Software Tools for ILC Detector Studies

- (Partial) Summary of ILC Software workshop at Orsay -

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Linear Collider Workshop LCWS07 DESY/Hamburg Germany May/June 2007

ILC Software and Tools Workshop

LAL - Orsay, May 2-4, 2007

Review on existing software tools - This talk

and their application - Talk by T. Yoshioka

75 Participants

44 Talks

Presentations by all four concepts and all three regions

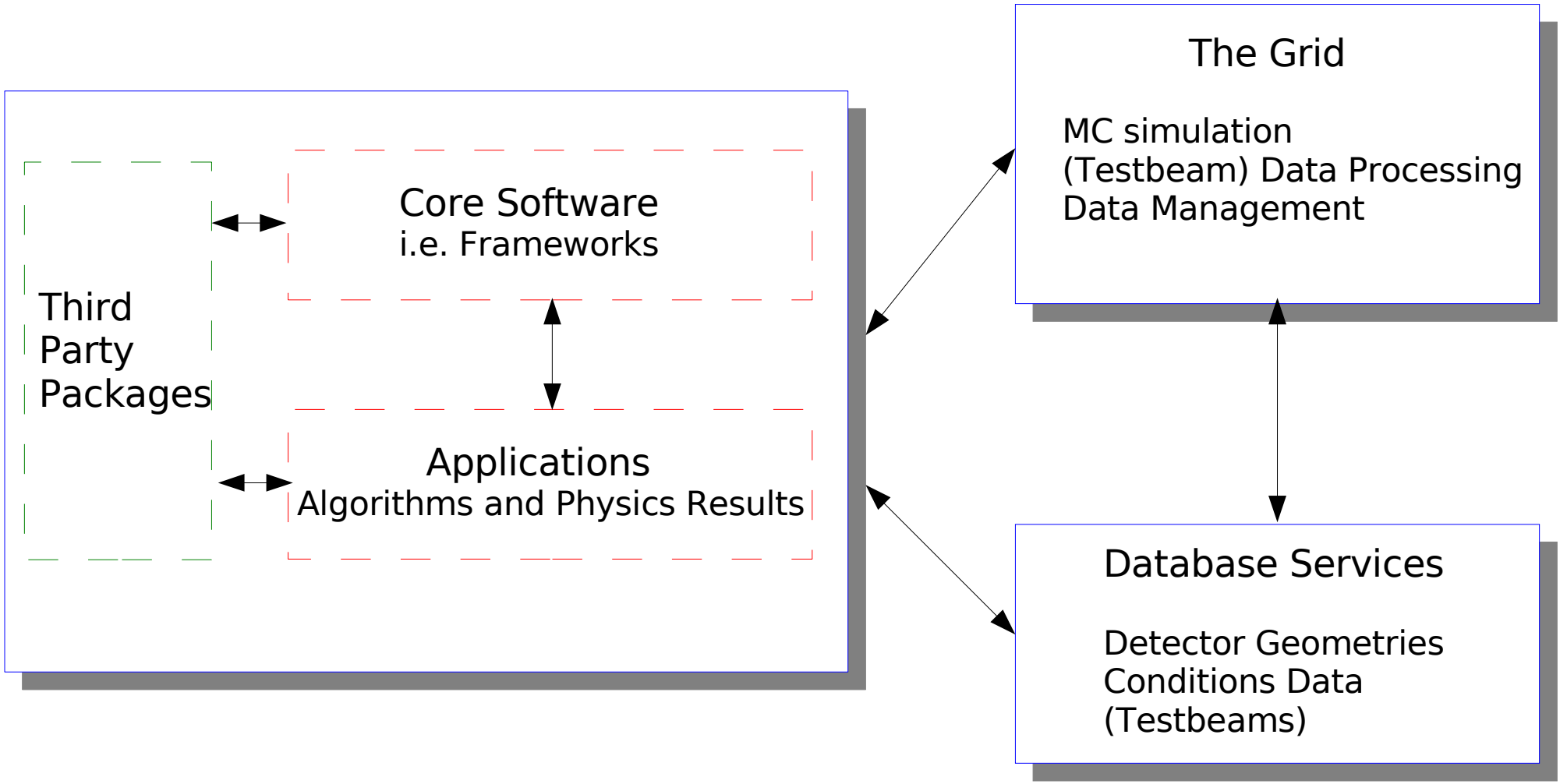
`http://events.lal.in2p3.fr/conferences/ILCSoftware/`

- This talk is to work out the main lines observed during the workshop
- This talk is not a pure compilation of the talks

ILC Software and Computing - The General Structure

The Actual Software

The Infrastructure



All these pieces are established for ILC in more or less mature form

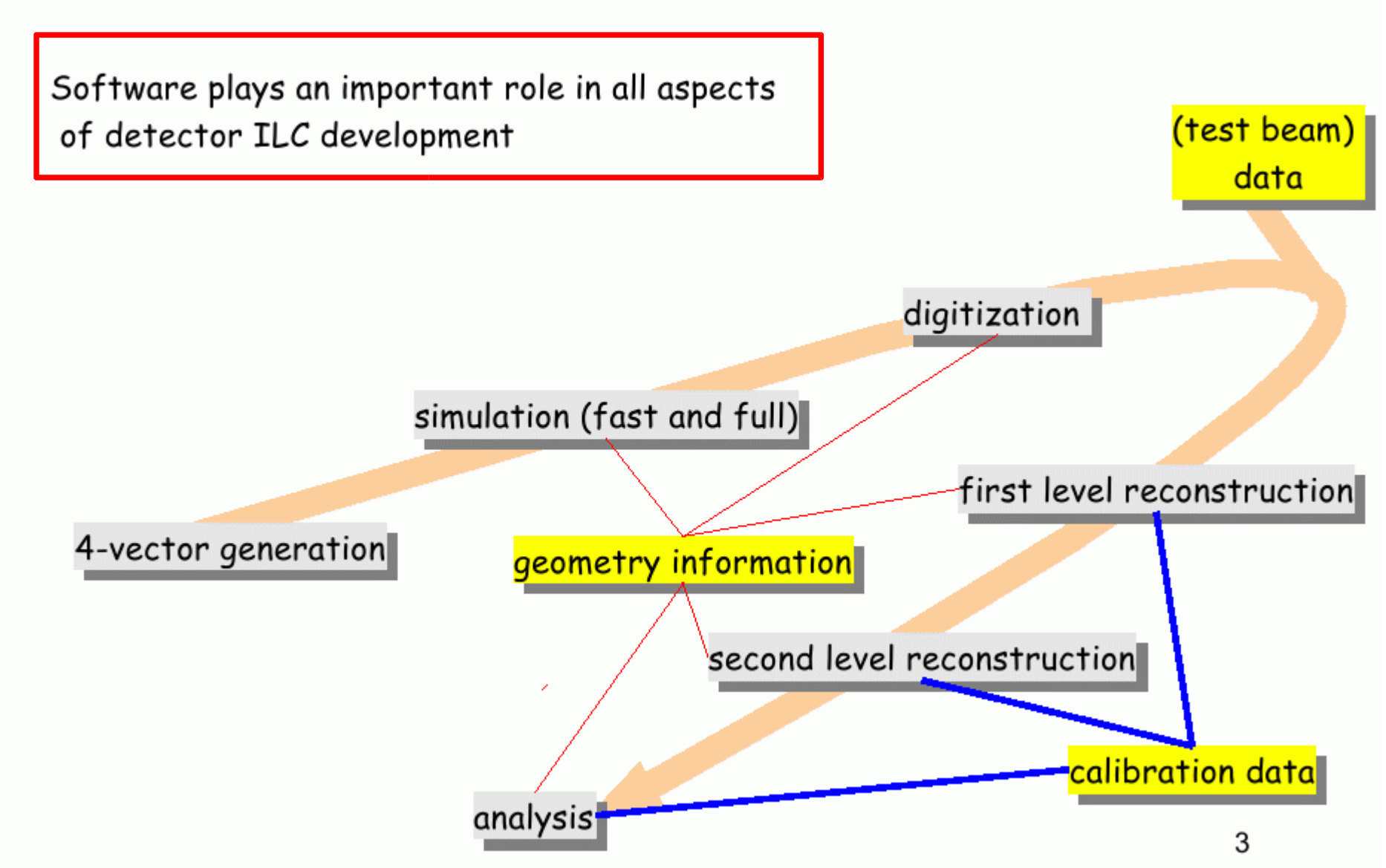
The Actual Software

We have four different detector concepts
in
three regions

Cannot do justice to all efforts

The view will be naturally eurocentric
but I will try to point out commonalities

Software for the ILC



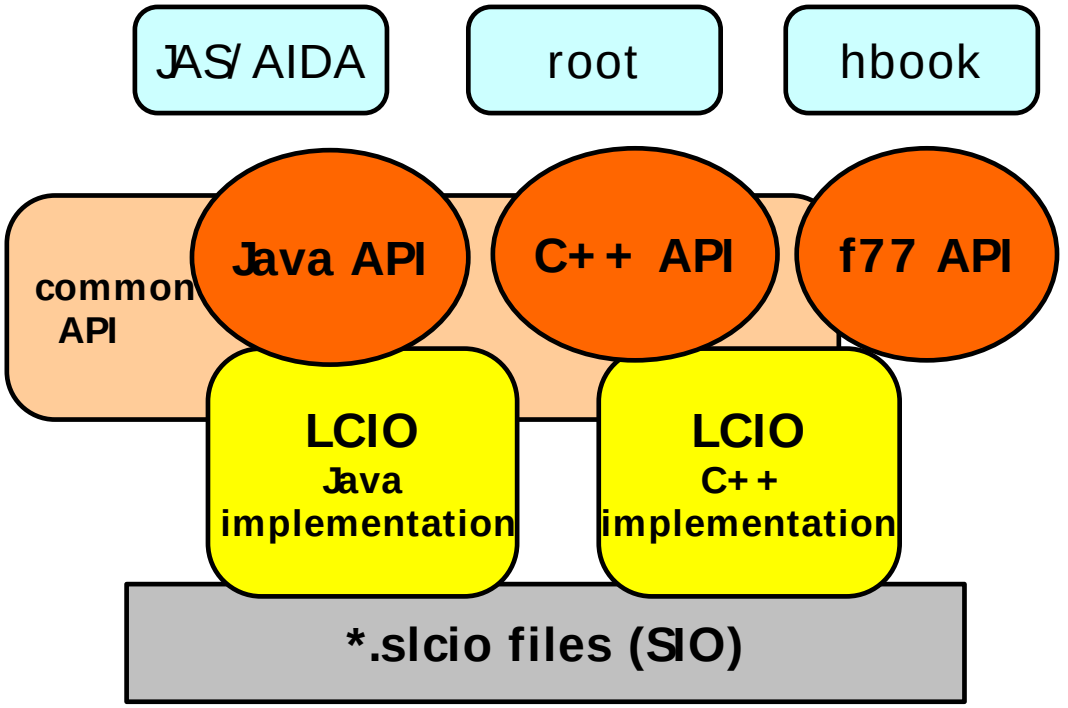
LCIO – A Common 'Language' !?

- Common Project of DESY et SLAC
  - (Current) Basis of ILC software

- Principle properties
  - Java, C++ and f77 (!) API
  - Data Model for simulation studies simulation (and beam tests ?)
  - User code separated from concrete I/O format
  - No dependency on other packages

Standard for
persistency & and data model
of ILC Software

SW Architecture



GLD Study and 4th concept
base their studies on root
however
Interface to LCIO envisaged

Current version: **v01-08-02**

Why LCIO ?

- A common data model facilitates the exchange of results over long distances

  Well defined interfaces

  Everybody knows what can be expected to be in the file

  Local extensions might be useful but we have to maintain a basis for the whole community

  New (useful) proposals can/have to be implemented into the data model

- LCIO supports C++, java (and fortran) programming languages

  Unique in particle physics

- Testbeam results can be easily transported into full detector studies

- The current status of LCIO is for sure not the final word but a solid basis

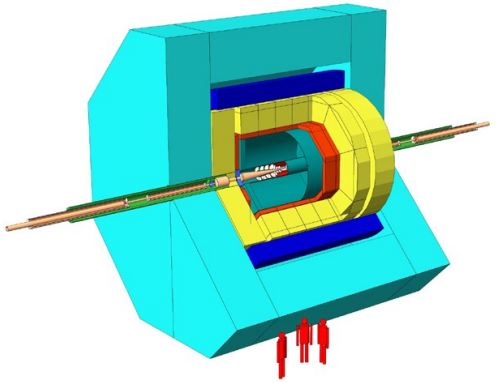
  Major improvements concerning file and event handling in last release

  Details on I/O layer under investigation

The other common basis - GEANT4

All concepts do exist as a GEANT4 implementation

LDC



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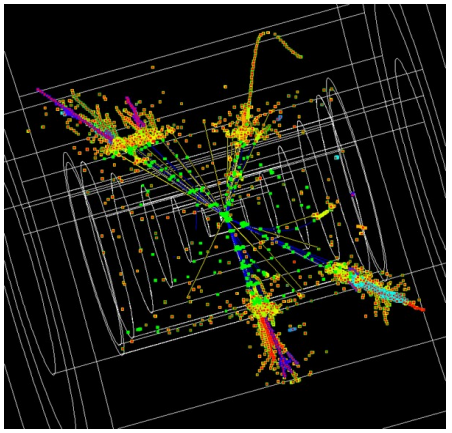
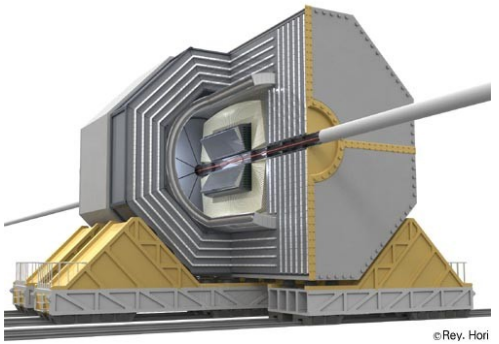
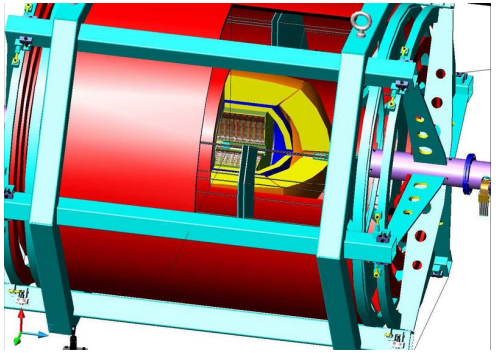


GLD



4th Concept



- However these implementations live in different (simulation) frameworks
  - Mokka in the LDC study
  - SLIC in SiD/ALCPG study
  - JUPITER in the GLD study
  - ILCROOT in the 4th concept study

- Attempts to 'cross implementations' in LDC and SiD study
  - No results on comparisons shown at Orsay
  - Difficult to pursue due to lack of manpower

- LDC and SiD/ALCPG produce LCIO files by default
  - (At least) facilitates comparison

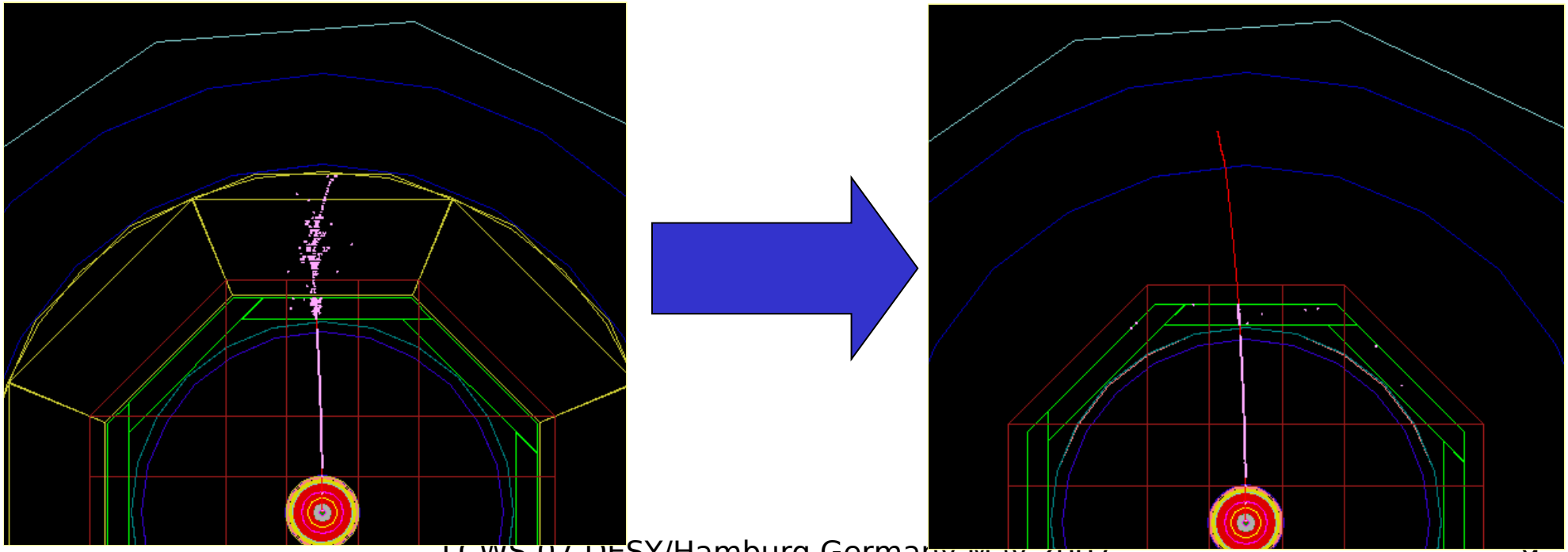
Flexibility of Models?

« Cooking models » in Mokka

The user is able to modify the model ingredients at launch time, ex :

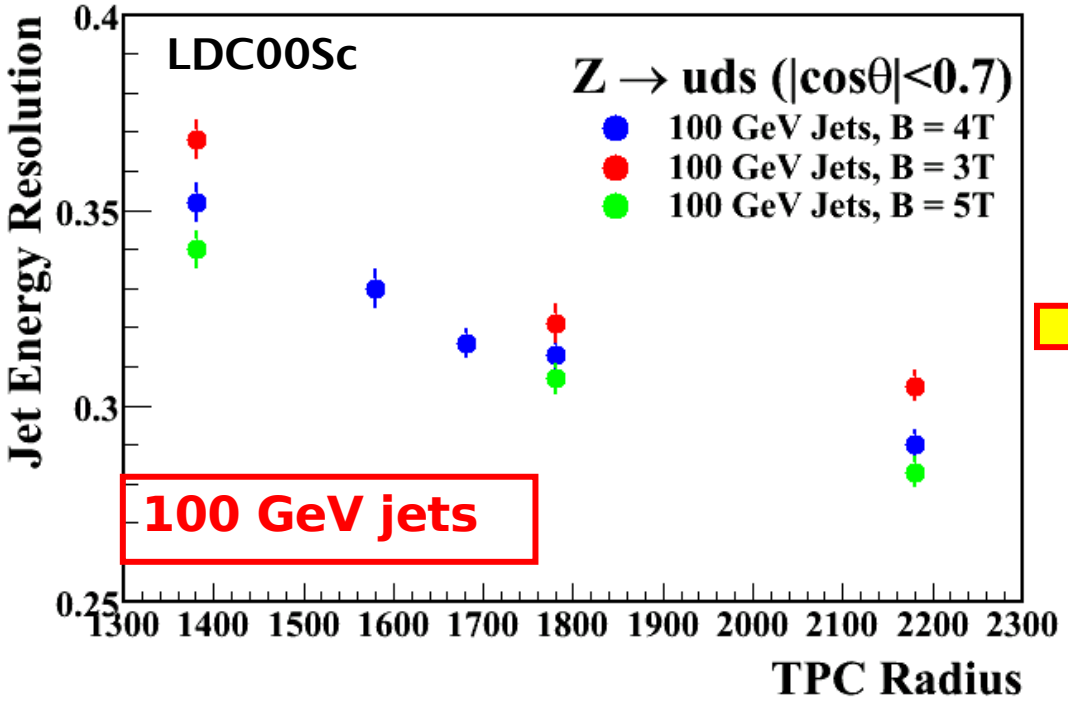
/Mokka/init/detectorModel LDC01

/Mokka/init/EditGeometry/rmSubDetector SHcal01



Example for an Optimisation Study in LDC

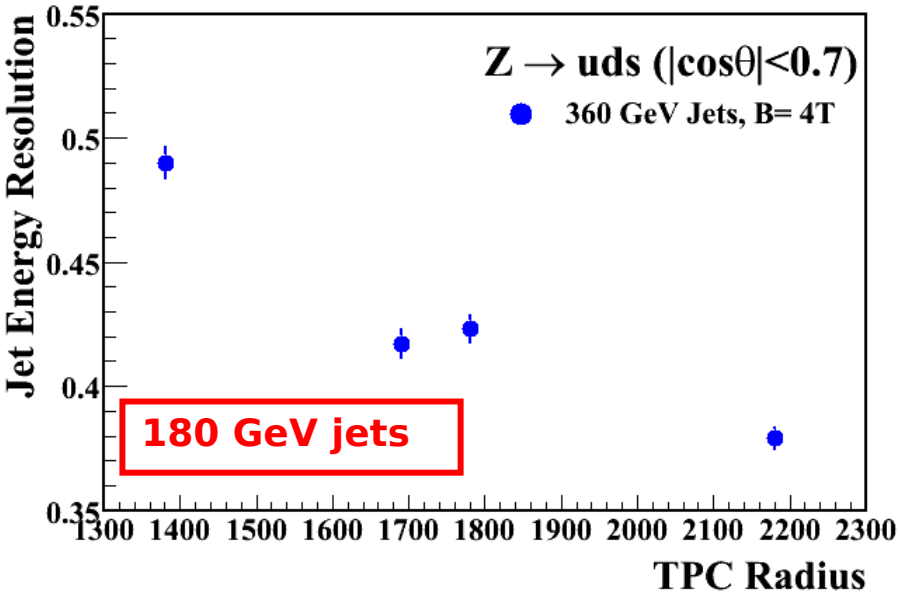
M. Thompson - Cambridge



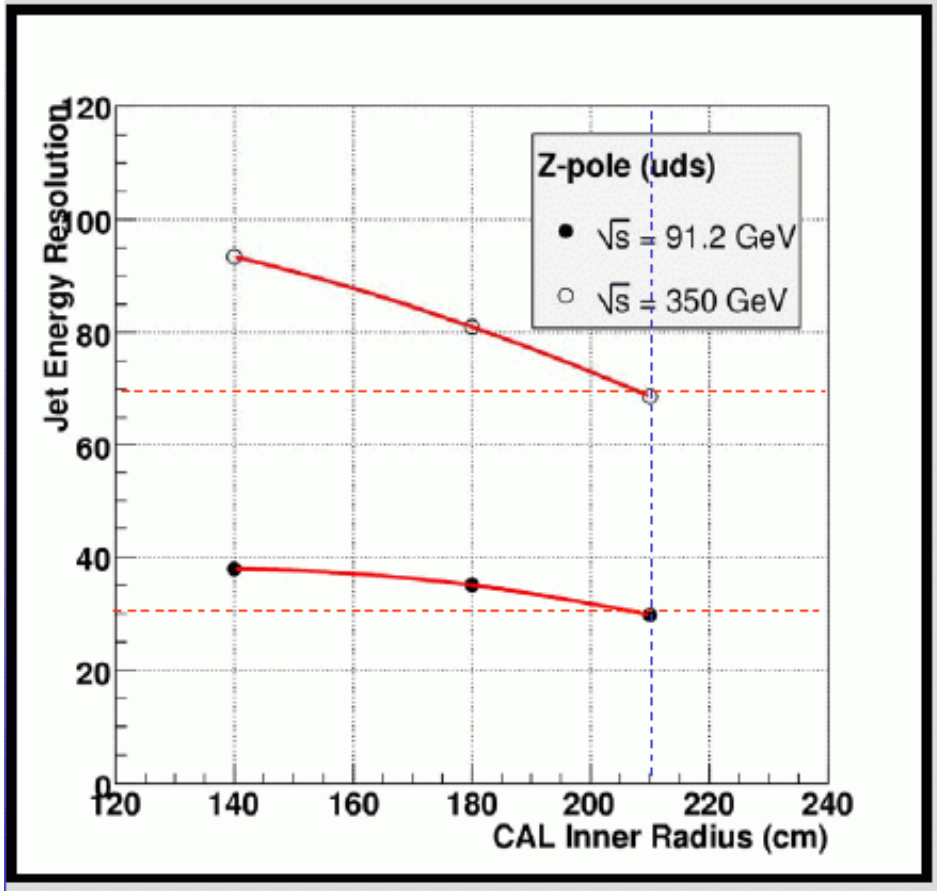
Radius more important than B-field

Radius more important at higher energies

B-field studies on the way…



- ECAL inner radius dependence of the PFA performance is studied.
  Default Radius = 210 cm, 1cm x 1cm cell size.

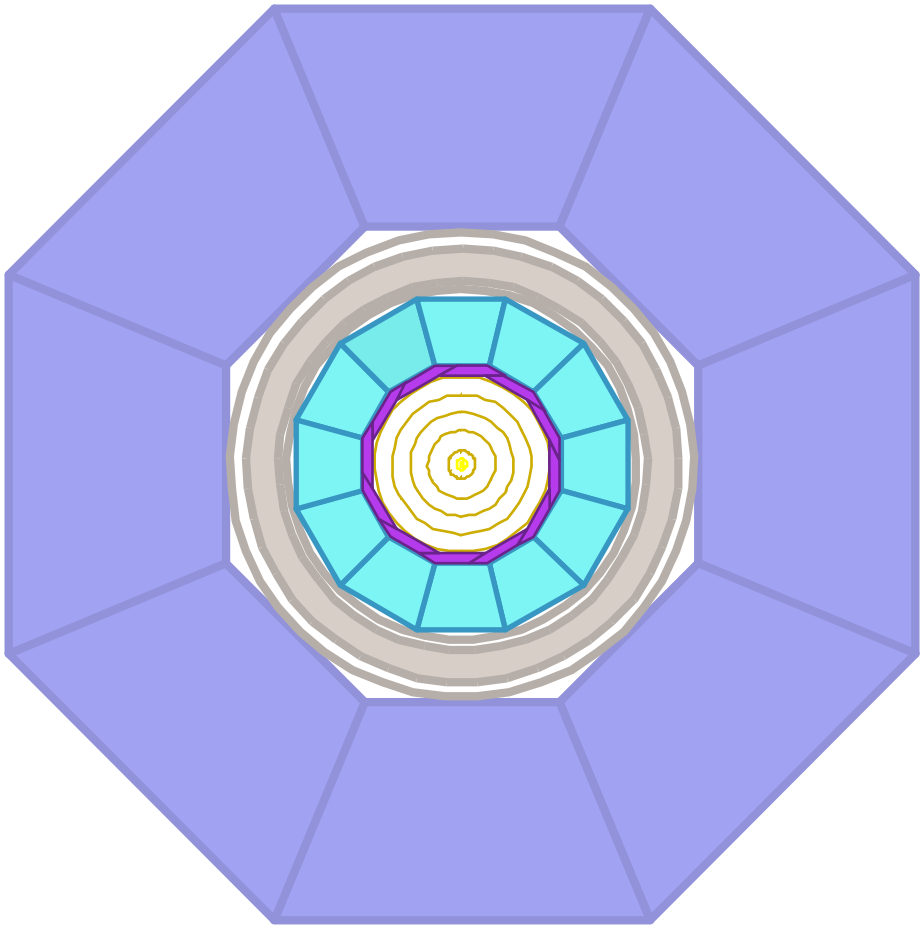


- Larger calorimeter radius gives better PFA performance as expected.
- PFA performance depends on the CAL radius squared.

Ecm	140 cm	180 cm	210 cm
91.2	37.9±0.4	35.0±0.4	29.8±0.4
350	93.4±1.5	81.0±1.3	68.7±1.1

Tamaki Yoshioka

(An) SID Implementation



Flexibility by Runtime XML format

- Stainless Steel vs. Tungsten HCal sampling material
- RPC vs. GEM vs. Scintillator readout
- Layering (radii, number, composition)
- Readout segmentation
  (size, projective vs. nonprojective)
- Tracking detector technologies & topologies
  - TPC, Silicon microstrip, SIT, SET
  - “Wedding Cake” Nested Tracker vs. Barrel+Cap
- Field strength
- Far forward MDI variants (0, 2, 14, 20 mr)

Reconstruction Tools - Frameworks

Each concept has developed tools for the full reconstruction chain

Each concept has developed its own reconstruction framework

- LDC - MARLIN

MARLIN is framework which is subdivided into

MARLINRECO	and	MARLINUTIL
Set of Reconstruction Algorithms		Helper Classes

All important software packages under one roof
New algorithms/tools can easily be embedded into MARLIN
Installation tool presented at Orsay

- ALCPG/SiD

Individual reconstruction packages centrally available

- GLD - URANUS

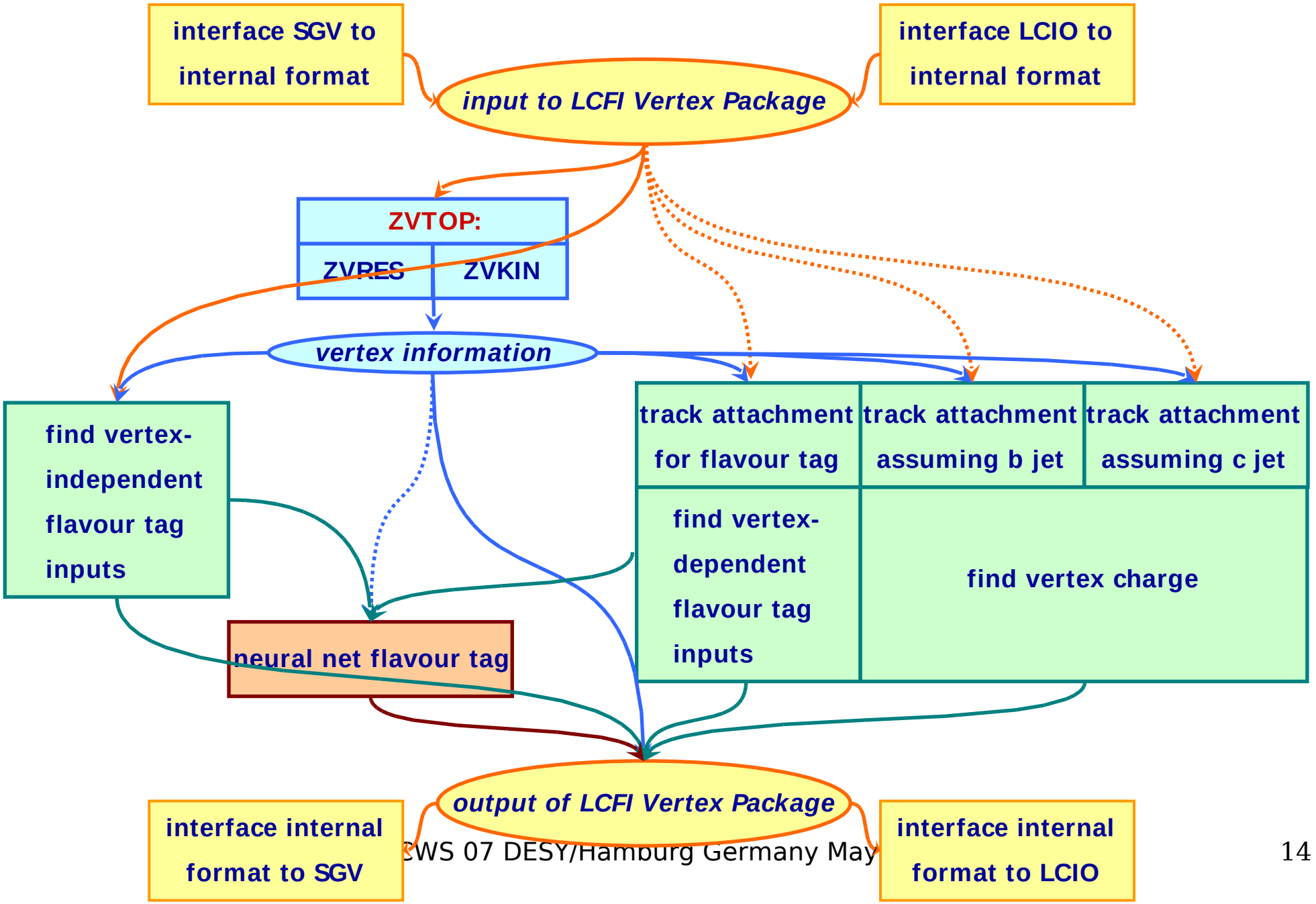
Assembly of Reconstruction and Analysis Tools

- 4th Concept - ALIROOT/ILCROOT

Benefit from a generic simulation/reconstruction suite for HEP Experiments

'New' Tools Presented at Workshop – Highlights I

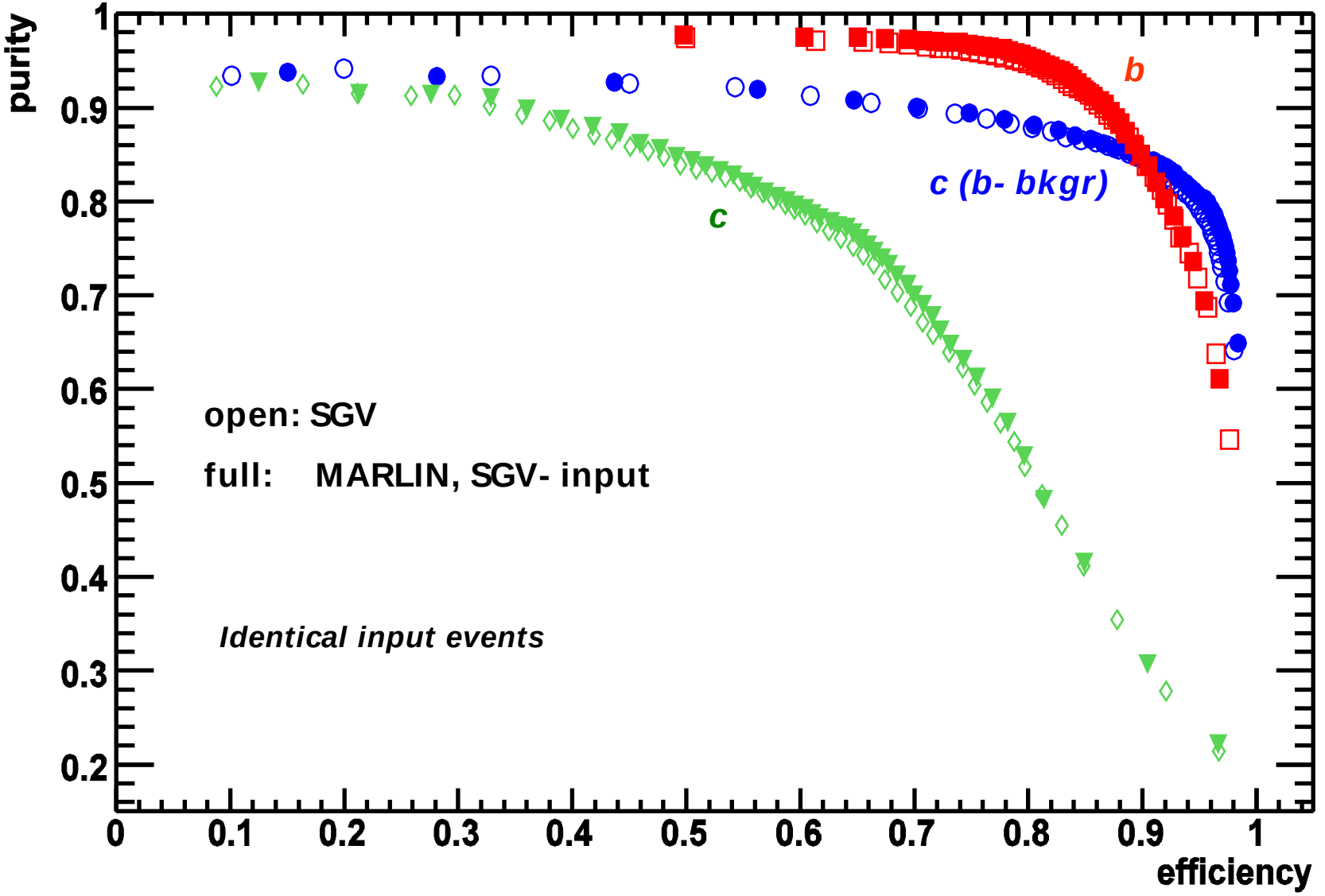
ZVTOP Vertex Finder 'for' MARLIN S. Hillert et al.



Ok that looks complicated

What are the results ???

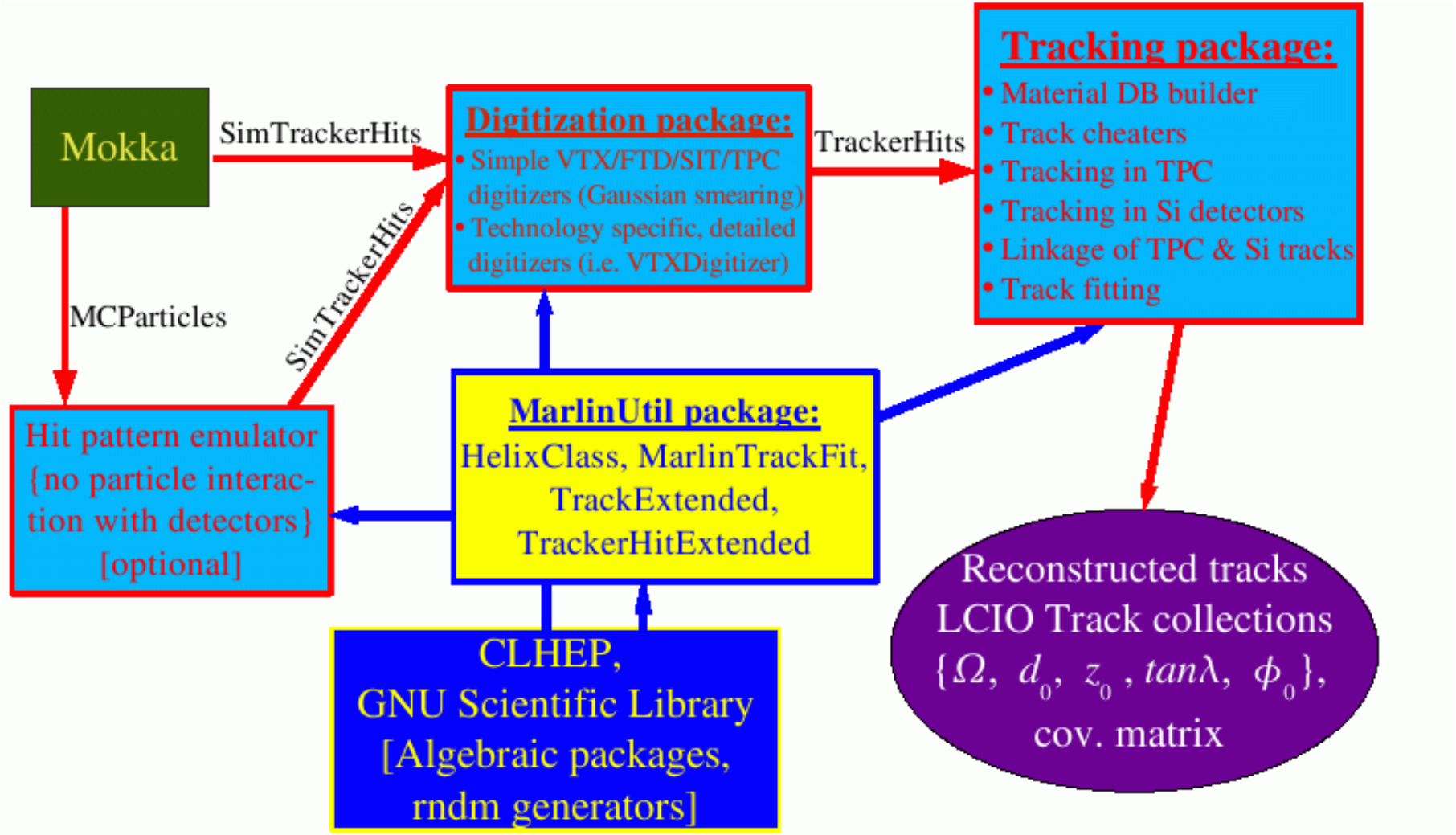
Flavour tag performance at the Z- peak



Excellent agreement between the LCFIVertex Marlin code and SGV!!!

'New' Tools Presented at Workshop – Highlights II

LDC tracking Package – A. Raspereza et al.

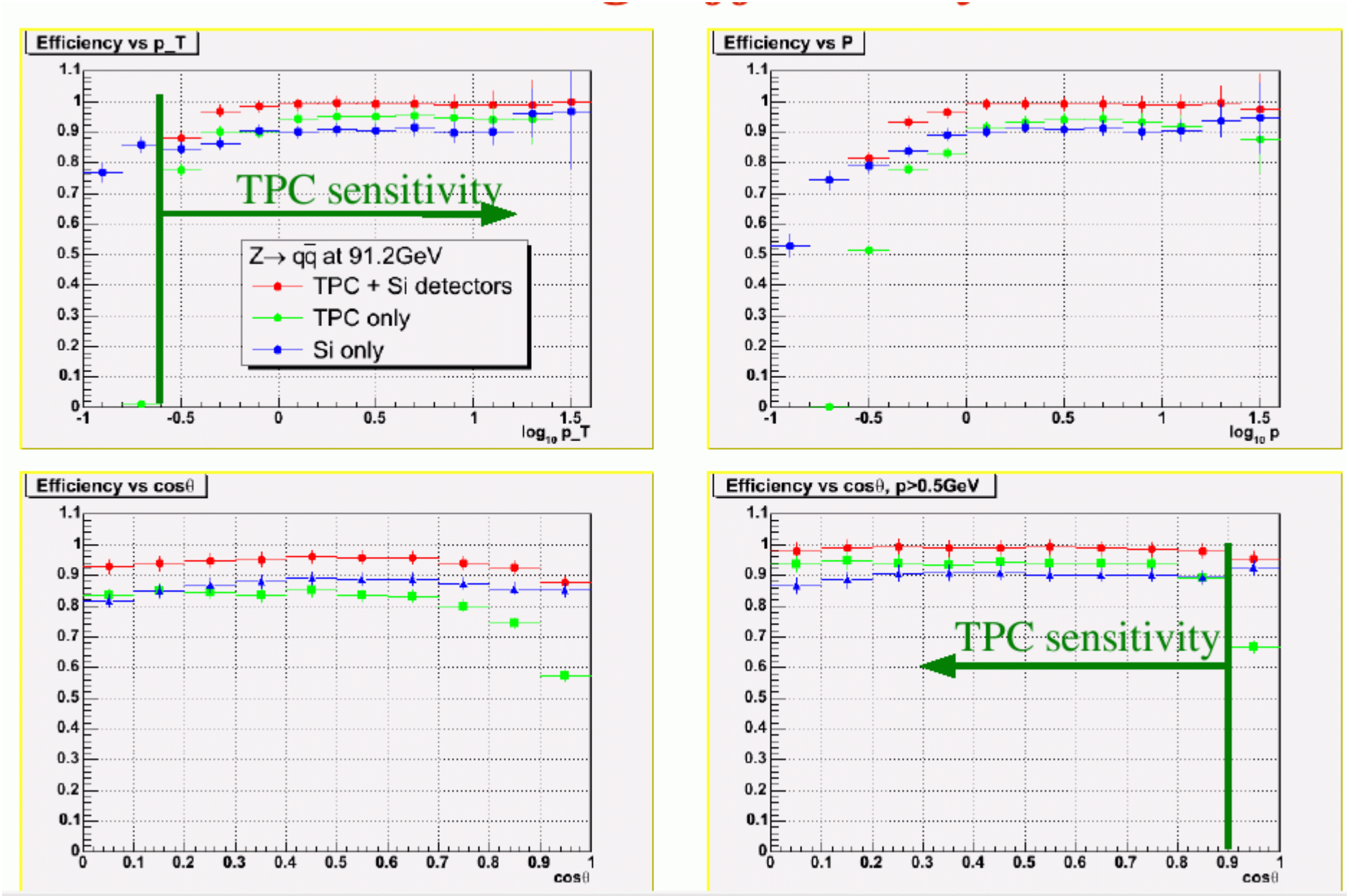


Beautiful Example of interplay of different pieces of LDC Software Chain

Will be interfaced to new ZVTOP package – See above

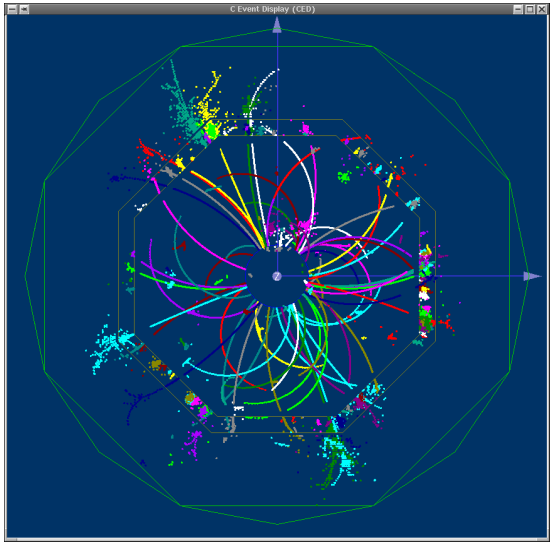
Is/will be used in PFA Studies

Track Finding Efficiency



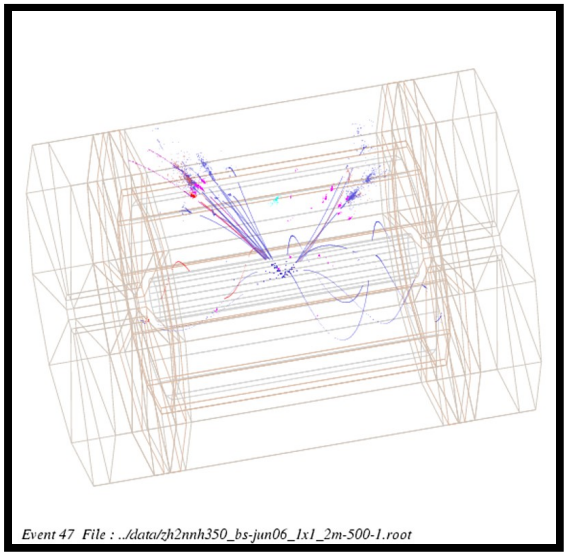
Open Issues I – Common Event Display

Each concept is using its own event display



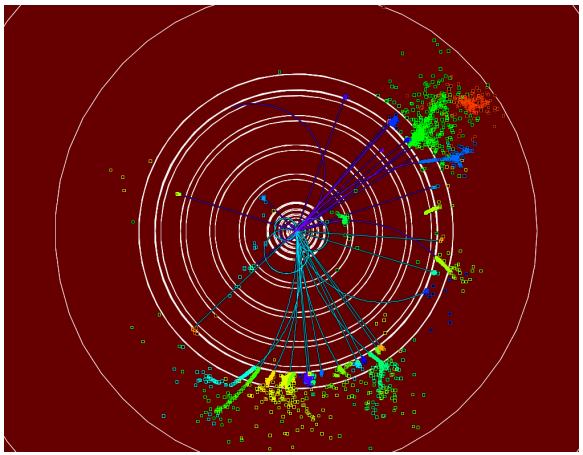
LDC

CED Event Display
Integrated in Marlin



GLD

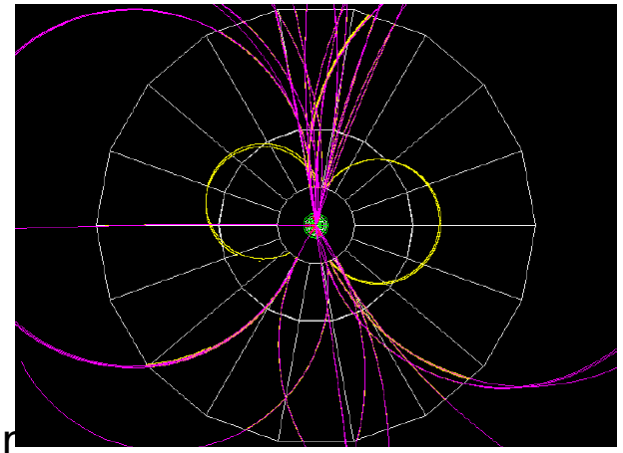
Root Event Display
Integrated
in Uranus



ALCPG/SiD

JAS3/WIRED
Event Display

High Interactivity!
Well coupled to
LCIO
Can be used by other
studies!!!



4th Concept

Root Event Display
Integrated in
ILCROOT

Remarks On Event Displays

- Development of an Event Display is clearly one source where there is a high risk to waste (human) resources

  Attractive piece of work
  Well visible and presentable

- High risk to re-invent the wheel over and over again

  ... but ILC Community is clearly short in manpower!!!!

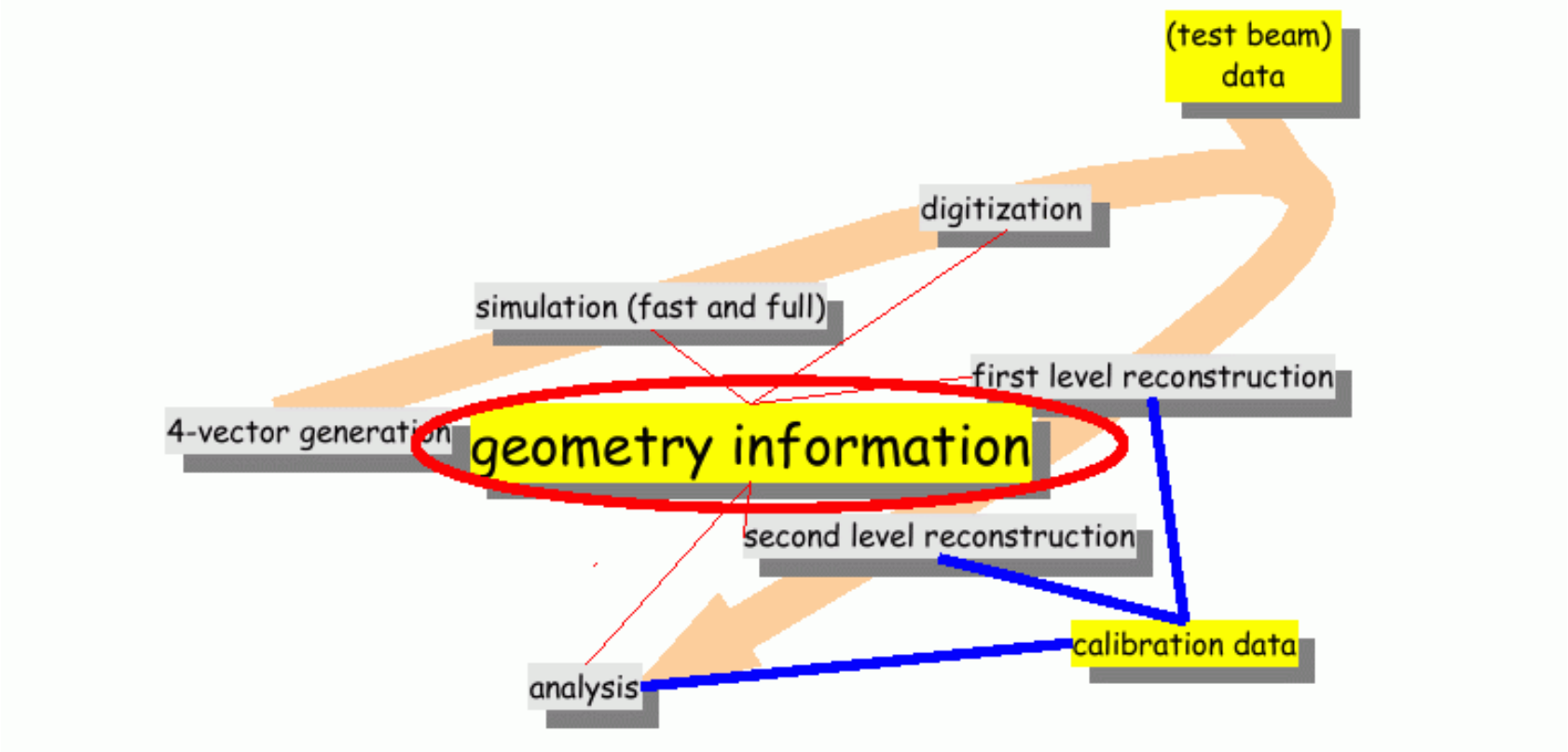
  will lead to '50%' solutions!!!

- Has to be put in the hands of one or two IT divisions in close collaboration with physicists

  Not to be written by physcists!!!

Open Issues II – Geometry Interface

Geometry Information is central to nearly all applications



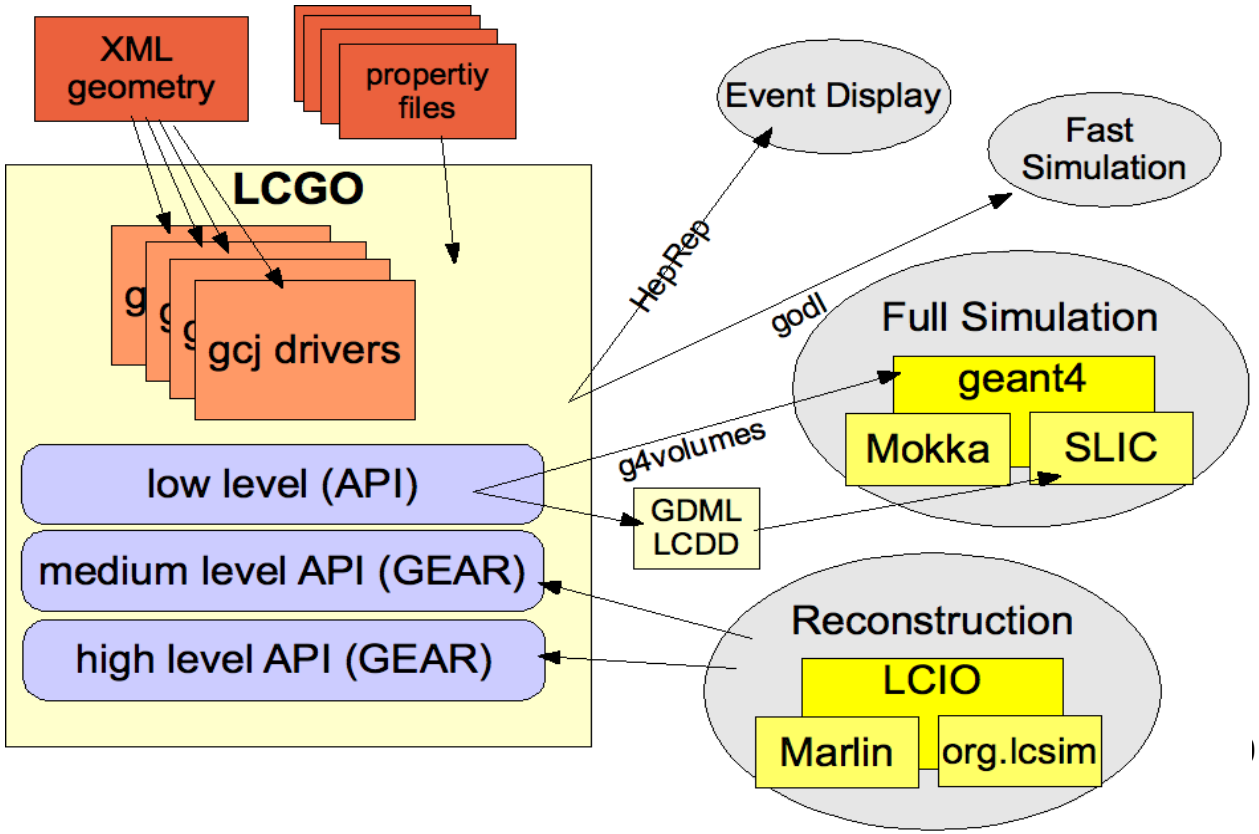
Access to Geometry Information is managed differently in different concepts

LCGO is ansatz for common interface

Common project by DESY and SLAC
These two divisions are already heavily charged with ILC software !!! Who else???

... On LCGO

- common geometry to be used in all ILC frameworks
  - SLAC-DESY project – (of course open for all collaborators)
  - goals for LCGO:
    - be at least as functional as existing systems (LCCD/SLIC, GEAR/Mokka)
    - enable smooth transition path from existing systems
    - encourage/increase interoperability between systems
    - have no known principle short comings: "everything should be possible"



work in progress
- manpower issues

The Infrastructure

ILC and the Grid – Introductory Remarks

- ILC is on the Grid

The virtual organisations (vo) 'ilc' and 'calice' have been established and are active!!!!

These vo are hosted by DESY

- This is the time to show our presence at the various IT centers around the world

A common task beyond borders of concepts and regions!!!!

Need to obtain clear commitment to support by IT centers
... in particular in view of the LHC start when these centers will be under pressure!!!
On the other hand of course we will benefit from their experience!!!

- Need to make up our minds ourselves

No clear strategy in ILC on how to make use of the (significant) resources
No manpower for management of tasks coming along with grid
Responsibilities for software, data and database management – FTE tasks!!!!
Situation is a bit different for calice

Support for ILC

- ILC is supported by a lot of sites world-wide, mainly Tier-2 sites
- Grid infrastructure is used parasitically, e.g. LCG
- DESY *hosts* the VOs ‘calice’ and ‘ilc’ in it Grid infrastructure which is also used for the HERA experiments as a Tier-2

- A strong commitment to ILC exists
- Sites dedicate resource *shares* to ILC

- Supporting sites are:
  - desy, ifh, freiburg
  - France (lal, lyon, ecole polytechnique (LLR), saclay)
  - fnal
  - ral, brunel, ic, cam, ox, bham, ucl, manchester, ed, lesc, qmul, rhul, gla
  - tau
  - kek

Why the using Grid??

Neither ILC nor Calice have an 'experimental center' like CERN, DESY etc. and maybe will never have

World wide distributed R&D effort requires distributed computing

- Easy sharing of data by common data storage accessible by everyone from everywhere

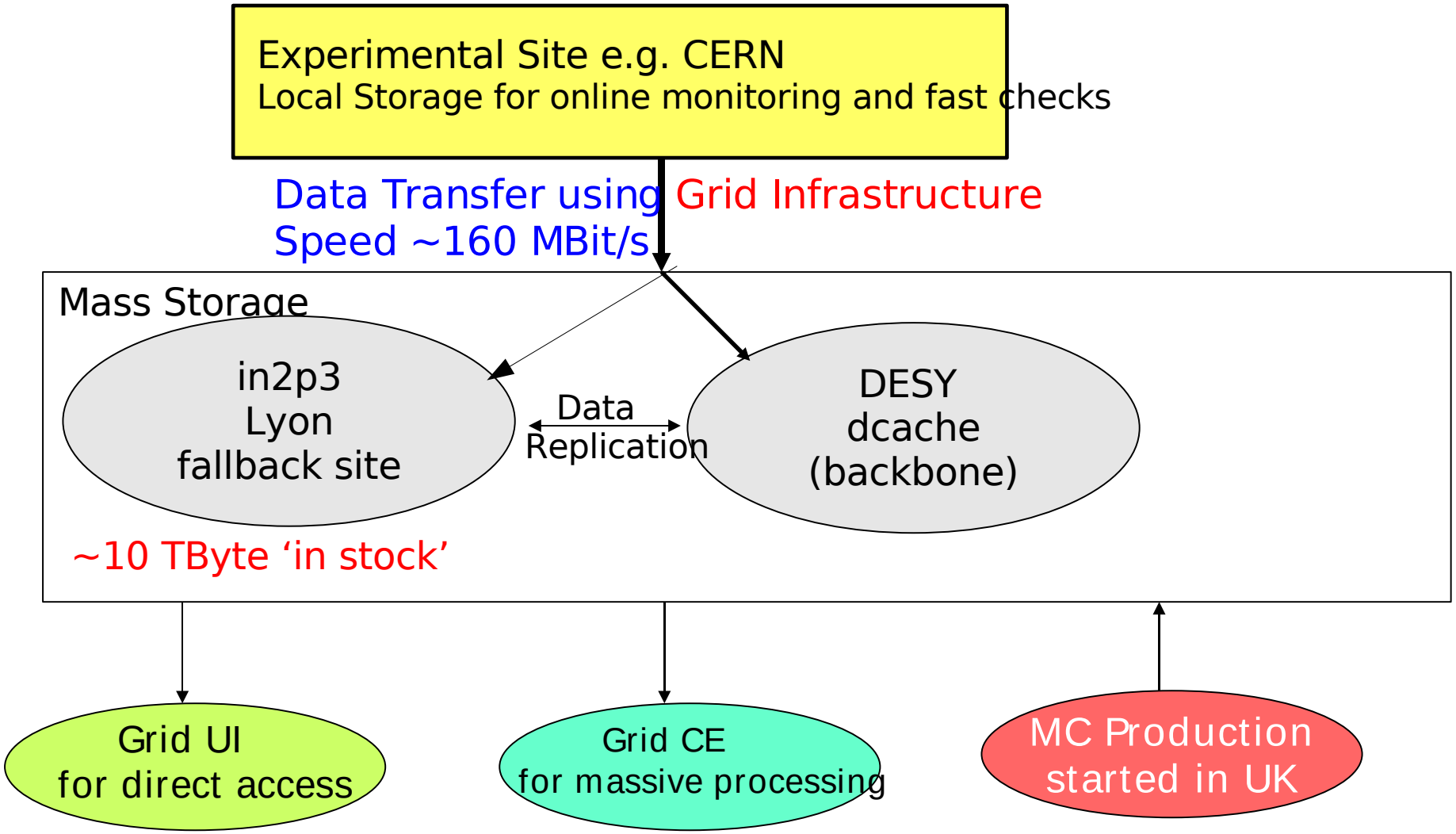
- Exploiting the Grid allows for quick data processing, e.g. Several reconstruction iterations for calice testbeam data

- Large simulation effort to come for the ILC requires large computing ressources

General strategic decision by HEP community and science politics to exploit and invest in Grid computing

- Exploring the Grid can be regarded as an engineering/R&D effort for the ILC just as hardware development or simulation studies (which in turn demand significant computing power)

An Example - GRID usage within Calice



- Grid tools used for data management
- Grid tools used for data processing and MC production

Last but not least - Conditions Data Handling

- LCCD – Linear Collider Conditions Data Framework:
  - Software package providing an Interface to conditions data
    - database
    - LCIO files

    Author Frank Gaede, DESY

First attempt heavily used within calice !!!

The importance of conditions data (not only) for 'real' data renders the development of a fully functional cd data toolkit to be a fundamental !!! piece of the ILC Software

So far no commitment for support visible!!!!

- Efficient storage and access to conditions data

  Browsing, convenient interfaces
- How to 'distribute' conditions data (e.g w.r.t to grid) ?

  BTW.: LHC does have some headache with that!

Conclusion and Outlook

- Software tools for detailed detector optisations studies exist in more or less mature form

  Expect many new results based on various analysis chains at this workshop

  Flexibility of simulations within one concept
  Very few cross implementations

- LCIO is 'backbone' of most software software packages
  2 concepts use it by defaults
  2 concept will provide interfaces

  LCIO is and will be used in Testbeam Efforts!

- ILC is on the Grid

  Still fairly low consumption
  Coherent approach missing (needed?)

- Clearly limited resources in many fields