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Stephen Hawking (January 8, 1942 - March 14, 2018) died in the early hours of March 14, leaving behind a rich intellectual legacy that will dominate theoretical physics for years to come. Coincidentally, March 14 is Albert Einstein's birthday and January 8 was the day Galileo Galilei died in Arcetri, Italy. Hawking held the Lucasian chair of Mathematics at Cambridge, a position once filled by Isaac Newton. It is indeed fitting that these names are all strung together in the same paragraph and mentioned in the same breath. They are the giants who transformed theoretical physics into the shape that it has taken today.

Hawking's early work (in collaboration with Roger Penrose) was on singularity theorems in Einstein's general theory of relativity. This work showed decisively that Einstein's theory predicted singularities: regions of space and time where our theories no longer hold. Einstein's general relativity seemed to predict its own demise. There was new physics beyond general relativity.

Another seminal work of Hawking's concerns the areas of black holes. He showed that the area of a black hole always increases with time. This suggested an analogy with entropy and the second law of thermodynamics, which predicts that disorder of a closed system always increases. This analogy was initially not taken seriously because it seemed so far-fetched and, indeed, flawed.



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However, Jacob Bekenstein, an Israeli physicist, persisted with the analogy, despite the obvious flaw that black holes absorb light and do not let it escape, whereas black bodies in thermal physics emit as well as absorb light. Hawking's striking insight was to realise that black holes were indeed thermodynamic objects which have a temperature and emit radiation - now called Hawking radiation.

This brilliant insight nailed the analogy and has led to deep relations between gravitation, quantum mechanics and statistical mechanics, which are still being explored today. Hawking has made many seminal contributions to cosmology, black holes and the relationship between geometry, gravitation and quantum theory, too numerous and technical to mention here.

Hawking brought to the subject a style of mathematical physics that used subtle methods from differential geometry and differential topology to bear on the physics of black holes and cosmology. There is a strong Indian connection here. The idea of a black hole had its roots in the work on the stability of white dwarf stars by S Chandrasekhar, an American physicist of Indian origin. Hawking's analysis of singularities and the area theorem relied crucially on an equation discovered by Amal Raychaudhuri, an Indian physicist whose name is perhaps better known abroad than in his native land. The classic book by Hawking and Ellis on the large scale structure of space time summarises some of these developments in a rigorous mathematical way.



The Theory of Everything.

Hawking has captured the public imagination both for the boldness of his ideas and the trying circumstances they were developed in. His bestselling book *A brief history of time*, and its sequels, have drawn lay public into the esoteric realms of space, time and black holes.

Hawking is very much a part of popular culture. He has appeared on *The Big Bang Theory*, a popular television serial that pokes gentle fun at the arcane mysteries of theoretical physics and the curiously warped personalities and personal lives of the cerebral and self-absorbed people behind the science. Hawking is featured in *The Simpsons*, another popular and satirical television cartoon show. He has also been sensitively portrayed by Eddie Redmayne in the movie *The Theory of Everything*.

What is most remarkable and has captured the public imagination is the circumstances in which Hawking did his seminal work. At the age of 21, he was diagnosed with Amyotrophic Lateral Sclerosis (ALS), a degenerative disease (also referred to as motor neuron disease). His doctors gave him two years to live. They were off by about fifty - 50 more years in which Hawking continued to defy the odds and leave his eternal mark on the theories of black holes and cosmology.

(Courtesy *India Science Wire*.)

<https://www.dailyo.in/technology/stephen-hawking-dies-76-als-black-hole-big-bang-theoretical-physics-cosmology/story/1/22846.html>