The search for sparticles

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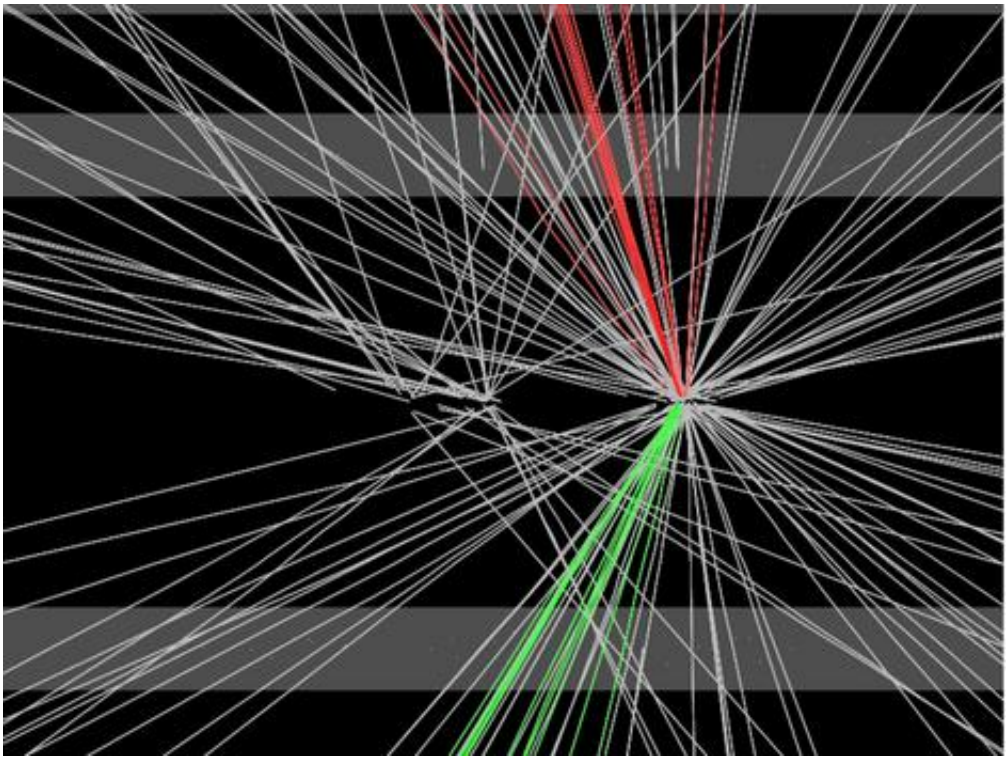

Visualisation of a recent collision captured by the ATLAS detector. Credit: ATLAS team.

One of the key theories underpinning modern physics is being tested by the latest results from the LHC's ATLAS experiment.

Supersymmetry theory says that every particle must have a Supersymmetric partner particle yet so far ATLAS hasn't found a single one of these 'sparticles'.

I asked Alan Barr, one of the Oxford University physicists behind ATLAS, about these new results and whether the theorists should be worried…

OxSciBlog: What is 'Supersymmetry' and why is it important?

Alan Barr: The subatomic world is described by a theory known as the 'Standard Model', which seeks to explain the basic building blocks of the universe, and the forces by which they interact.

The Standard Model has been very well tested over the last several decades, but it's known to have several nasty problems: for example it does not explain the origin of the gravitational force, nor does can it account for the invisible 'dark matter' that seems to make up the bulk of the universe.

The theory of 'Supersymmetry' extends the Standard Model, and solves many of its problems. The clearest prediction of this grander theory is that for every known type of particle there should be a Supersymmetric partner particle, known as a 'sparticle'.

OSB: How is ATLAS helping in the search for 'sparticles'?

AB: We can hunt for sparticles by studying the debris from the collisions at CERN's Large Hadron Collider. Einstein's famous formula E=mc2 tells us that energy can be turned into mass, so provided that the collision energies are high enough - and that the new particles are light enough - then we expect that some fraction collisions will produce sparticles. The heavy sparticles will rapidly decay, but they should leave tell-tale signs in the ATLAS detector.

OSB: What do these latest results from ATLAS tell us?

AB: Our team has looked for the signs of particular sparticles - the so-called ‘squarks’ and ‘gluinos’ - from the data recorded by ATLAS last year. Our results show is that if these sparticles do exist, they must be heavier than previously thought. They must weigh more than about 800 protons - otherwise we would have seen them already.

OSB: What more needs to be done to find out if Supersymmetry is real?

AB: There's certainly lots more work to do. We'll soon be firing up the accelerator again, and also increasing the rate of collisions. Then in 2013 we'll start running at even higher energies, which should give us sensitivity to even higher mass sparticles.

OSB: What would it mean if we could prove/disprove Supersymmetry?

AB: If we can prove the theory to be correct then we can hope to learn about the 'missing' 96% of the universe - the part which is not made out of atoms. Quite apart from the cosmological implications this would be a most impressive experimental confirmation of a very elegant theory of nature.

If none of these sparticles can be found, even in the highest-energy collisions, then it's back to the drawing board for the theorists...

Dr Alan Barr is based at Oxford University’s Department of Physics.

More information: atlas.ch/

Provided by Oxford University