

Cambridge Celebrity

Prof. Stephen William Hawking

Overview

Stephen Hawking is the most renowned theoretical physicist alive. He works at Cambridge University in England as a physics professor. He is a quantum cosmologist - a person who studies the universe at a time when it was so small that atoms had not yet formed. Hawking is best known for his work involving the exploration of the nature of black holes.

Stephen William Hawking was born on 8 January 1942 (300 years after the death of Galileo) in Oxford, England. His parents' house was in north London, but during the Second World War Oxford was considered a safer place to start a family. When he was eight, his family moved to St Albans, a town about 20 miles north of London. At eleven Stephen went to St Albans School, and then on to University College, Oxford, his father's old college. Stephen wanted



to study Mathematics, although his father would have preferred medicine. Mathematics was not available at University College, so he studied Physics instead. After three years and not very much work he was awarded a first class honors degree in Natural Science.

Stephen then went on to Cambridge to do research in Cosmology, as there was no-one working in that area in Oxford at the time. His supervisor was Denis Sciama, although he had hoped to have Fred Hoyle who was also working in Cambridge. After gaining his Ph.D. he first became a Research Fellow, and later a Professorial Fellow at Gonville and Caius College. After leaving the Institute of Astronomy in 1973 Stephen went to the Department of Applied Mathematics and Theoretical Physics, and since 1979 has held the post of Lucasian Professor of Mathematics. The chair was founded in 1663 with money left in the will of the Reverend Henry Lucas, who had been the Member of Parliament for the University, and had first been held by Isaac Barrow, and then in 1663 by Isaac Newton.

Stephen Hawking has worked on the basic laws which govern the universe. With Roger Penrose he showed that Einstein's General Theory of Relativity implied space and time would have a beginning in the Big Bang and end in black holes. These results indicated it was necessary to unify General Relativity with Quantum Theory, the other great Scientific development of the first half of the 20th Century. One consequence of such a unification that he discovered was that black holes were not completely black, but emitted radiation and would eventually evaporate and disappear. Another conjecture is that the universe has no edge or boundary in imaginary time. This would imply that the way the universe began was completely determined by the laws of science.

His many publications include *The Large Scale Structure of Spacetime* with G F R Ellis, *General Relativity: An Einstein Centenary Survey*, with W Israel, and *300 Years of Gravity*, with W Israel. Stephen Hawking has two popular books published; his best seller *A Brief History of Time*, and his later book, *Black Holes and Baby Universes and Other Essays*.

Professor Hawking has twelve honorary degrees, was awarded the CBE in 1982, and was made a Companion of Honor in 1989. He is the recipient of many awards, medals and prizes and is a Fellow of The Royal Society and a Member of the US National Academy of Sciences.

Stephen Hawking continues to combine family life (he has three children and one grandchild), and his research into theoretical physics together with an extensive programme of travel and public lectures.

Important Contributions

In 1973, theoretical physicists Yakov Zeldovitch and Alexander Starobinsky discussed the possibility that radiation could be produced by quantum effects acting just outside of a black hole. Hawking, interested in this idea, further explored it; he verified this assumption and he provided a precise prediction of how much radiation would be produced. This is now called Hawking Radiation. Hawking's calculations have been verified, but the technology to detect Hawking Radiation does not yet exist.

Hawking Radiation occurs when a pair of opposite particles form near the event horizon of a black hole. Normally, near a black hole, the particles spontaneously form from the energy of the black hole, and then they annihilate each other so the energy is given up, so no laws of physics are really violated. But, if one of the particles gets drawn into the black hole, then the other continues to exist, and therefore, the black hole loses some of its mass (by Einstein's equation, $E=m \cdot c^2$, this energy loss is a loss in mass).

The escaping particles form a halo around the black hole. As the black hole gets smaller, the halo gets bigger, brighter, and hotter. Finally, when the black hole reaches about one quadrillion degrees (1,000,000,000,000,000 degrees), the black hole explodes in a burst of light and energy. In less than a millionth of a second, it explodes with the energy of one billion atomic bombs.

In 1988, Stephen Hawking published his first book, *A Brief History of Time*. This book has been the best-selling scientific work in history. It was such a sensation that it was on the London Sunday Times best seller list for 237 weeks, has been translated into about 40 languages, and has sold the more copies than any other book (except the Bible and Shakespeare) at about one copy for every 750 people in the world.