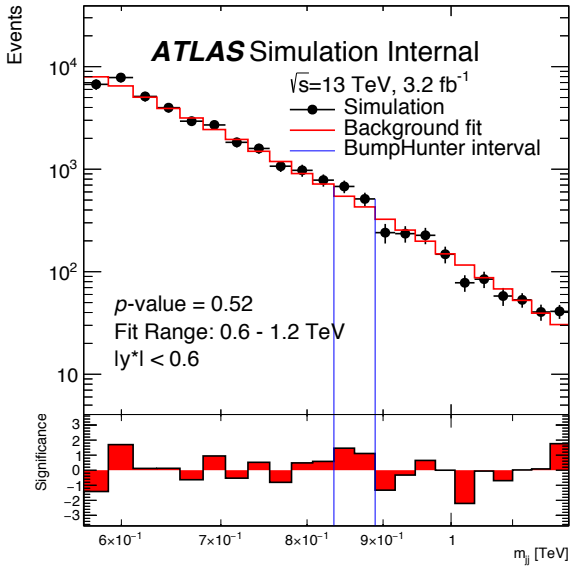
Spurious Signal - Check on S+B Fit

Laurie McClymont

Dibjet Meet

02 June 16

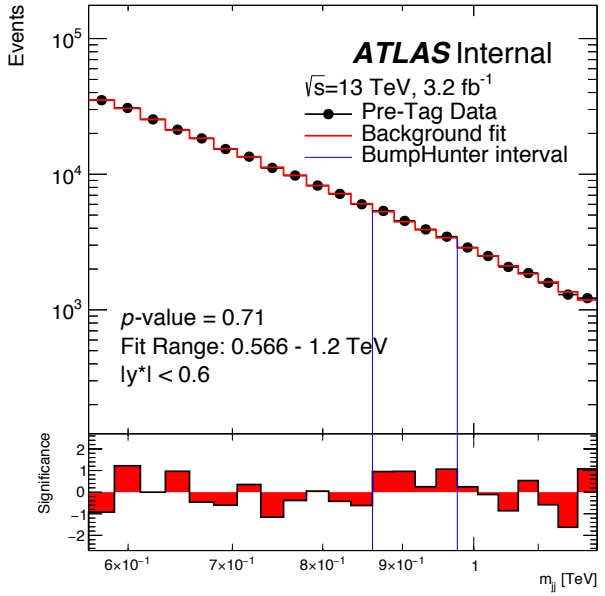
- **Spurious Signal**
  - By this we mean shape discrepancies between fit and bkgr. only causing (hiding) fake (real) signal
  - Done tests on MC and trigger only data
  - No large discrepancies seen in background only fit
  - pValues: Trigger only data = 0.71, MC = 0.52
  - No spurious signal in background only data



- **S+B Fit**
  - Comment from Koji:

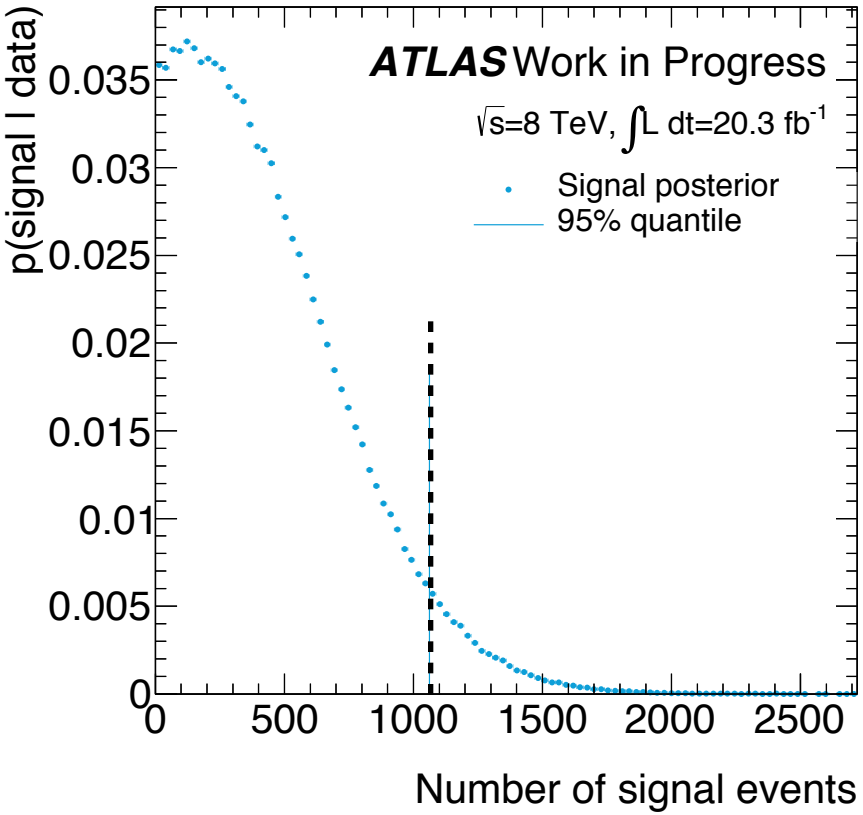
> *' l.304 / More relevant is spurious signal from signal+background fit to the background-only data (or MC) for limit setting. Has this been considered? '*

  - My understanding of this is we are asking if any shape discrepancies between bkgr. fit and bkgr. spectrum could cause biases in S+B fit.



S+B Fit

- **Signal + Background fit performed in Limit setting**
  - Floating background and signal normalisation
  - Other nuisance parameters will appear here
  - Likelihood distribution can be found for each mass point.
    - From this distribution 95% C.L limit can be found



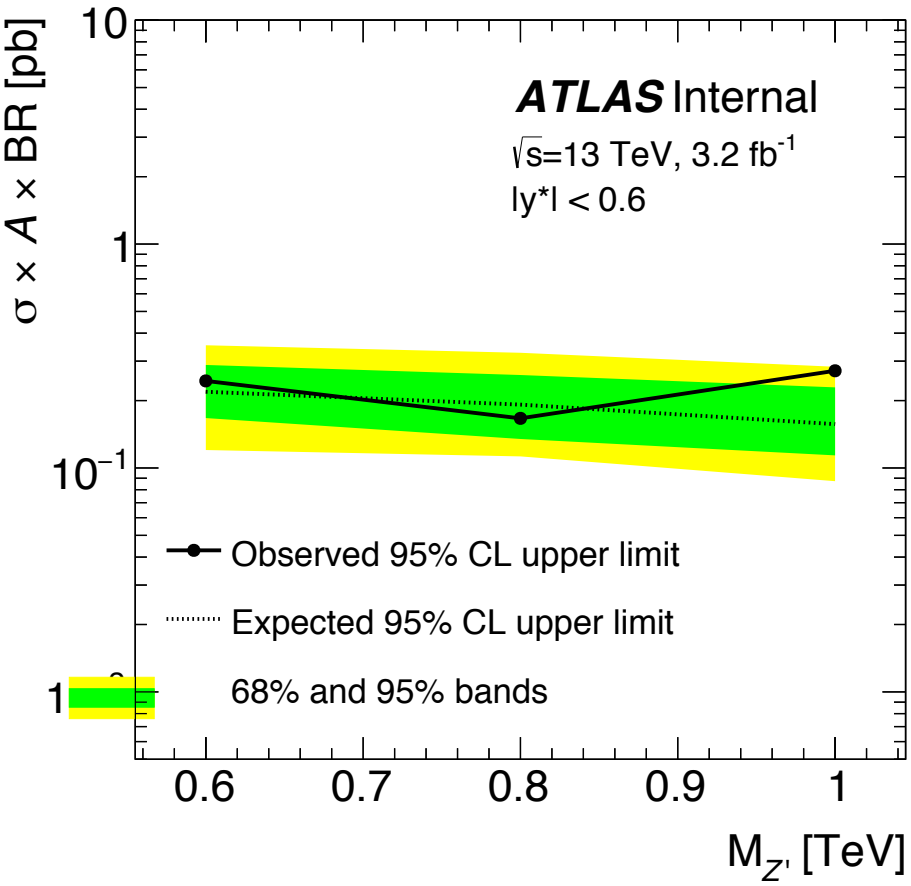
K. Pachal - Chapter 9

- **Spurious Signal**
  - Spurious signal (as well as statistical fluctuations) cause fit/data to be different
  - Fit/data discrepancies can morph the shape of likelihood distribution.
  - We get more aggressive/conservative limits depending on fluctuations

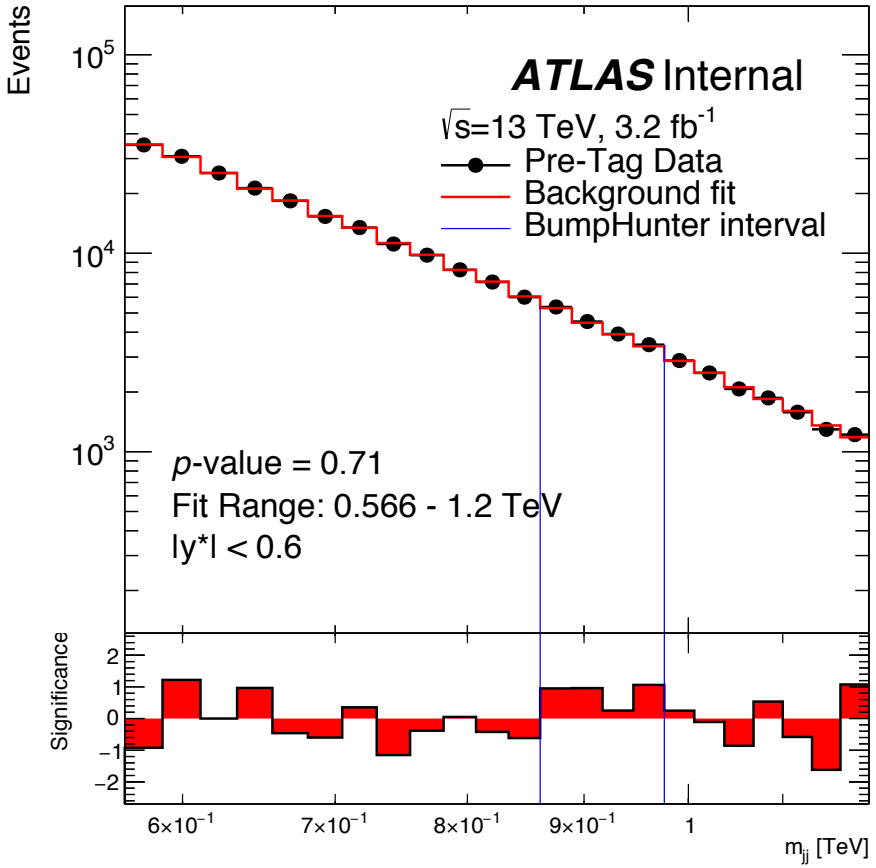
- **Expected Limits**
  - Limits taken from many pseudo-experiments thrown from fit.
  - These give distributions for expected limits
  - No spurious signal in expected limits
  - So we can compare observed to expected

Statistics: Spurious Signal - Trigger Data

- **Data:** Trigger but no offline tagging
  - Gives us a CR to test fit where we are not sensitive to bb decays
- **Signal:** Z' bb post-tag



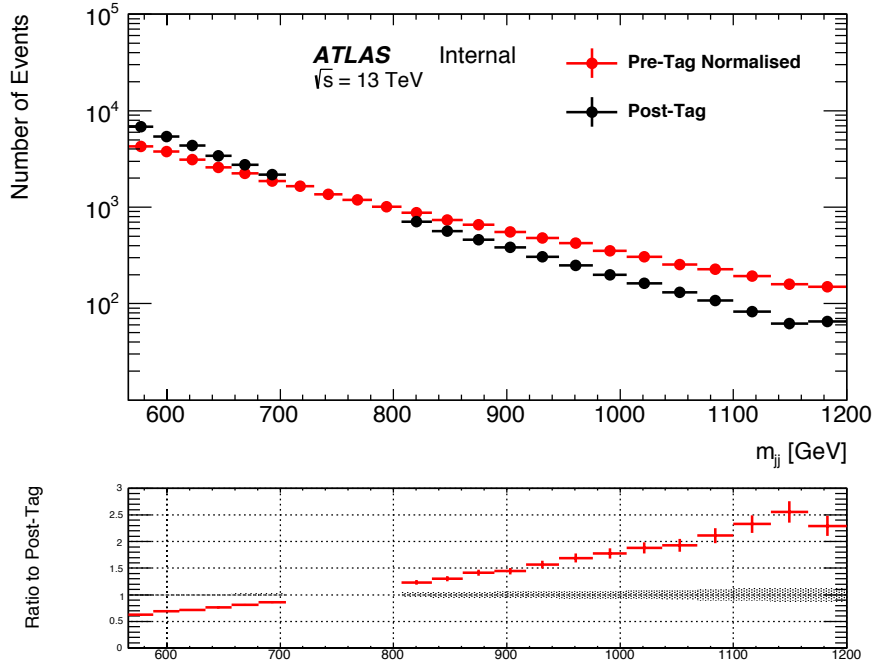
- **These are not physical limits!!!!**
- No systematics as well.
- But we can compare exp. to obs. to test for S+B fit bias

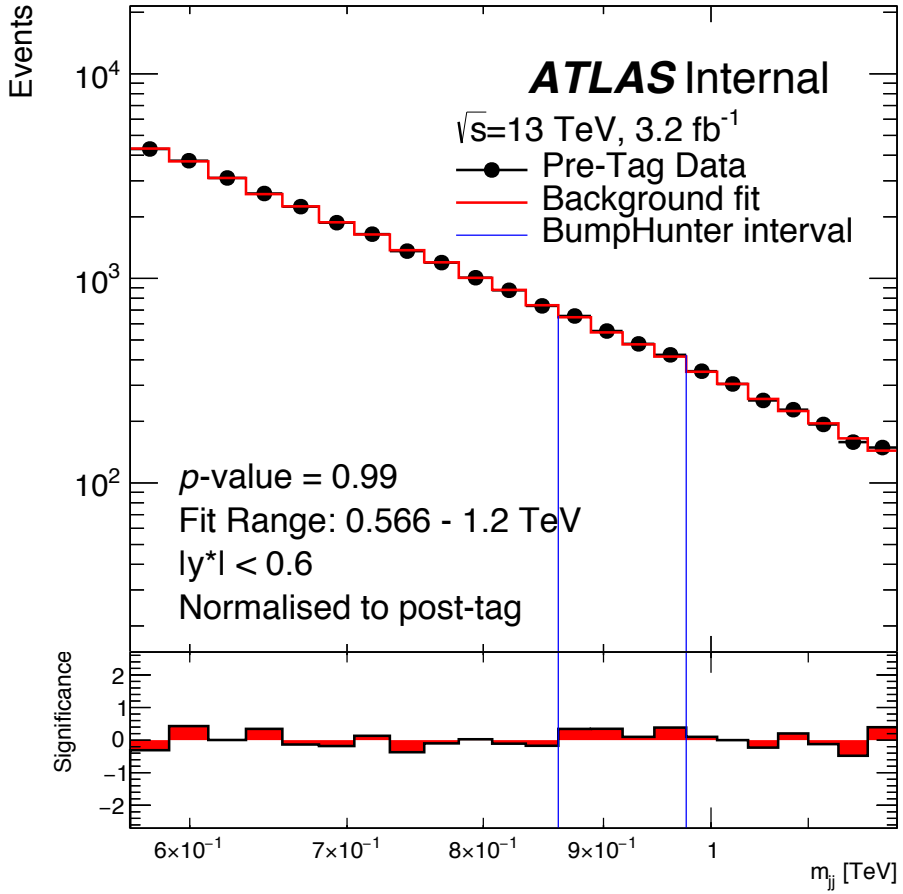


- Expected matches observed within stat. fluc. so no evidence of bias in S+B fit
- This is consisted with what we found in spurious signal test

Spurious Signal: Scaled Down

- **Scale Pre-Tag to Post-Tag**
  - Actual Fluctuations in Data
    ~ 1/sqrt($N_{Pre\text{-}Tag}$)
  - Toys for p-value fluctuations
    ~ 1/sqrt($N_{Post\text{-}Tag}$) {Larger fluctuations}
  - Fit and search for bumps





This gives us a precise data CR

Here, we are not sensitive to bb resonances

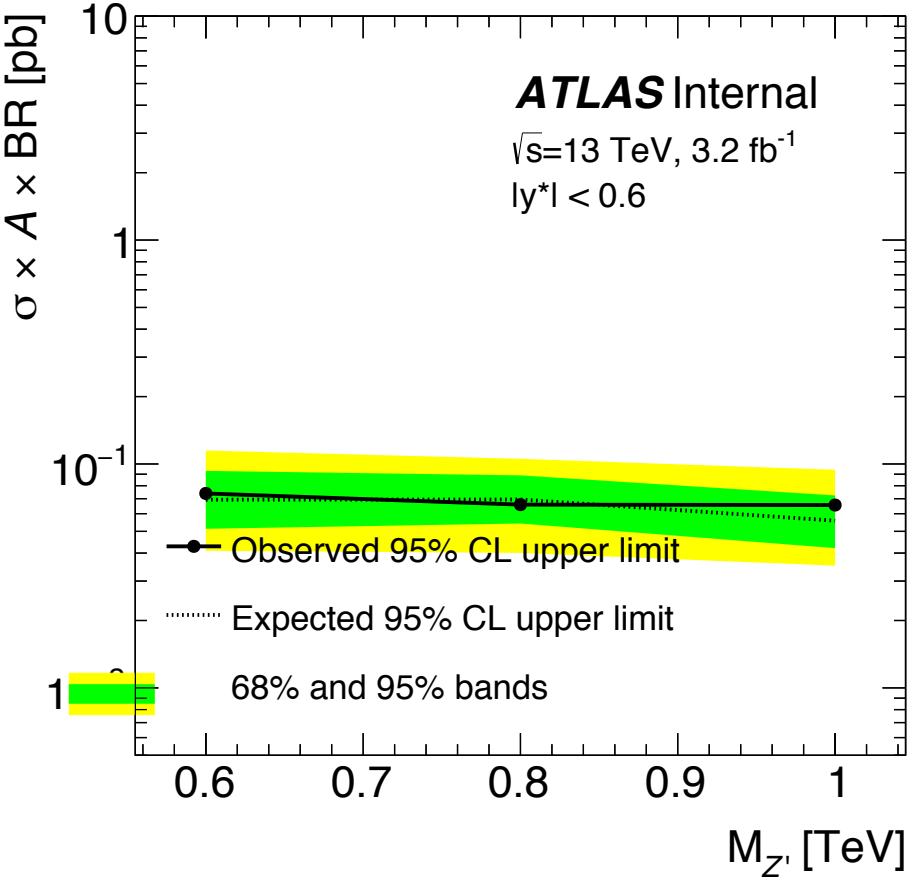
Similar shape to post-tag data set.

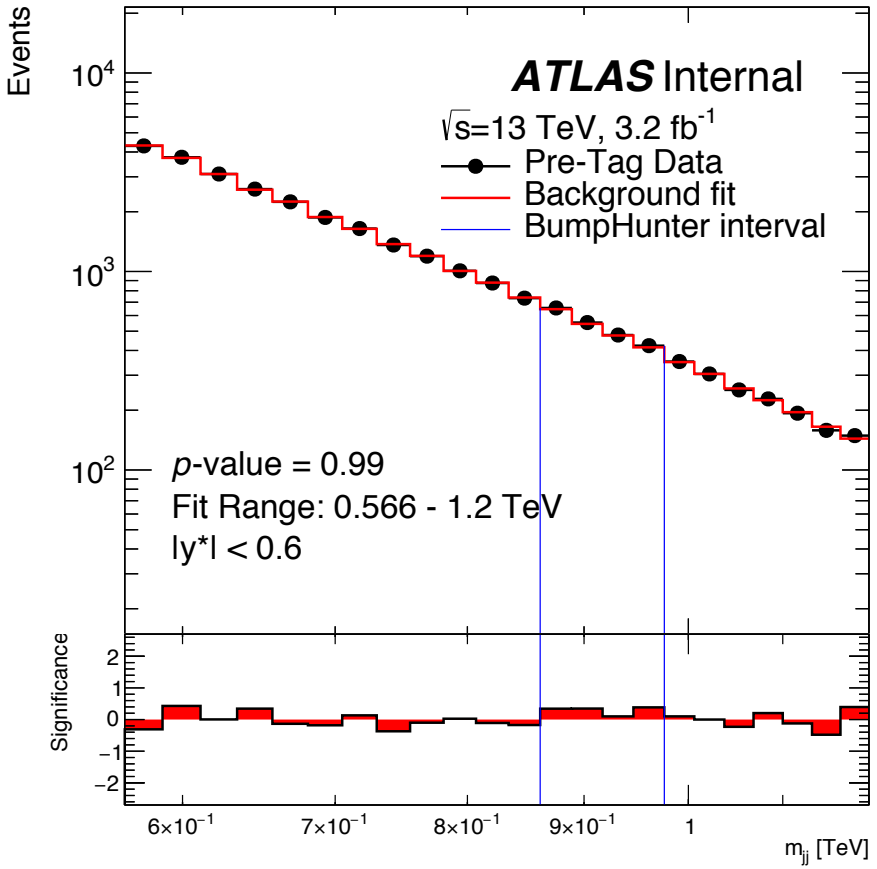
We see for background only fit quality is good

Statistics: Spurious Signal - Trigger Data Norm

- **Data:** Trigger but no offline tagging
  - Normalised to post-tag scale
  - Precise CR, not sensitive to bb
- **Signal:** Z' bb post-tag

- **Hence, these are not real limits!!!!!!**
- No systematics!
- But we can compare exp. to obs.



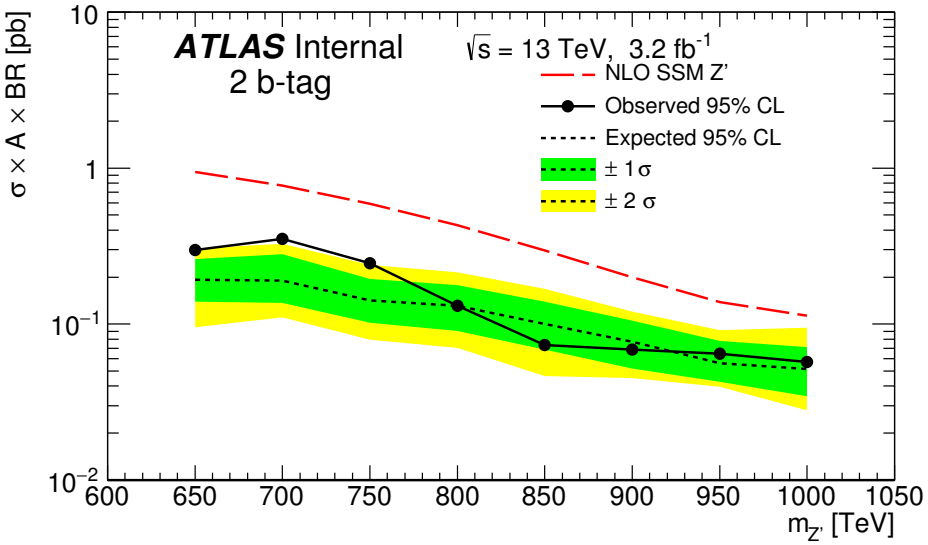


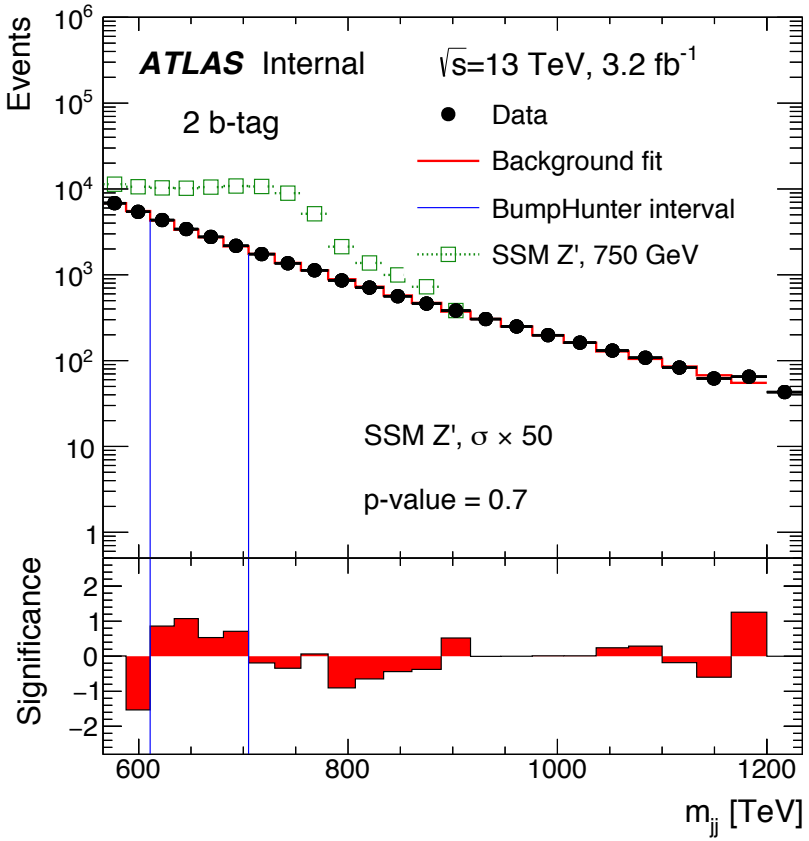
- Expected matches observed within stat. fluc. so no evidence of bias in S+B fit
- This is consisted with what we found in spurious signal test

Final Data Set

- **In addition we already look at observed vs. expected in full data set.**

  - **Data:** Full data Set
  - **Signal:** Z' bb post-tag





- Observed within expectations for data set
- No evidence of fit bias in S+B fit in final data set.

Conclusions

‘ l.304 / More relevant is spurious signal from signal+background fit to the background-only data (or MC) for limit setting. Has this been considered? '

1) The background only fit sees only small discrepancies, so we wouldn’t expect to see large deviations in the S+B fit

2) By comparing the expected and observed in the high-stat CR (and in the final data sample) we can see that there are no significant effects due to fit discrepancies (within error bands)
Hence, we can say no evidence of large S+B fit bias.

3) We already have systematics to account for fit function choice and fit parameters, so fit discrepancies are accounted for in systs.

Other additional tests

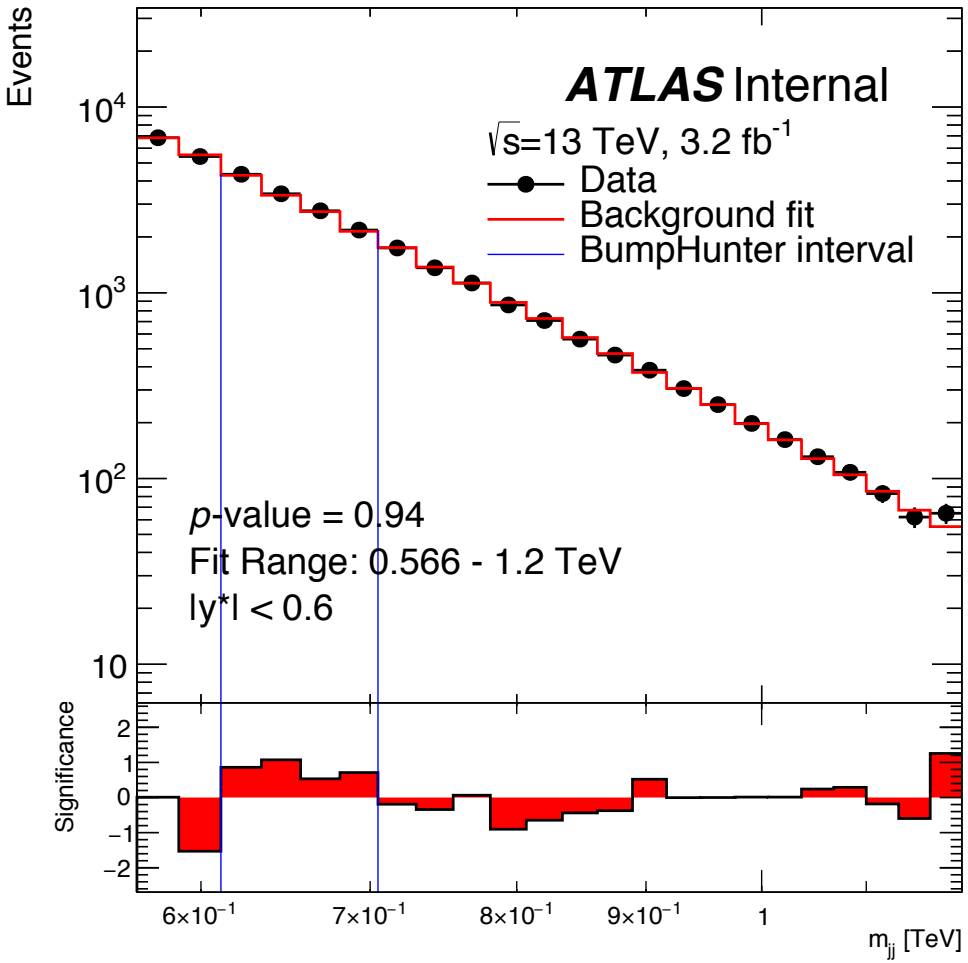
- Add in morphed signal points (working on this!)

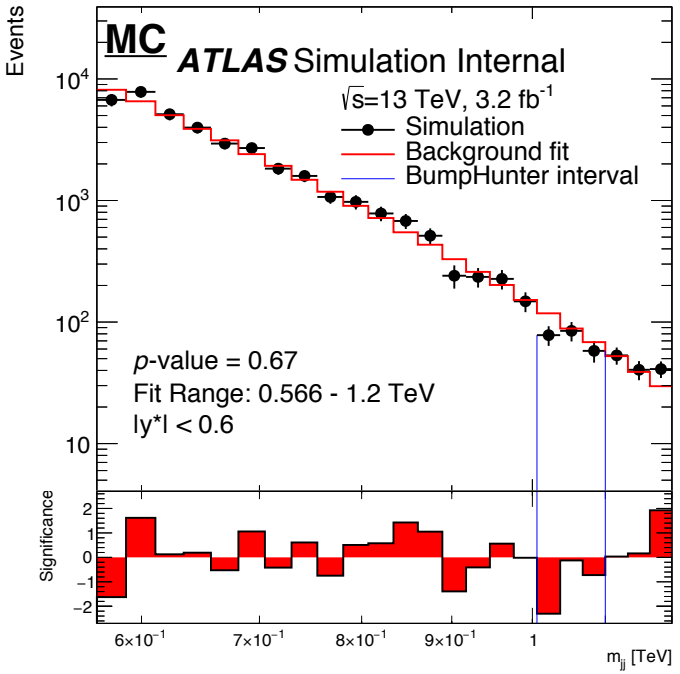
Other studies

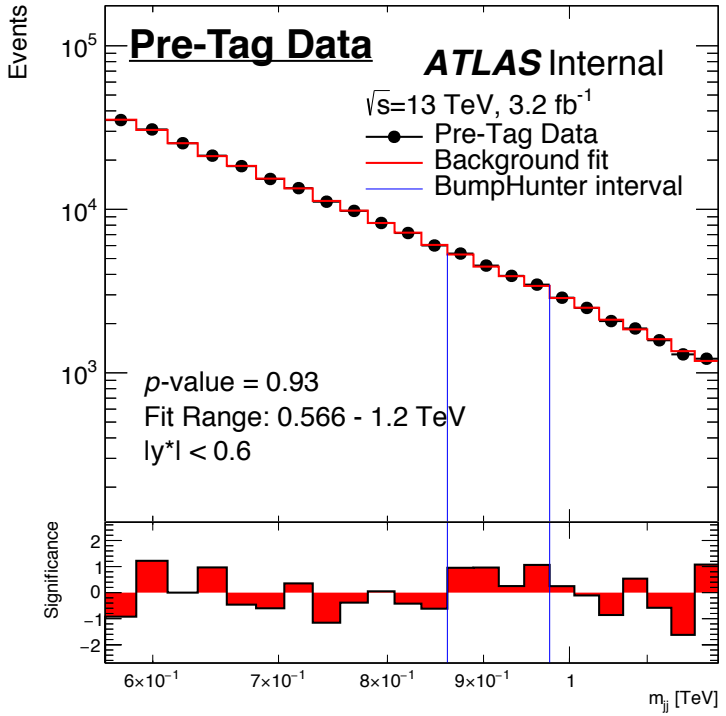
Deficit Hunter

- **Also look for deficits**
  - Most discrepant deficit or excess
  - Reports p-value of this!
  - No significant deficits…

Final Data Set





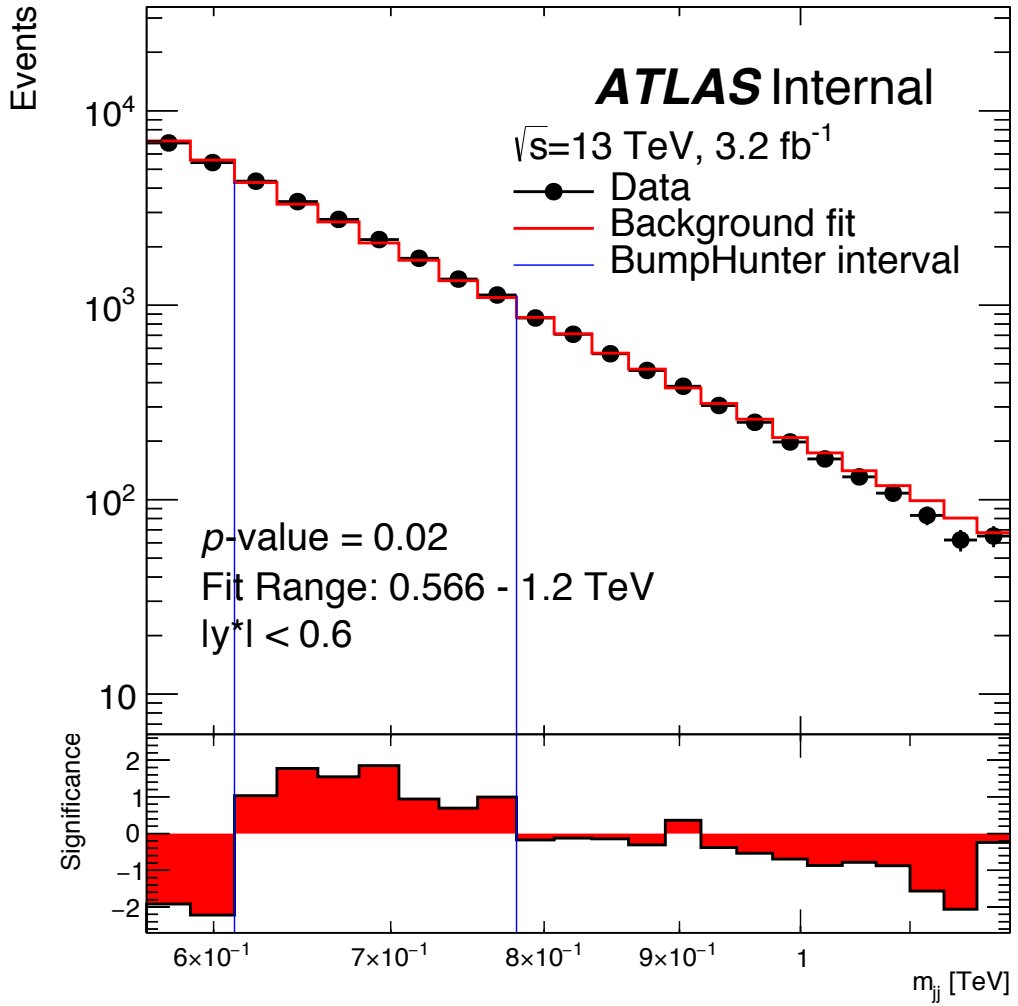


Setting p2 = 0

** I277 / P2 is much larger than typical suppression exponents in PDFs.*

How good is the fit if you force p2=0?

$$f(x) = (p1) * x^{(p3)}$$

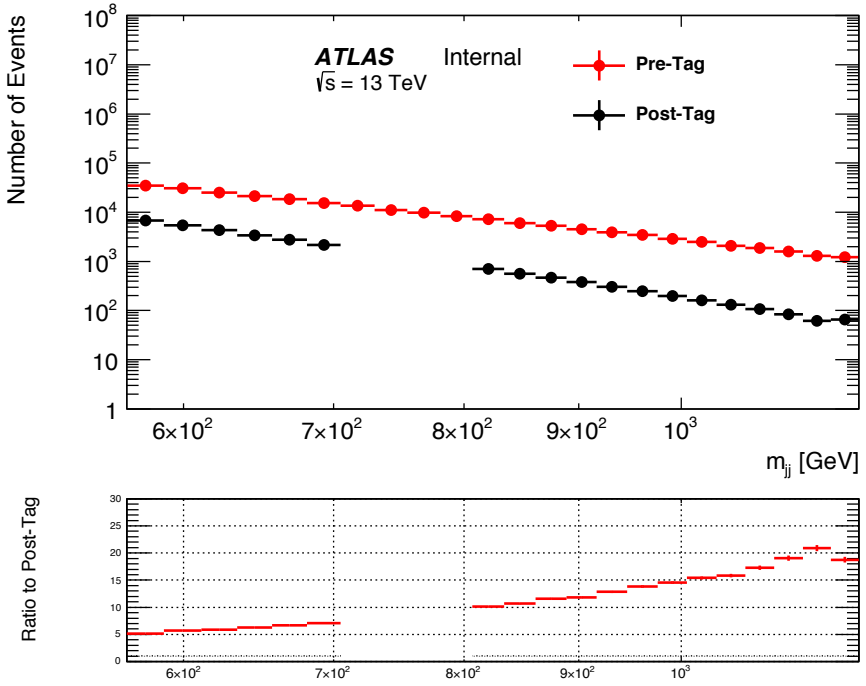


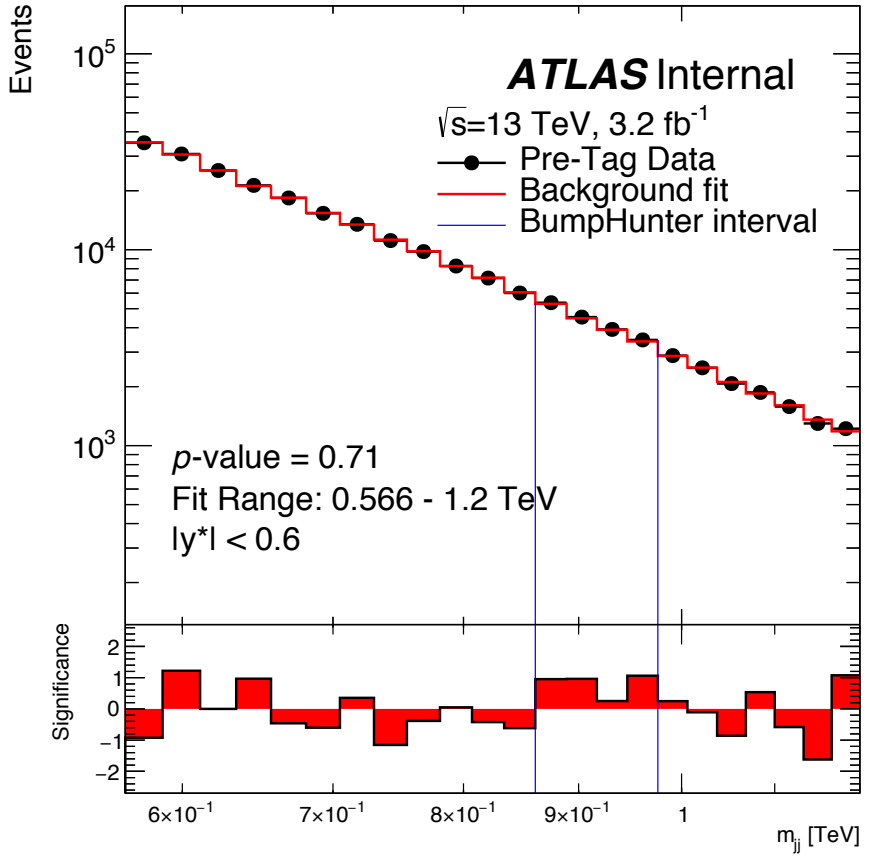
Backup

Statistics: Spurious Signal - Data, Trigger Only

- **Fit to Data with Trigger Applied**
  - b-Tagging not applied.
  - Dominated by bl, but this give us a similar, but different control region to test fitting

- **Overall fit is good quality**
  - No significant discrepancies
  - Possible structure in ratio





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  - Actual Fluctuations in Data
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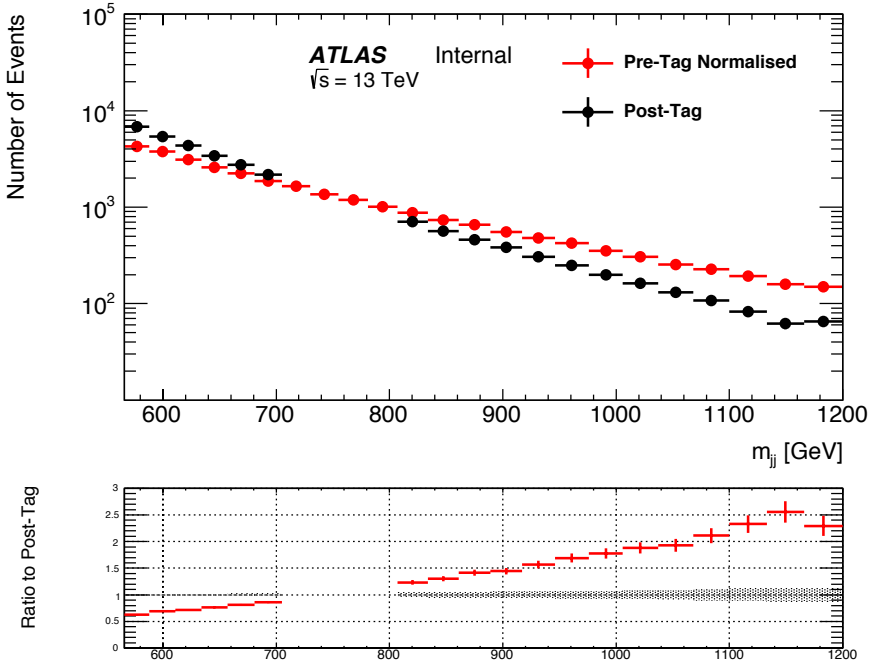

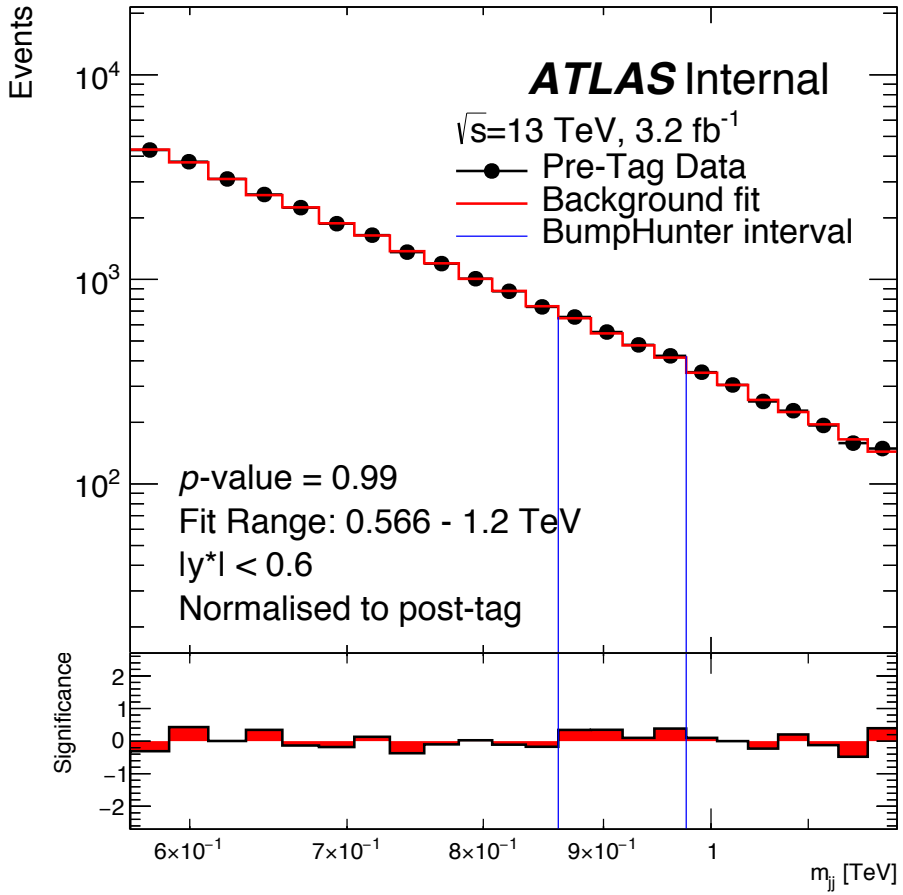

We see that at post-tag scale:

fit discrepancies <<
poisson fluctuations of post-tag

99% of toys have **worse** fit

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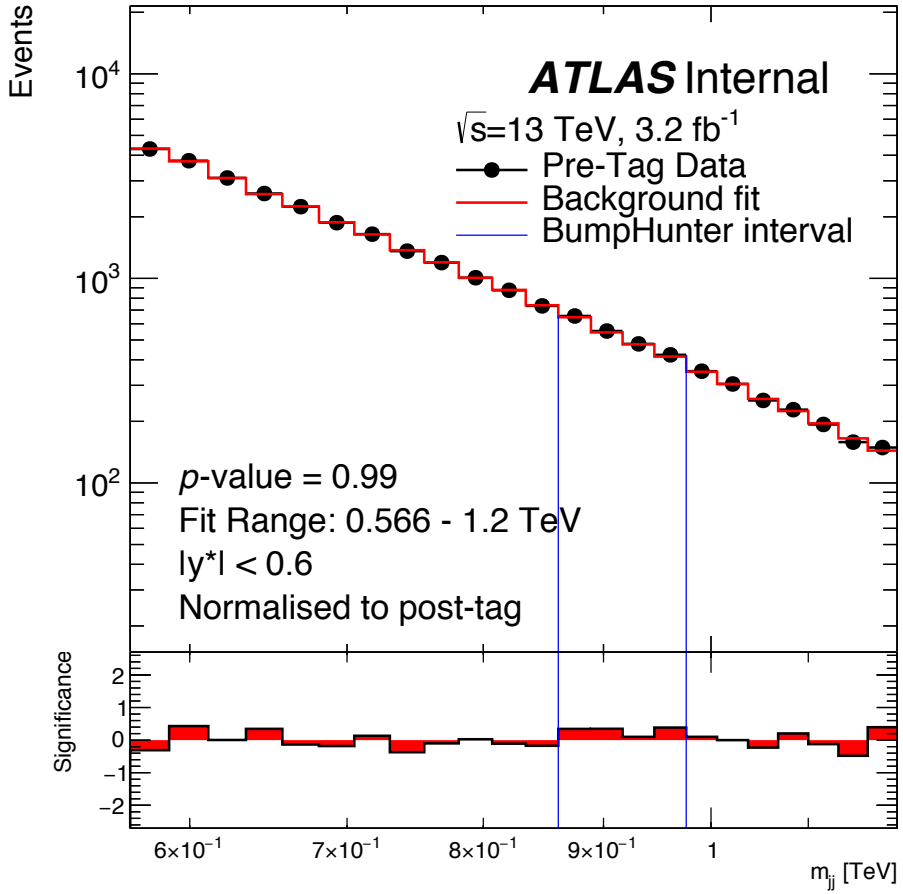

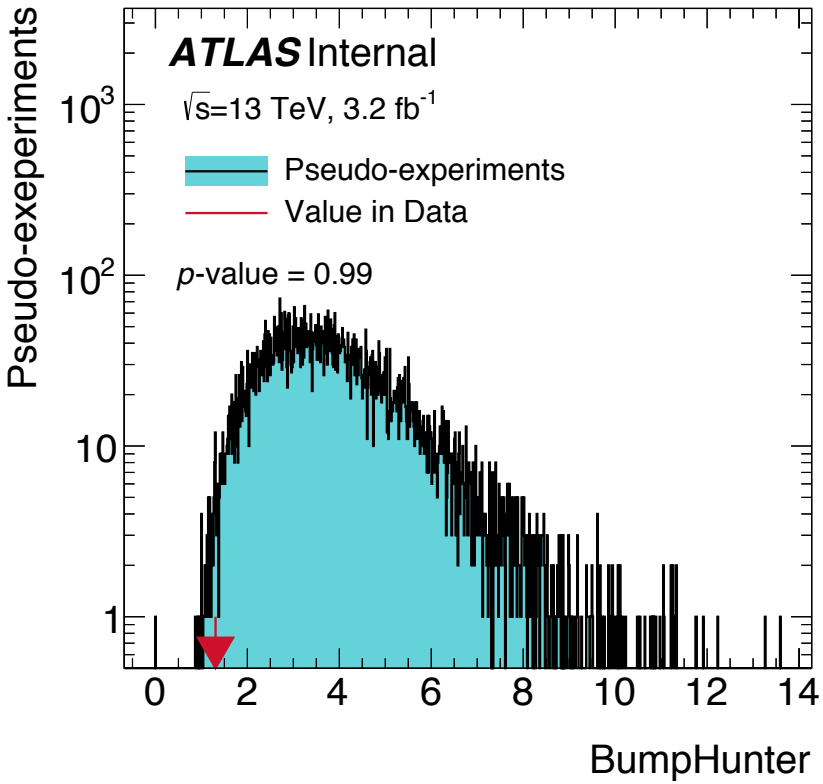

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