# VZERO Status Report

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On behalf of VZERO Group

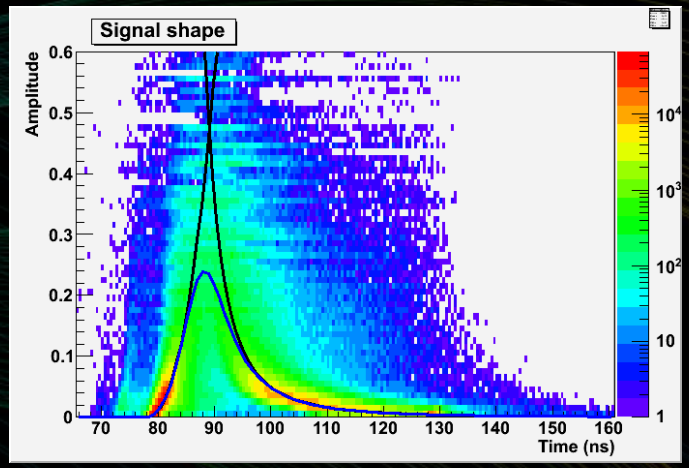
ALICE Offline Week
4/07/2010-8/07/2010

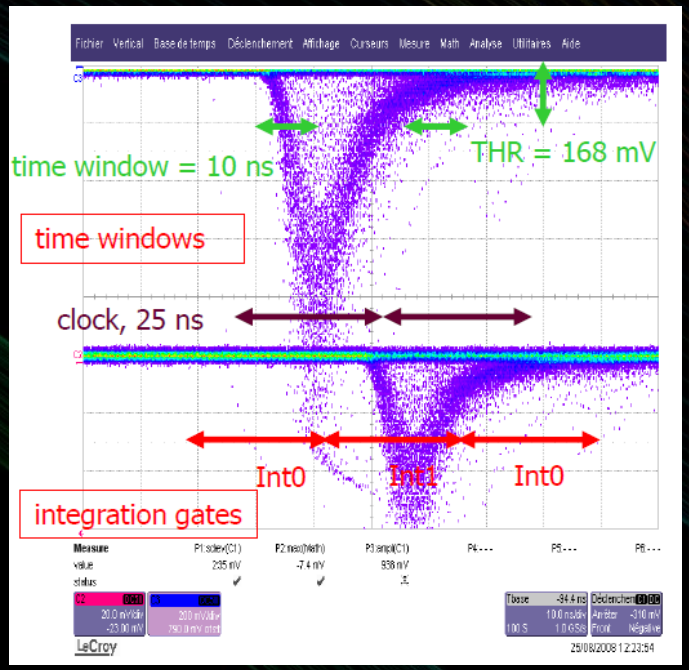
# Outline

- Simulation
  - New digitization code
  - Comparison with data
  - Event merging and embedding
- Trigger simulation
- Slewing and time resolution
- Reconstruction
- Pre-pulses
- OCDB
- QA
- Savannah bug reports
- Planning tool – remaining tasks

# Extraction of Signal Shape

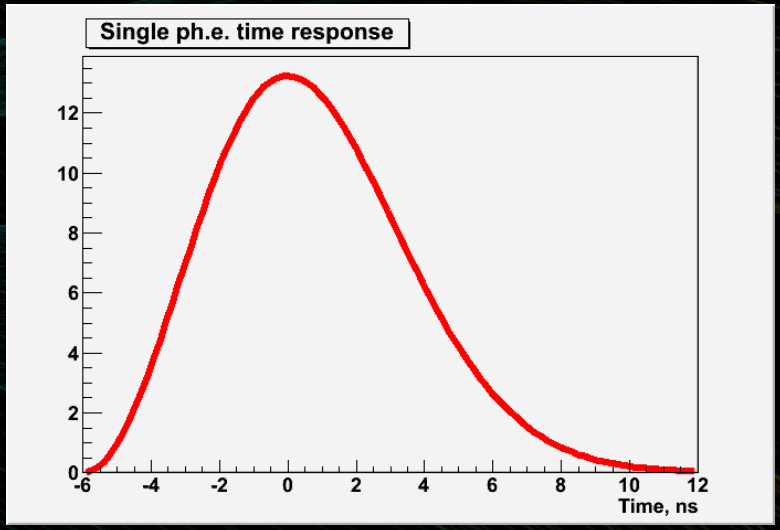
- Extracted from 20009 real raw-data (low thresholds)
- Procedure:
  - Fill 1/Signal Amplitude (in ADC) vs leading & trailing times of the signal
  - Fit leading and trailing distributions separately and extract parametrization function
  - Combine two functions in order to get the parametrized signal shape
- Quite compatible with shape obtained in the lab

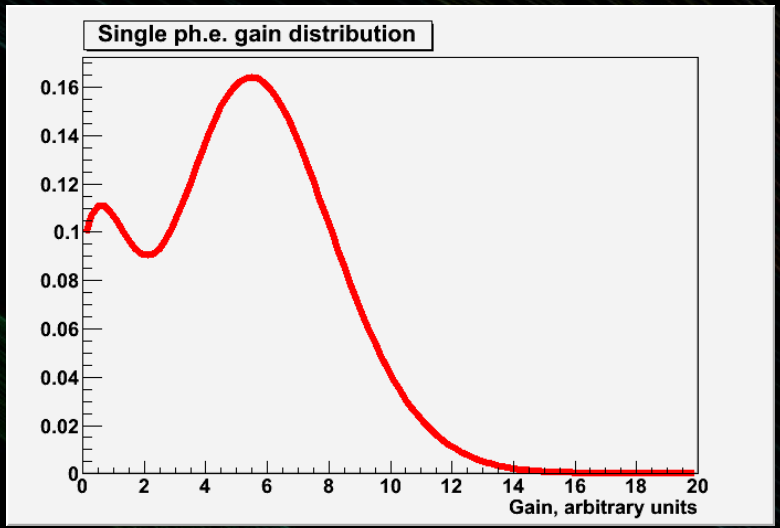


# PM response

- Digitization is done simulation the PM response to each individual photo-electron:
  - PMs are special – 'fine-mesh' type able to operate in strong mag.field
  - Time response according to PM specifications
  - Gain according to specifications (25% transparency of the first dynode)
  - Signal shape is de-convoluted using ph.e. time response function
  - De-convoluted shape is used in order to generate time of arrival of photons at the photo-cathode

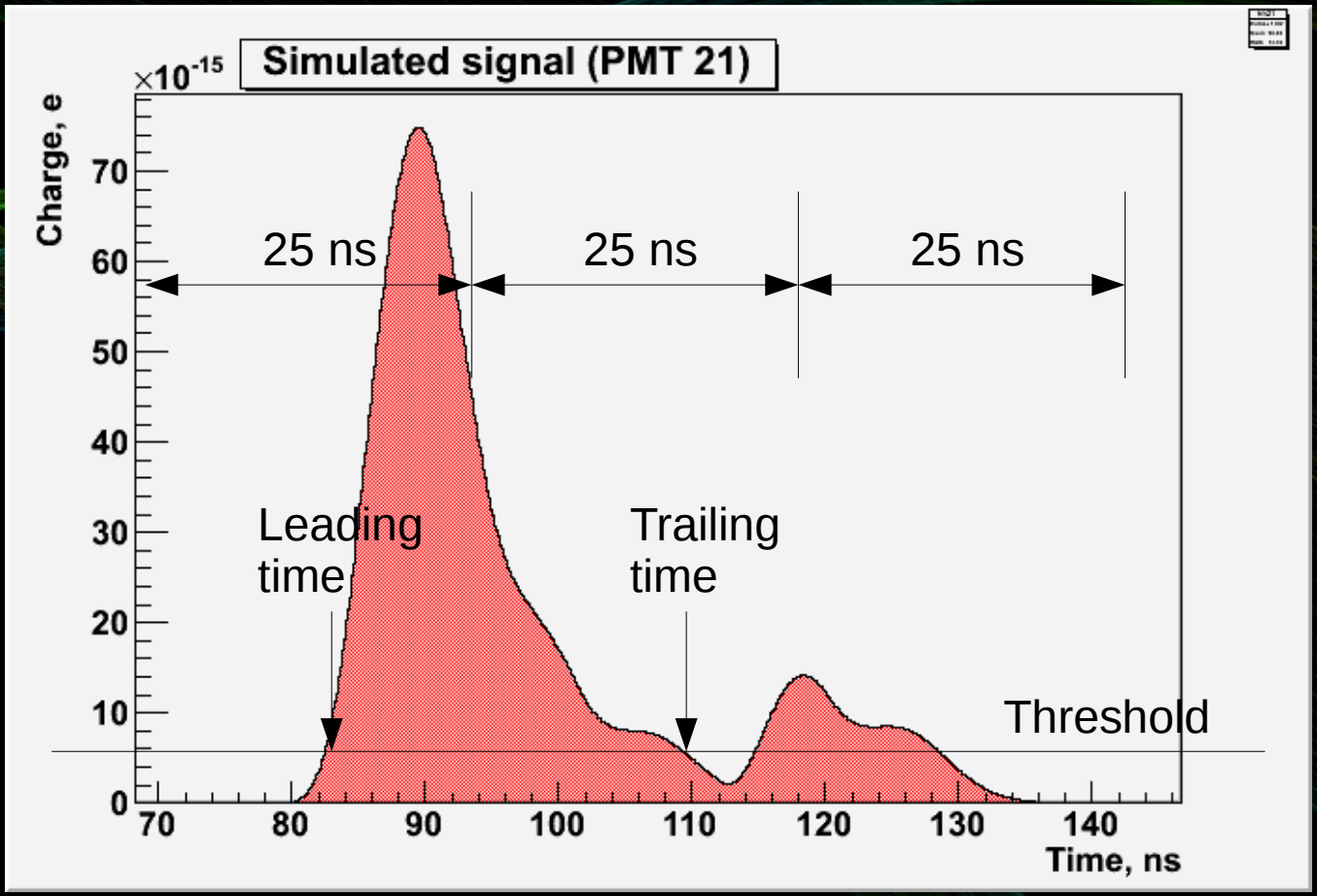


# Digitization

- Starting from hits (number of photons, tof)
- Light-collection eff obtained comparing to ADC signals from real raw data
- # of photons -> # of photo-electrons
- Each photo-electron generates a signal using
  - PMT gain distribution
  - Time of arrival according to de-convoluted signal shape
- Ph.e. Signals summed up channel-by-channel and stored in 'charge-distribution' arrays (binsize = HPTDC resolution)
- HPTDC thresholds are applied
  - Threshold value (defined in OCDB in units of ADC) transformed to charge
  - HPTDC leading and trailing times are extracted
- Charge is summed up in bins of 25 ns (ADC sampling period)
- Obtained ADC is smeared using the measured pedestal distribution and stored in Digits

# Digitization

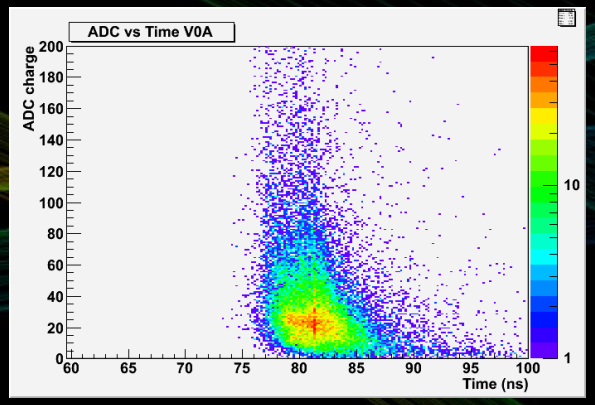


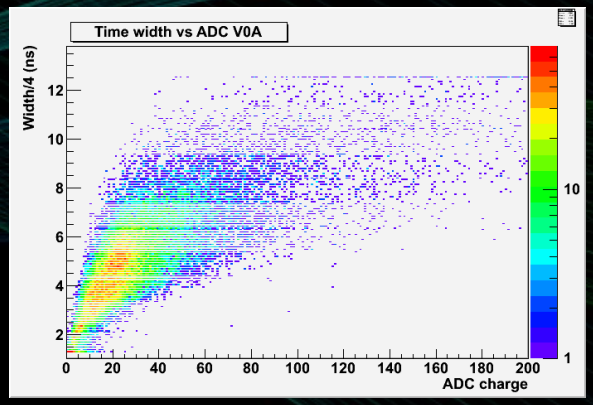
# Digits Format

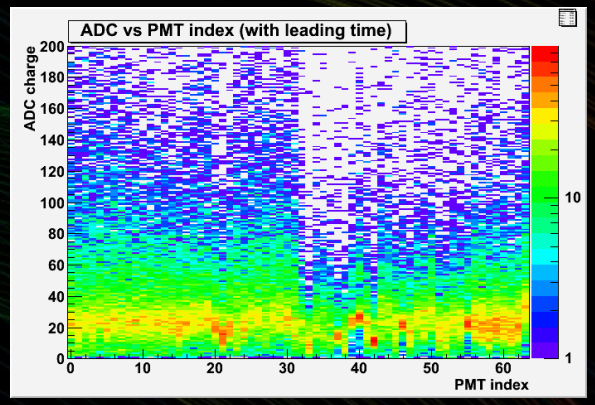
- New digitization allowed to change digits format in a way that it fully corresponds to raw data
  - 21x 25 ns ADC values
  - Leading time and signal width (trailing – leading time)

# MC: Comparison with data

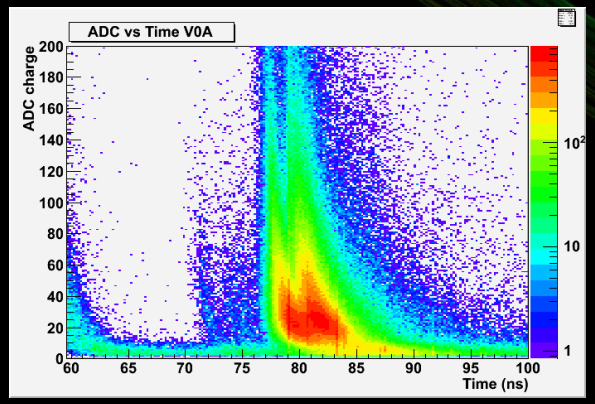
**MC**

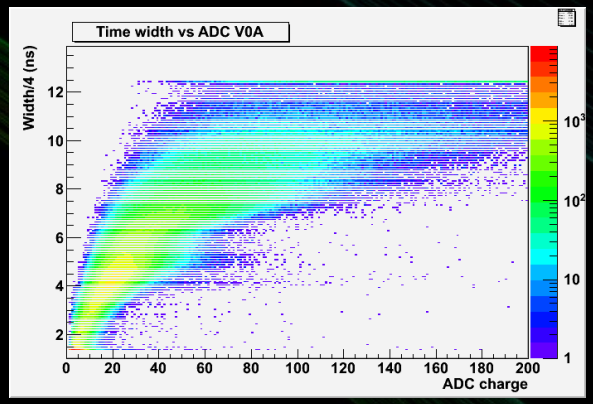


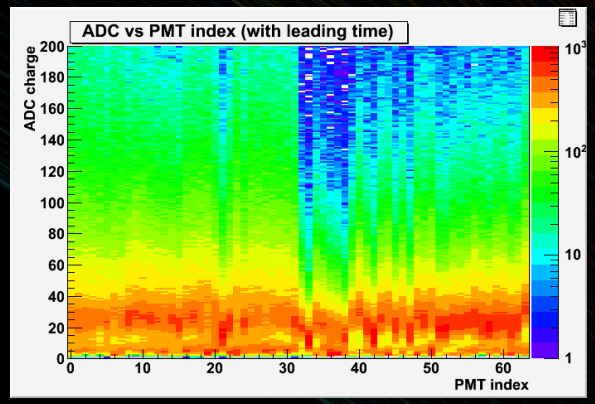




**DATA**



# SDigits, Merging and Embedding

- SDigit has been introduced
  - It contains mentioned before 'charge-distribution' array (binsize = HPTDC resolution)
  - That is the only contents allowing to make proper summing, but is a bit difficult for Raw->SDigits
- Hits->Digits, Hits->SDigits, Sdigits->Digits have been tested and committed
- Event merging was exercised and validated using test/merge suite in aliroot
- Raw->SDigits procedure (committed):
  - Reconstruct raw data and extract leading time (corrected for slewing) and total ADC charge per channel
  - Use the mean signal shape and produce 'charge-distribution' array
  - Caveats:
    - Signal width is not 'smeared', but is rather a function of ADC
    - Charge outside leading and trailing HPTDC times will be wrongly placed between them
  - Anyway, that is the best option with the limited data contained in raw-data stream
- Event embedding tested within test/embedding and outside
  - Validated on Hits->SDigits->Digits->Raw->SDigits->Digits->ESD sequence

# Trigger simulation

- VZERO provides trigger (inputs to CTP) based on HPTDC times or ADC charges
- Existing simulation was adapted slightly to new digitization
- Main improvement is that we now use only charge accumulated with 25 ns (trigger bunch crossing) and not the full charge coming from hits
- Still to be clarified:
  - TRD pretrigger and EMCAL trigger use VZERO analog signals
  - Presently both detectors load VZERO digits, that is bad because:
    - Both detectors depend on VZERO
    - Digits do not necessarily correspond to analog signals
  - The proposal is to use SDigits instead, moreover exchanged via detector-independent format
    - Can this be done in the new trigger simulation framework?

# Slewing and time resolution

- New detailed simulation allowed to understand the effects contributing to slewing and time resolution
- Slewing (diff. between the time when signal > threshold and time0)
  - Parametrized with much simpler function now

    **t = 10.5ns / sqrt ( ADC / Threshold )**
- Resolution:
  - **σ(t) = sqrt(390 ps ^ 2 + (2.5 ns / sqrt( Nph.e. ) ) ^ 2 + slewing term)**
    390 ps – intrinsic time resolution, finite size scintillators, fibers etc
    2.5 ns – single ph.e. time response rising edge
    slewing term – first derivative of slewing correction * ADC error
  - No more arbitrary functions – all terms come from well identified detector response effects
- <u>Both slewing and resolution are now parametrized in a way that they can be applied directly even in case of different HVs, thresholds etc.</u>

# Reconstruction

- No major changes, but still:
  - RAW->Digits revised using new Digits format
  - All the reconstruction-related code is moved to reconstruction from digits
  - New parametrization of time slewing and time-measurement error
  - <300 ps (C side) and ~450ps (A side) resolution @7 TeV
  - All the code from AliTriggerAnalysis (used in AliPhysicsSelection) is moved to the reconstruction
  - ESD contains:
    - Average time per side and its error
    - Offline-trigger decision per side (empty, beam-beam, beam-gas, control)
    - Trigger mask (beam-beam or beam-gas flags) from either raw data or simulation

# Pre-pulses

- Some small-amplitude pre-pulses seen already on the first 200 evts in 2009
- 2010 showed that these are not stat fluctuations
- On A side only appear also in beam-gas events
- Signal shape is either very short or overlapping with a consecutive one
- **<u>Identified as direct hits of charged particles in PMTs!</u>**
  - Compatible with the length of the fibers on both sides (very short - A side; 3-4 m – C side)
  - Compatible with very short signal shape

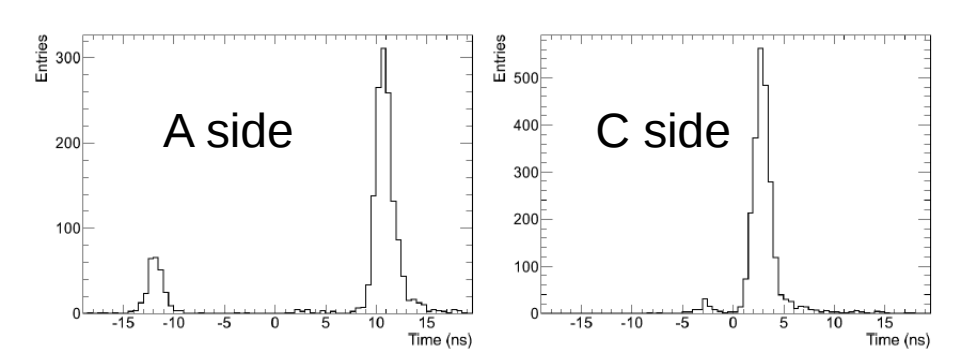
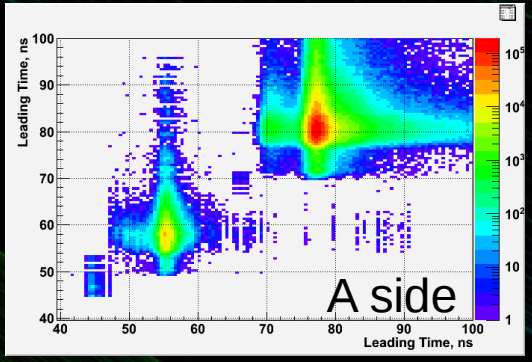
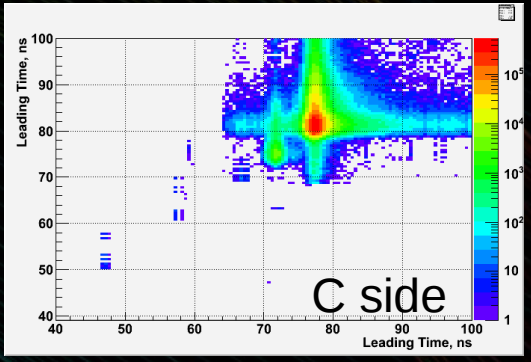
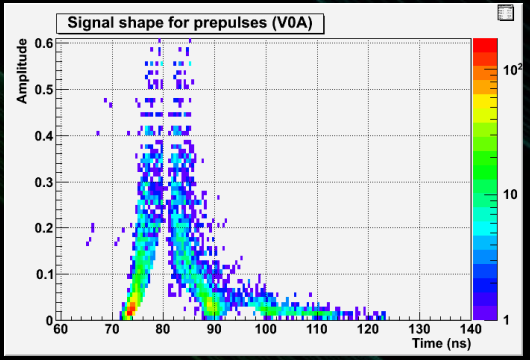



**Fig. 3.** Arrival time of particles in the VZERO detectors relative to the beam crossing time (time zero). A number of beam-halo or beam–gas events are visible as secondary peaks in VZERO-A (left panel) and VZERO-C (right panel). This is because particles produced in background interactions arrive at earlier times in one or the other of the two counters. The majority of the signals have the correct arrival time expected for collisions around the nominal vertex.



# OCDB

- Hopefully all needed data for proper simulation and reconstruction is now in OCDB
  - HPTDC parameters – search windows, resolution, thresholds etc.
  - Trigger – beam-beam & beam-gas time windows, ADC sum thresholds
  - HVs, pedestal values from DA
    - Pedestals calculated from charges with 150->250 ns before the trigger, DA has to be revised in case of incompatible LHC filling scheme
- Still one 'bug report' in CTP savannah
  - Last missing brick in the calculation of delays of the signals is the fine-delay setting in LTU
  - Underway, will be implemented via DAQ logbook/Shuttle
  - One array with LTU configuration for each detector (in GRP)
- One additional entry with light-collection eff might help to have more flexible code

# QA

- Few QA tasks still pending (see next slide)
- We have analysis task in QA analysis train
  - # of histograms could be reduced now
- To do:
  - AMORE module to be revised soon
  - Histograms for DQM shifter as well

# Savannah Bug Reports

- bug #68837: Correction for the wrong CTP alignment in the second fill of 2010 900 GeV data
  - Status: waiting for CTP to produce sort of reference alignment OCDB entry or a separate entry indicating the actual misalignment in these data
- bug #67277: Seasonal drift of LHC clock
  - Ongoing preparation to put the TOF time0 measurements to GRP (one number per file, validity: run->inf). Some of the TOF data will have to be corrected for a detector effect between LHC10b and LHC10c periods
  - Already now (?) the phase is (will be?) corrected online at CTP level using measurements from BPTXs, precision 0.5ns
  - From some moment one – the residual phase measured by BPTX -> GRP via DCS/Shuttle

# Planning tool – remaining tasks

| | | | | | | |
|---|---|---|---|---|---|---|
| | ***VO*** (137) | Brigitte.Cheynis | - | 01/01/2006 | - | 31/08/2010 |
| ✓ | ***Alignment*** (1147) | Brigitte.Cheynis | - | 01/01/2006 | 09/07/2008 | 18/09/2008 |
| ✓ | ***Calibration*** (1151) | Brigitte.Cheynis | - | 01/01/2006 | 26/05/2009 | 30/05/2009 |
| ✓ | ***Reconstruction*** (1157) | Brigitte.Cheynis | - | 01/01/2006 | 19/10/2009 | 30/05/2009 |
| ✓ | ***Simulation*** (1160) | cvetan.cheshkov | cvetan.cheshkov (100%) | 01/01/2006 | 02/07/2010 | 16/07/2010 |
| ✓ | Implementation of track references (2492) | Brigitte.Cheynis | Brigitte.Cheynis (100%) | 16/03/2009 | 30/05/2009 | 30/05/2009 |
| ✓ | Handling of the time information from hits during digitization (2489) | cvetan.cheshkov | cvetan.cheshkov (100%) | 16/03/2009 | 14/04/2010 | 19/04/2010 |
| ✓ | Accounting for detector response in the time information stored in digits (2490) | cvetan.cheshkov | cvetan.cheshkov (100%) | 16/03/2009 | 14/04/2010 | 19/04/2010 |
| ✓ | Propagation of labels from kinematics tree for Hits, Sdigits, Digits (2491) | cvetan.cheshkov | cvetan.cheshkov (100%) | 16/03/2009 | 01/06/2010 | 30/04/2010 |
| ✓ | Verification of the event merging procedures (2493) | cvetan.cheshkov | cvetan.cheshkov (100%) | 16/03/2009 | 28/06/2010 | 30/06/2010 |
| ✓ | Correct treatment of the detector signal in the sdigits for event merging (2494) | cvetan.cheshkov | cvetan.cheshkov (100%) | 16/03/2009 | 28/06/2010 | 30/06/2010 |
| ✓ | Verification of the embedding procedures (2495) | cvetan.cheshkov | cvetan.cheshkov (100%) | 16/03/2009 | 02/07/2010 | 16/07/2010 |
| | ***Quality Assurance*** (1403) | Brigitte.Cheynis | - | 01/01/2006 | - | 31/08/2010 |
| ✓ | Implementation of reconstruction in QA checker (2501) | Brigitte.Cheynis | Brigitte.Cheynis (100%) | 16/03/2009 | 30/05/2009 | 30/05/2009 |
| ✓ | Implementation of run type (2499) | Brigitte.Cheynis | Brigitte.Cheynis (100%) | 16/03/2009 | 04/03/2010 | 31/01/2010 |
| | Implementation of simulation in QA checker (2500) | Brigitte.Cheynis | Brigitte.Cheynis (100%) | 16/03/2009 | - | 31/08/2010 |
| | Implementation of reference data (2502) | Brigitte.Cheynis | Brigitte.Cheynis (100%) | 16/03/2009 | - | 31/08/2010 |
| | Extract QA data from large Monte Carlo production (2655) | Brigitte.Cheynis | Brigitte.Cheynis (100%) | 08/07/2009 | - | 31/08/2010 |
| ✓ | Implement method virtual Double_t * Check(AliQAv1::ALITASK_t /*index*/) (2671) | Brigitte.Cheynis | Brigitte.Cheynis (100%) | 27/07/2009 | 15/10/2009 | 31/12/2009 |
| ✓ | ***Trigger*** (2377) | Brigitte.Cheynis | Brigitte.Cheynis (100%) | 16/03/2009 | 24/06/2009 | 30/05/2009 |

# Conclusions

- New simulation code
  - One can use directly all entries from RAW OCDB
  - Much more realistic TDC and ADC response
  - Fully operation event merging and embedding
- Time slewing and resolution understood
  - Proper reconstruction using only conditions data written by Shuttle pp (HVs, TDC thresholds, ...)
  - In principle, no need in offline update of OCDB
- Reconstruction stream-lined
  - Fully compatible raw and digits reconstruction
  - All the code from analysis moved to reco
- Some pending QA tasks to be finalized soon