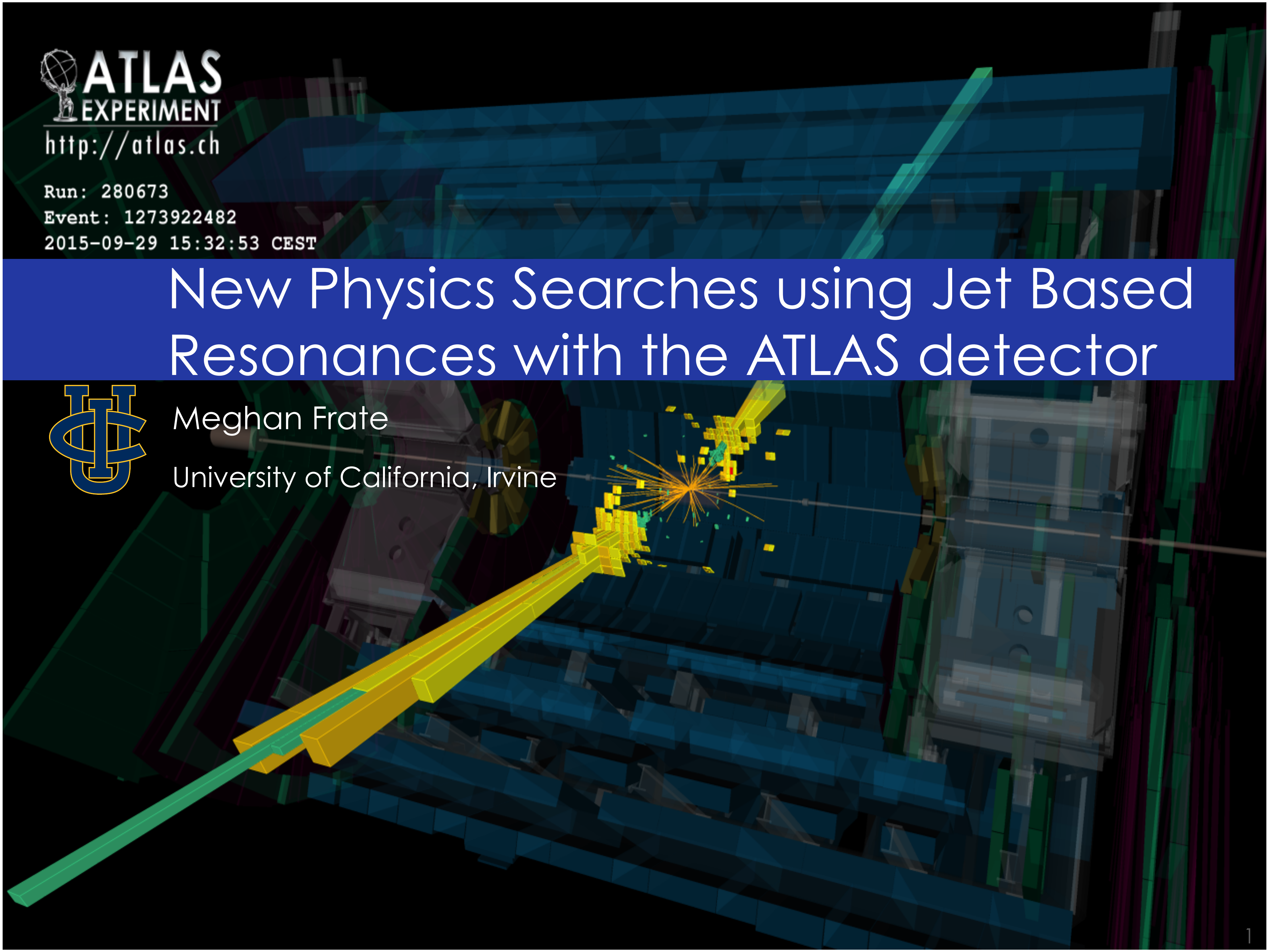


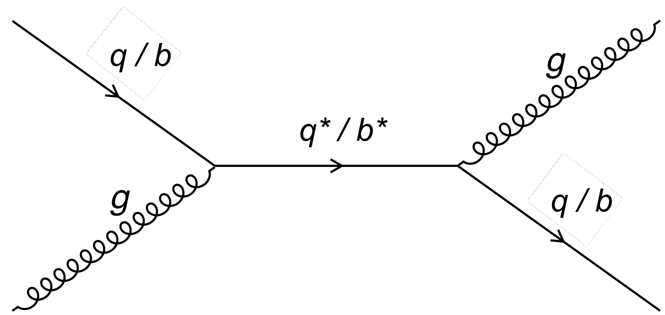
New Physics Searches using Jet Based Resonances with the ATLAS detector

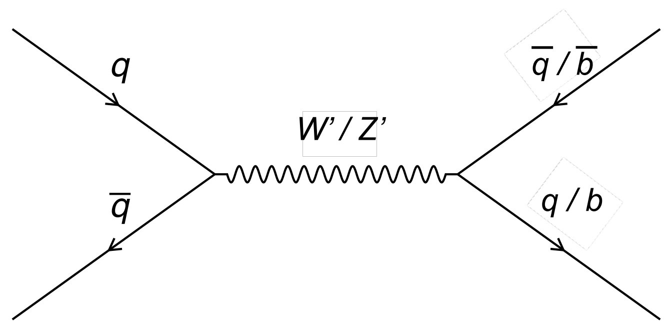
Meghan Frate

University of California, Irvine

Why dijets?

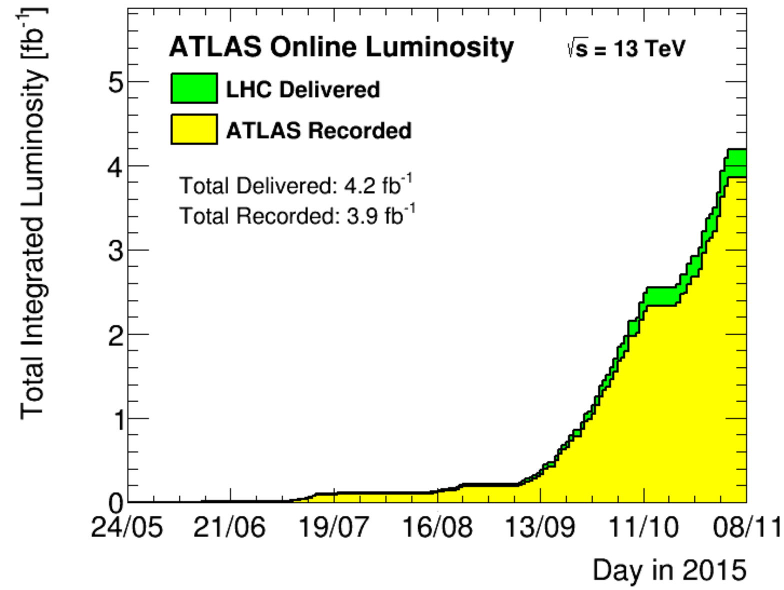
- Collide quarks
- Jets have highest production rate
- New physics preferentially decays to jets
- High momentum transfer
- Can search for wide variety of signals
  - Quantum Black Holes (QBH)
  - Excited quark (q*/b*)
  - Additional gauge bosons (W')
  - Dark matter mediator (Z')





ATLAS Detector Run Conditions & Sensitivity

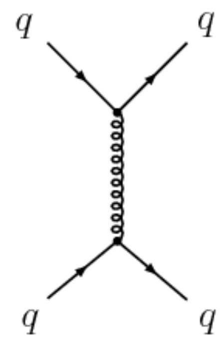
- Run II:
  - 13 TeV COM energy
  - 3.6 fb^{-1}
- Run I:
  - 8 TeV COM energy
  - 20.3 fb^{-1}



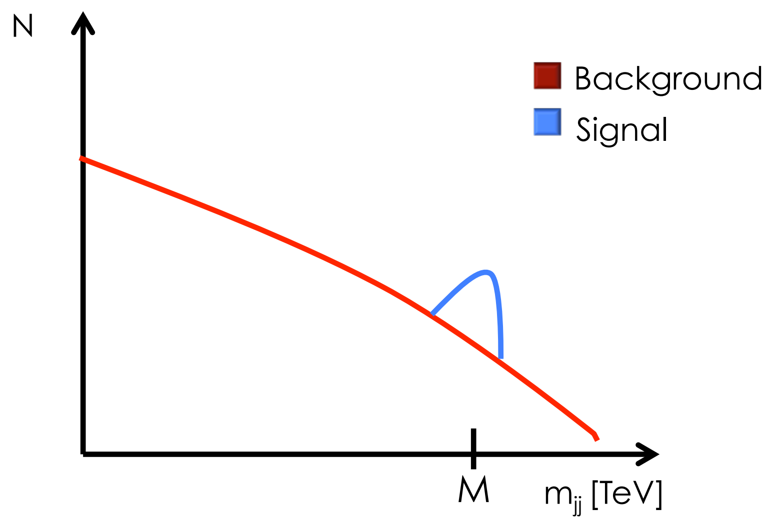
Model	95% CL Exclusion limit		
	Run 1 Observed	Observed 13 TeV	Expected 13 TeV
Quantum black holes, ADD (BlackMax generator)	5.6 TeV	8.1 TeV	8.1 TeV
Quantum black holes, ADD (QBH generator)	5.7 TeV	8.3 TeV	8.3 TeV
Quantum black holes, RS (QBH generator)	–	5.3 TeV	5.1 TeV
Excited quark	4.1 TeV	5.2 TeV	4.9 TeV
W'	2.5 TeV	2.6 TeV	2.6 TeV

Background: Dijet Analyses

- QCD scattering

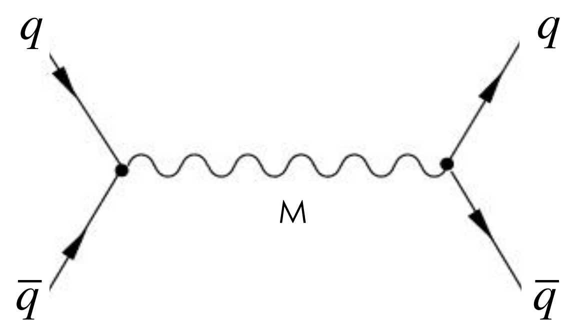


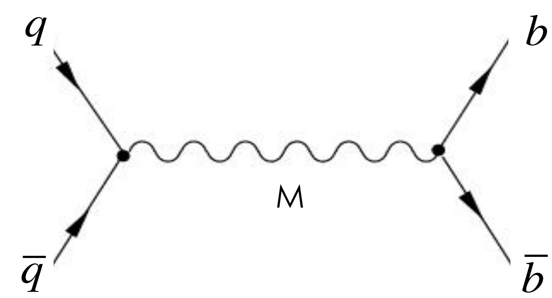
- Forms a smoothly falling m_{jj} distribution
- Look for new physics that would produce a resonance

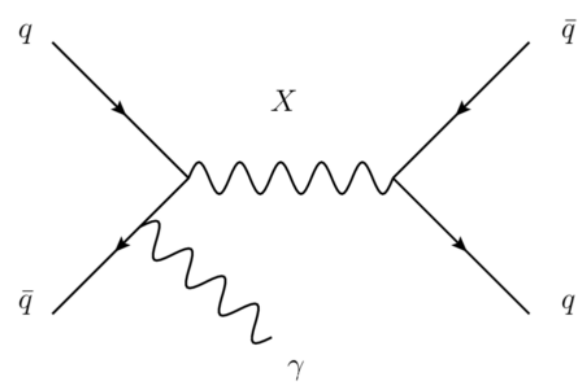


Dijet analyses

- High mass dijets
- High mass di-b-jets
- Low mass dijets (TLA)
- Dijet+ISR
- Low mass di-b-jets







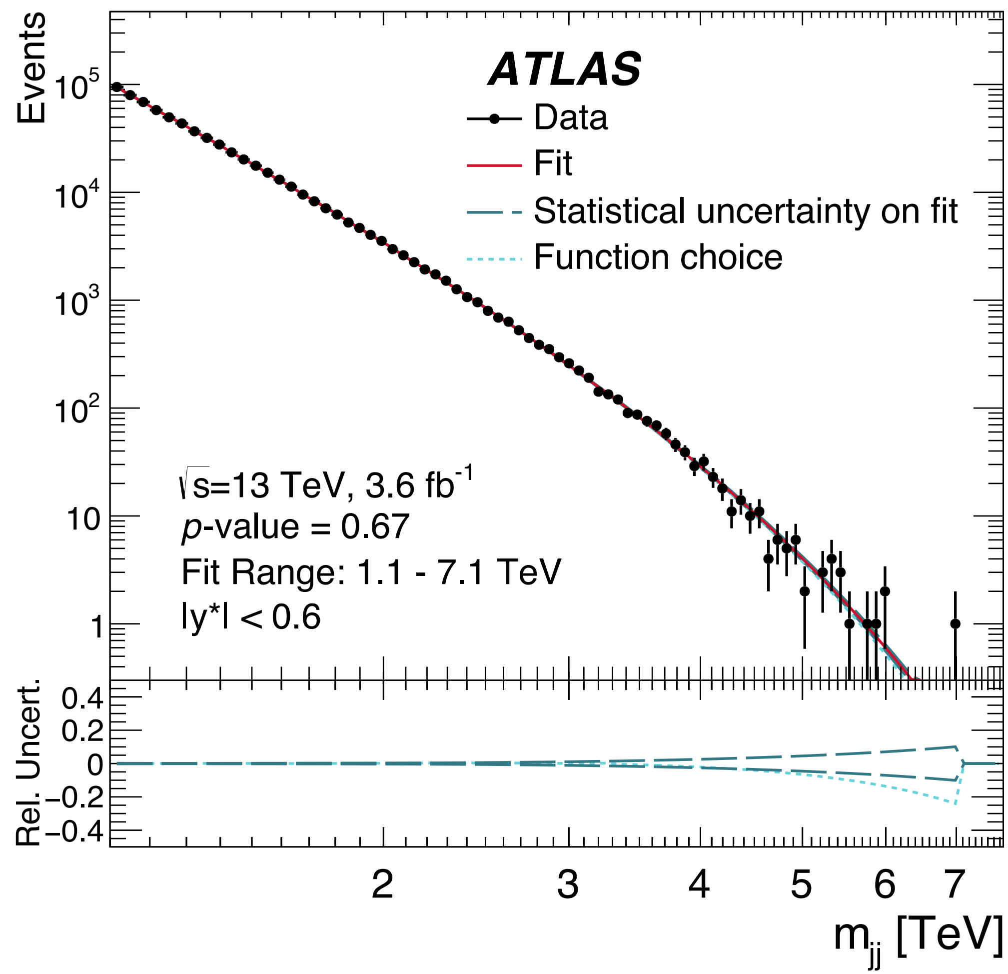
High Mass Dijet Selection & Background

- Selections:
  - m_{jj} > 1.1 TeV
  - Leading jet pT > 440 GeV
  - subleading jet pT > 50 GeV
  - $|y^*| = |y_1 - y_2|/2 < 0.6$
- Background: 3 parameter

$$f(z) = p_1(1-z)^{p_2} z^{p_3 + p_4(\ln x) + p_5(\ln x)^2}$$

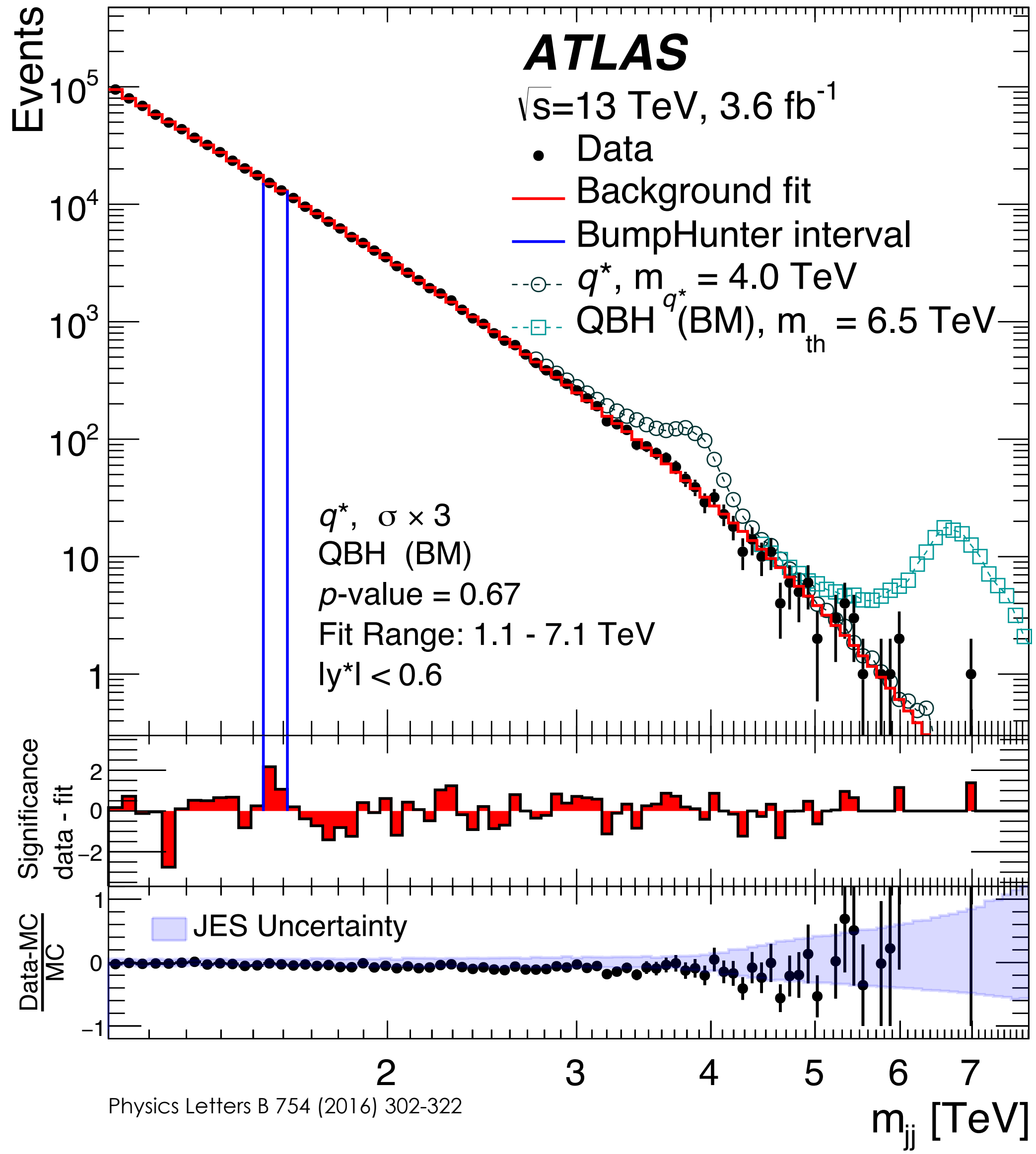
$$z = m_{jj} / \sqrt{s}$$

- Background uncertainties:
  - Choice of fit function
  - Fit function parameters



High Mass Dijet Results

- Top: data with fit function
- Middle: significance of data - fit
- Bottom: relative difference between MC and data



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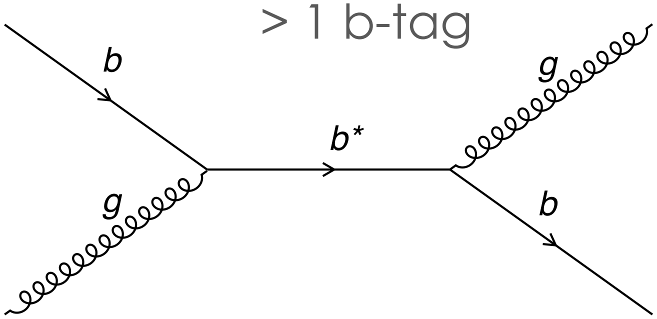
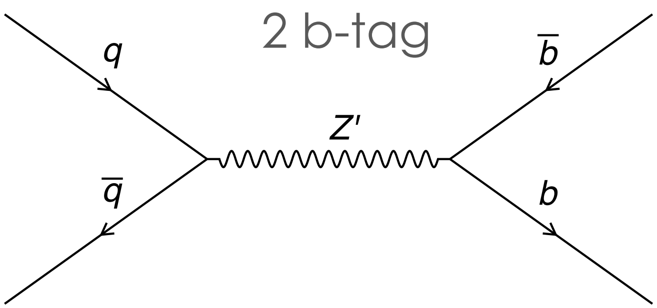
High Mass Di-B-Jet Results

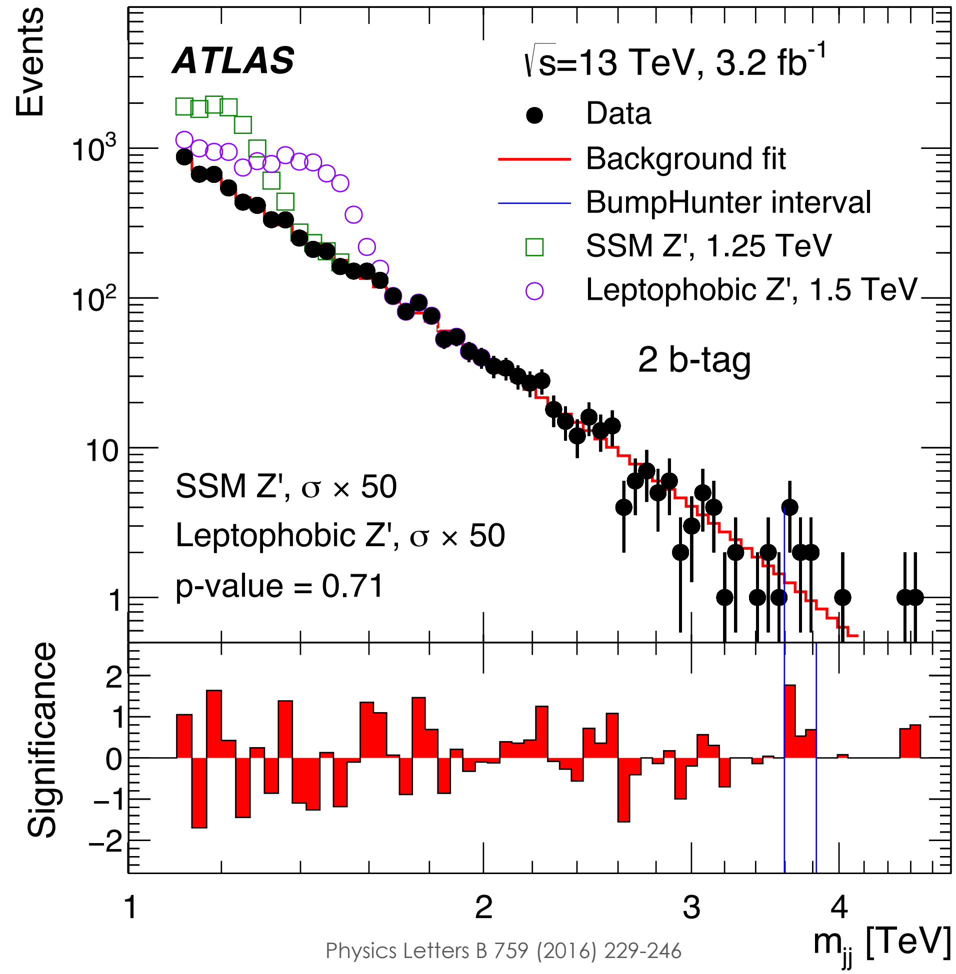
- Additional selection:
  - | η | < 2.4
  - > 1 or 2 b-tagged jets

> 1 b-tag



2 b-tag





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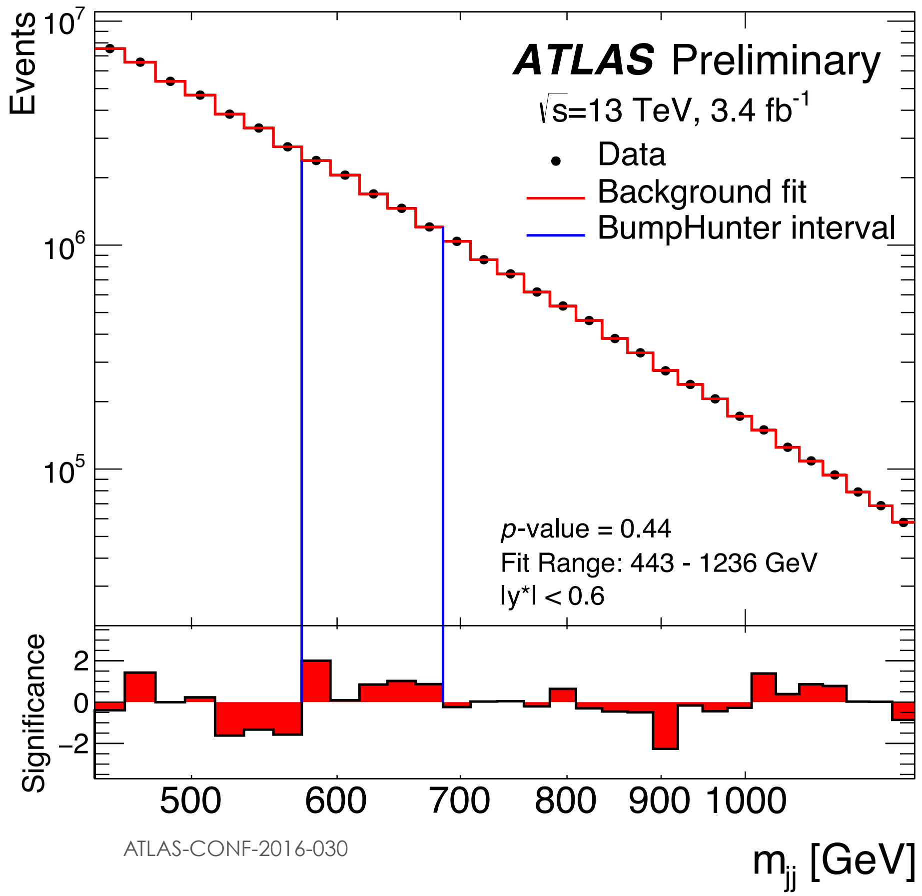
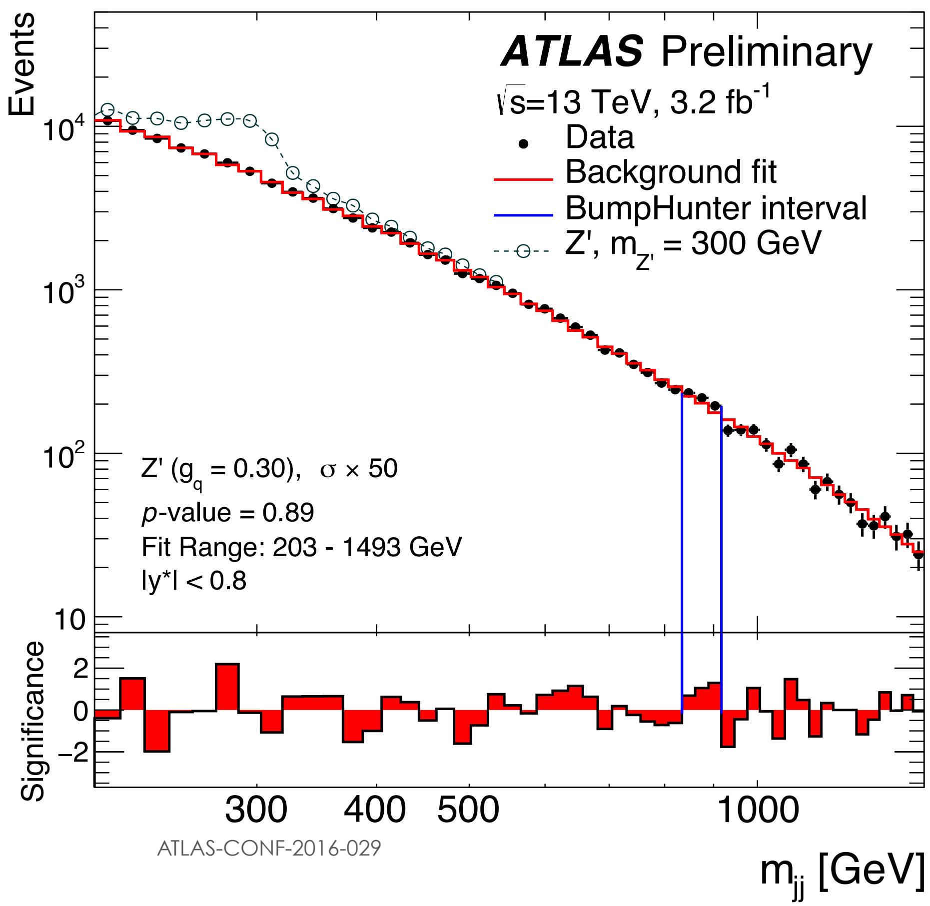
Low Mass Searches

- Traditional limited by high jet triggers
- Three searches:
  - Trigger-object Level Analysis (TLA)
    - Events partially saved
    - Dedicated jet calibration
    - Leading jet pT > 185 GeV
    - Subleading jet pT > 85 GeV
  - Dijet+ISR
    - Light resonance boosted by γ
    - γ > 130 GeV, jets > 25 GeV
  - Low mass di-b-jet
    - Trigger on a 2 b-jet event
    - Leading jet pT > 230 GeV
    - Subleading jet pT > 90 GeV

Low Mass Results: TLA & Dijet+ISR

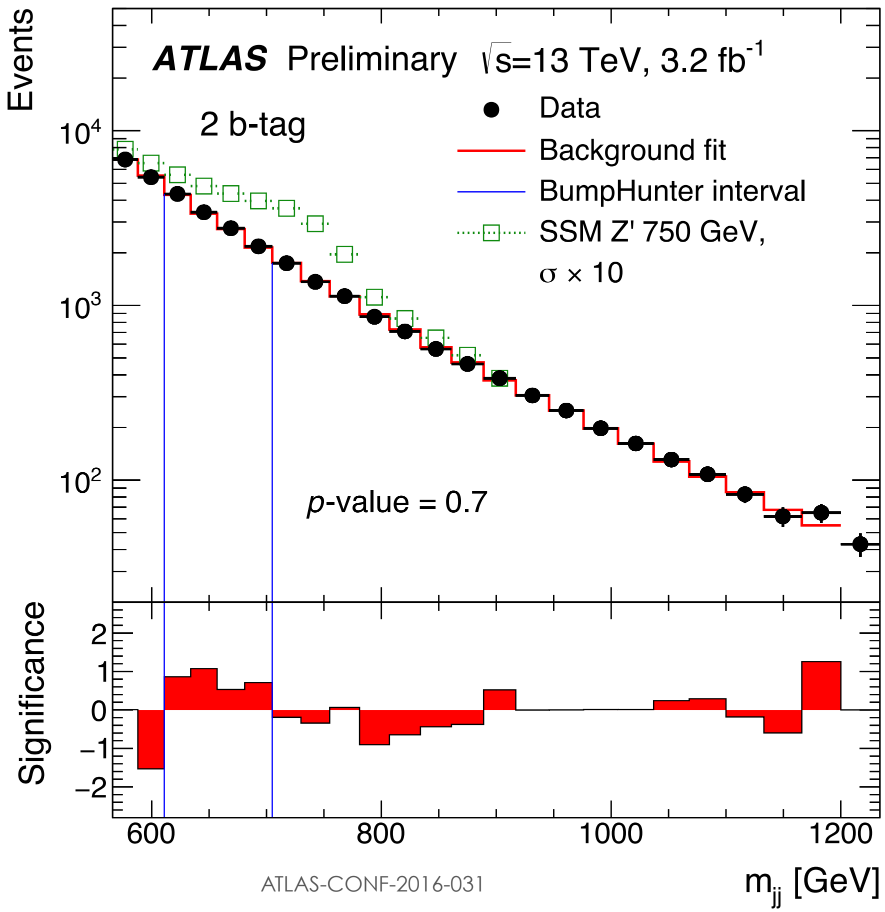


Low mass dijet (TLA)



Dijet + ISR

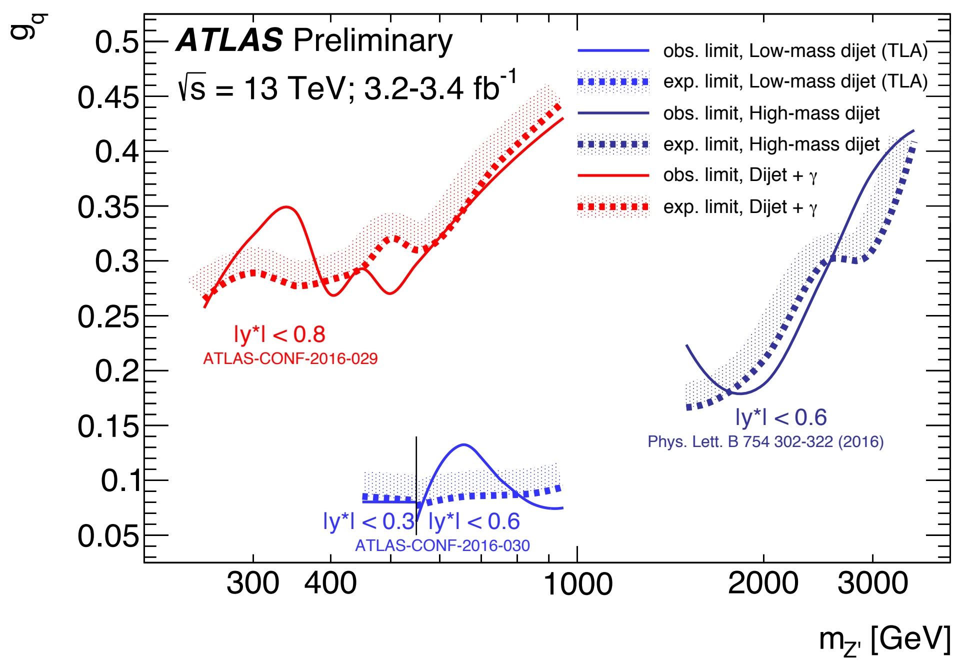
Low Mass: Di-B-Jet

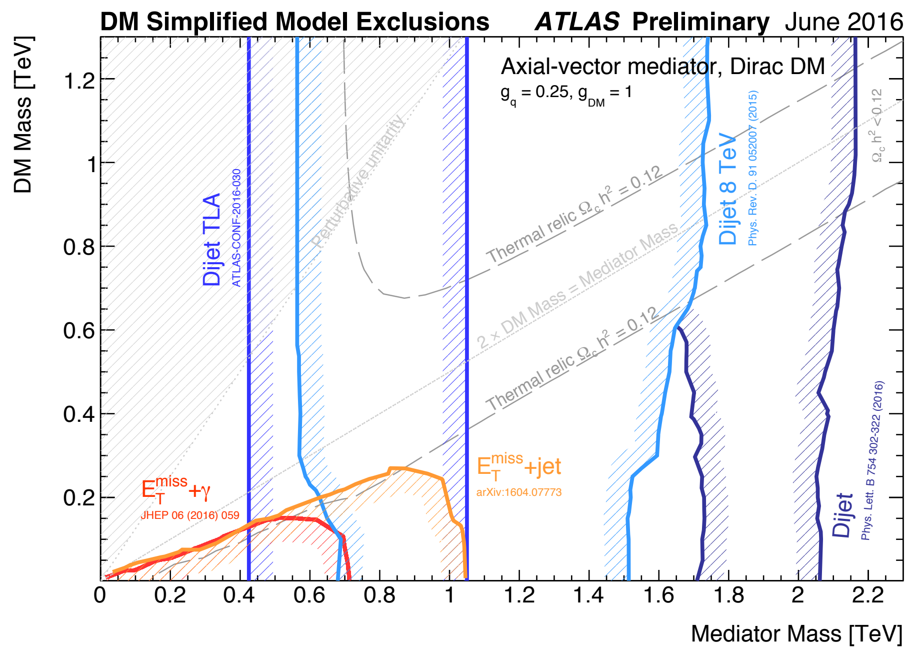


ATLAS-CONF-2016-031

Z': Dark Matter Mediator

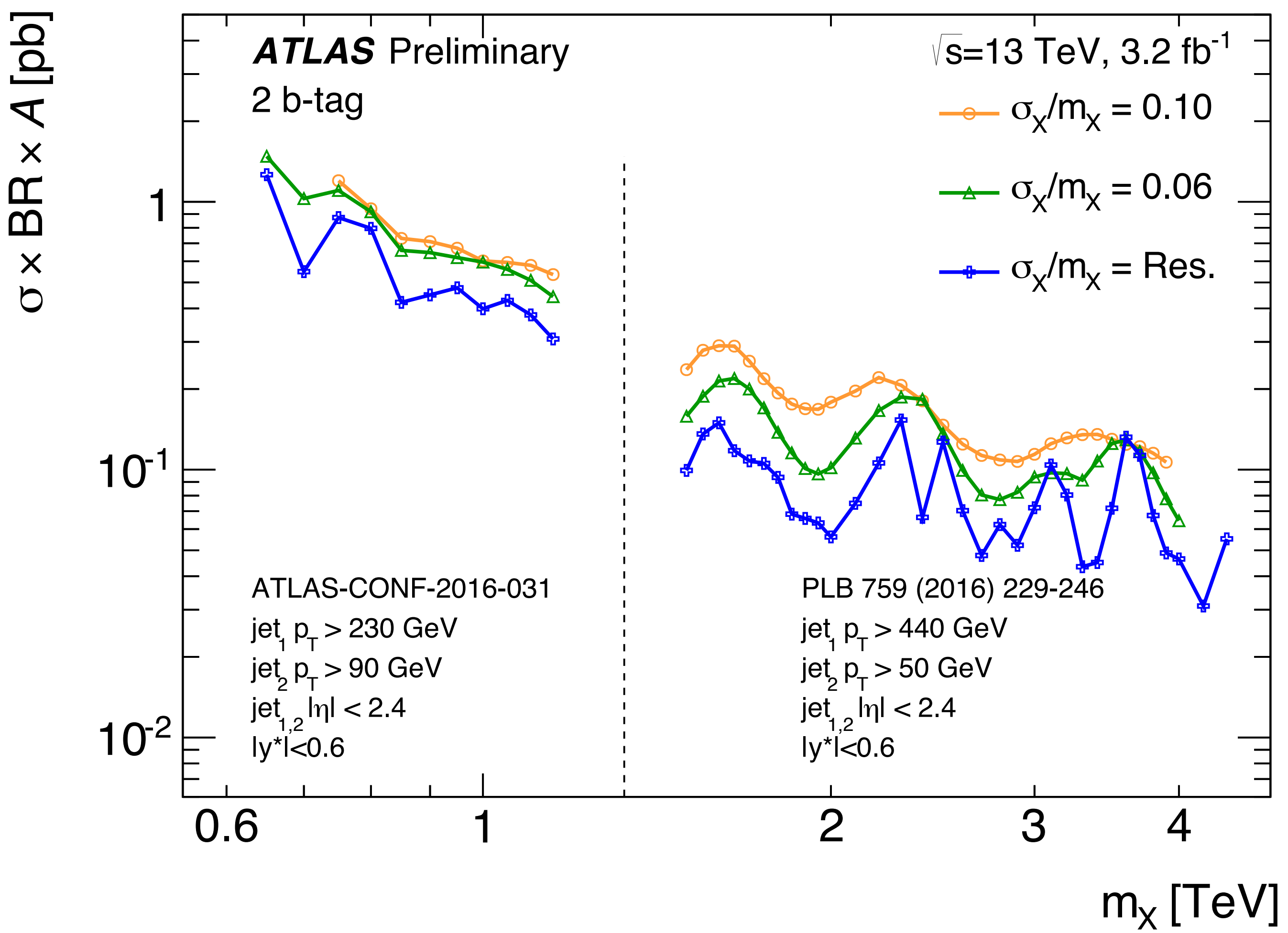
- Leptophobic Z': combined limits with high mass dijet, low mass dijet, & dijet+ISR





Generic Gaussian Signal Shapes

- Low and high mass di-b-jet searches



Conclusion

- No signs of new physics
- Set combined and individual limits on Z'
  - Individual limits on q*, b*, QBH, W' models
- Set individual limits on Gaussian signal shape
- Papers:
  - High mass dijet: Physics Letters B 754 (2016) 302-322
  - High mass di-b-jet: Physics Letters B 759 (2016) 229-246
  - Low mass dijet: ATLAS-CONF-2016-030
  - Low mass di-b-jet: ATLAS-CONF-2016-031
  - Dijet+ISR: ATLAS-CONF-2016-029
- Currently collected data
- Expect ~10 fb^{-1} Run II data out by ICHEP
- Expect ~25 fb^{-1} full 2016

Backup

High Mass Dijet Limits

Model	95% CL Exclusion limit		
	Run 1 Observed	Observed 13 TeV	Expected 13 TeV
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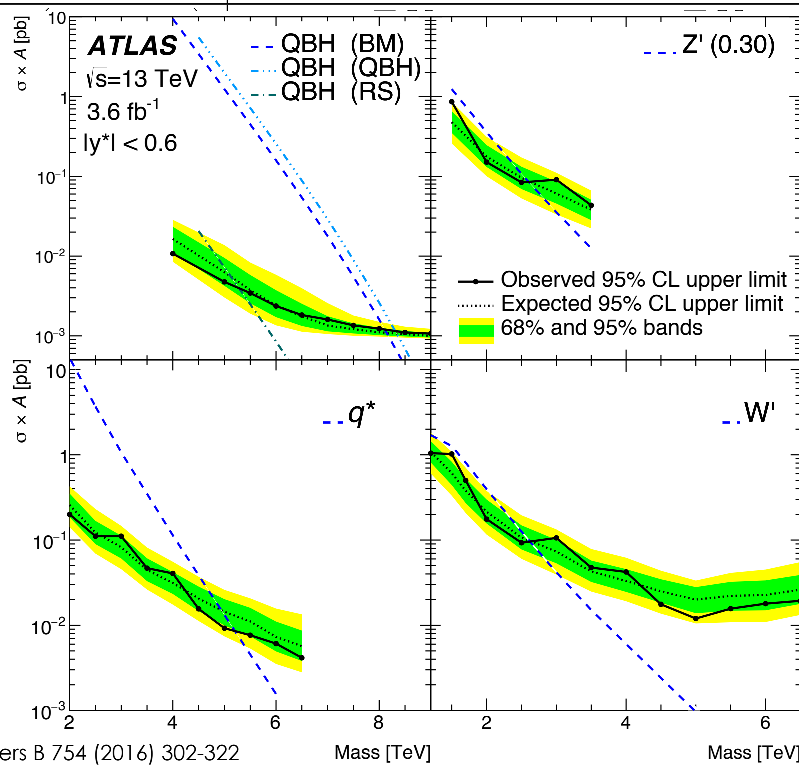

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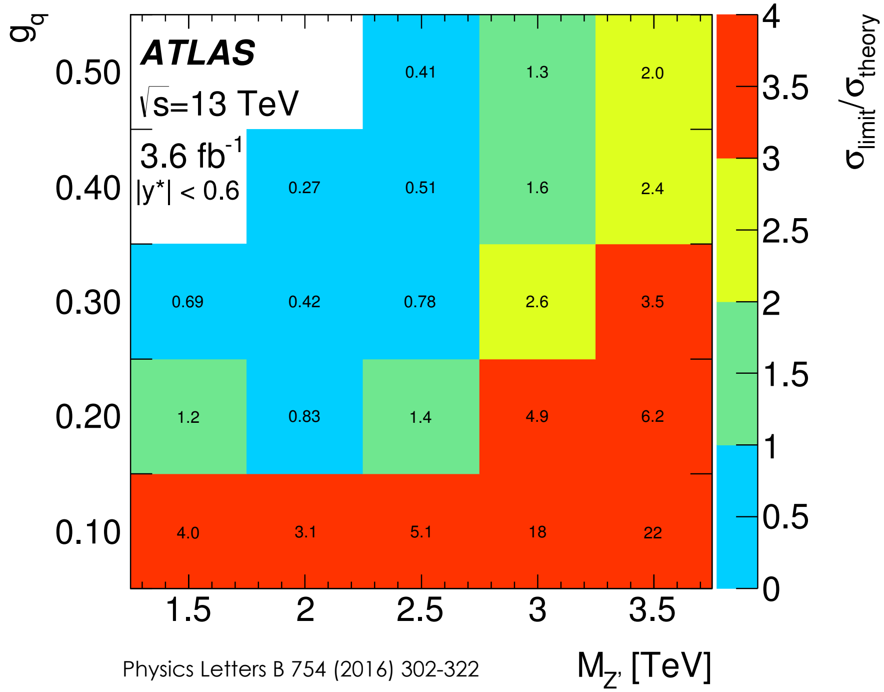
High Mass Dijet Limits

Z' limits from scan of g_q and $M_{Z'}$ (M_{DM} = 10 GeV, g_{DM} = 0.1)

Limits on generic Gaussian of various widths



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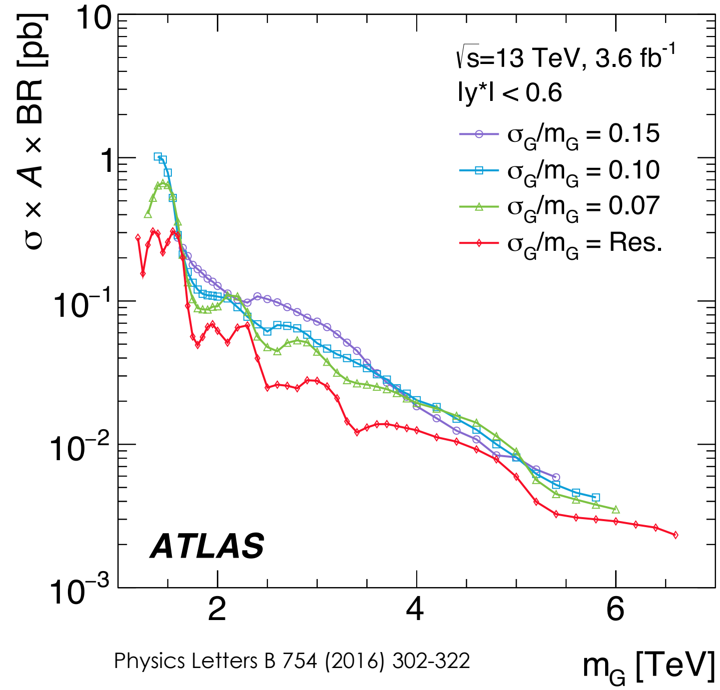

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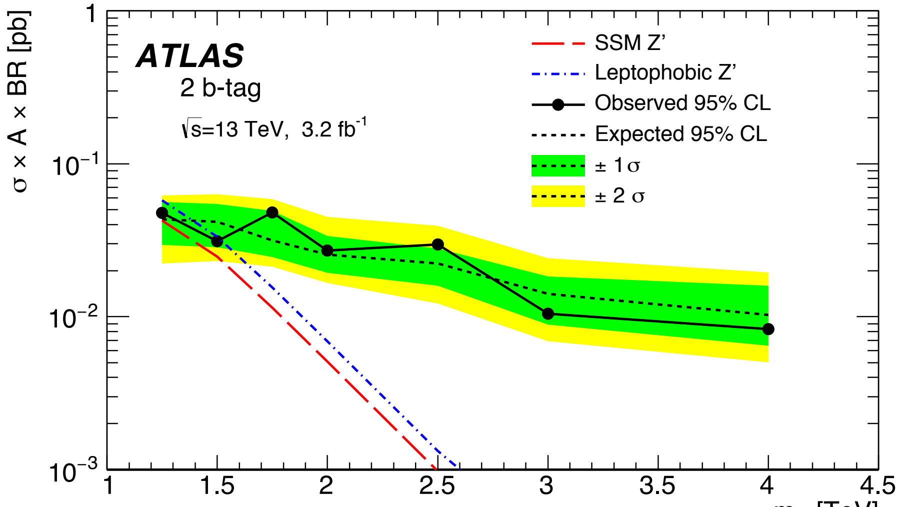
High Mass Di-b-jet Limits



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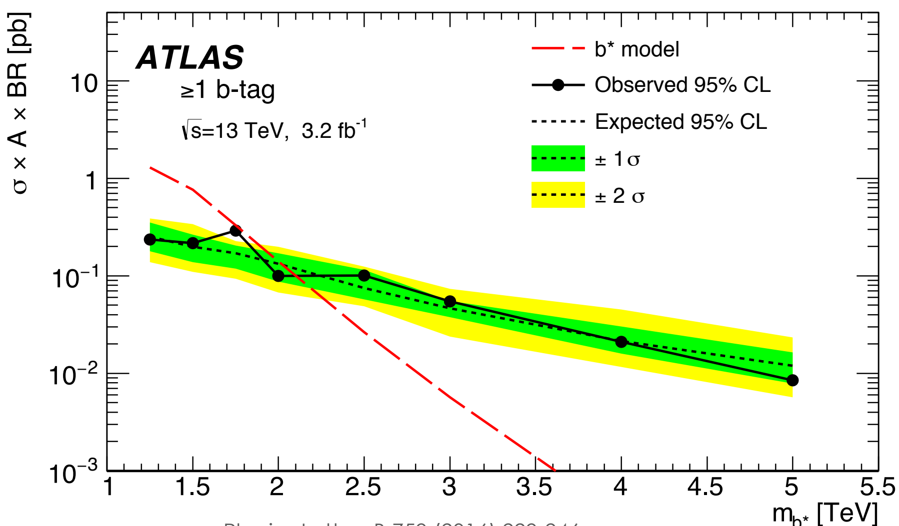

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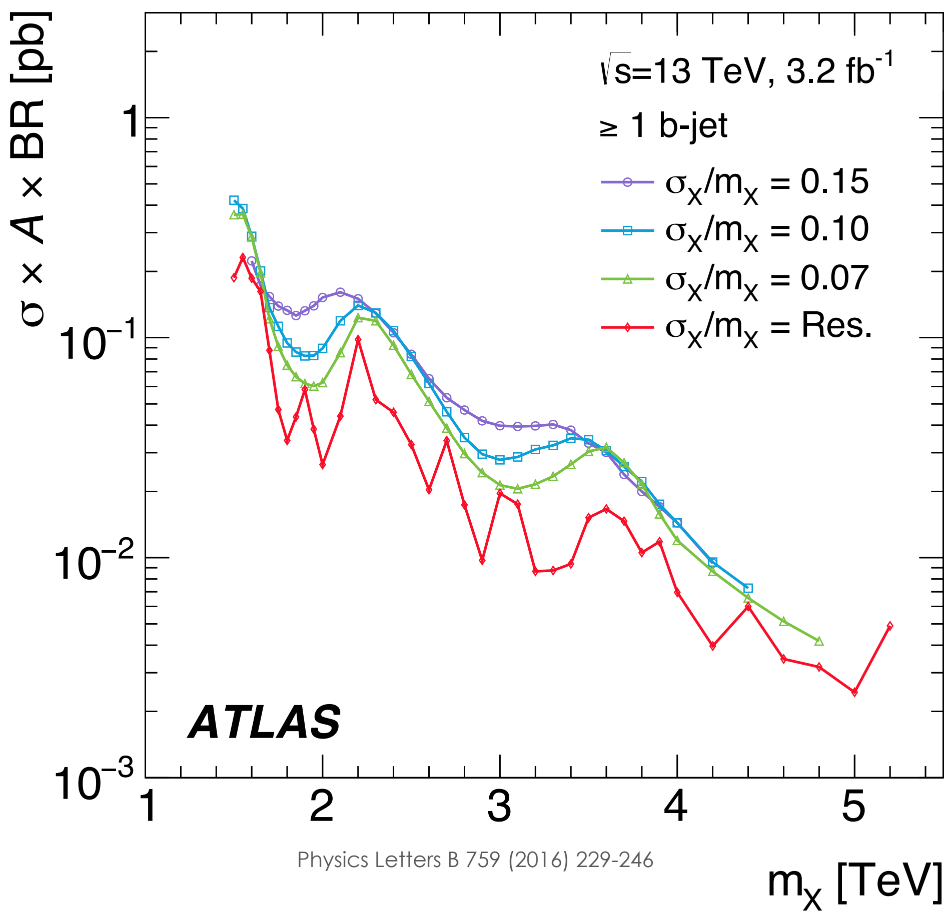

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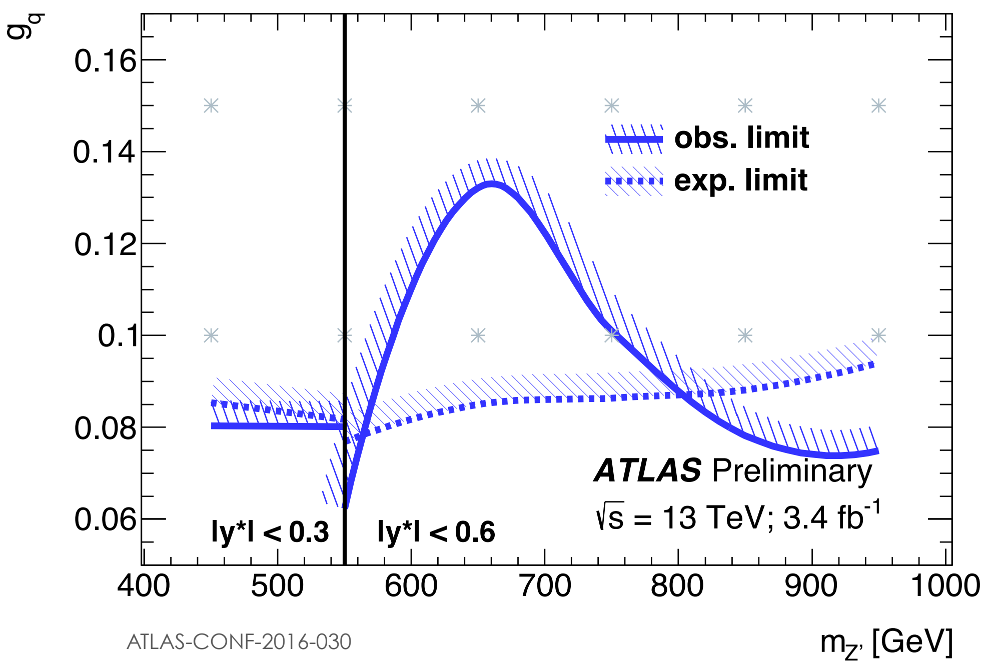
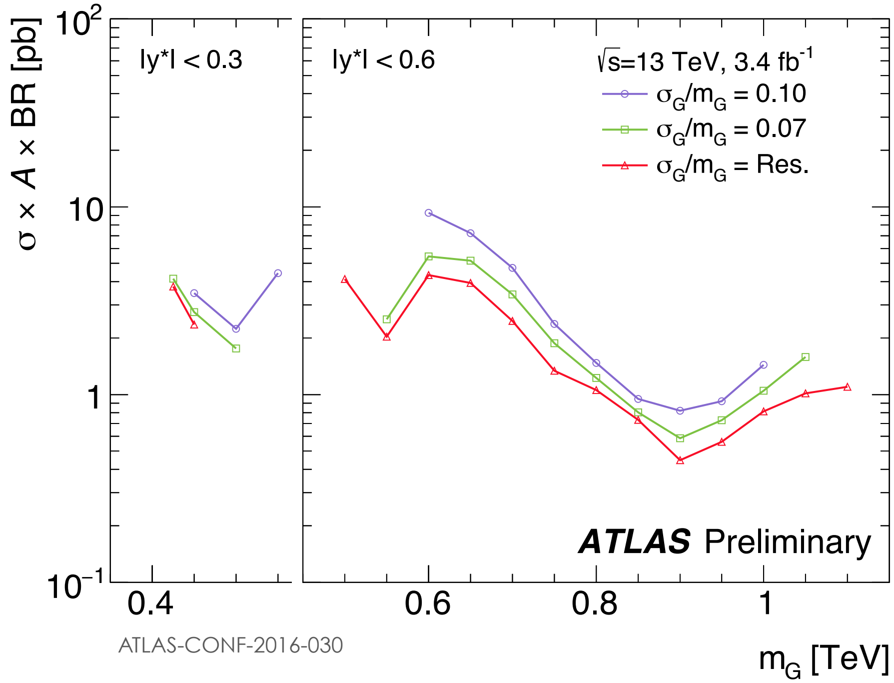
Low Mass Dijet Limits

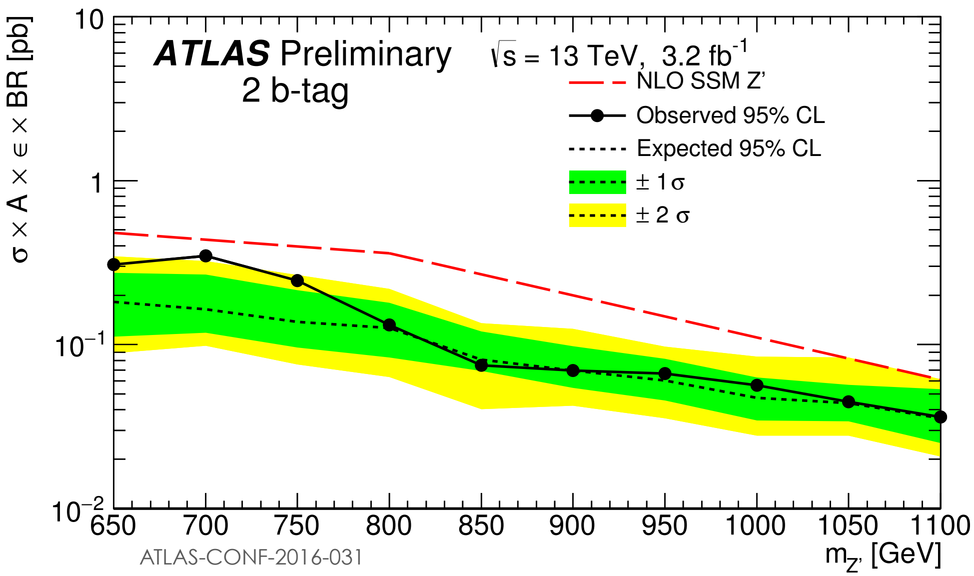


ATLAS-CONF-2016-030

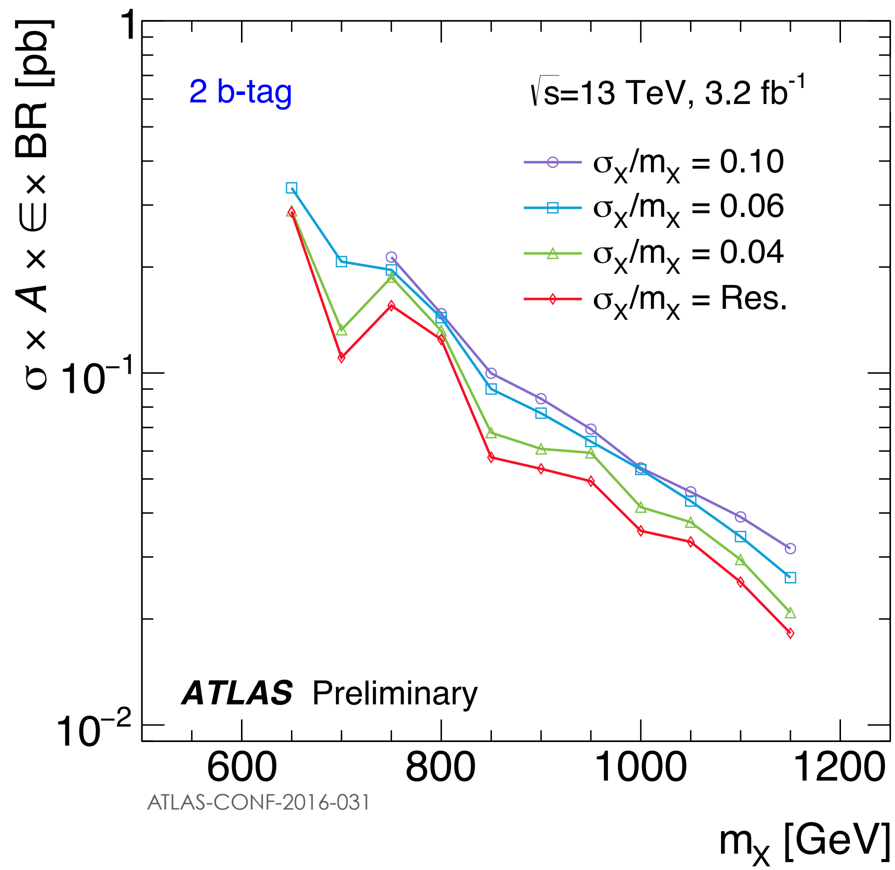


ATLAS-CONF-2016-030

Low Mass Di-b-jet Limits

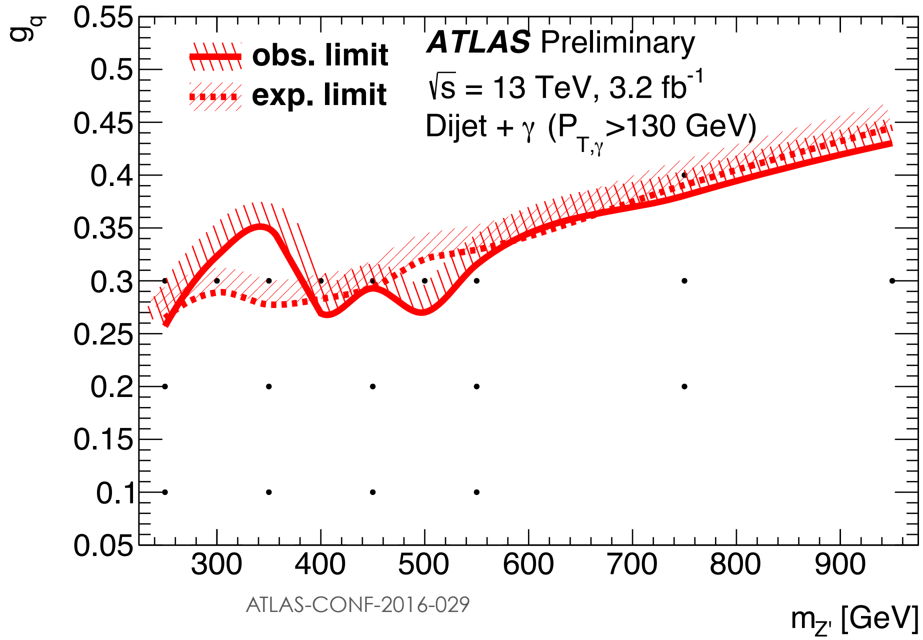


ATLAS-CONF-2016-031

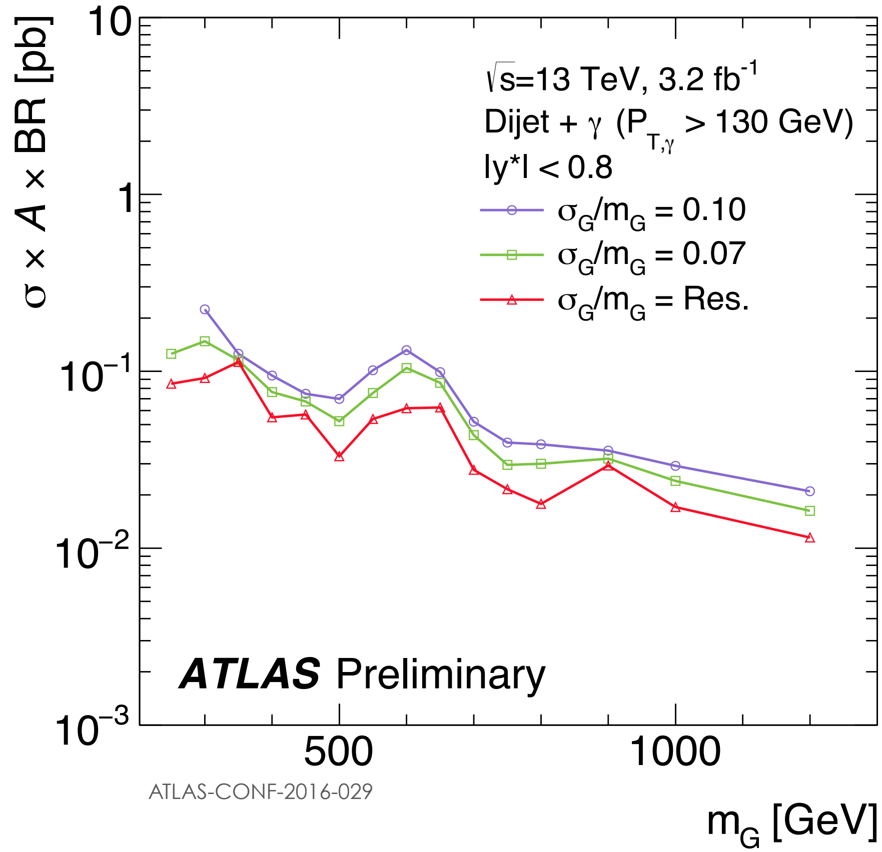


ATLAS-CONF-2016-031

Dijet + ISR Limits

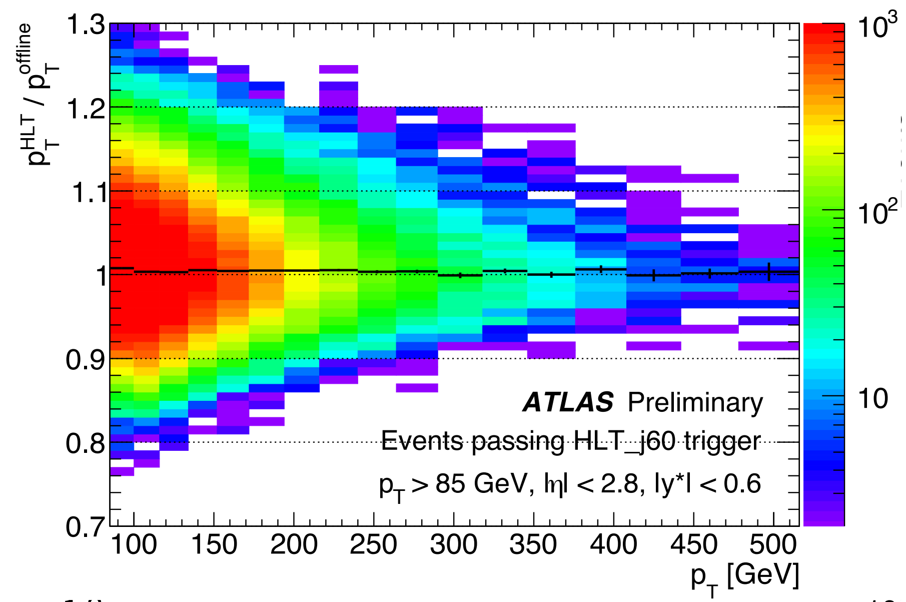


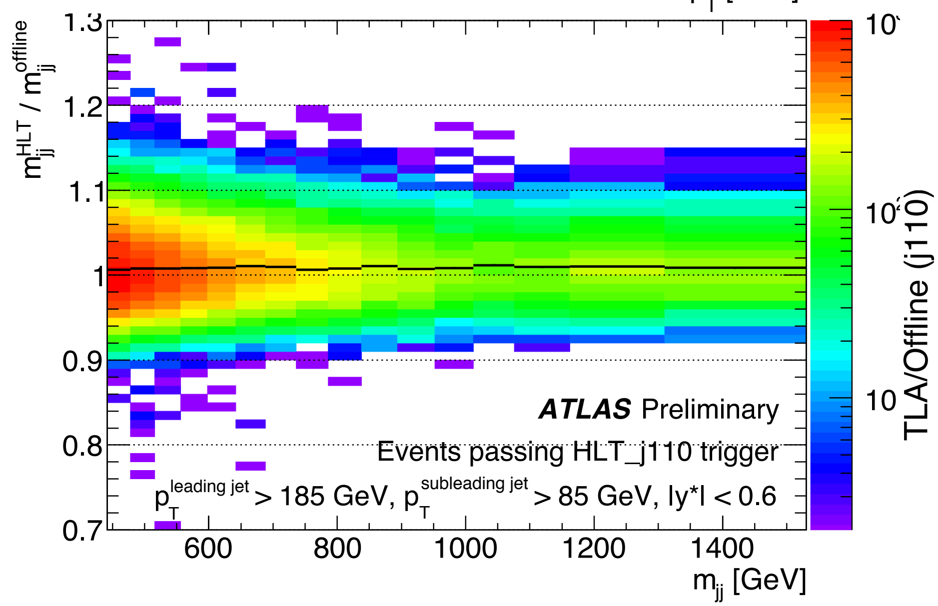
ATLAS-CONF-2016-029

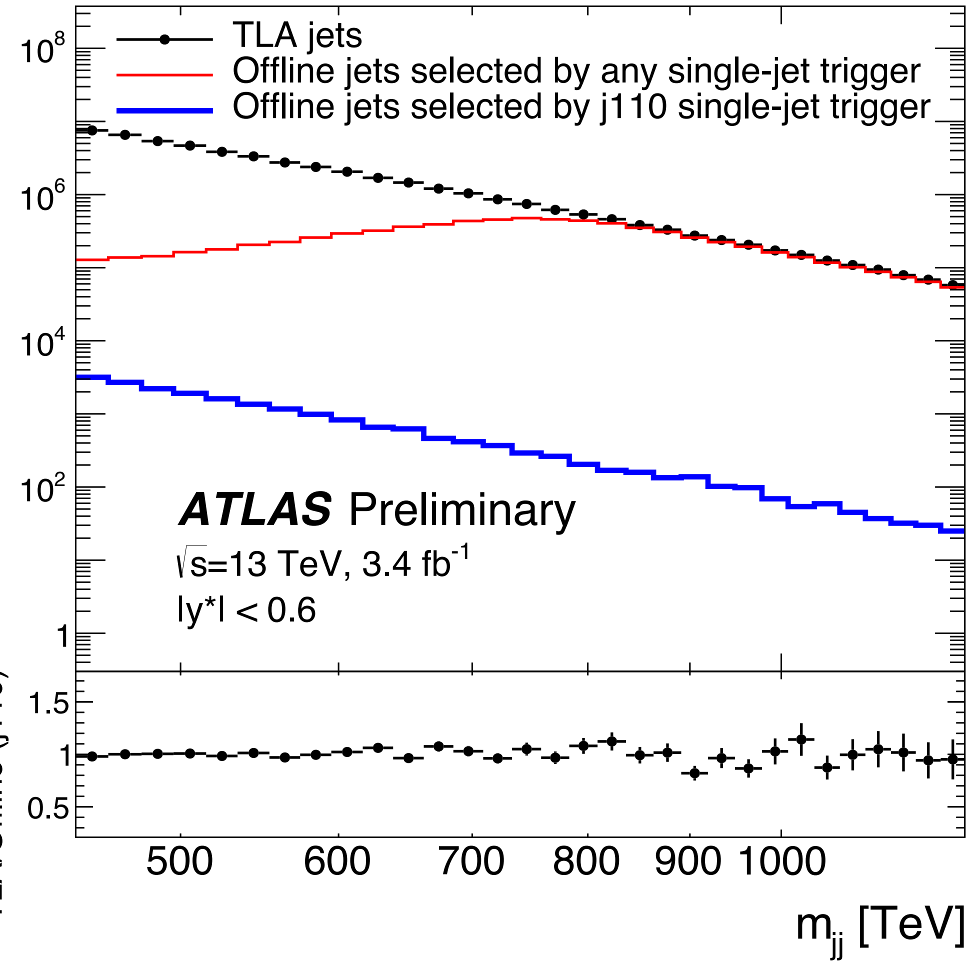


ATLAS-CONF-2016-029

Trigger jet calibration

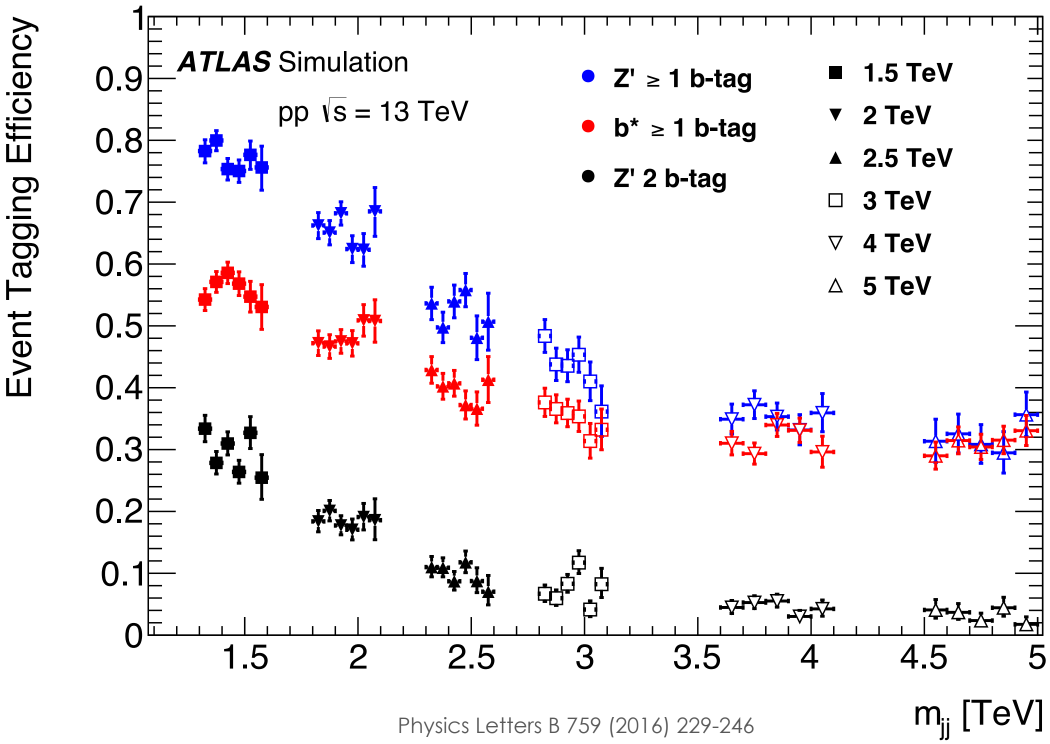






High Mass Limitations: Di-b-jet

- Limited in high mass range due to low b-tagging efficiencies



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Low mass b tagger efficiency