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Hawking, God and the Big Bang

A Tribute – Stephen Hawking turns 50

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Physicist Stephen Hawking, well known for his contribution to the theory of black holes and even better known as a science communicator, just completed fifty. Crippled by ALS or motor neuron disease that has confined him to the wheelchair, Hawking has lately lost his ability to speak and write as well and communicates through a computer which synthesises speech and helps him write. Though he is being helped by the wonders of the micro-chip, it should be remembered that he was given two years to live, by doctors, 29 years ago! This brilliant physicist completing 50 is a celebration of human grit and an occasion of joy for all.

Hawking's "A Brief History of Time", an international best seller, is a model of science communication. He conveys in the book, the evolution of man's understanding of the macrocosm and the microcosm in lucid terms and addresses himself to the questions "Where did the universe come from? How and why did it begin? Will it come to an end? If so, how?" On his fiftieth birthday, the ultimate tribute has been paid to Hawking's communicating abilities. Now, nestling alongside paper back pulp from Jackie Collinses, Jeffrey Archers, Sidney Sheldons et al, one can find, "A Brief History of Time" on the pavements of Mumbai's Flora Fountain.

While discussing the present day understanding of universe, its structure, evolution and origin Hawking examines many times the role of God, if any, in it. Till the nineteenth century all things heavenly: sun, moon planets, stars and all things earthly:

animals, plants and earth itself were looked upon as given, and not as products of a long evolutionary process. Not that there was no speculation regarding it, but there was no scientific evidence for it. In the mid nineteenth century, evidence accumulated towards Biological and Geological evolution which were a big blow to scriptures of various religions that had spoken about genesis of earth and creation of all plants and animals by God, more or less suddenly. To allow for some historical development of mankind the Church in Europe had even fixed 4004 BC as the date of creation. However in the 19th century, scientific evidence showed up a time lapse of millions of years for the evolution of different species of plant and animal life including man, showing natural laws in action rather than the hands of a creator.

Stellar evolution from gaseous Nebulae had been hypothesised by the German philosopher Immanuel Kant in the 18th century, however there was no direct evidence of evolution of universe itself. It was the discovery by Edwin Hubble in 1929 that galaxies are moving away from each other that led to the acceptance of the theory of expanding universe. But an expanding universe presupposed that matter and energy were expanding in all directions after originating at a point. Thus the name Big Bang was given to a theory that explained the expansion of universe, as due to the very creation of universe at a point billions of years ago. Then came in 1965 the discovery by Penzias and Wilson that weak electromagnetic radiation filled the space and it was not coming from any source, but it was just there, in the background! This is known as Cosmic Microwave Background Radiation. They received Nobel Prize for its discovery in 1978. Since Big Bang theory had predicted that some of the energy released during the creation would still be around, as weak electromagnetic radiation, this discovery thereby established the Big Bang theory.

According to the "hot Big Bang model", the history of universe in brief runs like this: at the Big Bang itself the universe is thought to have had zero volume and so to have been infinitely hot. But as the universe expanded, the temperature of radiation decreased. One second after the Big Bang the temperature was ten thousand million degrees. This is about a thousand times the temperature at the centre of the Sun. At this time the universe contained mostly photons - packets of electromagnetic energy,

electrons and neutrinos -extremely light and weakly interacting particles and their corresponding anti-particles viz. positrons and anti-neutrinos, together with some protons and neutrons.

About hundred seconds after the Big Bang, the temperature would have fallen to a billion degrees centigrade. At this temperature protons and neutrons would fuse to produce Deuterium or heavy Hydrogen nuclei, which in turn will fuse to form Helium nuclei and small amounts of Lithium and Beryllium.

After that, for another million years universe would have just expanded. Once the temperature had dropped to a few thousand degrees, electrons and nuclei would start combining to form atoms. In regions where matter was denser than the average, gravity would start coming into play. Thereby leading to the formation of galaxies, like our own Milky Way.

As time went by, Hydrogen and Helium gas in the galaxies would break into small clouds that would collapse under their own gravity and start the formation of stars. As these clouds contracted, temperature of the gas would increase until it became hot enough to start nuclear fusion reactions. Some would use up their Hydrogen in only about 100 million years, contract further and convert Helium into heavier elements Carbon and Oxygen. Then the central region of the star would collapse to a super dense Neutron Star or even a Black hole & the outer cloud would be blown away in a Super Nova explosion. Our own sun is a second or third generation star, formed some 5 billion years ago out of the debris of Super Novae. Small amounts of heavier elements in the debris collected together to form the planets round the sun.

This extremely brief and sketchy outline of evolution of the universe, might have many gaps but generally seems to agree with all observational evidence, that we have today.

What happened at the Big Bang, or before it? Physicists say these questions cannot be answered in the present model. Big Bang represents a critical point in the theory. At that point certain quantities like density become infinite, certain others like volume become zero, or in mathematical terms, Big Bang represents a singularity in theory. For the same reason we cannot extrapolate the model backwards in time to the period

before Big Bang. Though the Big Bang model satisfactorily explains the observed data so far, scientists do not like infinities appearing in theory. Thus, attempts are on, to avoid the Big Bang singularity. Hawking himself has worked on one such attempt where there is no singularity. But in this model we have to give up our present concept of time. Here, time has to be treated as any other space dimension or in mathematical terms we have "Euclidean space-time", where as theories like relativity treat time as different from space.

So far, the predictive capacity of various cosmological models is extremely limited. This is natural, when even basic data regarding distances of various galaxies from ours, the rate of expansion of the universe and the total matter in the universe etc. is still not available. Any way, till more observational data is available, may be from the Hubble Space Telescope launched through the Space Shuttle we have not much to chose from one model from the other. They explain the expansion of the universe and the left over, premordial Cosmic Microwave Background Radiation.

As we see, there is little scope for God in this scheme of things. In fact, once the scientists took on the job in earnest of observing nature and discovering laws of nature, they rejected the view that every thing goes according to the leela of an all powerful, eternal, all perfect, unlimited God. The laws of nature according to which matter seems to interact and develop, our understanding of which is developed and improved upon as new data and new phenomenon are found, seem to circumscribe the "unlimited" "all powerful God".

Thus started the view that God started off everything, and decreed the laws, which, then took over the running of the universe. Many scientists in Europe accepted this type of eclectic outlook known as deism. Issac Newton was one of them. He discovered the law of gravitation and described planetary motion accurately but assumed that God started it all or in philosophic terms God was the "efficient cause" of the world, or the "first impulse". Later developments in science described the evolution of the earth, the biological world, the origin of species, and even gave insights into bio-molecular origin of life itself. Thus there developed an agnostic view among most scientists who refused to take a stand on existence of God, but said "we don't have any proof of his existence

or non-existence". The famous French mathematician Laplace, is supposed to have presented the theory of solar system in the court of Napoleon Bonaparte and then when Napoleon noticed the absence of divine intervention in Laplace's theory, he is said to have boldly replied "but I have no need for that hyopothesis"! Strangely the evidence in favour of Big Bang, has given fillip to the religious minded, who say "God created the universe at the Big Bang!"

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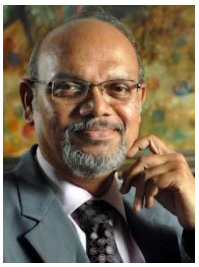

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