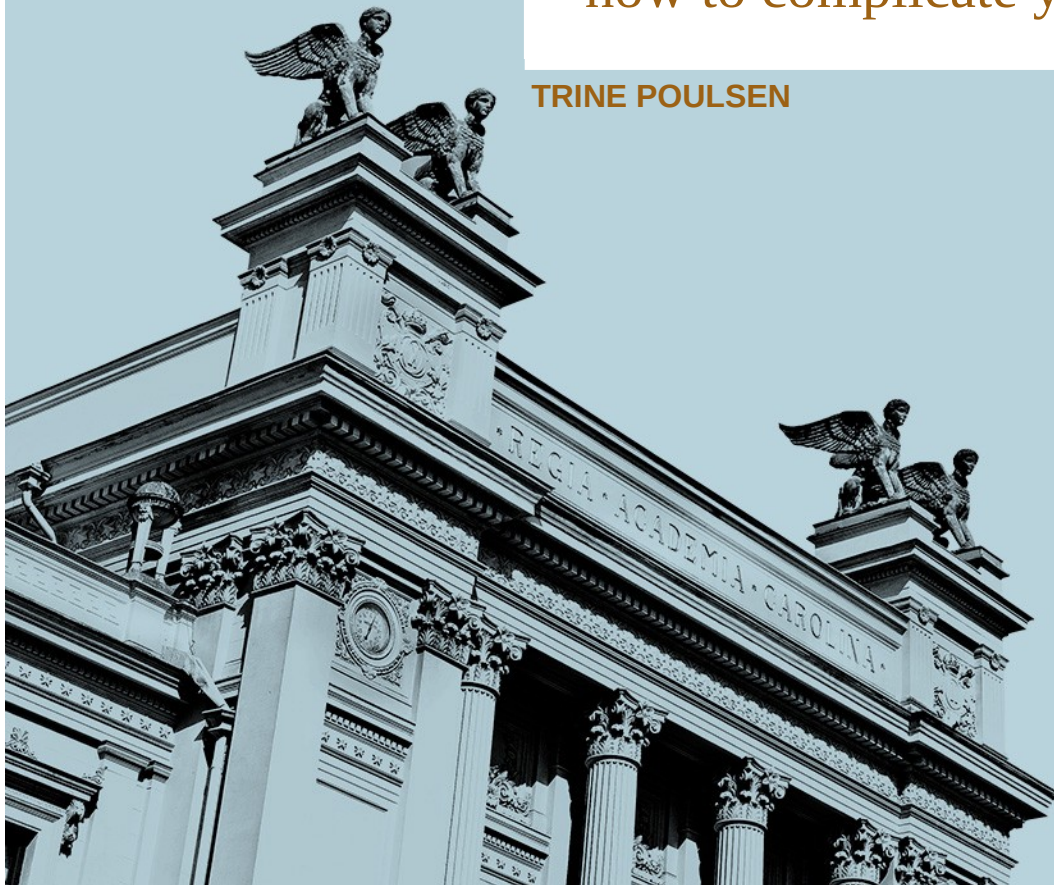# Fun with dijets

– how to complicate your life by taking ratios

TRINE POULSEN

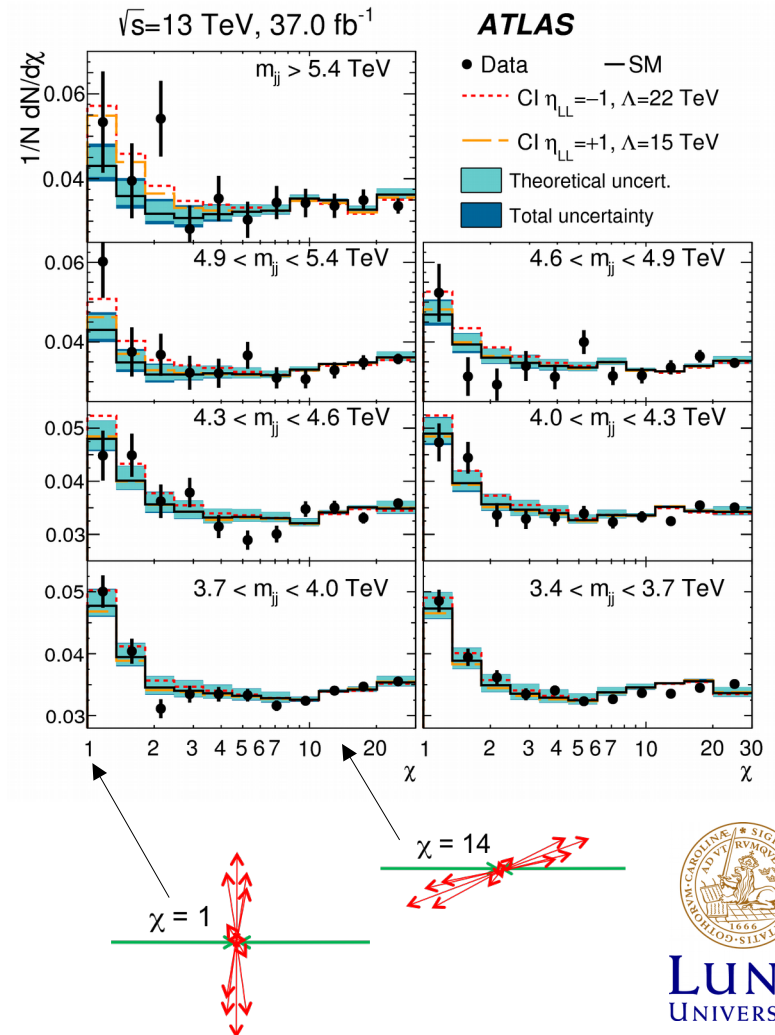DOKTORANDDAGEN, 19 JUNE 2018

Outline

- Angular dijet analysis
  - Previous analysis
  - Taking ratios
  - Getting certain about the uncertainties
  - How do we claim a discovery now?
- Top-tagging
  - Results by Yosse Andrean
  - Future studies
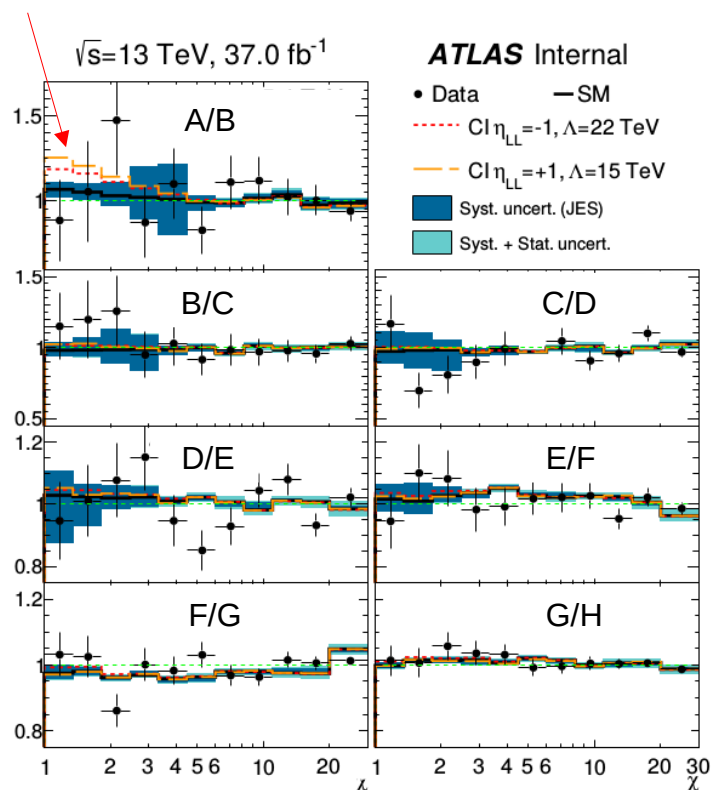- Recommendations

Angular dijet analysis

- Previous analysis

- The angular distribution of the dijets is given by $\chi = e^{|y1-y2|}$ and is divided into different mjj-bins
- The different mjj-bins have similar systematic uncertainties
- The uncertainties will be reduced by taking the ratio to the bin below

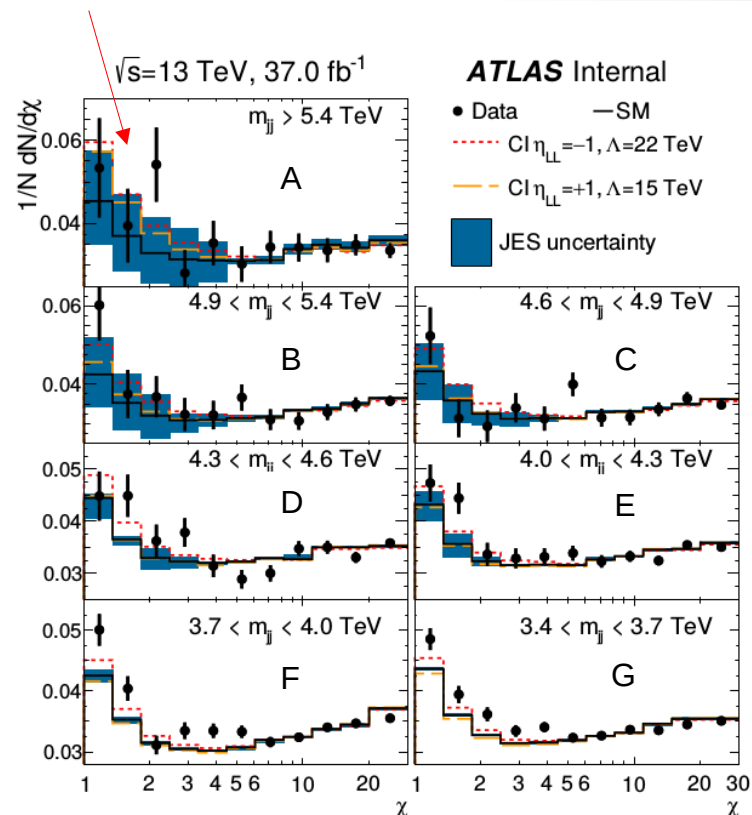# Angular dijet analysis
- Taking ratios (first results)

Ratio to bin below
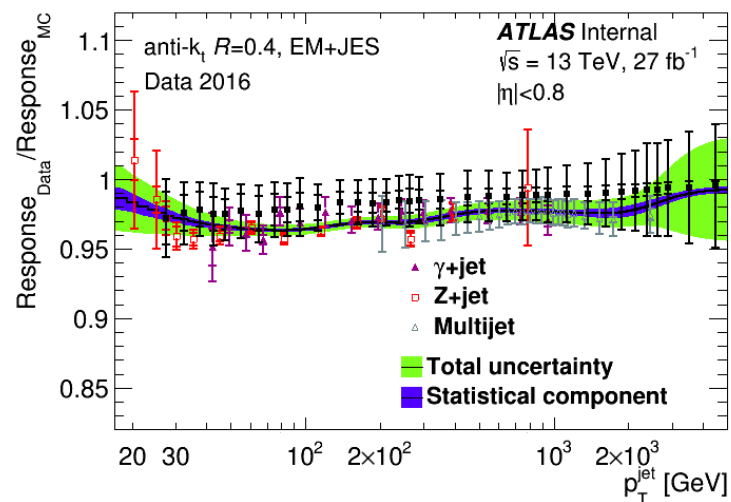
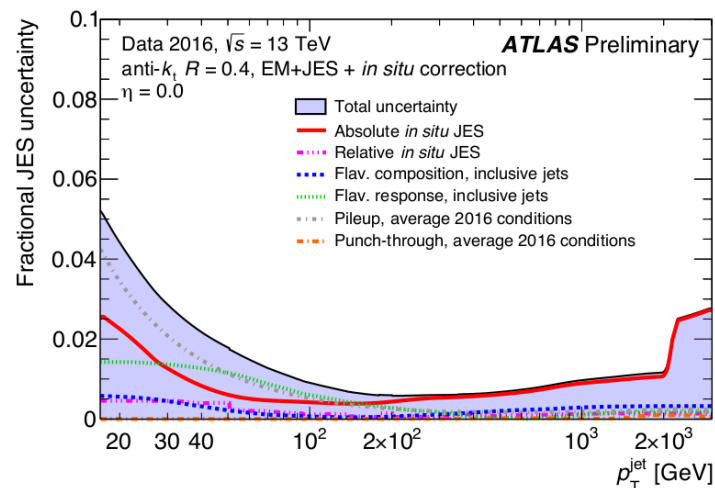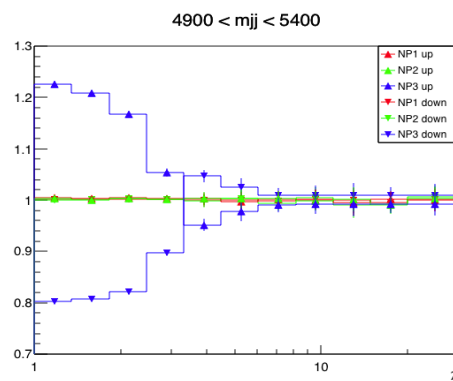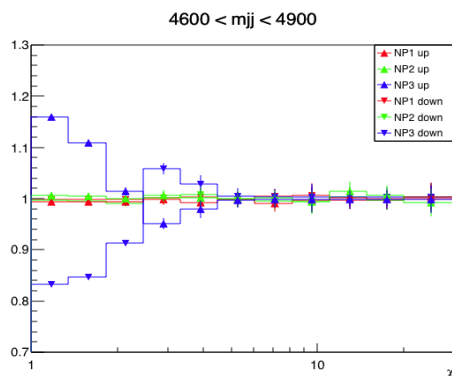Normal

Only including JES uncertainty!

Angular dijet analysis
- Getting certain about the uncertainties

- **JES uncertainty**
  - Going up rapidly at high pT
  - Migration between mjj-bins
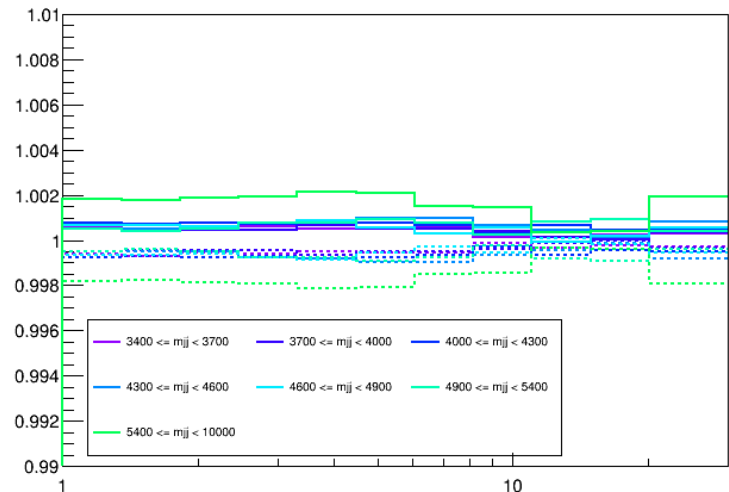 - Effect can be reduced by making more smooth transition at high pT

Angular dijet analysis
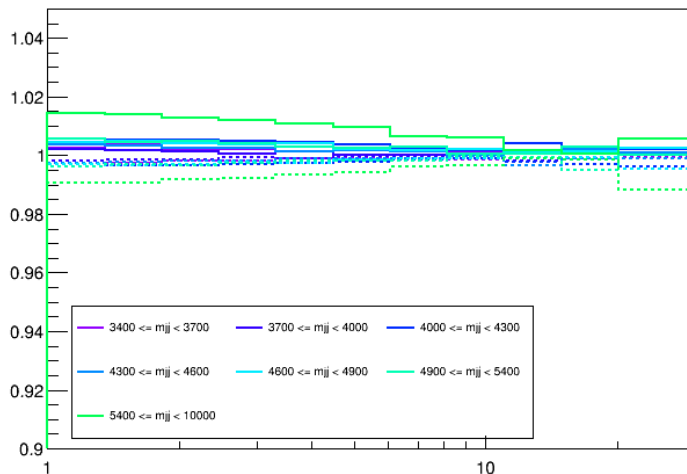## - Getting certain about the uncertainties

- PDF uncertainty
  - NNPDF2.3, CT10 and MSTW2008
  - Negligible
- Scale uncertainty
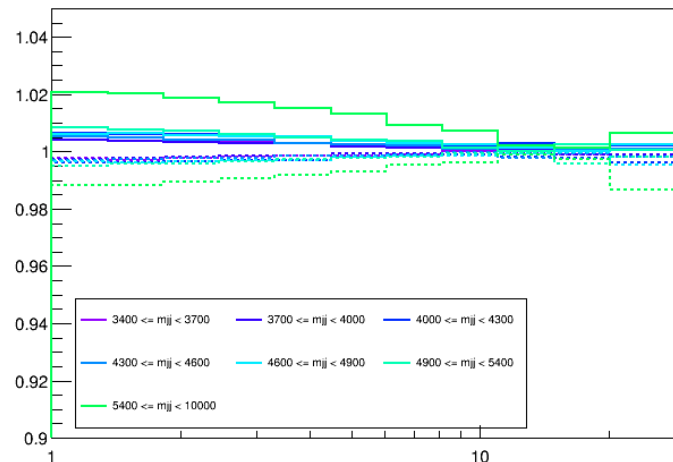 - Varying μ_R and μ_F
- Tune uncertainty

Relative PDF Unc. for Ratio to Bin Below
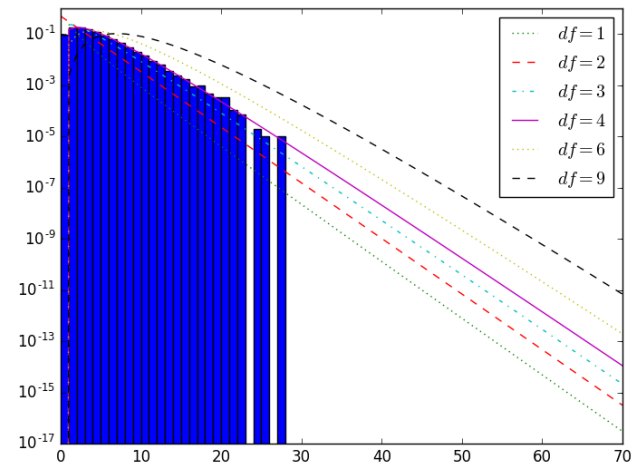

Relative scaleMUR Unc. for Ratio to Bin Below

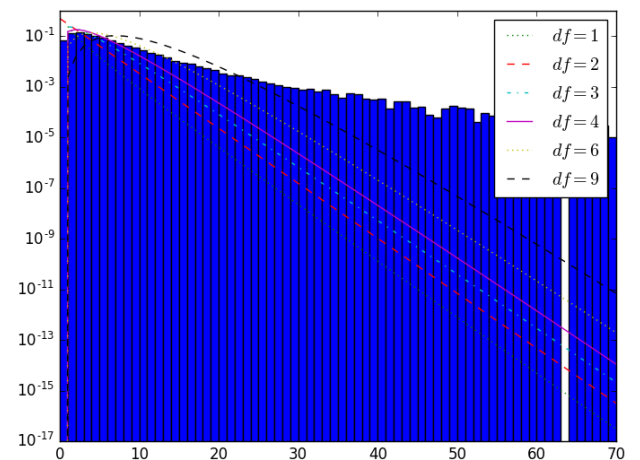Relative scaleMUF Unc. for Ratio to Bin Below

Angular dijet analysis
- How do we claim a discovery now?

- Statistical treatment gets more complicated when taking ratio
  - Correlation between different ratio plots (e.g. A/B and B/C)
  - Ratio of two Gaussians is not Gaussian
- Working with Alex Read (Oslo) on developing new limit setting procedure
  - Need to do pseudo-experiments to get test statistics since the asymptotic formula is not valid
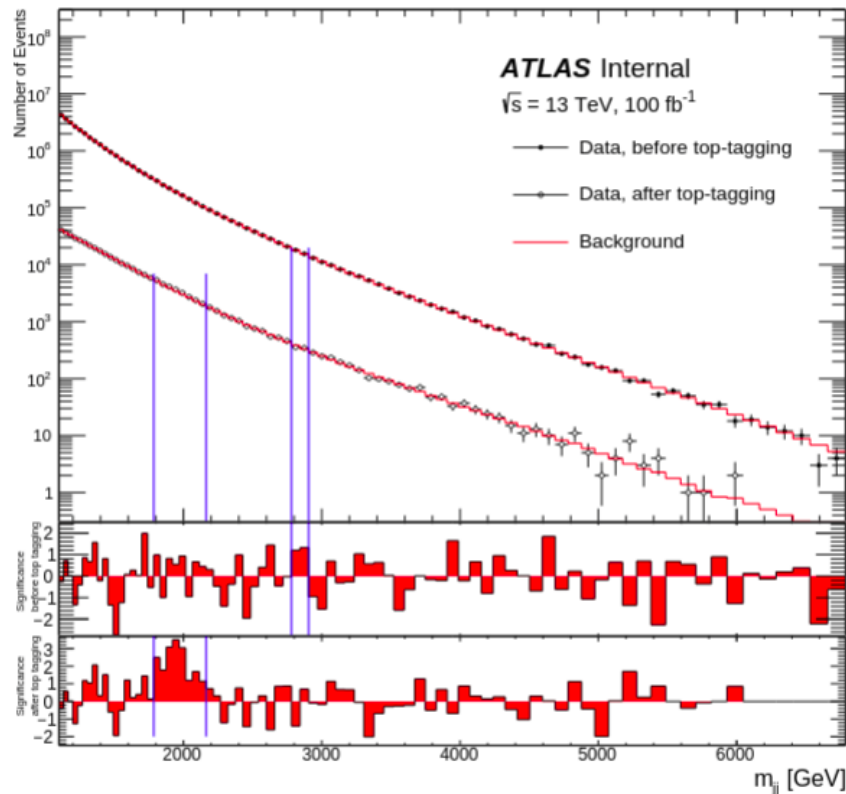

2 x multinomial with 3 bins

2 x ratio of multinomials

Top-tagging

- Results by Yosse Andrean

- BSM particle coupling to mass → top-quark pairs
- Improve the sensitivity of dijet search by using top-tagging

Top-tagging
- Future studies

- Improve top-tagging at high pT (UBC for 3 weeks)
    - Topocluster top-tagger (Deep Neural Network)
    - Uncertainties
- Include top-tagging in angular analysis
    - With ratio method

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Recommendations
- Advice from a "senior" PhD student

- Supervise!
  - Your ability to explain "simple" things will be tested
  - Experience useful later
  - Complementary studies for your thesis work
- Take a chill pill
  - It does not benefit anyone that you push yourself too hard
  - It will get easier
- Courses
  - Do LATHE after having teaching a lab once
  - High Performance Computing at KTH