



# Software and Computing Status

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# Section 1:

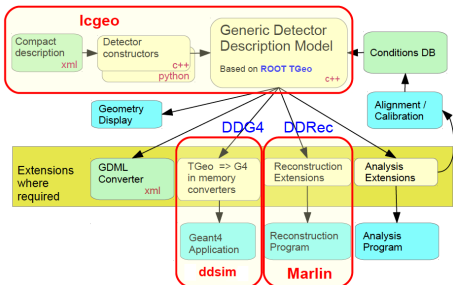
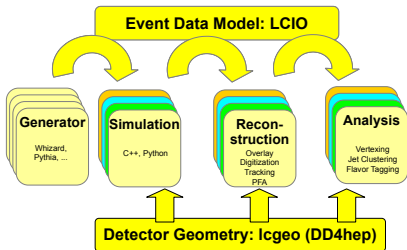


## 1 Introduction

# Introduction



- Future linear collider software chain based on two pillars
  - ▶ LCIO Event Data Model
  - ▶ DD4hep Geometry Source
- Recent developments
  - ▶ DD4hep core/DDG4/ddsim mostly finished
  - ▶ Finalising the detector model
  - ▶ Track reconstruction with full silicon tracking in MARLIN
  - ▶ Providing DD4hep based geometry information and tracks to PandoraPFA
  - ▶ Improvements in Pandora and LCIO, and other packages

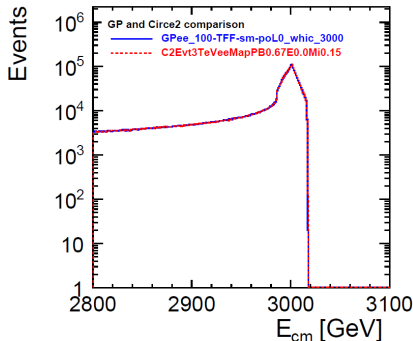


# Section 2:



## 2 Event Generation

- Validation of WHIZARD ongoing
  - ▶ CLIC luminosity spectrum reproduced inside WHIZARD 2
- Need to see if recently released v2.3.0 is suitable for mass production
- See also talk by Christian Weiss later in this session



Comparison between GUINEAPIG and WHIZARD2/Circe2 peak luminosity-spectrum (J.J. Blaising)

# Section 3:



- 3 Simulation, Detector Geometry
  - Performance Optimisation
  - Detector Model





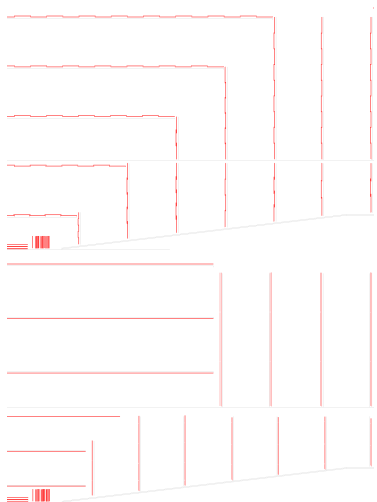
- Profiled DDG4 simulation run time and identified hot spots in the treatment of hits and Monte Carlo history
  - ▶ Both hot-spots could be removed for a run-time reduction of about 70% for 3 TeV ttbar events
  - ▶ Basically all run time now taken by GEANT4
- Further reductions might be possible with different compiler/linker settings, we could do for the large productions

Run-time profiling done with *Intel VTune Amplifier*: Fairly easy to use and very powerful, but need a license to use Available inside CERN

# Simulation: Detector Model



- Currently using detector model CLIC\_o2\_v04 for tracking developments
  - ▶ *old* tracker layout
  - ▶ 25 layers in ECal, wrong thickness for layers
- CLIC\_o2\_v05:
  - ▶ *old* tracker layout
  - ▶ 40 layer ECal and correct thickness
- CLIC\_o2\_v06:
  - ▶ Updated OTD3/4, ITD7, ECal-Endcap positions
  - ▶ Small changes in very forward region
- CLIC\_o3\_v04/5/6:
  - ▶ Updated tracker layout



See my presentation in optimisation session tomorrow morning

# Section 4:



- 4 Reconstruction
  - Pattern Recognition and Track Fitting
  - Particle Flow
  - Overlay
  - Very Forward Calorimeters
  - High Level Reconstruction



ClicPerformance package

<https://svnsrv.desy.de/public/marlinreco/ClicPerformance/trunk>

- Simulation and reconstruction steering files
- Performance and validation processors for tracking and pattern recognition

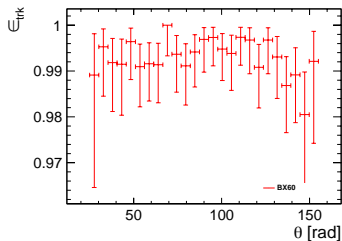
# Reconstruction: Pattern Recognition/Track Fitting



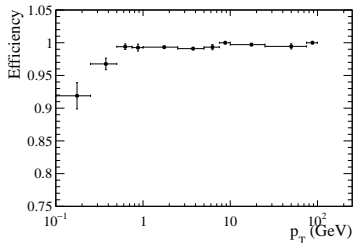
- Work on-going for track reconstruction
- Performance improvements of the conformal mapping pattern recognition
- Agreement definition of *Efficiency* and *Fake Rate* needed
- Have to reconstruct larger samples with and without overlay to find rarer bugs

See Rosa's presentation in the optimisation session tomorrow morning

Mini-Vector CA



Conformal Mapping CA



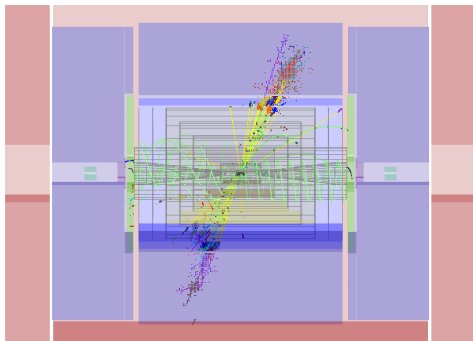
(R. Simoniello, D.Hynd)

# Reconstruction: Particle Flow



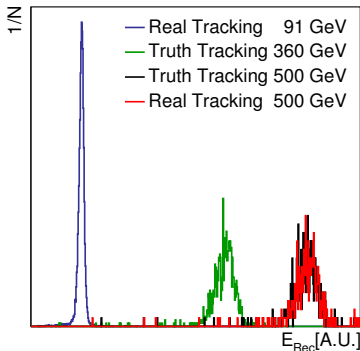
- Benefit from many developments compared to CDR software
  - ▶ Better performance
  - ▶ Improved Photon reconstruction
  - ▶ software compensation

See presentations by Lan Tran in this session, and by Steven Green and Matthias Weber in tomorrows optimisation session



## Very preliminary reconstructed jet energy distributions

- Reconstructed with real tracking and some with truth tracking for comparison
- Not completely calibrated
- No track selection
- No overlay



# Reconstruction: Overlay and Timing Cuts



- Using max timing of 10 ns for calorimeters at 3 TeV
- Overlay  $\approx$  30 BX (10 BX before/during physics event, 20 BX after)
- Need to study impact (or lack thereof) when overlaying larger number of bunch crossings?
- Overlay incoherent pairs?
  - Only in the trackers and the BeamCal?



# Reconstruction: Very Forward Calorimeters



Reconstruction of electromagnetic showers in LumiCal and BeamCal  
BeamCal:

- Reconstruction usable with dd4hep pending final validation

LumiCal:

- Not yet able to handle dd4hep geometry or input files

For particle ID tools see presentation by Strahinja Lukic in this session

- What is already available
- Develop additional tools

Flavour Tagging

- **LCFIPlus still not compatible with newer ROOT versions**

# Section 5:



- 5 iLCDirac and the Grid
  - Recent Use
  - Updates and Improvements
  - Future Productions
  - Support

# iLCDirac: Recent Use

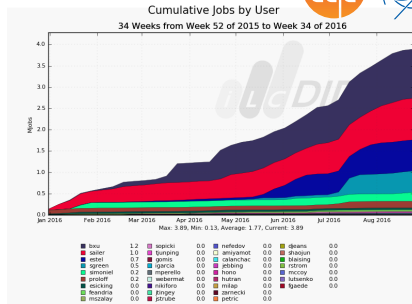


## Resource usage by users continues to grow

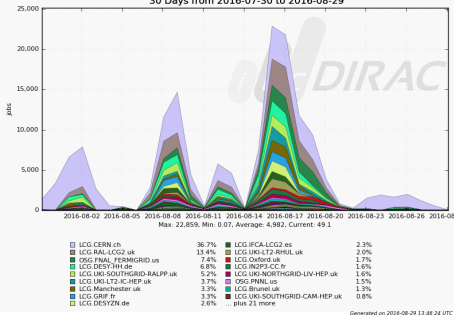
- More user jobs than production jobs
- Had a few days of more than 20k jobs running last month

## Large amount of transferred data

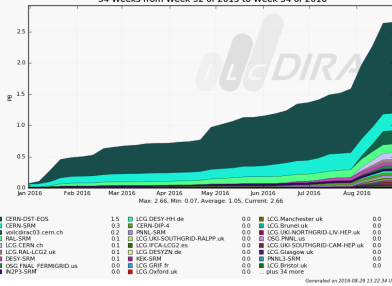
## Can always use more resources




Average Running Jobs Per Day  
30 Days from 2016-07-30 to 2016-08-29

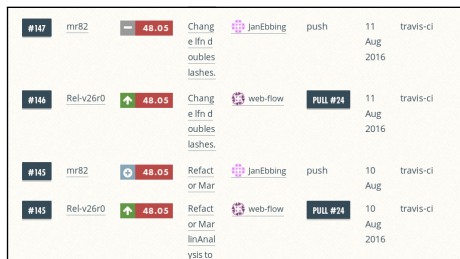


Transferred data by Destination  
34 Weeks from Week 52 of 2015 to Week 34 of 2016



- In the past, storage and file transfer was a major nuisance when running more than a few thousand jobs in parallel
- The EOS based storage element so far has handled our load of up to 20 thousand jobs
- Space is limited As EOS is disk only
- Have to move files ourselves to Castor tape system
  - ▶ Improved production system for data manipulations in latest DIRAC version
  - ▶ Been moving all REC files as soon as they are written to EOS
  - ▶ Need to move GEN/SIM files once they were used in production jobs to Castor as well
- Additional large ( $\sim 50\text{TB}$ ) XR00T based storage elements would be nice

- Updated to latest DIRAC production release (v6r15)
- Technical Student, Jan Ebbing, working on increased test coverage of the iLCDirac software
  - ▶ Covering 48% of iLCDirac code  

  - ▶ Better maintainability and extensibility
  - ▶ Avoid breaking existing functionality by defining expected behaviour through tests



#147	mr82	48.05	Change ifn d oubles lashes.	JanEbbing	push	11 Aug 2016	travis-ci
#146	Rel-v26r0	48.05	Change ifn d oubles lashes.	web-flow	PULL #24	11 Aug 2016	travis-ci
#145	mr82	48.05	Refact or Mar	JanEbbing	push	10 Aug	travis-ci
#145	Rel-v26r0	48.05	Refact or Mar linAnal ysis to	web-flow	PULL #24	10 Aug 2016	travis-ci

<https://coveralls.io/github/LCDsoft/iLCDIRAC>



- Small scale tests with ddsim in the production system already succeeded
- Create interfaces and Workflow Modules for WHIZARD2 once it is validated
- Update scripts and classes to create productions
- Potential synergy with other DIRAC users: LHCb, CTA, and Belle

Please remember this, and also remind your supervisees or colleagues

■ If case of fire:

- 1 [twiki.cern.ch/twiki/bin/view/CLIC/DiracForUsers](http://twiki.cern.ch/twiki/bin/view/CLIC/DiracForUsers)
- 2 Consult documentation:  
<http://lcd-data.web.cern.ch/lcd-data/doc/ilcdiracdoc/>
- 3 Before submitting a ticket, see: [https://twiki.cern.ch/twiki/bin/view/CLIC/DiracUsage#Error\\_report\\_support\\_request](https://twiki.cern.ch/twiki/bin/view/CLIC/DiracUsage#Error_report_support_request)
  - ★ Submit a ticket to the issue tracker  
<https://its.cern.ch/jira/browse/ILCDIRAC>
  - ★ Or send an email: [ilcdirac-support@cern.ch](mailto:ilcdirac-support@cern.ch)

Please remember this, and also remind your supervisees and colleagues



# Section 6:



## 6 Software Infrastructure

- Using more recent compiler (gcc 4.8/4.9), c++11
- Up-to-date and supported ROOT: 6.06
- Geant4 10.2
- Looking into moving iLCSoft to git(hub)
  - ▶ Code review, continuous integration, ...
  - ▶ easier to contribute, e.g., expecting some contributions from FCC to DD4hep



- CLICdp CVMFS: `/cvmfs/clicdp.cern.ch`
  - Replacement for software distributed via CERN AFS
- Git repository `https://gitlab.cern.ch/CLICdp`
  - replacing CERN SVN
  - Git tutorial: `https://indico.cern.ch/event/562188/`

# Section 7:



## 7 Conclusions

# Conclusions



- Finalising track reconstruction and detector models
- Start looking more closely at jet energy reconstruction
- Start with larger scale testing

# Thanks



Thanks to everyone for the hard work on  
DD4hep, Detector Models, Simulation, Reconstruction, (iLC)Dirac