SSD VALIDATION FACILITIES AND PROCEDURES IN LECCE

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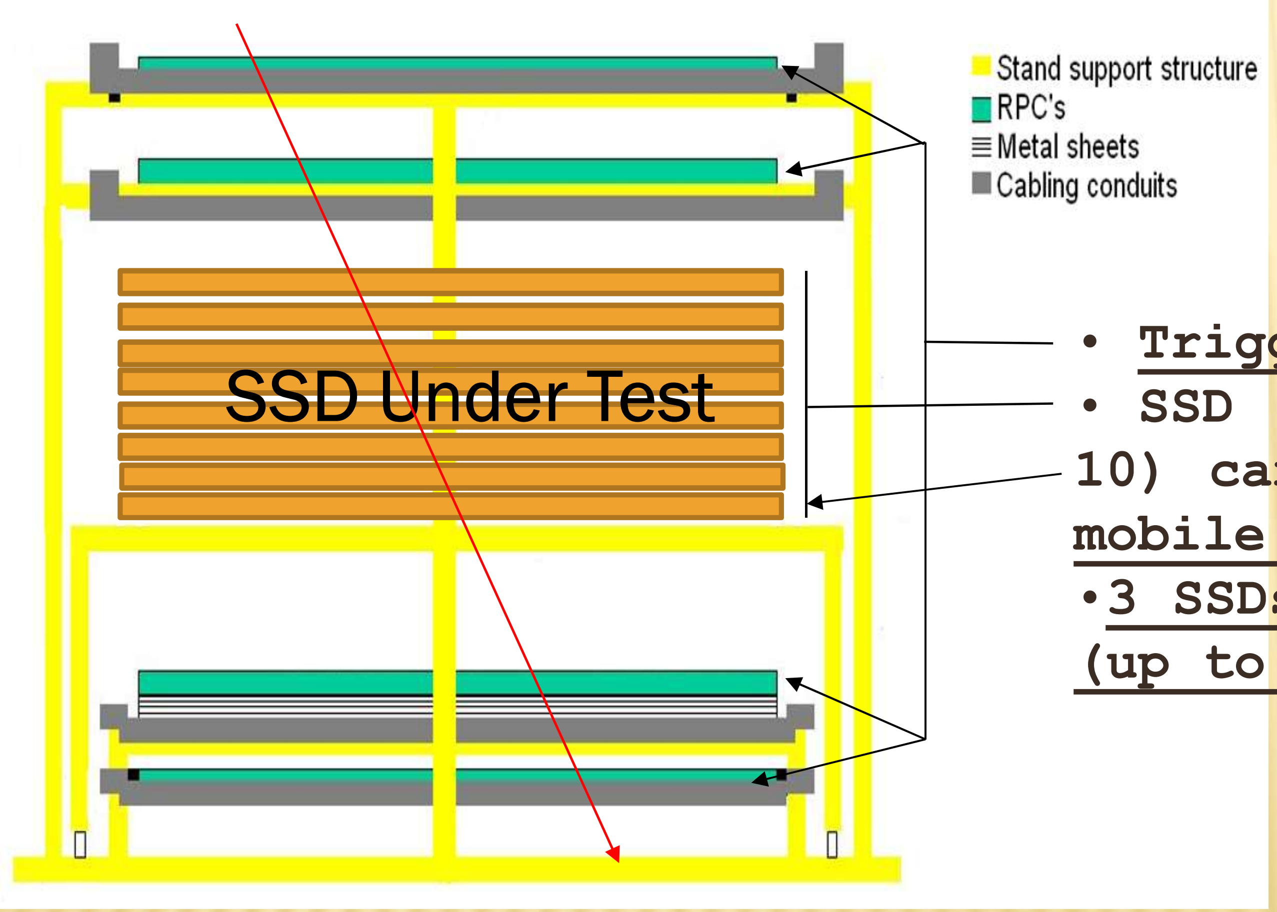
on behalf of

Lecce Auger Group

STARTING POINT: *ATLAS RPC TEST FACILITY*

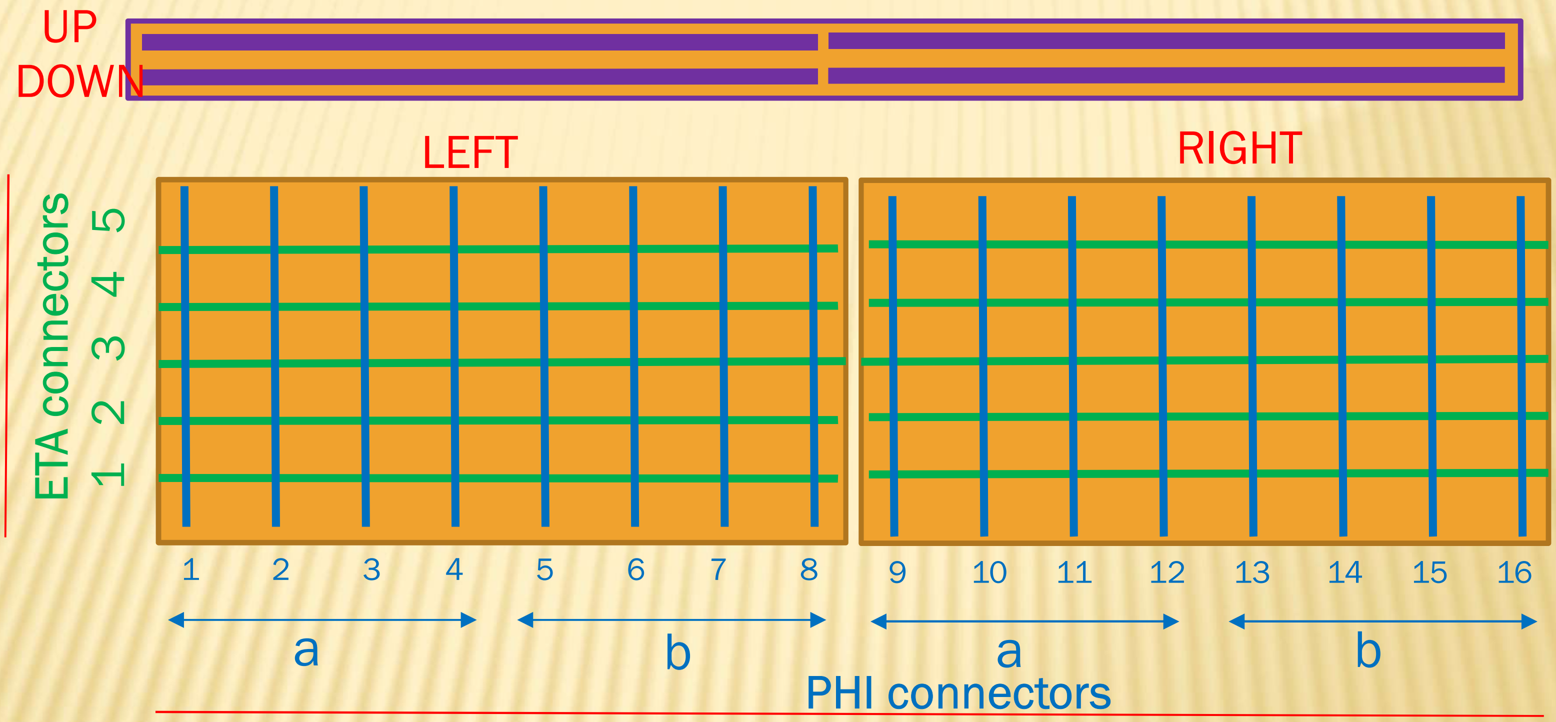
- Test facility in Lecce for testing all the RPC modules assembled in Lecce during ATLAS construction.
    - …… modules tested
- 2005 last run performed
    - RPC test stand was dismissed
    - 12 years of inactivity
- We started the reworking in autumn 2016
    - Self-confidence: *We will have all the RPC working again as well as DAQ, and everything….*
- Some gas leakage problems – ordinary like in the ATLAS experiment
    - Some parts more dismantled then inactive.
    - Electronic missing or broken.
    - DAQ too old.
    - Gas System in pieces.

RPC TEST STAND TRIGGER



- Trigger based on 4 RPC
- SSD under test (up to 10) can be located on a mobile structure
- 3 SSDs connected to PMTs (up to 8 DAQ channel)

RPC-CHAMBER LAYOUT



- Gap gas = 2 mm
  - $C_2H_2F_4$(94.7%), C_4H_{10}(5%), SF_6(0.3%)
- HV~10 KV Saturated avalanche regime
- Time response ~1 ns
- Readout panels: ϕ and η copper strip (pitch ~3 cm).

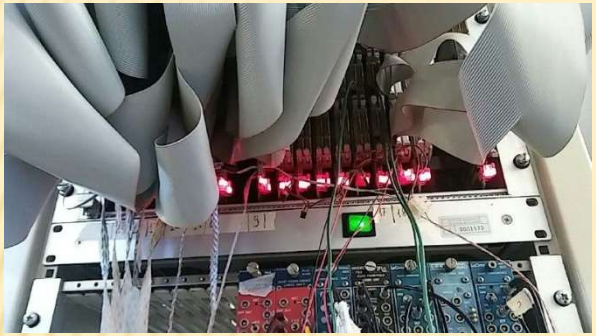
TEST STAND OVERVIEW

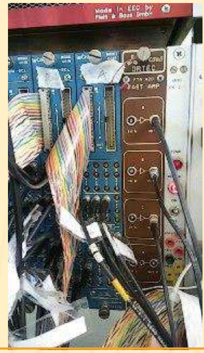
The stand is built with 4 RPC units triggering and tracking cosmic rays

It can host up to 10 SSD.

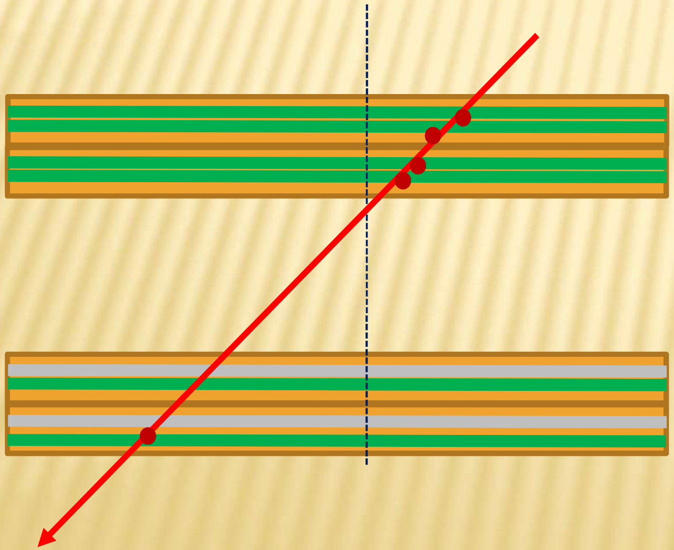
Only 3 equipped PMTs

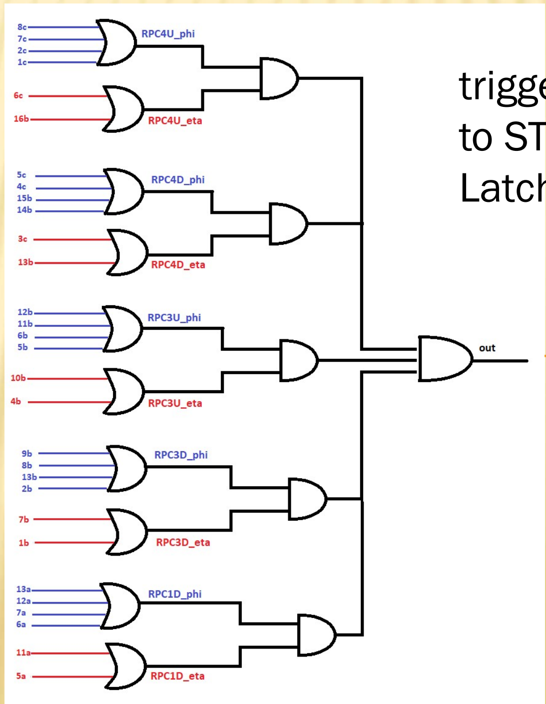
ACQUISITION SYSTEM





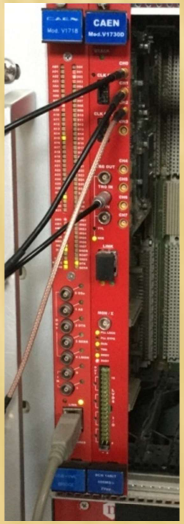
- VME **Modules (VXI System)**
  - **Receiver (TTL signals)**
  - **latch**
- **NIM modules for the trigger logic**
- **CAEN SY5527 (0-15kV)**
- **VME Caen Digitizer V1730D (14-bit @ 500 MS/s)**
- **DAQ-DCS developed using Labview**



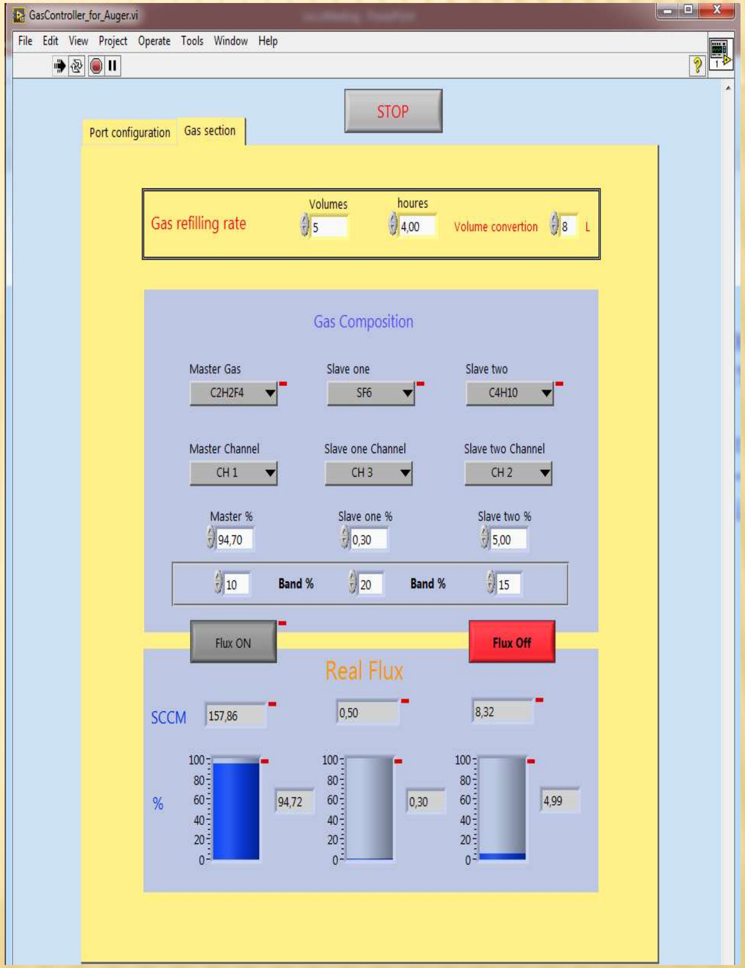


trigger-out is used to STOP the RPCs Latch

trigger-out is used to acquire the digitizer



GAS SYSTEM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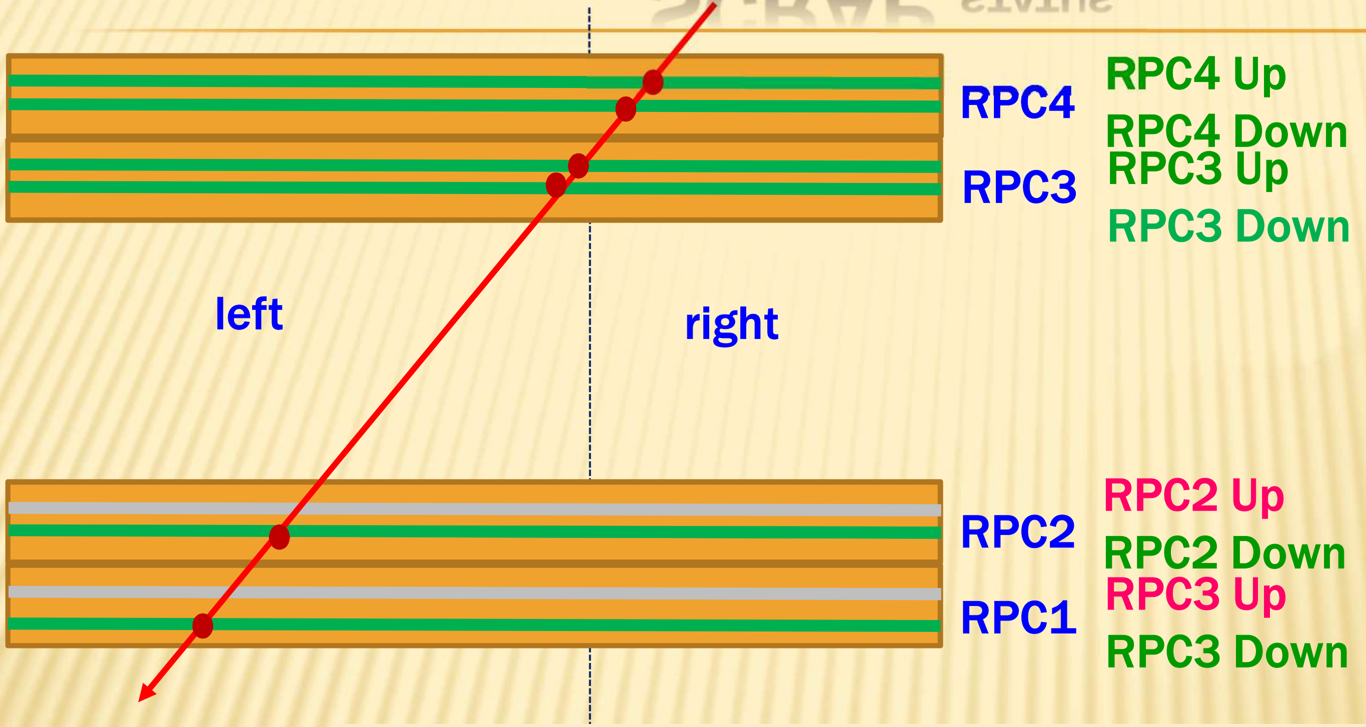
SF6
Slave two
C4H10
Master Channel
CH 1
Slave one Channel
CH 3
Slave two Channel
CH 2
Master %
94,70
Slave one %
0,30
Slave two %
5,00
10
Band %
20
Band %
15
Flux ON
Flux Off
Real Flux
SCCM
157,86
0,50
8,32
%
94,72
0,30
4,99

SCRAP STATUS

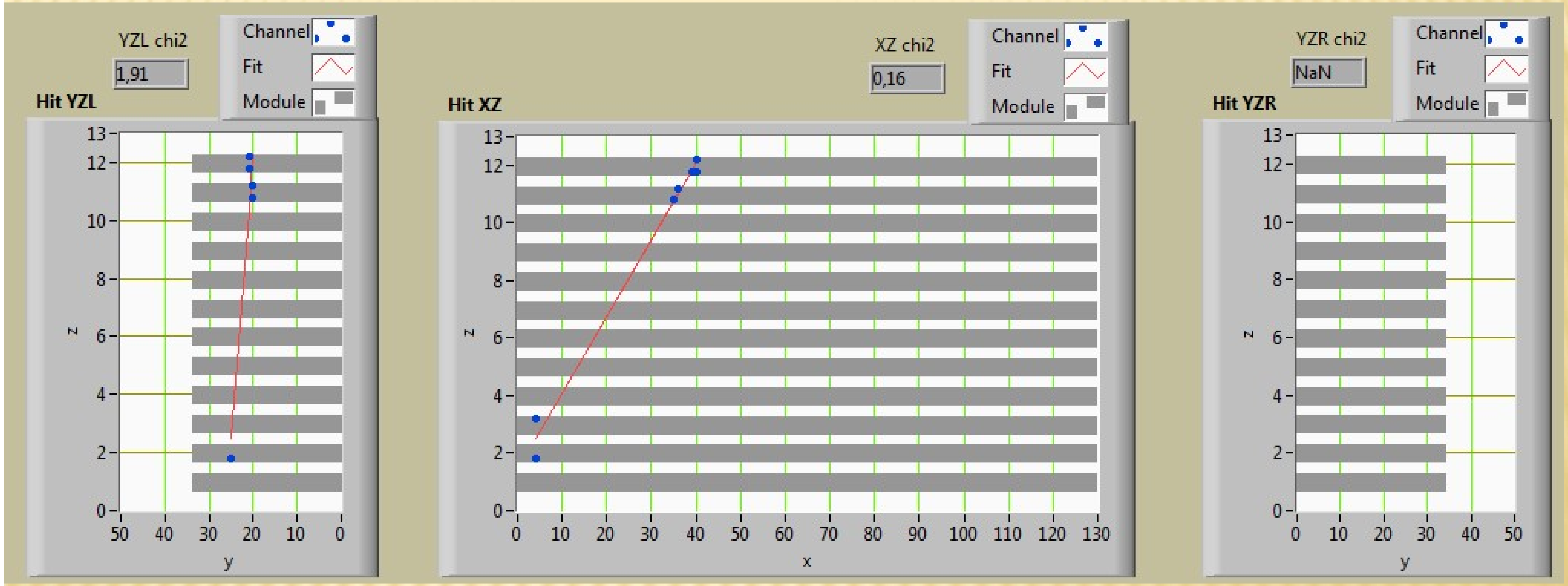


5 gas volumes used for trigger.
6 gas volumes used for tracks

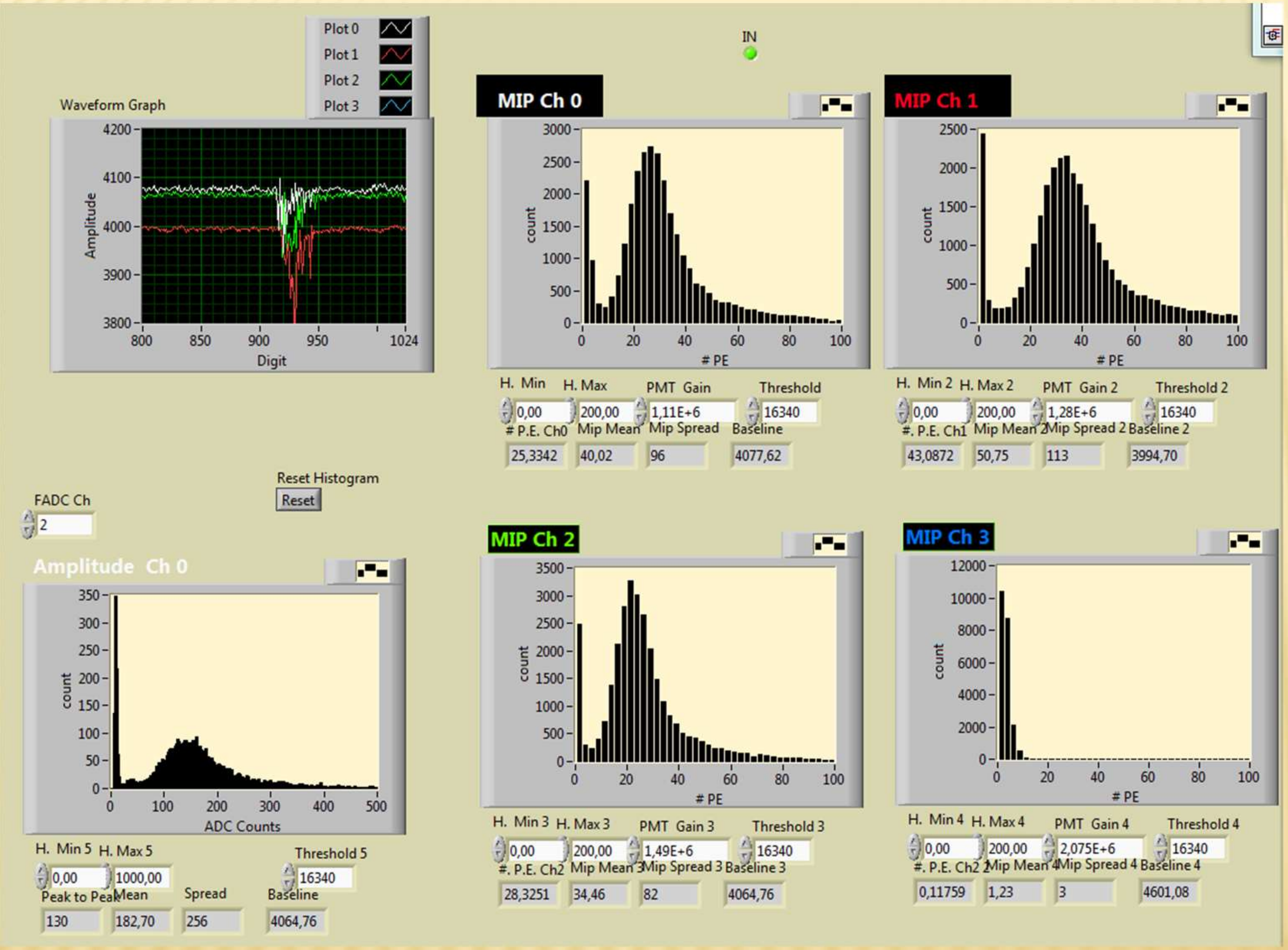
After 12 years of inactivity we have turned on the ATLAS RPC's Test Stand and renamed it SCRAP (Setup Cosmic Rays Auger Production)

- Labview for DAQ and Monitoring
- Reconstruction software (C++ under Unix)
- Digitizer data from the SSD module merged with the RPC data.
- Analysis and Production of ROOT tree to test MIP, light tightness and Homogeneity of the SSD detectors.

SCRAP- EVENT DISPLAY FOR RPCs



SCRAP-EVENT DISPLAY FOR SSD



From the digitizer signal to the MIP passing from ….

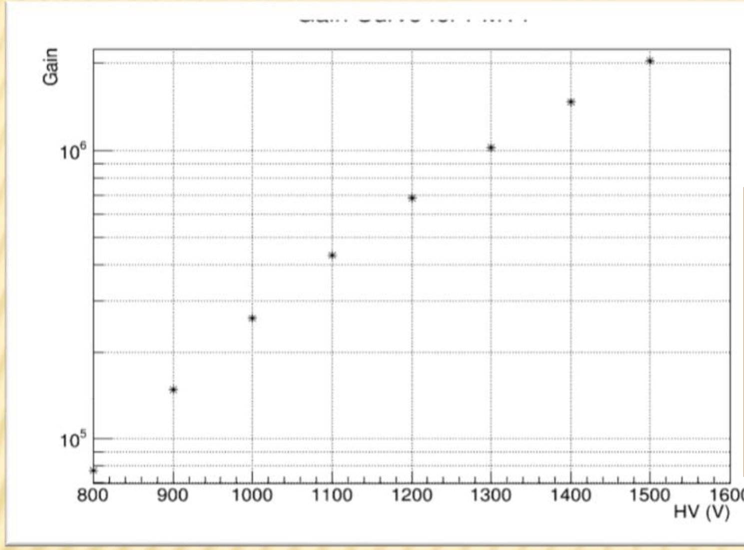
THE CALIBRATION OF PMTs

- Every PMT used for the test is calibrated in a dark box in order to establish the gain at different HV, respect to SPE.
- 3 PMTs with passive base and selected range DD3851,DD4151, DD4251.
- All PMTs have mu-metal shield.

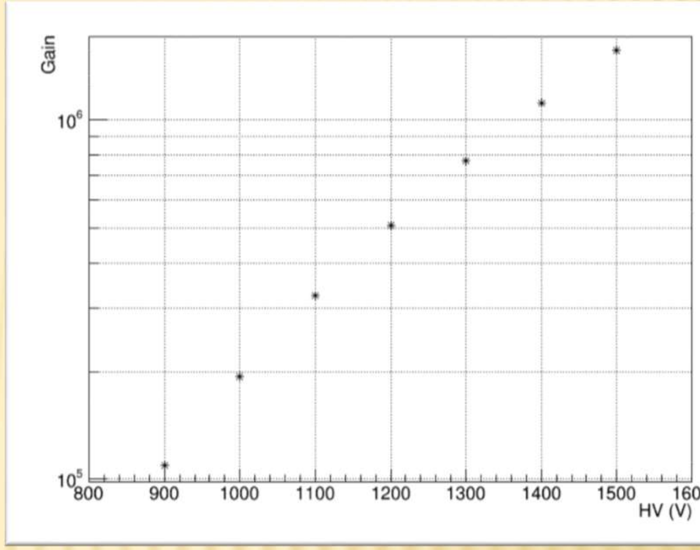
CALIBRATION METHOD

- A blue LED (470 nm, 45 deg viewing angle) pulsed light source is used.
- SPE search (usually @1400V or @1500V)
  - The pulsed light source is tuned (via a transmittance filter) in order to have 90% pedestal, and 10% signal. For Poisson distribution, the absence of photoelectron 90% of the time ensures a very low contamination of events with >1 PE.
- GAIN Vs HV
  - To get the gain as a function of Voltage, the LED intensity is fixed while varying the PMTs HV.
  - The curve is then normalized to the SPE value.

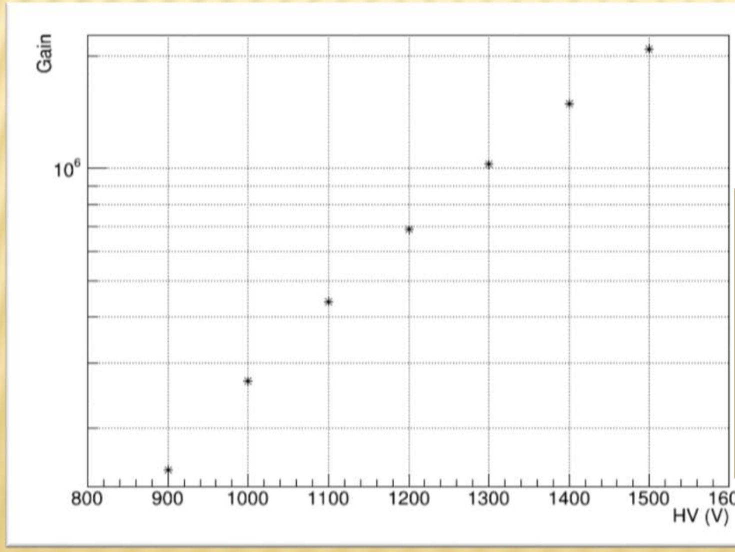
GAIN Vs HV CURVES OF PMTs



DD3851



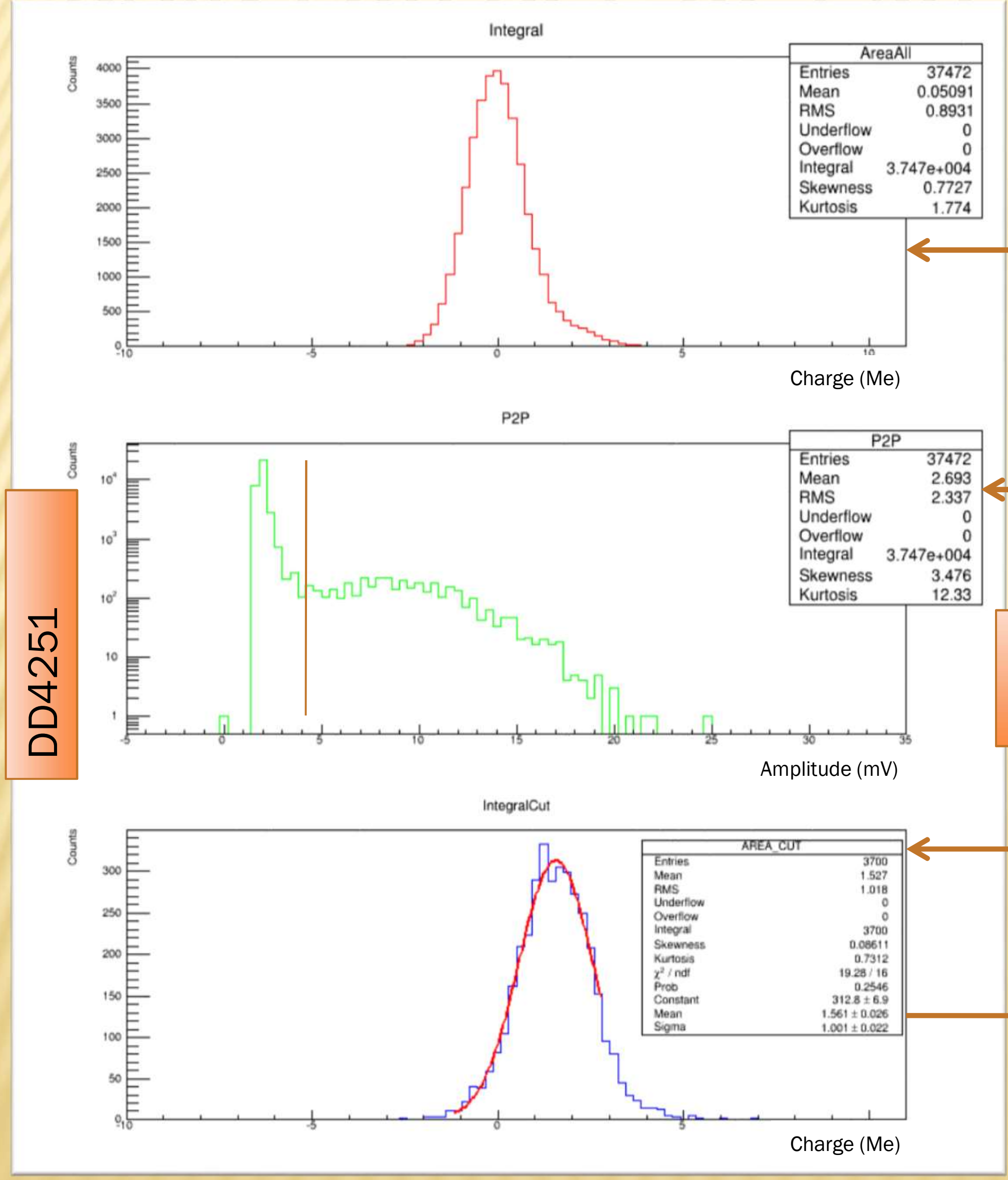
DD4251



DD4151

GAIN FOR SPE OF PMT

DD4251



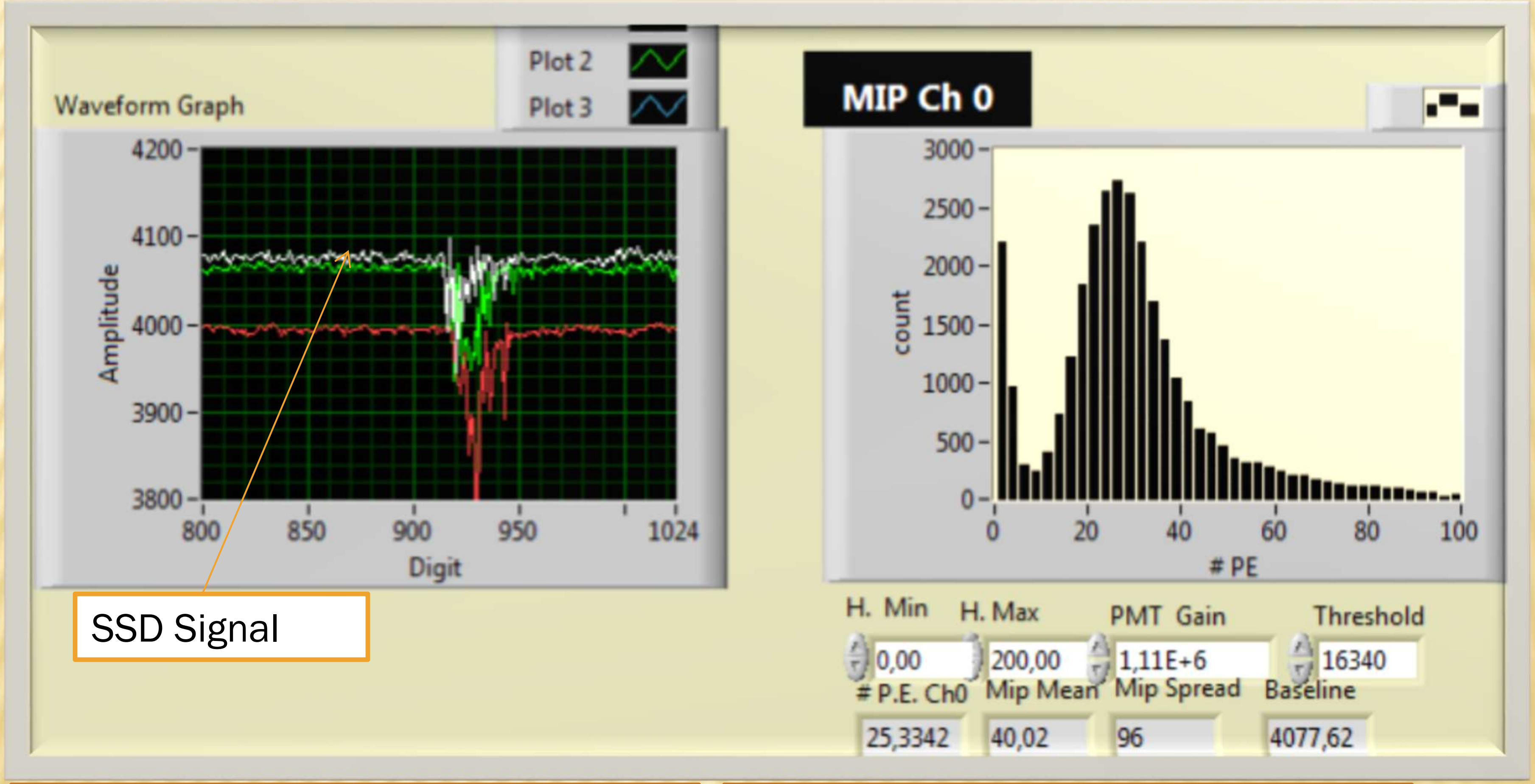
Charge integral in 90% pedestal, and 10% signal

Peak to Peak in 90% pedestal, and 10% signal

Charge integral after a cut on “Peak to Peak”.

Gain of spe @1500V

NUMBER OF PHOTOELECTRONS IN A MIP-MONITORING

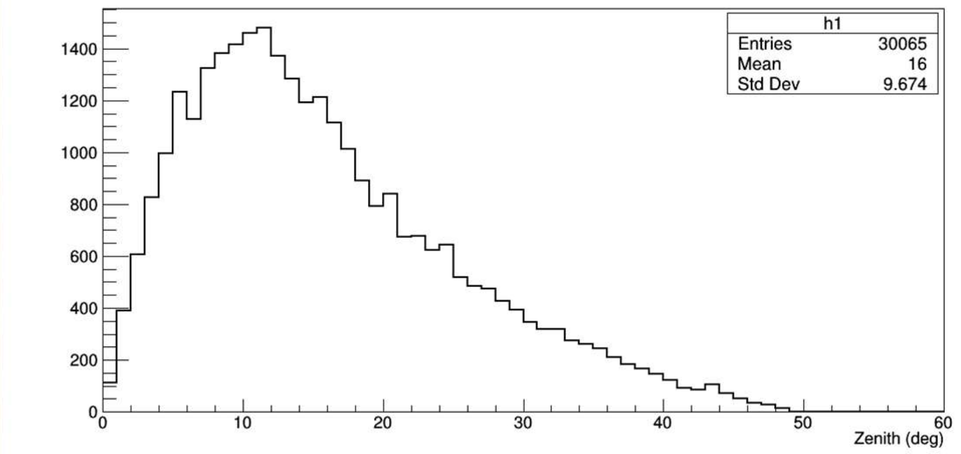


✓Find the minimum
✓Integrate in a window of 140 nsec subtracting the baseline

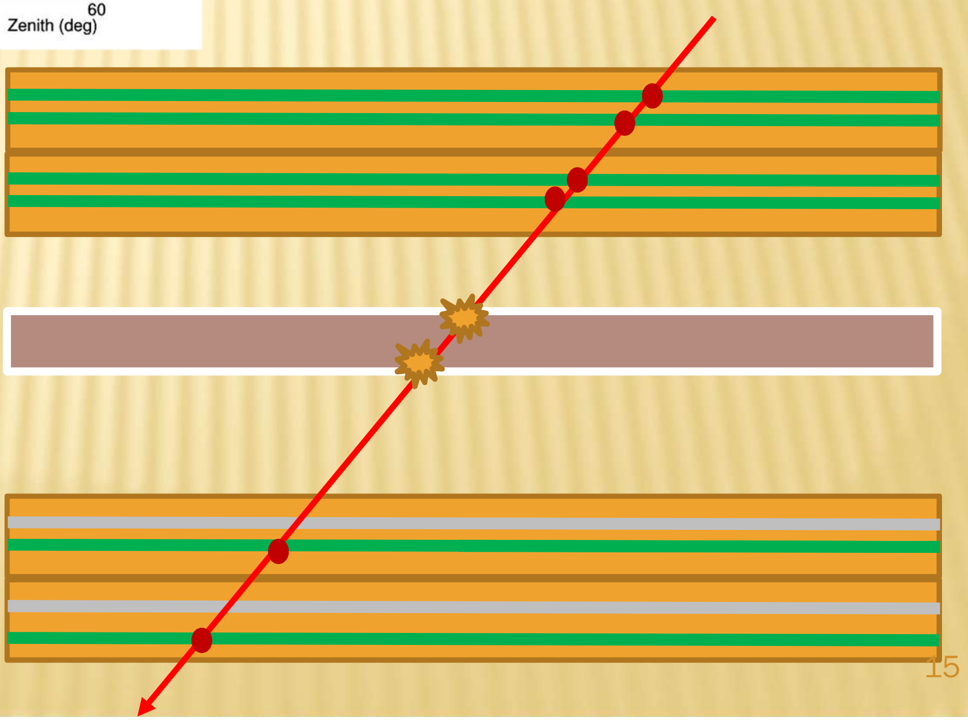
✓Use the gain to determine a number of photoelectrons per MIP

NUMBER OF PHOTOELECTRONS IN A MIP- GEOMETRY

Reconstructed zenith angle.



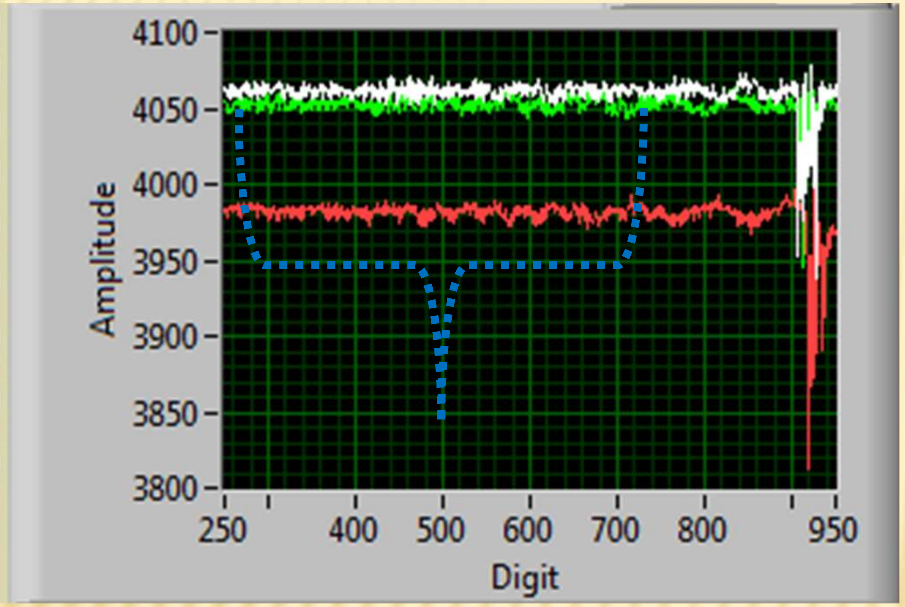
✓Offline- Reconstruction of the track of the RPCs
✓Calculation of the zenith angle and track lenght

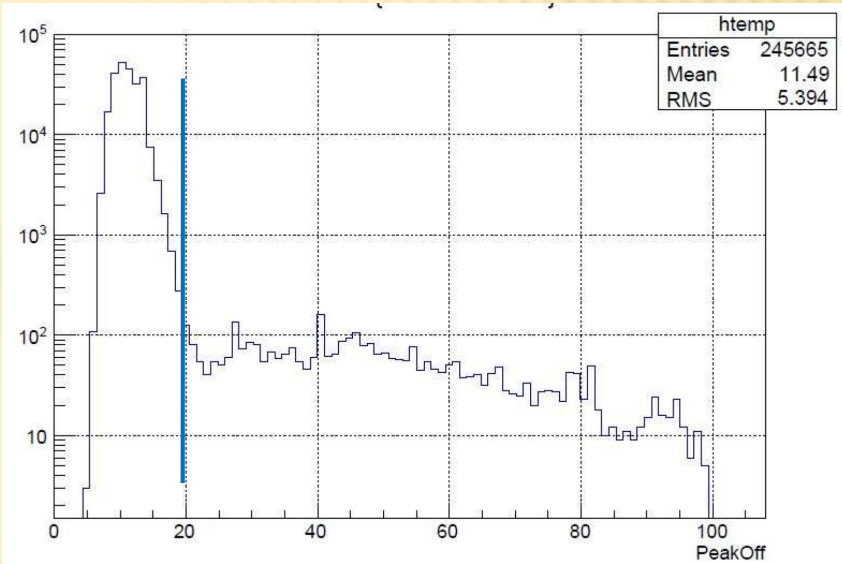


The reconstructed zenith angle is used to correct the track lenght, in order to refer to a "Vertical MIP"

.. see the results in Daniele's talk

LIGHT TIGHTNESS OF SSD EVERYDAY CHECK!





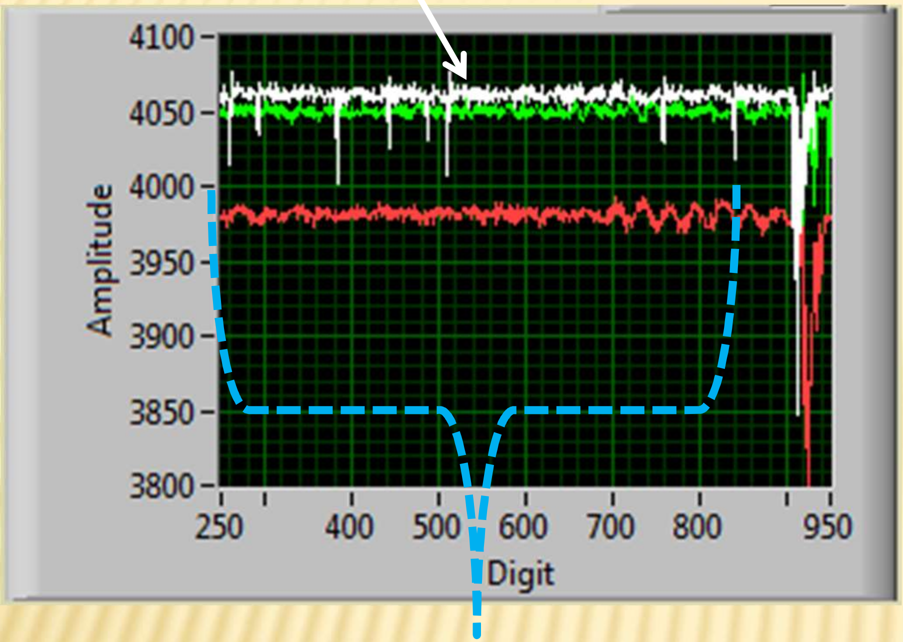
- ✓Find the minimum "off signal" (pre-signal)
- ✓Cut on ADC-count distribution
- ✓Integrate in a window of 140 nsec subtracting the baseline
- ✓Calculate the rate of "#pre-signal/baseline"

✓If the ratio is higher then 2%.

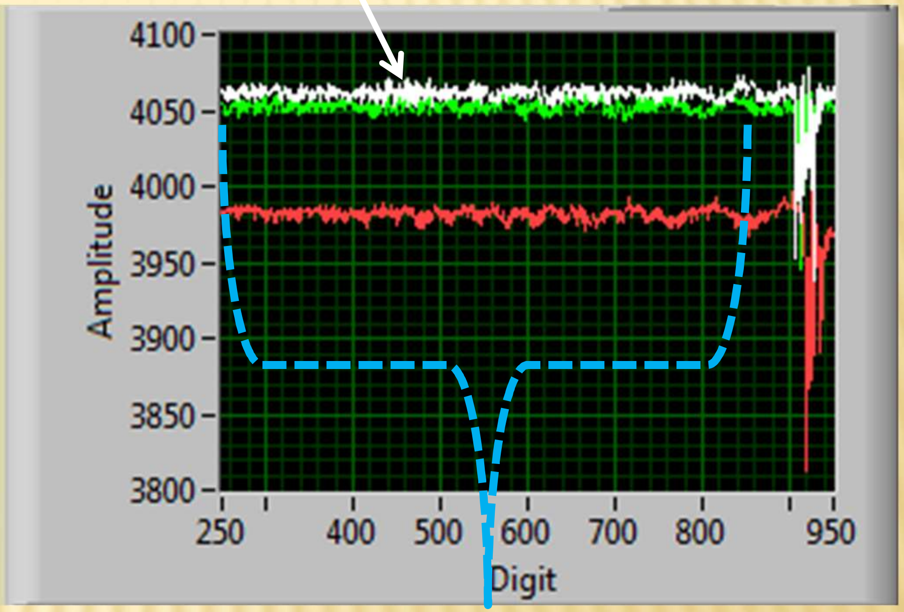
DO THE LIGHT CHECK!

LIGHT TIGHTNESS OF SSD

✓CIPOLLA- before light care



✓CIPOLLA- after light care

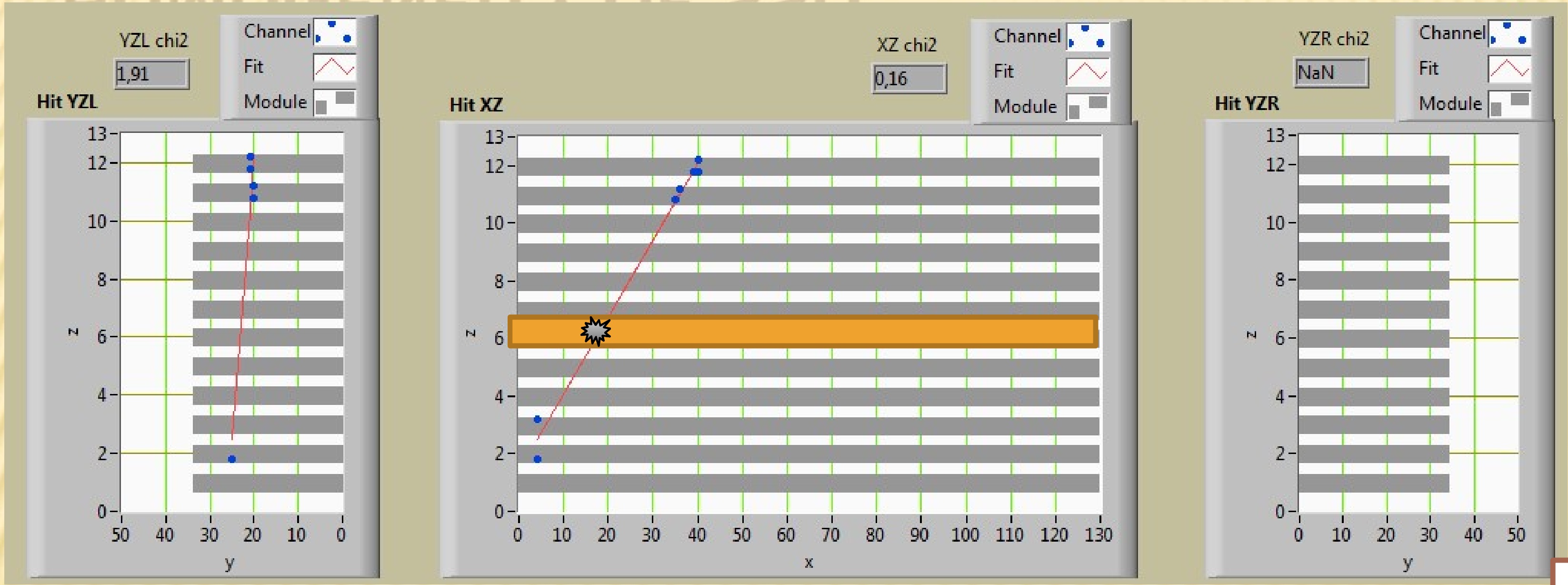


✓Go with a flash light around the detector until you catch "THE POINT".
✓This was in correspondence of a part of "panel-frame" contour.

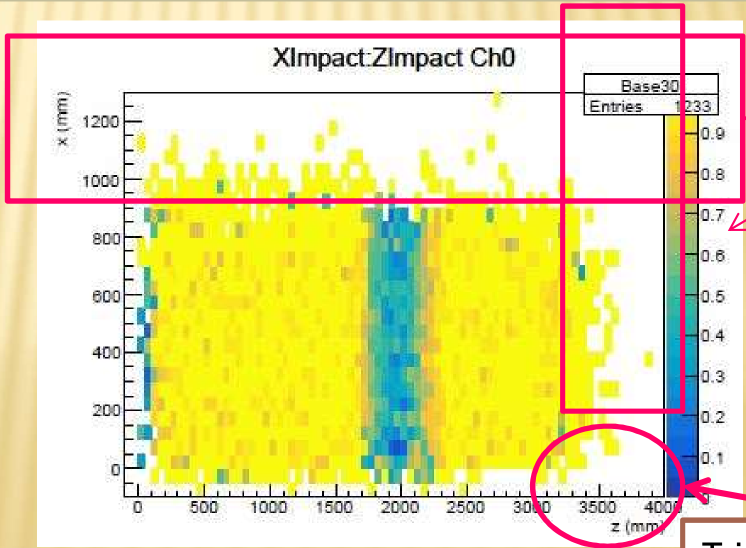
✓"THE POINT" After sealing.

✓Do again the "Peak-off analysis"

HOMOGENEITY OF SSD.



- ✓Use SCRAP-RPCs to determine the impact point on SSD.
- ✓Map ON/OFF the SSD.



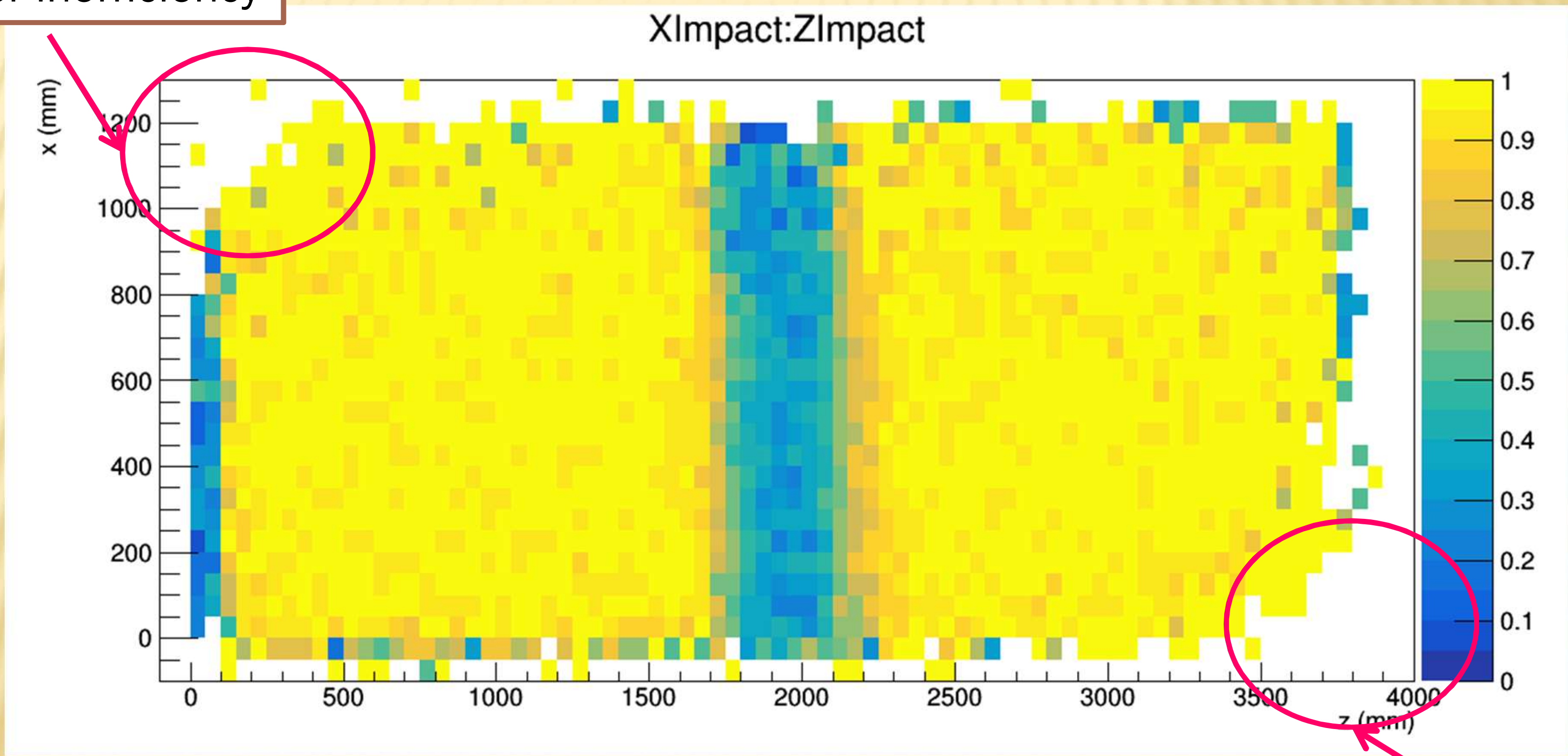
RPC tower too small

Trigger inefficiency

HOMOGENEITY OF CHAMBER.

✓Rotate the chamber to have a better map (THE RPCs are smaller then SSDs)
✓Merge the detectors

Trigger inefficiency



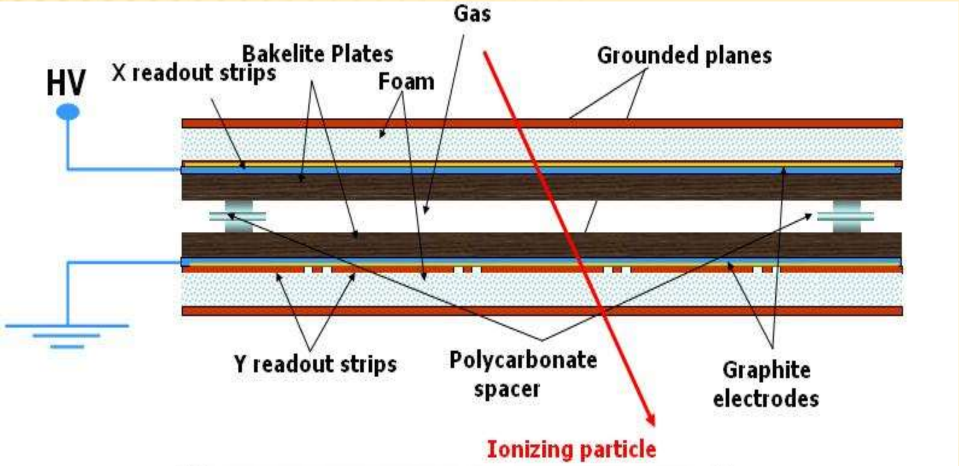
Trigger inefficiency

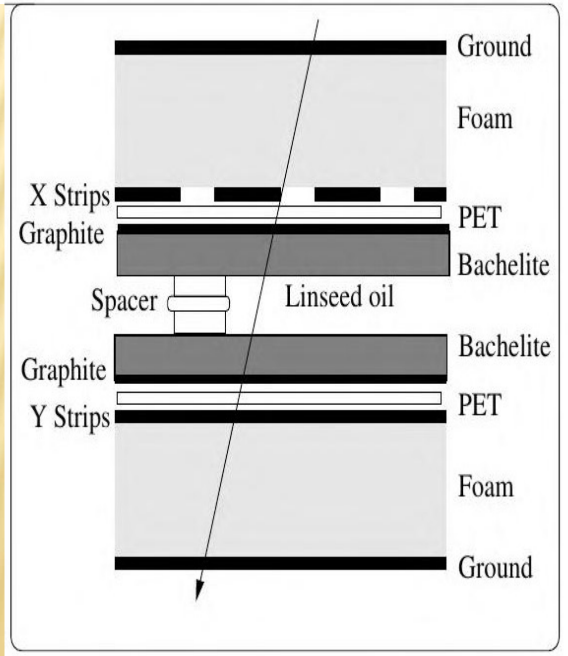
CONCLUSIONS

- SCRAP is in *routine* mode.
- 3PMTs (passive base) have been equipped for SSD tests.
- The SSD checks performed are:
  - Number of Photoelectrons per MIP
  - Light Tightness
  - Homogeneity

BACKUP

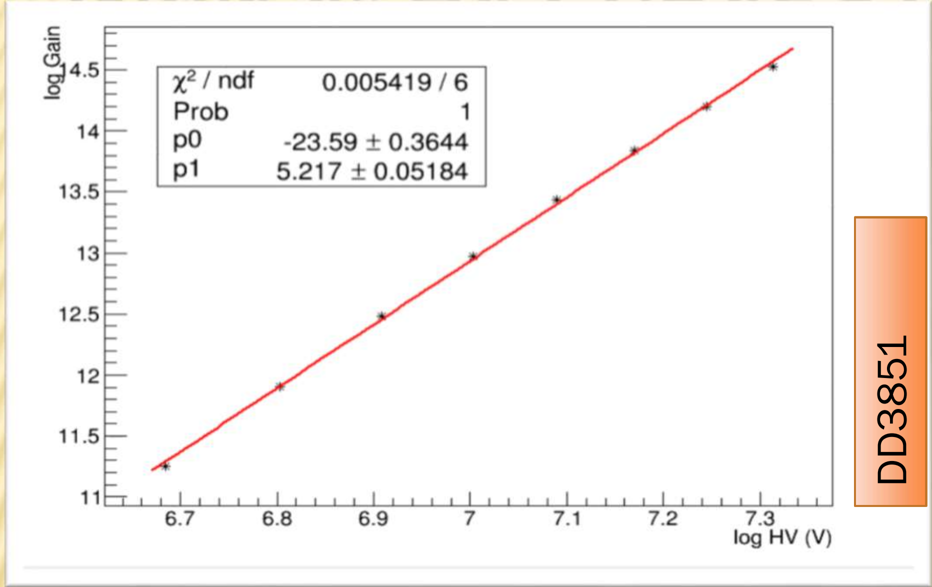
ATLAS RPC (RESISTIVE PLATE CHAMBER)



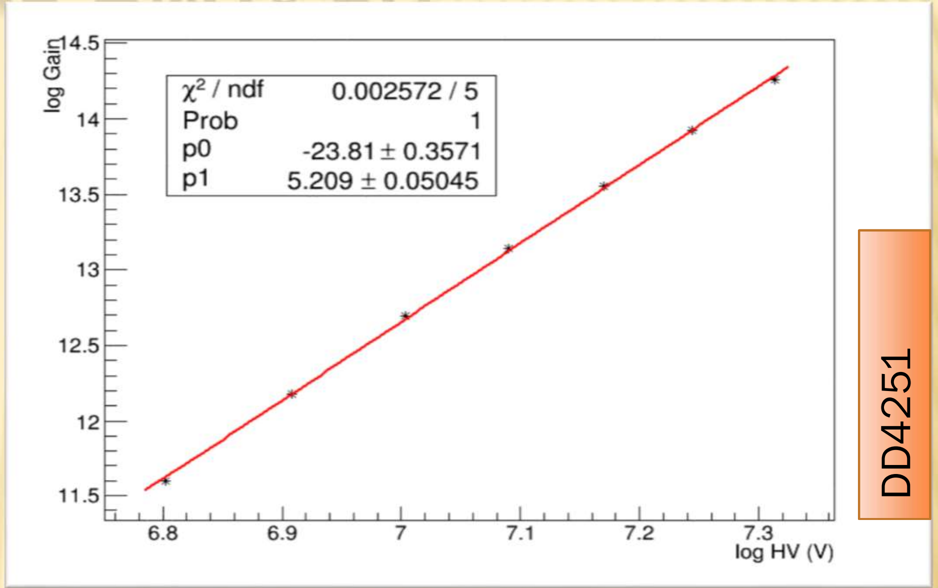


- Gap gas = 2 mm
  - $C_2H_2F_4$ (94.7%)
  - C_4H_{10} (5%)
  - SF_6 (0.3%)
- HV~10 KV Saturated avalanche regime
- Time response ~1 ns
- Readout panels: ϕ and η copper strip (pitch ~3 cm).
- Spatial resolution (~ 1 cm).
- Rate Capability ~1 kHz/cm^2@Eff.>98%
- Gap volume size 4×1 m
- Electrodes: graphite layer + 2 mm thick bakelite (ρ~ 1÷4x10^{10} Ωcm).

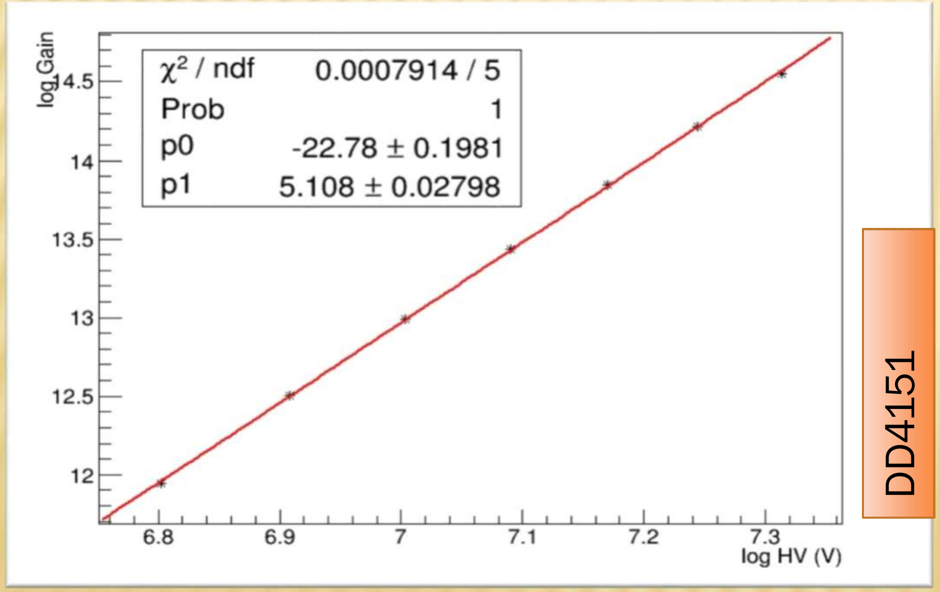
GAIN Vs HV CURVES OF PMTs FIT



DD3851



DD4251



DD4151