to understand the basic laws of nature."

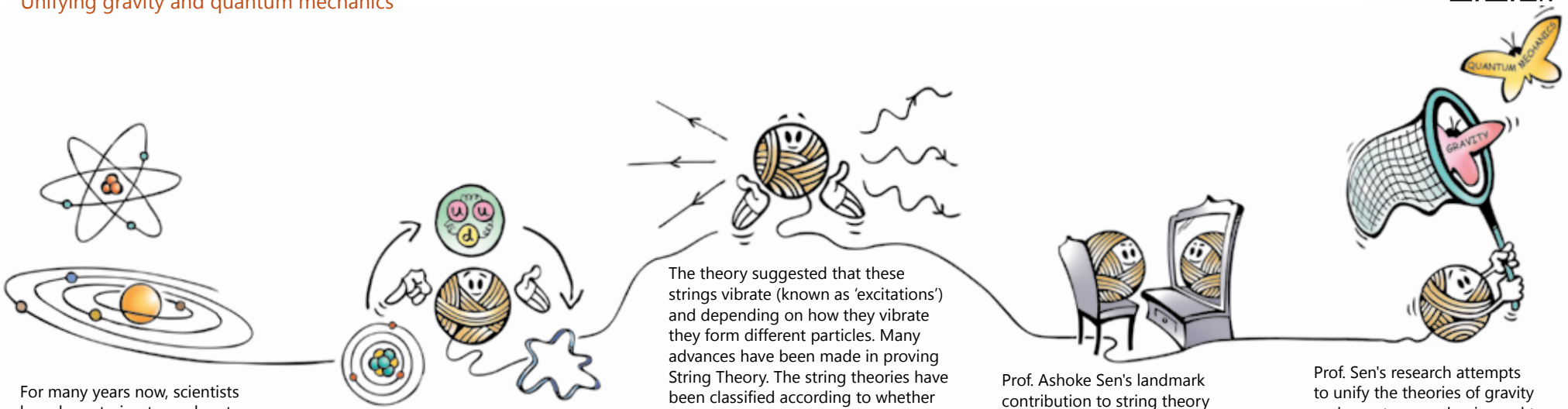
Ashoke Sen

Professor, Harish-Chandra Research Institute, Allahabad

- B.Sc. in Physics from Calcutta University
- M.Sc. in Physics from the Indian Institute of Technology, Kanpur
- Ph.D. in Physics from the State University of New York, Stonybrook
- Post doctoral research at Fermilab, Batavia, and at SLAC, Stanford

Prof. Ashoke Sen is being recognized for his important contributions to String Theory, which is a vital part of Mathematical Physics. Among his contributions is his work on S-duality that established links between weak and strong coupling regimes of certain String Theories. This made it possible to make inferences concerning the behavior of the system in the strong coupling regime by a perturbative analysis of the system in the weak coupling regime.

Unifying gravity and quantum mechanics



For many years now, scientists have been trying to work out the composition of our universe. They first discovered that the world around us was made up of atoms and these in turn were made up of even tinier particles such as electrons, protons, neutrons, quarks and others. These particles interact via four different types of forces. These are gravity, electromagnetism, weak nuclear forces and strong nuclear forces.

So, what was the nature of particles and forces? Several theories came up, including String Theory. According to this theory all particles and forms of energy are arranged in the form of strings. These hypothetical strings had only the dimension of length.

The theory suggested that these strings vibrate (known as 'excitations') and depending on how they vibrate they form different particles. Many advances have been made in proving String Theory. The string theories have been classified according to whether the strings are open or closed and are further classified according to the allowed modes of vibration of the string. At one time, string theorists believed that each of the string theories were distinct and could exist without the other. Soon they realized that these theories are connected to each other and these connections came to be known as 'dualities'.

Prof. Ashoke Sen's landmark contribution to string theory has been his work on dualities. Sen has worked out a surprising connection between weak and strong coupling regimes of a String Theory. Coupling regimes refer to the strength of interaction in string theories. The coupling constants in the string theories are controlled by particular oscillation modes of the string called dilatons and they exhibit symmetry, which is called S-duality.

Prof. Sen's research attempts to unify the theories of gravity and quantum mechanics and to complete the task that Einstein had begun. His work on entropy function formalism has helped provide a statistical interpretation of Bekenstein-Hawking entropy of black holes. He has also made other important contributions to String Theory, including the construction and study of time dependent solutions that has led to cosmological models.