Plain English Summaries In ATLAS

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LHC Experiments have real data and real results
after ~20 years.

Need to explain the results to the public.

➡ **Plain English summaries**

(following precedents of D0 and CDF
and some LEP experiments)

ATLAS has prepared 3 Plain English summaries so far and is working on others.

The process involves a primary author of the paper, an Outreach Committee member and members of ATLAS leadership.

Current P.E. Summary is started on Homepage

ATLAS Results Revealed at EPS HEP 2011 Conference in Grenoble

27 July 2011

Many members of the ATLAS Experiment Collaboration have been at the European Physical Society's HEP 2011 conference in Grenoble, France, this week, revealing the results of 35 new and exciting physics analyses for the very first time.

The results are based on painstaking examinations of a large amount of data collected by the ATLAS Experiment as it combed the gleanings from high-speed proton collisions at the Large Hadron Collider at CERN in Geneva, Switzerland. This data amounted to one inverse femtobarn, which equates to around 70 million million collisions. Even more data will be taken during the coming months.

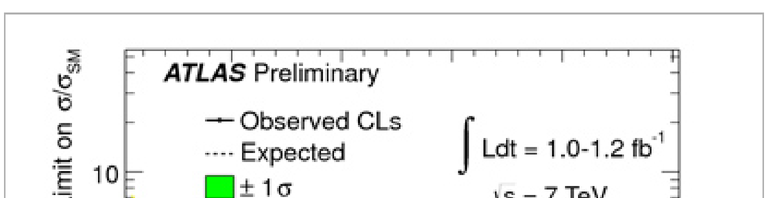
The new results build on extensive measurements already made by ATLAS to study physics processes related to the Standard Model of particle physics - physicists' current best theory describing fundamental particles and how they interact. ATLAS results presented at EPS narrow down the mass range where the much talked-about Higgs boson - the final missing piece of the Standard Model - could possibly be hiding. This is just the tip of the iceberg in the quest for new physics, though, and ATLAS is simultaneously exploring many possible scenarios, all of which were presented at the conference. Such topics include supersymmetry, extra dimensions of space, particles more fundamental than quarks, particles of new forces, and much more.

ATLAS physicists blogged live from HEP 2011, which gathered over 700 physicists and dozens of journalists from around the world.

Worldwide news coverage of EPS HEP 2011.

Example Plots

Combined Higgs:



Previous Stories

- A Search for New Physics Processes using Dijet Event - First Data from the ATLAS Experiment [June 2011]
- Is Nature Supersymmetric? First Data from the ATLAS Experiment. [May 2011]

Other Items

Discovery Quest

Check out the ATLAS fact sheets.

ATLAS FAQs

ATLAS eTours

ATLAS News Home

Is Nature Supersymmetric? First Data from the ATLAS Experiment.

24 May 2011

String Theory predicts a new symmetry, called "supersymmetry", that could shed light on some of today's mysteries of fundamental particles and interactions. In supersymmetry, every particle-type should have a "shadow" particle called a super-partner that (in general) has a much higher mass. The ATLAS Experiment has analyzed the first year of its LHC data and searched for evidence of these super-partners of ordinary matter.

In the proton collisions of the LHC, new heavy particles (the super-partners) could be produced. These super-partner particles would subsequently decay in a variety of ways, such as shown in Fig. 1, leaving many different telltale signals that ATLAS has sought to detect. Collision events with a so-called "momentum imbalance" are the key signature for the production of super-partner particles.

According to the law of momentum conservation, the momentum of all particles produced in the collision perpendicular to the proton-proton axis should exactly balance. An imbalance of the momentum would point to "missing" particles — particles that interact extremely weakly with matter. This imbalance occurs because the final decay products include particles that leave the detector without being detected (because they interact extremely weakly with matter). For the case of supersymmetry, these particles are the lightest super-partner particles (the "neutralino" $\tilde{\chi}_1^0$).

Since the neutralino $\tilde{\chi}_1^0$ does not decay at all, it is a permanent component of our universe. This particle might be the so-called dark matter that is 80% of all matter in the Universe. Therefore, these searches could shed light on the nature of dark matter. More about dark matter is here, and see the link to "PhD comics" therein.

The measurement of the momentum balance requires the precise reconstruction of all types of measurable particles and a combination of the many component devices of ATLAS. This makes it one of the most challenging measurements at ATLAS.

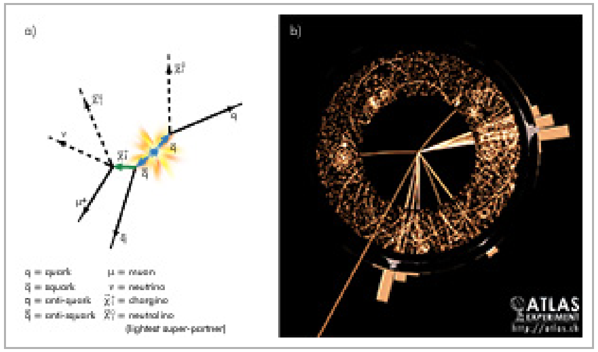
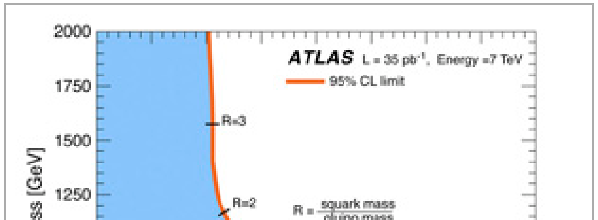


Fig.1 (Click picture for a larger version)

Fig. 1a): In this example, the collision of two protons results in the production of a squark and an antisquark (the super-partner of the quark and its antiparticle). These decay into lighter particles, one of which (a "chargino", written as $\tilde{\chi}_1^{\pm}$) also decays into still more particles. The chargino and squark are written with a tilde over them, which indicates that they are super-partner particles. The decays happen so quickly that no tracks are left in the ATLAS detector from the squark and chargino. In the end, two of the neutralinos $\tilde{\chi}_1^0$ (lightest super-partner particles) survive, because there are no lighter super-partners into which they can decay.

Fig. 1b): This figure shows an example of the momentum imbalance resulting from collision events such as in Fig. 1a). The two incoming (colliding) protons were perpendicular to this image, and the collision happened at the center. The visible particles are those that came out of the collision at the center. The solid bars on the outside show the areas where most of the energy went. It is clear that most of the momentum (and energy) went to the bottom and right. This imbalance was due to the lightest super-partner particles (and the neutrino) going undetected to the upper left. They leave no tracks and deposit no energy. This momentum imbalance is a signature for new particles.



A Search for New Physics Processes using Dijet Events

First Data from the ATLAS Experiment

21 June 2011

The ATLAS Experiment has extended the energy frontier of searches for new particles and new processes beyond those of the Standard Model by studying collision events with so-called "dijets".

As protons in the LHC collide, two collimated highly-energetic clusters of particles called 'jets' can be produced. The events with a pair of jets are called dijet events, see Fig. 1 and the video at the bottom.

At the unprecedented collision energy of 7 TeV, the LHC produces an enormous number of dijet events. This makes the dijet channel an ideal place to look for hints of new physics. Various theories that extend the Standard Model predict new particles that would decay to a pair of jets.

ATLAS has searched for possible deviations from the properties of dijet events that are characteristic of the Standard Model. Such deviations might be signals for excited quarks, microscopic short-lived black holes, "axigluons" or "technicolor-particles". Such studies might even tell us that the quarks are not fundamental particles, but are made of yet-more fundamental particles. In addition, these studies might provide us with the first signs of extra dimensions of space.

This type of search is somewhat different in concept to the searches for the Higgs boson and for supersymmetry. In those latter cases, the theory of interest is chosen, and a variety of different decay signatures are examined. Here the signature is fixed (dijets), and many theories can be investigated.

The ATLAS Experiment has taken data that significantly extend the mass regime explored and that allow us to look for signals of new physics. Even in the first full year of collisions at the Large Hadron Collider, these data take us into new territory, and Nature might surprise us.

If there were a new type of particle that decayed to two jets, it would show up in a plot of the distribution of a quantity known as "invariant mass". Invariant mass is the mass of the parent particle found by reconstructing it from the assorted particles into which it decayed (the particles in the two jets). The invariant mass is calculated from the energy and momentum of the decay products using the theory of Special Relativity, and it is equal to the mass of the particle that decayed.

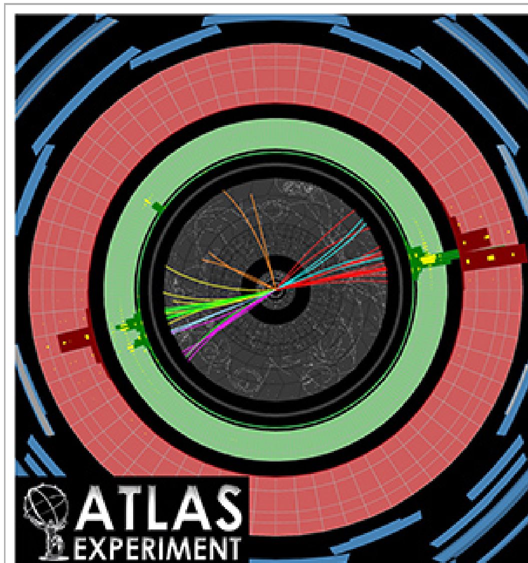
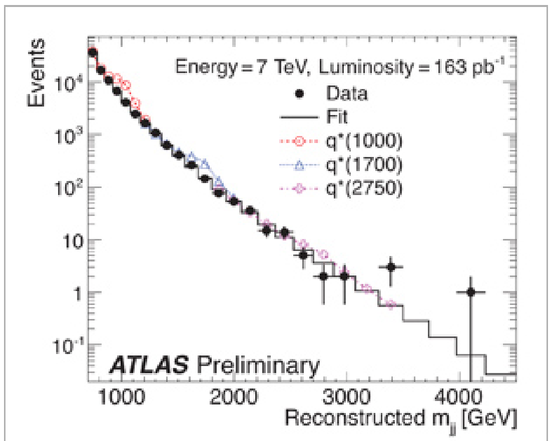


Fig. 1 (Click picture for a larger version)
This figure shows an example of a dijet event (a collision event with two jets). The two incoming (colliding) protons were perpendicular to this image, and the collision happened at the center. The particles came out of the collision at the center. The coloured lines represent the reconstructed tracks of the charged particles and the solid bars on the outside show the areas where most of the energy went.



Plain English summaries are an attempt to explain our results to a wider audience