Issues in Jet Physics Summary

Conveners: Gavin Salam, Markus Wobisch

Les Houches - June 20, 2007

Jet Sessions - Overview

- Discussion of available jet algorithms
- Jets nomenclature
- Final-state truth definition
- Experience from Tevatron, ATLAS, CMS
- Hopes for LHC jets from theory perspective
- Strategies for HI and pileup subtraction in CMS and ALICE
- Benchmarks for jet algorithms

- Not covered:
  - jets and BSM / interplay with searches
  - heavy flavor jets

Jet Algorithms

- Sterman-Weinberg proposal for a jet definition
- Snowmass Accord
- Tevatron Run II workshop
- TeV4LHC workshop

UA1 cone algorithm, iterative cone algorithm, JETCLU w/ ratcheting, midpoint cone algorithm, searchcone midpoint algorithm, second-pass midpoint algorithm, seedless cone algorithm, SiScone,

Jade, modified Jade, inclusive and exclusive variants of kT and Cambridge/Aachen algorithms, fastJET versions of kT/Cambridge/Aachen

Jets Nomenclature (1)

A **Jet Definition** specifies a procedure by which an arbitrary set of (physical) four-vectors is mapped into a set of jets.

- Proposed convention:

 jet definition is composed of **jet algorithm**, its **parameters** and a **recombination scheme**

What's needed for communication of results

Jet Definition

| Jet Algorithm Parameters Recomb. Scheme | + | Final–state truth–level spec. |

4
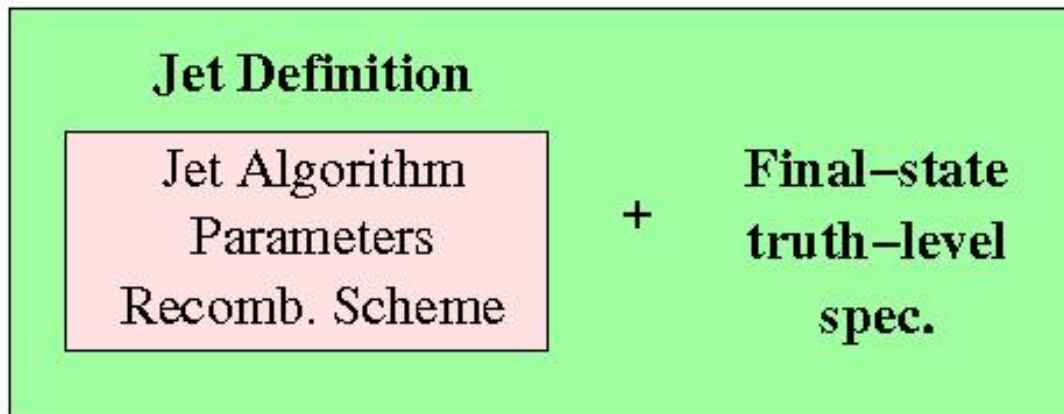
Jets Nomenclature (2)

- For consistent comparisons between experiments or between experiment and theory:

  Necessary to supplement the jet-definition with a **particle-level specification** which indicates exactly which set of 4-vectors are to be input to the jet-definition

- → see discussion on "Final-state truth level"

What's needed for communication of results

Jet Definition	
Jet Algorithm Parameters Recomb. Scheme	+ Final−state truth−level spec.
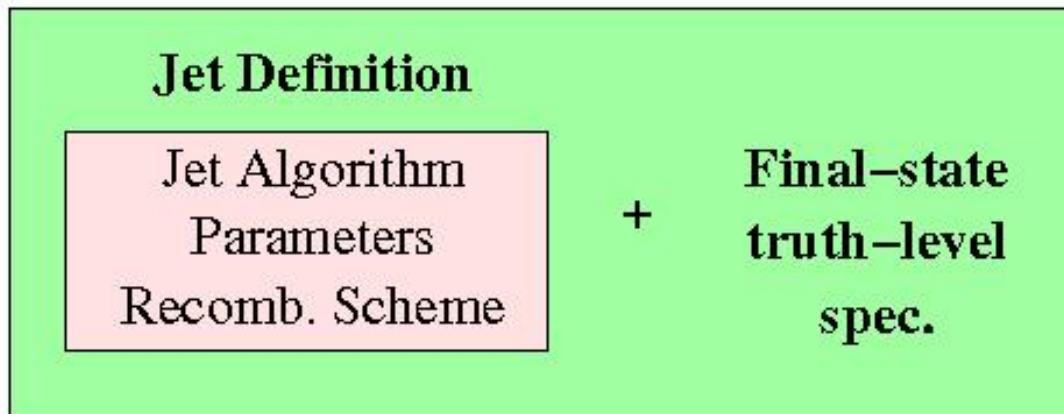
What is truth?

- Goal: consistent comparisons between theory and experiment
- Definition of "Truth Jets":
  "When experiments unfold/correct for detector effects, to what do we unfold/correct back?".
 **What is the input to your jet definition at the truth/ideal detector level?**

- Need: common definition for CMS and ATLAS (specifically for jets)
  → what is the "truth" final-state particle level?
- Aim for *"Les Houches recommendation"* to be adopted by experiments
- These definitions also apply to theoretical calculations:
  → hadronization corrections → underlying event corrections

Encouraging Talks ...

- … about experience from running experiments (from Tevatron)
- … about experience & status of experiments in preparation (from CMS, ATLAS)
- … about hopes of the outcome (from theory)
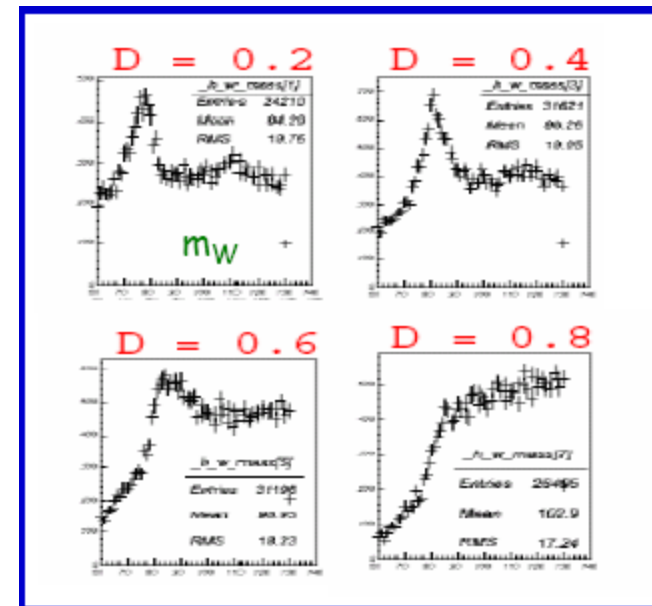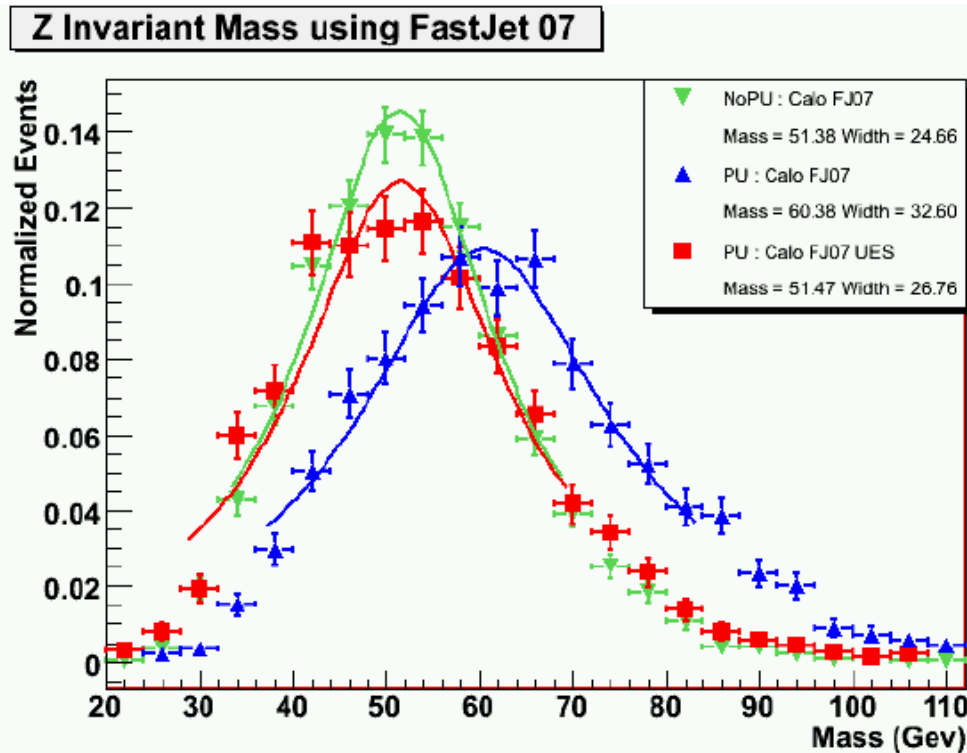
... with new concepts ...

... studied by the experiments:

- ATLAS: topological clusters
- Theory, CMS: Jet area definition
- Angular ordered successive recombination jet clustering algorithms
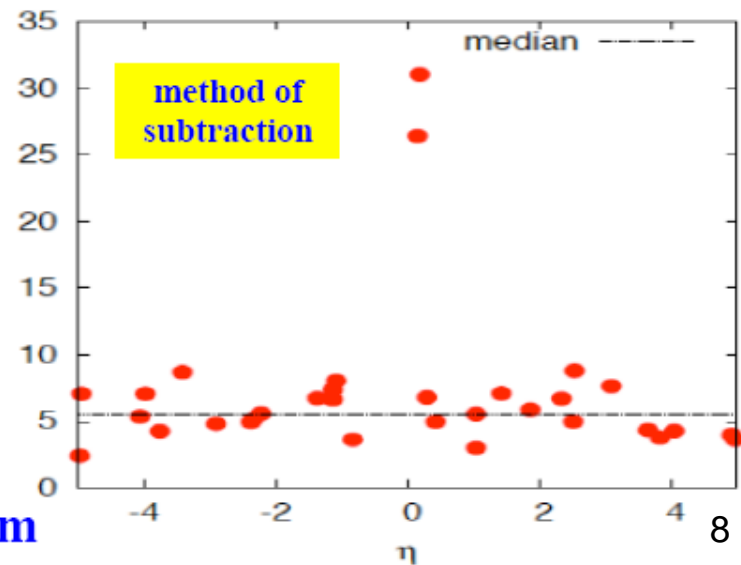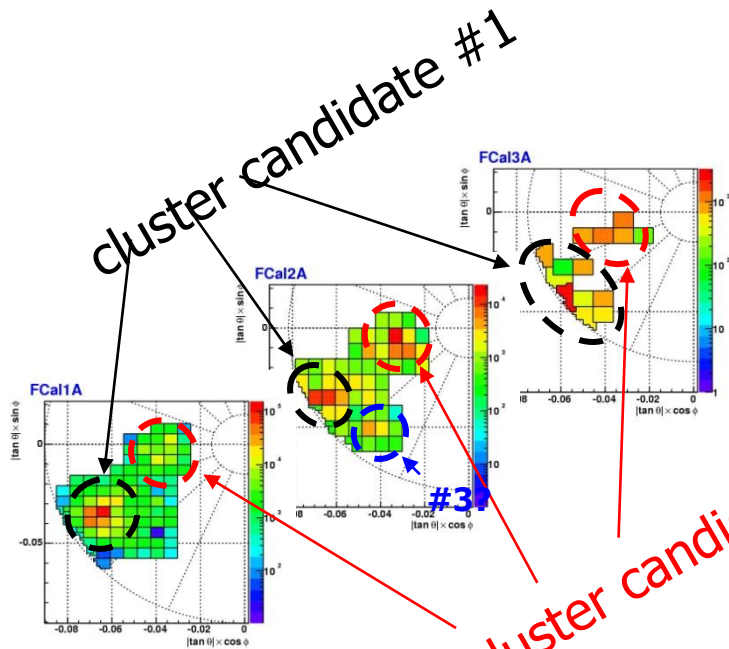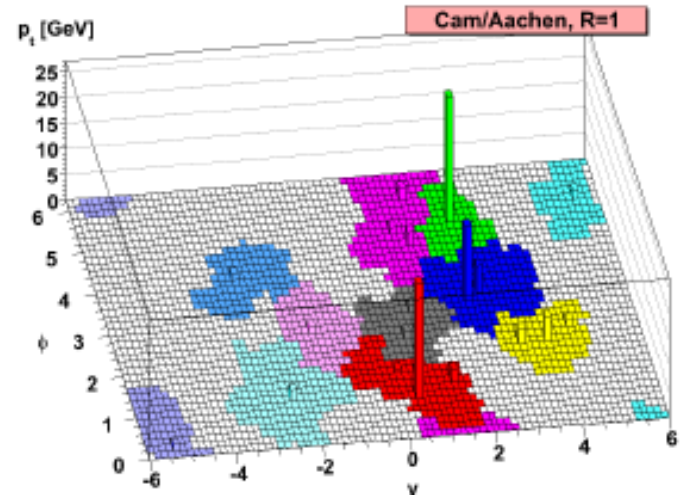
Jet Algorithms

- Not yet clear if the LHC experiments will really use better jet algorithms

- Promising: It seems that ATLAS/CMS have **experts** in charge for implementing the jet algorithms in their software framework $\rightarrow$ aware of relevant issues

- Good News: experiments want standardized jet codes
  - $\rightarrow$ take codes from external libraries fastJET, SpartyJet
       with version control
  - $\rightarrow$ identical algorithms between experiments
  - $\rightarrow$ Make it easy for beginners to use appropriate tools

Good prospects!!

Benchmarks

- Event generation with realistic underlying event model +PI
- WW, tt-bar, Z' → tt-bar, Squarks, Z' → jets
- HEP MC format at hadron level
- CDF midpoint cone, SiSCone, kT, Cambridge/Aachen
- Radius scan: 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1.0

- Z, Z' → qq   dijet mass → pT resolution
- tt-bar → multijets   balance between pT reconstruction
                        and multi-jet separation
- WW → hadrons,   high mass Z' → tt

 different environments to study reconstruction of highly boosted objects
- inclusive jets   hadronization and underlying event corrections

Result: quantitative comparisons of algorithms and parameters

Conclusion

- Promising:

  There are visible signs why jet physics at the LHC may use improved concepts

- Make sure our discussions are not an intellectual game

- The hardest part:

  Need to reach out to experimentalists & theorists

- Thanks to the organizers & thanks to the participants!!!