

A 3D visualization of a particle detector, likely ATLAS, showing a central collision point with a burst of orange lines representing particles. Several jets are visible as yellow and green structures extending from the center. The detector components are rendered in dark blue and grey.

# Jets, Jets, DM, and Jets

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Doktoranddag  
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**ATLAS**  
EXPERIMENT

Run: 282712

Event: 474587238

2015-10-21 06:26:57 CEST

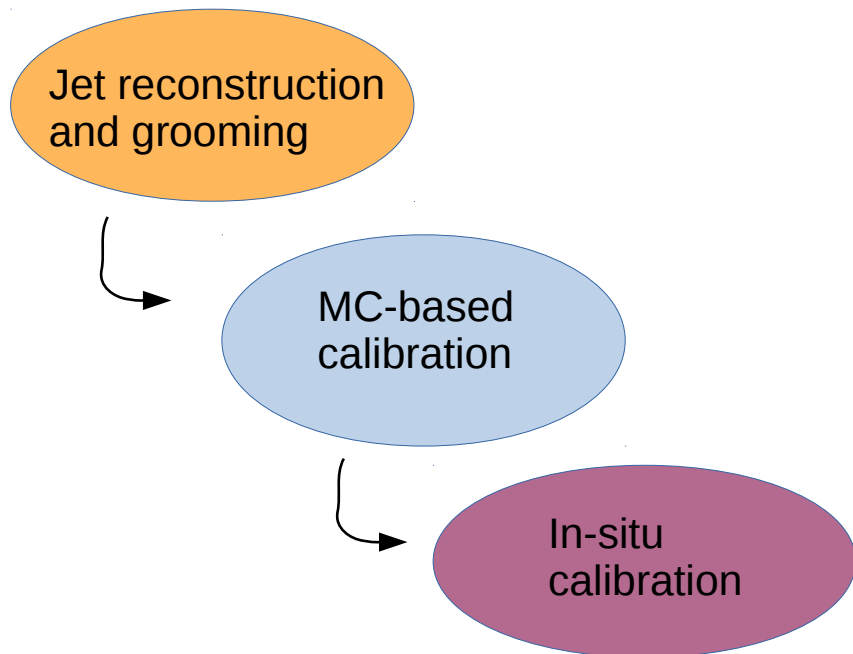
# So far, so good



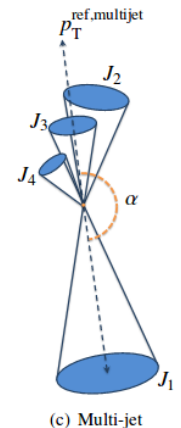
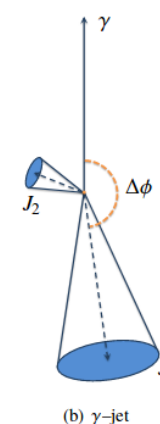
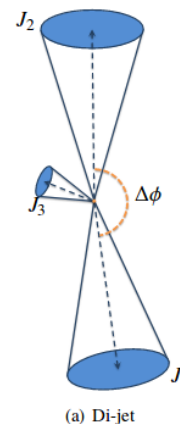
- Supervisor: Caterina the First
- One year and one week in to my PhD
- Dark matter searches with jet final states in ATLAS
- Until ~now: Mostly authorship qualification task
- From ~now: Mostly new analysis and upgrade work

# So far: Qualification task

- Constrain large-R jet response (JES,JER,JMS,JMR) with in-situ measurements
- Example: Balance jet against a well calibrated object in data and MC
- Last step of the calibration chain
- Done for the first time in 2016 data for large-R jets
- My job: Combine the measurements to cover more phase space



$$Response = p_T^{J1} / p_T^{ref}$$

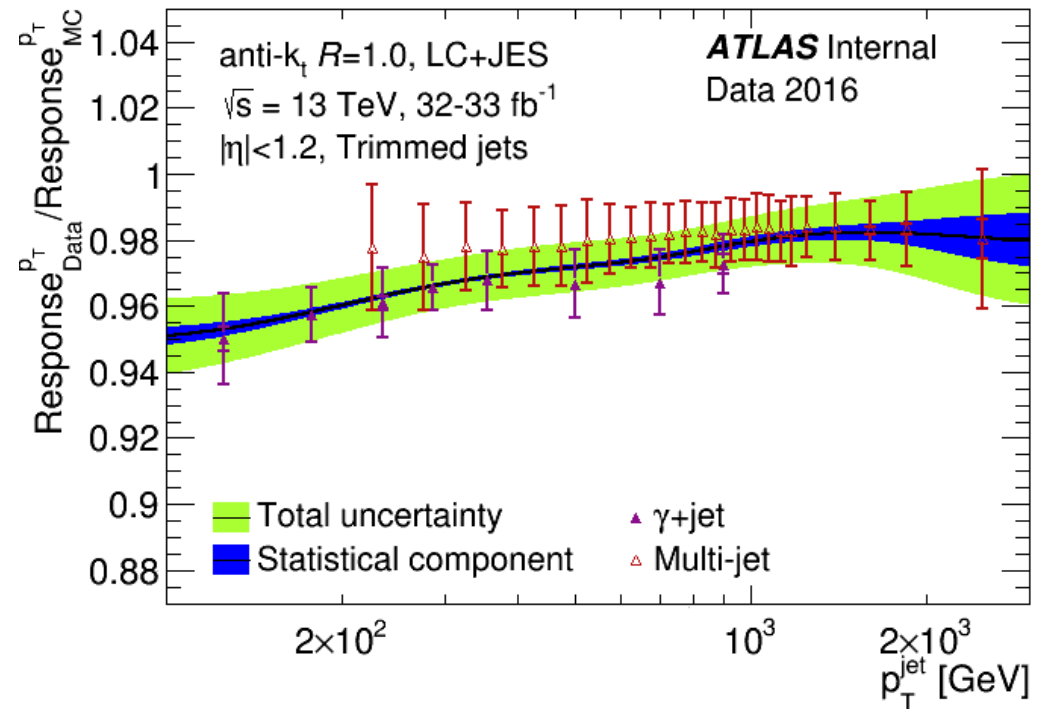
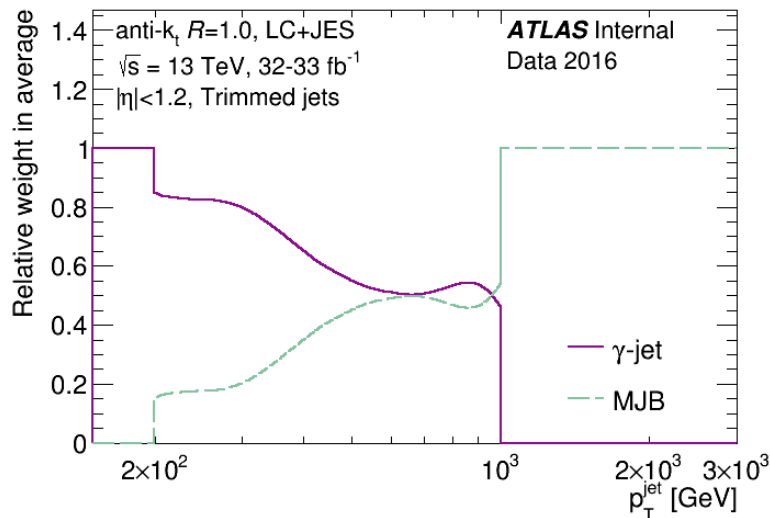
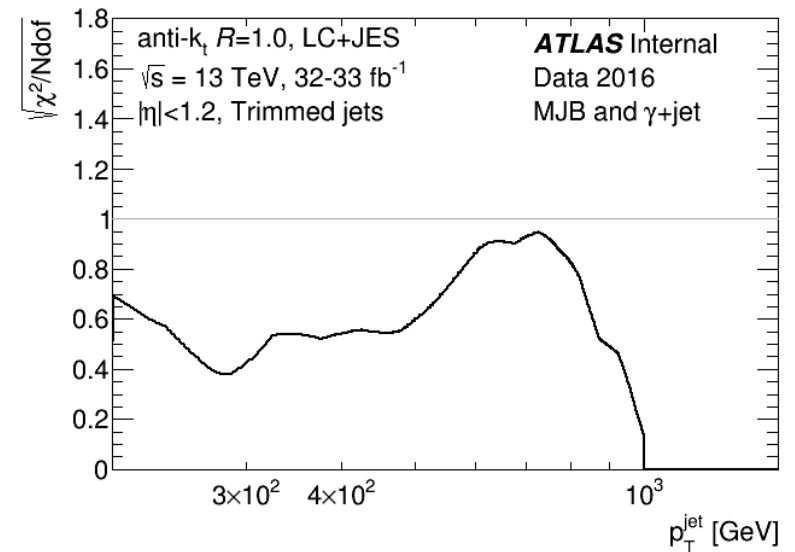


[1]



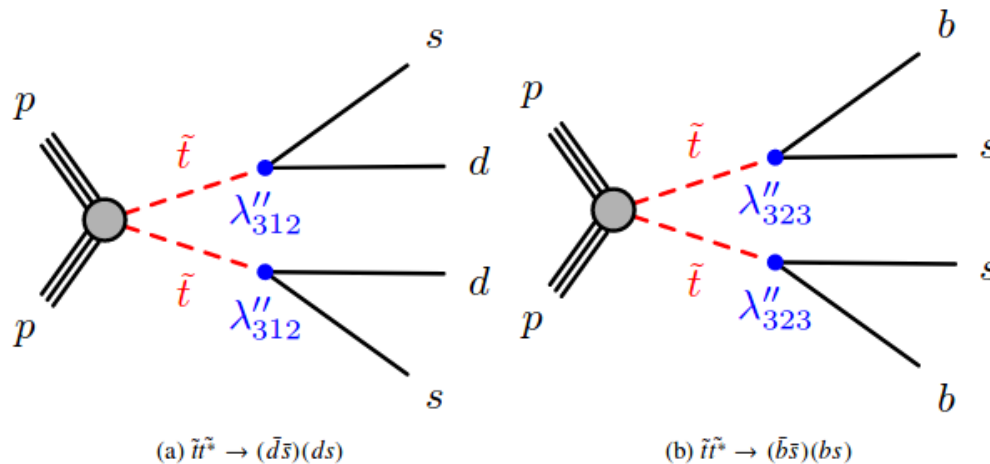
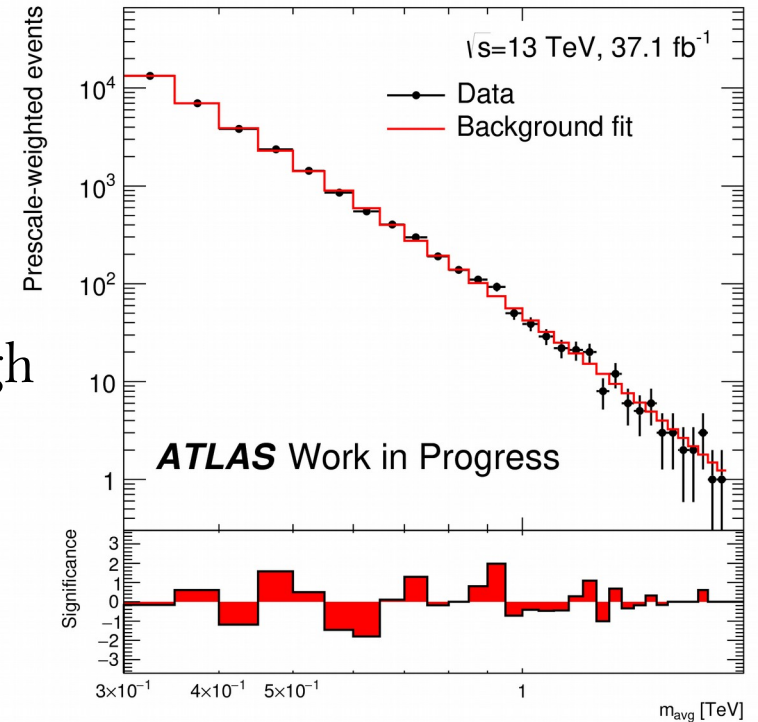
# In-situ Combination

- Measurements interpolated with cubic splines
- Weighted average based on  $\chi^2$ -minimization
- Weights account for systematics, correlations and different bin sizes
- Uncertainties scaled by the  $\text{sqrt}(\chi^2/N_{\text{dof}})$
- Response ratio and uncertainties smoothed with a Gaussian kernel



# So far: 4-jet analysis

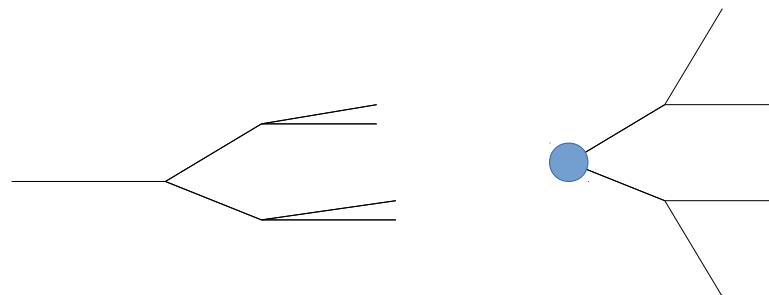
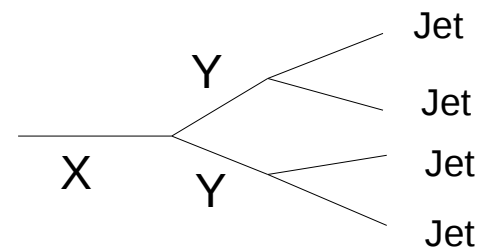
- Search for pair produced, massive resonances decaying to two jets each – No missing  $E_T$
- Interpreted in a SUSY simplified model where lightest particle is a Stop decaying to jets through R-Parity violating coupling
- My contribution: Fit background in ‘validation region’ to provide systematic uncertainty on background estimate



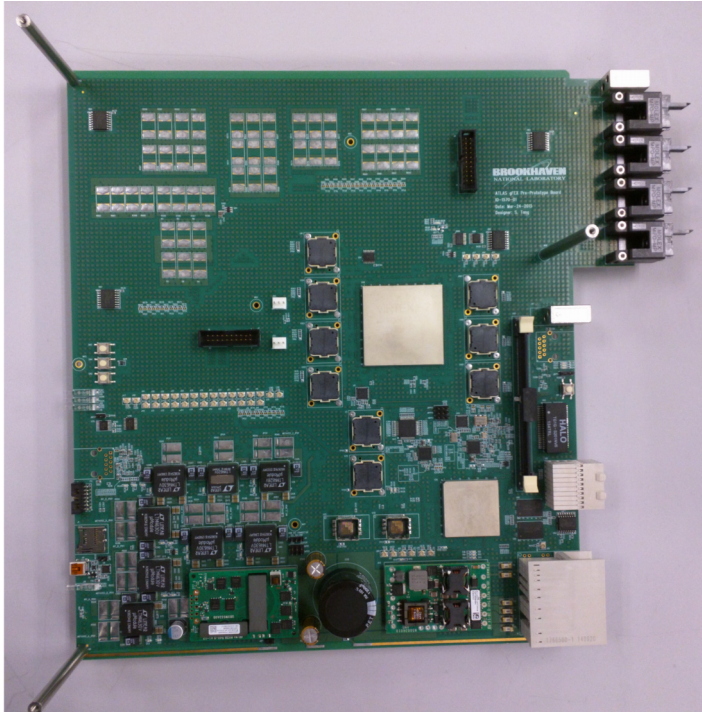
[2]

# Next 6 months: Nixon Analysis

- Paired dijet final states
- Will cover a wide range of masses for pair produced resonances associated to Dark Matter or SUSY
- Near future:
  - Show that (or whether) a different technique than 'normal dijets' is necessary for this signature
  - Test/develop generic, scale invariant anti-QCD tagger



# Next 6 months: Global Feature Extractor (gFex)



[3]

- Module for Phase-1 upgrade of L1Calo
- Entire  $\eta$  range of calorimeter available in one module
- Enables identification of large radius jets and substructure in real time
  - Capture Lorentz boosted W/Z/Higgs/top
- Other global event variables:
  - Missing transverse energy
  - Centrality in heavy ion collision
  - Event-by-event pile-up energy density
    - Local pileup suppression using baseline subtraction techniques
- My task: Software that controls connections and communication with databases

# Useful Course

- CERN School of Computing ([link](#))
  - Base technologies
    - Performance tuning
    - Parallelization
    - Security
    - Networking
  - Data technologies
    - Storage
    - Visualization
  - Physics computing
    - Multivariate classification
    - Data analysis

Creating Secure Software

CERN School of Computing

## Things to avoid



Situations that can turn very wrong very quickly

45

Sebastian Lopiński, CERN

The image shows a blue inflatable pool in an outdoor setting. A wooden table with several bottles of drinks is floating in the water. Two men are standing in the pool. In the foreground, a black and white dog is swimming. An orange callout box with white text points to the scene, stating 'Situations that can turn very wrong very quickly'. The slide is titled 'Things to avoid' and is part of a presentation on 'Creating Secure Software' from the CERN School of Computing. The slide number is 45 and the presenter is Sebastian Lopiński, CERN.



# Useful Course

- CERN School of Computing ([link](#))



# References

- [1] ATLAS Collaboration: “In-situ measurements of the ATLAS large-radius jet response in 13 TeV pp collisions”
- [2] ATLAS Collaboration: “A search for pair-produced resonances in four-jet final states at  $s\sqrt{=} = 13$  TeV with the ATLAS detector”
- [3] ATLAS Collaboration: “gFex Phase-1 TDAQ Upgrade: Final Design Report”