LHCC Poster Session - CERN, 5 March 2014

A general search for new phenomena with the ATLAS detector at sqrt(s) = 8 TeV

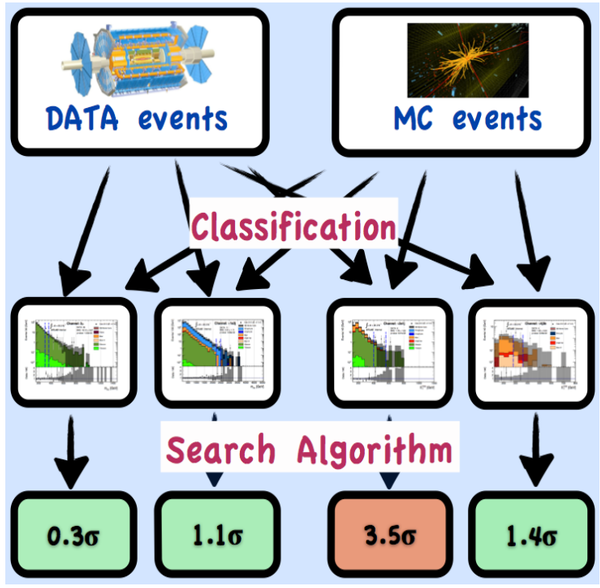
Hunting for New Physics

Many theoretical hints suggest to regard the Standard Model only as an effective theory, and to assume the existence of New Physics at the TeV scale. The great variety of proposed theories of New Physics makes it impossible to investigate all of them with dedicated searches, and it might be that nature has chosen a way not yet thought of.

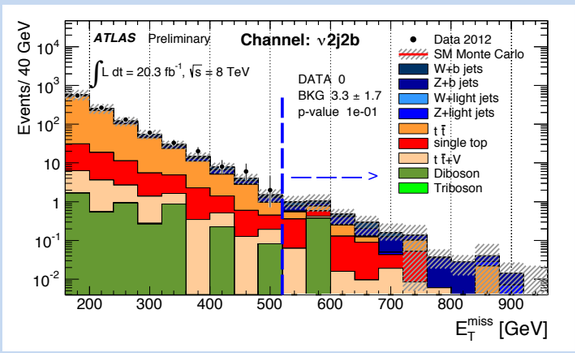
We need a model independent discovery tool!

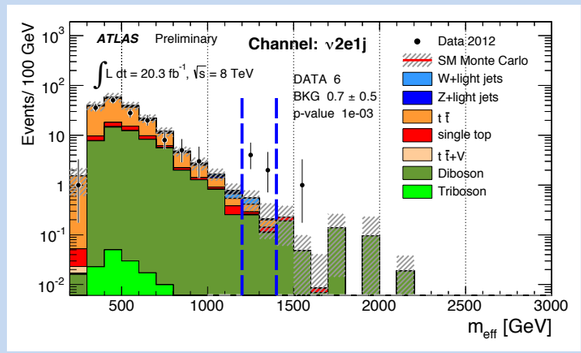
- A systematic search for deviations from the SM prediction (from MC simulation) is performed in all experimentally accessible final states.
- A statistical search algorithm is used to scan distributions and to identify regions which deserve a more through investigation.

ATLAS-CONF-2014-006



Search Algorithm





A statistical algorithm is used to search for deviations in the effective mass (the sum of the p_T of all objects and the E_T^{miss}), the missing transverse energy and the visible invariant mass distributions; to identify the region of greatest discrepancy between the Monte Carlo prediction and data.

The algorithm loops over all possible connected bin regions in the histograms, calculating for each of them a p-value, taking into account both statistical fluctuations and systematic uncertainties, the region of smallest p-value is taken as interesting. Both experimental and theoretical systematic uncertainties are considered.

$$p = \begin{cases} A \int_0^\infty db\, G(b; N_{\mathrm{SM}}, \delta N_{\mathrm{SM}}) \sum_{i=N_{obs}}^{\infty} \frac{e^{-b} b^i}{i!} & \text{if } N_{obs} \geq N_{\mathrm{SM}} \\ A \int_0^\infty db\, G(b; N_{\mathrm{SM}}, \delta N_{\mathrm{SM}}) \sum_{i=0}^{N_{obs}} \frac{e^{-b} b^i}{i!} & \text{if } N_{obs} < N_{\mathrm{SM}}. \end{cases}$$

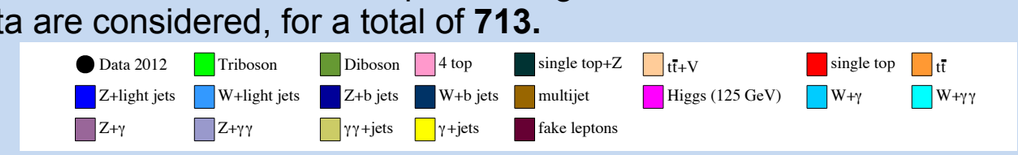
Event Classification

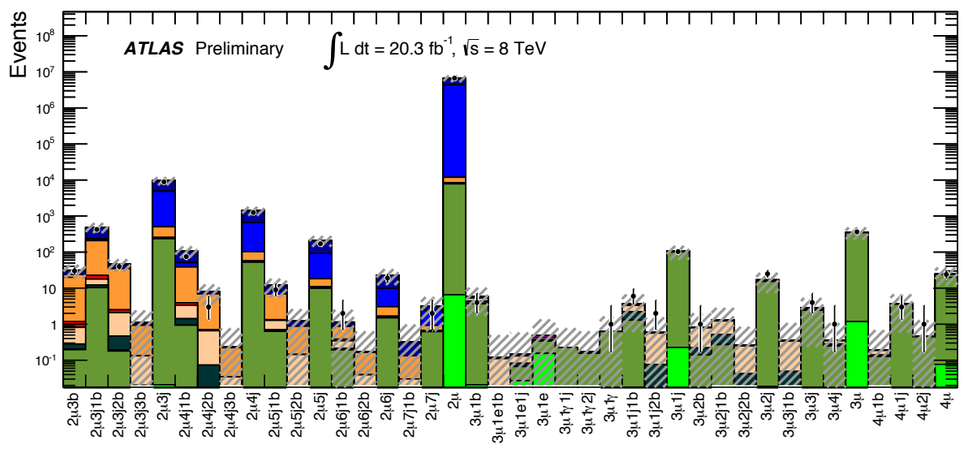
The analysis make use of the full dataset collected by ATLAS in 2012 using a set of single and multi object triggers.

Events are assigned to exclusive classes according to the number and type of high level reconstructed objects:

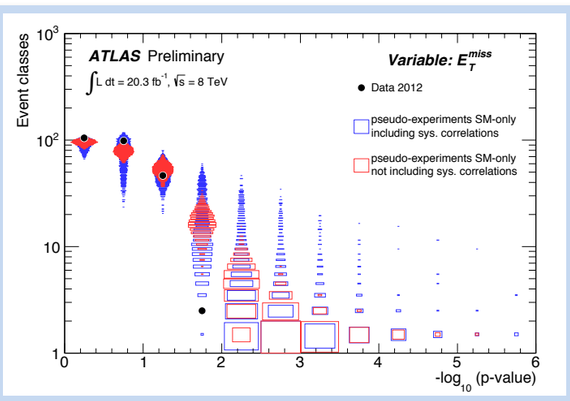
"e" – iso. electron, p_T>25 GeV
"g" – iso. photon, p_T>40 GeV
"m" – iso. muon, p_T>25 GeV
"j" – jet, p_T>50 GeV
"ν" – if E_T^{miss}>150 GeV
"b" – a jet with MV1 tag (70% OP)

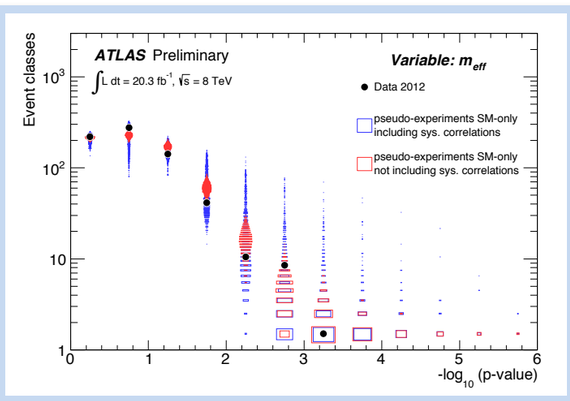
All classes with a total MC expectation greater than 0.1 events or with data are considered, for a total of **713.**

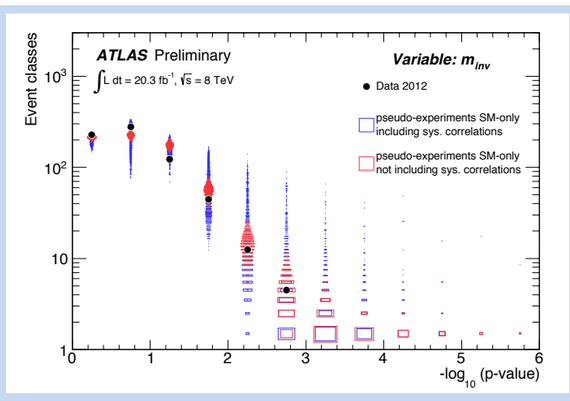




p-value distributions





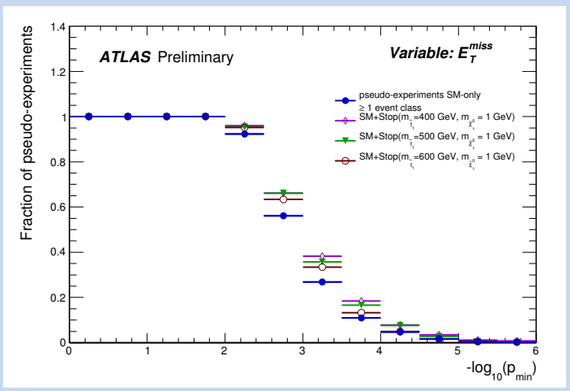


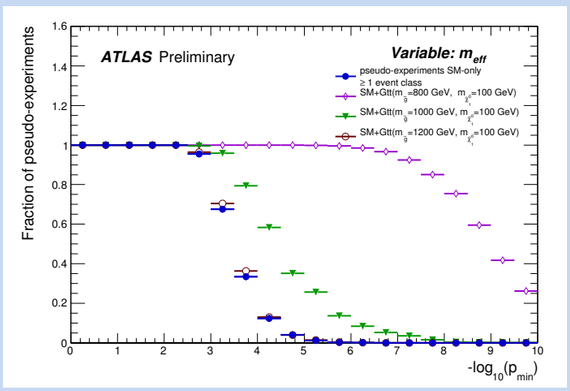
The p-value distribution observed in data is compared to an expectation obtained from many "ATLAS pseudo-experiments", which are scanned like real data.

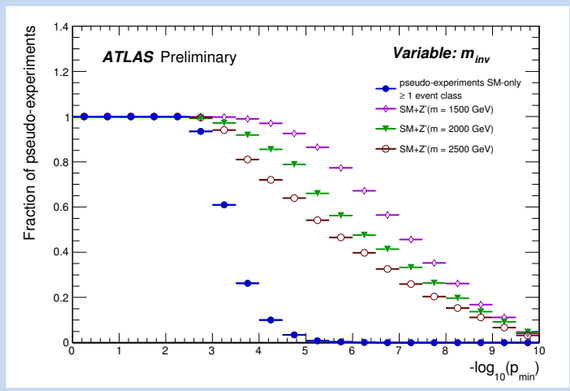
A good agreement is found in the three scans, with no deviation with a significance smaller than 10^{-4} found.

In the pseudo-experiments systematic uncertainties are separated into uncertainties correlated between all bins and classes and uncorrelated uncertainties.

Sensitivity to specific models







To quantify our sensitivity to popular new physics models we compute the fraction of pseudo-experiments in which at least one event class is expected to have a deviation greater than a given value (p_{min}), both under the SM and SM+signal hypothesis.

Models considered (with a range of particle masses) are: Gluino mediated stop production (Gtt), direct stop pair production (Stop), and a Z' model

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ATLAS EXPERIMENT