

Diatribes 180

The world's costliest scientific experiments – what for?

Last month I threatened you with a talk on the Large Hadron Collider; today I'll make good on this threat. Last time I mentioned that with a machine as complex as the LHC the notion flogged in the media that all you had to do on day one was to throw a switch was a nonsense. Predictably, the switch was thrown and predictably, things went wrong. Not in major ways; the glitch will only cost a million or two, at first, anyway. With a bit of luck, they'll be able to throw the switch again in April 2009. But let's start at the beginning.

The word "atom" came from the Greek, meaning indivisible. The ancients already had an idea that matter was made up out of tiny particles, and that it was the mixture of these particles which determined the nature of matter. Ever since Ernest Rutherford a century ago it became clear that, as usual with scientific certainties, the atom was far from indivisible and that there were other particles, much smaller and much more diverse which made up matter. The problem with these was that you couldn't see them, you could in most cases only infer their existence by a lot of inspired guesswork. Even then you were lucky if they existed for a millionth of a second before disappearing.

The discipline of particle physics gained respectability when, during World War II, what was at that time the world's costliest scientific experiment was used to destroy two Japanese cities and many of their inhabitants. Ever since, the world's people have lived in the shadow of nuclear destruction, or, as it used to be called, MAD or mutually assured destruction. And ever since then almost unlimited amounts of cash have been available from a large number of governments to continue the experiments which led to the nuclear age. The largest and costliest of these is called the Large Hadron Collider.

What does a collider do? Like most of these monstrous toys, it speeds up particles and smashes them together, and analyses the bits that fly out after the impact. The smaller the particles, the more difficult it is to separate them and to analyse them. In the case of the LHC as in many other particle smashers, particles are pushed around a ring and then let go. It is a bit like whirling a stone at the end of a bit of string, an exercise which worked, if you were to believe the legend of David and Goliath, thousands of years ago. Only in this case what they are swinging around is not a stone but a cloud of subatomic particles, and the whirling speed is getting within a tiny fraction of the speed of light which according to Albert Einstein, can never actually be reached. And, for their final trick, the physicists make another lot of particles run around the same circle in the opposite direction before they smash the two lots together.

The machine which does this is a ring 100 metres below ground in France and Switzerland. It has a circumference of some 27 kilometres which the particles will be made to traverse thousands of times per second. Like the stone on the string, and everything else in the universe, the particles would like to go in a straight line, so they have to be forced into a circular path and that is done by a lot of magnets. These magnets, weighing many tons, are toys compared to those used in the detectors which waylay the particles on the way out of the ring to make them give up their secrets.

This is not an ordinary ring, nor are the magnets merely big and heavy. The particles rushing round the ring should all be of the kind required in the experiment, so all the air has to be pumped out of the ring before the experiment begins and the particles are injected into the system. This requires a vacuum several times better than that at the surface of the moon. This means the ring and all the rest of the apparatus has to be well sealed.

There are, in all, 4 experiments planned at present. Each requires the bending of the particle stream by magnets. Measuring the amount of deflection is one of the ways of identifying the particles and their properties. The biggest of the detector magnets weighs some 12,000 tons. To house these detectors a hundred metres below ground veritable caves had to be dug, underground rivers had to be dammed, there were no end of problems which had to be overcome.

Perhaps the biggest of these is caused by the need to produce the magnetism by superconductors. This way, the amount of energy required to produce the magnetic force is zero, once the field has been established. However, establishing the fields and maintaining the low temperature required to maintain superconductivity consumes massive energy. Indeed, the temperature at which this baby runs is 1.9 degree Kelvin, lower than the temperature existing in the universe. To establish this low temperature the system needs initially to be flushed with liquid helium, tons and tons of it. Liquid helium has zero viscosity, meaning it will penetrate the smallest crack. Compared to this level of sealing the sealing of a nuclear reactor is child's play. And the energy needed to run the machine is not available in winter, because in winter they need it to heat France and Switzerland.

I am sorry to have spent so much effort in explaining what is after all a pretty esoteric machine or group of machines. This is unfortunately necessary if I am to explain the nitty gritty of my complaint. Such a machine is not cheap. The current estimate of its initial cost is 10 billion dollars, and its annual running cost is difficult to establish because it is not known how many of the 6000 top scientists associated with this project are being maintained at the expense of their institutions which, in turn, are supported by countries too numerous to mention.

Knowing my scepticism in relation to complicated technology it will come as no surprise to you that the last thing I would expect is for this system (it is a system, not a machine) to work faultlessly for any length of time. Sure enough, when it was first switched on amongst masses of hype, there were massive leaks of helium. They don't tell us how many, but I bet there were more than one. Here comes the bitter bit. Every time some adjustment or repair to this machine has to be carried out it takes 5 weeks to get it back up to room temperature, followed by another 5 weeks to cool it down again.

So, assuming they get it to work, what do they expect to get from it? The answer may well be – nothing. Each millisecond – no, microsecond – of operation will result in masses of data, because the events they are looking for last less than microseconds and will not be apparent until the data are fully digested, only some of which can be done by computers of which there are dozens. The answers they are looking for are like Douglas Adams' Hitch hikers guide to the Galaxy, about life, the universe and everything.

With all this, my beef is not about the amount of money spent on this project. After all, the Iraq war has already cost 100 times as much, and all it can ever produce is misery. My actual complaint is about priorities. Here we have at least 6000 of the world's top scientists beavering away to find Higg's boson(the particle which supposedly carries mass in the universe) which they already looked for unsuccessfully for some 20 years. Yes, we have problems which these very scientists could busy themselves with, such as global warming, or third world poverty. Instead, they are all dead keen to get their names on scientific papers which carry nothing but kudos, if that. And here we have politicians supporting these efforts with our money in the hope that despite what the scientists say, they will come up with some fearful new weapon that can destroy entire continents. What a world we live in!