ALICE MOVES INTO WARP DRIVE

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on behalf of the ALICE Collaboration

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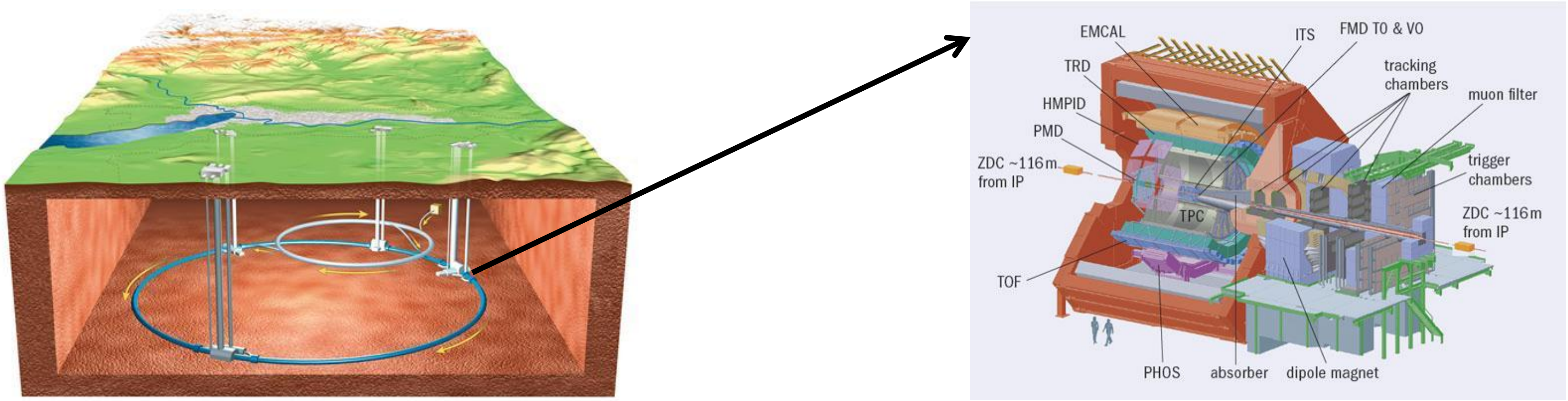
- ALICE operations
- Data taking efficiency
- In-run recovery procedures
- EOR Reasons bookkeeping
- Reporting
- Future plans
- Conclusion

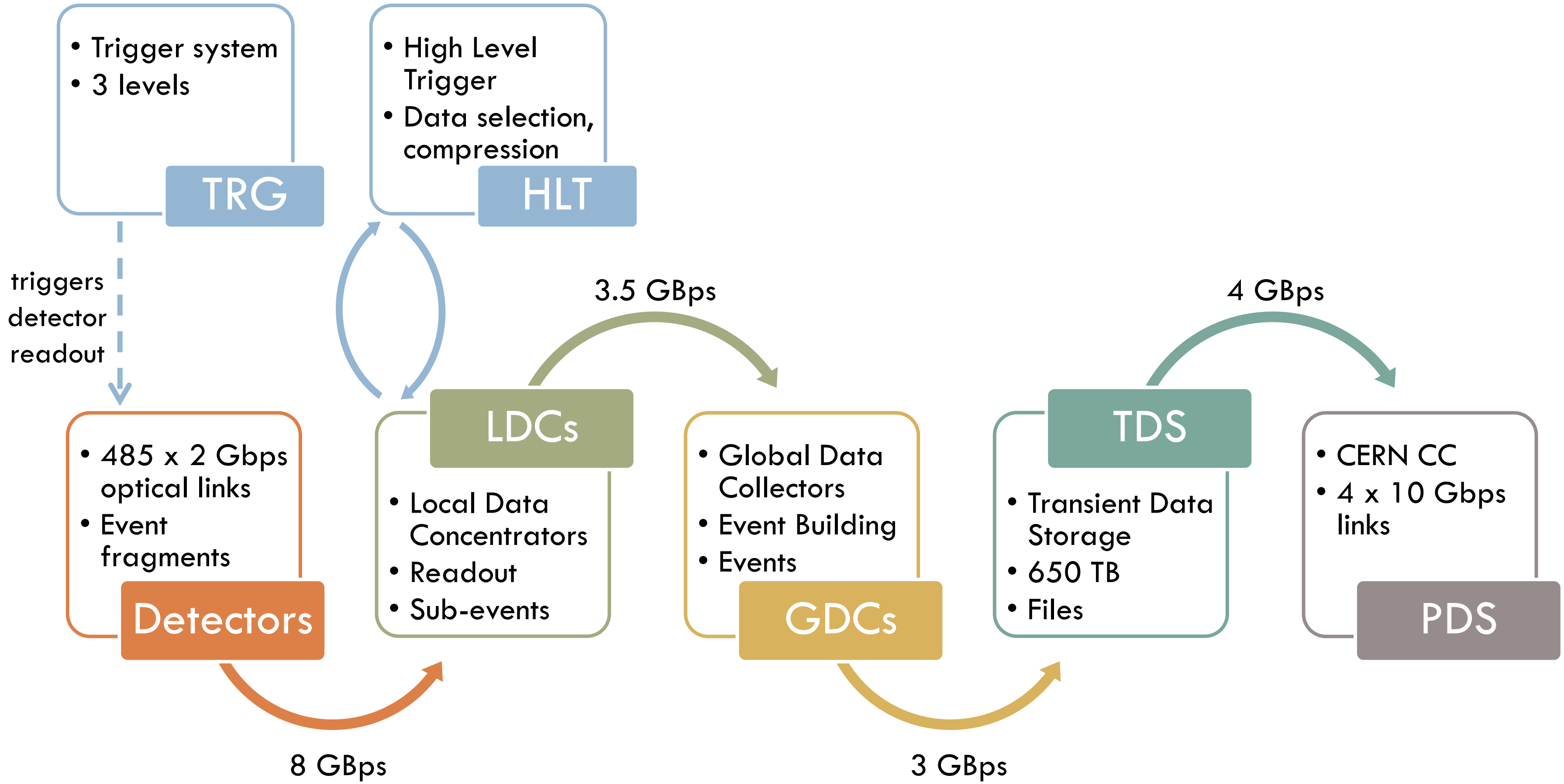
Introduction

The ALICE experiment

- A Large Ion Collider Experiment
  - Focused on heavy-ion collisions to study QGP
  - Central barrel + forward muon spectrometer
  - 17 installed sub-detectors
  - 5 online systems (DAQ, DCS, TRG, HLT, ECS)

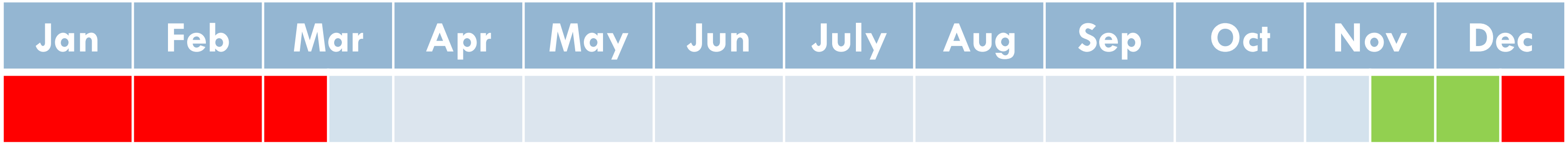


ALICE data flow

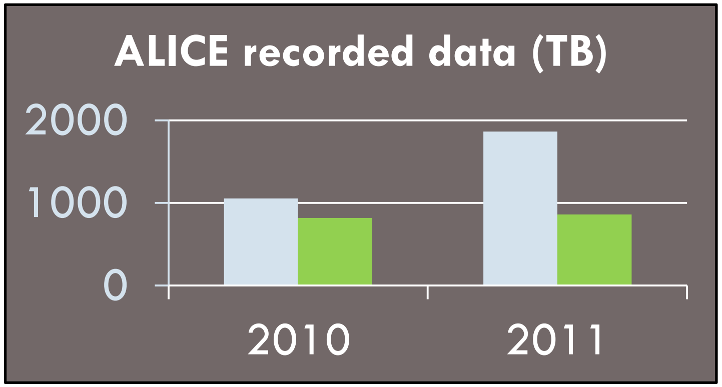


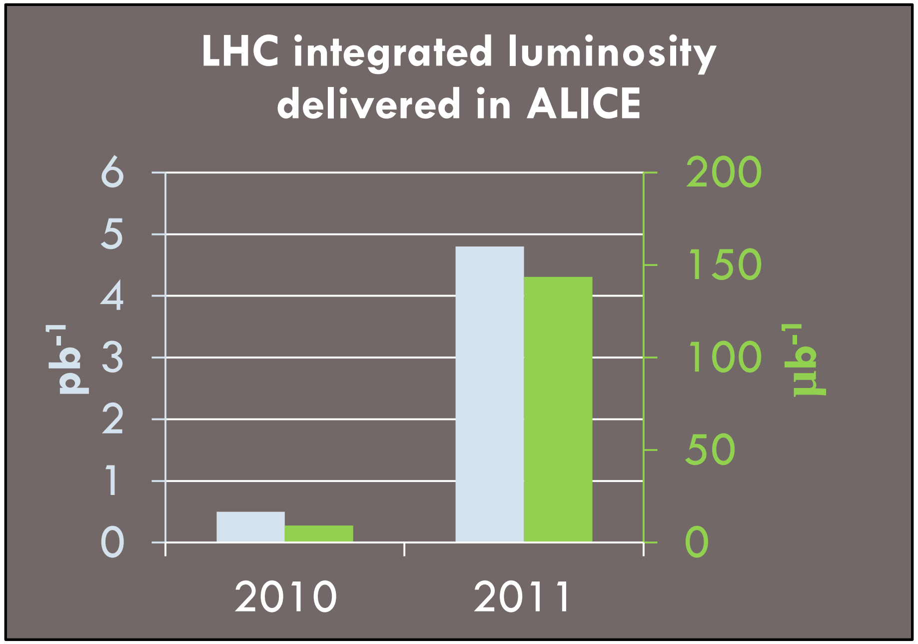
ALICE operations

A typical LHC year



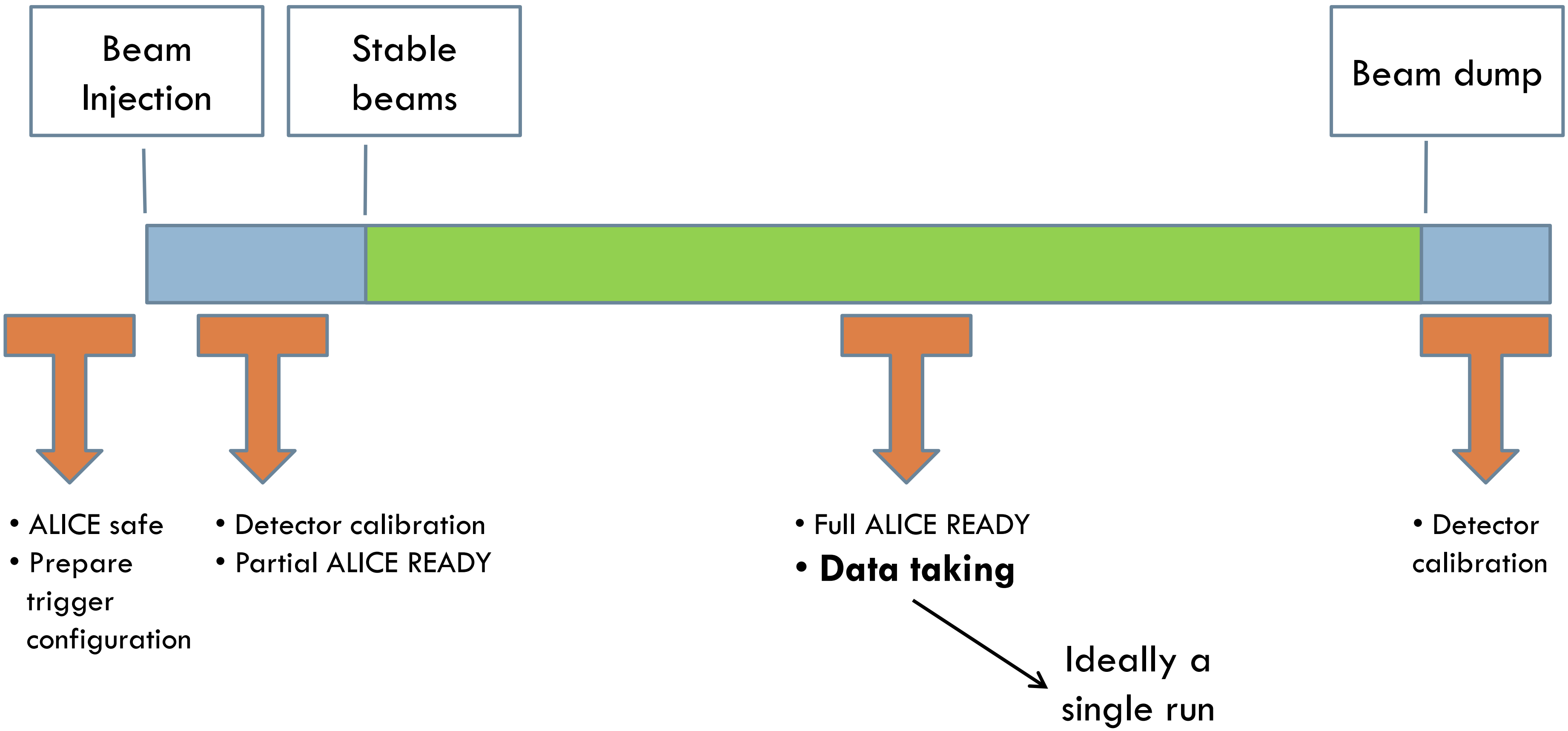
(red)	Shutdown for maintenance
(light blue)	proton-proton collisions
(green)	Heavy-ion collisions





ALICE operations

- A typical LHC fill in ALICE (0 - 30h)



ALICE operations

- A typical ALICE run

Logbook
- Bookkeeping
- Data taking metadata

Start-of-Run
- Config detectors electronics
- Start online systems
- Store data taking conditions

Data taking
- Readout
- Event building
- Online data monitoring
- Online calibration data

End-of-Run
- Export data taking conditions and calibration data to Offline
- Stop online systems

Poster: "The ALICE DAQ Detector Algorithms framework", Sylvain Chapeland, 24 May, 13:30 - 18:15

Reality is hard...

- 17 sub-detectors + 5 online systems
  - 1 failure stops the run
- Analysis of the ALICE Electronic Logbook metadata concluded:
  - Better downtime/efficiency diagnosis tools needed
  - Number of runs per fill is high
    - ~ 11 runs per fill during 2011 p-p
  - Starting/stopping runs is a costly operation
    - SOR ~ 3 min
    - EOR ~ 80 sec

Data taking efficiency

Data taking efficiency

- Calculated per fill:

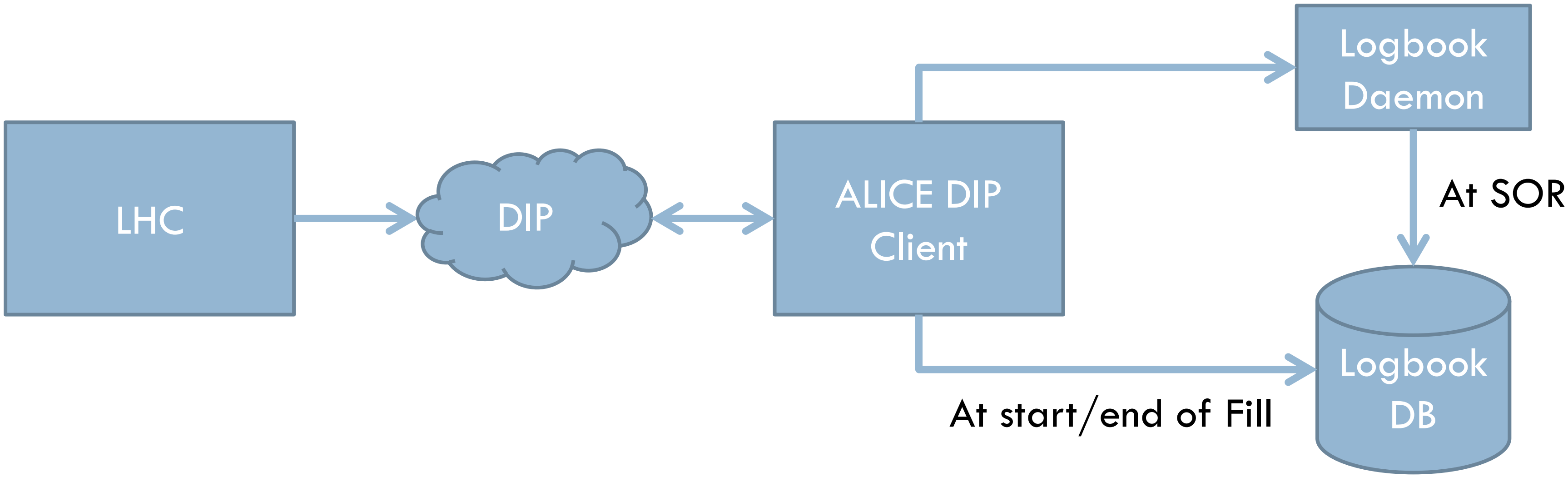
$$Efill = \frac{\sum(Rd - Rp)}{Fsb - Fusb} \cdot 100$$

Rd	run data taking duration
Rp	run pause duration (trigger disabled)
Fsb	fill stable beams duration
Fusb	fill unusable stable beams duration

- Stored in ALICE Electronic Logbook

Populating Logbook

- LHC publishes operational parameters via the Data Interchange Protocol (DIP)
- Dedicated ALICE software retrieves needed values and stores them in Logbook



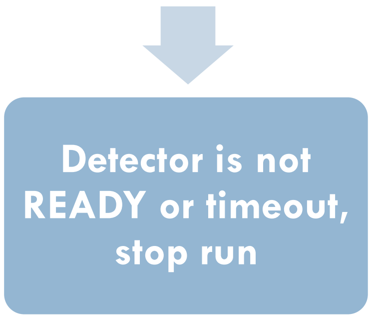
In-run recovery procedures

In-run recovery procedures

- To avoid stopping a run and lose beam time, thus increasing efficiency
- Recover from sub-detector issues
- 2 in-run procedures introduced:
  - via Detector Control System (DCS)
  - via DAQ using Detector Data Link (DDL)

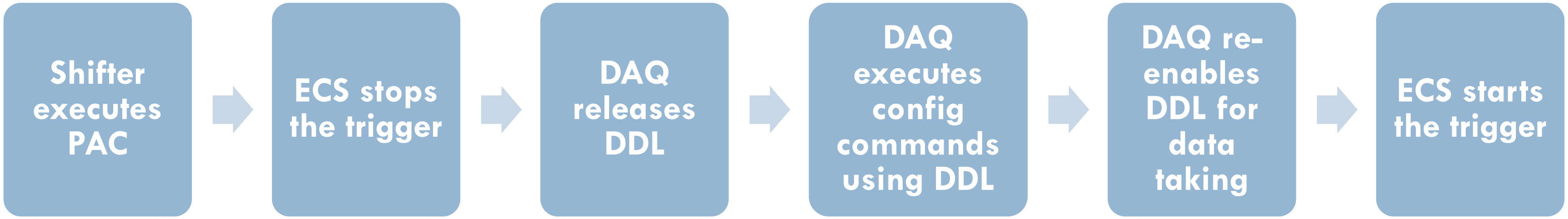
In-run recovery via DCS

- A new state was introduced in the DCS logic:
  - ERROR_RECOVER
- Example: TPC high voltage trips



In-run recovery via DDL

- DDL is bi-directional, can be used to configure FEE
- New procedure: Pause And Configure (PAC)
- Example: Single Event Upset in detector FEE
- Currently triggered manually by shifter



EOR Reasons bookkeeping

Typical EOR Reasons

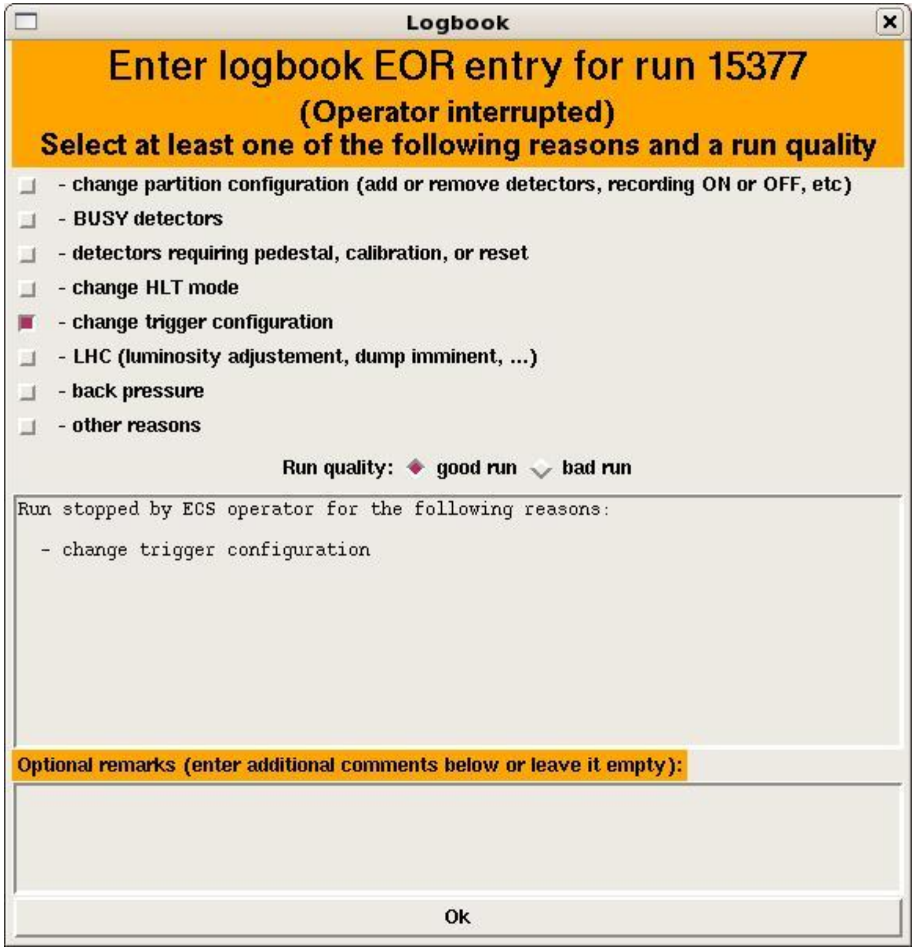
- Runs can stop for a multitude of reasons:
  - Decision by shift crew (manual operation)
    - Change trigger configuration
    - Add/remove detector
  - Problem with online systems
    - Process no longer running
    - Configuration error
  - Problem with detectors
    - High voltage trip
    - Front End Electronics (FEE)
    - Corrupted data

EOR Reasons bookkeeping

- Up to mid-2011:
  - Text based entry in Logbook
  - Statistics done manually (time consuming, error prone)
  - For abnormal stops, log search was needed
- For the 2011 HI run:
  - Structured data in Logbook
    - Automatic stops: inserted by Experiment Control System
    - Manual stops: prompt shifter

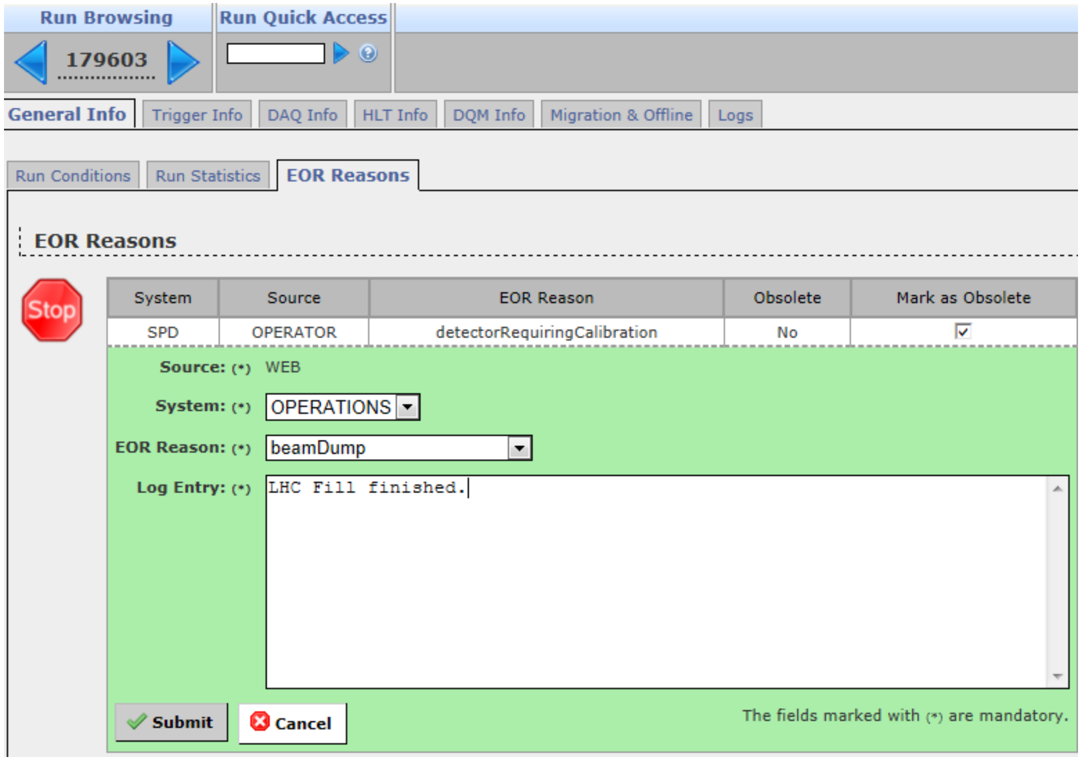
ECS End-of-Run panel

- Whenever a shifter stops a run, he/she has to choose from a predefined list of EOR Reasons
- Evolving list, changed when needed
- Shifters training is important!



Changing EOR Reasons *a posteriori*

- 100 % accuracy is very difficult:
  - Symptoms vs causes
  - Shifters mistakes
- Logbook GUI page to change EOR Reason



Reporting

Online reports in Logbook

- Fill Statistics

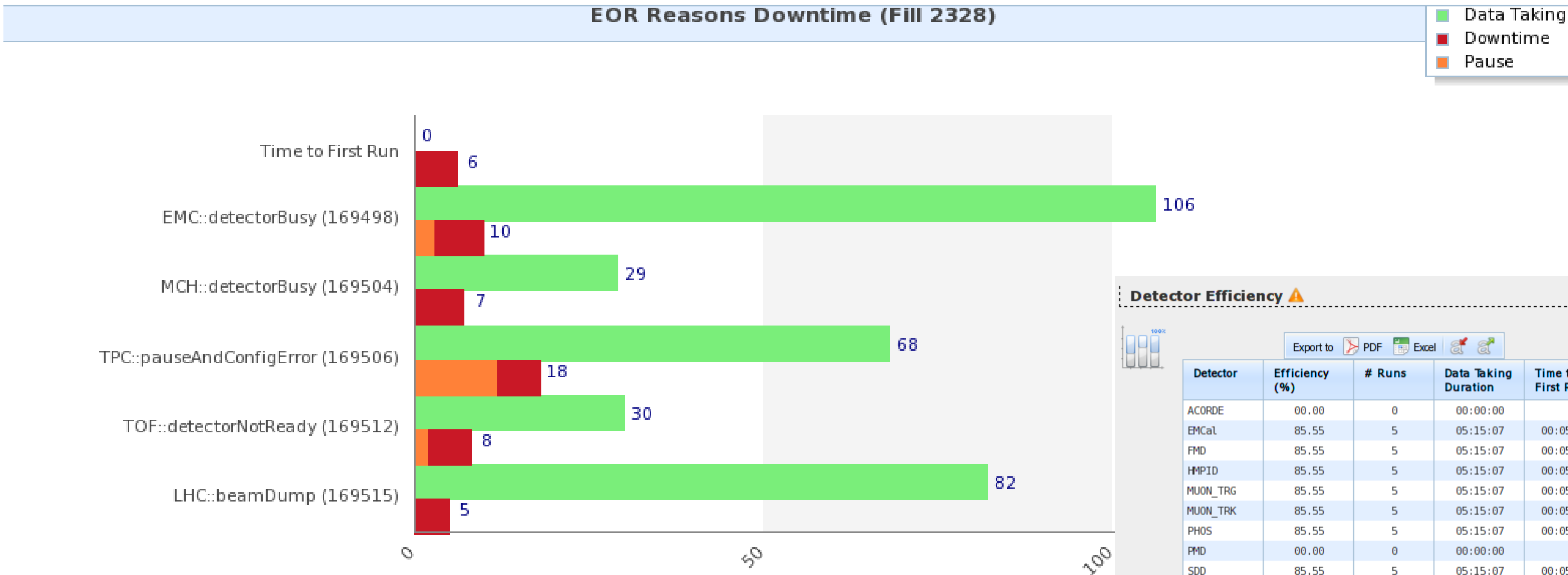
Page Browsing	Fills filters	Runs filters	Fill Quick Access	Actions
1-20 of 39 (Page 1 of 2)	Local filters Stable Beams Declared: Yes Fill Number: [2290..2351]	Fill Number: [2290..2351] Beam: Yes Partition: PHYSICS_1 Run Type: PHYSICS		Export...

Statistics | Overview

Fill Info Status	Fill Number	Stable Beams Declared	Stable Beams Start	Stable Beams End	Stable Beams Duration	Data Taking Duration	Pause Duration	SOR/EOR Duration	Efficiency (%)	# of Runs	Time to First Run
	2351	Yes	07/12/2011 08:41:13	07/12/2011 10:22:42	01:41:29	01:15:32	00:14:42	00:05:48	**74.43**	2	00:00:26
	2350	Yes	07/12/2011 02:57:23	07/12/2011 03:44:23	00:47:00	00:39:26	00:00:00	00:07:20	**83.90**	1	00:05:53
	2349	Yes	06/12/2011 21:02:16	06/12/2011 22:39:39	01:37:23	01:01:43	00:06:09	00:13:45	**63.37**	5	00:01:17
	2344	Yes	05/12/2011 22:52:14	06/12/2011 05:57:01	07:04:47	05:44:23	00:21:04	00:17:20	**81.07**	4	00:35:14
	2343	Yes	05/12/2011 03:15:22	05/12/2011 09:36:36	06:21:14	04:28:19	00:17:05	00:36:35	**70.38**	7	00:05:53
	2342	Yes	04/12/2011 18:26:20	05/12/2011 00:00:50	05:34:30	04:31:32	00:11:15	00:27:36	**81.18**	6	00:00:27
	2341	Yes	04/12/2011 11:48:19	04/12/2011 14:56:51	03:08:32	02:30:04	00:05:17	00:15:37	**79.60**	4	00:00:16
	2340	Yes	03/12/2011 22:53:02	04/12/2011 05:54:13	07:01:11	04:30:03	00:44:15	00:44:48	**64.12**	10	00:06:18
	2339	Yes	03/12/2011 14:05:21	03/12/2011 20:00:43	05:55:22	04:34:05	00:21:33	00:33:19	**77.13**	7	00:05:55
	2338	Yes	03/12/2011 00:29:16	03/12/2011 08:08:39	07:39:23	06:07:37	00:12:42	00:35:03	**80.02**	10	00:05:39
	2337	Yes	02/12/2011 13:18:20	02/12/2011 17:33:53	04:15:33	03:40:41	00:07:03	00:21:01	**86.36**	5	00:00:28
	2336	Yes	02/12/2011 04:19:26	02/12/2011 10:33:38	06:14:12	03:34:05	00:19:29	00:58:50	**57.21**	15	00:05:56
	2335	Yes	01/12/2011 15:27:05	01/12/2011 21:13:57	05:46:52	04:38:42	00:00:00	00:29:30	**80.35**	9	00:03:18
	2334	Yes	01/12/2011 04:58:48	01/12/2011 10:43:50	05:45:02	04:55:07	00:00:00	00:35:15	**85.53**	7	00:06:05
	2332	Yes	28/11/2011 19:11:09	28/11/2011 20:24:02	01:12:53	00:53:36	00:05:07	00:13:28	**73.54**	2	00:07:13
	2330	Yes	27/11/2011 22:03:15	28/11/2011 05:12:58	07:09:43	05:50:23	00:24:19	00:37:39	**81.54**	7	00:05:55
	2329	Yes	27/11/2011 12:29:22	27/11/2011 18:48:05	06:18:43	05:00:06	00:00:34	00:24:43	**79.24**	6	00:28:09
	2328	Yes	27/11/2011 00:03:26	27/11/2011 06:11:46	06:08:20	05:15:07	00:17:27	00:27:27	**85.55**	5	00:05:36
	2327	Yes	26/11/2011 19:58:45	26/11/2011 20:33:22	00:34:37	00:21:21	00:00:00	00:09:25	**61.68**	2	00:05:52
	2325	Yes	26/11/2011 08:04:31	26/11/2011 13:47:39	05:43:08	04:04:35	00:31:58	00:45:12	**71.28**	6	00:07:19

Online reports in Logbook

- Fill Details



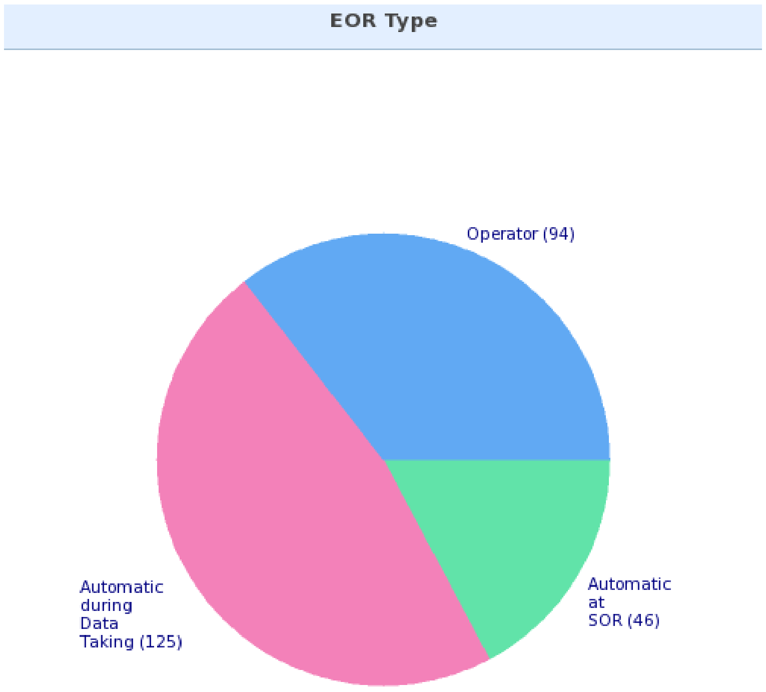
Detector Efficiency

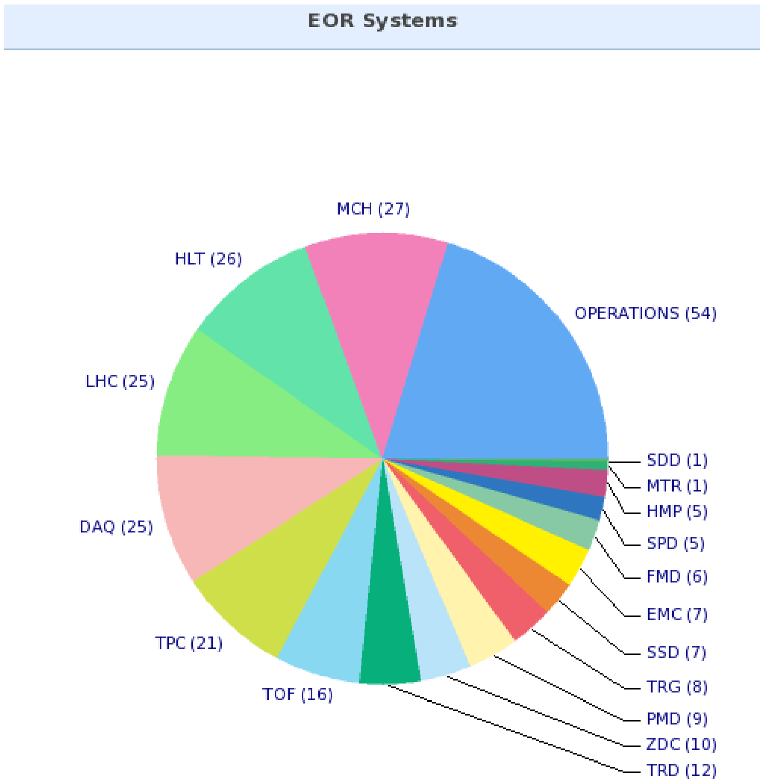
Export to PDF Excel

Detector	Efficiency (%)	# Runs	Data Taking Duration	Time to First Run
ACORDE	00.00	0	00:00:00	
EMCal	85.55	5	05:15:07	00:05:36
FMD	85.55	5	05:15:07	00:05:36
HMPID	85.55	5	05:15:07	00:05:36
MUON_TRG	85.55	5	05:15:07	00:05:36
MUON_TRK	85.55	5	05:15:07	00:05:36
PHOS	85.55	5	05:15:07	00:05:36
PMD	00.00	0	00:00:00	
SDD	85.55	5	05:15:07	00:05:36
SPD	85.55	5	05:15:07	00:05:36
SSD	85.55	5	05:15:07	00:05:36
T0	85.55	5	05:15:07	00:05:36
TOF	85.55	5	05:15:07	00:05:36
TPC	85.55	5	05:15:07	00:05:36
TRD	85.55	5	05:15:07	00:05:36
V0	85.55	5	05:15:07	00:05:36
ZDC	85.55	5	05:15:07	00:05:36

Online reports in Logbook

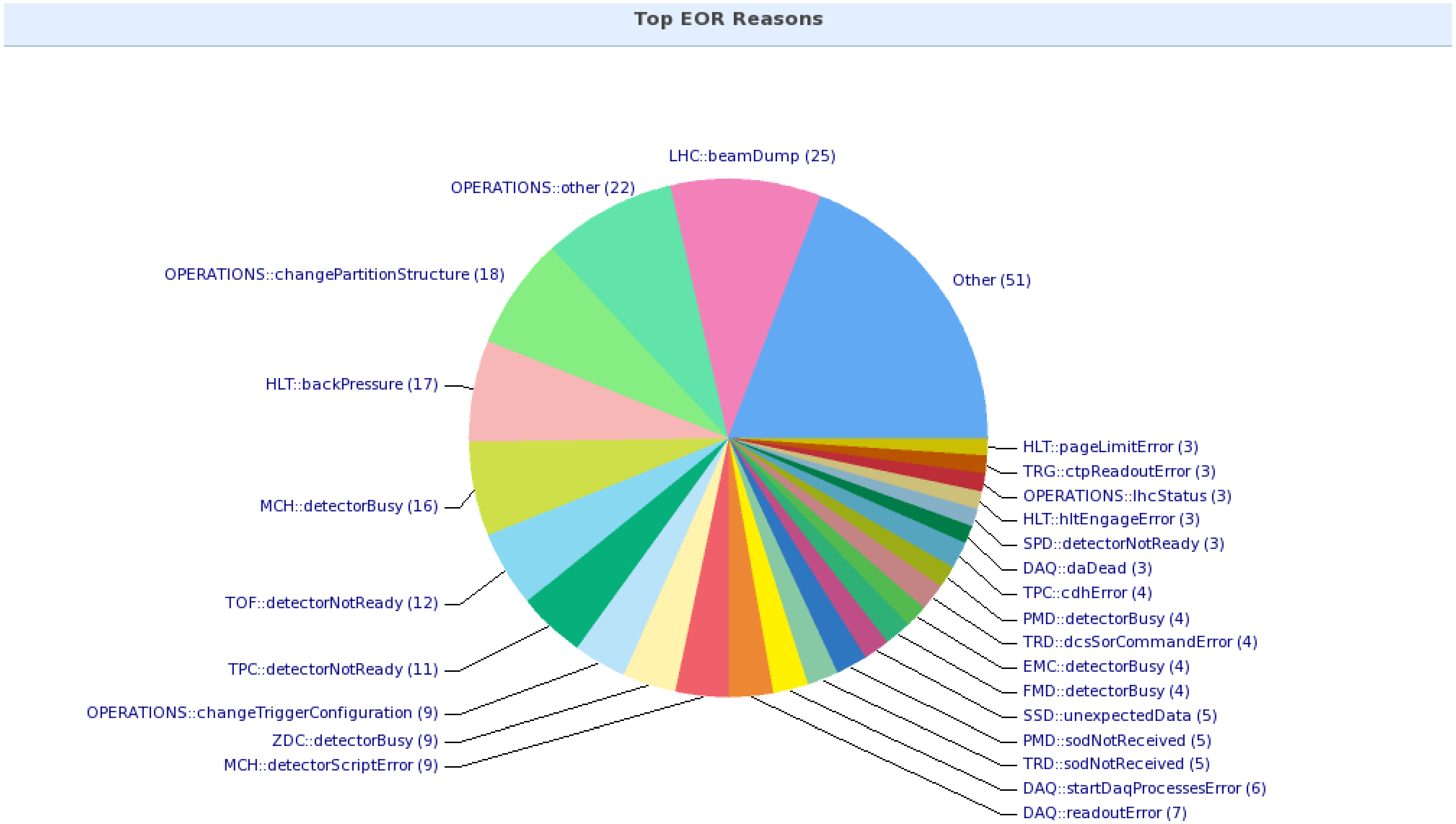
- EOR Reasons





Online reports in Logbook

- EOR Reasons



Fill Summary slides

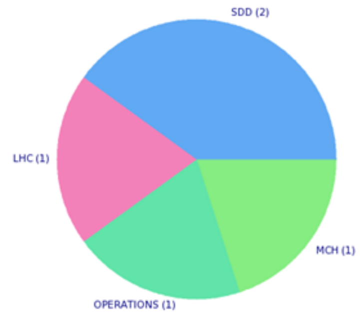
- A PPT slide with a summary of an LHC Fill
- Automatically generated every day and sent via email

Fill Info	
Fill #	2576
SB Start	01/05/2012 20:16:05
SB End	02/05/2012 02:33:52
Duration	06:17:47

Data Taking	
Duration	05:09:02
# of Runs	5

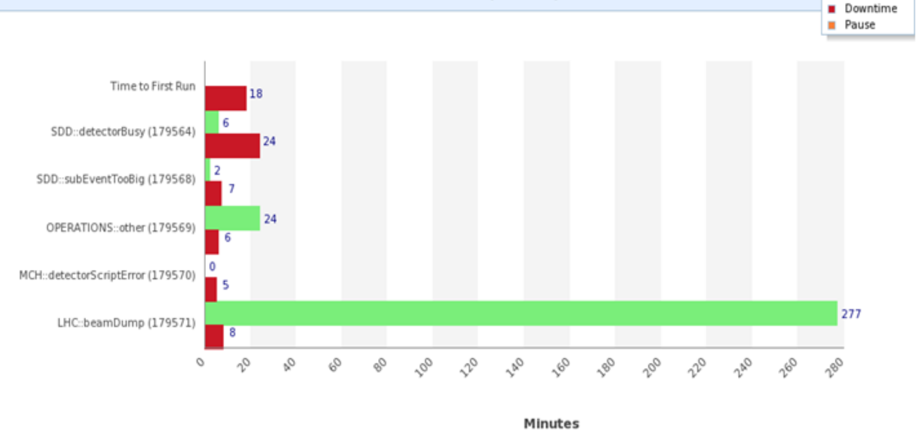
Efficiency	
ALICE	82%
ACO	82%
EMC	82%
FMD	80%
HMP	82%
MCH	82%
MTR	82%
PHS	82%
PMD	00%
SDD	02%
SPD	82%
SSD	82%
T00	82%
TOF	82%
TPC	82%
TRD	82%
V00	82%
ZDC	82%

EOR Systems (Fill 2576)



Comments

EOR Reasons Downtime (Fill 2576)



Future plans

Future plans

- Integrate EOR Reasons with JIRA issue tracking system
  - Logbook - JIRA interface being developed
- Extend in-run recovery procedure via DDL
  - Automatic detector request via bit in event header
  - New SYNC event to synchronize data sources
- Expert system for shifter support and automatic failure recovery
  - Reduce load on on-call crew

Conclusion

Conclusion

- 2 years of successful operational experience
- Big effort put in efficiency monitoring, EOR Reasons identification
- Introduction of in-run recovery procedures reduced downtime thus increasing efficiency
- Reports automation
  - Saved time
  - Increased visibility and "stimulated" issues resolution

Related presentations

- Poster: “The ALICE DAQ Detector Algorithms framework”, Sylvain Chapeland, 24 May, 13:30 - 18:15
- Poster: “Orthos, an alarm system for the ALICE DAQ operations”, Sylvain Chapeland, 24 May, 13:30 - 18:15
- Poster: “Preparing the ALICE DAQ upgrade”, Pierre Vande Vyvre, 24 May, 13:30 - 18:15

ALICE presentations

- "ALICE HLT TPC Tracking of Heavy-Ion Events on GPUs", David Rohr, now

- ❑ A review of data placement in WLCG
- ❑ Data compression in ALICE by on-line track reconstruction and space-point analysis
- ❑ The ALICE EMCal High Level Triggers
- ❑ Automated Inventory and Monitoring of the ALICE HLT Cluster Resources with the SysMES Framework
- ❑ Monitoring the data quality of the real-time event reconstruction in the ALICE High Level Trigger.
- ❑ Operational Experience with the ALICE High Level Trigger
- ❑ Flexible event reconstruction software chains with the ALICE High-Level Trigger
- ❑ Dynamic parallel ROOT facility clusters on the Alice Environment
- ❑ A new communication framework for the ALICE Grid
- ❑ AliEn JobBrokering Extreme
- ❑ Combining virtualization tools for a dynamic, distribution agnostic grid environment for ALICE grid jobs in Scandinavia
- ❑ ALICE Grid Computing at the GridKa Tier-1 center
- ❑ ALICE's detectors safety and efficiency optimization with automatic beam-driven operations
- ❑ Managing operational documentation in the ALICE Detector Control System
- ❑ An optimization of the ALICE XRootD storage cluster at the Tier-2 site in Czech Republic
- ❑ Certified Grid Job Submission in the ALICE Grid Services
- ❑ Rethinking particle transport in the many-core era
- ❑ Grid Computing at GSI(ALICE/FAIR) - present and future
- ❑ Employing peer-to-peer software distribution in ALICE Grid Services to enable opportunistic use of OSG resources

QUESTIONS ?

Extra Slides

ALICE timeline

- 1990 – First ideas HI@LHC
- 1993 – ALICE LoI
- 1995 – Technical Proposal
- 1997 – ALICE is approved
- 1998 – First TDR
- 2000 – Construction begins
- 2005 – Last TDR
- 2006 – Installation of services
- 2007 – Commissioning begins
- 2008 – LHC first beam
- 2010 – LHC first HI run

ALICE operations

- 24/7 on-site shift crew
  - Currently 4 shifters:
    - Shift Leader
    - DAQ + HLT + CTP (Central Trigger Processor)
    - DQM (Data Quality Monitoring) +Offline
    - DCS
  - One of them is SLIMOS (Shift Leader in Matters of Safety)
- 24/7 on-call expert support for each subsystem

Online reports in Logbook

- Fill Details

Detector Efficiency

Export to PDF Excel

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ACORDE	00.00	0	00:00:00	
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MUON_TRK	85.55	5	05:15:07	00:05:36
PHOS	85.55	5	05:15:07	00:05:36
PMD	00.00	0	00:00:00	
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