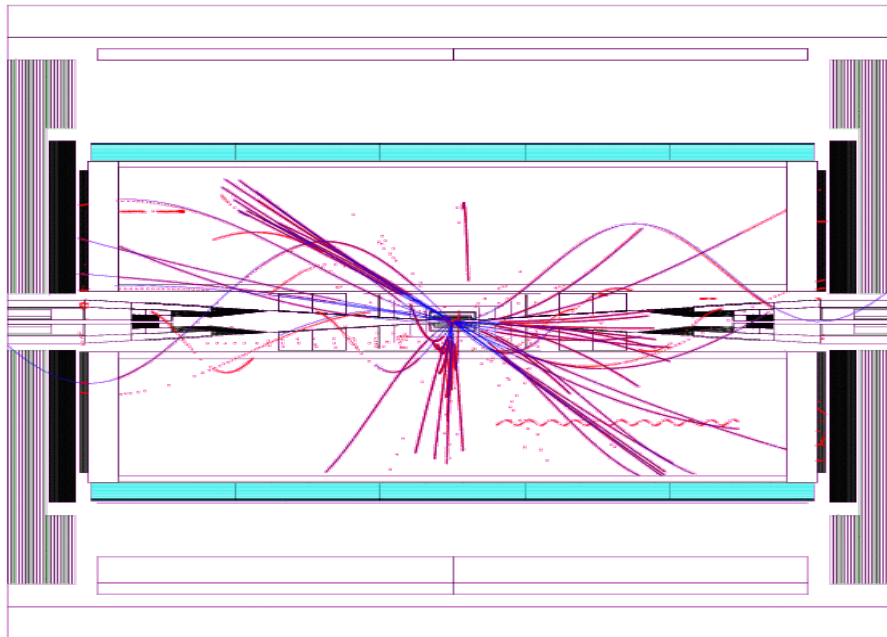


# Simulation Framework

- Full simulation systems: status report
- The next steps: where do we go from here
- The data challenge: status report



The LC simulation groups:

Europe: David Ward, Ties Behnke :[http://www-zeuthen.de/linear\\_collider](http://www-zeuthen.de/linear_collider)

US: Norman Graf :<http://blueox.uoregon.edu/~lc/alcpag/>

Asia: :<http://acfahep.kek.jp>

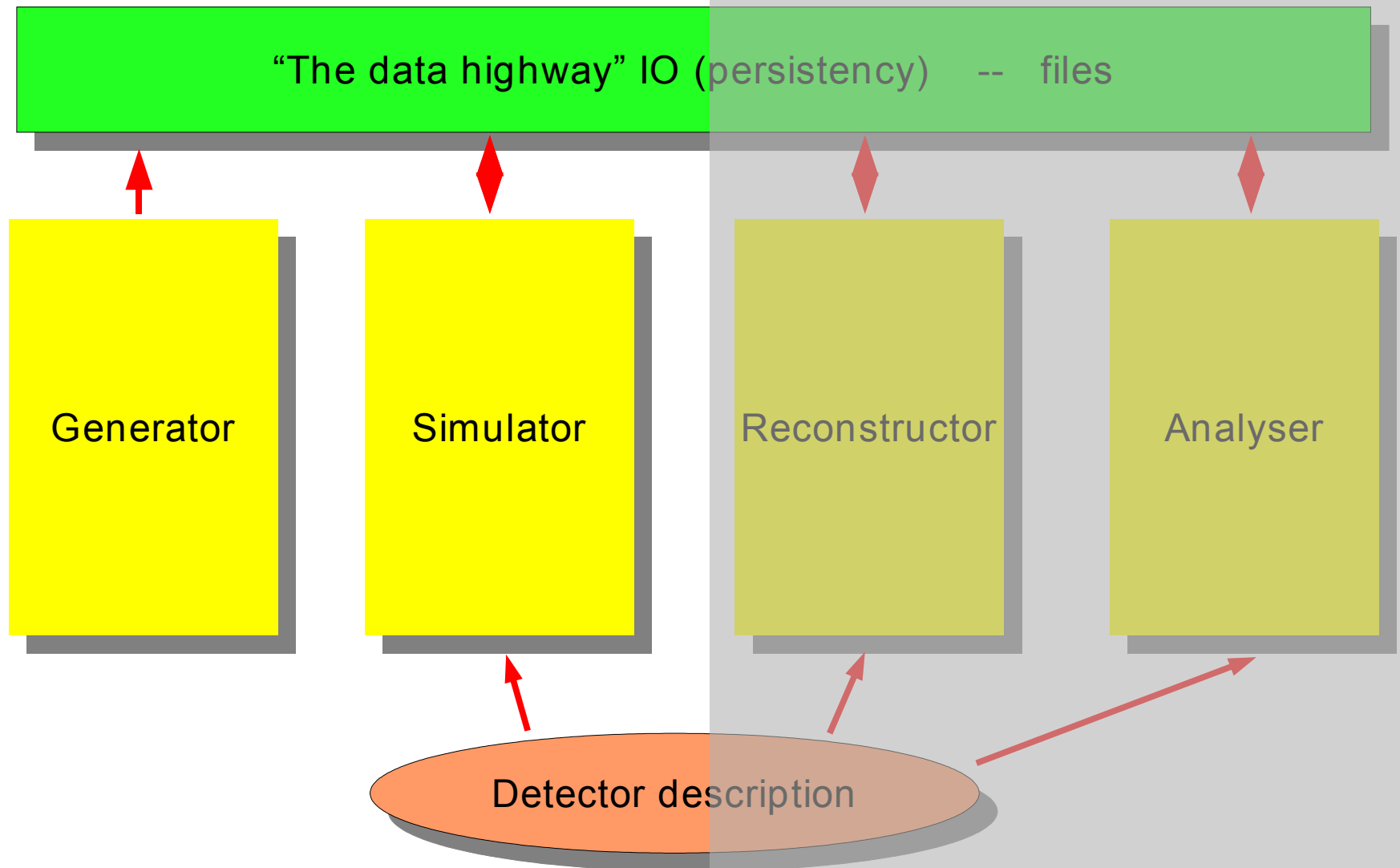
# The mission

- Coordinate the creation of appropriate simulation tools
- Coordinate the creation of appropriate reconstruction tools
- Provide a frame for the creation of appropriate analysis tools

The boundary conditions:

- System should be long lived
- Should be lightweight
- We are not a collaboration: commercial software is difficult (funding)
- Share across regions as much as possible
- Little to no personpower available

# The ingredients



# Full simulation

- BRAHMS:
    - GEANT3/ f77 based
    - TESLA TDR detector updated for recent changes
    - Complete simulation (and reconstruction)
  - MOKKA:
    - GEANT4/ C++ based
    - TESLA TDR detector “more or less”
    - No reconstruction framework
- BRAHMS is still the most complete package, but
- MOKKA is quickly getting there, will soon replace BRAHMS SIM



# The future of the simulator(s)

MOKKA is our main GEANT4 based full simulation environment

- GEANT4 based
- light weight, C++ code
- geometry via mysql and C++ drivers

Our US colleagues are evaluating MOKKA to use it as a base for their GEANT4 simulation environment.

MOKKA developments:

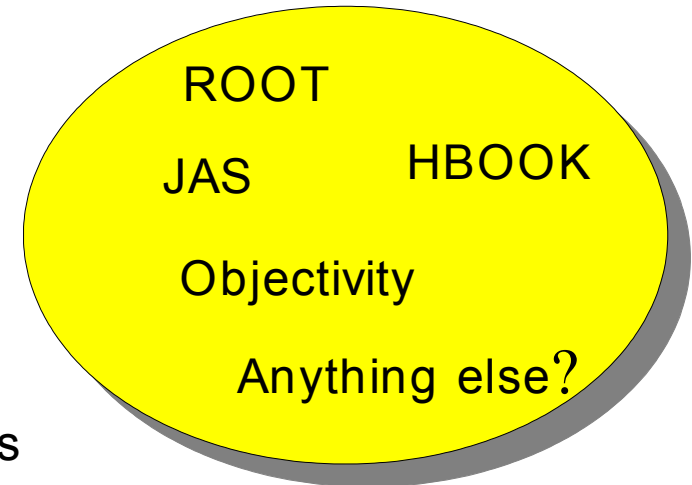
- Improve the detector models
- allow for more flexible system: concept of user plugins
- Watch closely CERN geometry developments (GDML)

# The data highway: LCIO

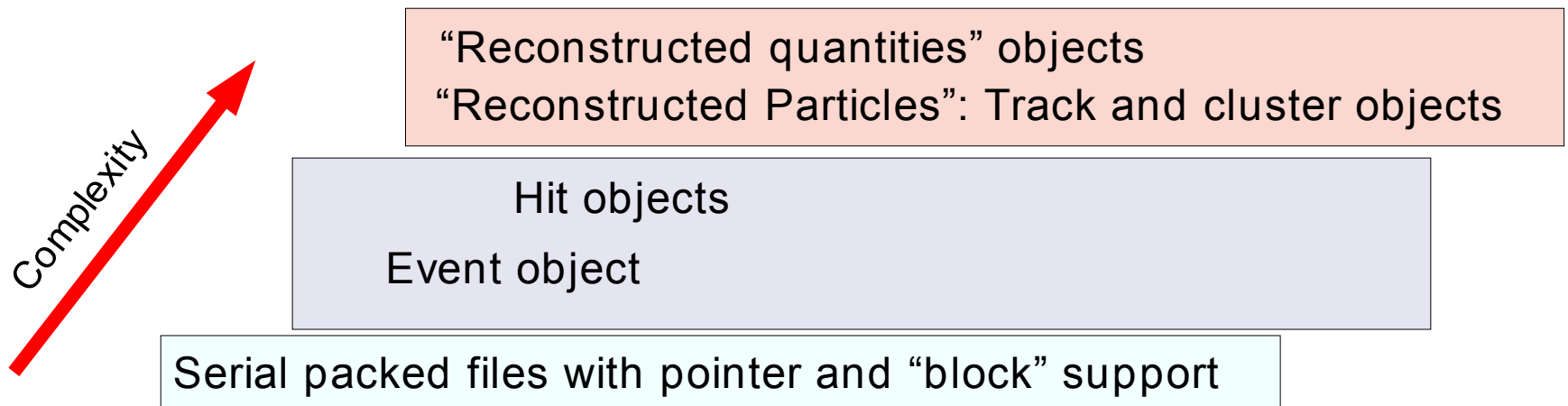
- Need definition of a data model:

- What is a hit
- What is a track
- What is a calorimeter cluster
- etc.

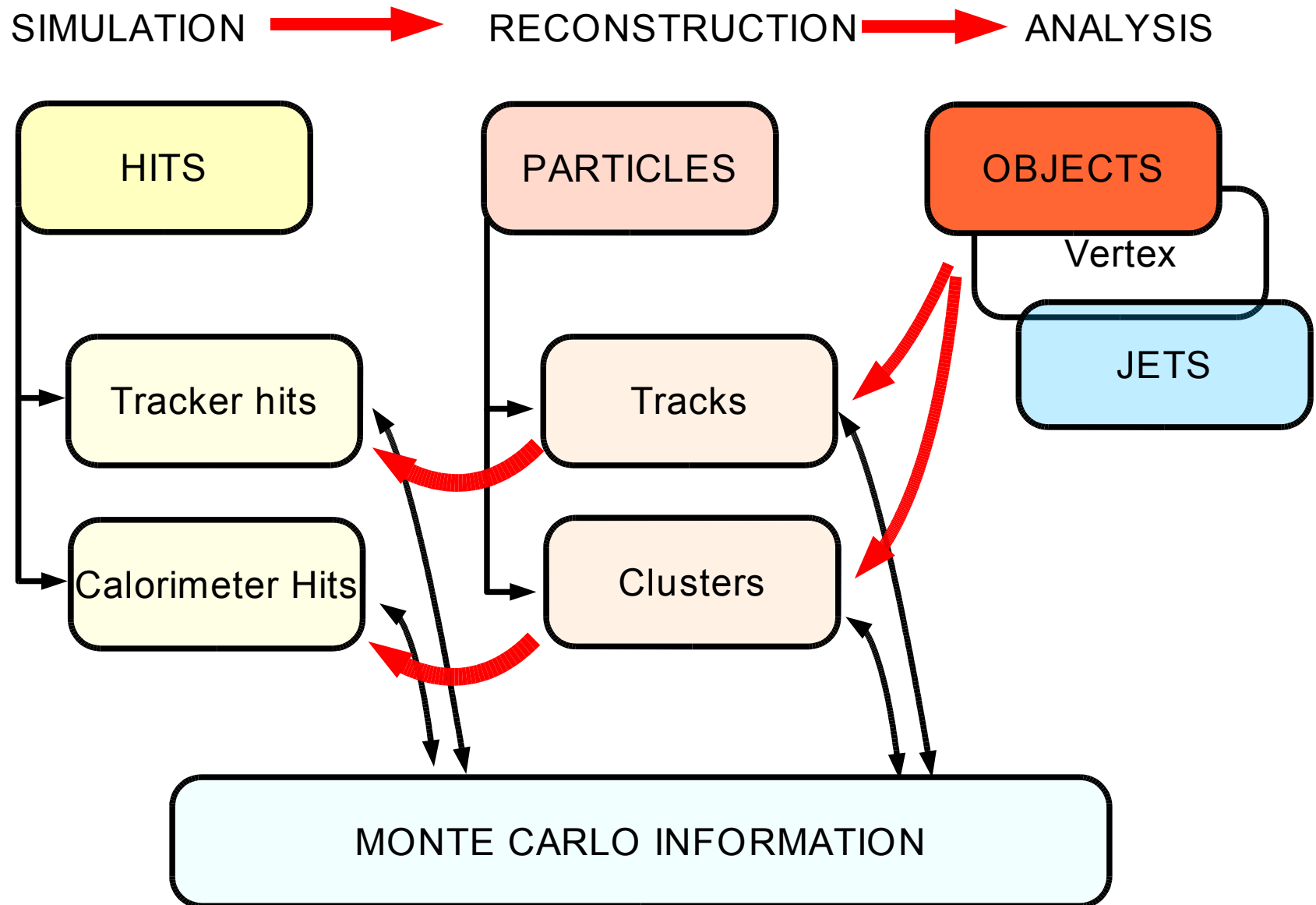
- Need a common way to store (“persist”) objects



- **LCIO**: a simple data model with underlying persistency system:



# LCIO: LC persistency framework



# LCIO: Status

- Developed in collaboration between SLAC / DESY / LLR (France)
- Common data model / persistency framework for LC studies
- Simple API to store and retrieve data
  - Same API in C++, Java (and Fortran)
  - Simple underlying IO format (SIO): can be changed easily at a later time

## Status:

- Development started December 2002
  - First public pre-release in March
  - First public production release for Montpellier: LCIO 1.0
    - Full C++ implementation
    - Full Java implementation
    - Full Fortran implementation
- Hit based data model “fully” defined, reconstructed objects under discussion

Release Version Icio 01-00 (first production release) done

WEB page Icio: [www-it.desy.de/physics/projects/simsoft/Icio](http://www-it.desy.de/physics/projects/simsoft/Icio)



# LCIO: Implementation

- LCIO interface exists for

- MOKKA
- BRAHMS

Write \*.slcio files

Simple event browser in JAS3:

The screenshot shows the JAS3 event browser interface. The top menu bar includes File, Edit, View, Tuple, Run, LCIO, Window, and Help. The main window displays a tree view on the left under 'DataSets' with 'panpyttbar-0-500.slcio' selected. Below this, a tree view shows the event structure: Event, EMBarrel, EMEndCap, HADBarrel, HADEndCap, MCParticle (selected), SiBarrel, SiEndCap, and VXD. The right pane shows a table of MCParticle data for 'Run:0 Event: 1'. The table has columns for N, Type, Status, Parent, PX, PY, PZ, and Mass. The status column contains truncated text 'Docum...'. The bottom status bar indicates 'Analyzed 1 records in 430ms' and '4.13/6.67MB'.

N	Type	Status	Parent	PX	PY	PZ	Mass
0	11	Docum...		0	0	250.00	0
1	-11	Docum...		0	0	-250.00	0
2	11	Docum...	0	0	0	250.50	0
3	-11	Docum...	1	0	0	-249.21	0
4	6	Docum...	2,3	-144.68	4.9229	102.32	177.29
5	-6	Docum...	2,3	144.68	-4.9229	-101.03	175.58
6	5	Docum...	4	-142.00	26.531	77.708	4.8000
7	24	Docum...	4	-2.6814	-21.609	24.613	80.216
8	-5	Docum...	5	53.262	-2.7891	-116.88	4.8000
9	-24	Docum...	5	91.424	-2.1338	15.857	76.864
10	-1	Docum...	7	18.556	25.386	7.2394	0.33000
11	2	Docum...	7	-21.238	-46.995	17.374	0.33000
12	15	Docum...	9	8.1708	5.2916	33.669	1.7770
13	16	Docum...	9	82.252	7.4254	17.812	1.0772

Similar functionality exists in C++ (examples in distribution)

# Reconstruction

- BRAHMS/ f77 based reconstruction:
  - Complete and sophisticated tracking
  - Particle flow reconstruction package
  - Tools (n-tuple for analysis, interface to main packages like ZVTOP, ...)
- OO world:
  - No coherent reconstruction frame yet
  - LCIO allows using f77 based reconstruction package on MOKKA output (REPLIC, BRAHMS reco to be released this week)

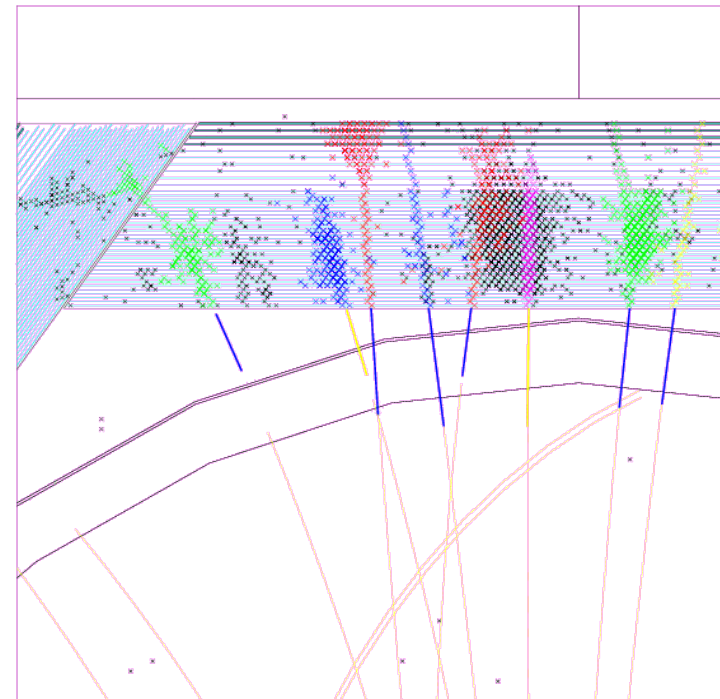
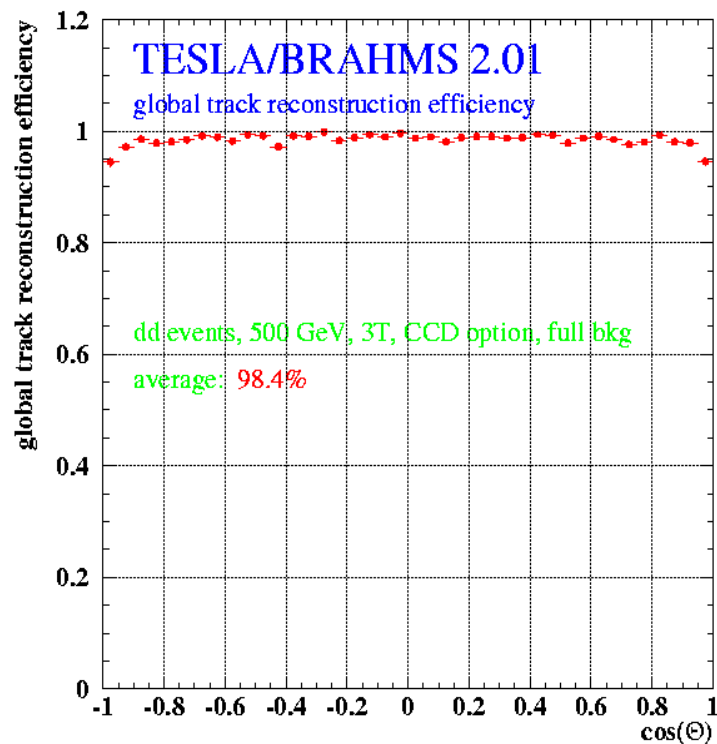
We need to move fast towards a OO based reconstruction framework, to enable reconstruction program developments!

# Reconstruction

Status of reconstruction packages:

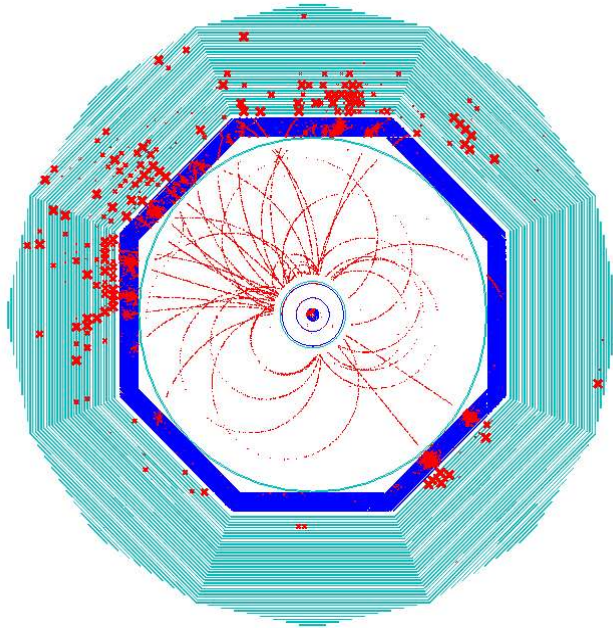
BRAHMS:

- sophisticated and complete reconstruction software available
- OO based: no reconstruction tools available at the moment

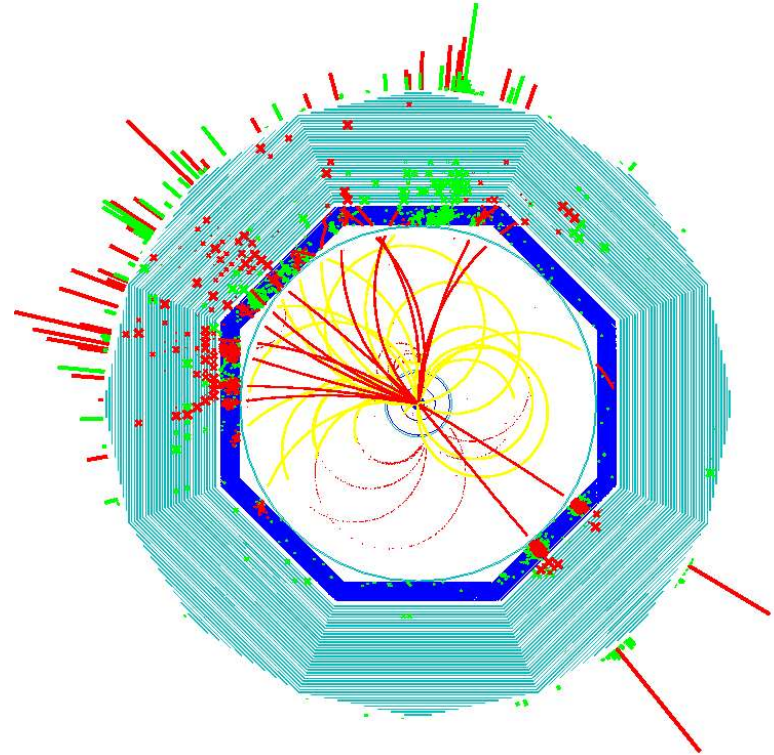


# Reconstruction

Hits simulated in detector (BRAHMS)



Tracks and Pflow objects reconstructed (BRAHMS reco)



Plots Karsten Buesser

# The Plan

- Develop a plain C++ reconstruction framework
  - LCIO as data model
  - Possibly CGA as geometry access model
  - Very simple interface, no fancy interactive environment for a start
  - Multi language support is no problem (JAVA ...)

Use LCIO ROOT  
LCIO JAS

to provide a simple user interaction with the reconstruction

At this stage:

remain independent of any particular environment (root, JAS, PAW, ...)  
be open for future developments  
be light-weight (minimise the number of libraries the user needs to install)

.... but we are still far from this goal...

# Fast Simulation

- SIMDET: fast, parametrised Monte Carlo

NEW: interface to used track based ZVTO P in SIMDET  
improvements to parametrisations

- SGV: fast, semi-parametrised Monte Carlo (produces hits)

Our US colleagues are developing a similar system

NEW: interface to ZVTOP in SGV

At the moment, fast simulations work, are producing physics results  
but  
we have no project for a modern fast simulator

# Software: Outlook

## Simulation:

- Converge towards GEANT4 based MOKKA simulation
- program should become more flexible and user friendly
- Close collaboration with our US colleagues on simulation established

## IO:

- LC specific persistency scheme and data model established
- Interface to C++, JAVA and Fortran exists
- Common development with our US colleagues

## Reconstruction:

- Next big project
- Digitisation and reconstruction “complete” in BRAHMS
- Much effort needed in OO framework: the next project

# Towards a data challenge

Software environment: see previous slides

Access to data:

- Need transparent and flexible access system
- Data volume small compared to LHC, but still significant

The plan:

- User interface/ interaction: use the GRID computing model and software

GLOBUS authentication manager

- Storage manager: dCache (FNAL and DESY, integrated into GRID)



# LC Data depository

- Database interface to data stored under dCache at DESY

File Edit View Go Bookmarks Tools Window Help

http://www-flc.desy.de/mc/ Search

Home Bookmarks The Mozilla Organi... Latest Builds

## Linear Collider MC Production Navigation Bar

[Search Run](#) [Enter new Run](#) [Administrate](#)

Runs matching your query:

Run Number	Category	MC Generator	Energy	Process	No. Ev.
<a href="#">5005</a>	2-Fermion	Pythia6.136	500	e+e-->Z/gamma->top+top-	160000
<a href="#">5004</a>	2-Fermion	Pythia6.136	500	e+e-->z/gamma-->tau+tau-	800000
<a href="#">5003</a>	2-Fermion	Pythia6.136	500	e+e-->z/gamma-->mu+mu-	800000
<a href="#">5002</a>	2-Fermion	Pythia6.136	500	e+e-->Z/gamma-->e+e- (only s-channel)	800000
<a href="#">5001</a>	2-Fermion	Pythia6.136	500	e+e-->z/gamma-->qq	6800000

Show detailed information about:

Run Number:

Search

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Philip Bechtle

Done

- Current problems: access from outside DESY

# Summary

- Software tools present a significant challenge
- Progress on the simulation:
  - GEANT3 based simulation more stable and complete
  - GEANT4 based simulation becoming available
  - Common persistency scheme is reality
- Progress on the reconstruction:
  - BRAHMS based reconstruction exists
  - OO reconstruction still in the future
  - LCIO input exists
  - LCIO output being defined
- Goals:
  - GEANT4 based simulator
  - Simple reconstruction environment independent of particular framework
  - LCIO as basic data format and model to facilitate data exchange
  - Management of data sets through GRID like system