

Web based HEP Analysis powered by Ajax

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Outline

- Introduction
- Ajax development framework
- Ajax in HEP
- Example applications
 - SVT Histogram viewer in CDF
 - CMS Silicon Strip DQM Web Interface
- Summary & Outlook

What is Ajax

(term coined in Feb. 2005)

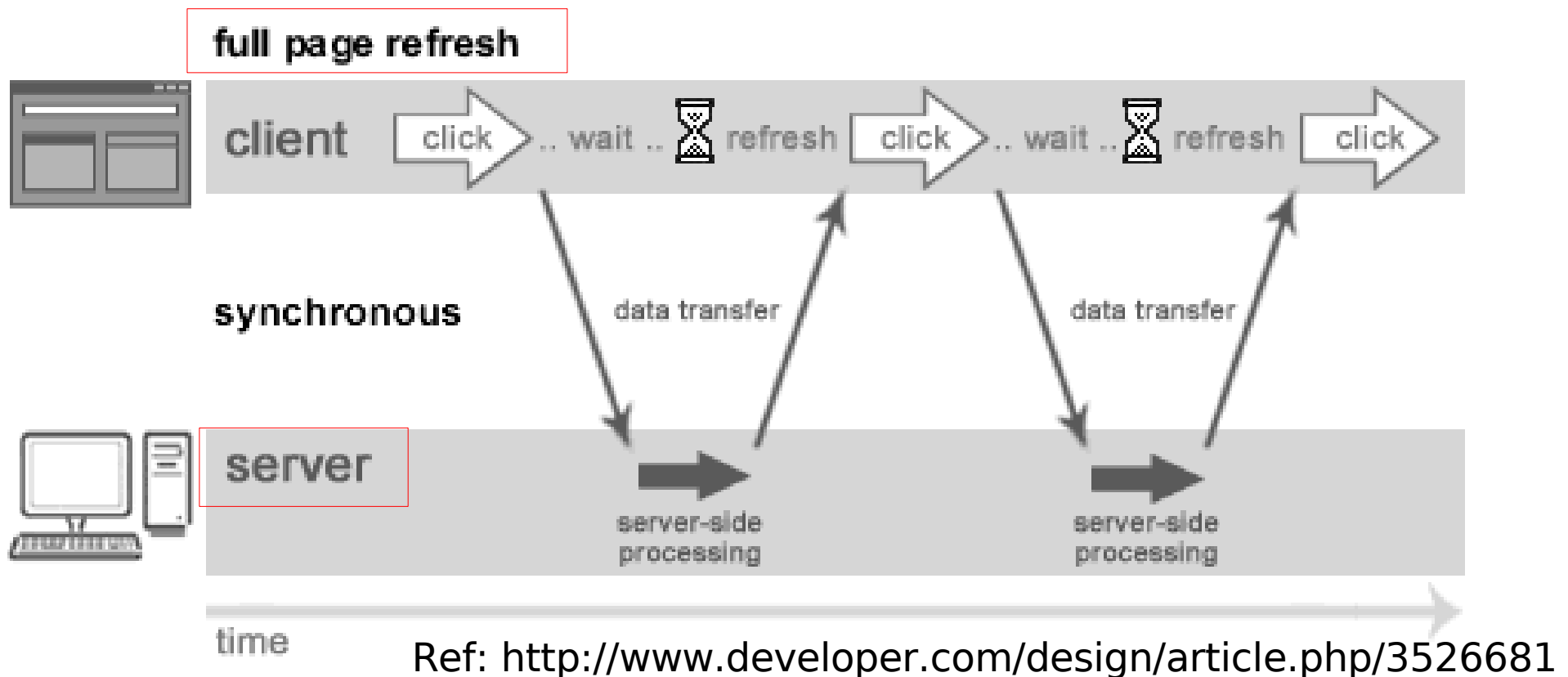
- Asynchronous Javascript and XML is an umbrella term for several matured, open source technologies that promotes reusable patterns for web-based development.

Ajax Features

- Ajax pattern based applications
 - are more **responsive** and natural than classical web apps
 - server and client sides have well defined responsibilities
 - have **look-and-feel** and **interactivity** of a native desktop application
 - use available **bandwidth** judiciously
 - avoid full page reload on each request
 - are not tied to a particular **programming language**, **data format** or **network object**

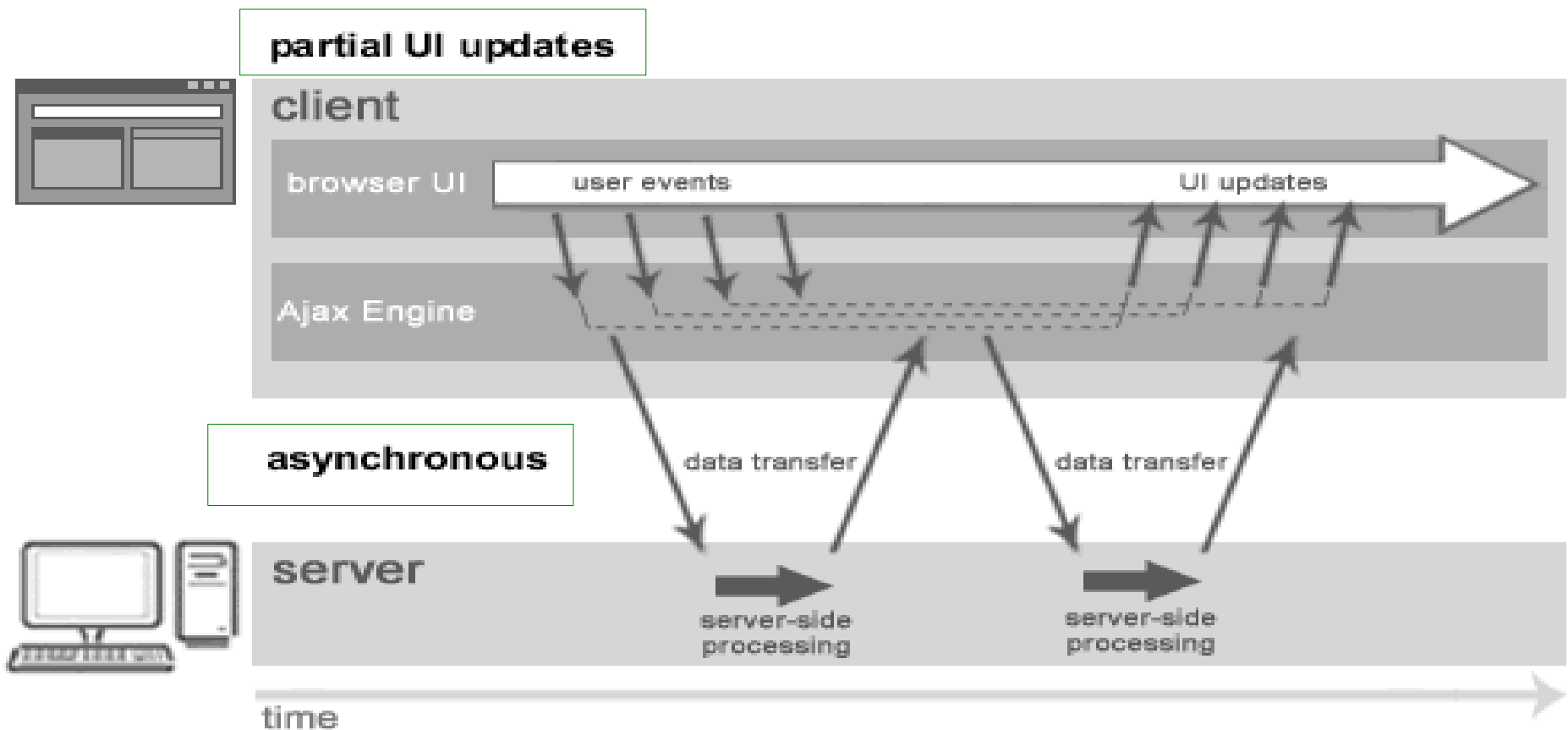
No need for client side installation beyond a browser

Traditional Web Application Model



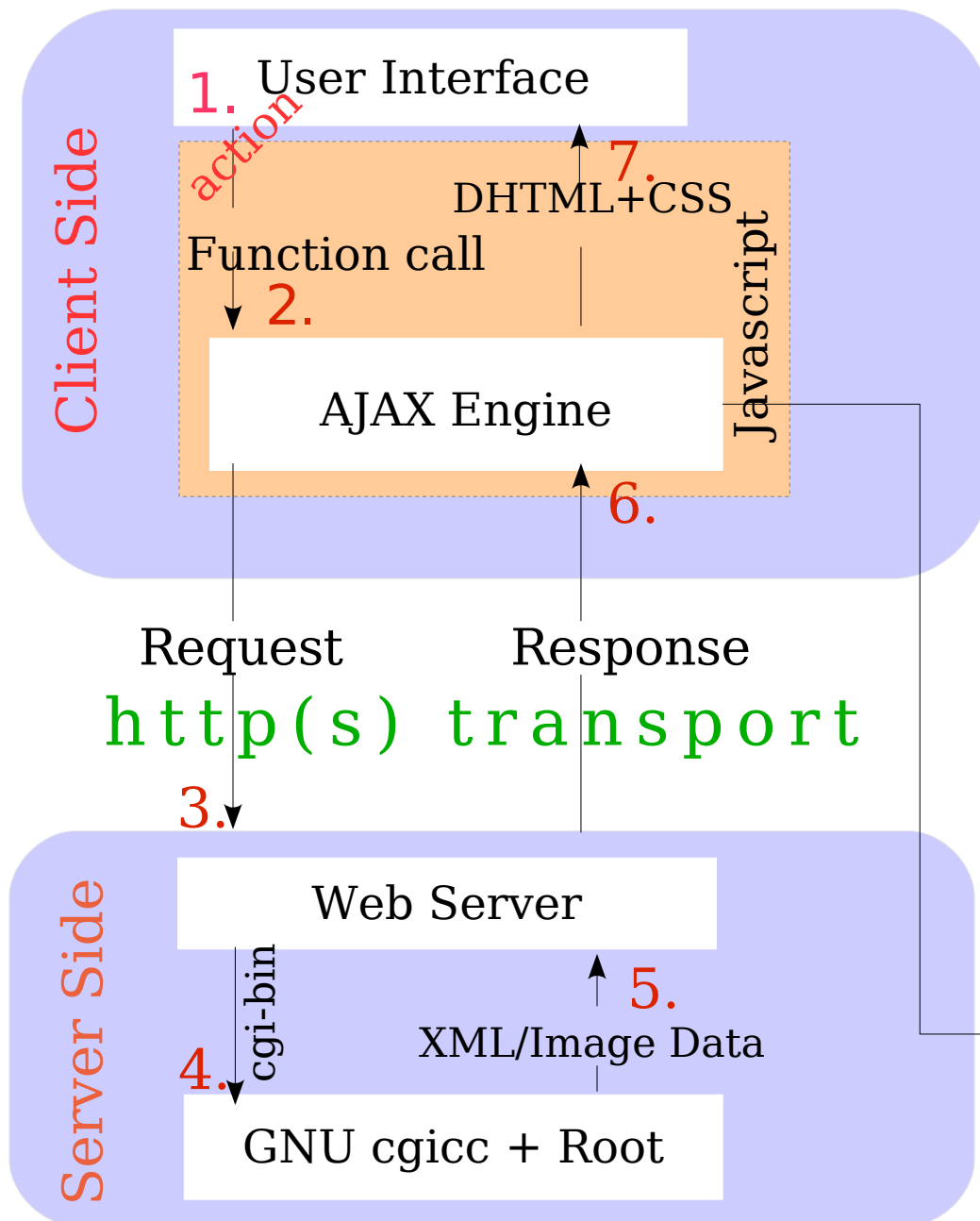
- request an **update of a page**
 - synchronous communication, blocks
 - server sends back the updated html, the browser does a full refresh
 - long dead time

Ajax Model



- request update for a **specific portion of a page**
 - asynchronous, does not block
 - server sends back specific data, only the relevant portion of the page updated, the rest stays untouched
 - significantly reduced dead-time

Ajax Model continued



Javascript takes center stage

- (a) the html page loaded only once
- (b) Javascript intercepts all subsequent Client-Server communication
- (c) the server side provides structured (XML, Text, JSON) and Image data as and when requested
- (d) Javascript updates the page programmatically
- (e) **Asynchronous** update key to responsiveness

XMLHttpRequest
Document Object Model (DOM)
eXtensible Markup Language (XML)
XSLT

XMLHttpRequest

- **Send request**

```
var request = null;
// form URL
var URL = 'https://www-cdfonline.fnal.gov/mon/ajax/viewer.html?'+ '&action=plot';
try {
    request.onreadystatechange = responseHandler;
    request.open('GET', URL, true); // Asynchronous
    request.send(null);
}
catch (err) {
    alert(err.message);
}
```

- **Handle response**

```
if (request.readyState == 4) {
    if (request.status == 200) {
        try {
            var response = request.responseXML;
            // var response = request.responseText;
            // var response = eval( '(' + request.responseText + ')' ); // JSON
        }
        catch (err) {
        }
    }
}
```


Ajax Development Framework

- Ajax inherits the weakness of Javascript
- Several development frameworks address the problem
 - **Prototype** (<http://www.prototypejs.org>) Javascript library forms the basis for many Ajax development frameworks
 - **Rico/OpenRico**
 - **Yahoo UI** (<http://developer.yahoo.com/yui>)
 - **Google Web Toolkit** (<http://code.google.com/webtoolkit>)
 - Ajax development with Java
 - **OpenLaszlo** (<http://www.openlaszlo.org>) web platform
 - Standard DHTML
 - Flash

Ajax in HEP

- First heard in a major conference in as early as February 2006

Interactive Web-based Analysis Clients using AJAX: with examples for CMS, ROOT and GEANT4

G. Eulisse, G. Alverson, S. Muzaffar, I. Osborne, L. Taylor, L. Tuura

CHEP 06

- presented
 - efficient web interface to the IGUANA event display
 - preliminary web interface to Data Quality Monitor plots

Event Display

Giulio Eulisse et. al
CHEP 06

G4 Visualization

Tree browser

- Event X
- + Hits ✓
- Tracks ✓
- + Low Momentum ✓
- High Momentum ✓
- + All ✓
- + Other Neutral X
- + Other Charged X
- + Gammas X
- + P0 X
- + P1 X
- + Muon X

3D Toolbar

3D Window

Event Toolbar

Panning and zooming controllers

Framework controller.

Tree browser with the full G4 description of CMS, as found in the old OSCAR simulation program

Live, navigable by mouse dragging 3D window. Does not require any plugin.

There was one error opening the page. For more information, choose Activity from the Window menu.



SVT Histogram Viewer

SVT Histogram Viewer

<https://www-cdfonline.fnal.gov/mon/ajax/viewer.html>

- The viewer works in offline and quasi-online mode
 - The SVT consumer saves updated histograms
 - at regular intervals
 - at the end of each run
- Implementation
 - Client side
 - HTML, CSS
 - Javascript components (tab, tree, tooltip etc.)
 - Javascript Ajax Engine and logic
 - Server side
 - Root
 - cgicc library

SVT Histogram Viewer

Run Number = 237311 Last Updated at = 2007/03/24 14:41:49

Final GB (GB_SPY_B) slot 19

Wedge

Barrel

Run: online Get Canvas List Consumer only

List View Tree View

- d vs phi (chi2<25) Final MRG sb MRG_OUT_SPY slot 11
- Wedge vs Barrel Final GB (GB_SPY_B) slot 19
- chi2 (All) Final GB (GB_SPY_B) slot 19
- d (ch2<=25 pt>2) Final GB (GB_SPY_B) slot 19
- phi Final GB (GB_SPY_B) slot 19
- curvature (All) Final GB (GB_SPY_B) slot 19
- d (chi2 <25) vs phi Final GB sb GB_SPY_B slot 19
- d (ch2<=25) barrel 00 with online beam corr.
- d (ch2<=25) barrel 01 with online beam corr.
- d (ch2<=25) barrel 02 with online beam corr.
- d (ch2<=25) barrel 03 with online beam corr.
- d (ch2<=25) barrel 04 with online beam corr.
- d (ch2<=25) barrel 05 with online beam corr.
- SVT processing time(us) FROM GB board

Options Fitting Macro

Toggle logy X Range: Force

Compare with run 237311

Multiple Plots rows: 2 cols: 2

Slideshow

Auto update

update Run List

find canvas name

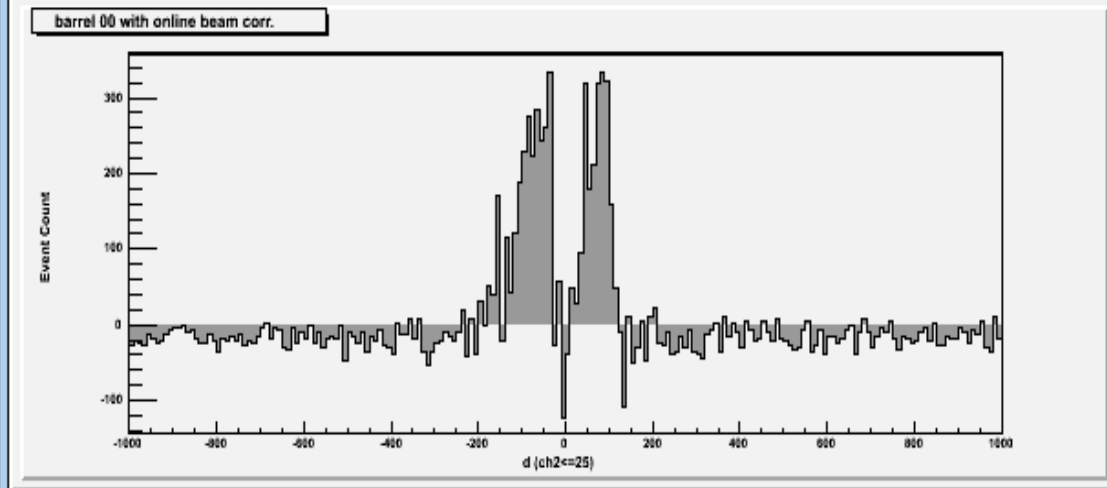
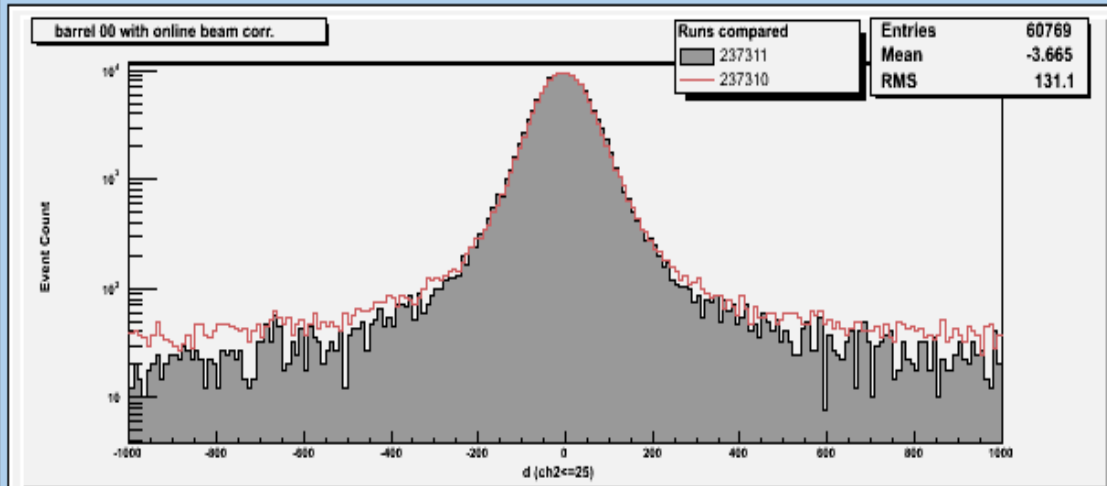
macro execution panel

slideshow control

- automatically updates the current plot every minute
- whenever the mouse enters the canvas area
- 'Auto update' can be toggled

Comparison

Drawing Canvas



Auto update

Get PDF

Drawing Controls

Run: **online** Consumer only

List View Tree View

d vs phi (chi2<25) Final MRG sb MRG_OUT_SPY slot 11
Wedge vs Barrel Final GB (GB_SPY_B) slot 19
chi2 (All) Final GB (GB_SPY_B) slot 19
d (ch2<=25 pt>2) Final GB (GB_SPY_B) slot 19
phi Final GB (GB_SPY_B) slot 19
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d (ch2<=25) barrel 04 with online beam corr.
d (ch2<=25) barrel 05 with online beam corr.
SVT processing time(us) FROM GB board

Options Fitting Macro

Toggle logy X Range: Force

Compare with run

237310

Multiple Plots

rows: cols:

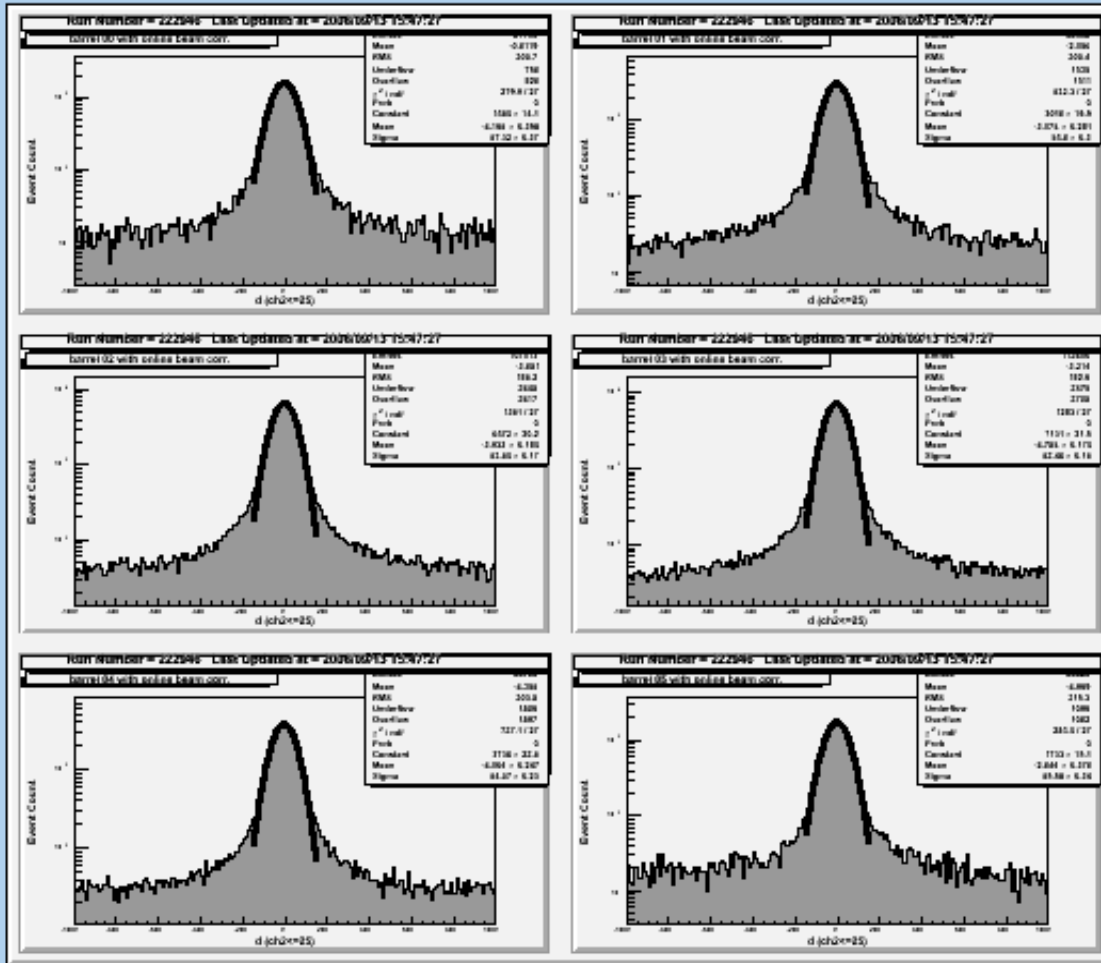
Slideshow



- works for a single plot at a time
- zoom on the x-axis

Fitting

Drawing Canvas



Auto update

Get PDF

Drawing Controls

Run: Consumer only

d vs phi (chi2<25) Final MRG sb MRG_OUT_SPY slot 11
 Wedge vs Barrel Final GB (GB_SPY_B) slot 19
 chi2 (All) Final GB (GB_SPY_B) slot 19
 d (ch2<=25 pt>2) Final GB (GB_SPY_B) slot 19
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 d (ch2<=25) barrel 02 with online beam corr.
 d (ch2<=25) barrel 03 with online beam corr.
 d (ch2<=25) barrel 04 with online beam corr.
 d (ch2<=25) barrel 05 with online beam corr.
 SVT processing time(us) FROM GB board
 SVT proc. time (1 ms range) (us) FROM GB board

Options **Fitting** Macro

Enable/Disable Fit Panel

Function: Fit Range:

Expression:

Parameters: (CSV)

- inbuilt Root functions - gaus, landau, poln etc. - supported, only gaus tested
- select fit range as Comma Separated Values (CSV)
- when multiple plots selected automatically switches to a (sensible) multi-zone display

Macro Execution

Drawing Canvas

Drawing Controls

Run: 228400 Consumer only

List View Tree View

XFT Tracks per road HBPP_OUT_SPY wedge 9
Road id HBPP_OUT_SPY wedge 9
Nxtrp Nxtrp in XTFA_TRK_SPY
phi_6 XTRP XTFA
Pt bin XTRP XTFA
short*2+iso XTRP XTFA
Number of Tracks (Sim-Real) TFPP_OSPY wedge 0
Number of Tracks (Sim-Real) TFPP_OSPY wedge 1
Number of Tracks (Sim-Real) TFPP_OSPY wedge 2
Number of Tracks (Sim-Real) TFPP_OSPY wedge 3
Number of Tracks (Sim-Real) TFPP_OSPY wedge 5
Number of Tracks (Sim-Real) TFPP_OSPY wedge 7
Number of Tracks (Sim-Real) TFPP_OSPY wedge 9
Number of Tracks (Sim-Real) TFPP_OSPY wedge 11

Options Fitting **Macro**

FittingDemo
SVT Board Error Summary (Truncated Output)

Auto update

- extend the web application with Root macros
- compile the macro and copy the [shared library](#) in the macro folder on the server. Direct upload from the browser may be unsafe.
- does not yet support [multi-page output](#)

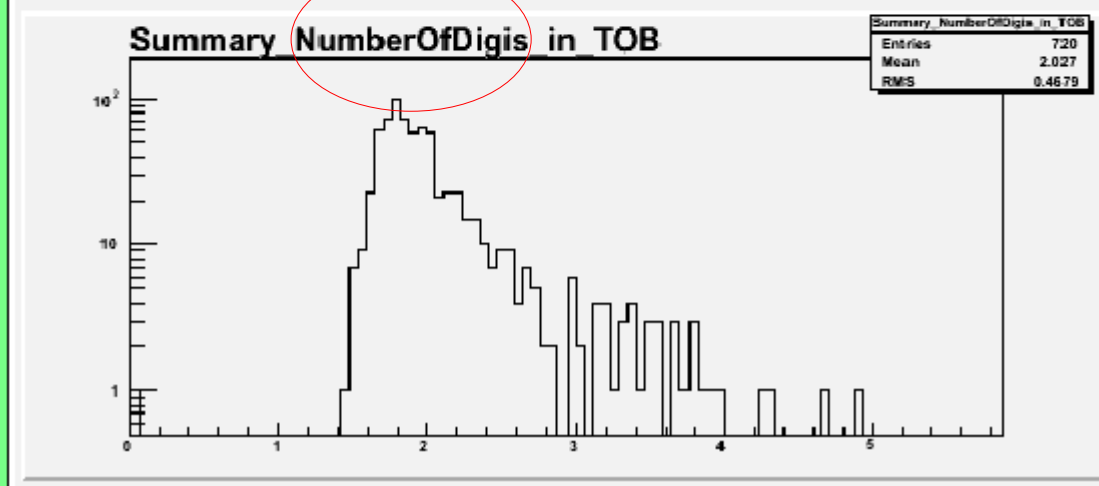
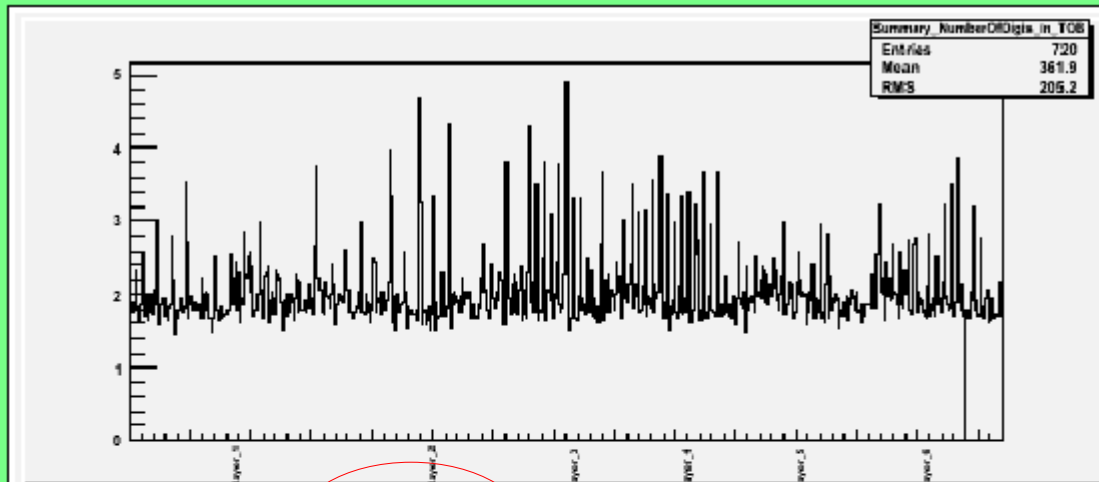
CMS Silicon Strip DQM Web Interface

CMS Silicon Strip DQM Web Interface

- Web interface look&feel same for both online and offline versions
- Server
 - xdaq application for **online**
 - Root based CGI application for **offline**

Suchandra Dutta

Drawing Canvas



Client Controls

Subscribe All

Collate ME

Update Summary

Save All

QTest Result

Create Tk Map

Single Module View

Summary View

Alarm View

Sub-Detectors: TOB

Get Tree

TOB

Summary_CMSNoiseProfile_in_TOB

Summary_NoisyStrips_in_TOB

Summary_NumberOfClusters_in_TOB

Summary_NumberOfDigis_in_TOB

layer_1

layer_2

layer_3

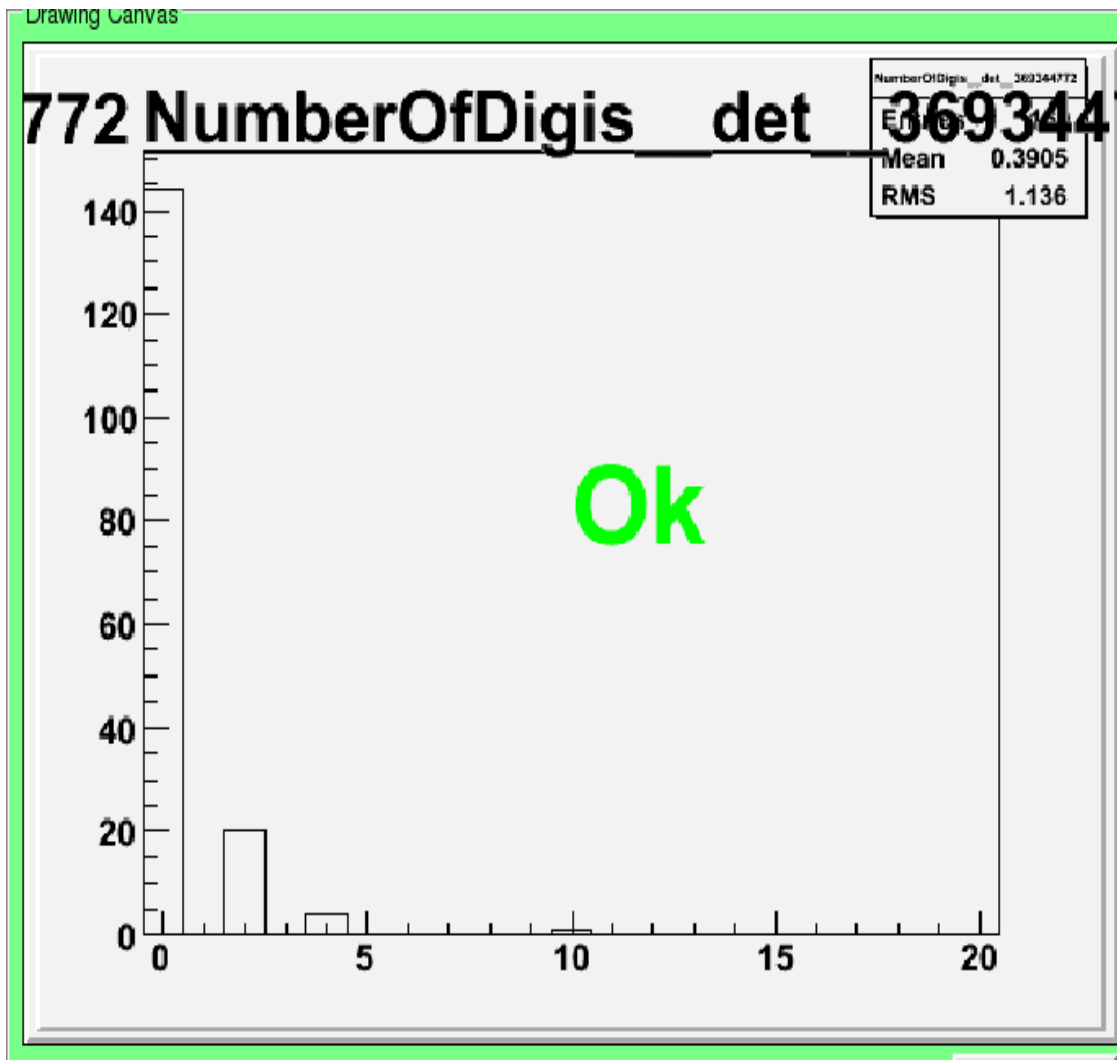
layer_4

layer_5

layer_6

CMS Silicon Strip DQM Web Interface

Histograms compared with reference and alarms generated on mismatch



Client Controls

Subscribe All Collate ME Update Summary

Save All QTest Result Create Tk Map

Single Module View Summary View Alarm View

Select a sub-detector type and get the tree

lay

- with alarm
 - forward_strings
 - external_strings
 - string_1
 - module_369344772
 - NumberOfClusters_det_369344772
 - NumberOfDigis_det_369344772
 - module_369344776
 - module_369344780

QTest Status : Ok

QTest Name : MeanWithinExpected:RMS (MeanWithinExpected)

QTest Detail : prob = 0.591722

Ajax applications ...

- CMS DBS data discovery page

<http://cmsdbs.cern.ch/discovery/>

- CMS Monte Carlo Production request system

<https://cmsdoc.cern.ch/cms/test/aprom/DBS/prodrequest/ProdRequest/getHome>

- A prototype job monitor

The screenshot displays a web-based job monitoring interface. On the left, a list of job IDs is shown, with 25634 selected. Below the list are filters for job state (Running, Queued, Completed, Unknown) and date ranges (From: 2007/3/26, To: 2007/3/26). The main area is divided into several sections:

- Job Info:** A table showing job details for Local JobID 25634, which is currently Running. It lists the local user as cmsprd (cms), the queue as cms, and provides submission and start times. CPU time is 19:25 hrs and wall time is 19:33 hrs. The execution host is cmswn006.pi.infn.it.
- Load/Memory:** Two line graphs showing performance over time (10-minute bins). The top graph shows CPU Load fluctuating between approximately 0.75 and 1.5. The bottom graph shows Memory Used (red line) and Virtual Memory (blue line) usage, with Virtual Memory peaking at 670 and Memory Used at approximately 335.
- Admin Info:** A table at the bottom providing administrative details such as RB (rb122.cern.ch), Subject (/C=IT/O=INFN/OU=Personal Certificate/L=Sns/CN=Federico Calzolari), Grid JobID, Proxy Validity, Role, and Job Description.

Ajax Summary

- **Pros**
 - desktop like UI
 - interactivity and responsiveness
 - band-width usage
 - separation of data, format, style and functions
- **Cons**
 - browser integration
 - back, reload buttons
 - search engine optimization
 - Javascript reliability
- **Issues**
 - missing standard
 - server initiated communication

Outlook

- Ajax is a perfect match for web based HEP applications
- Already in widespread use in HEP, mainly in
 - core computing
 - online data quality monitoring

obviously, has a much broader scope
- Open standard emerging gradually
 - will hopefully lead to faster adoption