ROOT Tutorial
Data Analysis software

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Outline

What is ROOT
   An Overview
   Why do we use ROOT?
   Caveats

Examples of what it does
   Histograms
   Histograms with Fits
   “Excel” plots

ROOT 101
   Set Up

Ready, Set, Go!
What is ROOT?
An Overview

- An open source, object orientated framework for handling large amounts of data in a very efficient way.
What is ROOT?
An Overview

- An open source, object orientated framework for handling large amounts of data in a very efficient way.
- What can you do with it?
  - Creates histograms in multiple dimensions
  - Draws functions
  - Fits functions to data
  - Takes in a data and performs calculations
What is ROOT?
Why do we use ROOT?

- It does the general analysis framework that we need
What is ROOT?
Why do we use ROOT?

- It does the general analysis framework that we need
- It... handle large amounts of data
- Works on any operating system
- Makes plots
- works on any operating system
- and it is FREE!!!
What is Root?

Caveats

- ROOT requires some knowledge of C++
- Not always the easiest or user friendly
- Documentation is not always there or leave a lot to be desired
- User interface is not what one may be use to, or the easiest to get around
What it does it do?

Histograms
What it does it do?

Histograms

Local Position on the MD bar for electrons that leave light in the MD bar

- Frequency
- Local Position on the MD bar (cm)

<table>
<thead>
<tr>
<th>h2_oct3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entries</td>
</tr>
<tr>
<td>Mean</td>
</tr>
<tr>
<td>RMS</td>
</tr>
</tbody>
</table>

Octant table
- Octant 1: Red
- Octant 2: Gray
- Octant 3: Blue
What does it do?

Histograms with fits
What does it do?
Histograms with fits

Corrected Far to Near Ratio with Oscillation Probability Fit

- Axis X: Neutrino Energy (GeV)
- Axis Y: Far to Near Ratio
"Excel" plots

Octants 1 and 5 - Q2 vs X beam position

<table>
<thead>
<tr>
<th></th>
<th>Octant 1</th>
<th>Octant 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\chi^2 / ndf$</td>
<td>12.96 / 7</td>
<td>15.99 / 7</td>
</tr>
<tr>
<td>Prob</td>
<td>0.07302</td>
<td>0.0252</td>
</tr>
<tr>
<td>$p_0$</td>
<td>25.1 ± 0.007553</td>
<td>25.1 ± 0.007604</td>
</tr>
<tr>
<td>$p_1$</td>
<td>-0.1251 ± 0.006738</td>
<td>0.1146 ± 0.006773</td>
</tr>
</tbody>
</table>

Octant table
- Octant 1
- Octant 5

X beam position (mm)
ROOT 101
Set Up

Open a Terminal Window

- Windows users: this will be through a program like Putty
- Mac and Linux users: find the Terminal program

Login

$ ssh -X RootTutorial@sporades.physics.wm.edu

Password

Rootisfun2013
See what is there
List the contents the home directory, via $ls$ command

[RootTutorial@sporades ~]$ ls
cplusplus_tutorial_files
cplusplus_tutorial_link.txt
cplusplus_tutorial_files.tar
root_tutorial_files
root_tutorial_files.tar
users
Create your directory

Create your own directory in the users directory

```
[RootTutorial@sporades ~]$ cd users
[RootTutorial@sporades users]$ ls
adorasmith dasalmon Henderson ...
an smith eahenderson hnguyen ...
cmkaramitsos Eahenderson itgordon ...
crhaufe eemikh janderson ...
[RootTutorial@sporades users]$ mkdir <yourWMusername>
[RootTutorial@sporades users]
```

This directory is only for you. Please don’t delete anything in someone else’s directory
Copy the ROOT tutorial files

[RootTutorial@sporades users]$ cd <yourWMusername>
[RootTutorial@sporades <yourWMusername>]$ mkdir root_tutorial_files
[RootTutorial@sporades <yourWMusername>]$ cp ~/root_tutorial_files/* ~/users/<yourWMusername>/root_tutorial_files/
Double Check
Make sure the files are there

```
[RootTutorial@sporades <yourWMusername>]$ cd root_tutorial_files/
[RootTutorial@sporades <yourWMusername>]$ ls
Analyze2009.C  Analyze.h  c1_n3.ps  ...
Analyze2009.h  AnalyzeHistogram.C  c1_n3.root  ...
Analyze.C  AnalyzeVariables.C  c1.ps  ...
  .  .  .  ...
  .  .  .  ...
  .  .  .  ...

If you feel the need to do the math you should have 74 files
Ready, Set, Go!

- Go into your `root_tutorial_files` and get started (you might be there)
- The first few pages of your tutorial book can be ignored - they are specific to a different location
Editor Options

text editors

- **nano**: a bare-bones text-based editors with basic syntax highlighting (after some effort). Exit by typing Ctrl-x
- **vi**: a text-based editor with a fairly steep learning curve. Exit by typing :q
- **emacs**: a graphical or text-based editors with a fairly steep learning curve. Exit by typing Ctrl-x, Ctrl-c
- **nedit**: a basic graphical editor with syntax highlighting (after some effort). Nedit runs smoothly over ssh connections.
- **kate**: a graphical editor with syntax highlighting. Kate supports opening files over ssh connections using the fish://server/path/to/file syntax.
Help??

Need help??

- Linux command, terminal navigation:
  http://files.fosswire.com/2007/08/fwunixref.pdf,
- ROOT website: http://root.cern.ch/drupal/
- Google: www.google.com