T0 offline status

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ALICE offline week

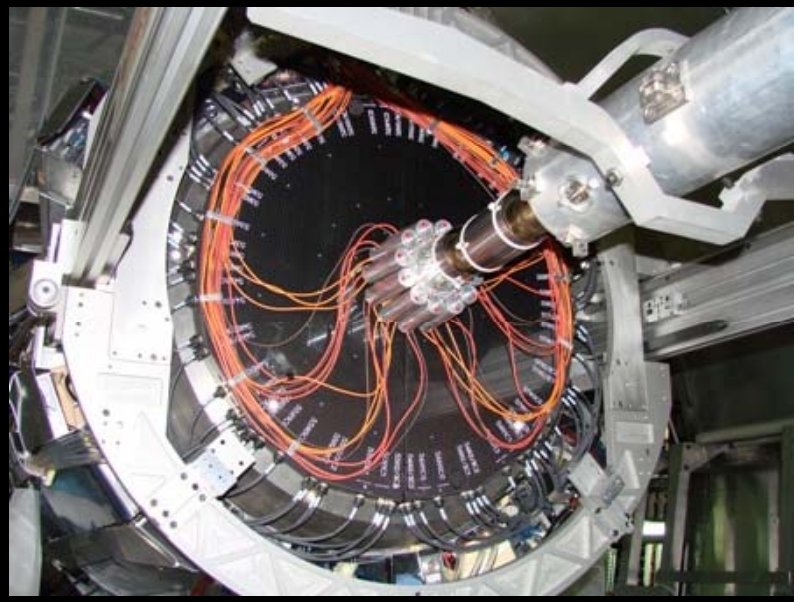
For T0 group

Outline

- T0 status
- Test of T0 electronics by LCS
- Tools show data for LCS
- Calibration
- Reconstruction
- QA
- Addendum: how HPTDC works

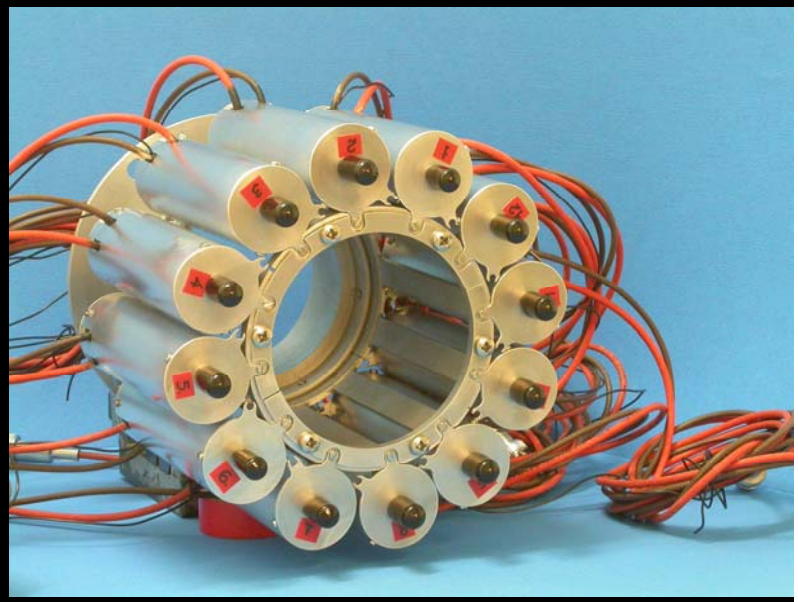
Status of T0

T0-C was installed in April and the T0 electronics production was completed in September. Electronics installation and testing will be completed before end 2007.



T0-C

At this moment we are completing the final tests of electronics in the T0 lab with T0-A and we are going to move the electronics to Point 2 to be able to run the detector during the magnet-on period in December. T0-A is now scheduled for installation in Jan/Feb 2008.



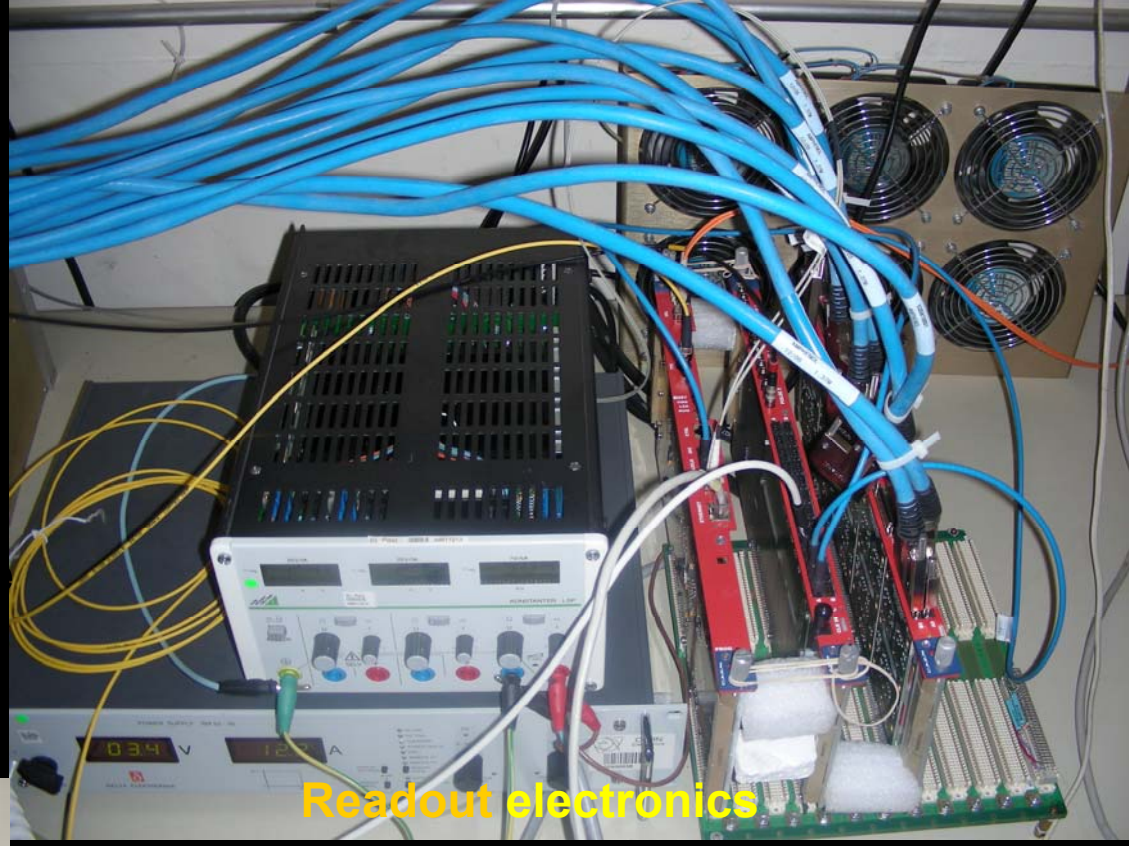
T0-A

Configuration during the September 2007 test:

Hardware

-T0-A detector
-Laser system
-New shoe-boxes (from F.Formenti)
-Fast electronics (final version)
-Readout electronics

CPDM TRM VME64X
DRM (final version)



Readout electronics

Fast electronics

Already tested :

-new shoe-boxes
-T0 Trigger Unit (T0TU)
-Start Laser system from pre-pulser comes from TTC
-Busy signal generated by DRM
-time & amplitude resolutions
-NIM crate control & Thresh. For CFD
-new version of TVDC

T0 readout channels

CFD	24 Constant Fraction Discriminators (Time)
LED	24 Leading Edge Discriminators (LED-CFD amplitude)
QTC	48 Charge –to-Time Converter amplitudes
meaner	$(T0_A + T0_C)/2$
QTC full	2 full multiplicities
TVDC	Trigger: vertex position in given range
T0A	Trigger: T0A
T0C	Trigger: T0C
central	Trigger: central
s-centr	Trigger: semi-central

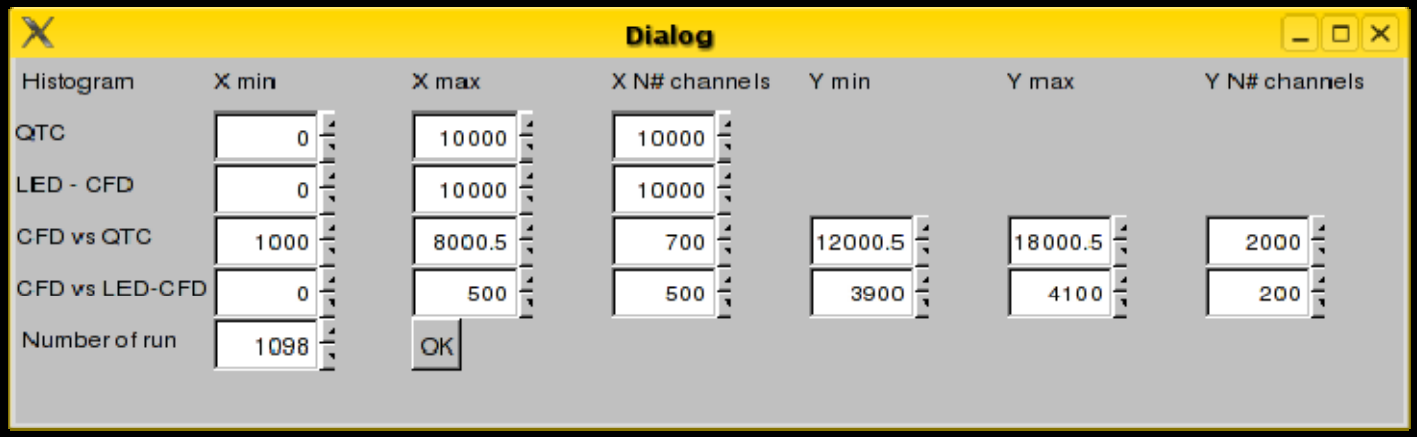
Current electronics test with Laser Calibration System (LCS)

The electronics test is running now.

Our engineers use AliRoot based tools to see what they measure.

The same tool (extended with writing to OCDB) can be used for Laser Calibration Runs in between physics runs.

Tools to show spectra from LCS AliT0CalibLaserData

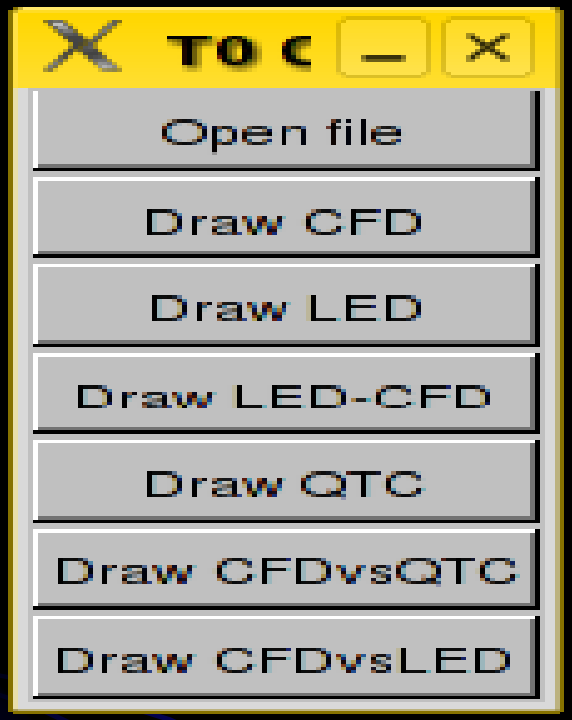


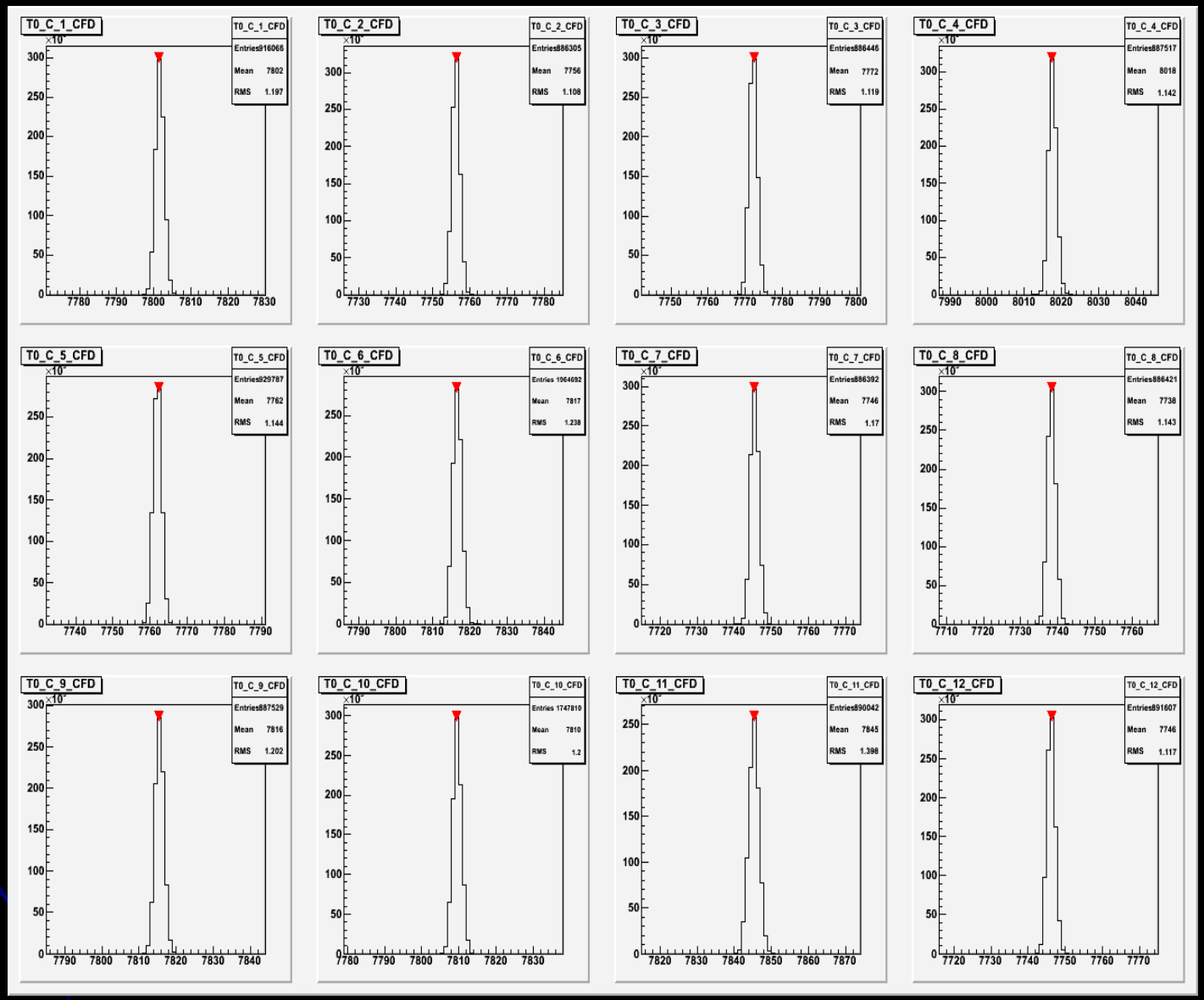
file with 105 1D histograms as readout output

24 QTC (QT1-QT0)
24 LED-CFD
24 CFD vs QTC walk correction by QTC
24 CFD vs LED-CFD walk correction by LED

OCDB

LaserDataViewer





Test shows that with full scheme we can provide time resolution 30-40ps

What T0 will measure

- Time when particles from interaction point hit T0 with accuracy 30-40ps ….with time reference synchronized for each T0 channel and TOF
- Interaction time $(T_C+T_A)/2$ that does not depend on vertex position but has the synchronized reference time for T0 and TOF. Can be used directly in number of channel units by TOF as START signal. Resolution of this signal is not worse than 30ps
- Vertex position with accuracy ~1cm. $(T_C-T_A)/2$ can be calibrated to cm units after 1st run using ITS vertex
- Granted: multiplicity in region $4.61 < \eta < 4.92$ && $-3.28 < \eta < -2.97$ with good φ division

Calibration procedure

Time signal on the exit of CFD channel consists of

- **time of flight of particles**
- **time delays in cables and electronics unique for each channel and not changing during run**
- **time shift depending on amplitude (walk)**

TOF
ΔTeq
ΔTwalk

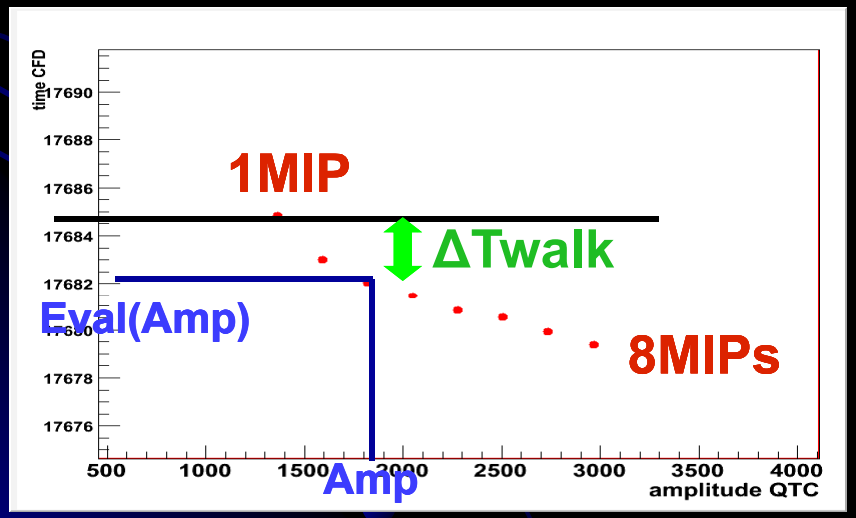
Time signals will be equalized on the entrance of OR module for perfect online trigger signals.

Time delays of channels on LCS are not the same as for the beam. So equalizing of time delays during data taking can be done only offline using DA information collected during run.

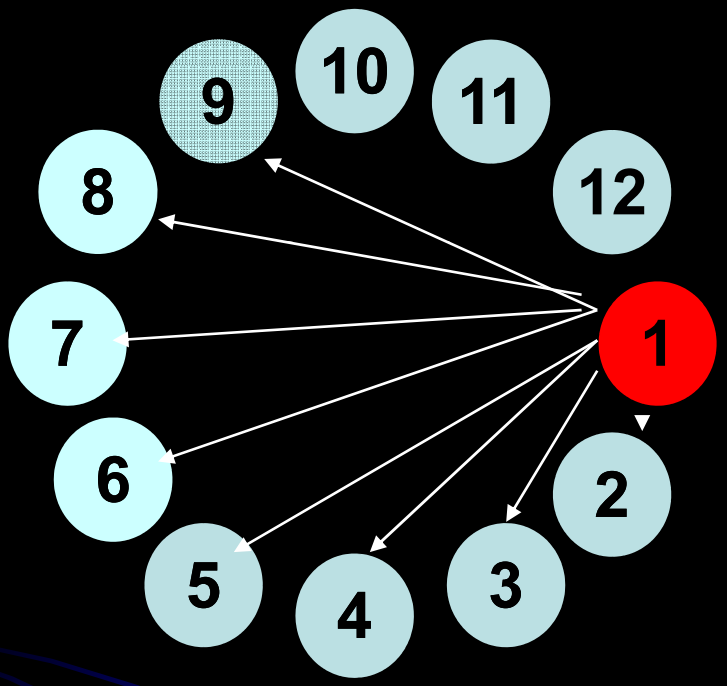
Laser calibration

Before 1st run and between runs LCS can:

- **check channel condition**
- **plot histograms for CFD, LED and QTC**
- **compare with existing in OCDB (Ref)**
- **write in OCDB new one if old was different (QA)**
- **using CFD, LED and QTC data produce 48 TGraphs "Walk correction"**
- **write "Walk correction" to OCDB**
- **write to OCBD scale to convert amplitude signal to MIP's unit**



Equalizing of channels



We decided that PTM1 will be the reference PMT with time T1

Event by event DA fill histograms with

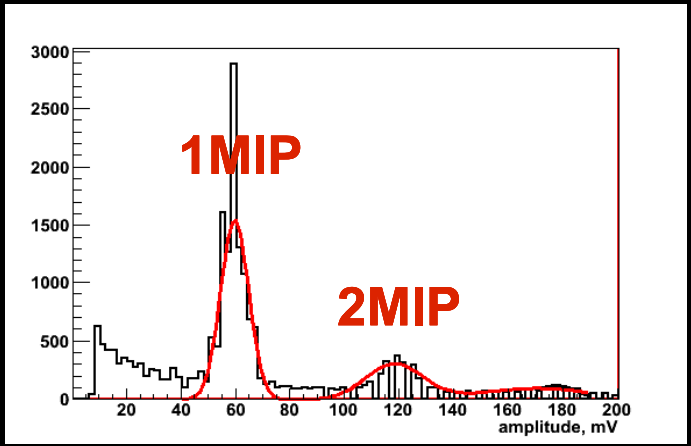
$\Delta T^{i}eq = T1-T^{i}$

Mean value of $\Delta T^{i}eq$ spectrum shows only the difference in delays between channels

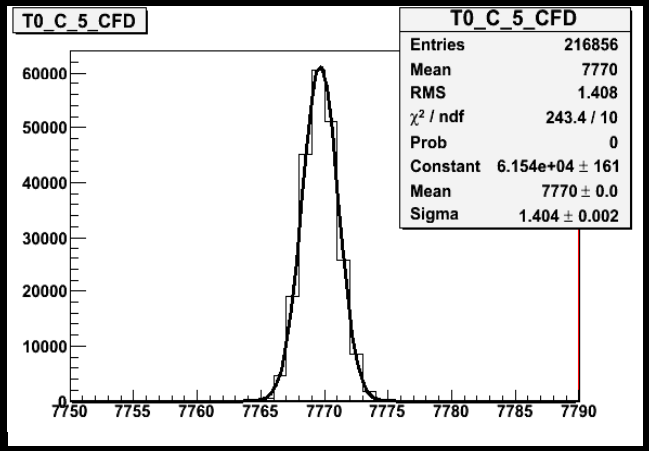
If can be possible to read information about 1MIP amplitude range (measured by LCS and written in OCDB) DA can choose only 1Mip signals and will provide information for one step perfect calibration and reconstruction

More about DA in Tomek's presentation

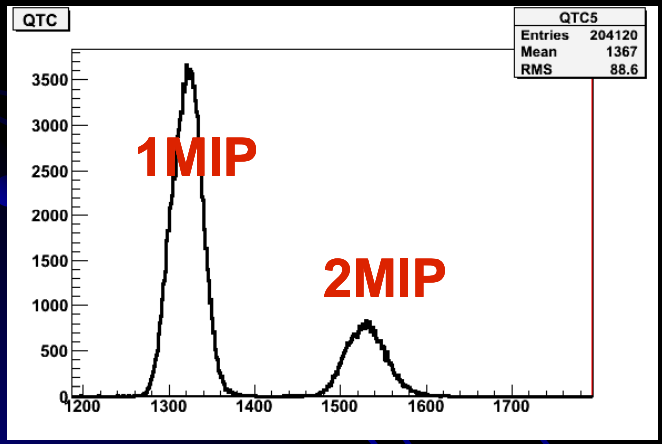
Emulation of PYTHIA time and amplitude spectra with LCS



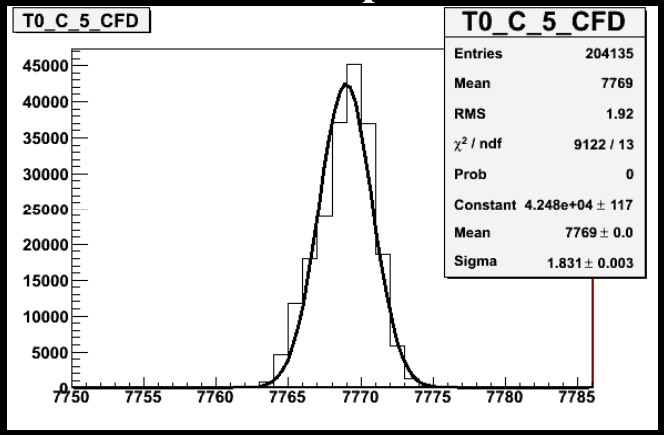
Particle multiplicity on the 1 PMT according to PYTHIA p+p@14TeV



Time spectra corresponding to 1MIP amplitude



Amplitude spectra of 1&2MIPs generated by LCS



Time spectra corresponding to 1&2 MIPs amplitude spectra

Because mean values are equal for 1MIP events and "PYTHIA cocktail" we can use CFD signal without amplitude selection as input for procedure for equalizing channels

Calibration parameters in OCDB

ΔTwalk QTCvsCFD	24 TGraph	LCS	Between runs
Δ Twalk LED-CFDvsCFD	24 TGraph	LCS	Between runs
Δ Teq	24 Float	DA during physics run	Each run
Vertex position #channel->cm	TGraph	offline	After 1st run Refresh time-to-time
LookUpTable	TMap	offline	Now Change if need
Amplitude scale #channel->MIPs	24 x 6 Float	LCS	Between runs

Calibration parameters in OCDB(ref)

CFD	24 fitted TH1F	LCS	Between runs
LED	24 TH1F	LCS	Between runs
QTC	24 Fitted TH1F	LCS	Between runs
QTC	24 Fitted TH1F	DA data taking	Each physics run
LED-CFD	24 Fitted TH1F	DA data taking	Each physics run

And more … about it in Tomek's presentation

Reconstruction

Input for reconstruction:

after calibration each time channel will be

$$T^{i} = T_{CFD} + \Delta Twalk + \Delta Teq$$

- **Choose PMT with smallest time on both (A & C) sides T0A & T0C (or weighted mean – is not clear yet)**
- **Calculate interaction time $(T_A+T_C)/2$**
- **Vertex position as $(T_A-T_C)/2$**
- **Convert amplitude information to 1, 2…MIPs units**

2nd step of reconstruction

If DA could not choose only 1 MIP particles for calculation ΔTeq we can improve time resolution by 2nd step of reconstruction using data of 1st step for calibration.

This improves the time resolution by ~5ps for p+p runs and is necessary for ion+ion runs reconstruction

Filling ESD

In ESD we have to write for physical issues:

- **Amplitude for each PMT**
- **Mean time**
- **Vertex position**
- **T0A**
- **T0C**

QA of reconstruction

For our own understanding of reconstruction quality we need for each PMT event-by-event time in number of channels, amplitude (LED and QTC),

All 5 trigger signals 24 INT, 48 Float, 5 Bool

We can write them in any place from where we can get them and look in:
???? ESD, ESDfriend ,
QA special place ????

QA of raw data

We need QA control of raw data and detector condition immediately after run. This knowledge allows us between runs

- **understand detector status during run**
- **recalibrate detector if it is necessary**
- **repair something….**

Collect by DA CFD, LED and QTC (additional 72 histograms), write to OCDB or RefCDB. After shuttle finish his work we can connect laptop and investigate histograms

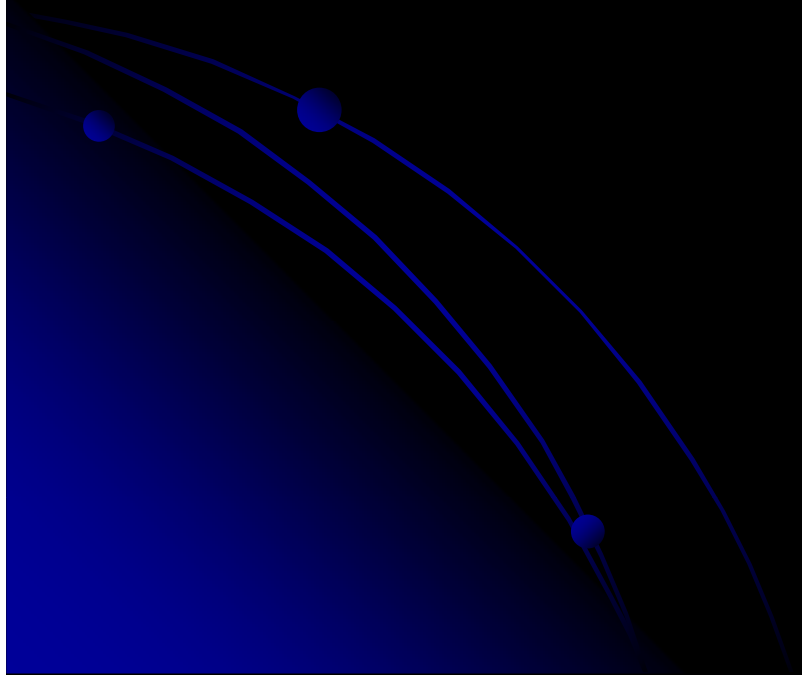
If Monitoring system will store histograms in the place we can reach them

To be done

This weekend we more or less finished our discussions about calibration and now we are ready to extend existing codes to fulfill it.

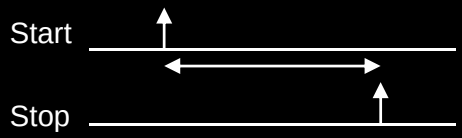
In the middle of November T0 offline will be "ready" for the 1st run

Addendum



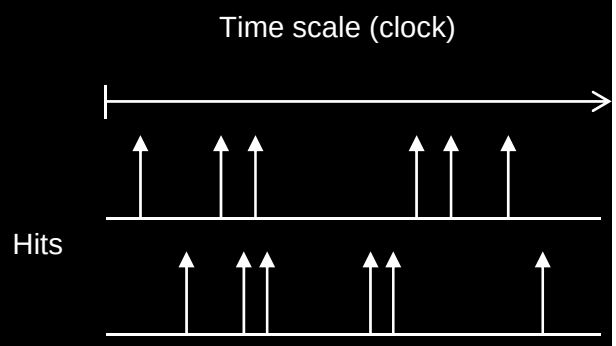
What is a TDC and its use I

- TDC's are used to measure time (intervals) with high precision
  - Start – stop measurement
    - **Measurement of time interval between two events:**
      start signal – stop signal
    - **Used to measure relatively short time intervals with high precision**
    - **Like a stop watch used to measure sport competitions**



From presentation of author of HPTDC

What is a TDC and its use II



- Time tagging
  - Measure time of occurrence of events with a given time reference
    - Time reference (Clock)
    - Events to be measured (Hit)
  - Used to measure relative occurrence of many events on a defined time scale
    - **Such a time scale will have limited range: like 12 hour or 24 hour time scale on your watch when having no date and year**
  - Like a normal watch

From presentation of author of HPTDC