Science & Speculation

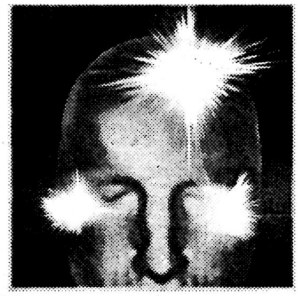
Behind the Veil of Cosmology

By Jayant Narlikar

Greek myths talk about the sculptor Pygmalion who crafted the statue of a beautiful woman as none of the women around him seemed attractive. He fell in love with his creation. The modern Big Bang cosmologist is the present-day counterpart of Pygmalion, preferring his creation, the Big Bang model to the real universe.

According to the Big Bang model, the universe began in a gigantic explosion with matter and radiation created out of nothingness. In the early stages, the universe was extremely hot, dominated by radiation. Since then it has been expanding and because of that it cooled down. Theorists expected some relic radiation of that hot period to have survived today. With the discovery in 1965 of smoothly distributed all pervasive microwave radiation, the Big Bang idea received a boost.

This made the cosmologists more ambitious in their efforts to know what the universe was like close to those traumatic moments of creation. After three decades of concerted effort by the leading theoreticians in the field backed by several spectacular observations, today's Big Bang cosmologists are confident that they know precisely what the universe is made of and precisely how it has evolved to that state.



Scientific traditions imply that a model so confidently claimed to be precise is based on well-founded physical theory with uniquely supportive evidence. Here is what a cosmologist will tell you if you ask him how the universe started. Its early history up to the epoch when it was 10 million billion billion billion billionth part of a second old, was determined by an as yet unknown law of gravitation that is supposed to describe spaces of extremely small size.

After the explosion, the universe grew in age and size, and new basic laws came to determine its behaviour. For example, at the age of around a billion billion billion billionth part of a second, the universe underwent a very rapid phase of expansion, that lasted till the age of the universe increased hundredfold. This fleeting stage, called inflation, is believed to have profoundly influenced the properties of the universe as seen today. The seeds of all the galaxies and clusters of galaxies seen today were sown at this early epoch.

On the basis of the recent findings of the satellite WMAP sent out by NASA the cosmologists confidently assert that the universe is 13.7 billion years old, that it has 23 per cent strange kind of dark matter as opposed to four per cent of ordinary matter that we are familiar with, that the bulk of its contents are in the form of (as yet unknown) dark energy.

The Big Bang theory tells us that before the universe was, say 100,000 years old, it was so densely packed with scatterers of light that no coherent image can be seen of anything prior to that epoch. Imagine that you are in a theatre trying to guess what lies on the stage behind a thick screen, when someone comes and tells you authoritatively what exists there. You are entitled to ask on what authority does he say what is going on behind the screen, since like you he too cannot see beyond it.

Big Bang cosmologists are trying to guess what lay behind the thick screen of radiation from the wrinkles spotted on the screen by WMAP. Do they have a cast iron theory that allows them to interpret so confidently what lay behind the screen from its wrinkles? Have physicists verified that strange matter and dark energy exist? Alas, No!

Particle physicists who are concerned with the pristine structure of matter are still groping in the dark to figure out these fundamental issues, and till these are well sorted out, claims of having found what the universe was like so early after its creation must be treated with considerable caution. In my childhood Hindi storybook I read the episode of a motorcyclist going through a village in remote area at night. No one saw the rider, but his wheel-marks on the dusty track were visible. What did those marks represent? The villagers had never seen a motorcycle before and so were completely foxed by the marks.

They approached the only wise man in the village who had answers to all questions. Having pondered over the query and inspected the marks that worthy replied: "These are the marks left by a rolling millstone pulled by a cat". Cosmologists have learnt the art of confident assertion and have improved on the village pundit.

Is all astronomy so speculative? Just because the astronomer theorises about distant stars and galaxies does not mean that he is expecting to get away with theories that no one can check. The study of interiors of stars like the Sun, has been based on well-tested physics, has clear predictions that have been observationally confirmed. Other examples where observations directly check theories include studies of interstellar dust, structures of radio sources, morphology of galaxies etc.

The essential feature of a scientific experiment is that it is repeatable. If you can explain the brightness of the Sun in terms of its mass, so must your formula apply to several other stars with different masses to see if it checks out.

The situation in cosmology is different. There is but one universe. It is not a repeatable experiment. So extra caution is required in making claims about its physical properties.