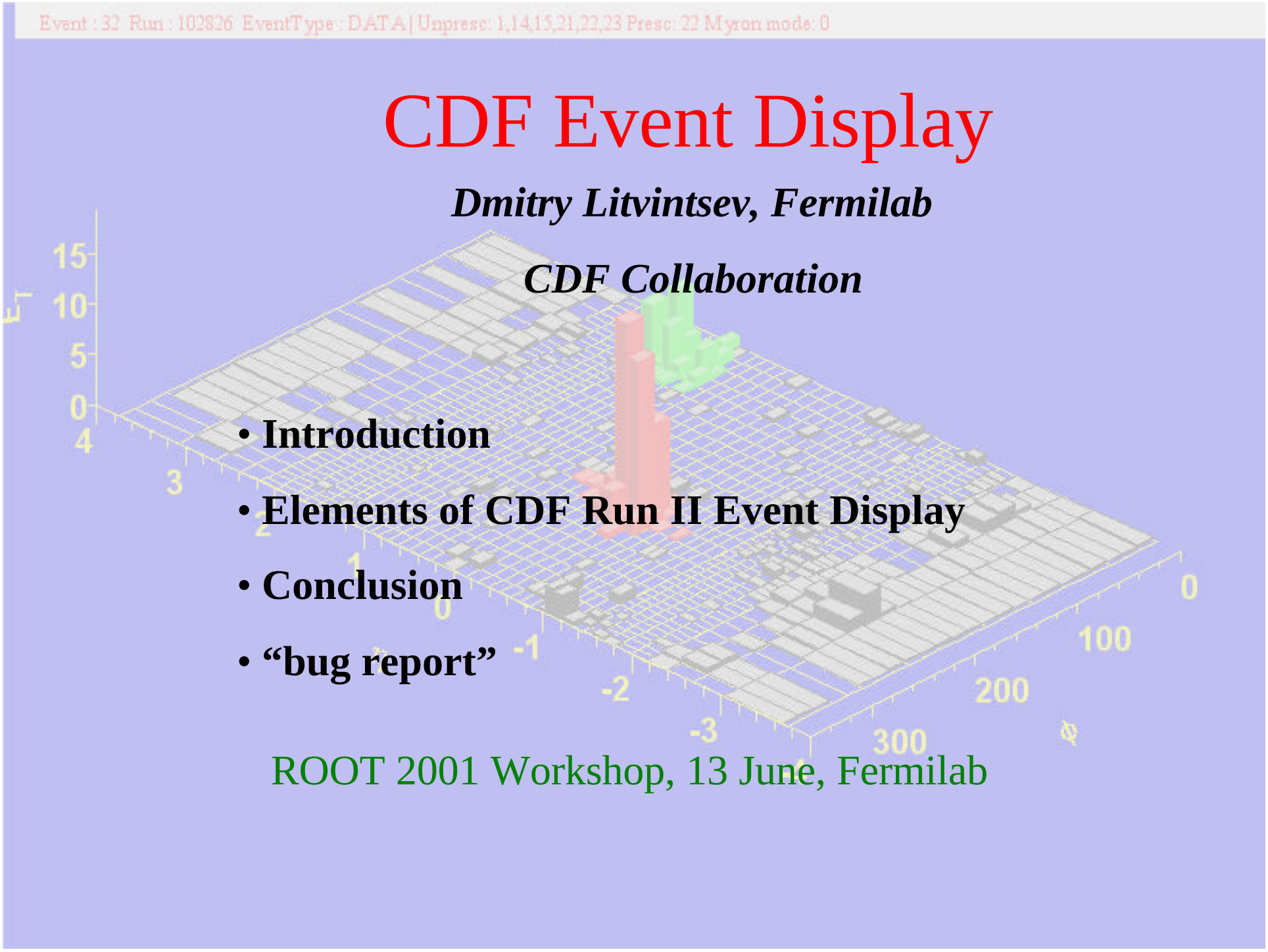


CDF Event Display

Dmitry Litvintsev, Fermilab

CDF Collaboration

- **Introduction**
- **Elements of CDF Run II Event Display**
- **Conclusion**
- **“bug report”**

ROOT 2001 Workshop, 13 June, Fermilab

Why Display Events?

- Final physics results are based on statistical analysis of *many* events. Standard forms of presentation are histograms, graphs and tables
- Human perception is based predominantly on visual input. Thus displays of *single* events are very efficient for:
  - Fast checking of validity of reconstruction/analysis or simulation algorithms
  - Public presentations
  - Graphical representation of detector states during on-line session helps to understand and react quickly to emergencies

Introduction

- Three kinds of objects:

  Real Objects, Graphical Objects and Views
  - Physics objects produced by reconstruction program as well as detector components are Real Objects
  - Real Objects are mapped to their graphical representations – Graphical Objects. These are usually derived from TObject
  - Views are different ways of visualization of sets of Graphical Objects. Typically a window with defined way of displaying Graphical Objects
- Operations: Any action made in ED. Usually performed using GUI interface. For example change of visual properties of graphical Objects

Components of CDF ED

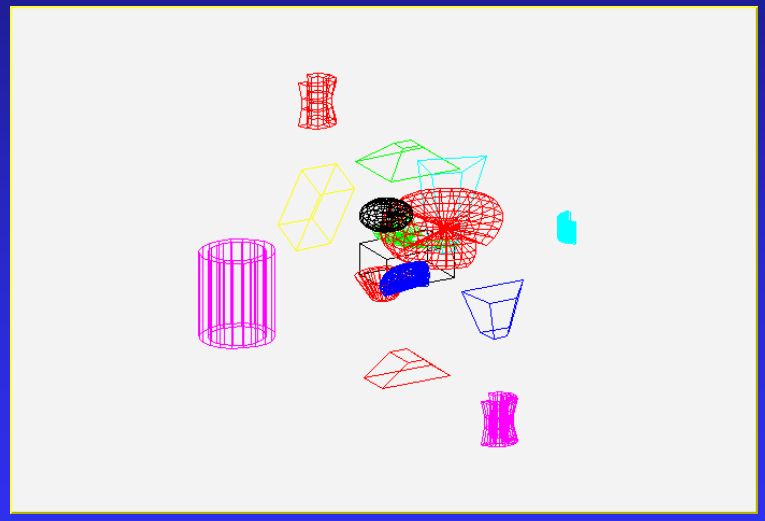
- Improvements of ROOT 3D Graphics in Canvas
- Windows
- Sliders
- Views or specific Displays

Improvements of ROOT 3D graphics

- Graphics objects are build using ROOT 2D and 3D primitives
- ROOT has no option of solid surface drawing of 3D primitives in canvas. This is a disadvantage since wireframed representations of complex geometries is extremely hard to comprehend
- Primitive *hidden line removal algorithm* has been developed within CDF Event Display package - RootEventDisplay. Primarily intended for LEGO h - f calorimeter plot. All shapes except TSPHE, TCONS, TTUBS are supported

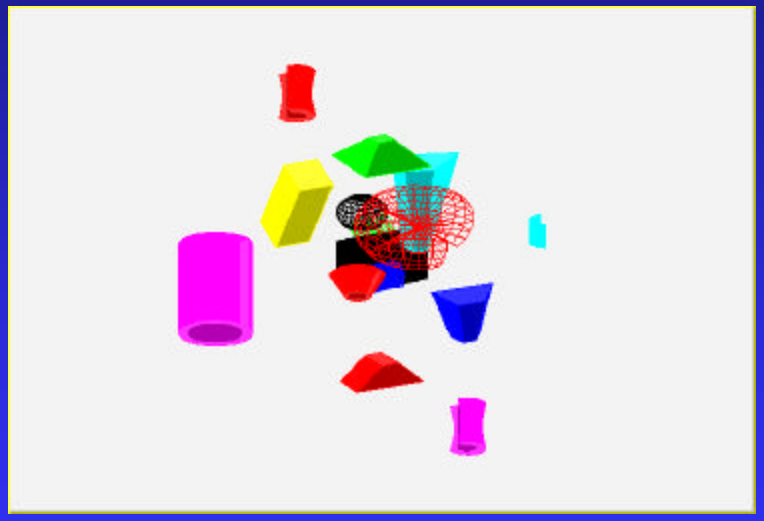
Improvements of ROOT 3D Graphics

Standard Shapes



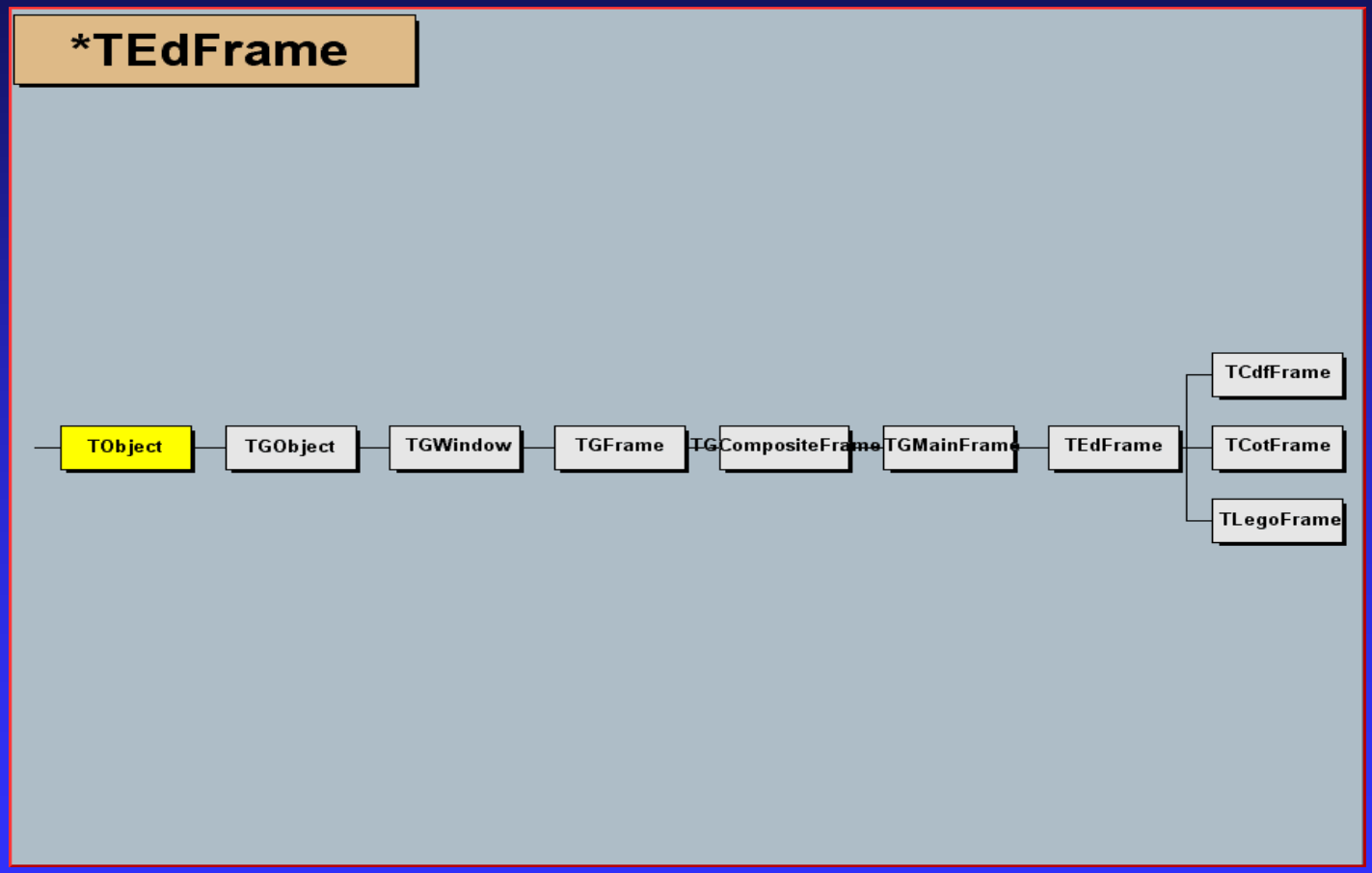
root[] .x shapes.C

TEd* Shapes

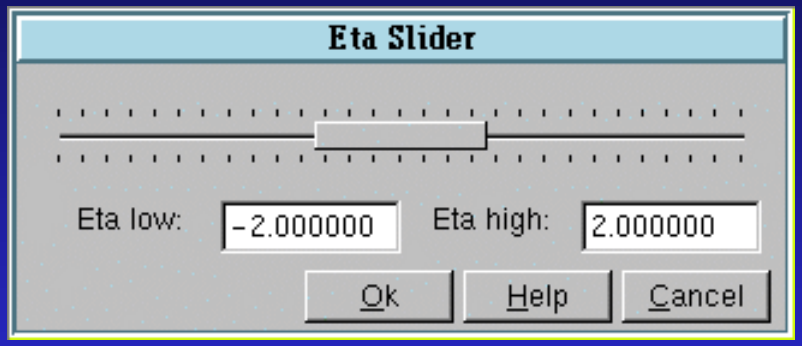


root[ ] .L libRootEventDisplayGraf.so
root[1] .x edshapes.C

Windows

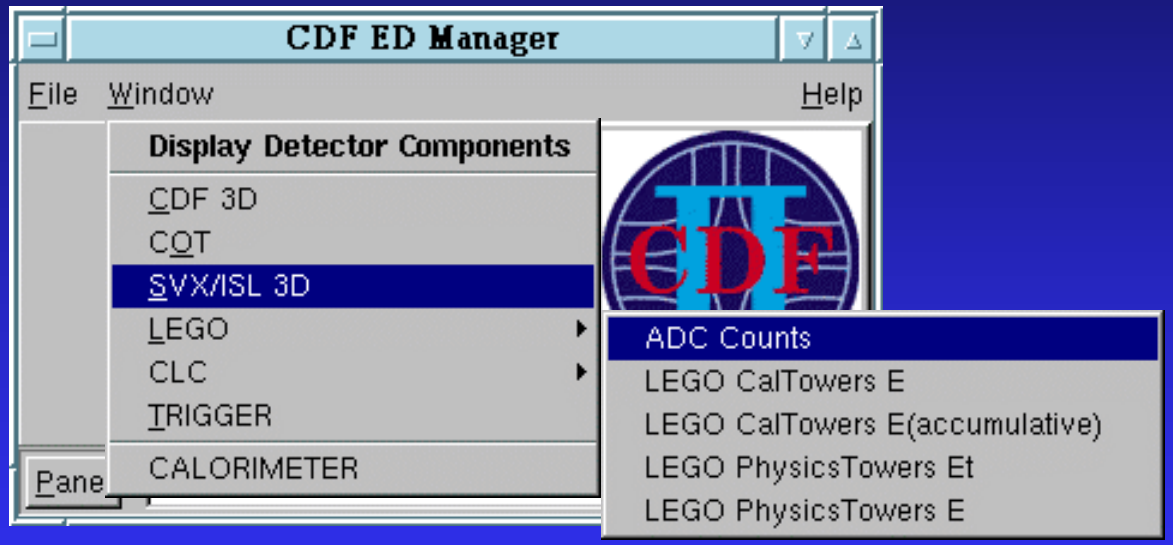

*TEdFrame
TObject
TGObject
TGWindow
TGFrame
TGCompositeFrame
TGMainFrame
TEdFrame
TCdfFrame
TCotFrame
TLegoFrame

Sliders


Eta Slider
Eta low:
-2.000000
Eta high:
2.000000
Ok
Help
Cancel


Et Slider
Et low:
5.632500
Ok
Help
Cancel

TEdManager


CDF ED Manager
File
Window
Help
Display Detector Components
CDF 3D
COT
SVX/ISL 3D
LEGO
CLC
TRIGGER
CALORIMETER
Pane
CDF
ADC Counts
LEGO CalTowers E
LEGO CalTowers E(accumulative)
LEGO PhysicsTowers Et
LEGO PhysicsTowers E

TCotDisplay

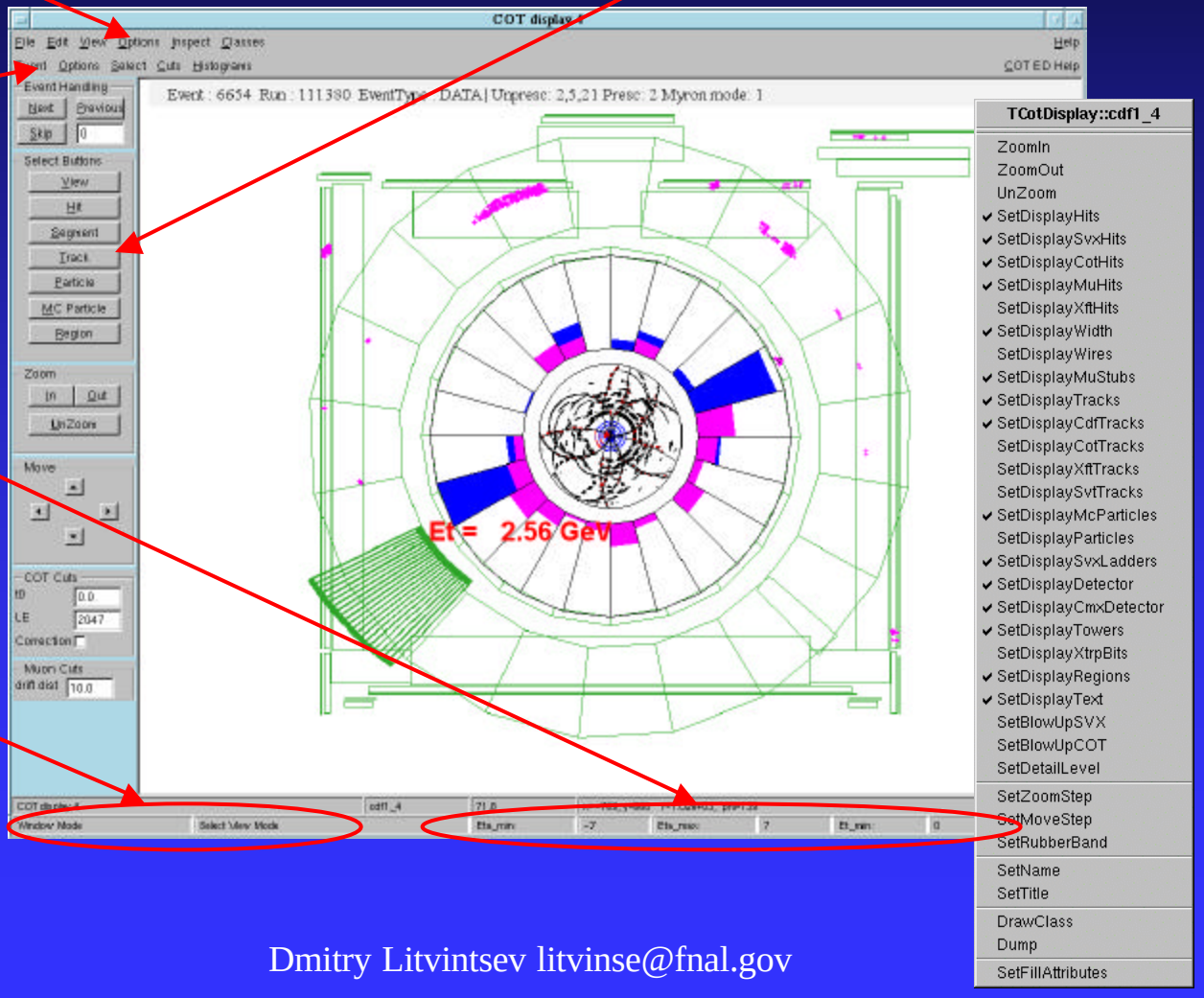
ROOT native Menu Bar

Select Mode Buttons

COT Menu Bar

Current values of Cuts

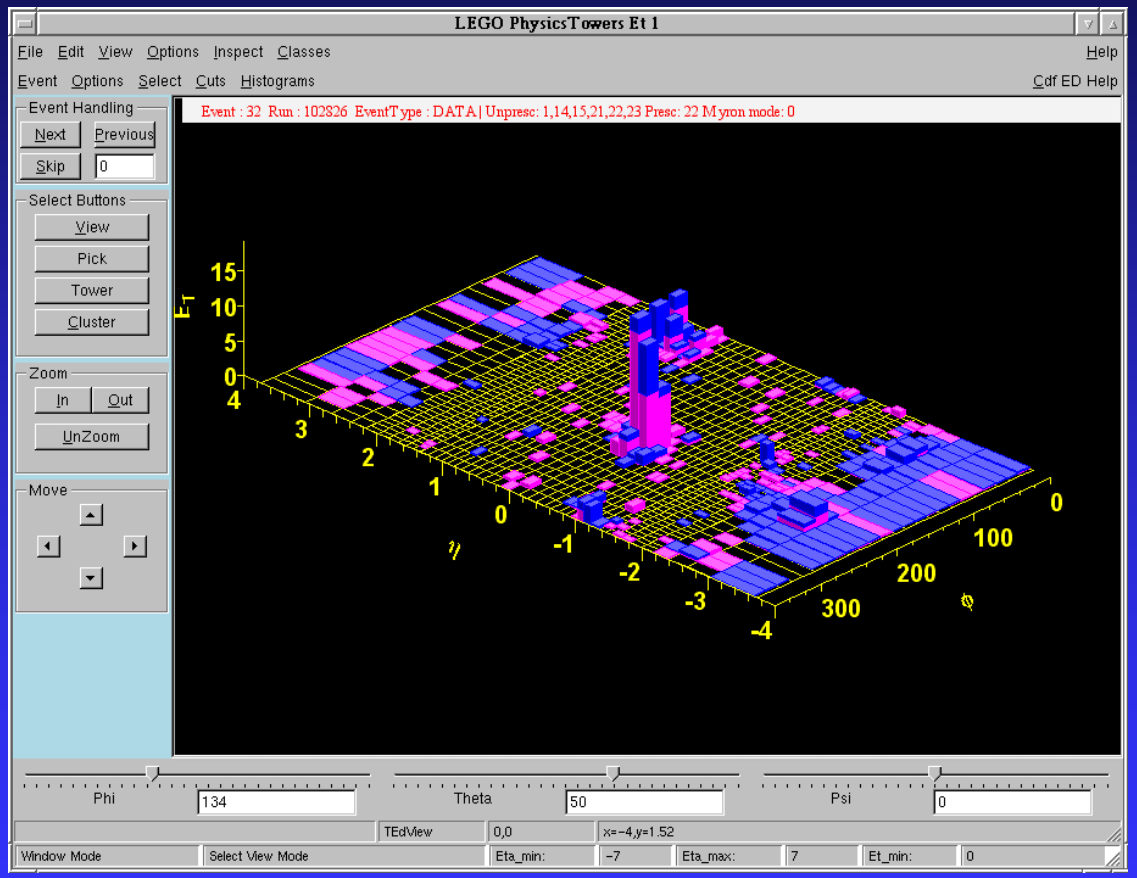
Window Status



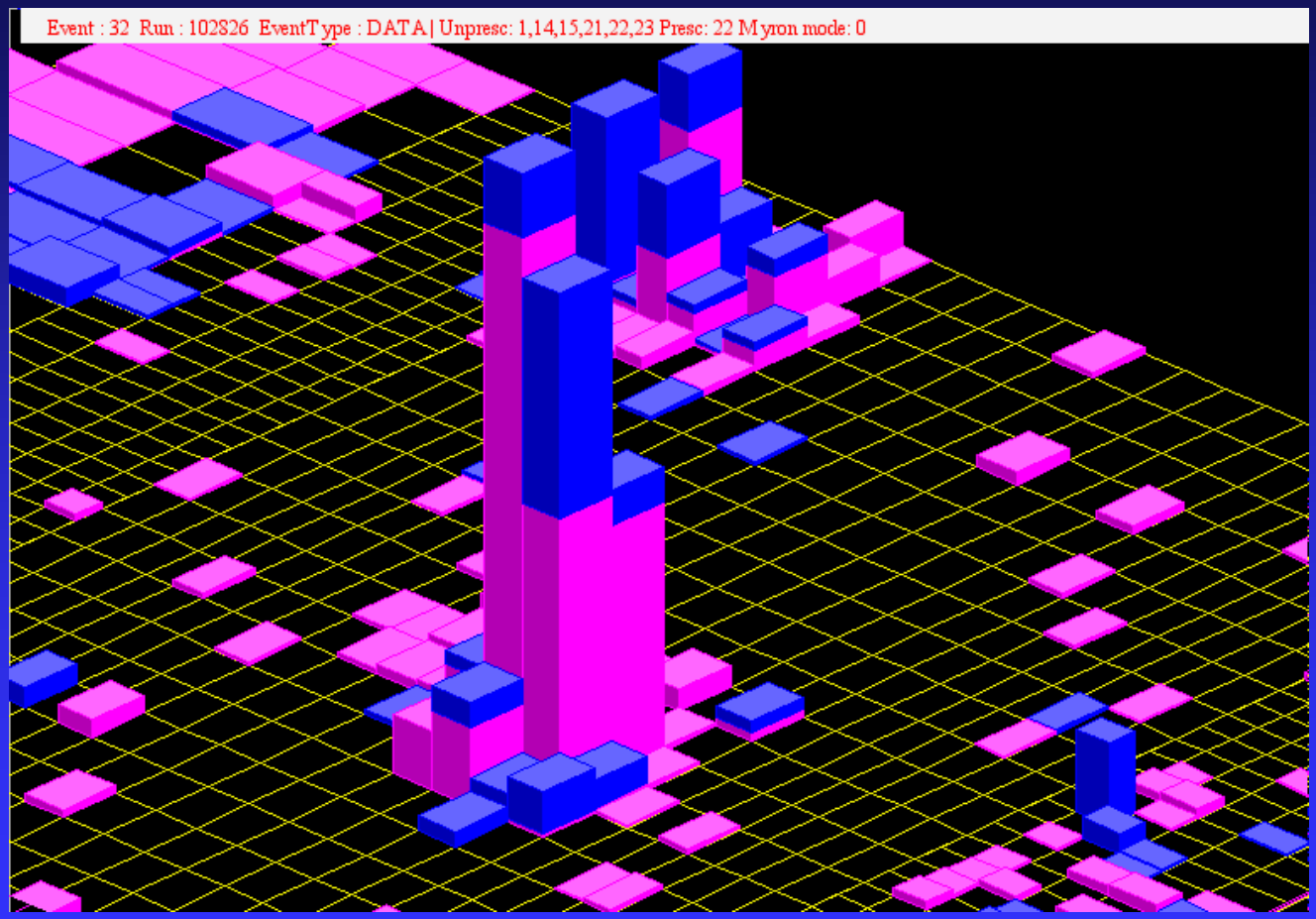
Window Properties

- Windows are synchronized. Change of visual properties of graphics objects in one window propagates into others. Same is true for cuts imposed from ED.
- If resized Windows preserve their original aspect ratio – prevent cirlces from turning into ellipses
- ZoomStep MoveStep can be modified
- Each action provided by ED can be performed in the variety of ways:
  - ✓ Using Context Menu
  - ✓ Using Pop Up menu of the Menu Bar
  - ✓ Using keyboard. E.g. zooming and translations can be performed by pushing Z/z, +/-, or using arrow keys
  - ✓ Explicitly typing desired command, e.g. `gDisplay->ZoomIn();`
  - ✓ Mouse action (Zooming, *Rubberband*)

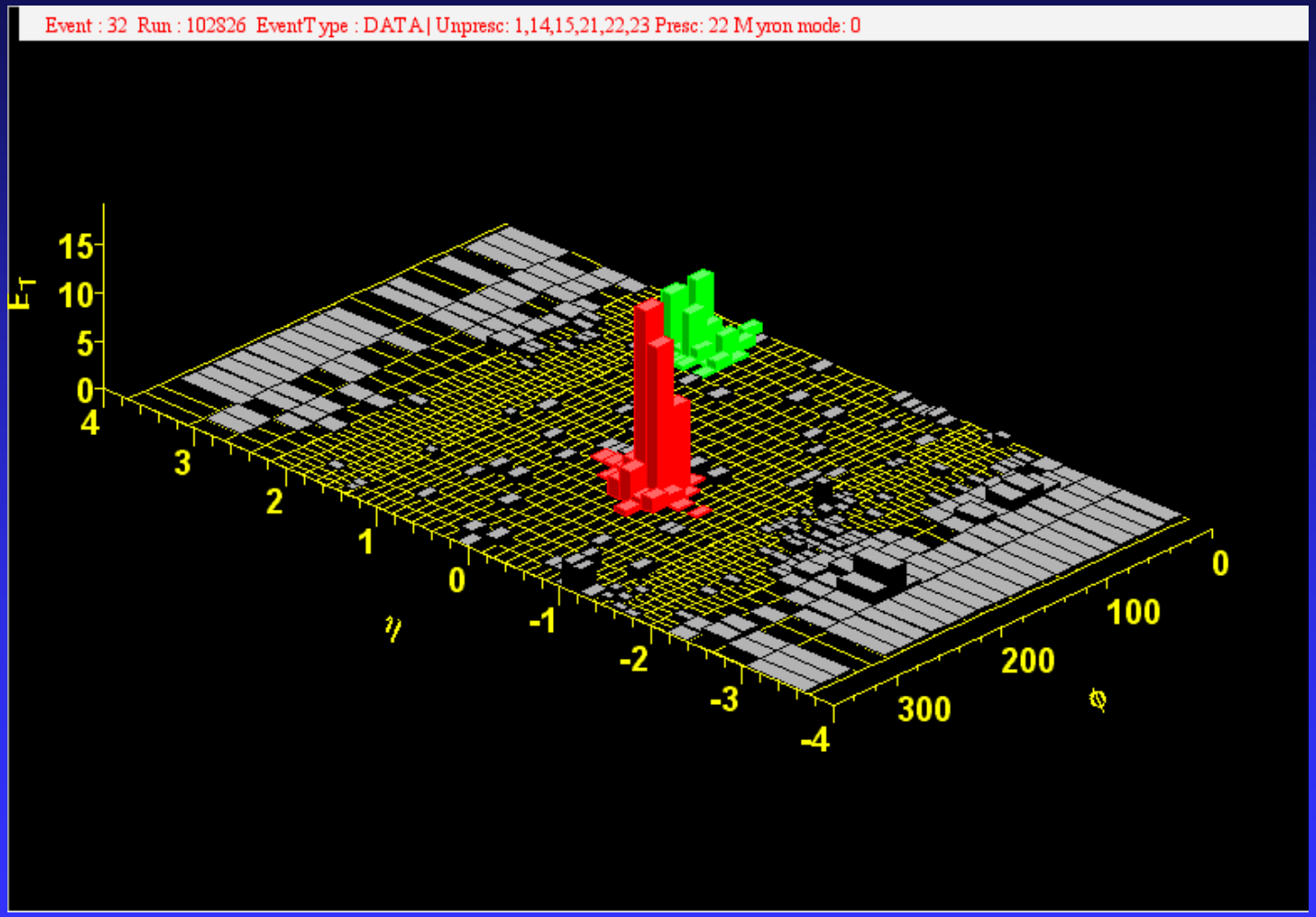
TLegoDisplay



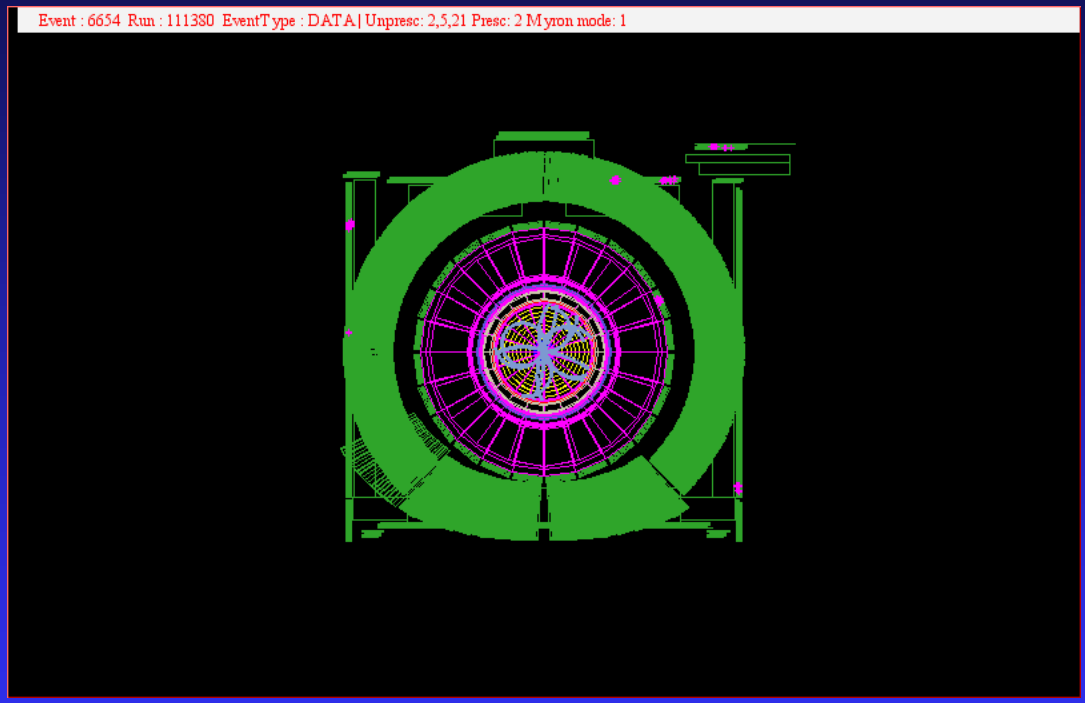
TLegoDisplay Zoom In



TLegoDisplay Jets

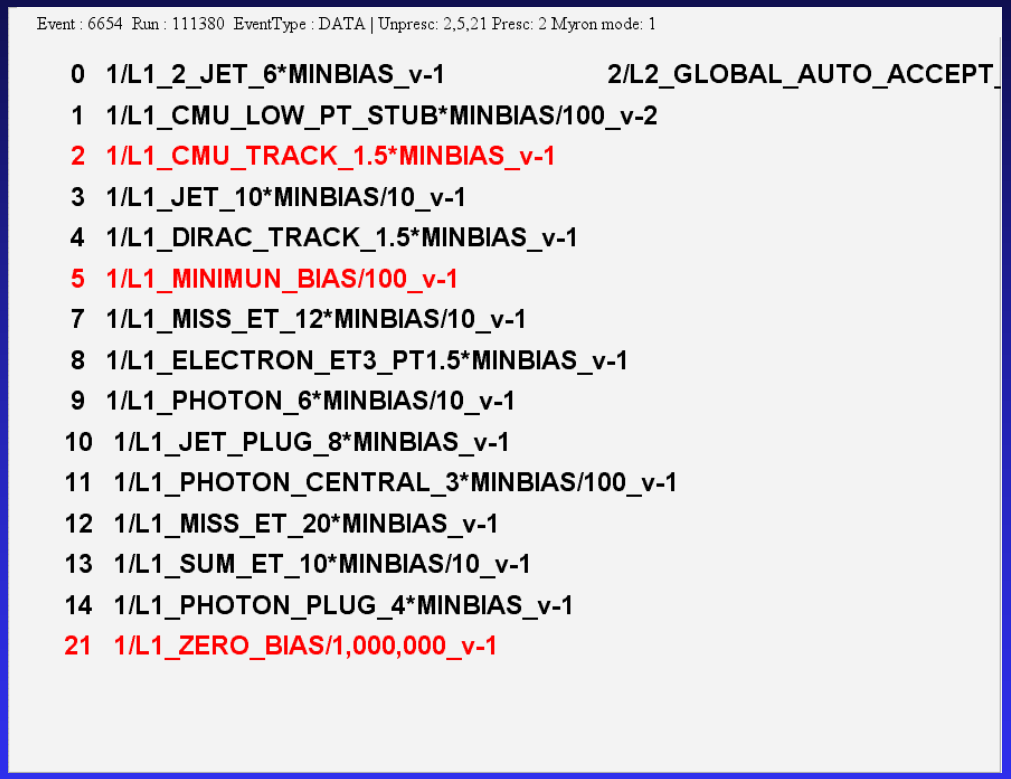


TCdfDisplay – 3D Geometry



CDF Geometry tree is automatically converted to ROOT TGeometry using CDF Geometry Browser developed by Joe Boudreau and adopted for RootEventDisplay package by Robert Harr

TTriggerDisplay



ED makes connection to Oracle trigger database and extracts the meaning of fired L1/L2 bits

Conclusions

- Choice or ROOT proven to be adequate for development of flexible Event Display for off-line and on-line use
- To be done:
  - In cooperation with detector and physics groups, continue to introduce graphical classes for objects available in CDF software
  - Implement R-Z view of CDF detector

Acknowledgement

It is a pleasure to thank people who contributed or continue to contribute to CDF Root Event Display project:

Jim Bellinger(UWM),
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Robert Harr (WSU),
Andrey Loginov (ITEP),
Pasha Murat (Fermilab),
Kurt Rinnert (IEKP)

Special Thanks to ROOT team and all the kind folks on the RootTalk

Miscellaneous

- CDF Event Display Code is available here:
  http://cdfcodebrowser.fnal.gov/CdfCode/source/RootEventDisplay/
- CDF Event Display Homepage:
  http://cdfcodebrowser.fnal.gov/CdfCode/source/RootEventDisplay/

“Bug Report” / requests

- Ability to open ROOT windows on several workstations
- Fix colors in X3D on 16 bits displays
- Fix OpenGL/X3D colors for color indices greater that 10
- Optionally preserve TCanvas’ Aspect ratio
- Improve OpenGL support – 3D text, object pick, change of transparency for individual object, etc.
- Do something with the speed of graphics in case of 8-bit display and open Netscape
- Improve documentation on ROOT GUI Classes. Can you add gif pictures of widgets to Classes and Members Reference Guide