

The Man from the Nine Dimensions

A 3D Full dome movie on the Theory of Everything

Vasumathy Jambunathan

WHEN I saw the notice announcing the screening of this movie at the Bangalore Jawaharlal Nehru Planetarium, my interest immediately got piqued. Nine dimensions?? It's hard enough for a common man to even imagine beyond the usual three dimensions and the 4th dimension of time; forget about nine!!

This special dome movie was hosted at the planetarium as part of an outreach programme by ICTS – International Center for Theoretical Sciences, Bangalore. Before the movie commenced a short lecture explaining the scientific concepts in the movie was given by Professor Hiroshi Ooguri (Fred Kavli Professor of Theoretical Physics and Mathematics). The movie has received numerous prizes and honours including the 2016 Best Educational Production Award of the International Planetarium Society.

This planetarium dome movie depicts the elusive search of scientists over the years for the “Theory of Everything”. Nicknamed TOE, the elusive theory is depicted as a mysterious man who keeps running away from the scientists who are chasing him. TOE would unify the two great bastions of twentieth century physics – the general theory of relativity and quantum theory.

General relativity describes the large scale cosmological structure of the universe. Quantum theory describes the microscopic subatomic structures. The unification of these theories would explain both the very big and the very small. Great scientists such as Albert Einstein and Stephen Hawking have spent days in pursuit of this elusive theory.

There are four fundamental physical forces in our universe: Gravity, Electromagnetic force, Weak nuclear force (force between electrons and nucleus in an atom) and Strong nuclear force (force between protons and neutrons in an atom).

Today a theory known as QFT – Quantum Field Theory – unifies the three non-gravitational forces. But General Relativity theory based on gravity and QFT are mutually incompatible theories – they cannot both be right. These two theories usually apply to different domains – QFT to small mass sub-atomic particles and GR to the large scale high-mass stars and galaxies. However, in



regions of extremely small-scale and high-mass, such as a black hole or during the beginning stages of the universe, this incompatibility between GR and QFT is apparent.

To resolve this conflict, a theory unifying gravity with the other three forces must be discovered: a single theory that is capable of describing all phenomena. Today, the superstring theory is the leading candidate for the Theory of Everything.

According to the superstring theory, the elementary particles in particle physics are strings of energy stretched out in one dimension. The Standard Model of Elementary Particles has 17 types of elementary particles. The superstring theory describes everything in terms of a single type of string. The differences in the vibration patterns of the string are believed to correspond to the various types of elementary particles.

To mathematically model the strings, the three spatial dimensions that we are familiar with are not sufficient; instead, nine spatial dimensions are necessary. The

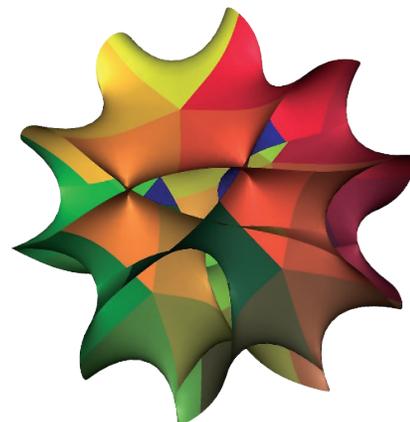
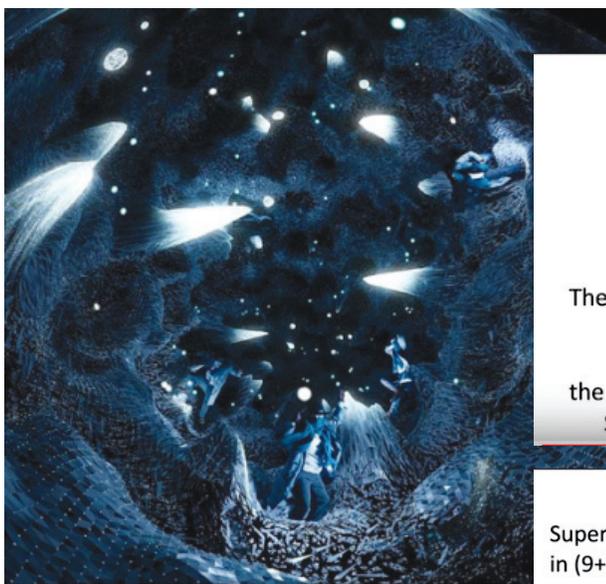


Image Courtesy: Wikipedia

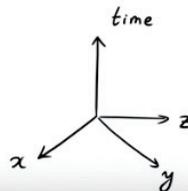
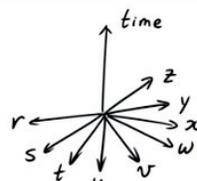
https://en.wikipedia.org/wiki/Calabi%E2%80%93Yau_manifold



The Man from the 9 Dimensions is a metaphor of Theory of Everything, which unifies the macroscopic world of gravity with the microscopic world of quantum mechanics. Scientists' quest to discover it continues.



Superstring theory is defined in (9+1) spacetime dimensions.



We live in (3+1) dimensions. At least we feel so.



remaining six dimensions constitute the “Calabi-Yau space”. The Calabi-Yau Space is folded very compactly, and can neither be seen or felt by us. This is why we only observe our three-dimensional world.

In the superstring theory, the string vibrates according to the shape of the Calabi-Yau Space, and the differences in the vibration patterns are thought to correspond to the 17 types of elementary particles.

In the movie, the mystery man TOE escapes with ease from the scientists and invites us to a fantastic journey through all the nine-dimensions. He traverses space and time, jumps between the microscopic world to the macroscopic world. TOE helps us to wander from the present day to the distant past until the birth of the Universe. He takes us on a journey beyond dimensions. Through a lot of elaborate graphics, the movie gives a visual representation of the six extra dimensions of the Calabi-Yau space as it is seen from our three dimensions. The film also depicts the Standard Model of particle physics with visual representations of elementary particles such as Higgs Boson and Neutrino.

One would have thought that with a subject so scientifically complex, the non-scientific community in the audience would have been bored or the children would

become restless. However, throughout the 30-minute duration of the movie the audience was spellbound. There was pin-drop silence in the theatre. Adults and kids alike were riveted and glued to the screen.

A subject that is normally best described using differential and integral equations came alive for all of us on screen ala Bollywood style. TOE kept the audience enthralled with his singing and dancing. Jumping around between microscopic and macroscopic worlds he leads all the scientists through a terrific chase!

In the last scene, the scientists manage to almost catch TOE, but are left with only a string from his shawl while he runs away again leaving us with the conclusion that while the String theory is a good candidate for TOE, there is still a long way to go to really understand the Theory of Everything.

Ms Vasumathy Jambunathan is an engineer from BITS Pilani and holds a Masters degree in Chemistry. Currently she is a senior technical software architect at Infosys in Bangalore. Address: 5032 Sobha Palladian, Yemalur road, Marathahalli, Bangalore-500037. Email: suma78@yahoo.com

Pictures and technical information on Theory of Everything, Calbi Yau space and Superstrings theories have been referred from the following websites:

- https://en.wikipedia.org/wiki/Theory_of_everything
- <https://www.icts.res.in/lectures/9-dimensions>
- <https://www.miraikan.jst.go.jp/sp/9dimensions/en/commentary/>
- https://ooguri.caltech.edu/documents/80-aspen_times_article.pdf