More fun with jets

Eva Brottmann Hansen

Doktoranddag
19. June 2018

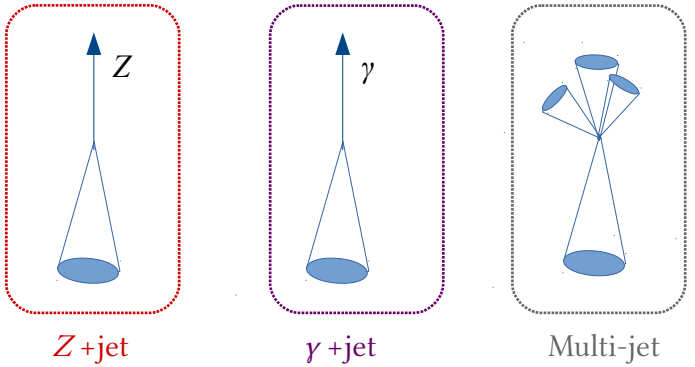
Quick overview

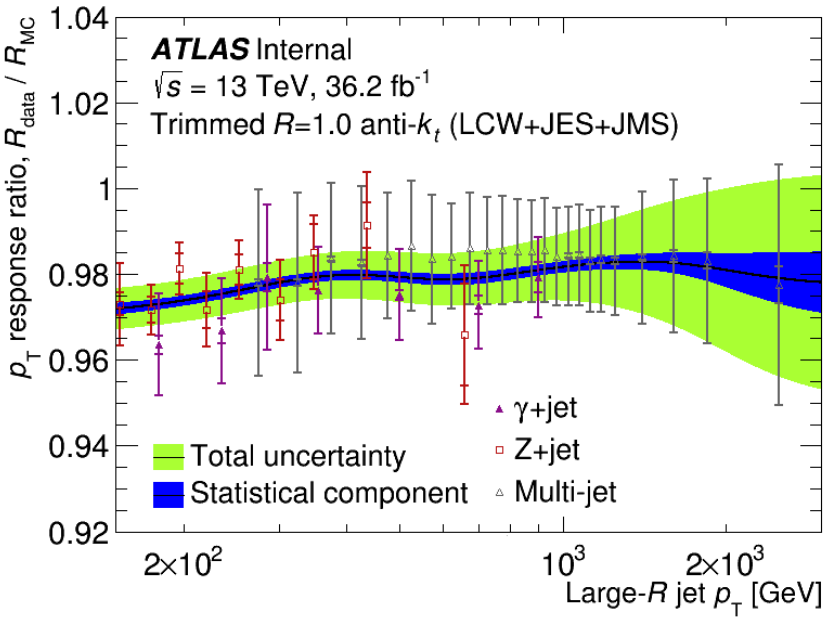
- 1.75 years into my PhD
- Main theme: Dark matter searches with jet final states in ATLAS
- Since last D-day: Mostly performance and upgrade work
- From ~now: Mostly analysis and upgrade work (Hopefully)

Performance

In-situ combination - 1

- In-situ methods are used to constrain discrepancies in jet response between data and MC
- JES: pT balance of jet against a well calibrated object
- JMS: Track jets and top/W events
  - Only done for large-R jets
- My job: Combine the measurements to cover more phase space
- Currently working on a paper on large-R in-situ calibration
- Latest and greatest recommendations for small-R jets scheduled to be completed this summer

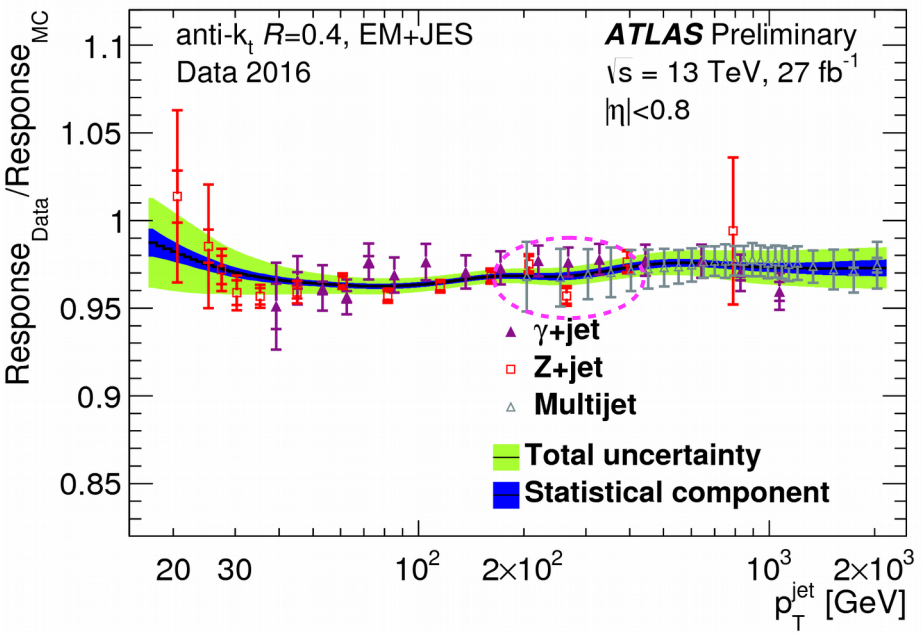


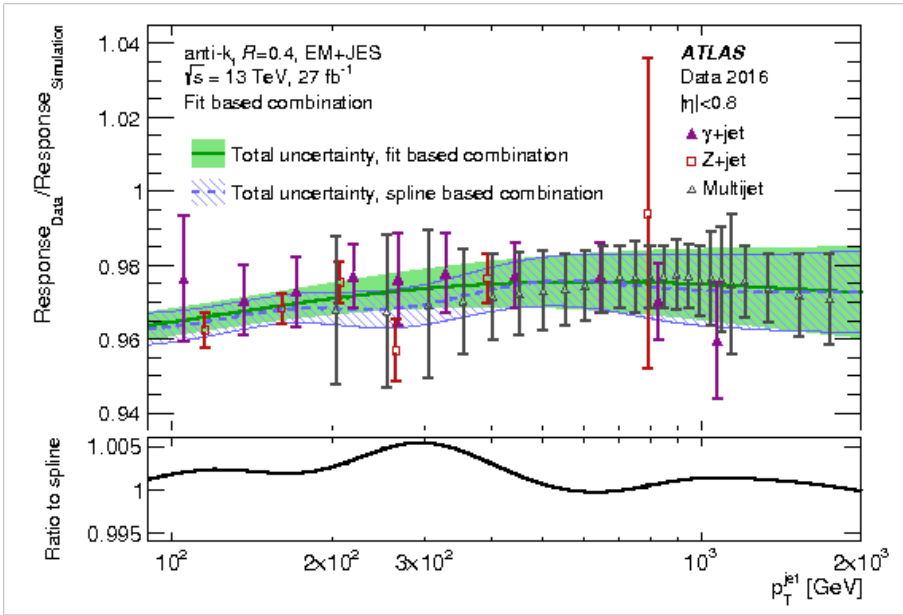


In-situ combination - 2

Performance

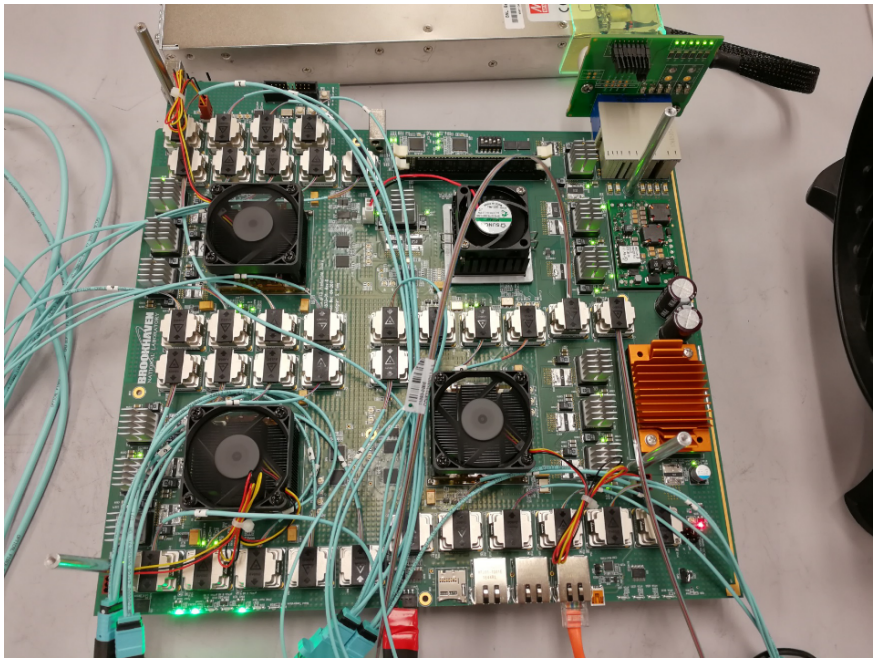
- We have seen that high-statistics makes analyses sensitive to structures in the jet calibration
- An alternative combination procedure was developed and used for the Dijet trigger level analysis which ensures a smooth calibration curve
  - Combination procedure based on a polynomial fit instead of interpolating splines





General Feature Extractor (gFEX) - 1

Upgrade



- Module the phase-1 upgrade of the Level 1 Calorimeter Trigger
- Entire η (and φ) range available in one module
- Enables identification of large radius jets and substructure in real time

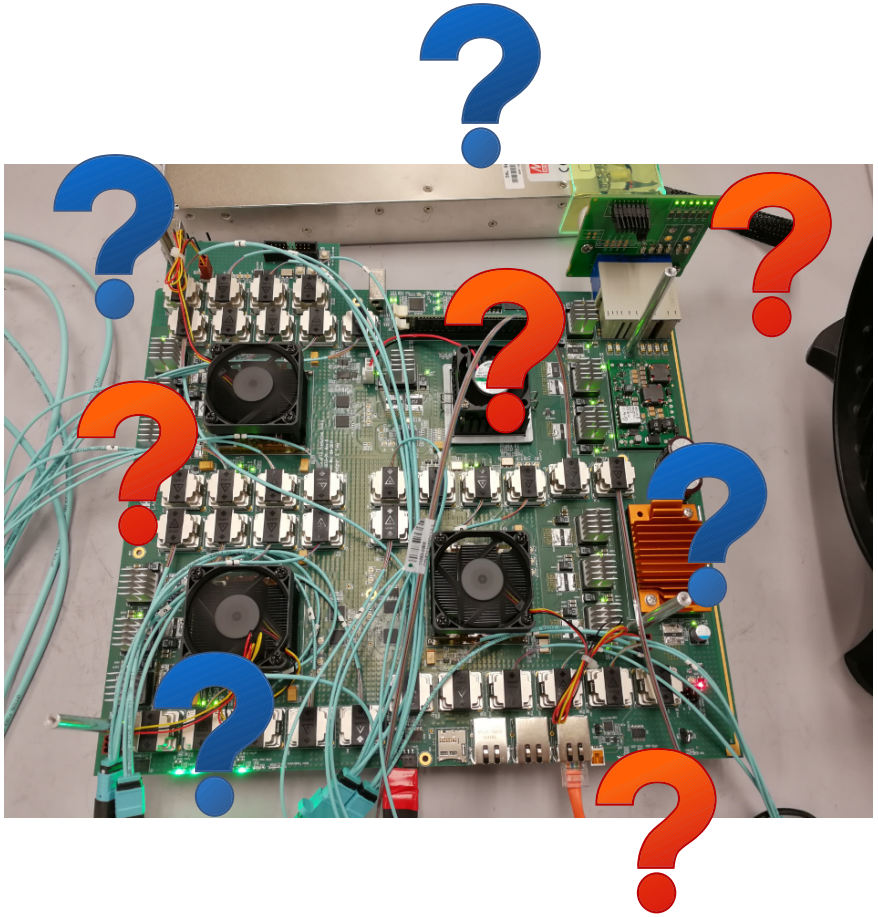
  → Capture Lorentz boosted W/Z/Higgs/top

  → TLA with boosted object
- 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

General Feature Extractor (gFEX) - 2

Upgrade

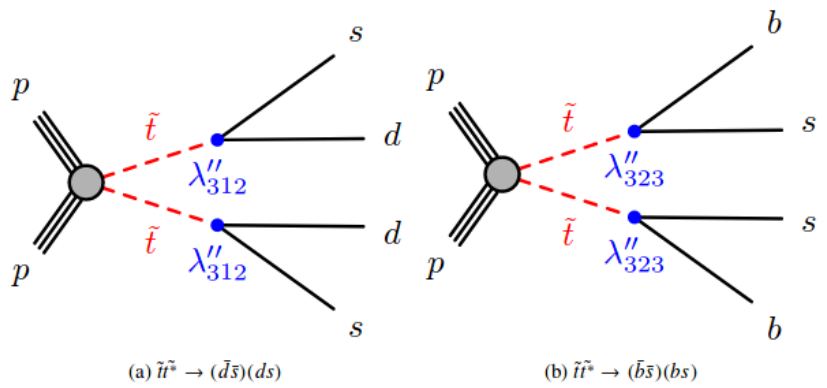


- My job: Control Software
  - Prepare for run, configure links, load from database, etc.
- Current status:
  - “Skeleton” software package based on L1Topo control software
  - Include few simple methods
  - Hardware emulators are set up and ready for testing and development
- Many specifications still need to be determined by firmware engineers

Analysis

4-jets - Motivation

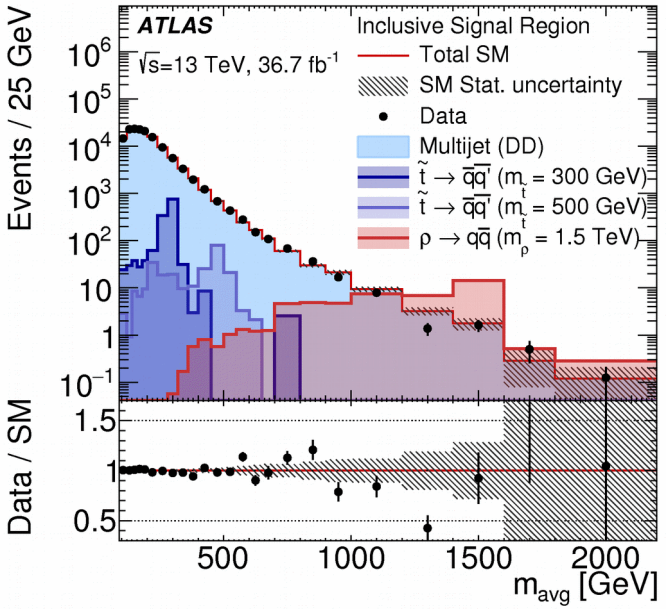
- Paired dijet resonances are predicted in many SM extensions
  - Supersymmetry with R-parity violating (RPV) couplings allows the lightest supersymmetric particle (LSP) to decay to two jets
  - Models with Dirac gauginos, additional gluinos
  - Axigluons, colorons, compositeness, topcolor
- Naturalness suggests higgsinos and top squarks below 1 TeV
- Top squarks in R-parity conserving scenarios have been thoroughly searched for and are ~excluded below 1 TeV
- Allowing RPV couplings significantly relaxes existing bounds on mass

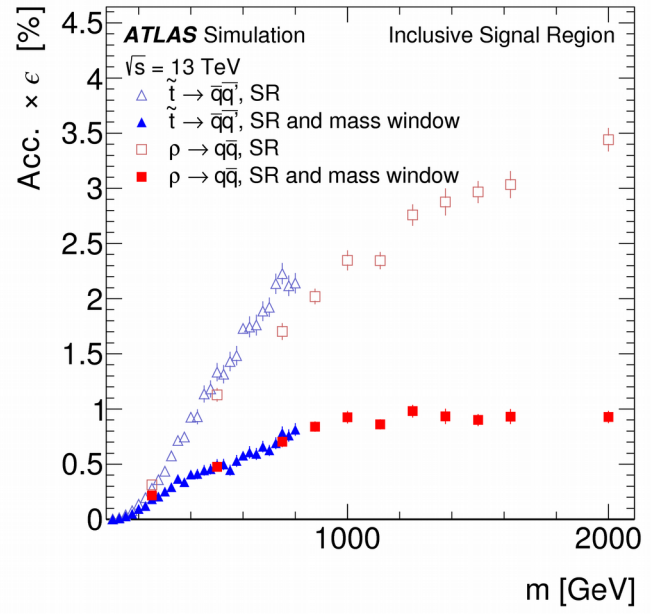


Analysis

4-jets – Results and outlook

- First iteration was published in EPJ C with 2015 data
  - Focus was on SUSY with RPV couplings allowing the lightest supersymmetric particle to decay to two jets
- Second iteration (Full run-2) is about to start
  - More model independent
  - Increase acceptance
  - Background fit as primary method for background estimation
  - Fat jets with substructure

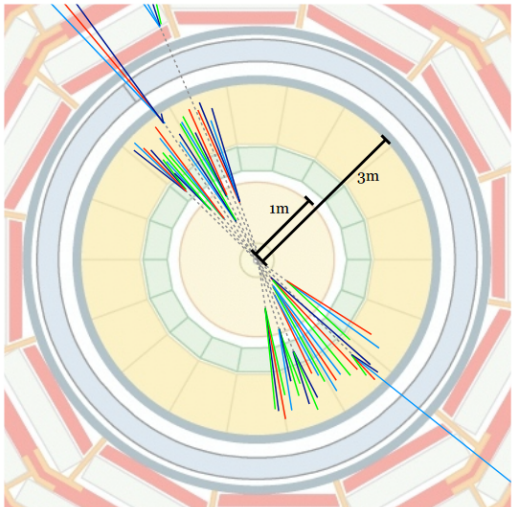


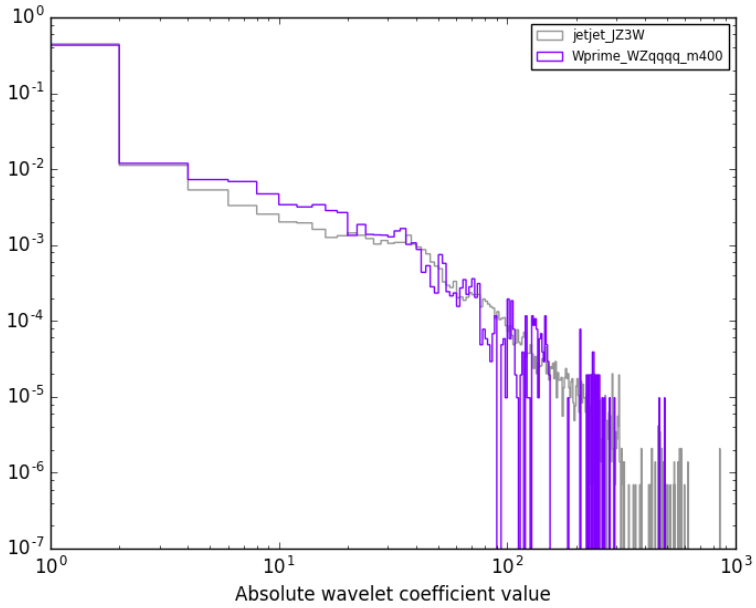


Analysis/performance

Wavelets for emerging jets

- Emerging jets are are an interesting signature which ~no LHC analyses are currently sensitive to
- Wavelets might be a model-independent way of picking up the structure of such object
- Very preliminary study of the possibility of targeting emerging jets with wavelet techniques was slightly positive
- More thorough studies indicate wavelets might not be efficient
  - Substructure techniques could be more fruitful
- Might be a master thesis project





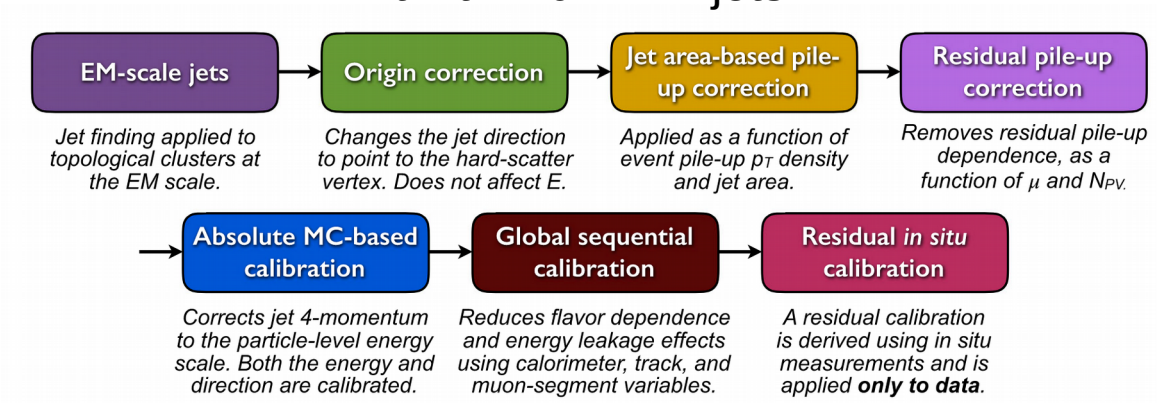
Recommendations

- Go to the International School of Trigger and Data Acquisition (ISOTDAQ), if you are interested in TDAQ software and hardware
- Teach the lab of Introduction to Particle Physics, if you like to play with NIM modules and oscilloscopes and want to know the muon lifetime

Back up

Jet calibration chains

Anti-kt R=0.4 EM jets



Anti-kt R=1.0 LCW jets