Performance Analysis of the AD Detector Control System in the ALICE Experiment

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ALICE

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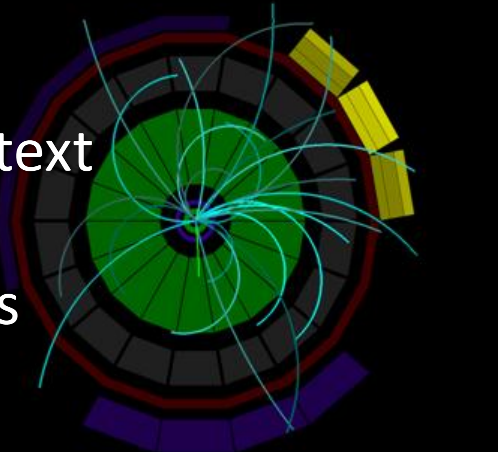

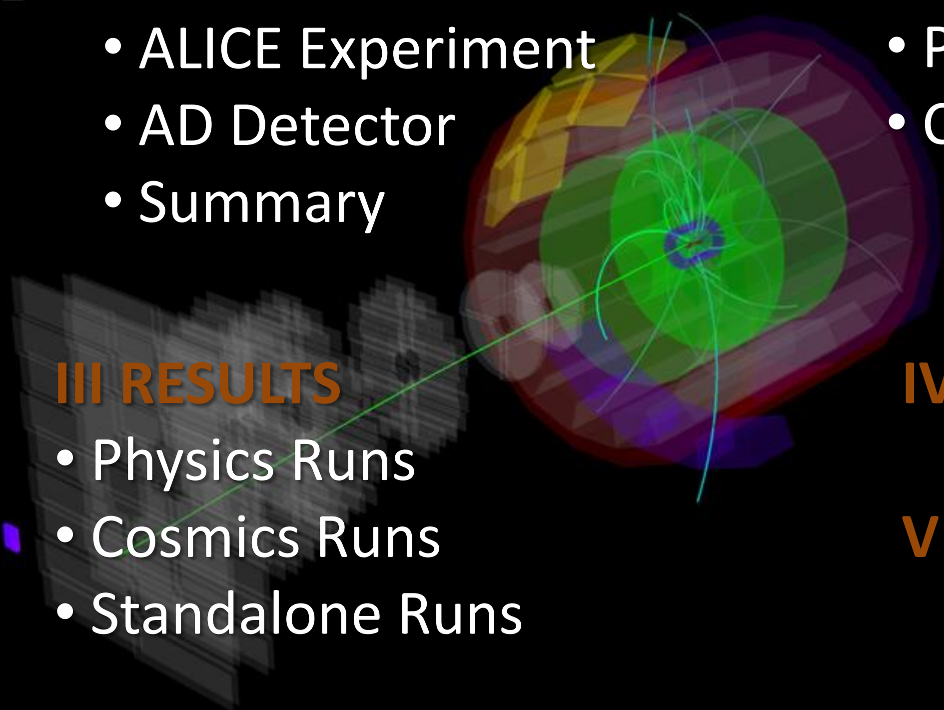

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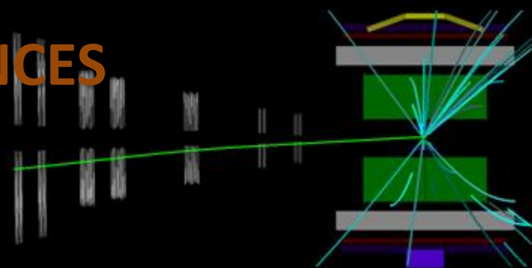
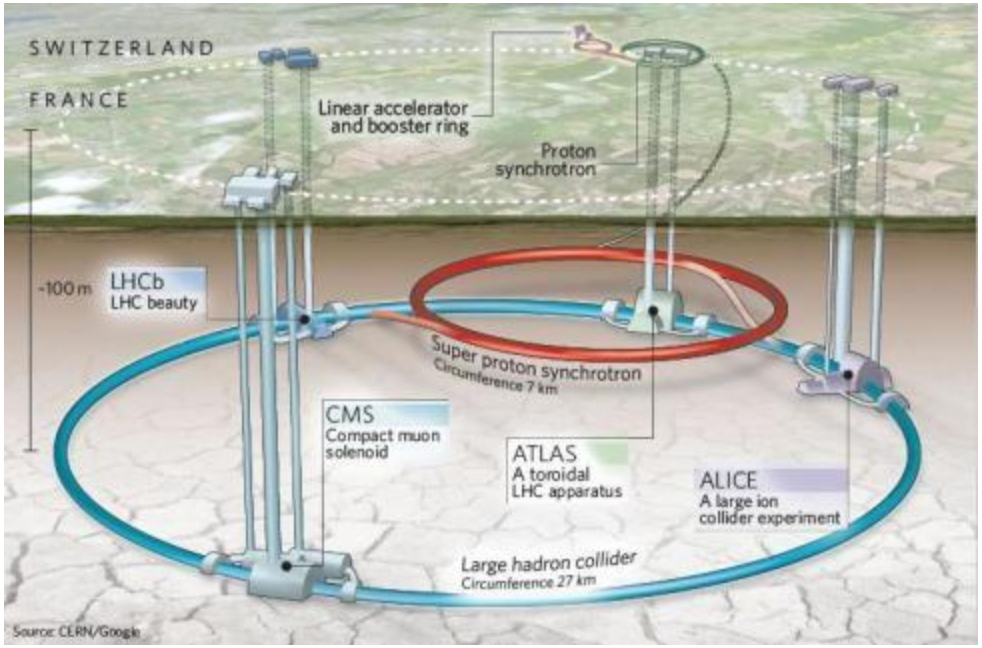
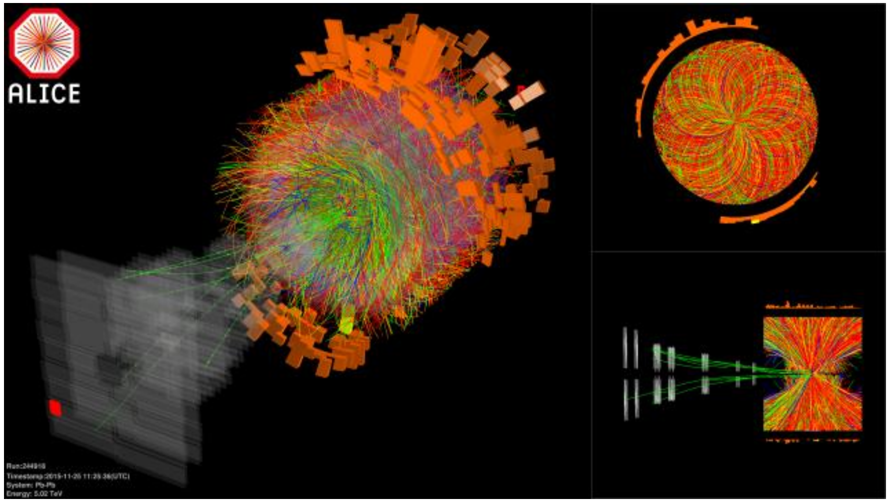


Run:252245
Timestamp:2016-04-23 00:24:47(UTC)
Colliding system:p-p
Energy: 13 TeV

ALICE EXPERIMENT



- Heavy-ion detector
- Physics of strongly interacting matter
- Extreme energy densities
- Proton-proton (pp)
- 19 detectors

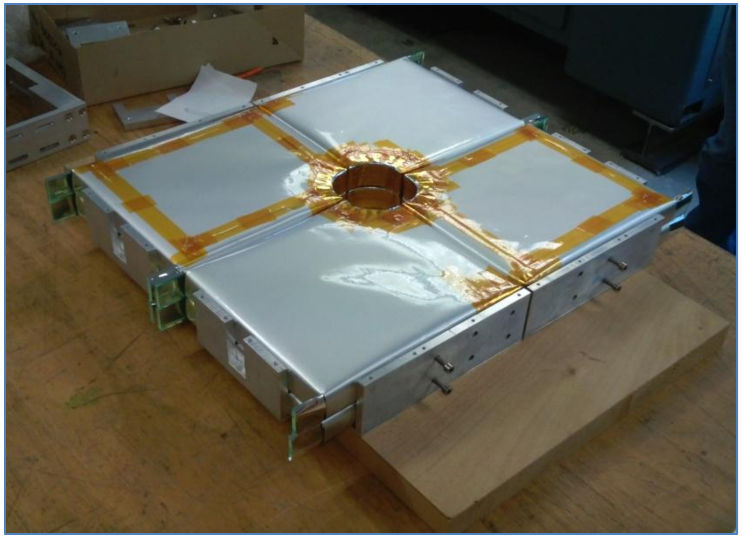


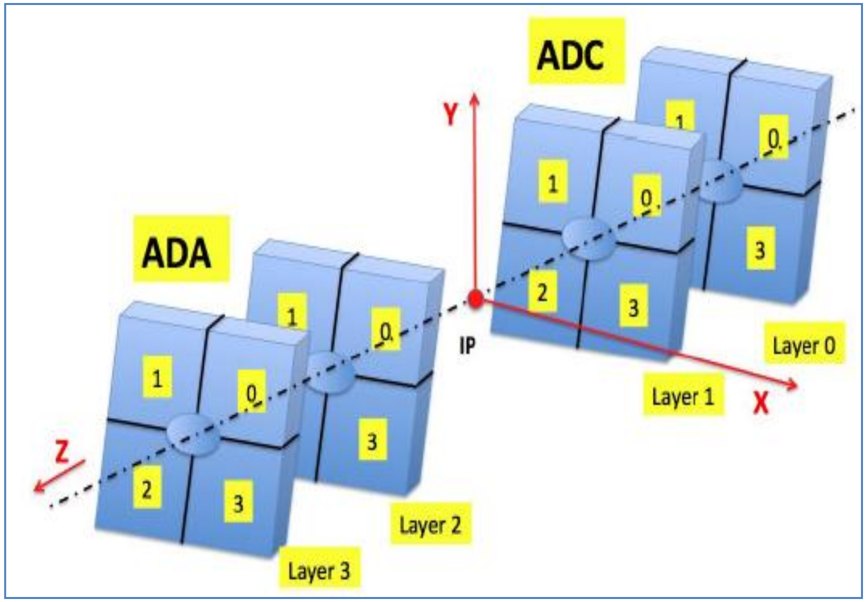
MOTIVATION

- The control system in ALICE must ensure safe and sustained monitoring and operation of detector, both at data taking time and during LHC shutdowns.
- This is done by means of:
  - Configuration of detector parameters relevant for the modes of operation.
  - Monitoring and control of the detector subsystems status during runs.
  - Monitoring and control of safety parameters.
- This work is a first approach to quantitatively evaluate the achievement of these tasks.
- This analysis is a way to know the impact and relevance of the detector control system (DCS) for the performance of the AD detector and, in general, of the ALICE experiments.

ALICE DIFFRACTIVE (AD) DETECTOR

- Two sub-detectors
  - ADA
  - ADC
- Each sub-detector consists of 8 scintillator pads assembled in two 2x2 arrays of pads
- Trigger detector for diffractive physics events in p-p collisions





SUMMARY

- Results on the AD detector performance
  - 2015 and 2016 LHC runs
- Evaluation and Comparisons of the control systems (DCS) main parameters
  - AD and some other ALICE detector and systems
  - Physics runs
  - Cosmics runs
  - Standalone Pulse / Bunch Crossing runs
- Parameters:
  - Number and duration of runs
  - Data Taking Efficiency (DTE)
  - End of Runs (EOR)
  - Pause and Reconfiguration (PAR) procedures
- ALICE Logbook

ANALYSIS CONTEXT

- ***Physics runs***

Type of collisions:

- Proton-proton (p-p)
- Lead-lead (Pb-Pb)
- Proton-lead (p-Pb)

Year	LHC15	LHC16
Beam	Yes	Yes
Run type	Physics	Physics
Partition	PHYSICS_1	PHYSICS_1
HLT mode	C *	C *
Duration of runs	> 10 minutes **	> 10 minutes **
ECS start time	From: 15/03/2015 To: 20/12/2015	From: 01/03/2016 To 20/12/2016
ECS end time	From: 15/03/2015 To: 20/12/2015	From: 01/03/2016 To: 20/12/2016

Table 1. Characteristics of the selected physics runs filters in the ALICE Logbook

* HLT C mode: full HLT functionality - trigger and data processing
** Time reasonably enough for a run to produce useful data for physical analysis.

ANALYSIS CONTEXT

- ***Physics runs***

Detectors can operate during each run as:

- ❑ *Readout Detector*
- ❑ *Trigger Detector*
- ❑ *Trigger & Readout Detector*

Detectors			On-line system
ACO	AD	CPV	*HLT*
EMcal	FMD	HMPID	*TRIGGER*
MUON TRG	MUON TRK	PHOS	*ECS/DAQ*
SDD	SPD	SSD	
TO	TOF	TPC	*DCS*
TRD	VO	ZDC	

Table 2. List of the most recurrent on-line systems and detectors in the PHYSICS_1 partition of the ALICE experiment

ANALYSIS CONTEXT

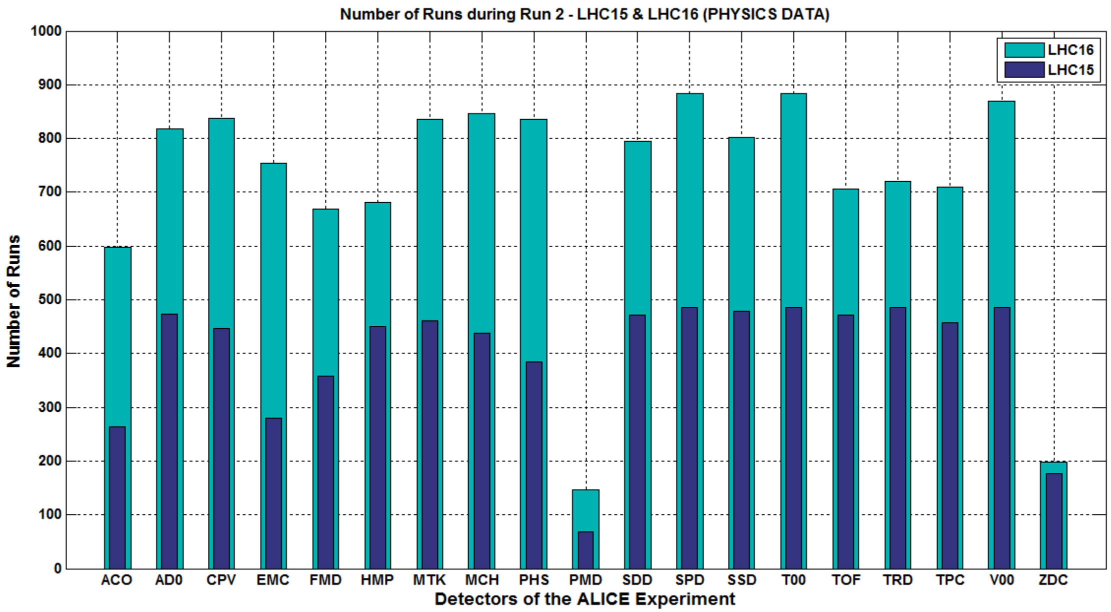
ALICE
A JOURNEY OF DISCOVERY

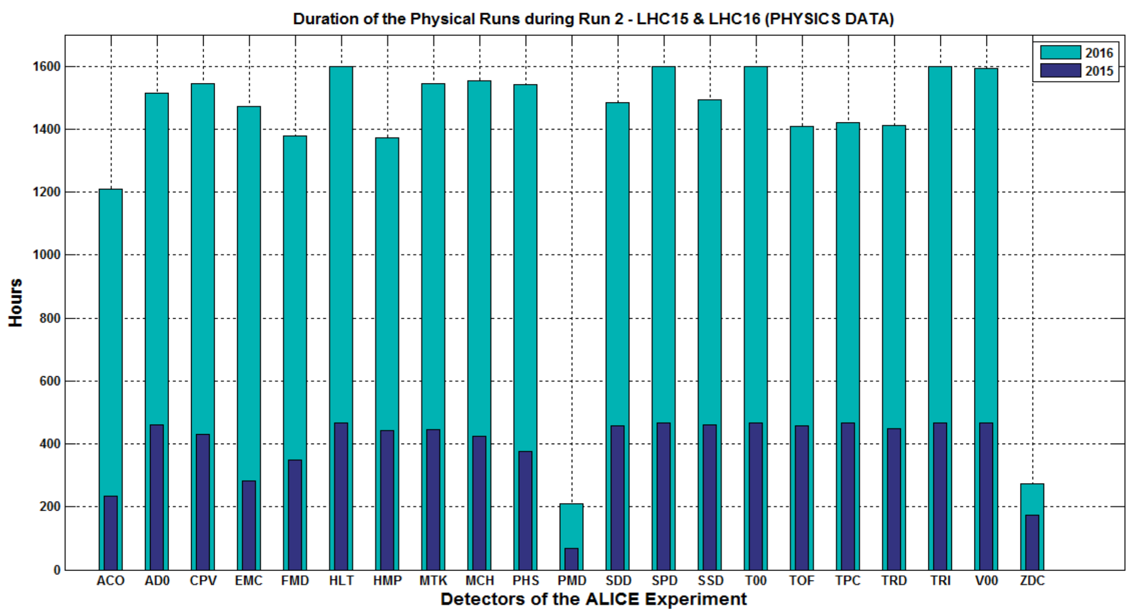
- ***Cosmics runs***

Year	LHC15	LHC16
HLT mode	C	C
Duration of runs	> 10 minutes	> 10 minutes
Shuttle done	Yes	Yes
ACT Instance	cosmic	cosmic
ECS start time	From: 01/03/2015 To: 20/12/2015	From: 01/03/2016 To: 20/12/2016
ECS end time	From: 01/03/2015 To: 20/12/2015	From: 01/03/2016 To: 20/12/2016

Table 3. Characteristics of the selected cosmics runs filters in the ALICE Logbook

RESULTS - Physics Runs -





Number and duration of physics runs

Figure 1. Plot of the number of physics runs in the ALICE experiment detectors during the years 2015 and 2016

Figure 2. Plot of the total time in physics runs for each detector in the ALICE experiment during the years 2015 and 2016

RESULTS - Physics Runs -

ALICE
A JOURNEY OF DISCOVERY

Number and duration of physics runs

- According to the previous plots it can be concluded that AD detector:
  - It was one of the ALICE experiment detectors that more often participated in the LHC runs during 2015 and 2016 for physics data taking.
  - This detector had a considerable number of operation hours for physical data with respect to other detectors.

RESULTS - Physics Runs -

End of Runs (EORs)

• Detectors and systems (internal or external) that originated EORs.

• Some EORs were automatic during data taking, and others were performed by operator due to explicit requests or disturbances in systems

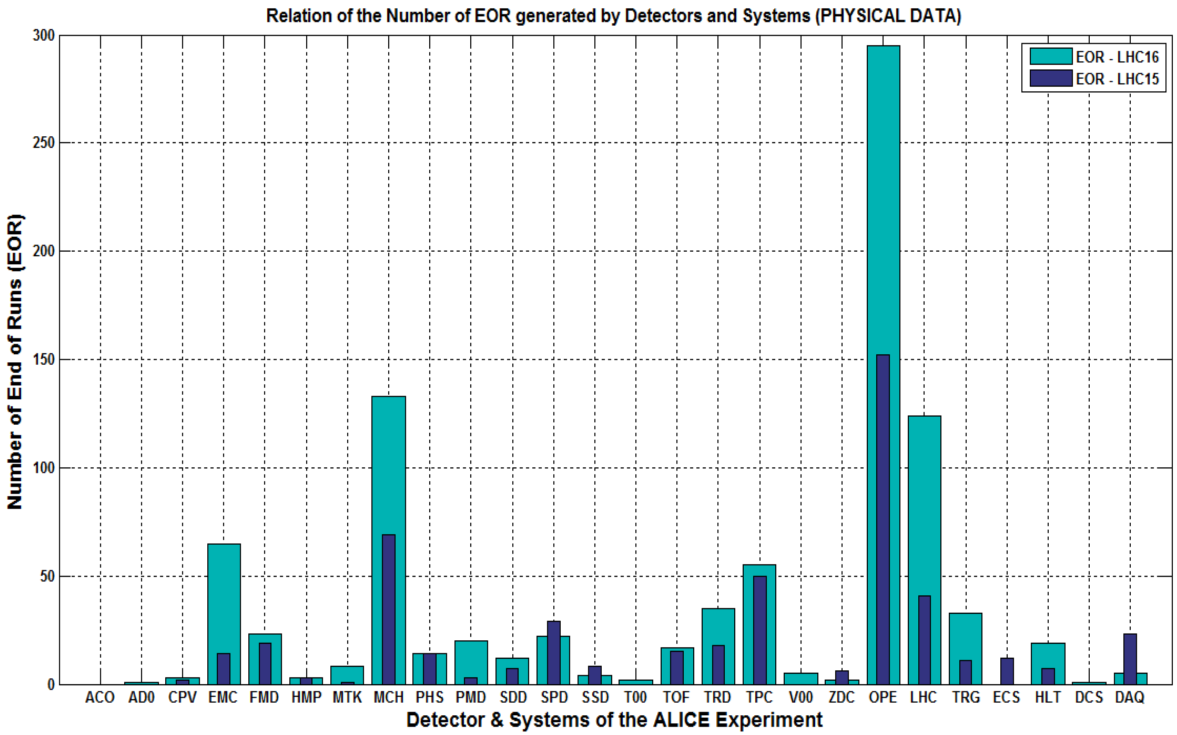
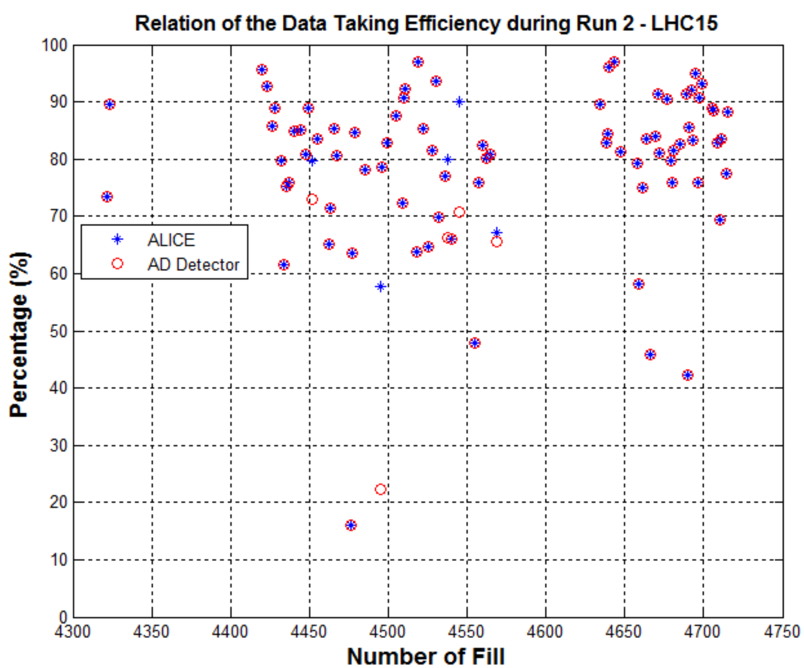


Figure 3. Plot of the number of EORs originated by detectors and systems in physics runs in the ALICE experiment during the years 2015 and 2016

RESULTS - Physics Runs -

Data Taking Efficiency (DTE)

- Data taking efficiency (DTE) is calculated, for each fill, as the ratio of the detector running time to the LHC stable beam time.

a) 

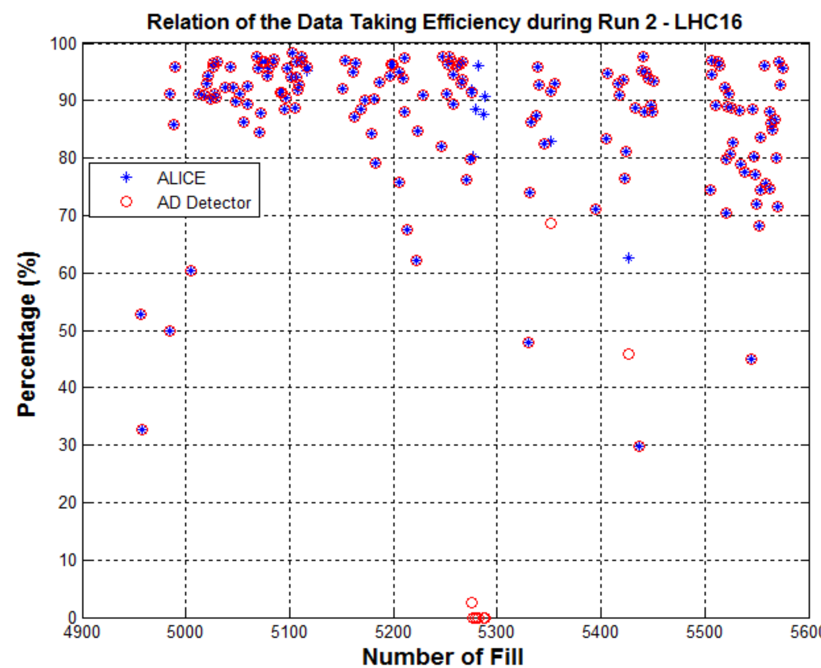
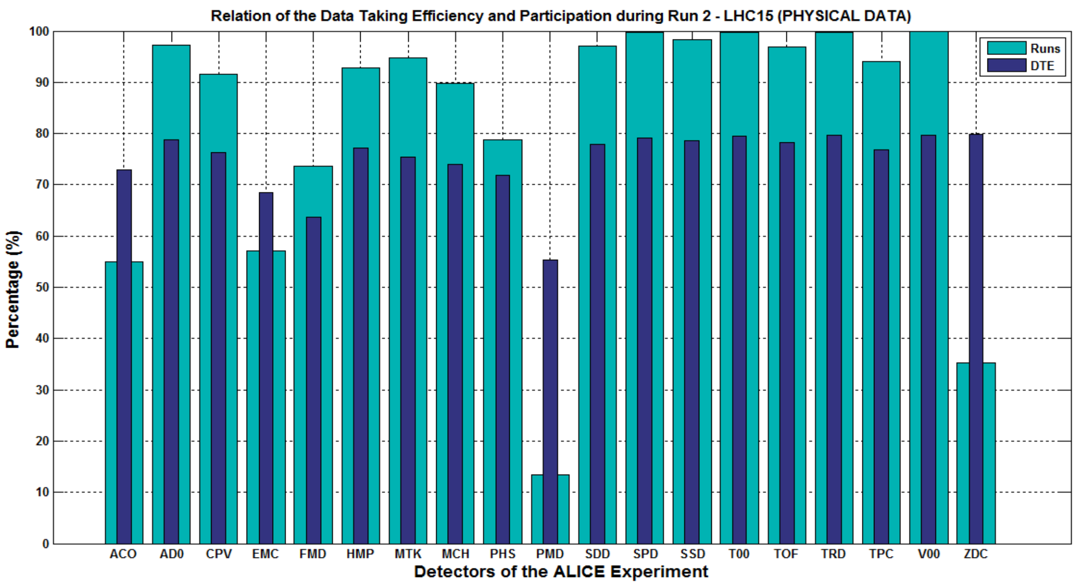
b) 

Figure 4. Data-taking efficiency comparative plots for the AD detector with respect to ALICE experiment for each LHC beam injection in physics runs during: a) 2015 and b) 2016

RESULTS - Physics Runs -



a)

Data Taking Efficiency (DTE)

b)

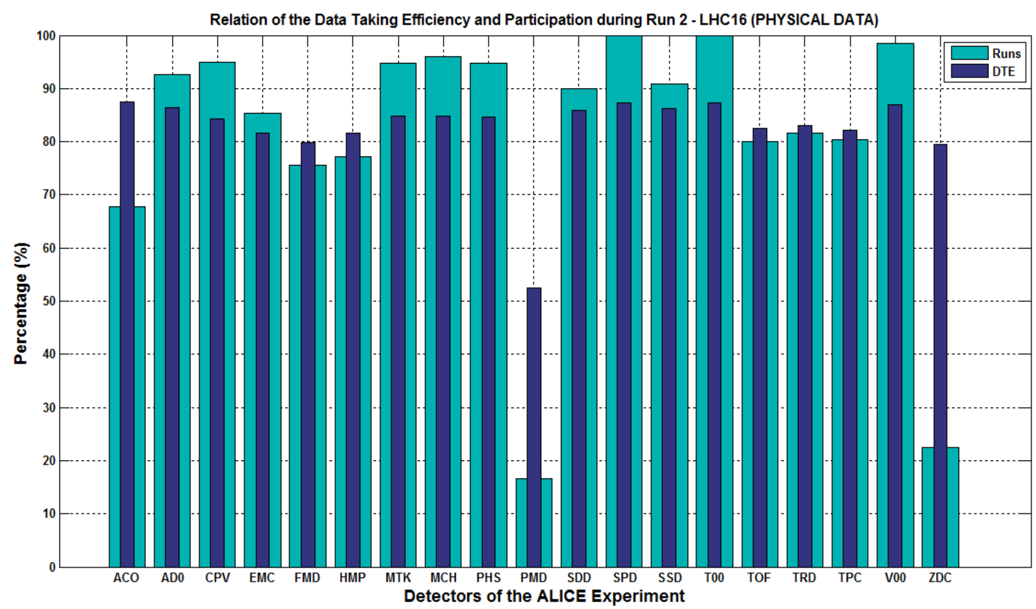


Figure 5. Percentage of the data-taking efficiency and standardized participation of the detectors in the physics runs of LHC Run 2 during a) 2015 and b) 2016

RESULTS - Physics Runs -

Data Taking Efficiency (DTE)

- Last plots shows a good balance between efficiency (DTE) and number of runs for AD during the years 2015 and 2016.
- It presented high efficiency values and a high number of runs.
- Some detectors had an acceptable efficiency, but their participation in the runs is low, and vice versa; like PMD and ZDC detectors cases.

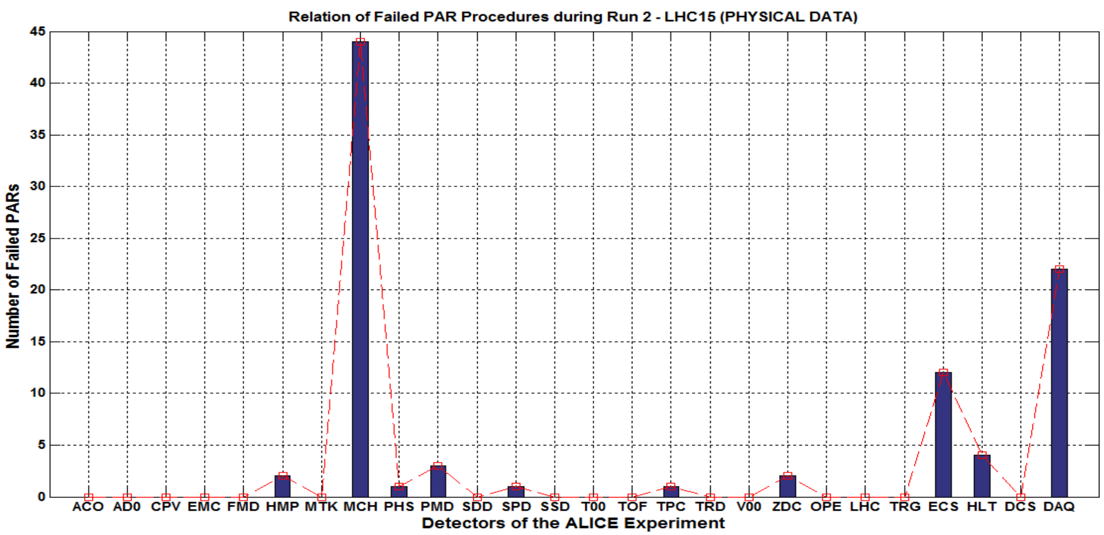
RESULTS - Physics Runs -

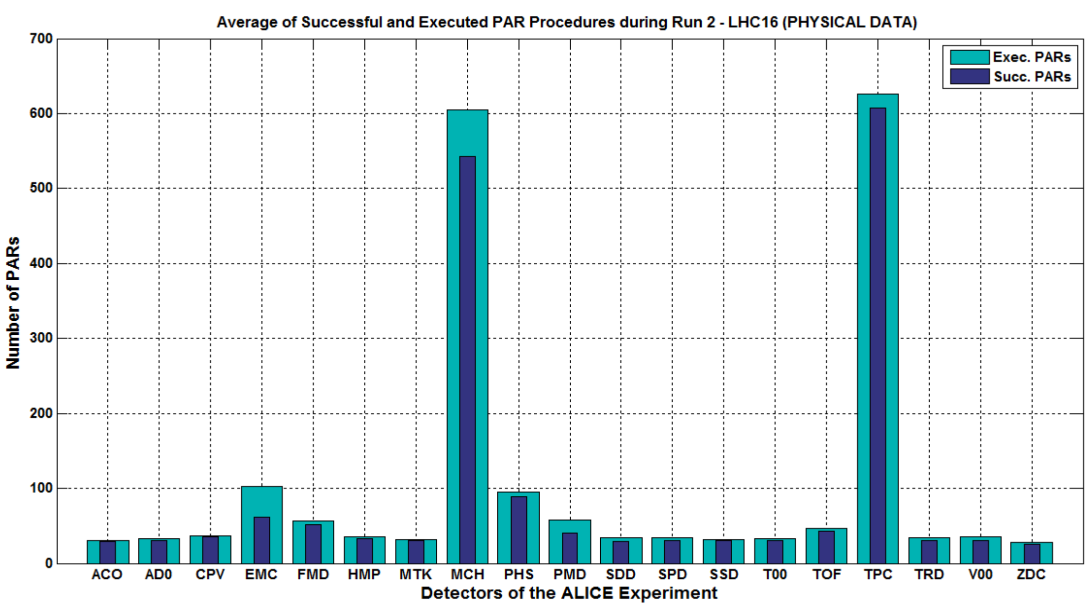
Pause and Reconfiguration (PAR)

DAQ-ALICE work group established a procedure called Pause and Reconfiguration (PAR) to:

- Recover individual detectors triggered by messages in data, state changes in DCS or commands sent by ALICE shifters.
- Monitor detectors to verify their status and eventually recover them if necessary.
- Maintaining detectors that are running in good condition.

RESULTS - Physics Runs -





Pause and Reconfiguration (PAR)

Figure 6. List of erroneous PAR procedures in the ALICE experiment of the physics runs in the year 2015

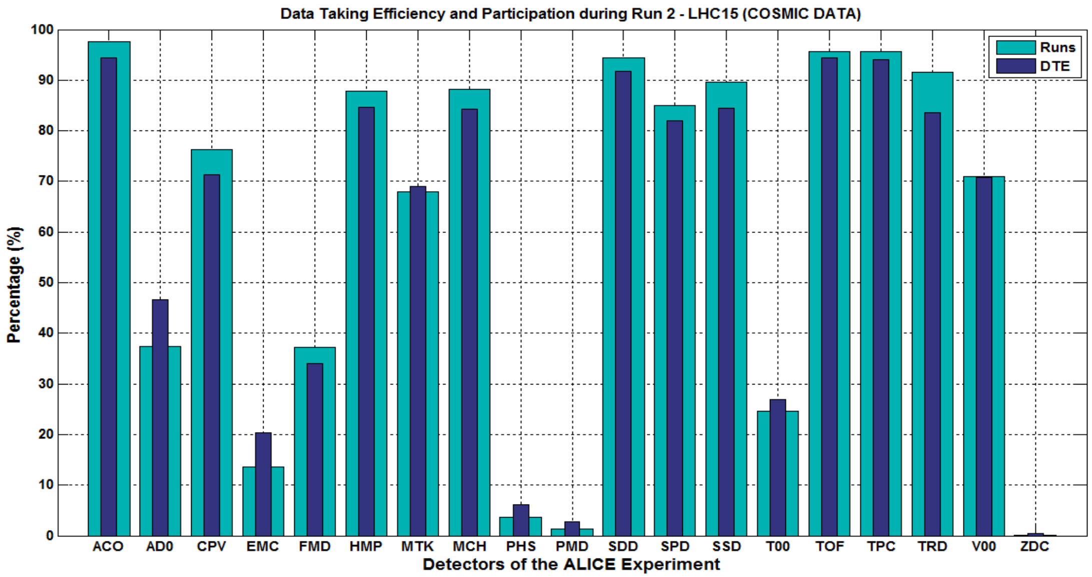
Figure 7. Number of successful and executed PAR procedures in the ALICE experiment detectors for physics runs in the year 2016

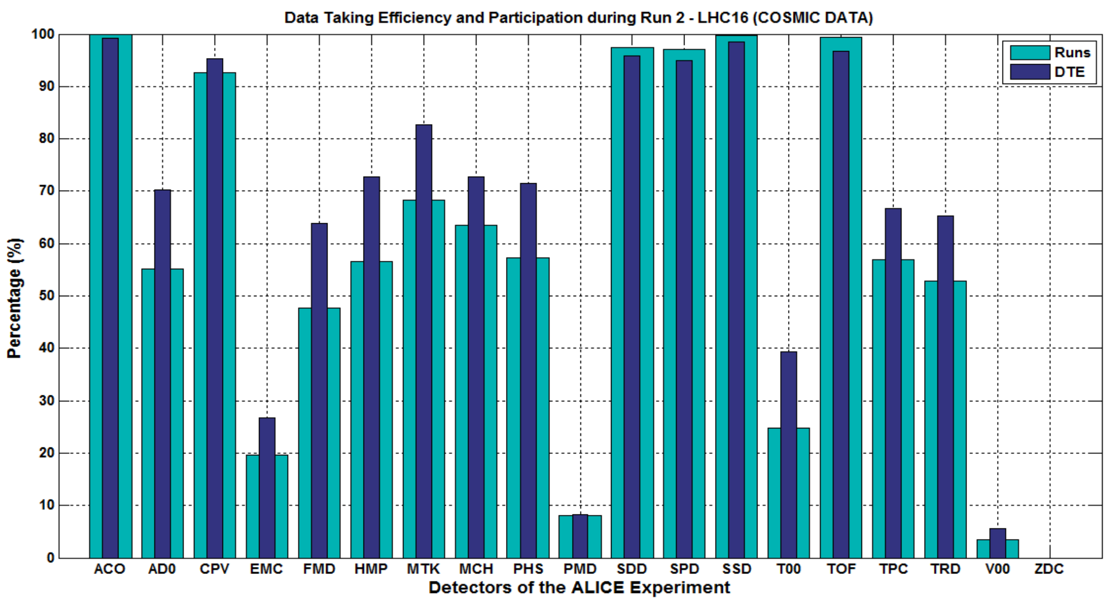
RESULTS - Physics Runs -

Pause and Reconfiguration (PAR)

- Most of the PARs with erroneous results during 2015 were due to the MCH, PMD, and HMPID detectors; as well as ECS, DAQ and HLT systems, mainly.
- During 2016 main detectors that originated PAR actions like: MCH, TPC, EMCAL, PHOS, and PMD, mainly. While PMD and EMCAL detectors, were the least efficient in the success cases of the executed PAR in that year.

RESULTS - Cosmic Runs -





Data Taking Efficiency (DTE) & Participation Percentage

Figure 8. Plots of the data-taking efficiency percentage and participation percentage of the ALICE detectors in the cosmics rays runs during the year: a) 2015 and b) 2015

RESULTS - Standalone Runs -

Number of Standalone Pulse/BC runs

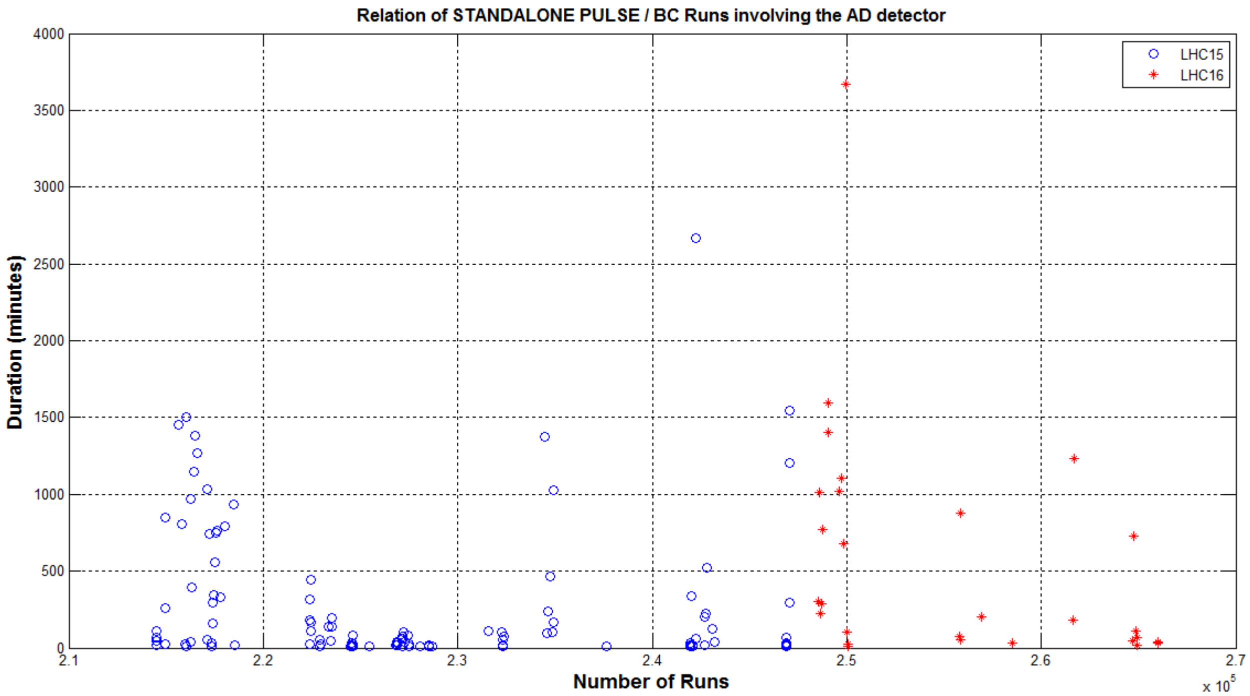


Figure 9. Plots of the STANDALONE PULSE / BC runs in which AD detector participates during the years 2015 and 2016

- A modest participation of AD detector in cosmics runs is appreciated.

- A high participation of AD detector in STANDALONE PULSE / BC runs, which aim to:
  - ❑ Correctly calibrate values of the most relevant detector parameters
  - ❑ Optimize performance

RESULTS - Cosmic Runs -

End of Runs (EORs)

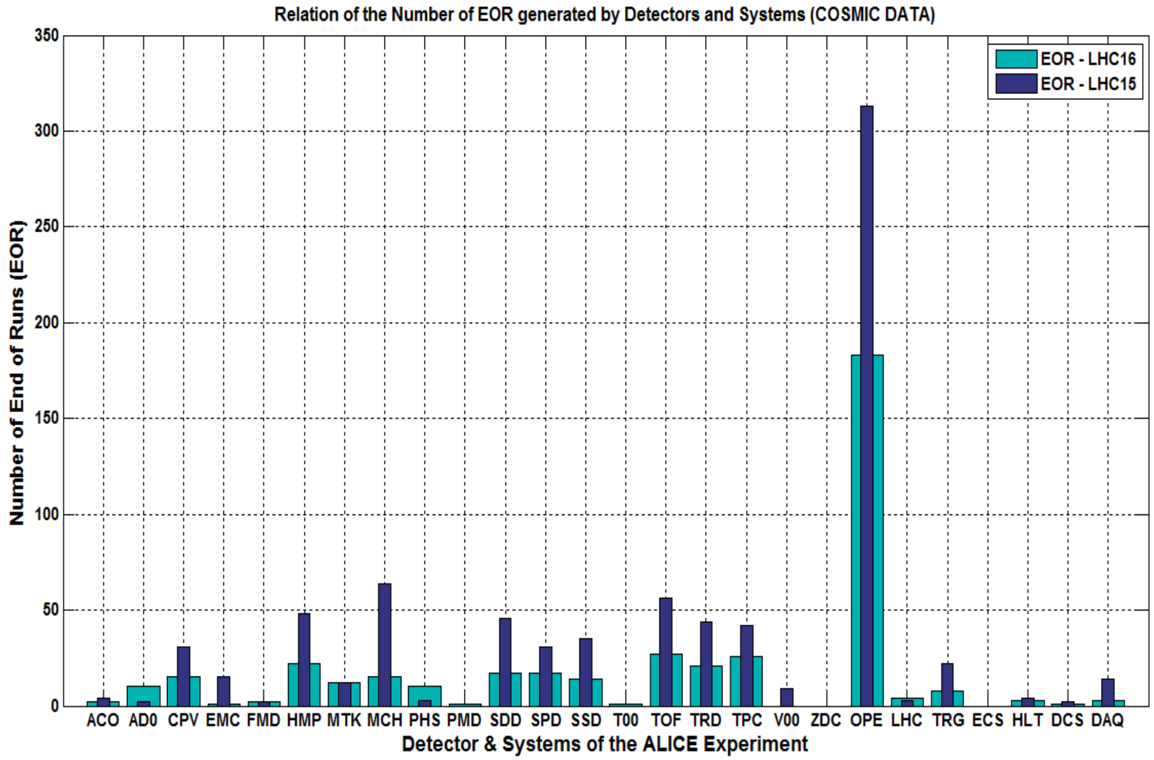


Figure 10. Plot of the number of EORs generated by detectors and by internal and external systems of the ALICE experiment in cosmics rays runs during the years 2015 and 2016

RESULTS

Year	LHC15	LHC16
Number of Fills	86	162
Periods of Fills	i, j, k, l, n, o	h, i, j, k, l, m, n, o, p, q, r, s, t
Number of Runs	486	883
Number of EORs	504	901

Table 4. General results of physics runs of the ALICE experiment detectors during 2015 and 2016

Year	LHC15	LHC16
Duration (minutes)	64,844.33	53,821.95
Number of Runs	589	340
Number of EORs	802	414

Table 5. General results of cosmics runs of the ALICE experiment detectors during 2015 and 2016

CONCLUSIONS

- AD DCS was integrated to the DCS of the ALICE experiment to allow control and monitoring of its integrated subsystems. This detector was fully functional since the start of LHC Run 2 in March 2015.

- The performance of the AD DCS was comparable with other ALICE detector (TPC, SPD, TRD, etc). In terms of data taking efficiency and percentage participation in physics, cosmic and standalone runs.

Additional Slides

DATA TAKING EFFICIENCY

- Quantify the success of the experiment's data taking activities

$$Efill = \frac{\sum(Rd - Rp)}{Fsb - Fusb} \,.\, 100$$

Where:

○ **Rd**: *run duration, given by the difference in seconds between the stop and the start of the trigger online subsystem;*

○ **Rp**: *run pause duration, period in seconds during the run in which the data taking was paused;*

○ **Fsb**: *fill stable beams duration, given by the difference in seconds between the declaration of stable beam conditions and the end of the fill;*

○ **Fusb**: *fill unusable stable beams duration, period during a fill in which - even if declared as stable - the LHC beam was unusable for data taking (e.g. high background noise).*