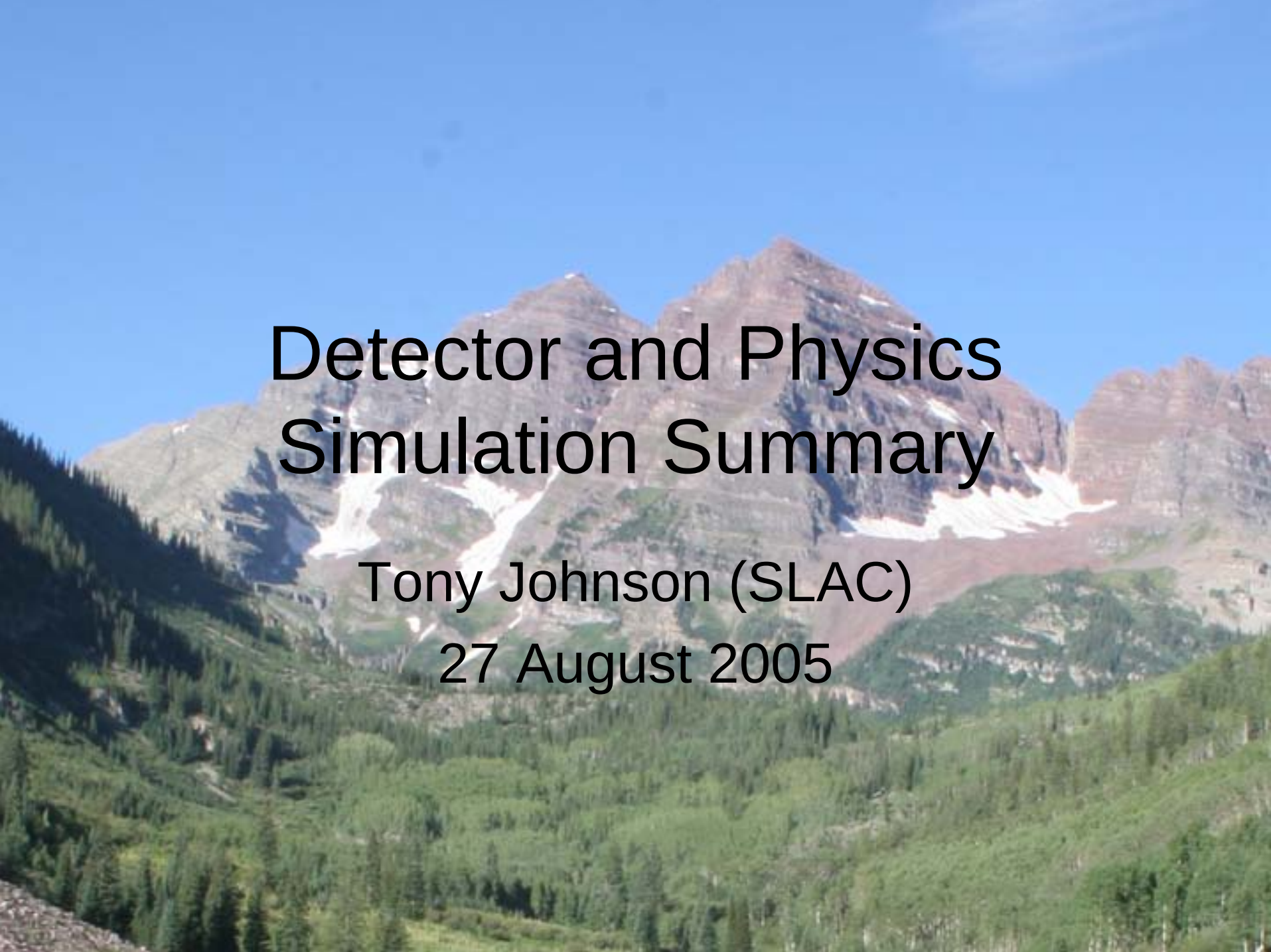


Detector and Physics Simulation Summary

Tony Johnson (SLAC)

27 August 2005

Detector and Physics Simulation Summary

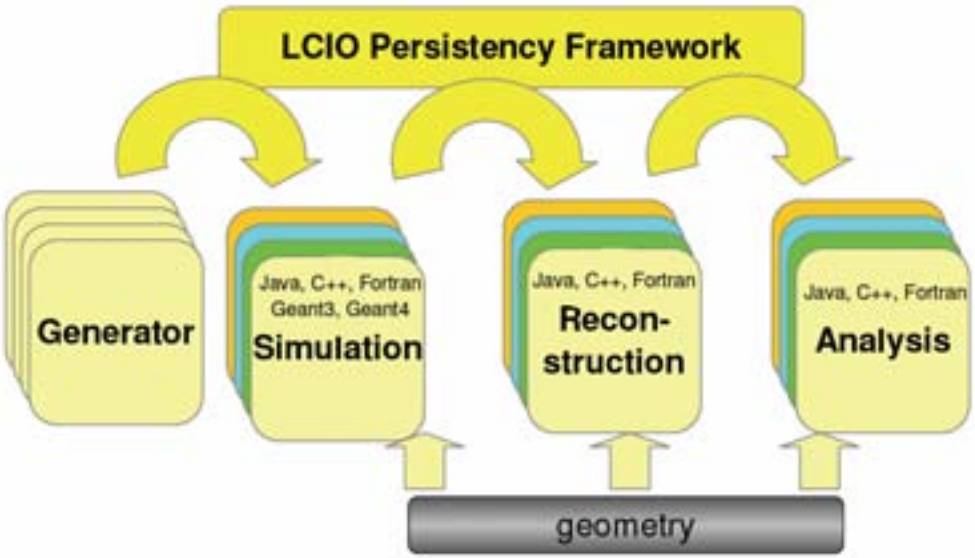
- Simulation group did a lot of work preparing for Snowmass
  - 2 CD's with Software and tutorials distributed
  - 1 DVD with simulation data from 3 detector concepts
- Simulation group only had one formal session
  - Experience shows that simulation sessions in parallel to physics/detector session attract limited attendance
- Remainder of time spent "working"
  - Running software tutorial sessions
    - Working with individual users
    - Working with physics/detector groups
  - Taking opportunity to work together on improvements to tools
    - Improving functionality of existing tools
    - Testing interoperability/compatibility of existing tools
    - Refining standards (e.g. LCIO)

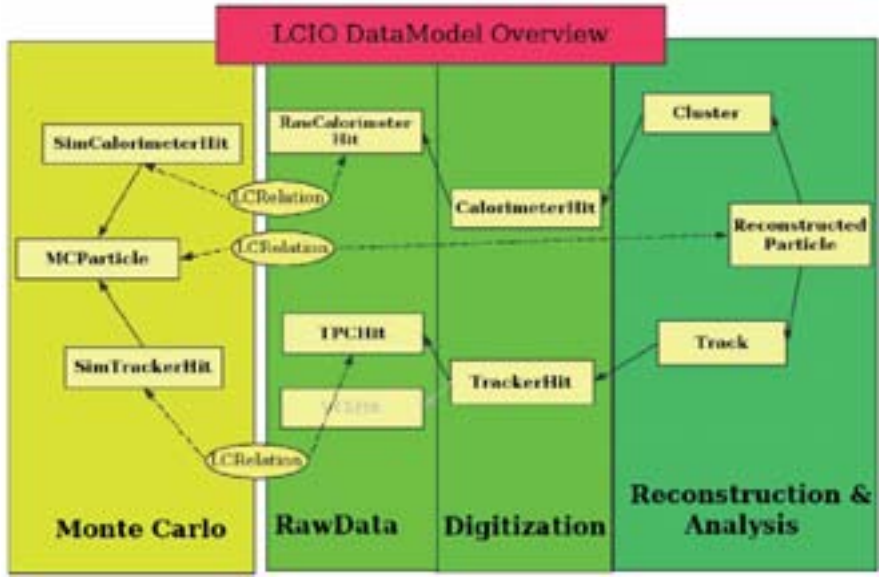
Tools Overview

	Description	Detector	Language	IO-Format	Region
Simdet	fast Monte Carlo	TeslaTDR	Fortran	StdHep/LCIO	EU
SGV	fast Monte Carlo	simple Geometry, flexible	Fortran	None (LCIO)	EU
Lelaps	fast Monte Carlo	SiD, flexible	C++	SIO, LCIO	US
Mokka	full simulation - Geant4	TeslaTDR, LDC, flexible	C++	ASCI, LCIO	EU
Brahms-Sim	Geant3 - full simulation	TeslaTDR	Fortran	LCIO	EU
SLIC	full simulation - Geant4	SiD, flexible	C++	LCIO	US
LCDG4	full simulation - Geant4	SiD, flexible	C++	SIO, LCIO	US
Jupiter	full simulation - Geant4	JLD (GDL)	C++	Root (LCIO)	AS
Brahms-Reco	reconstruction framework (most complete)	TeslaTDR	Fortran	LCIO	EU
Marlin	reconstruction and analysis application framework	Flexible	C++	LCIO	EU
hep.lcd	reconstruction framework	SiD (flexible)	Java	SIO	US
org.lcsim	reconstruction framework (under development)	SiD (flexible)	Java	LCIO	US
Jupiter-Satelites	reconstruction and analysis	JLD (GDL)	C++	Root	AS
LCCD	Conditions Data Toolkit	All	C++	MySQL, LCIO	EU
GEAR	Geometry description	Flexible	C++ (Java?)	XML	EU
LCIO	Persistency and datamodel	All	Java, C++, Fortran	-	AS,EU,US
JAS3/WIRED	Analysis Tool / Event Display	All	Java	xml,stdhep, heprep,LCIO,..	US,EU

LCIO

- 1.5 years ago we realized not possible or desirable to force everyone to use single tool
  - Decided to collaborate to define single persistency framework

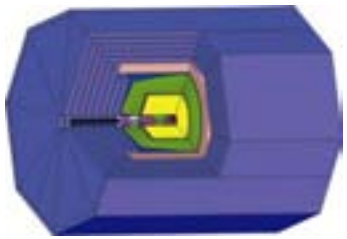




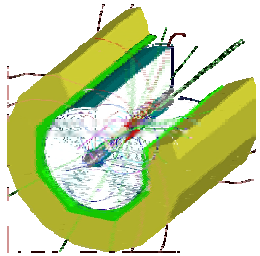
- All major simulation programs now read/write LCIO
  - Makes possible cross-checks between simulation programs
  - Makes possible sharing reconstruction algorithms
  - Makes possible writing one physics analysis and using it with
    - FastMC/Full simulation-reconstruction
    - Different detector concepts
    - Different simulation/reconstruction tools

Full Simulation Tools

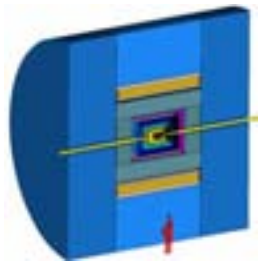
- Geant4, StdHep and LCIO are common feature
  - Support for LCPhys physics lists
- Each aims to be generic with different different approach
  → different ways to define geometries



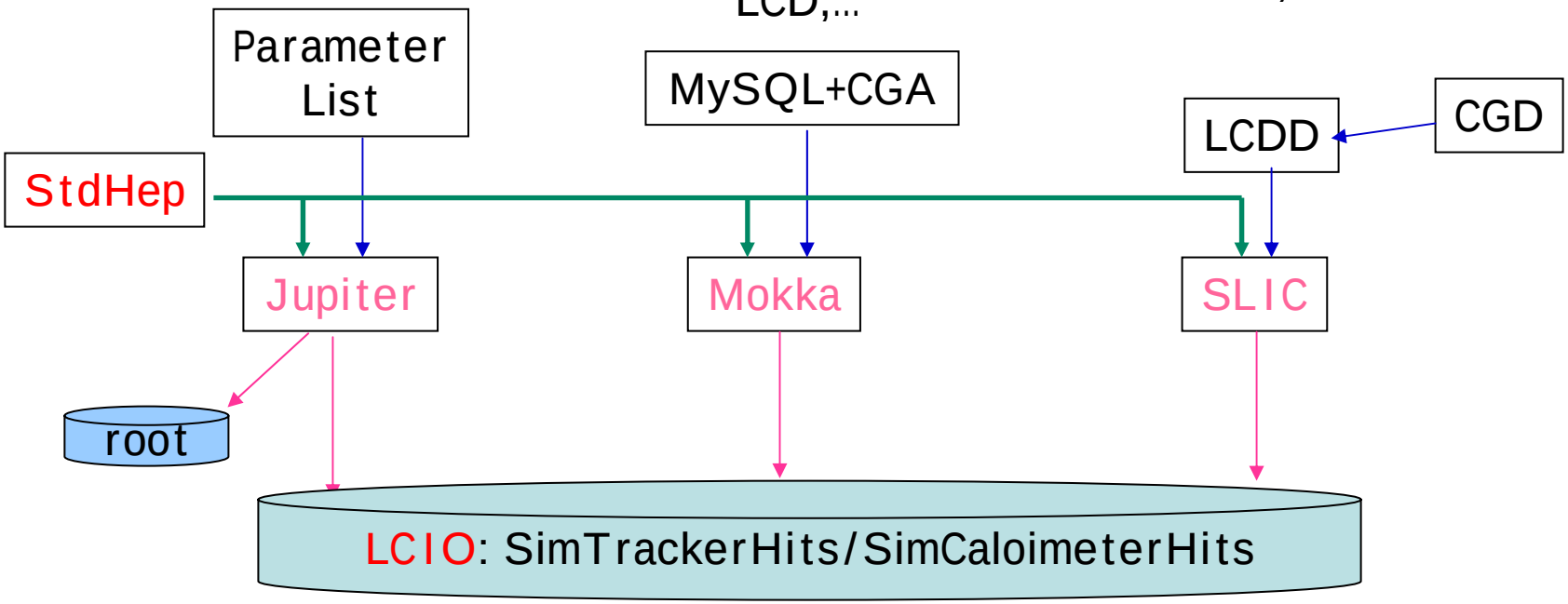
GLD,...



LCD,...

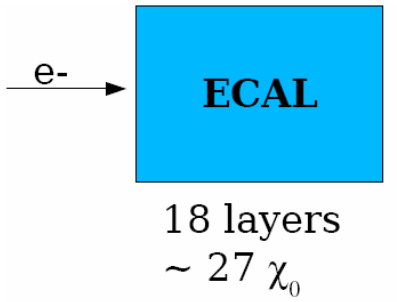


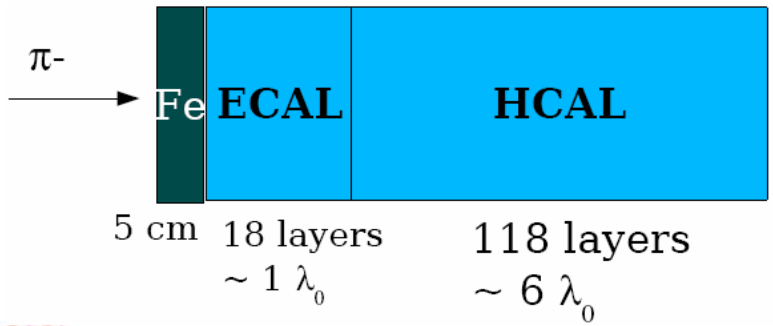
SiD,...

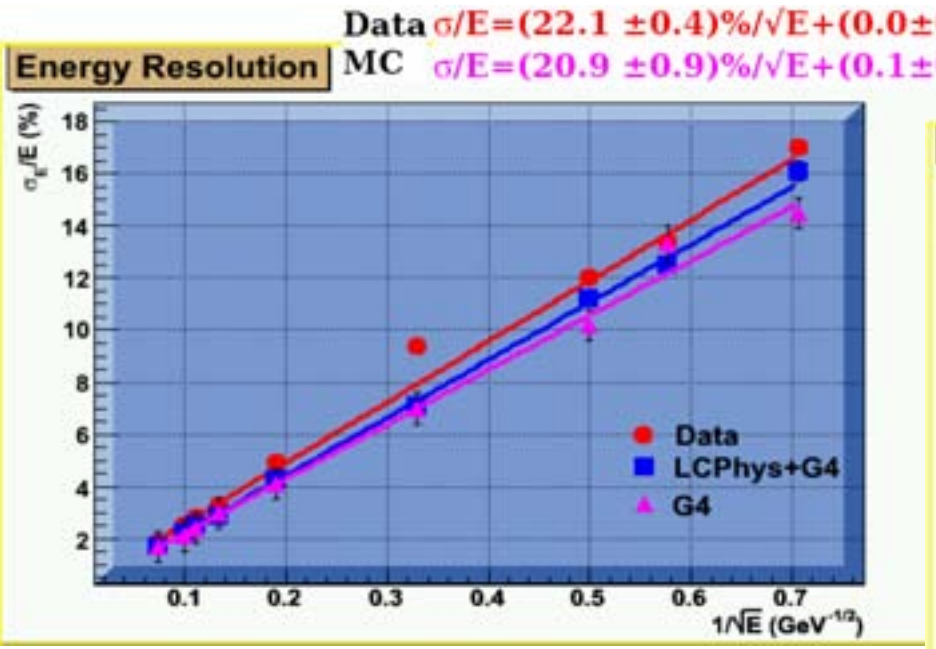


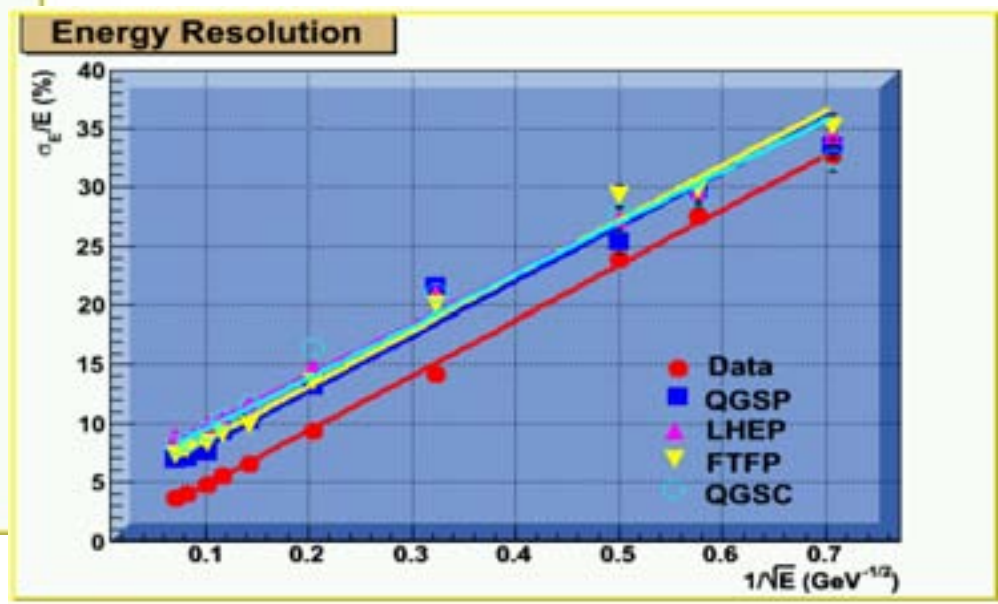
Geant4 Physics Verification

Lead (8mm) Scintillator (2mm)



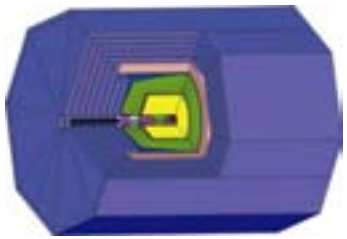




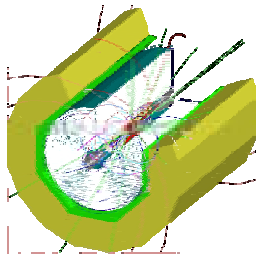


Reconstruction/Analysis Tools

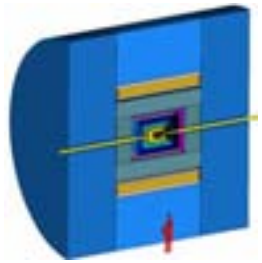
- Common features, LCIO input and output, geometry independent algorithms
  - Digitization,Tracking, Clustering/PFA, Vertexing, Jet finding, Cheaters, FastMC
- Each aims to be generic with different different approach
  → different ways to define geometries



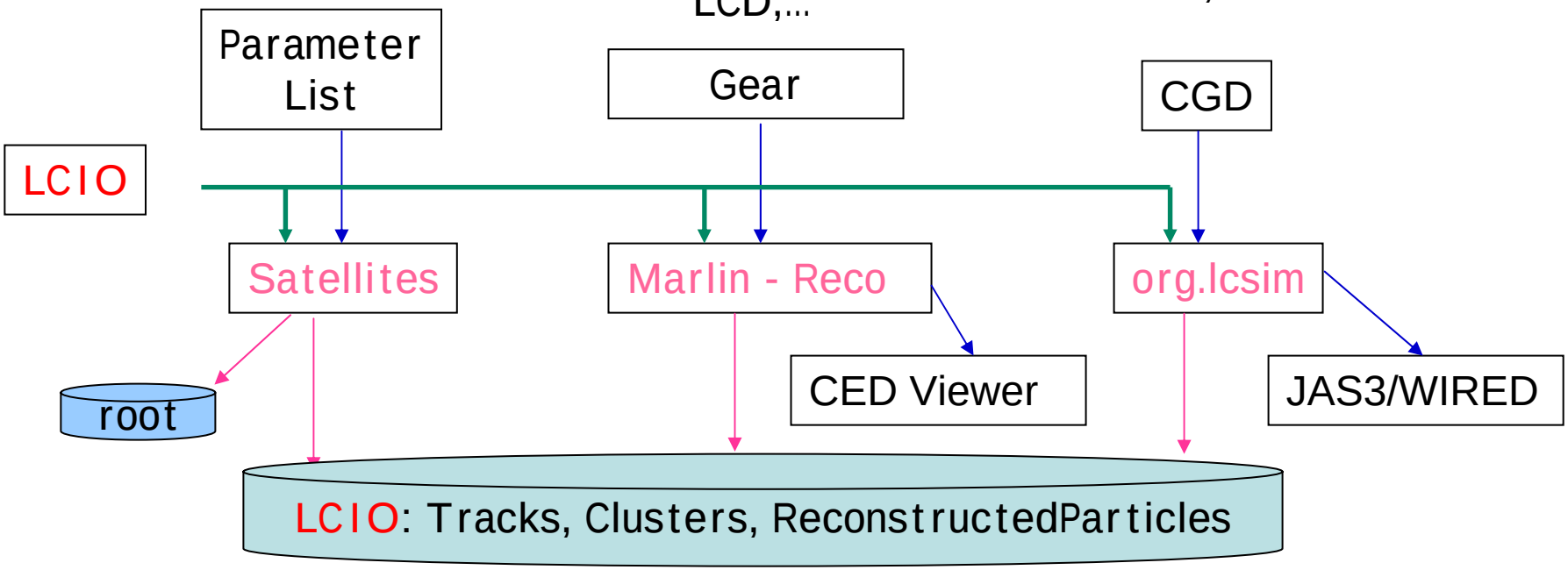
GLD,...



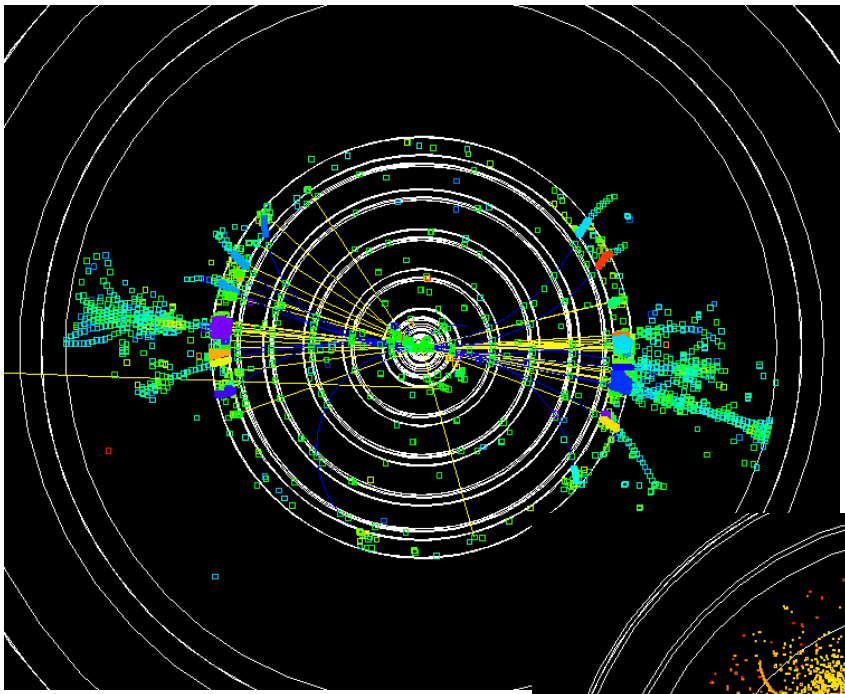
LCD,...



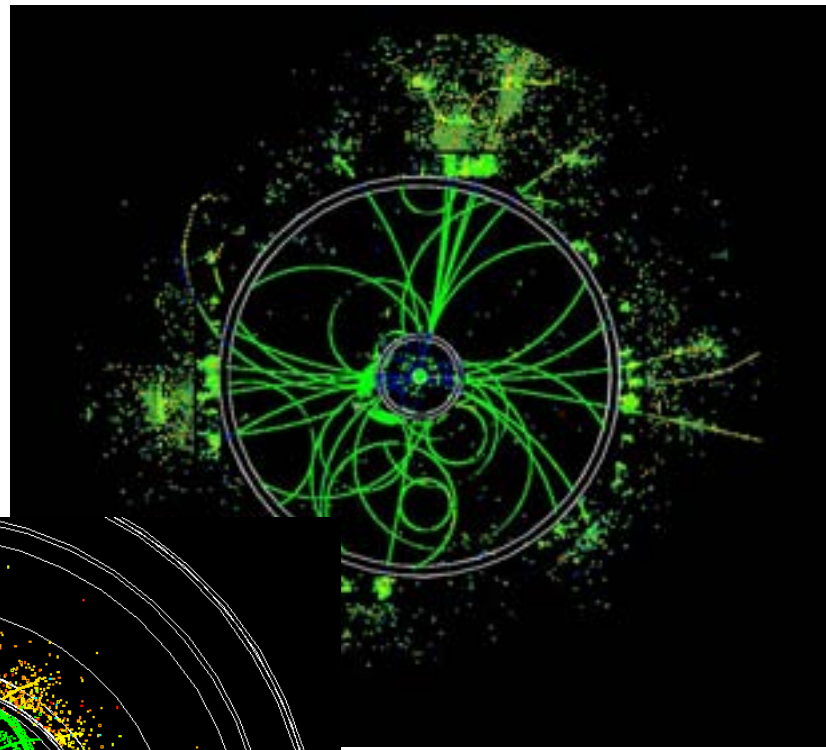
SiD,...



Interoperability - Event Display

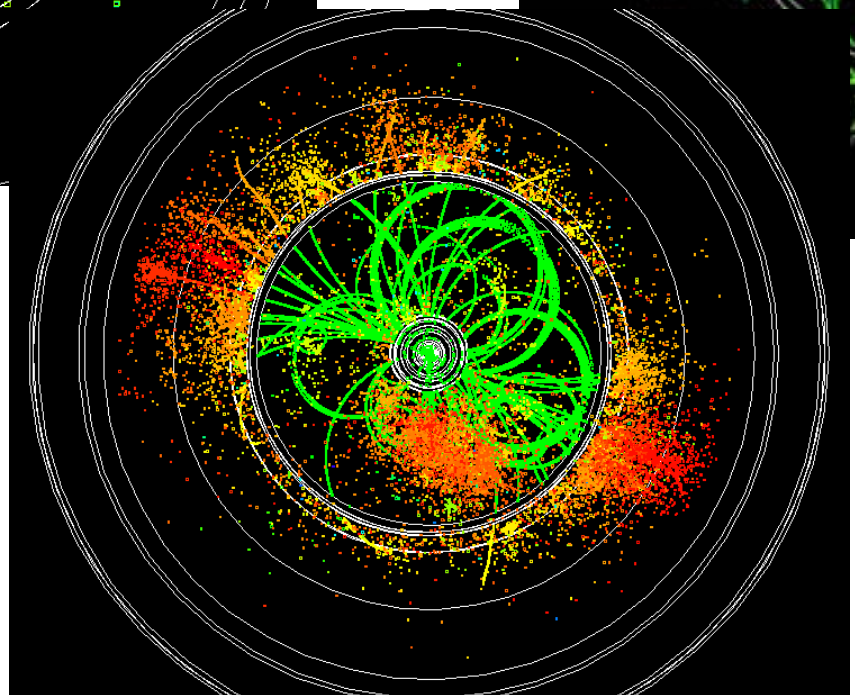


SiD (SLIC)



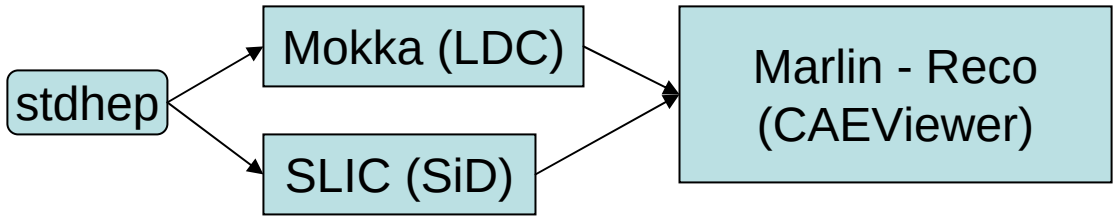
LDC (Mokka)

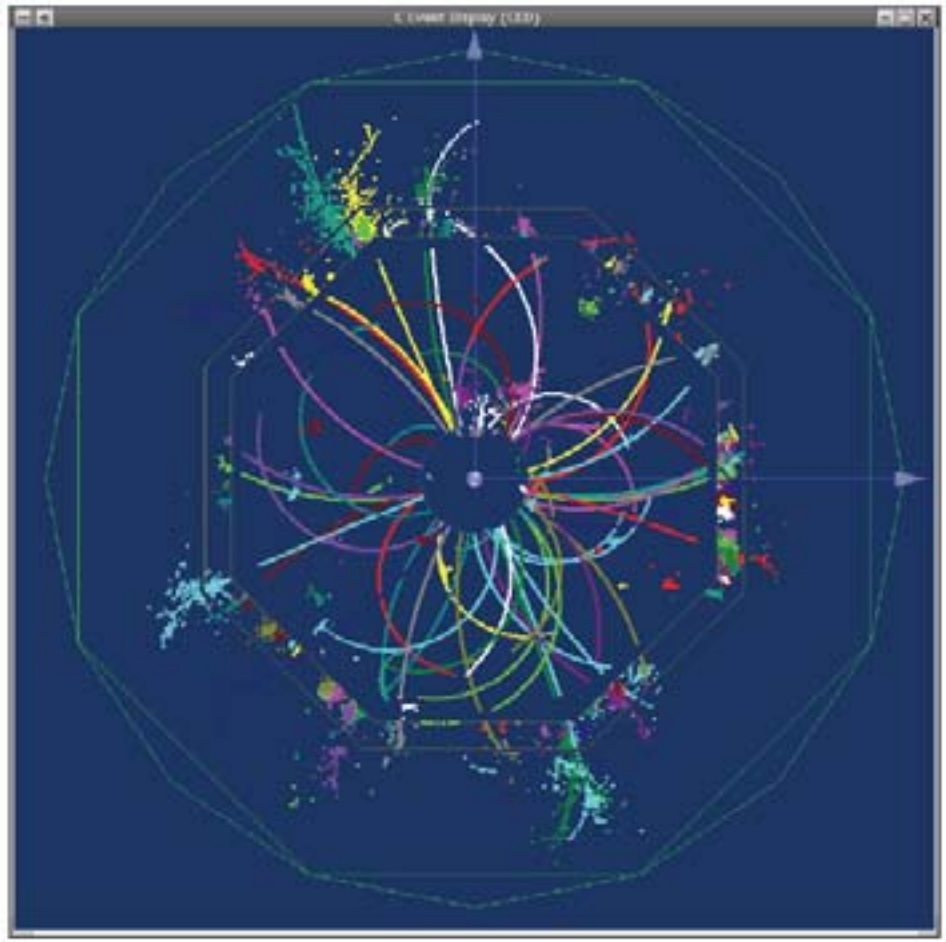
Events from Snowmass Event DVD

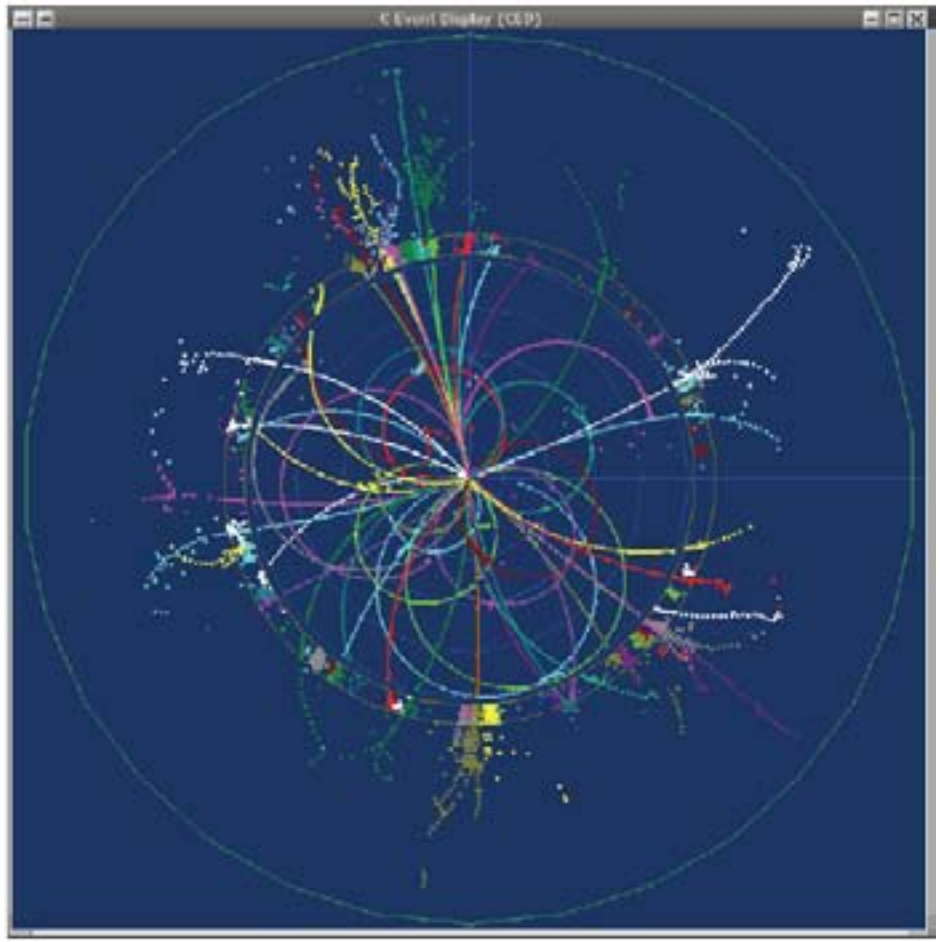


GLD (Jupiter)

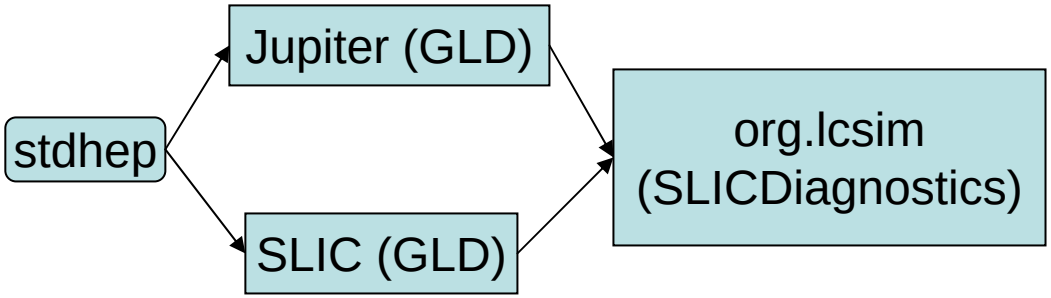
Interoperability: Reconstruction

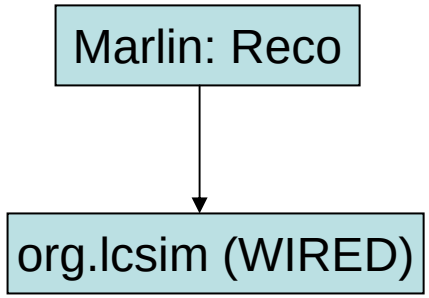


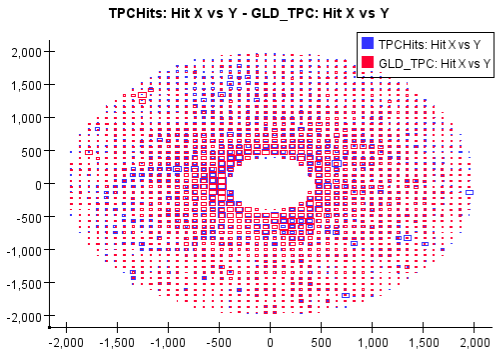


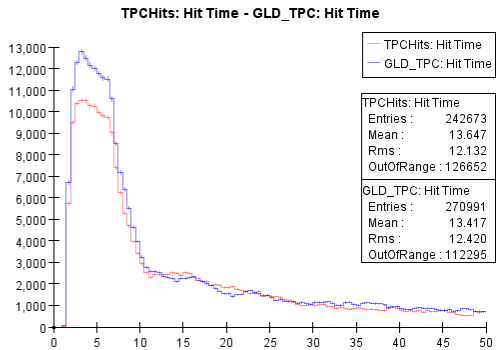


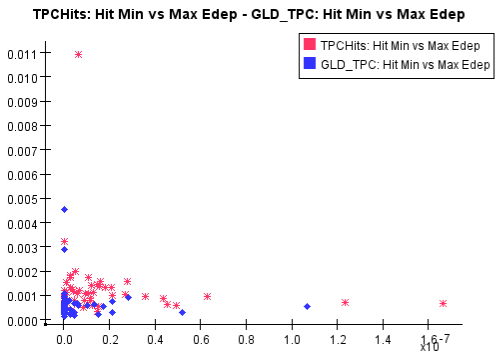
Interoperability: Diagnostics

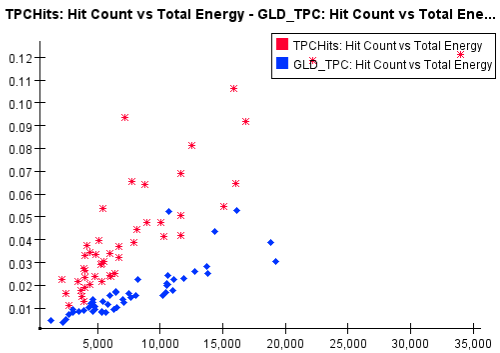


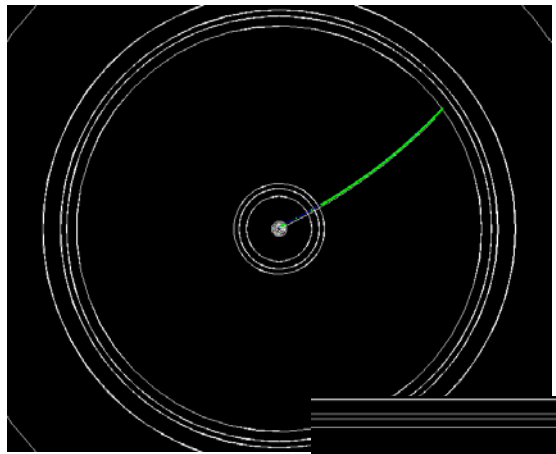


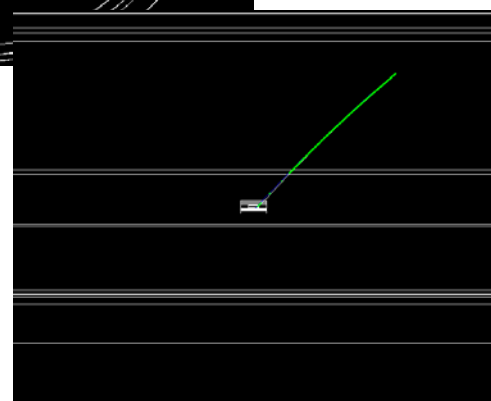












Areas for Continued Collaboration

- Geant4 validation/physics lists
- Geometry Formats
  - As reconstruction frameworks have matured geometry systems have grown closer
- ILCGrid for sharing resources for event simulation/reconstruction?
- LCIO, Interoperability
- Validation tools (c.f. SlicDiagnostics)

- Simulation workshop next winter?

Conclusions

- Full simulation and reconstruction frameworks are available
  - All support flexible geometry for experimenting with detector concepts
  - Still plenty of work to do, especially on optimized reconstruction for detector concepts
  - State of full simulation/reconstruction is quite advanced for this stage of project
  - Available tools, combined with hardware R&D make possible realistic comparison of detector concepts

- Where to go for more information/help
  - http://www.lcsim.org/software/
    - Comprehensive list of simulation and reconstruction software
    - Links for documentation, CVS, etc.
  - http://forum.linearcollider.org/ - discussion/help forum