"**To Infinity and Beyond"**
Professor Andy Parker
Cavendish Laboratory in Cambridge

Professor Parker described the current state of knowledge of the fundamental particles that form the basic building blocks of Nature. He started with the atom, made up of a nucleus and electrons and then the components of the nucleus and how they interact. Particles such as protons, neutrons, neutrinos, quarks, bosons, leptons and gluons, some of which have no mass and are very short lived. Physicists have developed a "Standard Model" which defines the electromagnetic, strong and weak nuclear interactions which mediate the dynamics of the known sub-atomic particles. However the Standard Model is not a complete theory since it does not incorporate gravitational forces and does not explain the mass of some fundamental particles. Since the fundamental particles are extremely short-lived, they are normally only detected from their interactions when larger particles such as protons are made to collide at high speed in a cyclotron.

The most powerful cyclotron is now the CERN Large Hadron Collider in Switzerland. The collider is almost 27 miles in circumference and enables two beams of subatomic particles called 'hadrons' e.g. protons to travel in opposite directions inside the circular accelerator controlled by 8000 superconducting magnets , gaining energy with every lap. The two beams collide head-on (up to 40 $x10^6$ collisions/sec) and teams of physicists from around the world analyse the particles and interactions created in the collisions using an Atlas detector. The planned 10 year programme started in 2008 and one aim is to confirm or eliminate the existence of the Higgs Boson – a theoretical particle predicted by the Standard Model to resolve some of its inconsistencies. Since the start-up of the collider, more than 75 academic papers have been published from the results to date (although it has only reached about 50% of its full power). However the Higgs Boson has yet to be detected.

Professor Parker finally briefly discussed efforts to achieve a "unified" theory incorporating gravity which may require 4 or 5 space-time dimensions.

Given on Wednesday 14 September at the Ashcroft Centre