

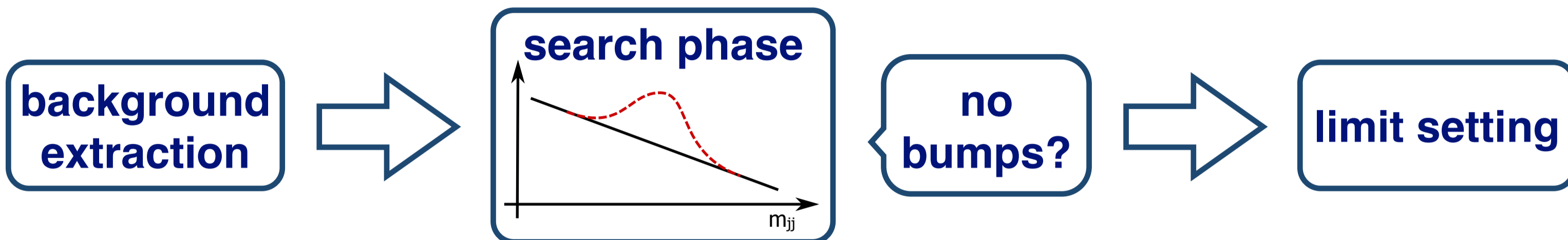


# Search for New Phenomena in the Dijet Mass Distribution updated using 13.0 fb<sup>-1</sup> of pp Collisions at $\sqrt{s} = 8$ TeV collected by the ATLAS Detector

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The **invariant mass distributions of dijet events** produced in pp collisions at a center of mass energy of 8 TeV by the LHC has been studied using the ATLAS detector. A total integrated luminosity of 13.0 fb<sup>-1</sup> collected in 2012 has been employed. The observed dijet masses extend up to 4.69 TeV. **No local excesses** have been observed. A 95% C.L. **limit** on the production of a **benchmark model of excited quarks**, q\*, has been set at **3.84 TeV**. The previous ATLAS 95% C.L. limit on q\* mass using 5.8 fb<sup>-1</sup> of 2012 data was set at 3.66 TeV. Limits on cross section times acceptance,  $\sigma \times A$ , have also been updated using simplified Gaussian models in order to allow limit setting on new theories.

## Analysis Strategy



## Trigger

Events are selected using the logical OR of **two central, single jet triggers** requiring at least one large energy deposit in the calorimeter, avoiding inefficiencies due to splitting and merging of jets.

## Background Extraction

The analysis looks for **local excesses** in the dijet invariant mass distribution. The **background is extracted from data using a smooth fitting function**:

$$f(x) = p_1(1-x)^{p_2} x^{p_3+p_4 \ln x} \quad x \equiv m_{jj}/\sqrt{s}$$

This reduces the effects of the uncertainties deriving from jet energy scale and luminosity while avoiding to fit possible local excesses.

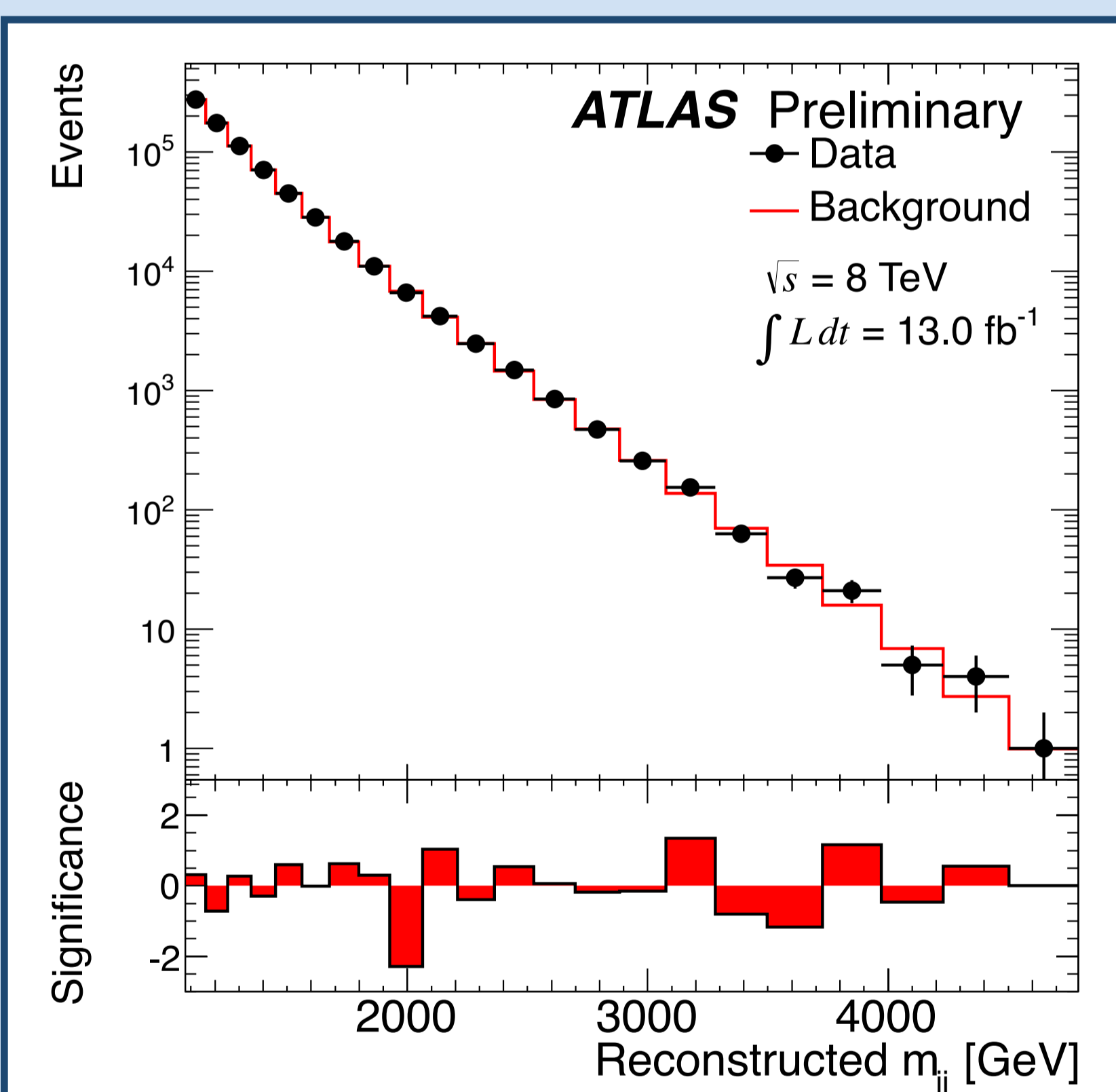
## Event Selection

- ◆ **anti-k<sub>T</sub>** jets, R = 0.6
- ◆ **jets calibrated** to remove pile-up effects and energy restored to the **hadronic scale**
- ◆ two central jets:  $|\eta| < 2.8$
- ◆ jets' rapidity in CM:  $|\eta^*| < 0.6$
- ◆  $m_{jj} > 1000$  GeV

The adopted kinematic selection criteria restrict the jets in the analysis to a minimum  $p_T$  of 150 GeV. The **highest jet p<sub>T</sub>** measured is **2.34 TeV** while the **highest dijet mass** observed is **4.69 TeV**.

## Search Phase

In order to have more stability in the bins with less events, a **Maximum Likelihood fit** is performed on the dijet invariant mass distribution using the smooth four-parameter function described above. For each bin, the significance of the statistical deviation from the fit is calculated using Poisson distributions, where a positive significance indicates an excess in the data. The fit gives  $\chi^2/\text{NDF} = 15.5/18$  with a **p-value** obtained from pseudoexperiments of **0.61**, confirming the overall **agreement between data and fit**. The **BumpHunter** algorithm has been used to look for localized excesses. **No significant excess** (p-value lower than 0.01) has been observed.



**excellent agreement between data and background**

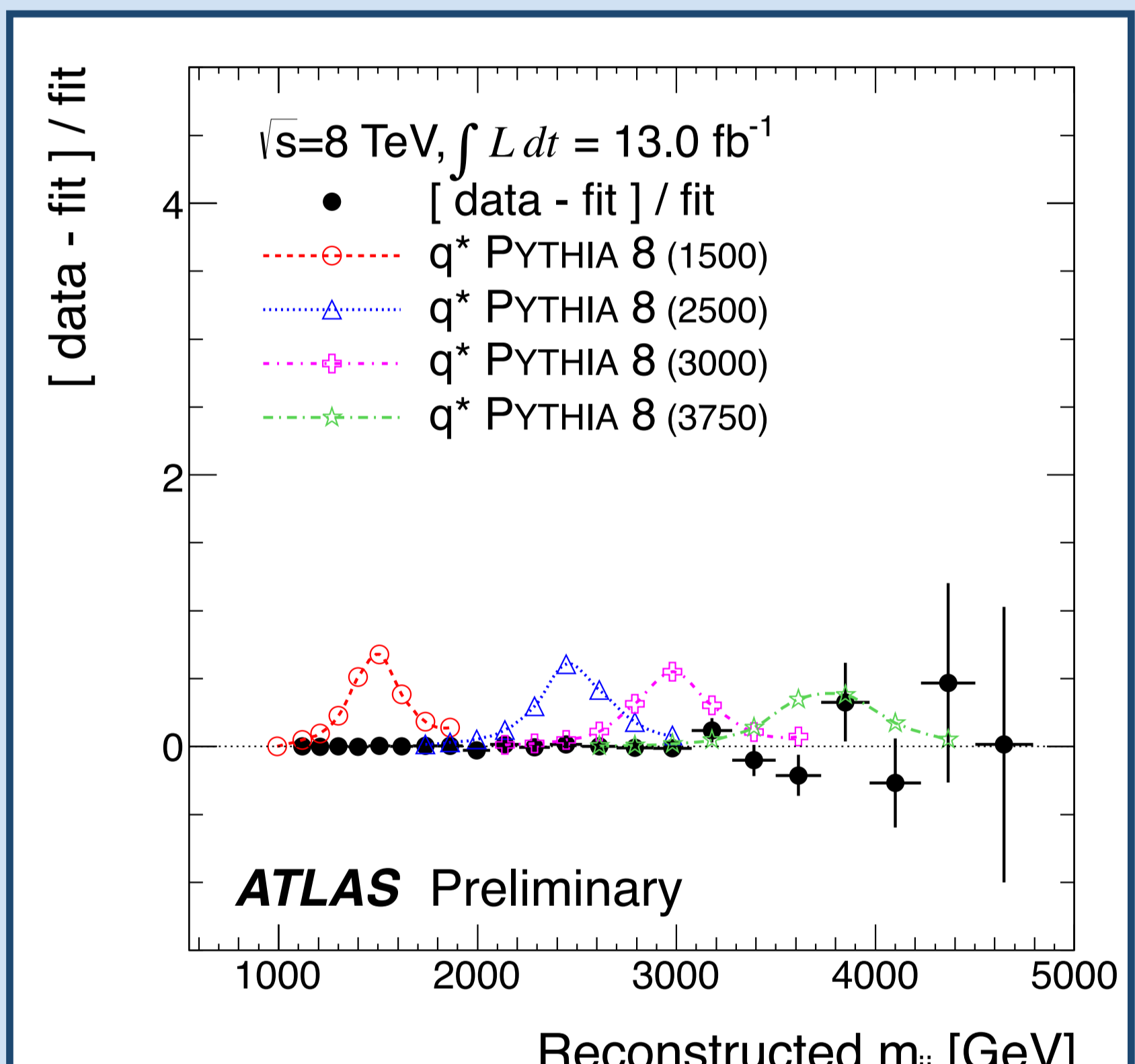
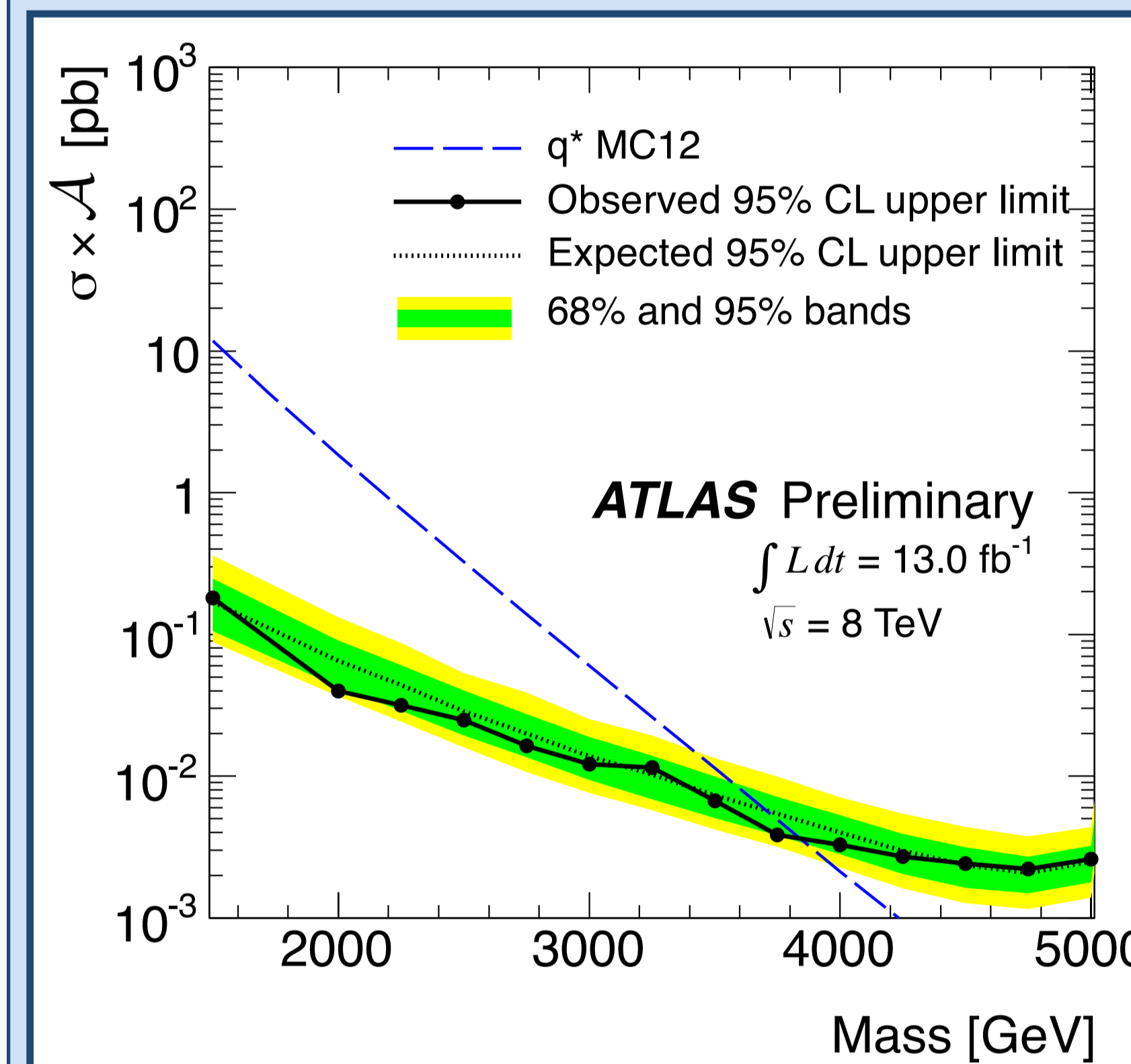
$$\chi^2/\text{NDF} = 15.5/18$$

$$p\text{-value} = 0.61$$

**no significant excess observed**

## Excited Quarks Limit Setting

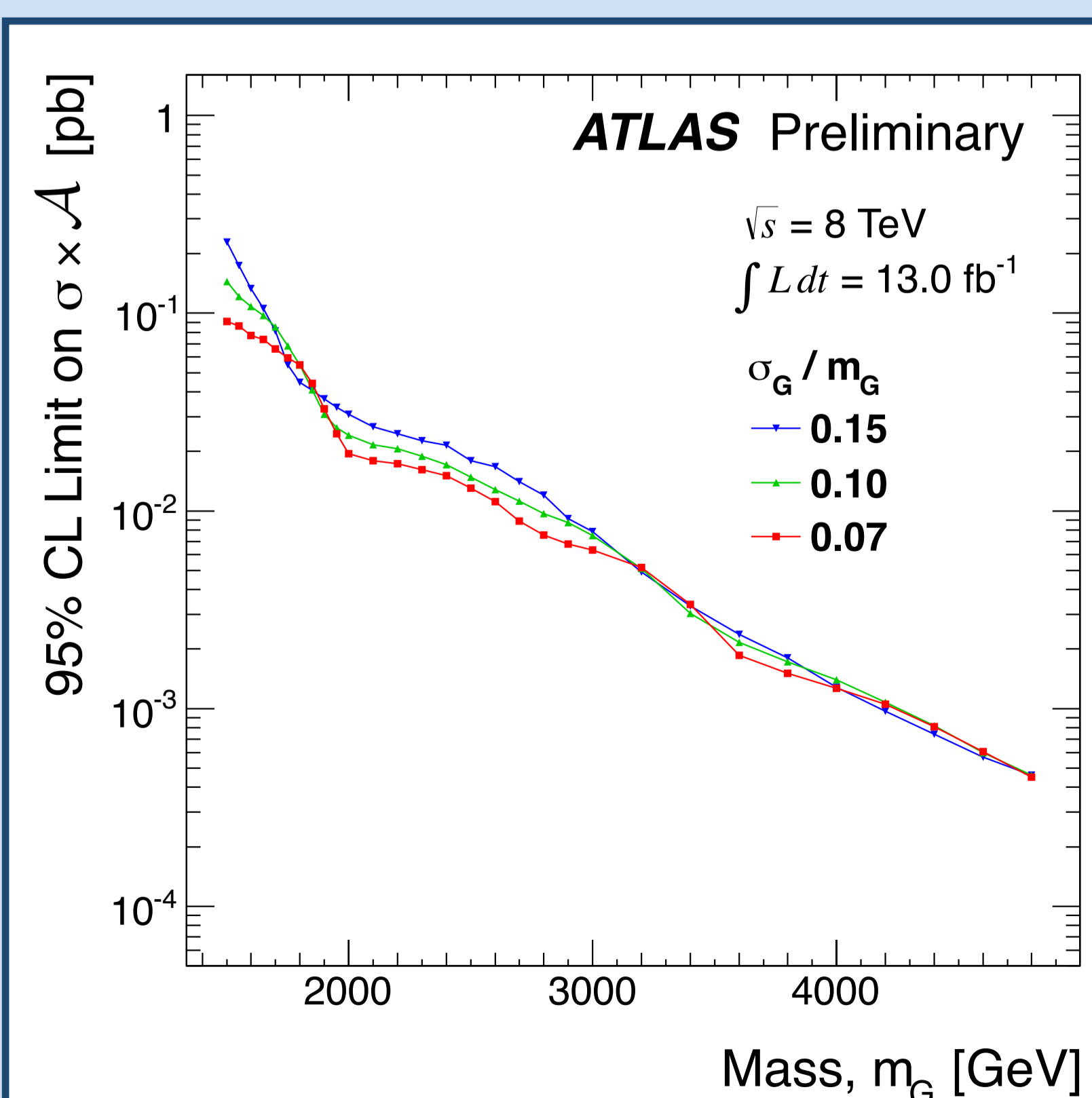
The Bayesian method has been used to set 95% C.L. limits on  $\sigma \times A$  for a benchmark model of excited quarks producing dijet events. The **observed upper limit on q\* mass is 3.84 TeV**, in agreement with the expected value of 3.70 TeV obtained from pseudoexperiments.



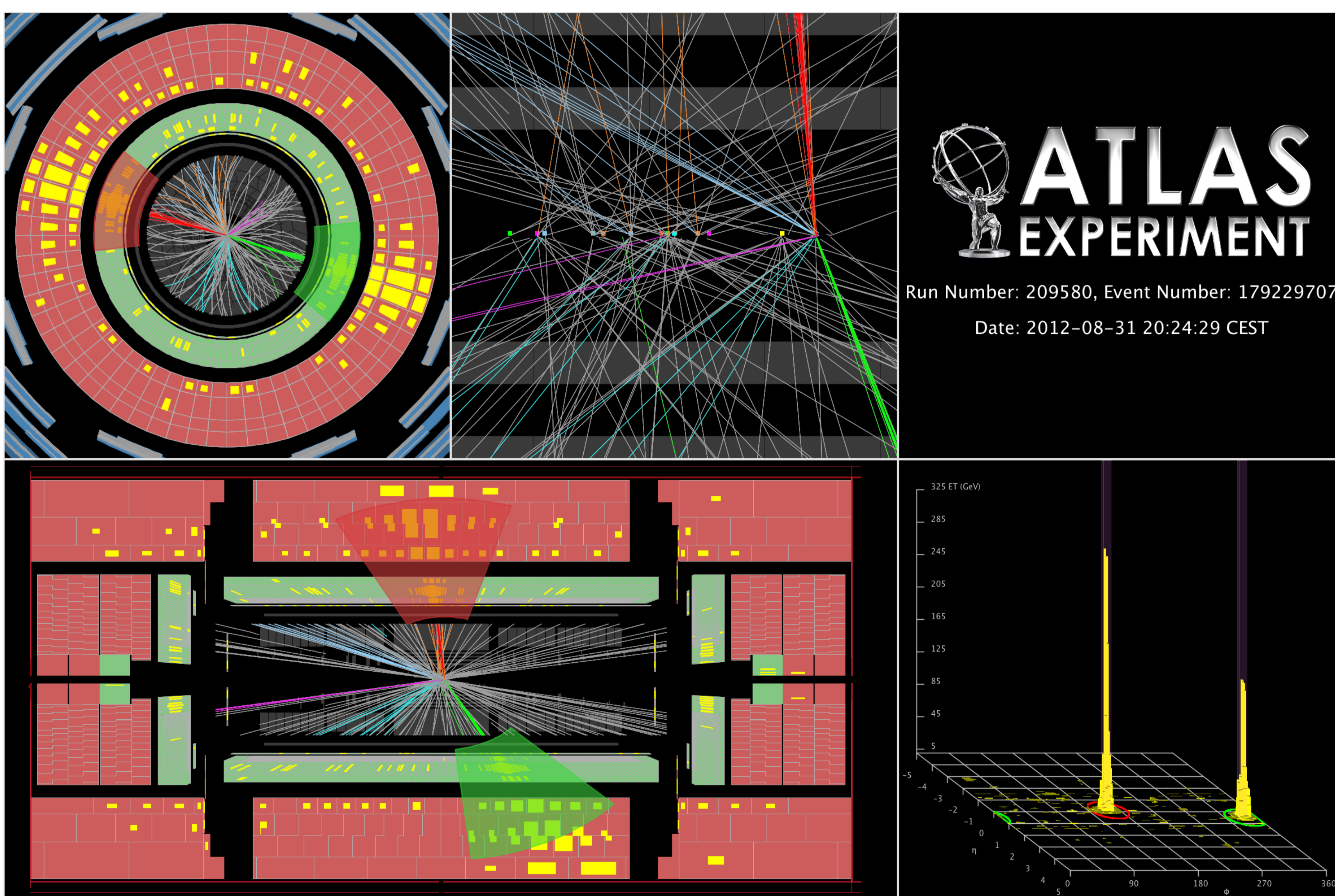
**the observed limit on q\* mass is 3.84 TeV, the expected limit is 3.70 TeV**

## Gaussian Limits

95% C.L. limits on  $\sigma \times A$  have been set on simplified Gaussian models to **allow comparison with other new physics models** producing dijet resonances. This can be done as long as the signal given by models after the analysis selection is Gaussian. Results are presented for three different resonance signal widths.



## Highest m\_jj Event Display



**Highest m<sub>jj</sub> event:** m<sub>jj</sub> = 4.69 TeV, p<sub>T</sub><sup>leading jet</sup> = 2.29 TeV, p<sub>T</sub><sup>subleading jet</sup> = 2.19 TeV.

ATLAS-CONF-2012-148, ATLAS-CONF-2012-088  
<https://atlas.web.cern.ch/Atlas/GROUPS/PHYSICS/CONFNOTES/ATLAS-CONF-2012-148/>  
<https://atlas.web.cern.ch/Atlas/GROUPS/PHYSICS/CONFNOTES/ATLAS-CONF-2012-088/>