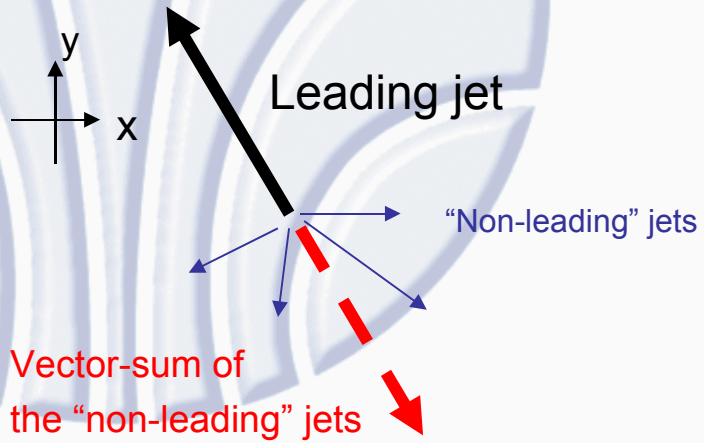
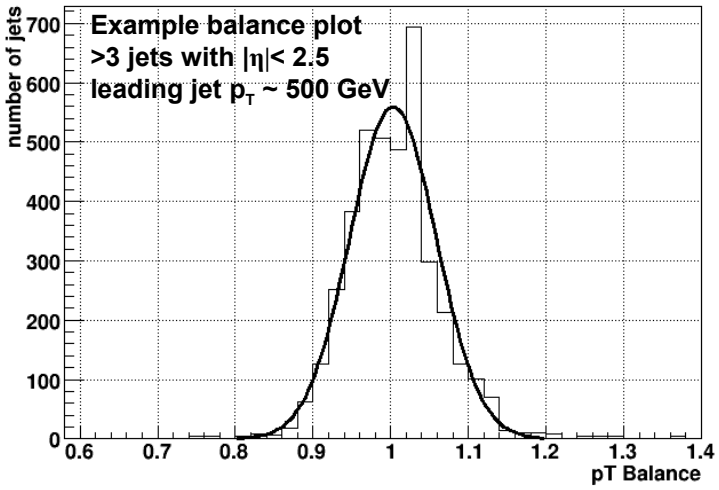
“Bootstrapping” the Jet Energy Scale to High p_T

Jet-”Intercalibration” in Transverse Momentum



- Basic idea:
  - select events with at least 3 jets, one having significantly more p_T than all others

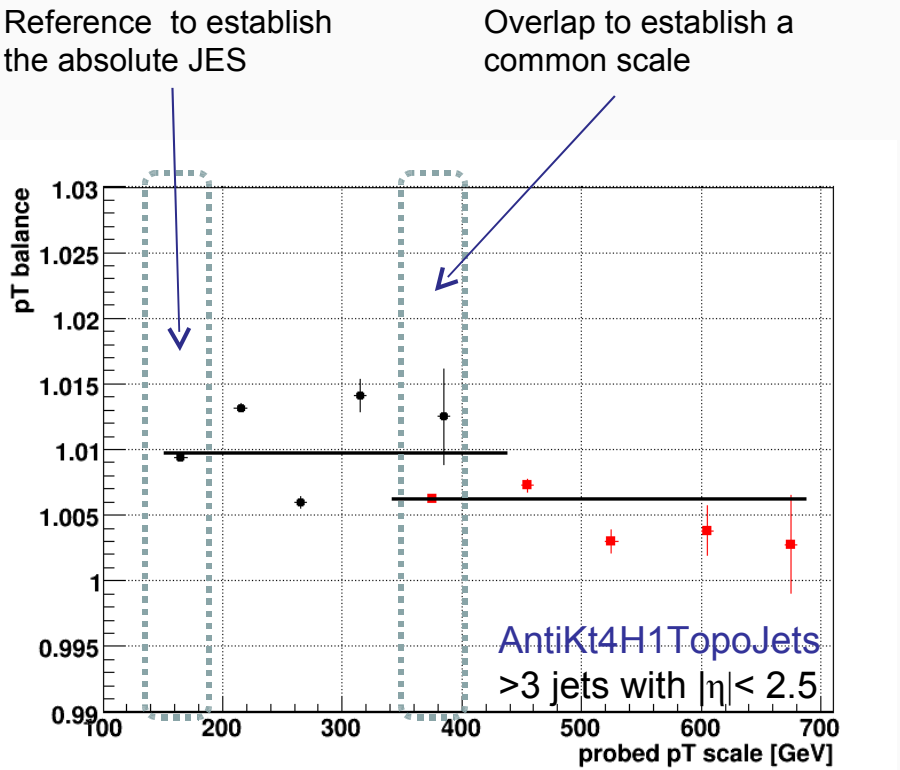


  - **Balance this jet with the vector sum of all others**

- Simulated Data: Unskimmed “Lisbon” D2PDs without pileup, Pythia QCD jets, normalized to **100 pb^{-1}** of integrated luminosity

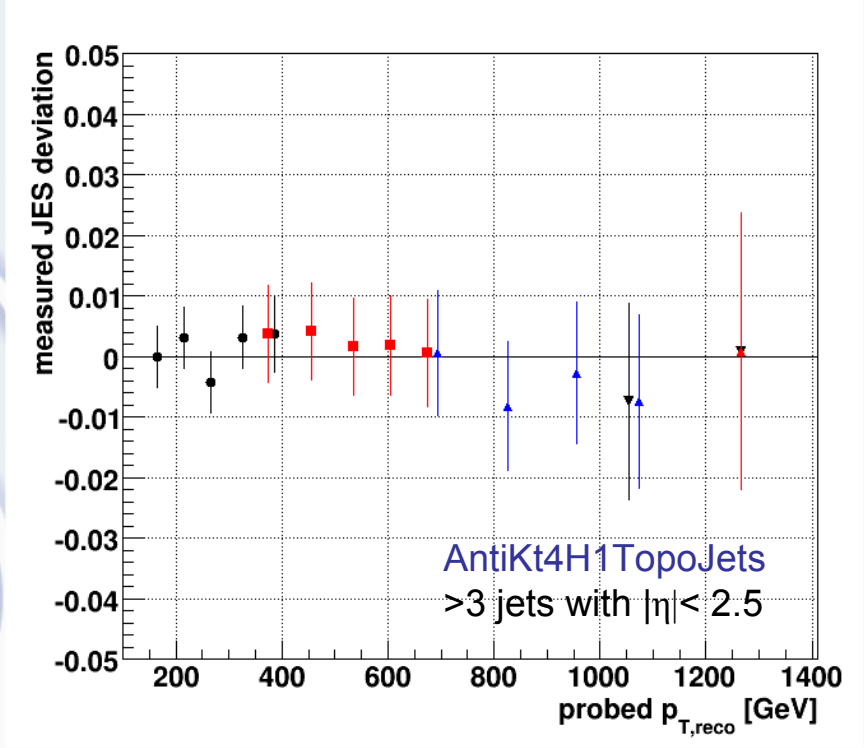
Specifics of the Presented Method

- Fixed event selection criteria based on the non-leading jets
  - Imbalance is then flat in p_T (within 0.5%)
  - **Allows to closely and directly model the JES over large ranges of jet p_T**
- Iterative process, with relaxed selection on non-leading momenta
  - **significantly increased statistics by extending the reference region**

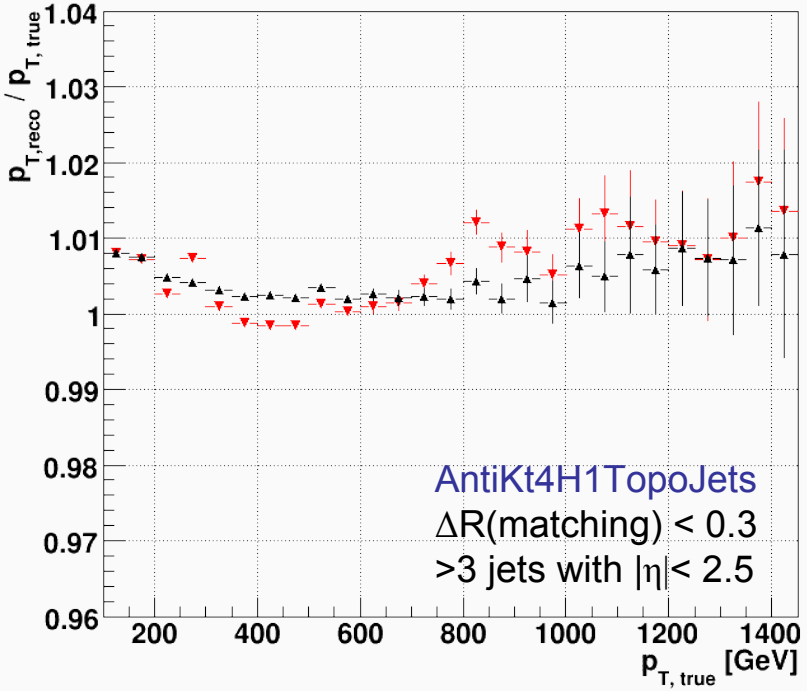


- High reach in pT due to the iterative process
- Overlapping bins between iterations establish a common scale
- Overlap with other in-situ methods establishes the absolute Jet Energy Scale (JES)

Results



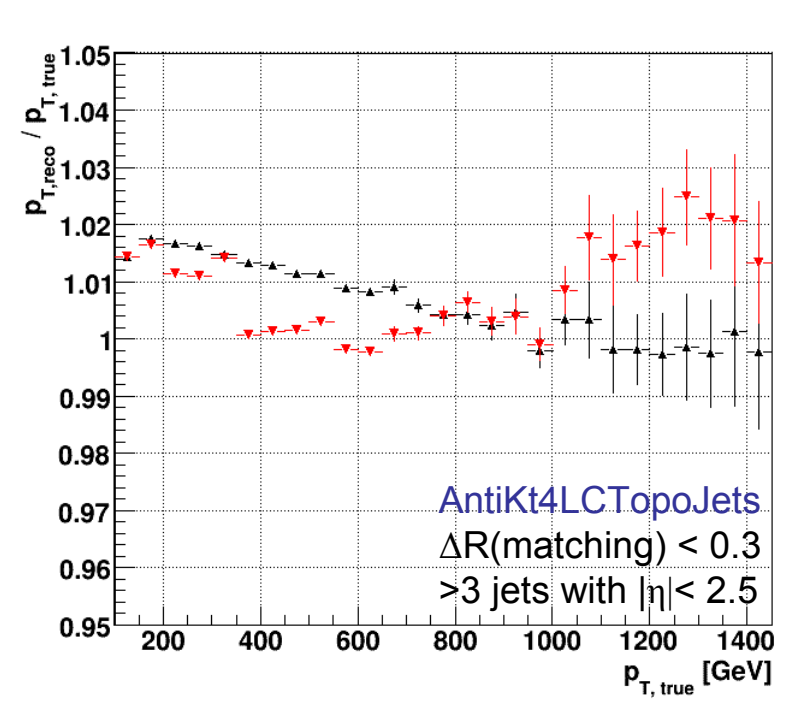
Resulting measurement of the JES, relative to the reference region (colours are used to highlight iterations)



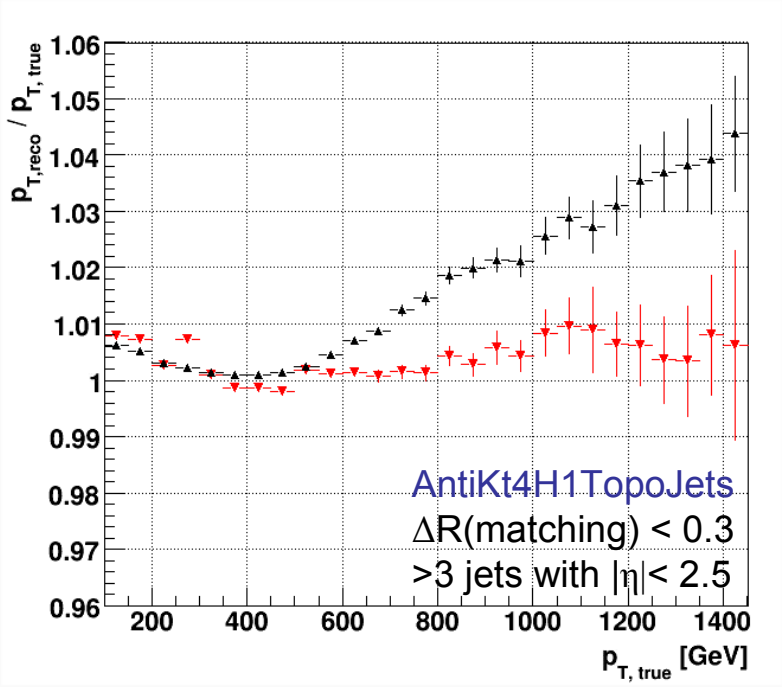
Jet response before (black) and after (red) applying a simple correction based on multijet bootstrapping (jet-by-jet)

- The JES is correct within 2% up to 1.4 TeV jet p_T, for an integrated luminosity of 100 pb^{-1}

Further Example Results



Jet response before (black) and after (red) applying a correction based on multijet bootstrapping



Above an **arbitrary non-linearity was introduced** on jet-level, of the form: $p_{T,wrong} = \frac{p_{T,reco}}{a \cdot \left(1 + (\frac{e}{h} - 1) \cdot b \cdot \ln(p_{T,reco})\right)}$ and corrected afterwards (red)

- Again the JES is correct within 2% up to 1.4 TeV jet p_T

Conclusions

- An in-situ method to calibrate the JES at high jet momenta was presented
- This method does not require Monte Carlo information
- The estimated performance for **100 pb^{-1}** of integrated luminosity is to linearize the jet response **up to 1.4 TeV** of jet transverse momentum with an accuracy of **2%**
  - The JES uncertainty in the reference bin (here: around 170 GeV) has to be added to result in a final JES uncertainty
  - Systematic effects will have to be studied in data, and may have a larger impact compared to simulated data (where they have been found to be < 0.5% per iteration)