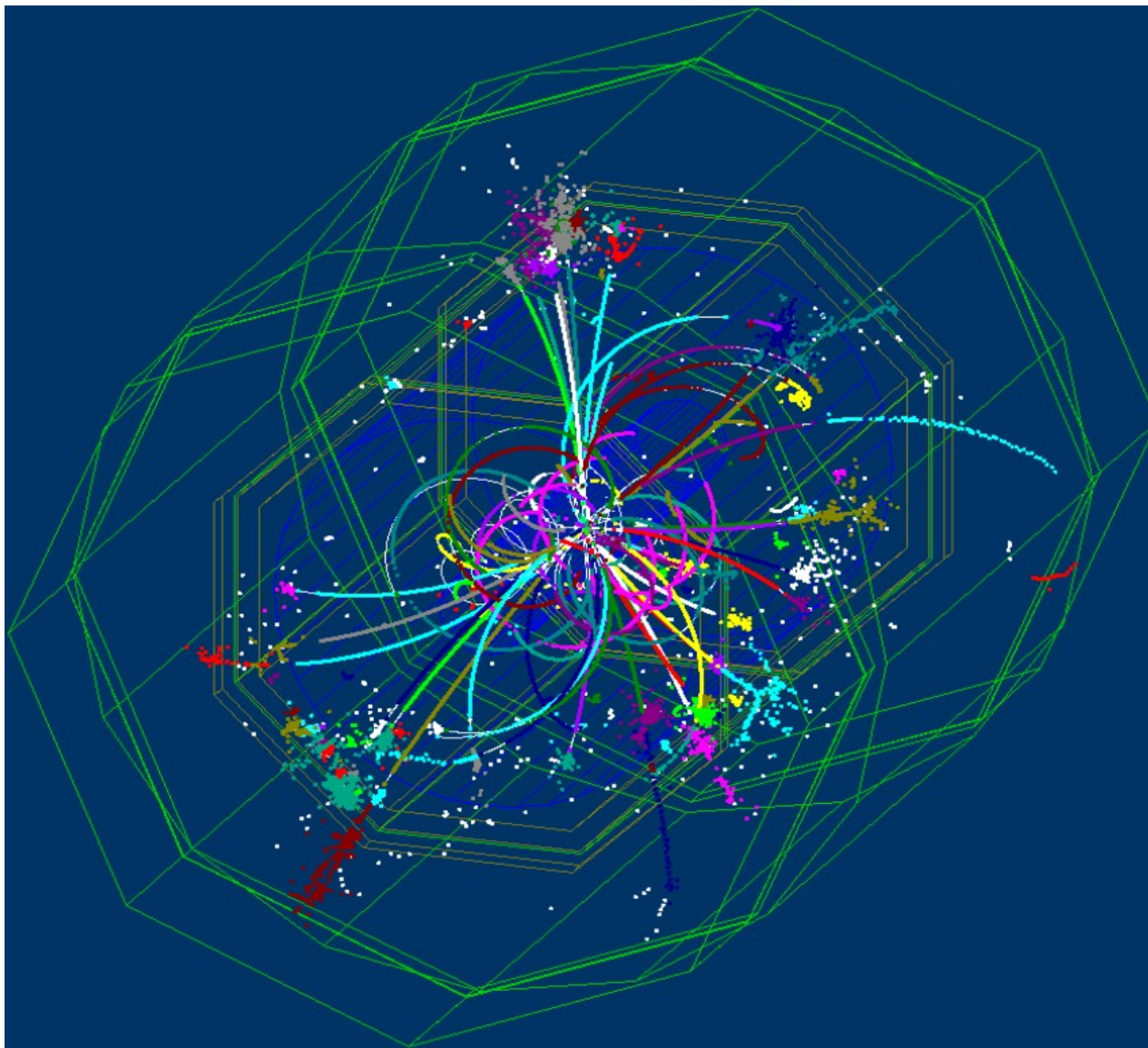
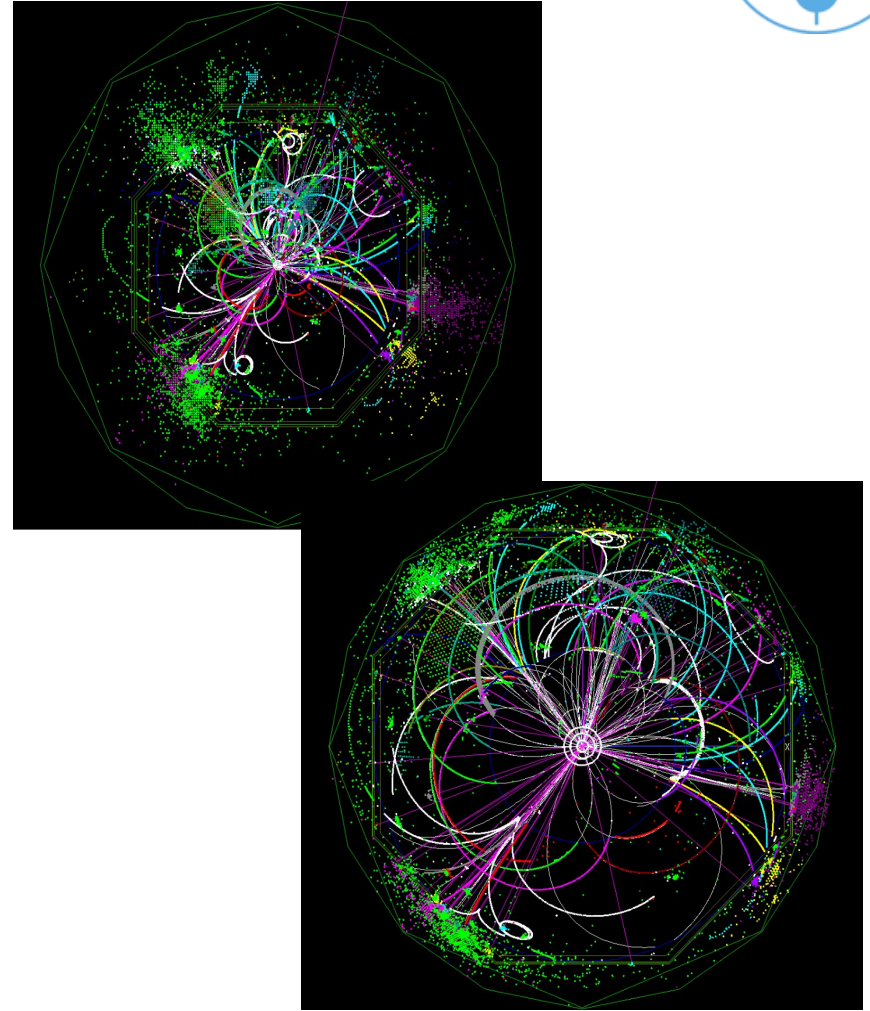

Recent developments in CED

Jan Engels

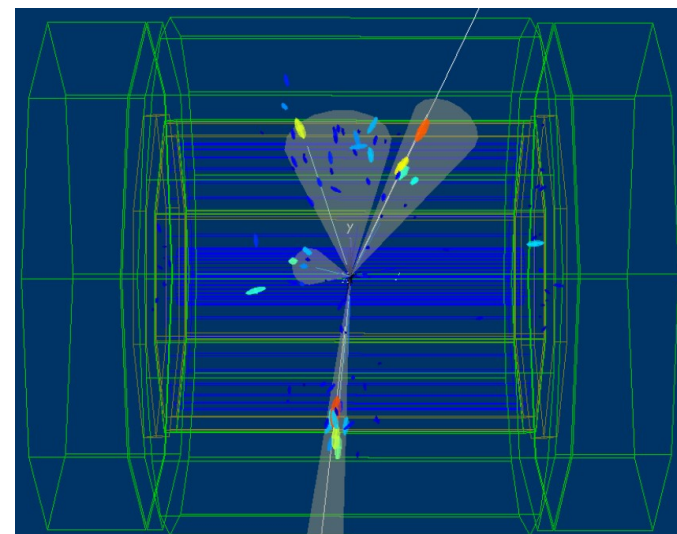
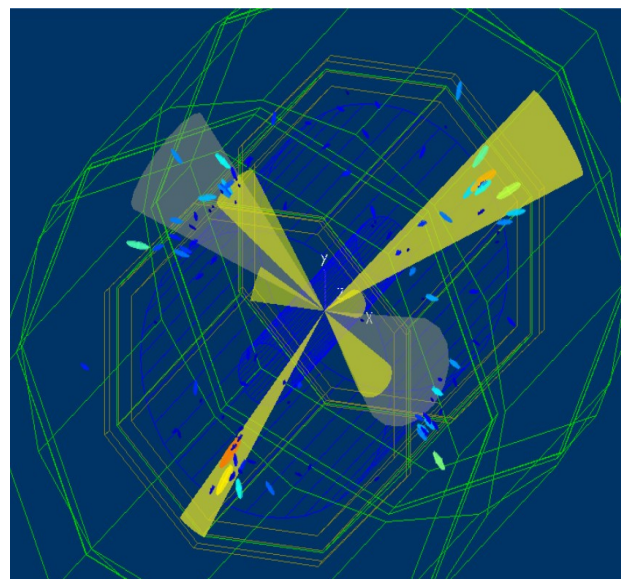
ILD Software and Integration Workshop 2010
Desy, 6th July 2010



- Originally developed by Alexey Zhelezov
- Based on GLUT/OpenGL
 - <http://freeglut.sourceforge.net>
 - <http://www.opengl.org>
- Follows a Client-Server Model:
 - **CED Server** (glced) (requires GLUT)
 - **CED Client Library** (ced_cli.h/libCED.so)
- An interface for Marlin is already available:
 - **MarlinCED** (lives inside MarlinUtil)
- Nice features:
 - **Lightweight and extremely fast!!**
 - real time 3D rotation and zoom in
 - easy to extend
 - fisheye view (S. M. Haugh: www.desy.de/f/students/2009/reports/martin-Haugh.pdf)



- Can display:
 - MC particles
 - Simulated and reconstructed hits
 - Reconstructed tracks and clusters
 - Jets
 - Detector geometry based on GEAR
- Marlin Processors available:
 - CEDViewer
 - GenericViewer
 - DSTViewer (S. Daraszewicz)
 - www.desy.de/f/students/2008/reports/daraszewicz.pdf
 - **Users can quickly write their own viewing processor!**
- To build CED use **cmake** (www.cmake.org):
 - cd path/to/CED
 - mkdir build
 - cd build
 - cmake [-DCED_SERVER=ON] ..





- Enabled picking (double-click on objects)
- Mouse-wheel zooming
- Command line option to set background color (-bgcolor)
- Support for filled boxes (calice)
- Background color toggle pressing the "b" key
 - light-blue, black, gray shades, white
- Bug fix: crash when drawing more than ~350.000 hits

Picking (Snapshot)



The screenshot displays a Linux desktop environment with two windows open. The terminal window on the left shows the output of a simulation, including a 'Picking' operation for a hit. The CED window on the right shows a visualization of the detector hits, with a central hit highlighted in purple and labeled 'Z'.

```
5095, -0.213274
[ MESSAGE "MyGenericViewer"] PathLength          3.01e-01
Picking: HIT 34513
[ MESSAGE "MyGenericViewer"] ----- SimTrackerHit -----
[ MESSAGE "MyGenericViewer"] CellID              0xffffffffb
[ MESSAGE "MyGenericViewer"] Position [mm] (x,y,z)    -140.682, -171.377, -1447.33
[ MESSAGE "MyGenericViewer"] dE/dx [GeV]             2.07e-03
[ MESSAGE "MyGenericViewer"] Time [ns]              2.50e+02
[ MESSAGE "MyGenericViewer"] PDG of MCParticle      13
[ MESSAGE "MyGenericViewer"] Momentum [GeV] (x,y,z) [not verified] -140.682, -171.377, -1447.33-275.57, -378.717,
-28.6102
[ MESSAGE "MyGenericViewer"] PathLength          8.24e+00
Picking: HIT 44496
[ MESSAGE "MyGenericViewer"] ----- Track -----
[ MESSAGE "MyGenericViewer"] Id                0000add0
[ MESSAGE "MyGenericViewer"] Type              -2147483648
[ MESSAGE "MyGenericViewer"] D0                +3.58e+01
[ MESSAGE "MyGenericViewer"] Phi               +3.63e+00
[ MESSAGE "MyGenericViewer"] Omega             -2.25e-03
[ MESSAGE "MyGenericViewer"] Z0               -3.61e+01
[ MESSAGE "MyGenericViewer"] Tan Lambda       -8.33e-02
[ MESSAGE "MyGenericViewer"] ReferencePoint    16.7508, -31.6922, -36.1229
[ MESSAGE "MyGenericViewer"] dEdx              +0.00e+00
[ MESSAGE "MyGenericViewer"] dEdx Error        +0.00e+00
[ MESSAGE "MyGenericViewer"] Chi2              +1.47e+00
[ MESSAGE "MyGenericViewer"] Errors:           +1.54e+00, -6.13e-03, +2.46e-05, +7.22e-07, -1.13e-10
[ MESSAGE "MyGenericViewer"]                   +2.78e-11, -4.46e-03, -1.63e-04, -1.81e-06, +1.83e+00
[ MESSAGE "MyGenericViewer"]                   -2.13e-04, +1.70e-06, +8.40e-09, -8.59e-03, +0.00e+00
[ MESSAGE "MyGenericViewer"] Tracks(id):      +78630
[ MESSAGE "MyGenericViewer"] Hits:            [330] [478] [624] [769] [915] [1060] [1204]
[ MESSAGE "MyGenericViewer"]                   [1346] [1487] [1628] [1765] [1901] [2037] [2172]
[ MESSAGE "MyGenericViewer"]                   [2307] [2443] [2579] [2715] [2850] [2985] [3119]
[ MESSAGE "MyGenericViewer"]                   [3253] [3387] [3515] [3646] [3778] [3910] [4042]
[ MESSAGE "MyGenericViewer"]                   [4169] [4318] [4465] [4615] [4764] [4916] [5067]
[ MESSAGE "MyGenericViewer"]                   [5215] [5365] [5513] [5659] [5805] [5950] [6094]
[ MESSAGE "MyGenericViewer"]                   [6235] [6374] [6510] [6644] [6779] [6916] [7036]
[ MESSAGE "MyGenericViewer"]                   [7146] [7254] [7360] [7467] [7573] [7679] [7784]
[ MESSAGE "MyGenericViewer"]                   [7889] [7994] [8097] [8200] [8303] [8405] [8508]
[ MESSAGE "MyGenericViewer"]                   [8611] [8714] [8817] [8921] [9025] [9129] [9233]
[ MESSAGE "MyGenericViewer"]                   [9337] [9441] [9545] [9647] [9747] [9845] [9942]
[ MESSAGE "MyGenericViewer"]                   [10038] [10135] [10229] [10323] [10417] [10510] [10603]
[ MESSAGE "MyGenericViewer"]                   [10696] [10789] [34693]
[ MESSAGE "MyGenericViewer"] Radius of innermost hit 2.22e+02 / mm , subdetector Hit numbers :
[ MESSAGE "MyGenericViewer"]                   0, 1, 0, 86, 0, 0, 0, 1, 0, 86, 0, 0
```



- Summary:
 - CED is a fast, easy to extend, ilcsoft supported event display toolkit
 - It already provides some generic functionality (as a toolkit)
 - Generic event display processors are available in Marlin
 - For very specific functionality you may need to write your own Marlin plugin

- Outlook:
 - More user-friendly point-and-click interface for basic functionality:
 - show/hide tracks, sim/rec hits, mc particles ...
 - Currently only available with key-shortcuts
 - Register user-defined labels for layers

- CED Download:
 - http://ilcsoft.desy.de/portal/software_packages/ced