Individual Particle Reconstruction

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People

- NIU - Lima, Zutshi, Chakraborty
- SLAC - Graf, Cassell, McCormick, Johnson
- Iowa - Charles
- ANL - Magill, Xia, Kuhlmann
- Kansas – Wilson, Benavidez
- Anyone else?

Tools

- event generation
  - whizard, pandora, pythia, herwig, isajet, …
  - single particle diagnostic generator
- detector descriptions
  - compact.xml → geant, reconstruction & event display
- detector response simulation
  - slic (Linux, Windows, Mac binaries, runtime control)
- event reconstruction
  - org.lcsim framework (command-line or JAS usage)
- analysis
  - JAS & Wired

Detectors

- A number of detectors are pre-defined and explore a wide variety of designs
  - SS, W and Pb absorbers
  - Scintillator, GEM & RPC readout
  - EM Cal composition (40, 30, 20+10 layers)
  - EM Cal radius
  - B Field

http://lcsim.org/detectors/

Existing Data Sets

- Extensive suite of single particles for diagnostics and calorimeter response determination.
- Single particle resonances for testing
- Single W & Z
- Z→ light quarks for SLC/LEP comparisons
- SM physics processes at several center of mass energies (350, 500, 1000 GeV)
  - e.g. Zh, WW, ZZ, VV νν, tt, …

http://lcsim.org/datasets/ftp.html

Digitization

- DigiSim Package (NIU)
  - flexible, complete tool for digitization of hits, inclusion of noise,inefficiencies, thresholds, timing, etc.
- DONE. Is used as first step in any reconstruction analysis program
  - calorimeter calibration
  - clustering
  - etc.

Calorimeter Calibration

- Standard calorimeter calibration code for any detector model
  - partly done, but still dependencies on models, no standard method yet
  - "accepted" methods used by many participants, but not all yet
  - Currently based on single particles and models intrinsic detector response
  - Needs fine tuning for each clustering algorithm

“Perfect” IPR Results

- Standard calculation of Perfect IPR results for a detector model
  - i.e. no confusion term, no clustering effects.
- Partly done, but still differences between developers
- Need to have standard calorimeter calibration first (see previous), then a prescription of how to use in calculating Perfect IPR
- Under development

Cluster Algorithm Development

- Have many cluster algorithms in a standardized format
  - (Minimum Spanning Tree, Directed Tree, Nearest Neighbor, Cheater, Fixed Cone, …)
- Allows easy substitution and comparison of algorithms
- Not all in standard format (ANL density clusterer)
- Comparison software done - very useful for choosing optimal clusterer and/or clusterer combinations (example, Ron's DT + NN option for photons)
- Mostly done - many CAs and comparison tool in standardized format - perfect for IPR development

Analysis Algorithms

- Crux of IPR development
- Many algorithms under development (track/mip finders, photon finders, cluster/track matchers, fragment associations, etc.)
- Very little standardization so far - working to make interface standard (see next slide)
  - However, analysis is always very specific to individuals, plan is only to standardize interface to algorithms, not arrive at the “one true way”.

IPR Template

- Standard steering routine for IPR development
- Allows optimization of each step with standard I/O
- Allows easy comparison of Calorimeter Clustering & Analysis Algorithm combinations
- Allows easy merging & separation of steps in the complete IPR
- Essential for comparison of algorithms and complete analyses for various detector models, different physics processes, different CM energies, etc.
- Under develpment - some parts finished including DigiSim inclusion, standard clusterer inclusion, some hitmap code

Priorities

- IPR Template
  - Number 1 priority - allows flexibility of analysis comparisons essential for development, optimization of detector design
  - Under development - DigiSim, Standard cluster algorithms already compliant
  - Working to add analysis algorithms to complete development
- “Optimal” IPR
  - With template done, cluster/analysis algorithms will automatically be compliant when developed within the template
  - Will be able to compare at each step various algorithms and detector models to ultimately obtain both an optimized IPR and an optimized detector

External Input

- Have very little guidance from physics or benchmarking groups on what performance is required by the science:
  - What particle (e, μ, τ) energy threshold, purity, resolution?
  - What photon resolution? (Energy & position)
  - What jet resolution? (Energy & position)
  - What missing transverse energy resolution?
- Any input appreciated.