LCD Reconstruction and Analysis Tools

(not FastMC/Vertexing – see Wolfgang's talk)
(not Root based tools – see Masako's talk)

Gary Bower/Tony Johnson
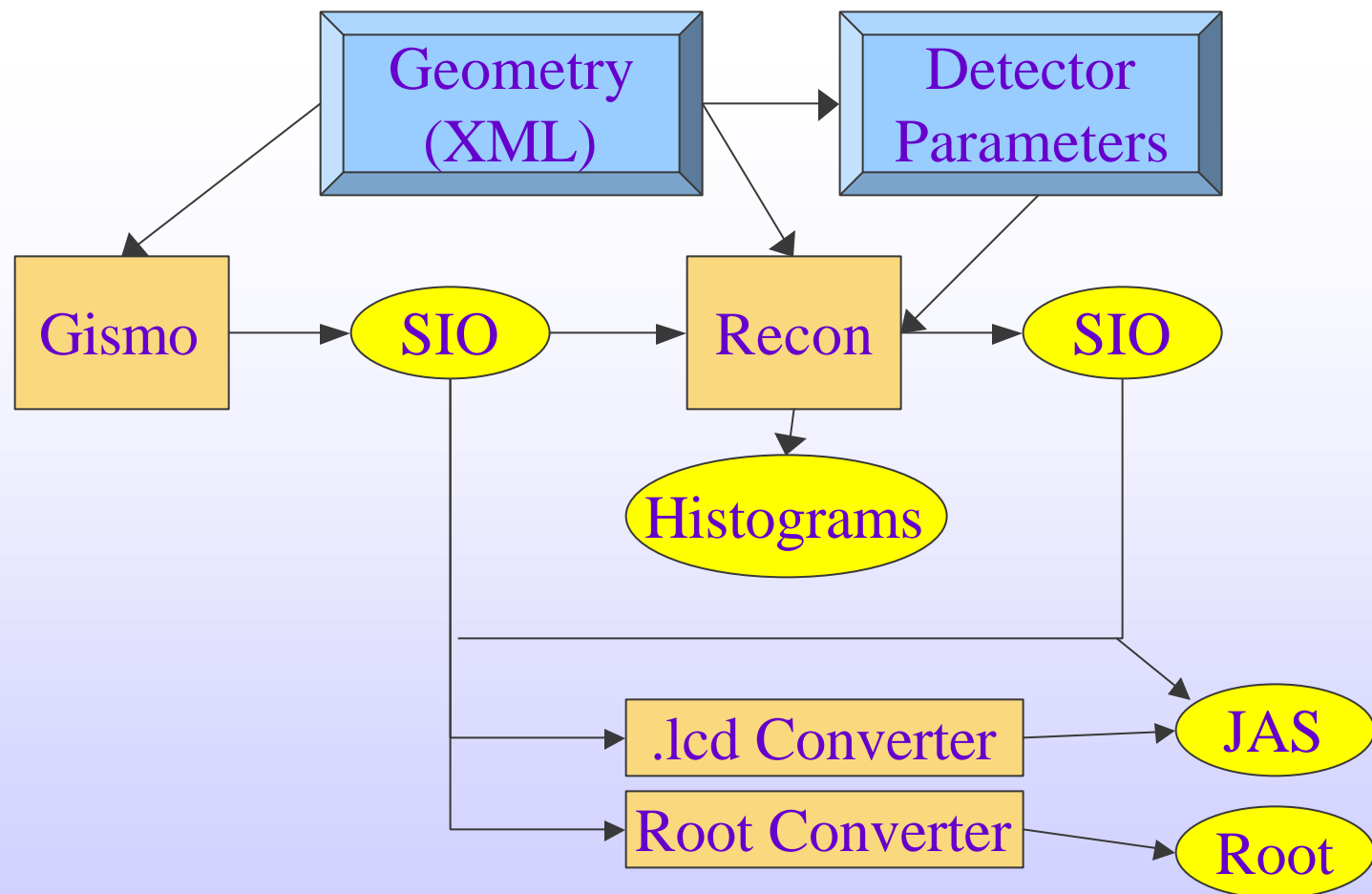
SLAC – October-2000

Contents

- ? Reconstruction Status
  - Current Status
  - Plans/To Do list
- ? Analysis Tools
  - Java Analysis Studio
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- ? Documentation

Reconstruction Road Map (Goal)

- Recon written in Java – totally portable to different platforms
- Recon can run standalone, or inside JAS

Reconstruction

? Track Reconstruction

– Track Finding uses M.Ronan's (TPC) pattern finding

• Tuned for Large + Small detector

– Track Fitters:

• SLD Weight Matrix Fitter

• Can do Single Detector or Combined fit (e.g. VTX+TPC)

? Hit Smearing/Efficiency (Gismo gives "perfect" hits)

? Random Background overlay

? To Do:

– More Track Finding Algorithms (Cheater, Projective Geometry)

– More Track Fitting Algorithms (Kalman Filter)

– End Cap tracking, Hit Merging

Reconstruction cont.

? Cluster Finding

– Three Clustering Algorithms Currently Implemented

- Cluster Cheater (uses MC truth to "cheat")
- Simple Cluster Builder (Touching Cells)
- Radial Cluster Builder
  - All algorithms tend to produce many very low energy clusters - important to set sensible thresholds

? To Do

– Cluster Refinement Stage

- Combine HAD + EM clusters
- Endcap + Barrel overlap region

– Track Cluster Association

– Need to Extend Definition of Clusters to exploit fine segmentation

- Directionality, Entry point to calorimeter

Code Availability

? Reconstruction

– All code in CVS for universal access

• Browse CVS repository on Web

• Connect with your favorite CVS client

– Platform independent make (jmk) now used

• Builds identically on NT and Unix

Recent Work

? Switch to SIO format (replaces ASCII file)
  - SIO reading working
  - ToDo:
    - SIO recon output format needs to be defined
    - SIO writing needs to be completed
    - Converter utilities (sio->lcd, sio->root) need to be upgraded

? Support for S2, L2 (+ old) detectors
    - Retune recon for new geometries

? Calorimeter Geometry now more flexible
  - Calorimeter Cell Merging in process
  - Will allow detailed studies of calorimeter clustering without re-running Gismo

Beam Background Overlays

- Take output from Guinea Pig beam
- Feed events into full Gismo simulation
- Build library of simulated background bunches
- Overlay backgrounds on signal events at start of reconstruction
  - Adjust timing of hits (for TPC e.g.)
  - Combine (add) energy in calorimeter cells
  - Allows to change #bunches/train, bunch timing
- ToDo
  - Ability to overlay events
   - Time shifts in TPC, Merge hits in calorimeter

Background Overlays
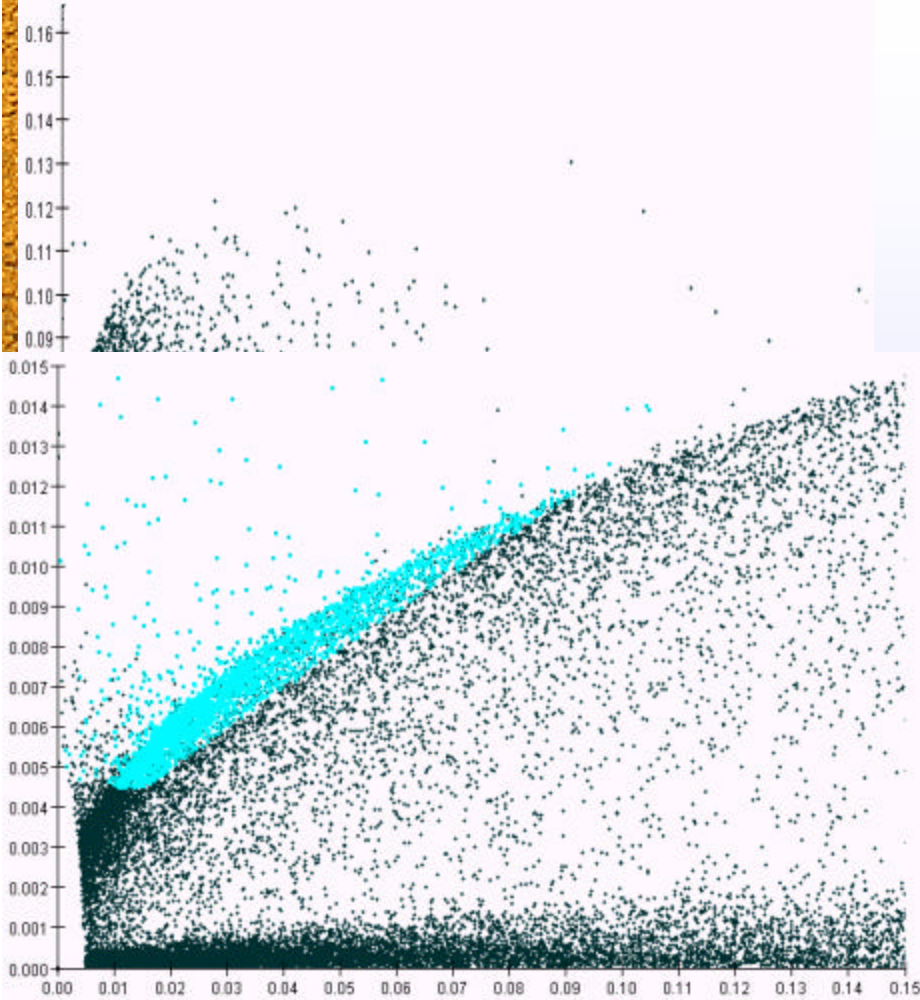
- ? L1 Detector
  - 4 Tesla field
  - 1cm beampipe +- 5cm from IP
- ? Primary particles from single bunch crossing
  - 90k particles/bunch
  - 95 bunches/train
- ✍ Blue particles interact with detector in central region
  - ✍ 80k particles/physics event
- ✍ Effects on recon yet to be studied

Quality Control (Ron Cassell)

? Standard set of diagnostic plots for checking generator/simulation/reconstruction output.
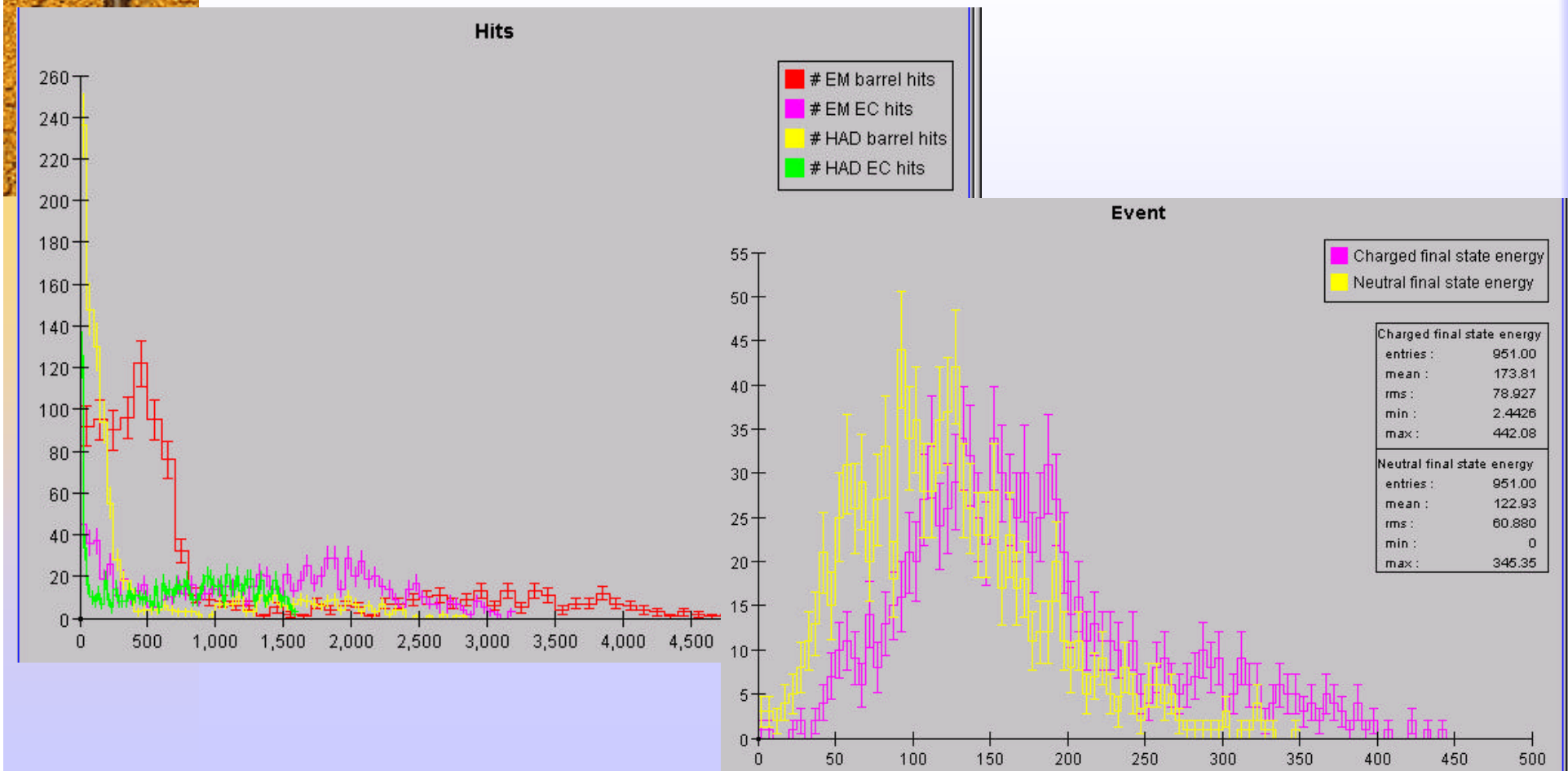
Track Reconstruction Efficiency (Wolfgang Walkowiak)
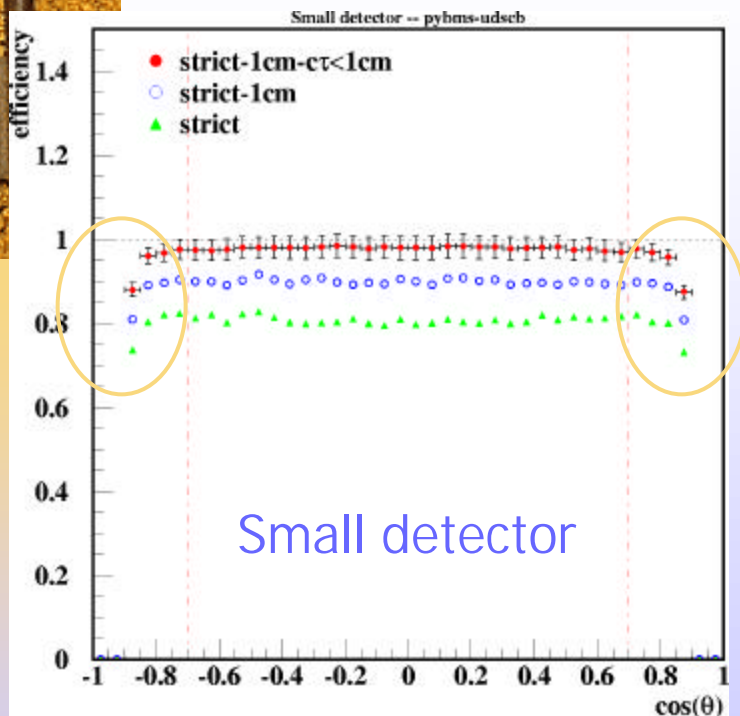
? Obtained efficiencies: (all cuts)

Cuts	?(small)	?(large)
Strict	80.9%	80.8%
Strict-1cm	90.0%	92.6%
Strict-1cm-ct1cm	97.9%	97.7%

? Pythia+bms udscb samples

? Low efficiency at low momentum.

? Forward disks missing in reconstruction.

? Problems with e.g. K_s^0 and ? decay vertices.

– **Believed fixed – needs checking**

Small detector -- pybms-udscb

- strict-1cm-cτ<1cm
- strict-1cm
- strict

Small detector

Recon To Do List

- ? Tracker hit merging
- ? Support for merging signal/backgrounds
- ? Additional Track Finders (projective, "cheater")
- ? Improved Cluster Description
- ? Track/Cluster Association
- ? Cluster Refinement
- ? Define recon output structures
- ? Support for SIO format writing/SIO data converters
- ? Switch to XML based geometry description
- ? Define "standard" recon for batch running
- ? Small Angle Tracking
  - **Volunteers Needed!!!**

LCD Analysis Tools

Java Analysis Studio

JAS – New Release -- 2.2.1

? New Features (of importance to LCD)

– Much easier to compare plots from different datasets/algorithms

– Much easier to download/install plugins (e.g. lcd.jar file)

– Support for printing plots greatly improved

Physics Utilities

? **Physics Utilities**

- 4-vector, 3-vector classes
- Event shape/Thrust finder
- Jet Finder
  - All standard e^+e^- algorithms implemented
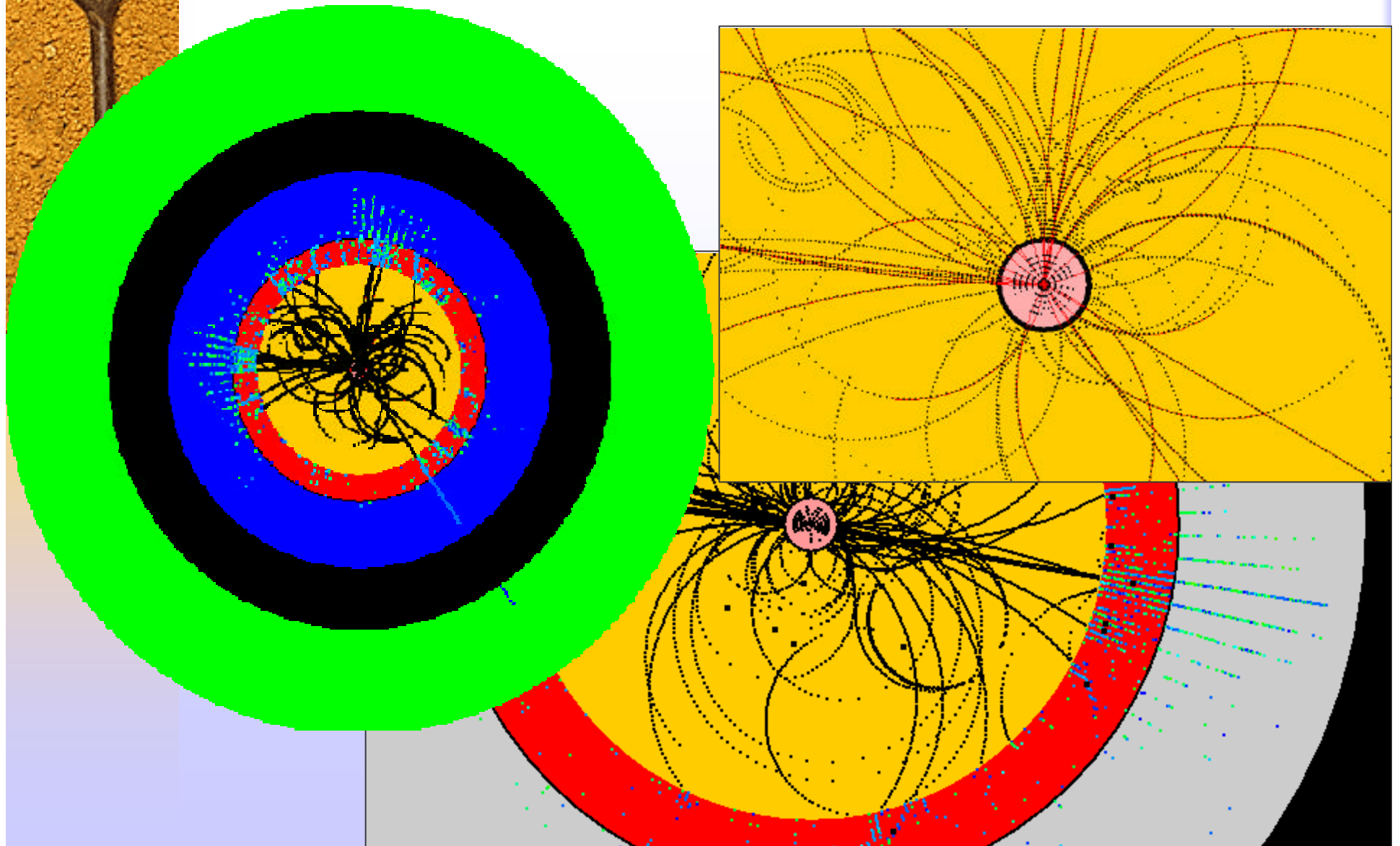 - Extensible to allow implementation of other algorithms

? Contrib. Area

- Analysis Utilities and sample analyses provided by users

? 2 Event Displays

- 2D - Suitable for debugging reconstruction and analysis
- Wired for full 3D support

? MC Particle Hierarchy Display/MC Particle Table

2D Event Display

Wired Event Display

MC Particle Table

Java Analysis Studio

File Edit Job Histogram View Window LCD Help

StdHEP/Pythia-gen

Default Job
  Data
    pybms-tt-500-
    StdHEP/Pythia

Page 1 | Welcome | MC Table

Run:0 Event: 1 Etot: 91.260

N	Type	Status	Parent	PX	PY	PZ	E
0	e+	Documentation		0	0	45.630	45.630
1	e-	Documentation		0	0	-45.630	45.630
2	e+	Documentation	0	0	0	45.630	45.630
3	e-	Documentation	1	0	0	-45.630	45.630
4	e+	Documentation	2	0	0	45.630	45.630
5	e-	Documentation	3	0	0	-45.630	45.630
6	Zo	Documentation	4,5	0	0	-9.8320E-8	91.260
7	b	Documentation	6	-4.2967	-0.19971	45.172	45.630
8	b_bar	Documentation	6	4.2967	0.19971	-45.172	45.630
9	Zo	Intermediate	6	0	0	-9.8320E-8	91.260
10	gamma	Final State	0	0	0	1.1267E-7	1.1267E-7
11	gamma	Final State	1	0	0	-1.4351E-8	1.4351E-8
12	b	Intermediate	7	-10.435	5.1745	19.271	23.024
13	gluon	Intermediate	7	-0.54817	-2.3544	4.0034	4.6767
14	gluon	Intermediate	7	0.39785	0.060380	0.64574	0.76086
15	gluon	Intermediate	7	1.7791	-1.3330	7.0767	7.4177
16	gluon	Intermediate	7	1.1111	-2.0143	5.0487	5.5481
17	gluon	Intermediate	7	0.76648	0.64118	1.7788	2.0403
18	gluon	Intermediate	7	2.9282	-0.36018	4.2306	5.1578
19	gluon	Intermediate	8	-0.065443	0.15341	-0.071891	0.18162
20	b_bar	Intermediate	8	4.0657	0.032525	-41.984	42.452

JAS

Analyzed 1 events in 10 milliseconds

Physics Utilities

? **Diagnostic Generator**
  – N particles per event
    • Any particle type
    • Particle/Anti-particle mixture
  – Can generate pairs of particles for track separation tests
  – Can generate displaced vertices for vertex finder testing

? Can be run directly in JAS
  – E.g. for running FastMC tests

? Can be run standalone
  – E.g. for writing stdhep files

? Generator framework extensible for other generators

Documentation

? All documentation updated for latest release of JAS/hep.lcd

? Tutorial being updated and extended
  – Wired Event Display
  – Diagnostic Generator
  – Automatic testing of all tutorial code with each release

? http://www-sldnt.slac.stanford.edu/jas/documentation/lcd/