Cheltenham Science Festival – 12/06/12 to 17/06/12

Dark Matters

This hilarious talk was presented by two of the funniest scientists I have had the pleasure to watch, Drs Tom Whyntie and Andrew Pontzen.

They discussed the 'Where's and wherefores' of the existence of Dark Matter in the style of the two Ronnie's, acting out a number of scenes with both cases for and against presented.

Scene 1, was two scientists, one and astronomer and the other a physicist, explaining observations made of spiral Galaxies revolving too fast and discussing the reasons for this. They came to the conclusion that there must be something unseen, unfelt, un-taste-able, un-smell-able, something that was probably Dark, Dark Matter even that was causing this situation.

Scene 2, saw our intrepid duo coming to terms with the LHC's inability so far to find any definite proof either.

Scene 3, delved into the dangers of students pinning their whole academic careers into research, and trying to find Dark Matter, and then not finding it.

In the last scene they looked at possible career and budgetary dangers of delving into alternative theories, going against the current wisdom. The world can be a cruel place.

Can Robots Think

There were three speakers who between them outlined some of the methods being investigated in the development of robotic intelligence.

The first method outlined was to start from scratch. In other words try to develop robotic intelligence from the ground up without using any existing examples, for example, biological systems as a template.

The next approach is to try and develop a working model of a brain within a computer, albeit a seriously big, powerful super computer. There are a small number of teams attempting to do this and have so far managed to build simulations of clusters of a few hundred neurons. They hope to achieve something as complex as a rats brain in the next 10 or so years.

The last method is to try to build a brain totally in hardware, whereby all the brains circuitry is copied using current day silicon chip technology. I am not sure how far down the line they are in developmental terms using this method. Most of the remaining discussion was to do with trying to define what was meant by ”thinking”.

During the discussion mention was made of the Turing Test also how science fiction in particular i-Robot and Blade Runner seemed to try and explain how robots could be considered to be thinking.

One thing that was not discussed was robotic swarms and the development of the “Hive” mind, where seemingly intelligent behaviour may appear from simple commands having been programmed into robots which have been linked together in a group or swarm.

Superconductors

An explanation of how superconductors were first discovered by Dutch physicist Heike Kamerlingh Onnes who initially was trying to develop ways of freezing mercury down to or at least as near to absolute zero as possible.

The basis of superconductivity was explained and is well understood in most superconducting materials and is dependent on electrons pairing up, called Cooper Pairs, but there are some materials which exhibit superconductivity at higher temperatures where understanding of this process is limited.

Some applications for superconductivity were discussed such as their use in MRI scanners and other similar medical scanning technology, also in the powerful magnets used in particle accelerators such as the Large Hadron Collider. They are also used in some “maglev” trains and in frictionless bearings.

Lastly their use in the development of atomic fusion at the Joint European Torus or JET project in Harwell and its future use in ITER, the next phase in fusion research in France, was outlined.

Fusion: The Holy Grail?

Ever since the start of the JET project in the 70's the search for a safe clean source of energy has been accelerating with fusion being one of the sort after Holy Grails. The two speakers, Dr Kate Lancaster and the MD of the JET lab at Harwell gave a synopses of their particular methods by which fusion could be obtained.

Kate started first. She explained the process and some of the science behind Fusion while keeping the explanation relatively simple and entertaining. Her method of creating Fusion is to bombard a small target, plastic covered, metal pellet the size of a pea with a powerful blast from a high powered laser. This oblates the outer plastic layer causing the metal 'pea' to be compressed whereupon fusion takes place with the release of an immense amount of energy. The one main problem in this method is that to create a steady stream of energy you need to fuse a steady stream of pellets into the 'target' zone from something similar to a machine gun. This as yet has not been invented.

The other speaker then presented the JET method of producing fusion. This involves heating an isotope of Hydrogen gas till it becomes a plasma, then injecting this into a magnetically confined holding container called a Torus. Due to the type of magnetic confinement used, the plasma heats up to over 100 million degrees Kelvin, far hotter than the centre of the Sun. At these temperatures the protons are forced together and fusion takes place. So far however, JET has only managed to keep the fusion process going for a few seconds at the most, but is hoping that by 2015 they will have succeeded in sustaining this process for a much longer period. Also by then a new torus many times more powerful will have been completed in Provence, France This is called ITER. ITER will be able to reach temperatures of 200 million degrees Kelvin and it is hoped that it will be able to hold a fusion reaction going for many hours..

Hunt for the Higgs Boson

Our two speakers were Dr John Ellis and Dr Jim Burly, both of whom work at the LHC at CERN in Geneva, Switzerland. The LHC is a circular particle accelerator 27km in circumference some 500m under the Swiss countryside.

Dr John Ellis began by outlining some of the questions man has puzzled over for a very long time:

- What is matter made of?
- How was matter created?
- Where did the Universe come from?
- What is the Universe made of?
- How is the Universe evolving?
- And more recently, what is Dark Matter?

John explained that there are basically 4 known forces in nature – Gravity, Electromagnetic, the Strong Nuclear and the weak Nuclear Force. Of these only Gravity is proving difficult to understand. Also the other forces seem to be related but Gravity cannot be linked as easily.

The Standard Model of atomic physics was postulated in 1954 and in 1964 Dr Peter Higgs suggested that Mass was an attribute of what has become to be known as the Higgs field. The particle associated with this field is the Higgs Boson.

It is hoped that the LHC is big enough and powerful enough to be able to smash protons together at such speeds allowing the Higgs Boson to be inferred from the debris of the collision. So far there has been a small blip in a couple of results which look promising.

Dr Jim Burly described the way in which the 2 main experiments, Atlas and CMS, at the LHC work and displayed a number of graphs showing their results.

Playing God

The prequel and sequel to evolution is discussed by Adam Rutherford.

Adam gave us a brief history of the formation of the Earth 3.8Billion years ago and the theories that suggested that the first life started to appear shortly after this and the sort of environment where it all started, sulphurous hydrothermal vents under the sea. This environment would have been ideal for the formation of a particular type of porous rock which would have acted as a scaffold for heavy metals plus other chemicals to bind together into a cell like structures.

He also discussed the work of Stanley Miller and other scientists who tried to duplicate the harsh conditions first encountered on the Earth to see if life or at least life building blocks could be formed. He also talked about Darwin's theory of Evolution and how this was initially considered to be blasphemous.

Moving onto the sequel side of things, Adam showed us a picture of a goat and explained that this particular animal had been genetically modified to produce spider silk proteins which could be extracted through a relatively simple process and used to weave spider silk cloth. This led him to talk about the latest developments in Bioengineering and what is now called Synthetic Biology.

Companies have sprung up offering pre-designed biological building blocks which can be thought

of as logic circuit elements and these can be put together in a similar fashion to conventional programming, to produce the required biological process. As he explained what now can be done in less than a week would have taken him 2 to 3 years when he was doing his PhD.

He also gave us an example of where this process had already been used to produce a gene which when inserted into a living cell would cause that cell to fluoresce. And this could be tailored to only activate in the presence of an external factor, such as a virus infection.

Alien Hunters

David Grinspoon,Shawn Domagel-Goldman and Lewis Dartnell discuss some of the latest discoveries in this field.

Currently around 2 to 3 thousand planets have been discovered in orbit around other suns in our galaxy. Some of these are thought to inhabit what is known as the Goldilocks zone, not too hot, not too cold, not too acidic etc. for life as we know it to exist.

They discussed “What is Life” and came up with a number of possible definitions and how these could be looked for on other planets.

The moons of Jupiter and Saturn were discussed as a number of these are proving rather exciting for the astro-biologists as the conditions on some of them are thought be suitable for sustaining at least bacterial forms of life.

Later this year a space craft will deposit on Mars the Curiosity Rover, a car sized vehicle which will be carrying out experiments on the Martian surface to determine if micro-organisms exist just under the surface.

Marius Stuart