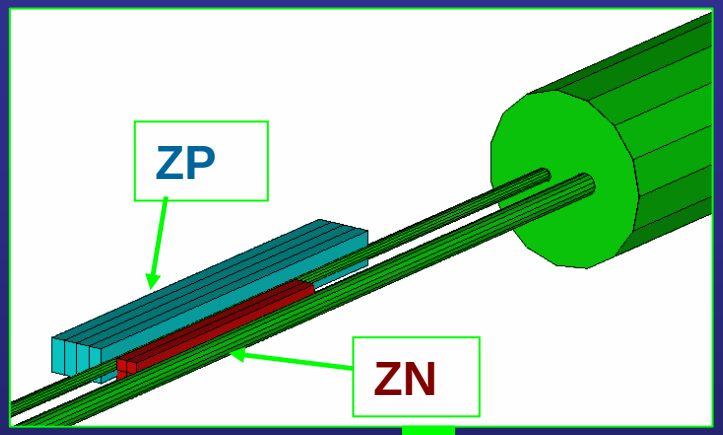
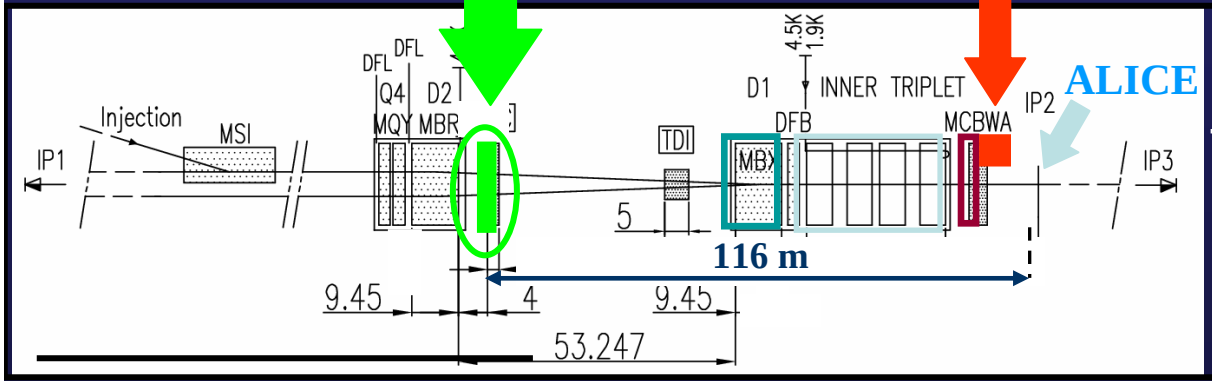
ZDCs – Calibration and alignment issues



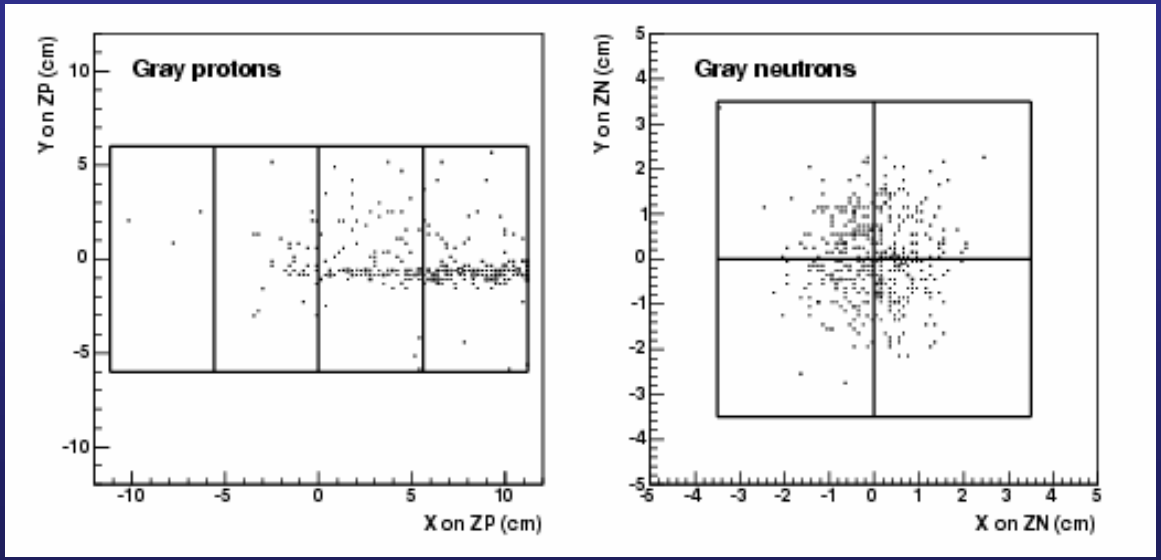
- 2 pairs of hadronic calorimeters (ZN,ZP) @ 116 m from IP
- 1 (small) e.m. calorimeter (ZEM) in front of the compensator dipole of the dimuon arm



- **Dipole to compensate the field of the dimuon arm dipole**
- **Quadrupole triplet to focalize ion beams**
- **Dipole to separate beams**

Calibration object

- Must contain information needed for:
  - Pedestal subtraction
  - Relative calibration between towers
  - Absolute energy calibration



- Read-out channels
  - 5 (PM) × 2(ZN,ZP) × 2(sides) × 2(high gain,low gain) = 40 ADC
  - e.m. calorimeter → 2 (PM) × 2(high gain,low gain) = 4 ADC
  - External PM → 3 ADC
  - Scintillator for muons → 8 ADC channels (or PU)

} 55 × 2 channels

Creation of calibration object (pedestal)

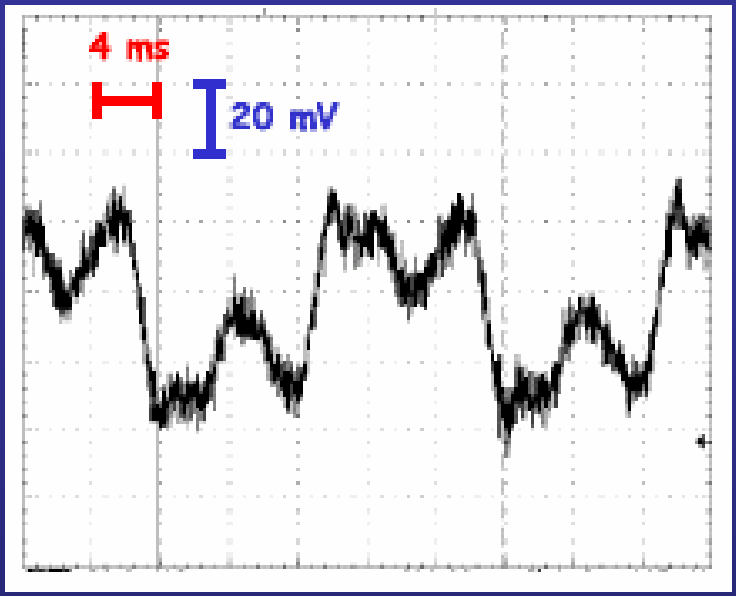
- Generator trigger needed
  - Two possible implementation in the data taking scheme
    - Dedicated run (once per fill, assuming ≥ 1 fill/24 h)
    - Inside normal data taking (low-rate, read only ZDC)

  } Useful to have both

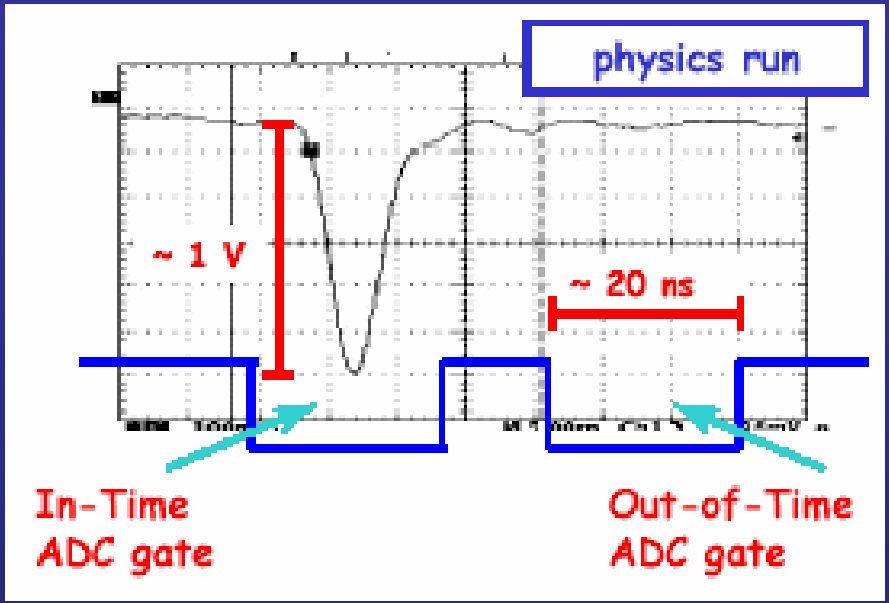
- Creation of calibration object (pedestal)

- Each physical channel has two corresponding read-out channels
  - In-time (with the event)
  - Out-time (~ 50 ns delay)
- Store in the calibration object
  - 1-d histo with ADC spectra (max 110)
  - 2-d histos with correlation In-time vs Out-time (max 55)
  - Fit parameters of the correlation (linear fit of the 2-d histos) (220 float)
  - Average values and RMS of the 1-d histos (mean pedestal) (110 float)

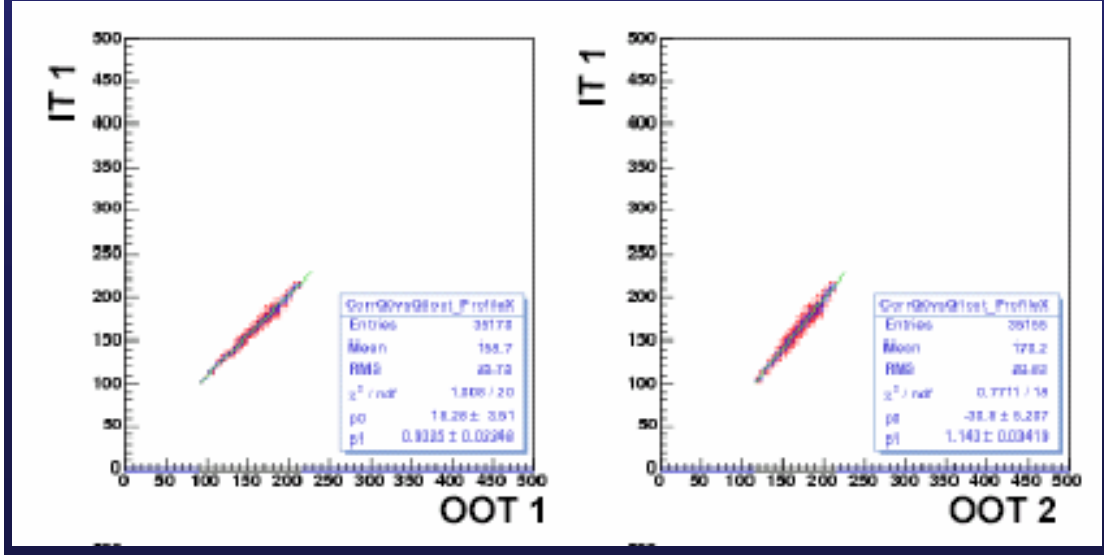
Example (from NA60)



Low frequency oscillation
of the base-line



Timing of the ADC gates



Typical 2d-histo
to be stored in
the calibration object
(together with the fit
Parameters)

Creation of calibration object (calibration)

- Initial relative calibration factors for the ZDC towers

  ZN (4 towers $\times$ 2 devices) $\rightarrow$ 8
  ZP (4 towers $\times$ 2 devices) $\rightarrow$ 8
  ZEM (2 towers $\times$ 1 device) $\rightarrow$ 2

  } obtained off-line (1 per year, typically)

- During data taking
  - Laser trigger $\rightarrow$ inject light to test PM relative stability
  - E.m. dissociation $\rightarrow$ 1 neutron/proton emission in ultraperipheral collisions to give absolute energy calibration

- Creation of calibration object (2nd step)
  - Re-read object (pedestal coefficients)
  - Subtract pedestal from ZN, ZP spectra (high-gain chain)
  - Store laser and e.m. dissociation spectra (20 1d-histo)
  - Calculate relative and absolute calibration coefficients
  - Store them in the calibration object

How many objects ?

- Depends on how long a typical run will be
- A useful calibration object should be created from ~ 10^3 events per trigger type
  - generator triggers
  - laser triggers
  - e.m. dissociation events
- If it is possible to collect 10^3 generator "mini-events" per run
  → 1 calibration object per run, identified by run number
    - Validity: for that run only
- If typical runs are rather short
  → Group runs when creating the calibration object
    - When 10^3 events are reached
      - Write calibration object
      - Validity: for that group of runs

Runs can be grouped only if running conditions do not change

Additional information

- Additional information needed in order to:
  - Eliminate runs clearly not good for physics analysis
  - Precisely determine groups of runs with similar conditions
    $\rightarrow$ be able to set limits for validity of calibration files

- Need
  - ZDC DCS information
    - HV of all ZDC towers $\rightarrow$ identify malfunctioning of the detector
  - Non-ZDC information
    - Currents in the (main) elements of the beam line
      $\rightarrow$ may influence LHC orbit and, consequently, ZP response
  - Geometrical information
    - Vertical position of ZN,ZP (adjustable by user/machine)
    - Once per fill
      - Vertical scan to maximize response
      - Final position needs to be stored (DCS ?)

Status of AliRoot implementation

- Simulation
  - ZDC digits already expressed in ADC channels in a realistic way
    - Coefficient photoelectrons → ADC channels
    - Pedestal added, with gaussian smearing set by user
  - Framework good for testing of calibration procedures

- Calibration object
  - Class prototype created by Alberto (AliZDCCalibData), based on the corresponding NA60 class (NaZDCCalib)
    - Very similar
      - Hardware (Quartz fiber calorimetry)
      - Software (na60root, derived from root/aliroot)

- Still to be coded
  - Creation of calibration objects
  - Use of calibration objects in the reconstruction (calibrator)

Calibration strategy already tested with real data in previous experiments