# Integration of Alignment in the ALICE calibration Framework

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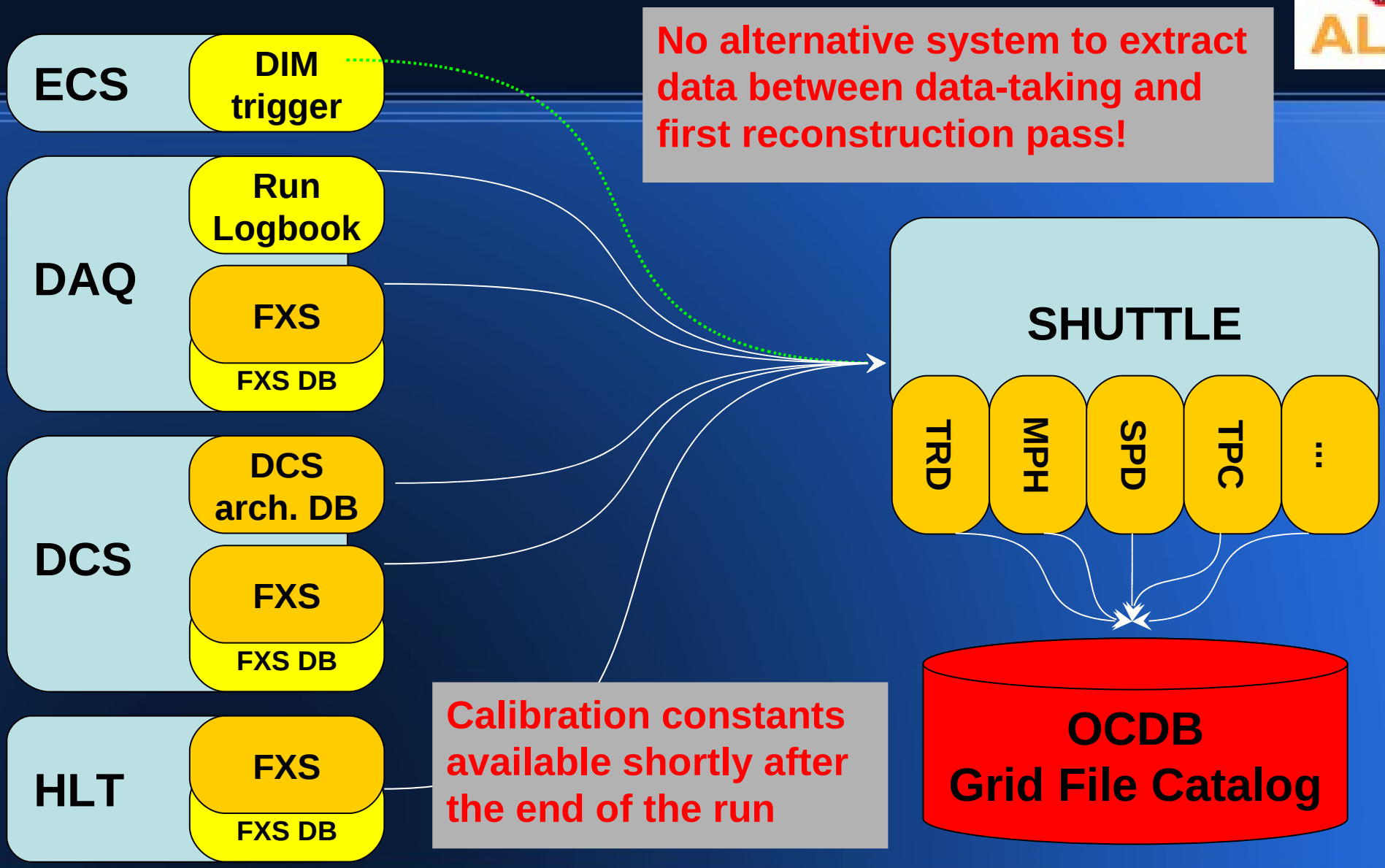
3rd LHC Detector Alignment Workshop

# Outline

- Overview of ALICE calibration framework
- Input data for alignment
- Alignment procedure
- Alignment on ALICE CAF
- Alignment validation
- Conclusions

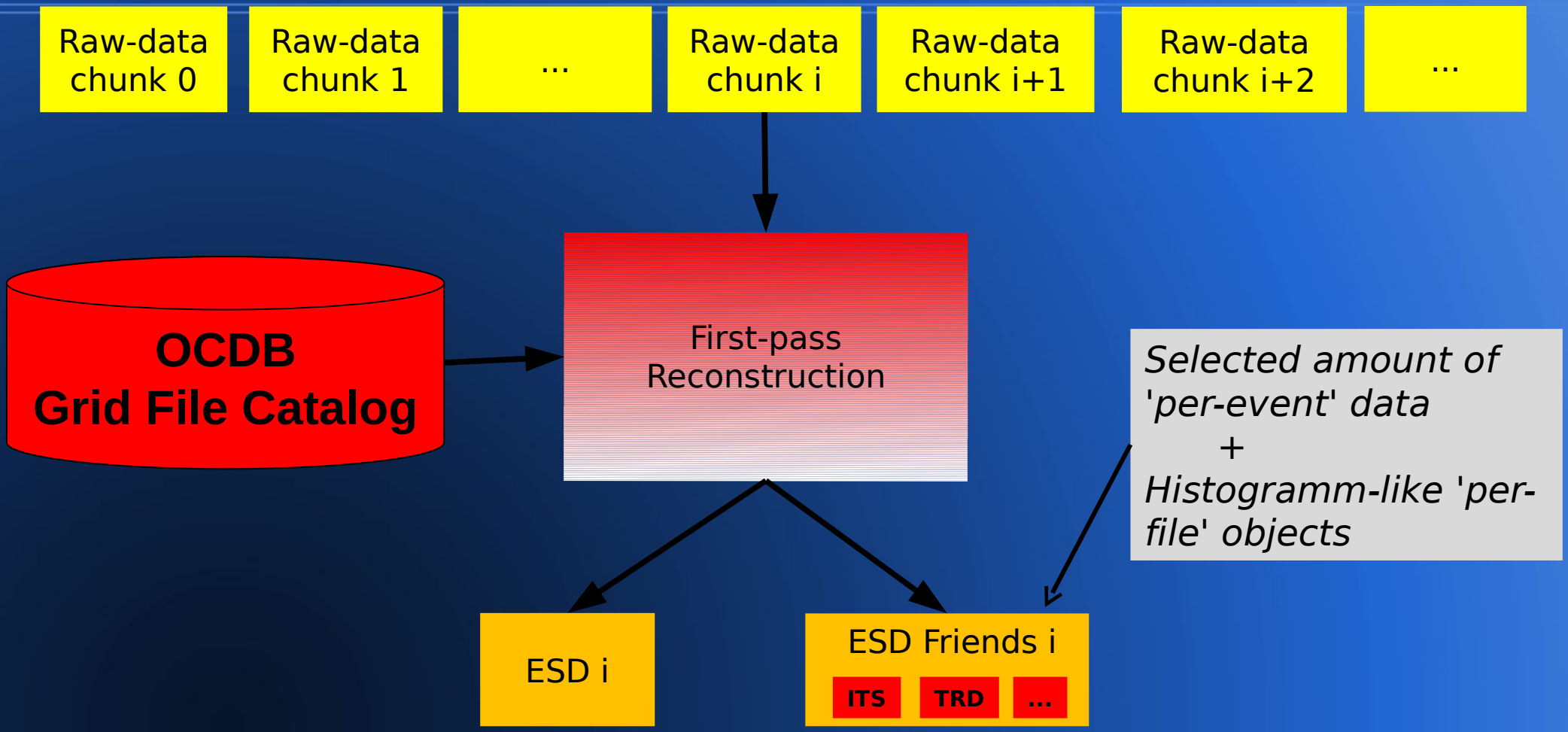
# 'Online' Calibration (Shuttle)



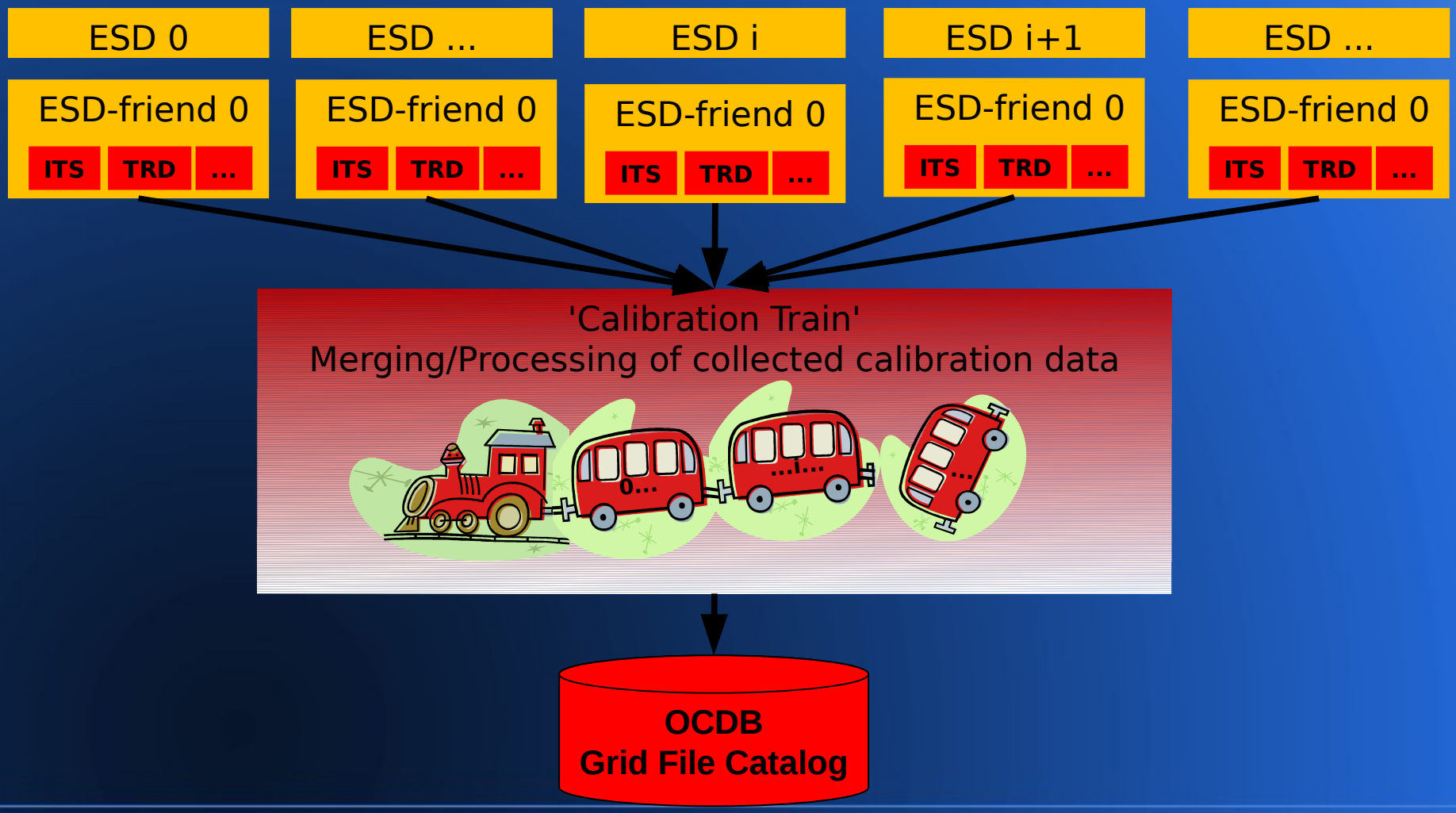
# 'Offline' Calibration

- Done in two main steps:
  - Extraction and storage of calibration related data during the reconstruction
  - Processing of collected calibration data and producing of calibration constants for OCDB
- Done on the GRID by using only ESD (Event Summary Data) and ESD-'friend' (calibration related data) from the first-pass reconstruction
- Operated via well structured and centrally managed 'calibration train' identical to the ALICE analysis train
- Train runs on a homogeneous data sample defined by the ALICE production manager
- Validity range of slowly changing calibration constants (including alignment) from particular run# to infinity
  - Allows to start next run period reconstruction with better calibration and alignment

# 'Offline' Calibration – Step 1



# 'Offline' Calibration – Step 2



# Alignment within Step 2

- 'Calibration train' produces single file per detector(s) with all selected tracks/space-points
- Final alignment processing (millipede-based or iterative track-fitting approaches)
  - Runs on single CPU
  - Initially performed manually by detector experts with the aim to switch as soon as possible to automatic processing on the GRID + automatic update of OCDB

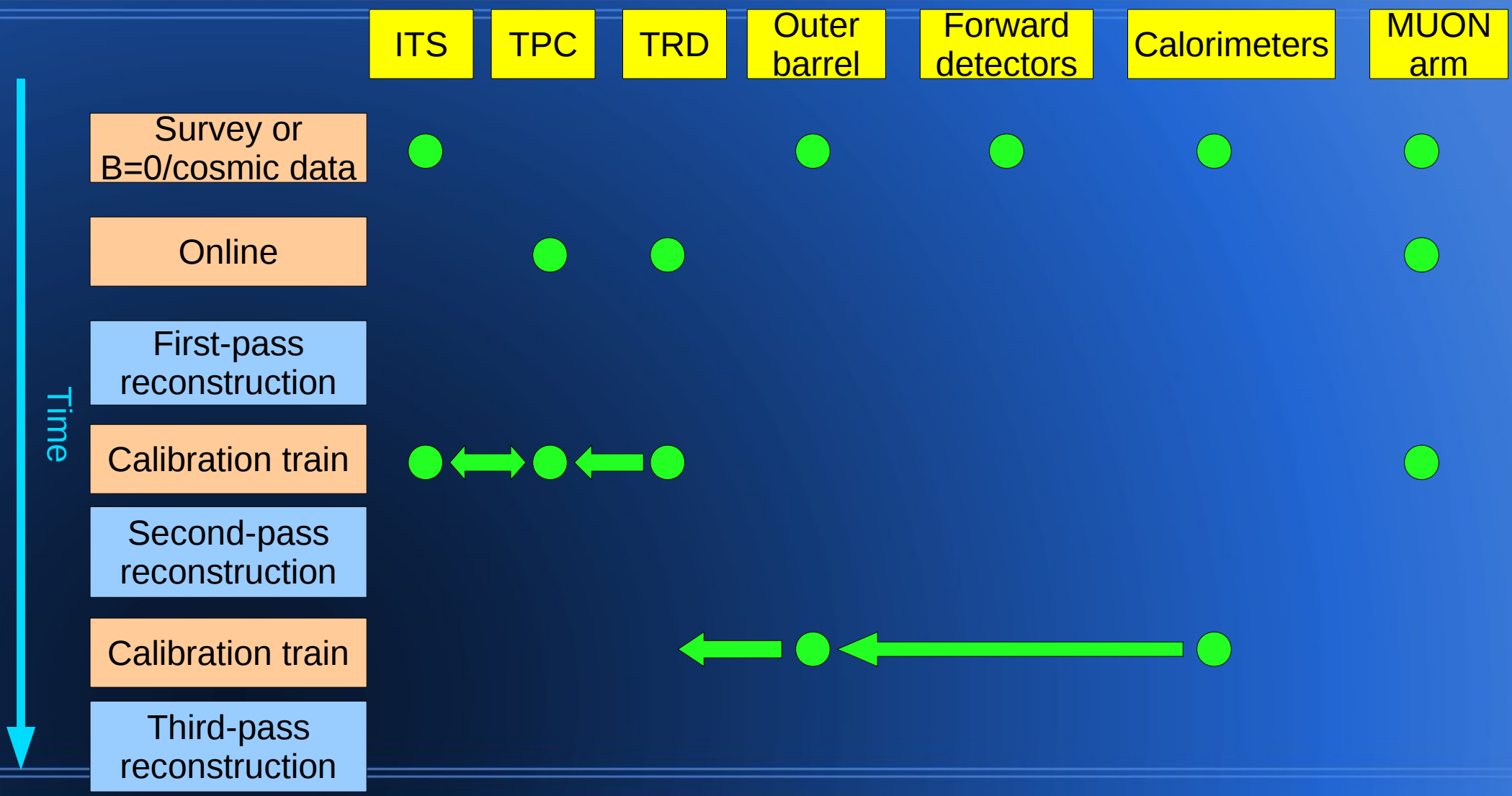
# Input Data for Alignment

- Reconstructed clusters associated to tracks are stored as space-point arrays:
  - In global coordinate system
  - Full covariance matrix
  - Drift time, charge – needed by drift detectors performing spatial calibration and alignment simultaneously
- First-pass tracking with wide track-finding roads
  - Sufficiently high efficiency
  - Minimum bias for alignment

# Input Data for Alignment

- Space-points stored in ESD-friend
- ESD-friend size << ESD size
  - Track selection (high Pt, golden tracks)
  - Sampling from all reconstructed tracks
- Detectors are now evaluating the required statistics

# Alignment Procedure (Picture)



# Alignment Procedure (Remarks)

- First-pass 2009 LHC data will be reconstructed using the alignment obtained from the preceding cosmic run
- Drift detectors (TPC and TRD): online detector algorithms for simultaneous alignment/calibration online within Shuttle
  - For example TPC analyzes special laser events
- MUON arm: hardware monitoring system data online within Shuttle

# Alignment on ALICE CAF

- CAF (CERN Analysis Facility) – ROOT PROOF-based cluster hosted by IT
- Parallel processing of the data
- Used for debugging and tuning of ALICE reconstruction/calibration/analysis
- CAF provides access to sizable amount of data from previous reconstruction passes + access to raw data
- Between reconstruction passes will be used by the detector experts to tune and validate their alignment procedures

# Alignment Validation

- Validation data:
  - Track-cluster residuals
  - Impact parameter (ITS)
  - Track-to-track residuals (cosmic data)
  - Later on - physics observables
- These data are intrinsic part of the ALICE Quality-Assurance (QA) Framework
- They are produced during the reconstruction

# Alignment Validation

- After the 'Calibration Train' is finished and the alignment constants are prepared
  - Pre-production using sufficient fraction of raw data
- Quick check of ESD + QA is performed by the detector experts
- Global (inter-detector) alignment is checked and validated centrally

# Conclusions

- ALICE has designed calibration strategy including alignment
  - Two main phases: 'online' and 'offline'
- The input data for alignment are defined and exercised during the ongoing MC productions
- ALICE alignment procedure is mostly finalized
  - In the future the aim will be to move more and more alignment algorithms towards earlier reconstruction passes or even online
- Alignment validation is operational as a part of ALICE QA framework