LHC: The Large Hype Creator



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SINCE LAST year, 2009, newspaper headlines and TV channels with their breaking news are telling us that we stand on the threshold of knowing how our universe began in a gigantic explosion called the Big Bang. Cosmologists who study questions related to the origin, evolution and the end of the universe have come up with a generally accepted belief that the universe started with the Big Bang some 13.7 billion years ago. The theory underlying this belief contains a lot of speculation that has not been independently verified. Let us see why such speculation is unavoidable once we put all our eggs in the Big Bang basket.

The observations of galaxies out to large distances build a fairly convincing picture that the universe is expanding. If we seek to describe the phenomenon within the framework of the best known theory of gravitation, namely Einstein's General Theory of Relativity, we are led to the conclusion that the universe had a point-like state sometime in the past. The relativity theory breaks down at this stage, and it is assumed that this singular state represents the origin of the universe in a big bang. The physicist starts the universal clock ticking at this instant.

The astronomer, on the other hand, measures the "look-back time". If he observes a galaxy at a distance of a billion light years, he is seeing it as it was a billion years ago, for light has taken a billion years to travel from the galaxy to here. The expanding universe provides a convenient measure of this past epoch. We ask, by how much has the universe grown in linear size since the light left that galaxy. If the answer is, say, five, then it means that the universe has become six times (five plus one) its original size in that period. This growth fraction can be measured in the spectrum of light received from the galaxy and is known, for technical reasons, as redshift. So in the above example the redshift of the galaxy is five. Clearly, the larger the redshift of an astronomical source, the farther is it located from us and the smaller was the universe at the epoch when light left that source in order to travel to us.

By this reckoning, the Big Bang epoch has infinite redshift and it is tempting to visualise a super-telescope capable of seeing as far as that epoch. Unfortunately, this is not possible. The Big Bang theory itself provides the reason why. By the time we try to probe sources beyond a redshift of a thousand, we encounter an opaque universe. Estimates put the age of the universe at that epoch at around a lakh of years. So what lay beyond that epoch cannot be seen by the astronomer. Necessarily, therefore, the astronomer is forced to rely on extrapolations of his theoretical model coupled with speculation to guess what the universe was like before that epoch. This is much like a spectator trying to guess what is going on behind the stage-curtain which has come down between two acts of a play.

To help his speculation the astronomer has turned to the physicist for guidance. As he tries to imagine what the universe was like closer to the Big Bang epoch, he finds that its constituents were moving with greater and greater speed as the Big Bang was approached. To figure out what happens to them the astronomer therefore needs information on how particles of matter behave at increasing energy. The physicist can provide help because he has built particle accelerators which make them collide at very high energies. Two major particle accelerator labs have been providing useful information on this topic: one CERN, near Geneva, Switzerland, and the other, Fermilab, near Chicago, in the US.

It should be noted that these labs have been in existence for several decades and their main purpose is to study the behaviour of sub-atomic particles at higher and higher energies. The quantum theory which became established as the correct framework for studying particles on a small scale tells us that if we need to probe the structure of matter at very very small scales, we will correspondingly need particles of higher and higher energy. Indeed these labs have contributed significantly to our understanding of how particles interact at energies as high as several hundred giga electron volts (an energy measuring unit often written as GeV). For example, the verification of the framework unifying the weak theory with the electromagnetic theory was carried out at CERN by generating collisions of particles of energies of the order of 100 GeV.

The next landmark in high energy particle physics aims very high: it is the energy required for unification of the above electroweak theory with the strong interaction, an achievement that will show that three of the four basic interactions of physics are part of a "grand unified theory", or GUT. Can one augment the capacity of the present accelerator to test the properties of GUT? It will also help the cosmologist in his quest for the state of the universe very close to the Big Bang for, many of the crucial issues of the present universe are related to how the universe operated in the GUT era and shortly thereafter. The recent much hyped Large Hadron Collider (LHC) is planned to reach energies of 7,000 GeV, about seven times the capacity of the previous top accelerators. To date it has reached half that target.

Unfortunately, that holy grail of particle physics is well beyond the present technology or even the technology of the foreseeable future. For the energy needed to be reached is some 1,400 billion times the aimed energy of the LHC!

So why is the LHC so hyped? Certainly if it fulfils its objectives of verifying some details of present theories of particle physics, it will have served its purpose. For example, if it provides evidence for the existence of a speculated particle, the Higgs boson, or gives support to some conjectures of the so-called super-symmetric theory, it will have made a significant advance in our understanding of high energy particle physics. But it is still a long way to go for simulating the Big Bang, as so avidly claimed. Nor does it stand in any danger of accidentally producing world-gobbling black holes.

I wish scientists could forward and correct the media-generated frenzy; otherwise the LHC may stand for a large hype creator.

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