Introduction to the Jet Energy Scale Session, Part IV

Hadronic Calibration Workshop

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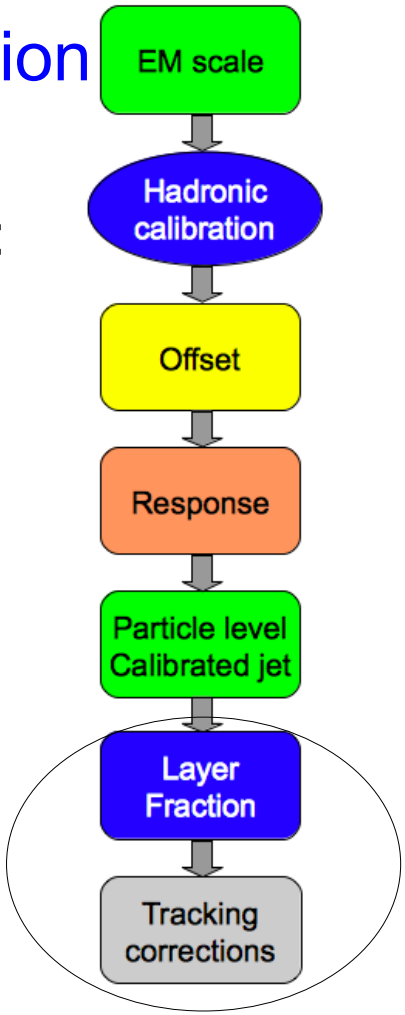
Overview of the session

- Techniques to improve the jet energy resolution after calibration
- Discussion on systematic uncertainties

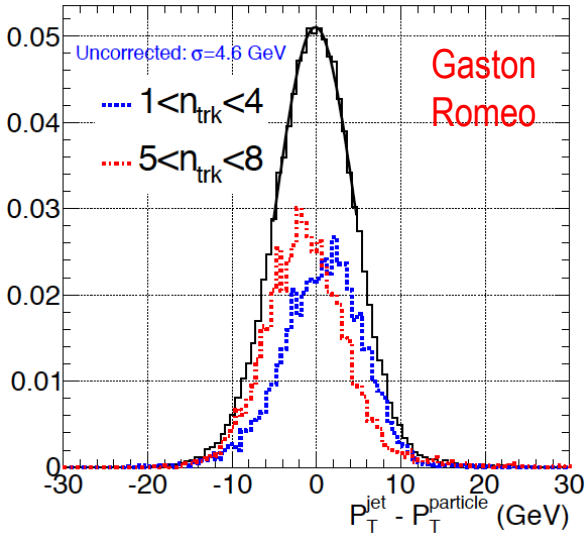
Corrections after the Jet Energy Scale

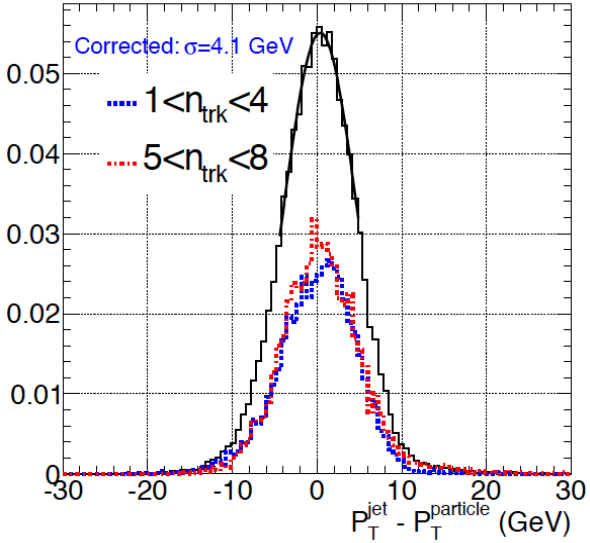
- Jet-by-jet corrections using additional information from calorimeter and tracker sub-detectors:
  - Reduce some of the sources of energy fluctuations: improvement in energy resolution.
  - Correct for the dependence of the response on jet variables sensitive to jet fragmentation, dead material, and non-compensation.
- Factorized, sequential procedure, after JES:
  - Average jet energy scale is not changed.
  - Apply one variable (correction) at the time:
    - Simple procedure to derive/validate corrections and to incrementally add complexity.
    - Decouples energy scale from resolution improvements.
  - Tested/derived with di-jet data.



Corrections after the Jet Energy Scale

- Layer Energy Fractions:
  - Response corrections as a function of the jet energy fraction deposited in the pre-sampler, EM3 and Tile1.
  - Similar concept than layer weighting, but applied after JES, in a sequential way.
- Track-based Response corrections:
  - Track-multiplicity correction (sensitive to dead material and non-compensation)
  - Jet-vertex-fraction correction:
    - Jet-by-jet pile-up correction and jet-vertex association





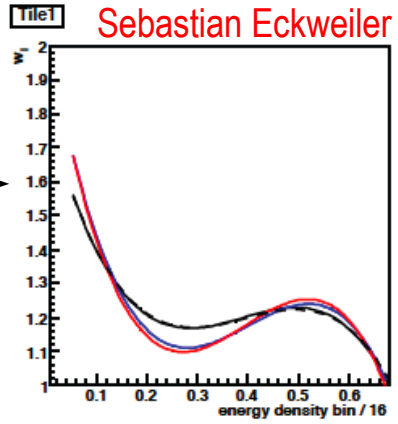
Discussion on Systematic Uncertainties

- Systematic tests and validation of calibration techniques with data:
  - How do we assess the performance in data and the agreement between data and MC?
  - What are the requirements to be able to apply a particular correction. How do we validate the inputs?
    - Multi-dimensional corrections.
  - What are the criteria to validate a given technique?
- Jet energy scale systematic error:
  - Systematic uncertainties from individual corrections: hadronic calibration, offset, Eta-dependent, photon background, ...
  - Topology and flavor (sample) dependence.
  - Data/MC differences. Validation with real data.

Discussion on Systematic Uncertainties

- Clusters:
  - Monte Carlo modeling:
    - How to systematically verify/validate clusters as input to jets with data?
    - Splitting (data/MC) EM/HAD classification.
    - Noise: non-Gaussian tails.
    - Pile-up (need overlay data to MC) vertex multiplicity dependence, LHC bunch structure, luminosity profile within runs (stability)
- Hadronic calibration:
  - Monte Carlo modeling: E/p
  - Unphysical energy density weights
  - How to systematically validate weights in data?
    - Comparison with data-driven weights?

Diagnostic plots? (JetPerformance?)



Discussion on Systematic Uncertainties

- Jet energy scale systematic uncertainty
  - Hadronic calibration:
    - Single pion response (G4 physics lists)
  - Offset pile-up correction (vertex efficiency, zero-suppression, agreement between different methods)
  - di-jet and gamma+jet balance, MPF:
    - Photon background, radiation (Dphi back-to-back)
    - Fits, interpolation.
  - Fragmentation, flavor, and sample dependences