



# Exploring Data-Driven Decision with Oracle Big Data Discovery

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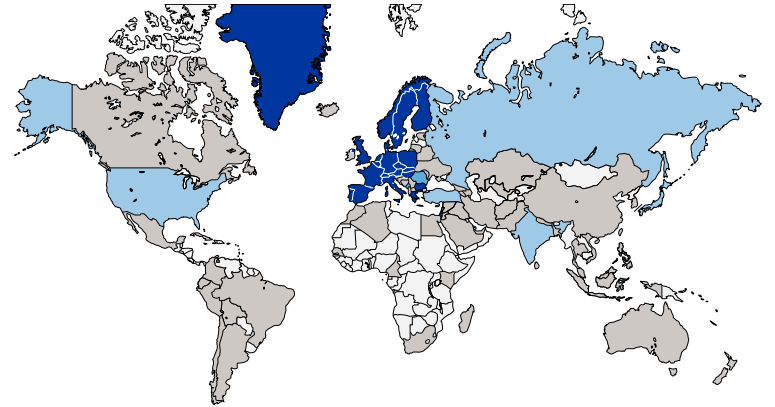
**Cloudera & Oracle - Big Data Analytics Innovation Summit**

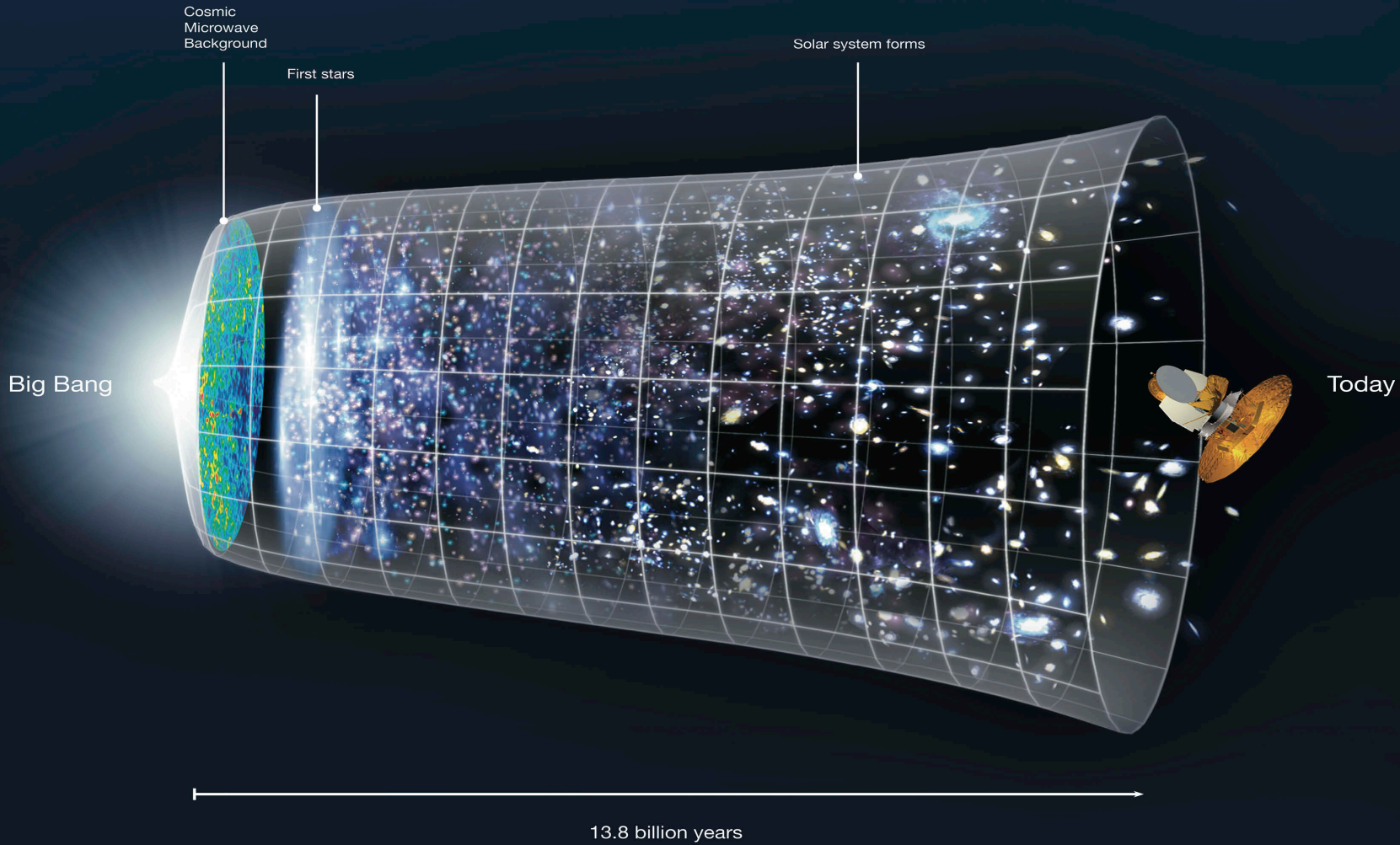


**CERN** openlab

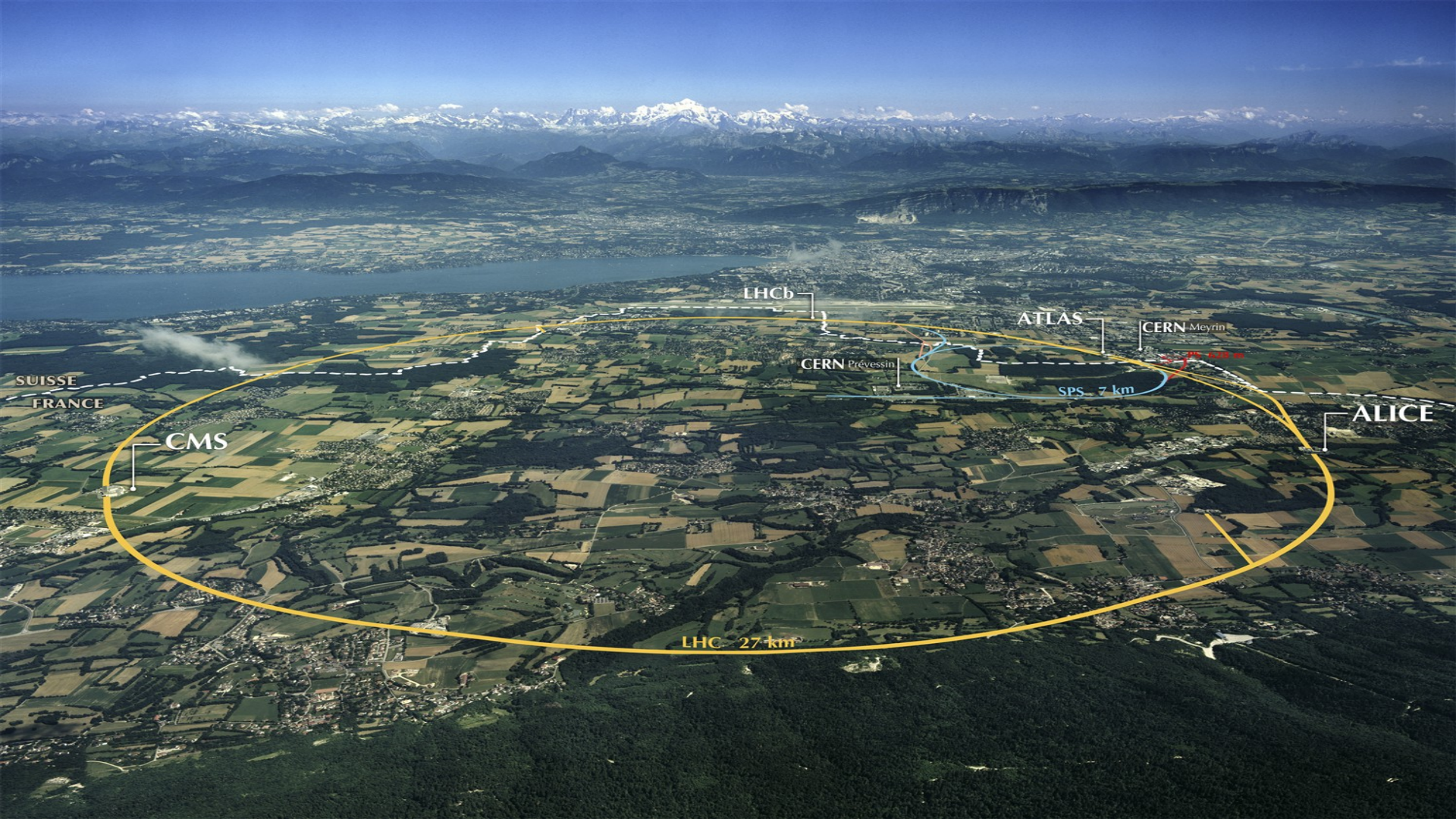
# CERN

- CERN - **European Laboratory for Particle Physics**
- Founded in **1954** by **12 Countries** for fundamental physics research in a post-war Europe
  - Science for Peace
- **Worldwide Collaboration**









SUISSE  
FRANCE

CMS

LHCb

ATLAS

CERN Meyrin

CERN Prévessin

SPS 7 km

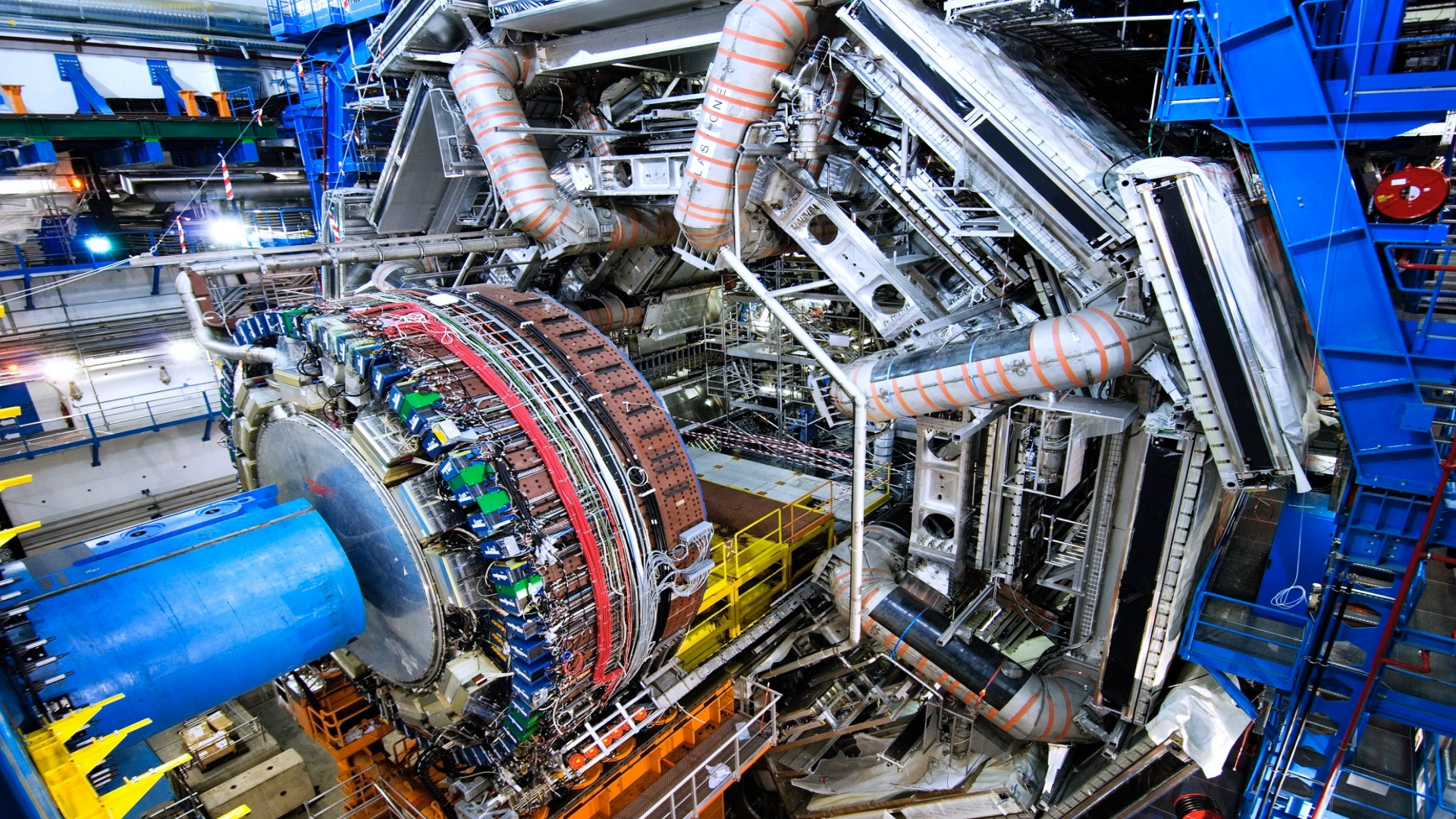
ALICE

LHC 27 km



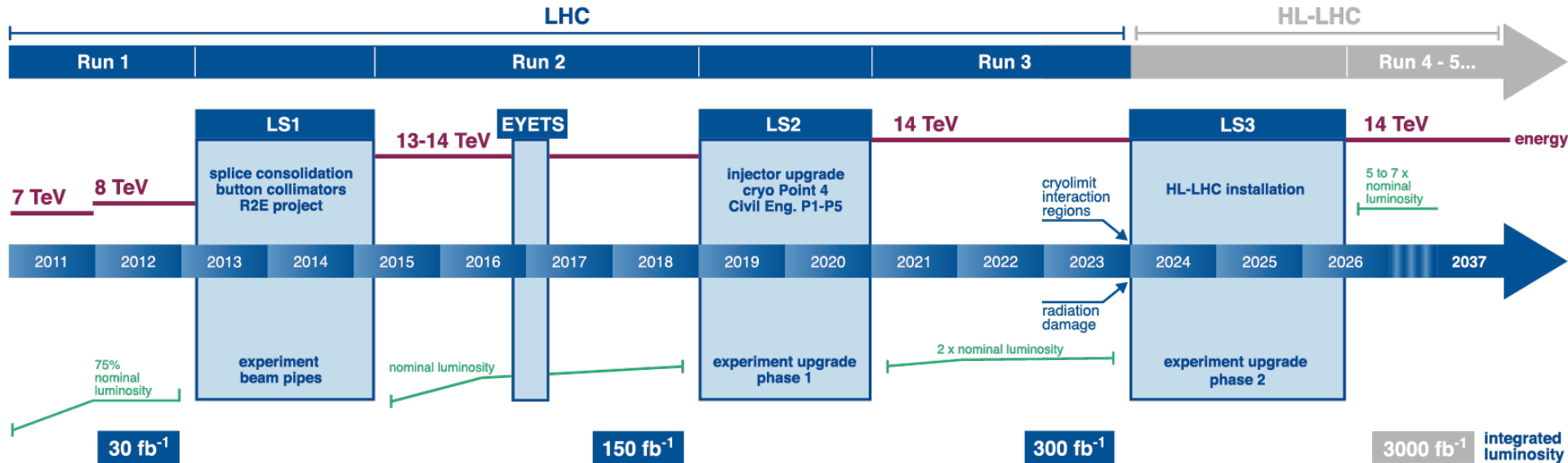






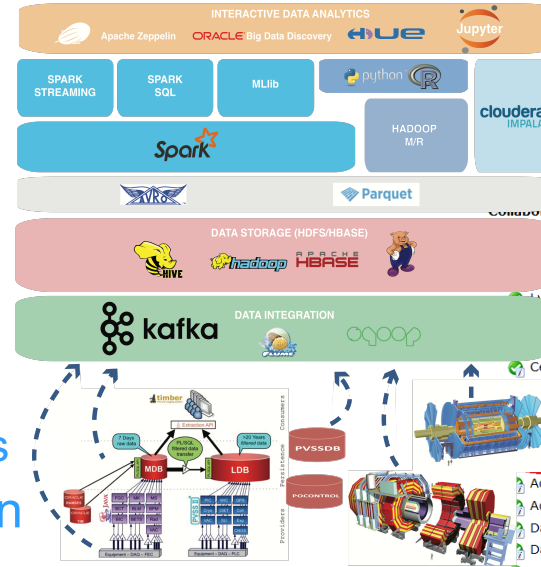


# LHC / HL-LHC Plan



# Hadoop and Analytics – IT-DB-SAS

- New scalable data services
  - Scalable databases
  - Hadoop ecosystem
  - Time Series databases
- Big Data Analytics
- Activities and objectives
  - Support of Hadoop Components
  - Further value of Analytics solutions
  - Define scalable platform evolution
- Hadoop Production Service



Cooperation Services

Normal since: 31 Aug 2015 11:21  
[Link to availability history](#)

**Details:**

- Cluster: **Hadalytic** (overall availability: 100)
  - HDFS - Availability: 100
  - YARN - Availability: 100
  - Spark - Availability: 100
  - HBase - Availability: 100
  - Hive - Availability: 100
  - Impala - Availability: 100
- Cluster: **LXHadoop** (overall availability: 100)
  - HDFS - Availability: 100
  - YARN - Availability: 100
  - Hive - Availability: 100
- Cluster: **Analytix** (overall availability: 100)
  - HDFS - Availability: 100
  - YARN - Availability: 100
  - Spark - Availability: 100
  - Hive - Availability: 100

Desktop Service

- Linux Desktop
- Windows Desktop

Load Balancing

- Messaging

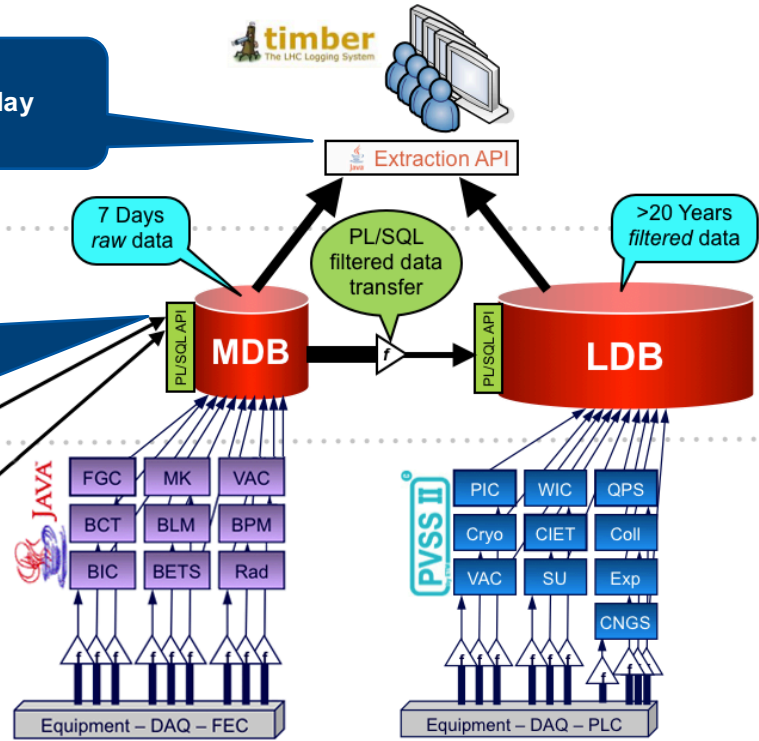
# CERN Accelerator Logging Service



- +800 extraction clients
- +5 million extraction requests per day
- 130 custom applications

- ~ 1 million signals
- ~ 300 data loading processes
- ~ 4 billion records per day
- ~ 160 GB / day
- 52 TB / year stored

- ~ 250'000 Signals
- ~ 50 data loading processes
- ~ 5.5 billion records per day
- ~ 275 GB / day
- 100 TB / year throughput



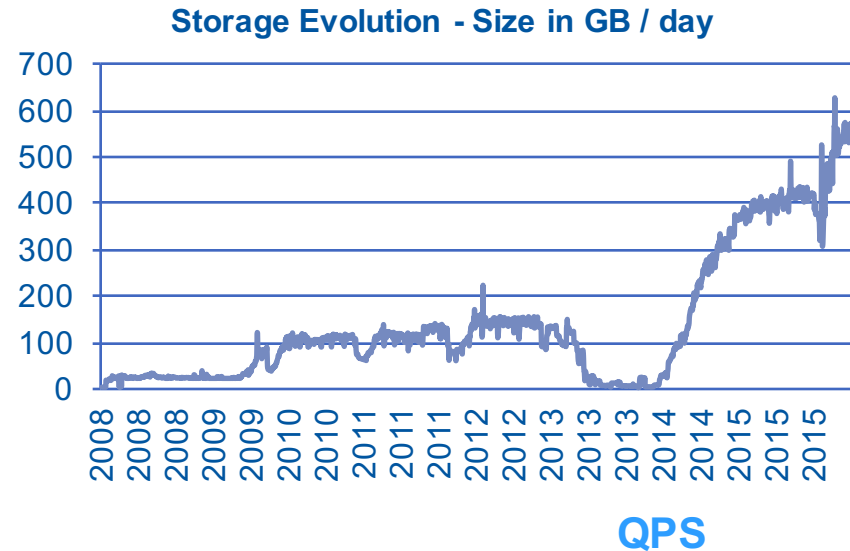
Filters for data Reduction

Credit: BE-CO-DS



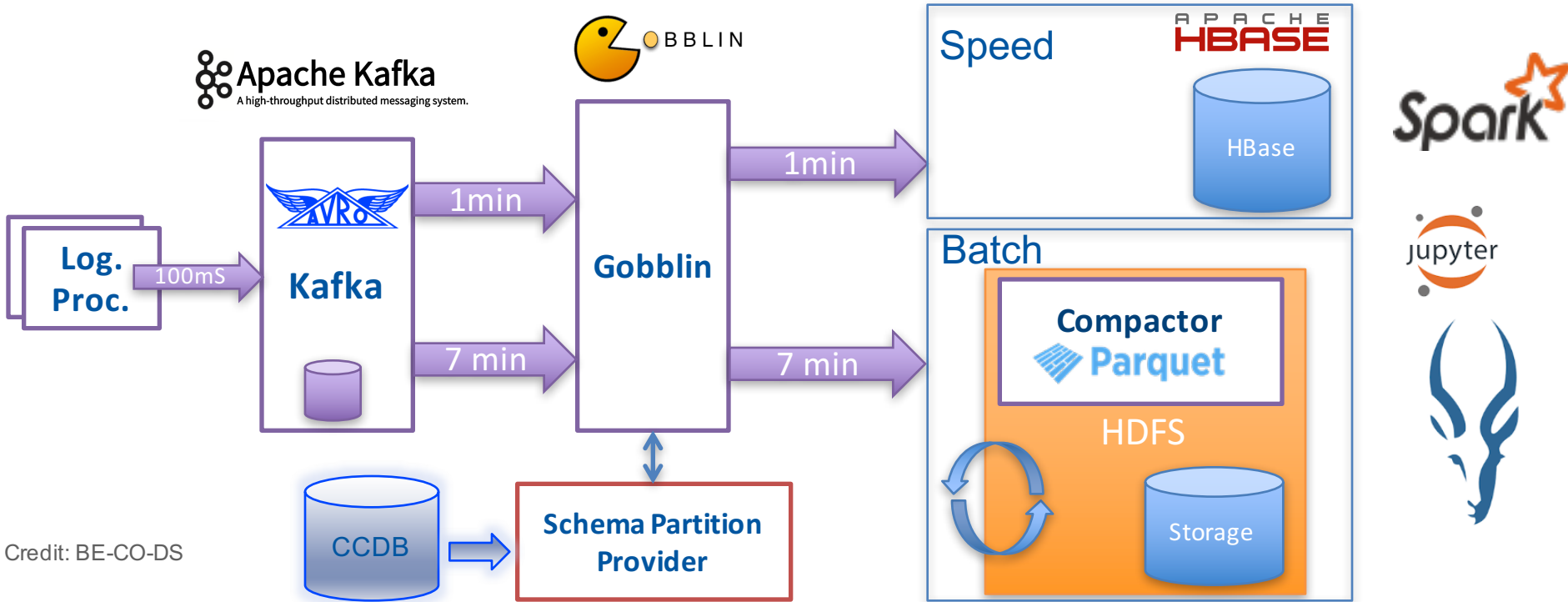
# CERN Accelerator Logging Service

- New Landscape bring new challenges
  - Better Performance on bigger datasets
    - Big Data queries: Impala, Spark SQL
  - Leverage analytics capabilities
    - Spark Analytics: Python, ML, R
  - More heterogeneous data access models



Credit: BE-CO-DS

# CERN Accelerator Logging Service

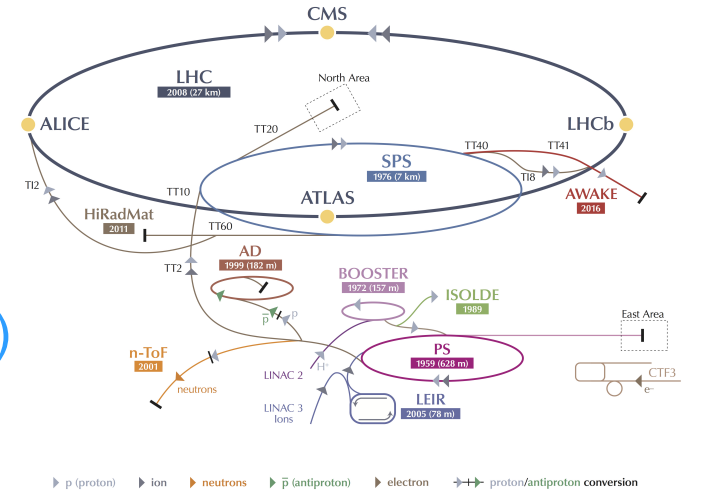


Credit: BE-CO-DS



# Accelerator Postmortem Analysis

- Postmortem Analysis
  - Diagnostic on failures
    - Continue operations safely
    - Intervention Required
- Designed for CERN LHC
  - Extended to injectors complex (SPS)
  - External Post Operational Checks
  - Injection Quality Checks



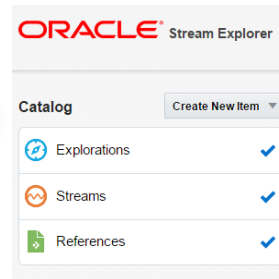
LHC Large Hadron Collider SPS Super Proton Synchrotron PS Proton Synchrotron  
AD Antiproton Decelerator CTF3 Clic Test Facility AWAKE Advanced WAKEfield Experiment ISOLDE Isotope Separator OnLine Device  
LEIR Low Energy Ion Ring LINAC LINear ACcelerator n-ToF Neutrons Time Of Flight HiRadMat High-Radiation to Materials

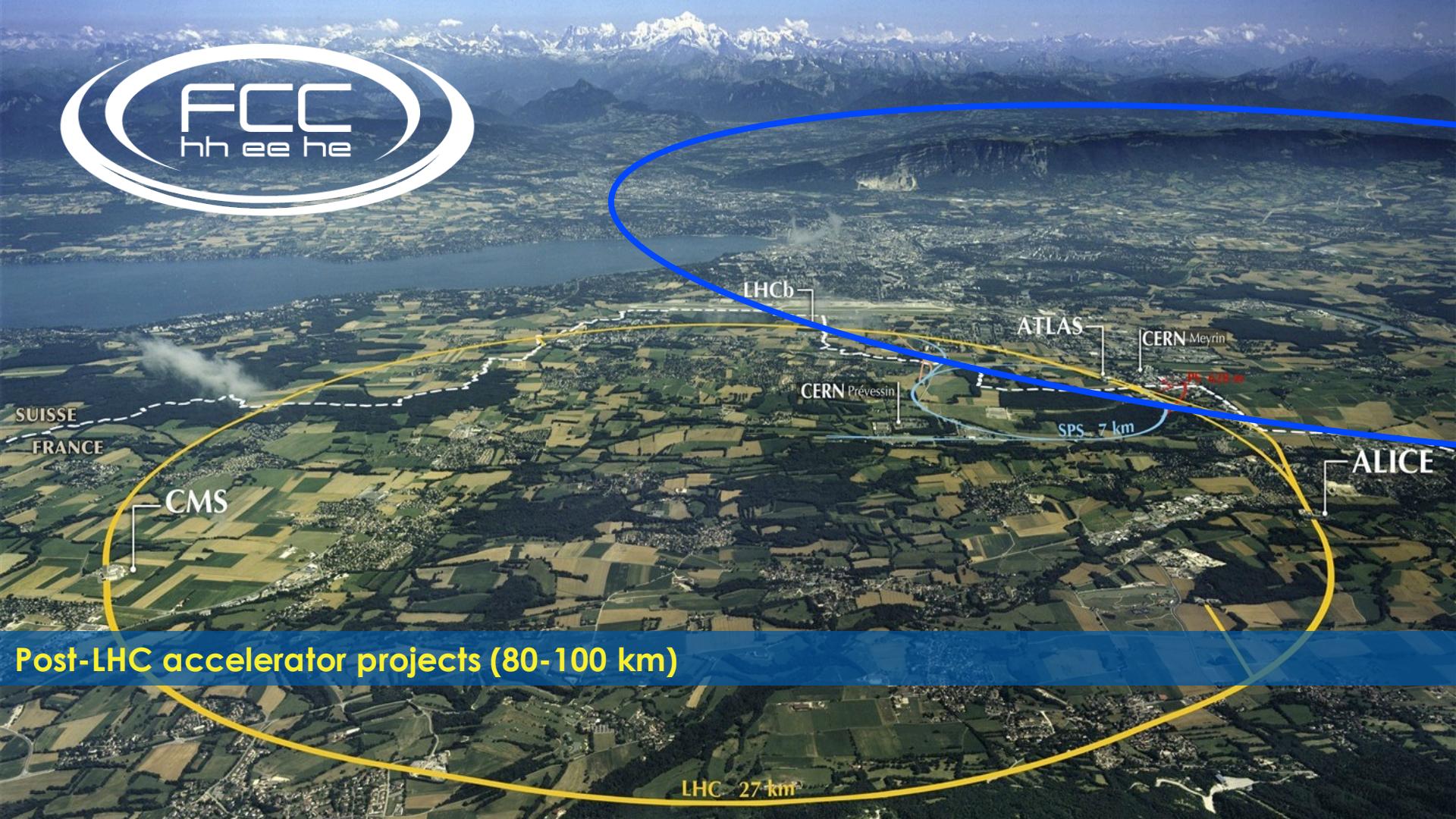
# Accelerator Postmortem Analysis

- Challenges:
  - Stringent Timing Constraint
  - Better scalability
    - data storage
    - IO throughput
  - Real Big Data Streaming Analytics



Spark  
Streaming





LHCb

ATLAS

CERN Meyrin

PS 6.28 km

SPS 7 km

CERN Prévessin

ALICE

SUISSE  
FRANCE

CMS

Post-LHC accelerator projects (80-100 km)

LHC 27 km



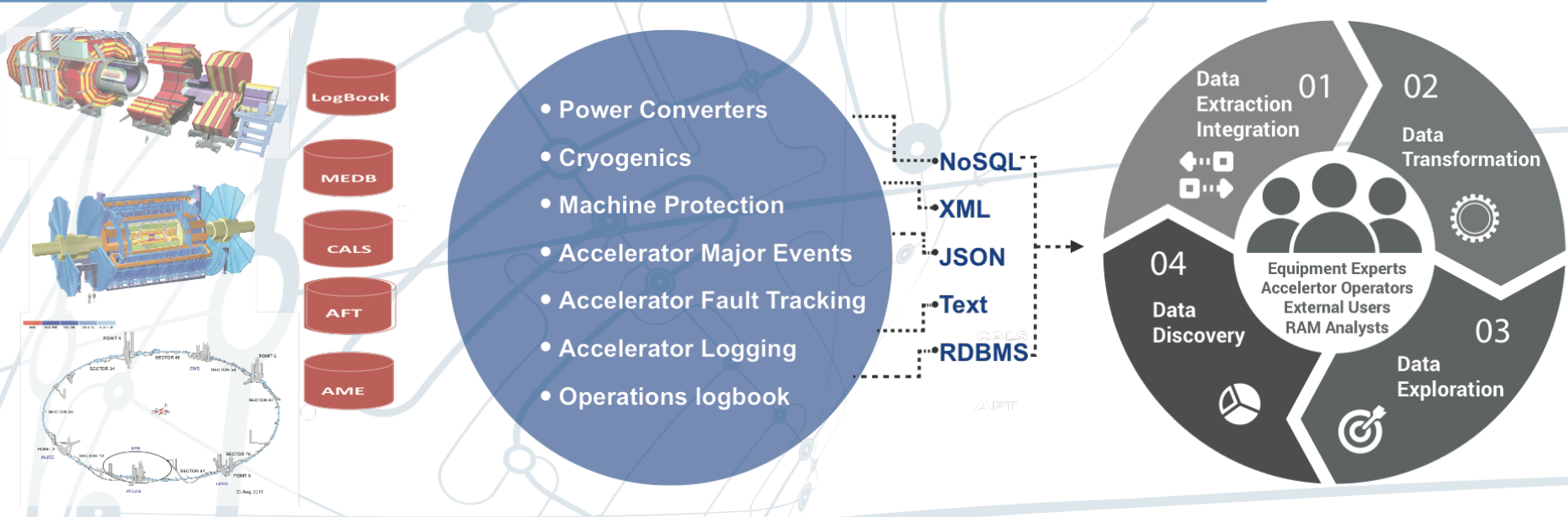
# Use Case: FCC RAMS

- Reliability, Availability, Maintainability and Safety (RAMS) studies for the Future Circular Collider (FCC)
- Study and increase the reliability and availability of the LHC
- Use RAMS findings to assess the feasibility of the needs of FCC
- Data distributed across multiple sources
  - Operations e-logbook
  - Accelerator Fault Tracking project
  - Accelerator logging service
  - Accelerator schedules
  - Cryogenics
  - Vacuum, Power Converters, etc.



# Use Case: FCC RAMS

## Scenario



# Deployment overview

cloudera®

CDH 5.7.1  
16 nodes, 24 GB ram  
Intel Xeon L5520 @ 2.27GHz  
165 TB HDFS

Oracle Big Data Discovery  
Libraries + Hive table detector



Resource Management (YARN)

Data Storage



Data Integration



C  
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a  
t  
i  
o  
n



Big Data Discovery v1.2.2  
Dgraph & Studio



ORACLE®

EXALYTICS



4x Xeon E7-8895 v2 (15 cores each)  
2 TB RAM  
4.8 TB Flash + 6 x 1.2 TB 10K HDD

# Oracle Big Data Discovery Overview

- **Data Exploration & Discovery**
  - Interactive catalog of all data
  - Assess attribute statistics, data quality and outliers
  - Quick data exploration or create dashboards and applications
- **Data Transformation with Spark in Hadoop**
  - Apply built-in transformations or write your own scripts
  - Data Enrichment
    - Text: Entity extraction, relevant terms, sentiment, language detection
    - Geographical information: address, IP, reverse
  - Preview results, undo, commit and replay transforms
- **Collaborative environment**
  - Share and bookmarks
  - Create and share transformed datasets

# Data Transformation UI - ETL

LOGBOOK Clear All FAULT\_CREATED is Not Null

999.8K of 1.7M 44.3K 13  
Records Sampled Filtered Records Attributes

Basic Convert Advanced Shaping Editor

Create geo hierarchy Extract entities Extract key phrases Tag from whitelist Group values Manage null values

Select options to extract key phrases from blocks of text

Input language: English  Use smart casing for input text  Adjust output text to lower case

Configure Output Settings  
New Attribute Name: COMMENT\_TERMS

TRANSFORM SCRIPT

```

logbook_id - Delete
shift_id - Delete
comment_id - Delete
element - Delete
EVENT_DATE - Convert to Date Time
shift_start - Delete
EVENT_COMMENT - Extract Key Phrases: COMM...
LINENAMES - Create
    
```

Commit to Project

Cancel Preview Add to Script

COMMENT_TERMS	EVENT_COMMENT	EVENT_DATE	EVENT_ID	FAULT_CREATED	FAULT_DESCRIP...	FAULT_GROUPN...	FAULT_ID	FAULTNAME	LINENAMES	LOGBOOK_COM...
switching	ASACUSA requests the switchin...	2010-06-29 22:35:53 UTC	1297268	2010-06-29 22:22:08	POWER_SUPPLY		1020608	VOID	ALPHA	Pbar Complex
No beam	No beam	2010-07-03 05:29:10 UTC	1298821	2010-07-03 05:30:02	OP		1020759	Access	CNGS1, SFTLONG2	SPS
No beam	No beam	2010-07-26 09:44:24 UTC	1309158	2010-07-26 09:45:15	CPS		1021337	PS	CNGS1, SFTLONG2, LH...	SPS
beam	No beam - stopped for access	2010-07-28 13:08:34 UTC	1310429	2010-07-28 09:53:52	Water leak	CVS	1021388	Cooling	CNGS1	SPS
lhc, accelerator	LHC SEQ: ACCELERATOR MO...	2010-08-03 09:38:28 UTC	1312689	2010-08-03 09:10:22	Technical Services		1021537	Electrical Services	BEAM	LHC
No beam	No beam	2010-08-08 04:14:13 UTC	1315081	2010-08-08 04:15:05	CPS		1021679	PS	CNGS1, SFTLONG2	SPS
piquet, token, RCO, RCD,...	Calling EPC piquet to know what...	2010-08-08 19:32:59 UTC	1315230	2010-08-08 19:11:20	communication lost	Cryogenics	1021684	Controls	BEAM	LHC
piquet, settings, injection, ...	When driving injection settings, s...	2010-08-09 09:38:27 UTC	1315466	2010-08-09 11:09:20	Water fault	Power converters	1021695	Voltage source	BEAM	LHC
start softstarting the kickers	start softstarting the kickers	2010-08-28 19:04:18 UTC	1323741	2010-08-28 14:21:42	movement problem	SPS	1022208	No beam	BEAM	LHC
No beam	No beam	2010-09-04 11:58:33 UTC	1326340	2010-09-04 12:02:19	...	CPS	1022301	PS	CNGS1, SFTLONG2, LHC3	SPS
RQT13, S12, RB82, Prec...	Recycles of S12, 81 and RQT1...	2010-09-10 08:17:57 UTC	1328955	2010-09-10 08:55:59	No QPS OK	QPS	1022472	Hardware	BEAM	LHC
ABR8, OK, QPS, injection, ...	QPS OK for MB.ABR8 is bad ...	2010-09-14 17:08:03 UTC	1331128	2010-09-14 17:27:40	TGB timing disabled	PS	1022558	Hardware	BEAM	LHC
mettons, signaux, nous, t...	No beam PS. TGB.KFA45. Inbit ...	2010-09-18 00:22:07 UTC	1333075	2010-09-18 00:41:36	heater discharging	QPS	1022667	Control	LHCPROBE, SFTPRO, A...	PS Complex
collimators, b1, lhc	LHC SEQ: B1 Collimators to par...	2010-09-21 04:43:25 UTC	1335090	2010-09-21 05:27:13	...	Controls	1022800	Software	BEAM	LHC
beam	LHC RUN CTRL: BEAM MODE ...	2010-09-23 08:15:04 UTC	1336024	2010-09-23 10:23:55	...	Hardware	1022869	Hardware	BEAM	LHC
No beam	No beam	2010-09-28 17:32:45 UTC	1338241	2010-09-28 17:36:57	...	RF	1022997	RF Power	LHCION1, CNGS1, CNG...	SPS
No beam	No beam	2010-10-23 03:53:43 UTC	1349101	2010-10-23 03:55:19	...	OP	1023504	Setting Up	CNGS1, SFTLONG2, LHC3	SPS
ctrl, lhc	LHC RUN CTRL: BEAM MODE ...	2010-10-25 19:18:09 UTC	1350121	2010-10-25 21:09:03	...	Cryogenics	1023541	Controls	BEAM	LHC
No beam	No beam	2010-11-01 02:04:06 UTC	1352843	2010-11-01 02:04:57	...	RF	1023673	RF Power	CNGS1, SFTLONG2	SPS
No beam	No beam	2010-11-17 08:13:31 UTC	1360713	2010-11-17 00:51:50	...	CPS	1034081	PSB	CNGS1, SFTLONG2, LHC2	SPS
Genoud, PSB	<center>=>H.Genoud<center>...	2010-11-17 21:11:37 UTC	1361115	2010-11-17 21:05:19	...	LINAC2	1024134	Control	LHCPROBE, SFTPRO, A...	PS Complex
mspb, remove, sc	Remove MSPSB from SC. End ...	2010-11-19 12:50:38 UTC	1361990	2010-11-16 20:18:16	HV-Interlock	PSB	1024072	Kicker	EASTA, EASTB, EASTC, ...	PS Complex

aft\_faults\_extended logbook









# Discovery Applications

AFT\_FAULTS\_EXT... Clear All

REFINE BY

- AFT\_FAULTS\_EXTENDED
  - accelerator
  - creator
  - eelogbook\_fault\_id
  - fault\_description
  - fault\_id
  - fault\_state
  - full\_name
  - logbook\_faulty\_element
  - op\_duration
  - op\_end\_time
  - parent\_fault\_id
  - prevents\_injection
  - start\_time
- Other
  - comment\_terms
  - event\_comment
  - fault\_groupname

Filter...

AFT

QPS

Power converters

SPS

Technical Services

RF

Miscellaneous

Collimator

Beam instrumentation

Injection

Access

Beam dump

PS

Vacuum

Controls

PdB

Experiments

BIS

Operation

SIS

More Select All

faultname

linenames

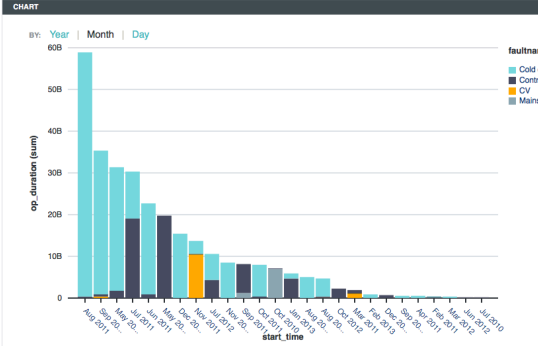
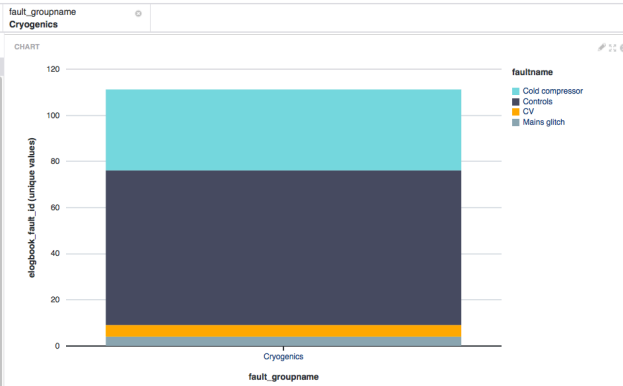
logbook\_nickname

op\_mode

Expand selection

LOGBOOK\_CLEAN

AFT Logbook



COLUMN CONTAINER

RESULTS TABLE

Other 0 RECORDS SELECTED

comment_ter...	event_comment	fault_groupname	faultname	linenames
<input type="checkbox"/> ghh	GHF & Reyes	Cryogenics	Cold compressor	IONPHY
<input type="checkbox"/> compensat...	LHC SEQ: ramping up ALICE DIPOLE and COMPENSATORS	Cryogenics	Cold compressor	ACCESS
<input type="checkbox"/> beams	- started the shift with a stable beams happily ongoing (Fill #2309).	Cryogenics	Cold compressor	IONPHY
<input type="checkbox"/> I4, lhc, ond...	LHC SEQ: ONDULATOR L4 U_RES RESETED	Cryogenics	Cold compressor	ACCESS
<input type="checkbox"/>	For Philippe	Cryogenics	Cold compressor	IONPHY
<input type="checkbox"/> bctfd, lhc	LHC SEQ: BctFd tests finished. Overall result: SUCCESS	Cryogenics	Cold compressor	ACCESS
<input type="checkbox"/> b2, collima...	LHC SEQ: B2 Collimators to parking starting	Cryogenics	Cold compressor	IONPHY
<input type="checkbox"/> 3hrs, MKD...	MKD switch replaced, and now synchronization and local energy scans for 3hrs, then if needed, a change of the delay board. Final...	Cryogenics	Cold compressor	IONPHY
<input type="checkbox"/> LDM_LED...	short access for LED on LDM at UX451	Cryogenics	Cold compressor	ACCESS
<input type="checkbox"/>	LHC SEQ: ONDULATOR L4 ON	Cryogenics	Cold compressor	ACCESS
<input type="checkbox"/> l5b1, eps...	ROT12.L5B1 QPS_OK missing	Cryogenics	Cold compressor	PROTONPHY
<input type="checkbox"/> PM55, acces	end of access in PM55	Cryogenics	Cold compressor	IONPHY
<input type="checkbox"/> beam	LHC RUN CTRL: BEAM MODE changed to BEAM DUMP	Cryogenics	Cold compressor	IONPHY
<input type="checkbox"/> lhc	LHC SEQ: ALICE & LHC READY for T12 SETUP	Cryogenics	Cold compressor	ACCESS
<input type="checkbox"/> lthoop	*History application has been captured from lthoop	Cryogenics	Cold compressor	ACCESS
<input type="checkbox"/> lhc	LHC SEQ: MCS checks finished	Cryogenics	Cold compressor	PROTONPHY
<input type="checkbox"/>	Cryo compressor restarted, the recalibration was successful.	Cryogenics	Cold compressor	PROTONPHY

TAG CLOUD

B1 b1 B2 b2 bct beam

bpmhc calibration checks

collimators compensators c

confirmation cryo Cryo cryo

dipole EPC fill injection inter

lhc LHC LHCs ondul

pliquet post precycle QPS ramp

sanity settings setup solenoid

vacuum valves warnings

Explore comment\_terms by Number of records

Inside this project

AFT\_FAULTS\_EXTENDED REFINEME...

comment\_terms - Other

ORL

event\_comment - Other

- ...ORL, around midnight start cooling ma...
- ...ORL that gave a wrong signal (at 10-4)...
- ...ORL line C affecting DFB MB. Trying t...
- ...ORLGE\_03R8\_TT947. It could be that ...

fault\_description - General

...ORL

LOGBOOK REFINEMENTS

EVENT\_COMMENT - General

- ...ORLAB\_23R7\_TT943.POSST) is actu...
- ...ORL). All pressure are ok.
- Leak in ORL sector 4-5 subsector B45.Q...
- ...ORL SSB Stable : VGP.230.8R4.Q : 3e...
- ...ORL that gave a wrong signal (at 10-4)...

EVENT\_ID - General

- ...ORL closed the valves. Clean dump
- ...ORL.Controls.Cryogenics.2012-09-03 ...
- ...ORL.Controls.Cryogenics.2012-09-03 ...
- It looks like a vacuum gauge on the ORL...
- ...ORL sector 4-5 subsector B45.Q stable;

3 more refinement matches >

FAULT\_DESCRIPTION - General

...ORL

LOGBOOK\_CLEAN REFINEMENTS

event\_comment - General

- ...ORL that gave a wrong signal (at 10-4)...
- ...ORL).
- ...ORL SSB
- Leak Sector 4-5 ORL subsector B : stable
- ...ORL, around midnight start cooling ma...

6 more refinement matches >

fault\_description - General

...ORL

Save as default state

# Notebooks

- Easy to create and share documents that contain live code
- Step by step execution reproduce the analysis, charts, etc.
- Support for multiple languages/kernels
- Multiple notebook software available
  - Jupyter/IPython
  - BDD provides notebook from version 1.2.0 (BDD Shell)
    - Can be used with Jupyter/IPython
  - HUE notebooks
  - Apache Zeppelin
  - More...



# HUE Notebooks

My Notebook

DATABASE  
foc\_rams

TABLES  
aft\_cardiogram  
aft\_faults  
high\_level\_summary\_schedule  
lhlog\_cryo  
op\_logbook

```
Impala SQL  
select variable_name, count(*) as numrows  
from lhlog_cryo  
group by variable_name  
order by numrows desc  
limit 10
```

X-AXIS  
variable\_name

Y-AXIS  
 numrows

SORTING

Variable Name	Count (numrows)
QRLAB_23L1_GT943.POSST	6,887,080
QRLHA_05R4_GT936.POSST	~6,000,000
QRLAB_15L6_GT947.POSST	~5,800,000
QRLHA_05R4_GT937.POSST	~5,000,000
QRLFE_04L8_GT930.POSST	~5,000,000
QRLCC_07L4_GT947.POSST	~4,800,000
ATLAS-LUMI_TOT_INST	~4,500,000
QRLDE_06R8_GT931.POSST	~4,500,000
QRLHA_05L4_GT935.POSST	~4,200,000
QRLLEA_06L2_GT931.POSST	~4,200,000

```
Impala SQL  
select avg(value) as value, extract(utc_timestamp, "hour") as hour_  
from lhlog_cryo  
where utc_timestamp > "2015-06-12"  
and utc_timestamp < "2015-06-13"  
and variable_name = "QRLAB_23L1_GT943.POSST"  
group by hour_  
order by hour_
```

X-AXIS  
hour\_

Y-AXIS  
 value  
 hour\_

SORTING

hour_	avg(value)
0	12.333
1	12.337
2	12.325
3	12.326
4	12.337
5	12.318
6	12.314
7	12.322
8	12.324
9	12.320
10	12.320
11	12.327
12	12.311
13	12.318
14	12.323
15	12.323
16	12.326
17	12.323
18	12.311
19	12.316
20	12.320
21	12.328
22	12.326

# FCC RAMS studies: Cryogenic valves reliability

- Reliability of degrading components of valves in the cryogenic system of the CERN Large Hadron Collider (LHC) - *Elena Rogova, Delft University of Technology*
  - Analysis of the difference between request and feedback of the valve aperture
  - Coding in Matlab
- Next: Scale processing using Spark
  - Process valves in parallel/distributed
  - Generate charts for each valves
  - Notebooks using PySpark
    - Collaborative review and improvement of the code
    - Share results

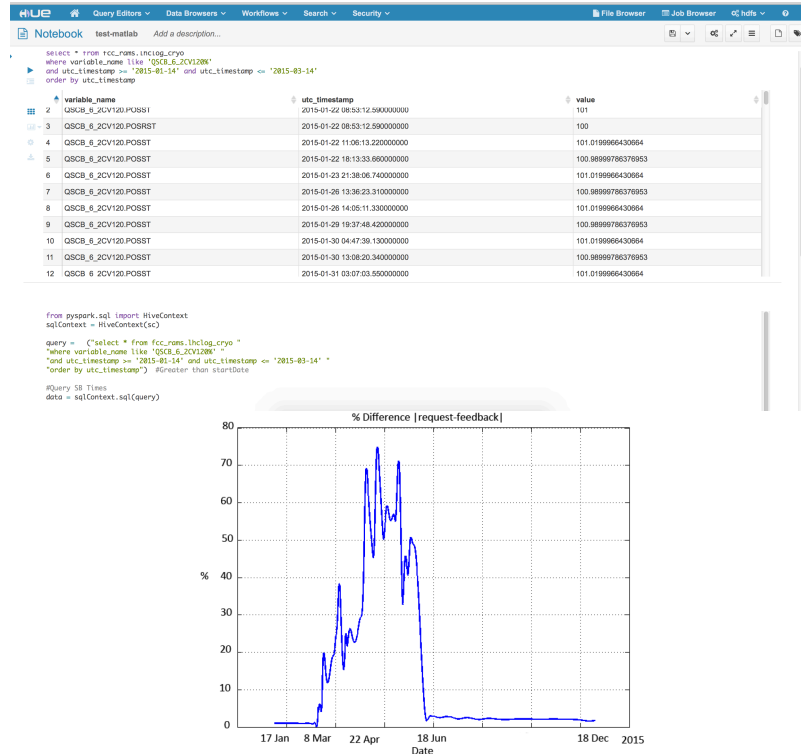
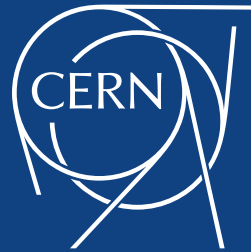


Figure 6. Absolute difference (%) between request and feedback for QSCB\_6\_2CV120

# Conclusions

- Overcome technical limitations for several CERN use cases
  - Allows to gain more value from data investment
- Great ecosystem for data ingestion, processing, analytics, SQL engines, etc.
- Heterogeneous data access
- Important to facilitate the interaction with data
  - Data visualization and discovery
    - Helps users to browse, explore and understand their data
    - Combined with ETL for data cleaning and feature engineering
  - Notebooks are easy to use and powerful for advanced analytics
  - Self-service tools improve productivity
    - Users should be able to do what they need without IT intervention
  - Collaborative environment



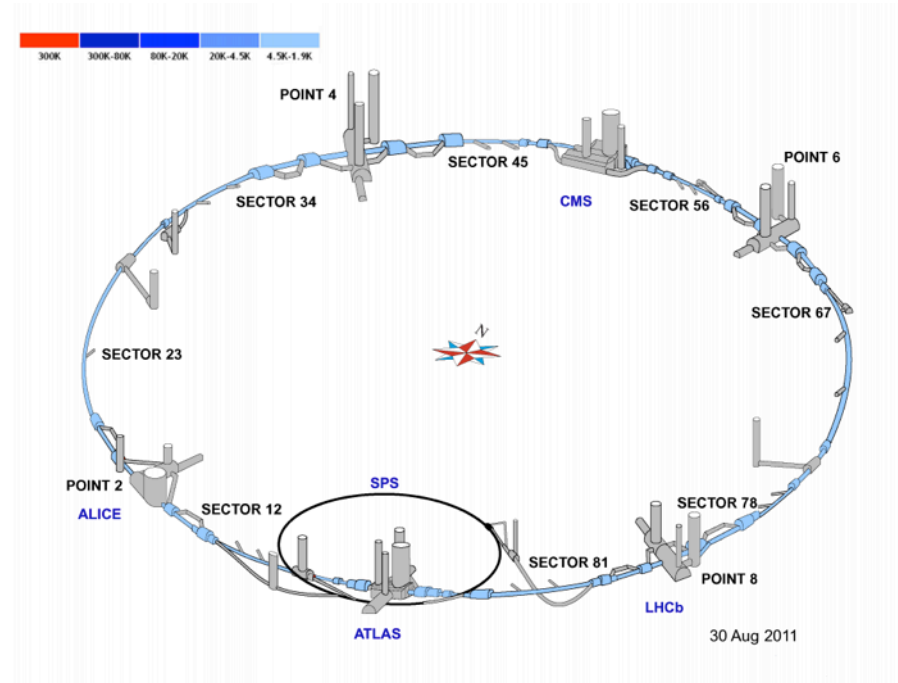
[www.cern.ch](http://www.cern.ch)



# Largest Cryogenics Installation

- 50k I/O, 11k actuators, ~5k control loops
- Control:
  - ~100 PLCs (Siemens, Schneider)
  - ~40 FECs (industrial PCs)
- Supervision: 26 SCADA servers


Instrument/Actuators	Total
Temperature [1.6 – 300 K]	10361
Pressure [0 – 20 bar]	2300
Level	923
Flow	2633
Control valves	3692
On/Off valves	1835
Manual valves	1916
Virtual flow meters	325
Controllers (PID)	4833



# Datasets Catalog

ORACLE Big Data Discovery

Search     

 **7 Projects**  
[View all](#)

 **11 Data Sets**  
[View all](#)

 **Add Data Set**

## Refine By

### USAGE

Created By Me

### CONTENT

Contains Dates

Contains Locations

### METADATA

Project Author

Data Set Author

Project Tags

Data Set Tags

Last Modified

Number of Records

Number of Attributes

Data Source Type

## Recently Viewed Data Sets


**aft\_faults**

Data Source: fcc\_rams.aft\_faults  
(1.8k records)   
[Preview](#)

**op\_logbook**


Data Source: fcc\_rams.op\_logbook  
(1.1M records)   
[Preview](#)

**cms\_lhcfills**

Data Source: cms\_lhcfills.csv  
(621 records)   
[Preview](#)

## Most Popular Data Sets [View More](#)

**op\_logbook**

Data Source: fcc\_rams.op\_logbook  
(1.1M records)   
[Preview](#)


**apache\_mwctl\_prod\_db...**

Data Source: apache-mwctl-test-db-a0...  
(183 records)  
[Preview](#)


**apache\_mwctl\_prod\_db...**

Data Source: apache-mwctl-test-db-a0...  
(745 records)  
[Preview](#)

**aft\_faults**

Data Source: fcc\_rams.aft\_faults  
(1.8k records)   
[Preview](#)

**cms\_lhcfills**

Data Source: cms\_lhcfills.csv  
(621 records)   
[Preview](#)


**aft\_cardiogram**

Data Source: fcc\_rams.aft\_cardiogram  
(1.2M records)   
[Preview](#)


**cms\_runs\_for\_fill**

Data Source: cms\_runs\_for\_fill.csv  
(2.5k records)  
[Preview](#)

**cms\_tmb\_rates**

Data Source: cms\_tmb\_rates.csv  
(820.8k records)   
[Preview](#)

**high\_level\_summary\_sc...**

Data Source: fcc\_rams.high\_level\_sum...  
(63 records)   
[Preview](#)

**lhclog\_cryo**

Data Source: fcc\_rams.lhclog\_cryo  
(1.1B records)   
[Preview](#) New

**naive\_ml\_prediction**

Data Source: naive\_ml\_prediction.csv  
(1.2M records)  
[Preview](#)

**lhclog\_cryo** (1,078,271,323 records)

Data Set Info **Used in Projects (1)** **Related Data sets (4)**

**+ Tags** *To add tags, click the Tags button at left.*

## Attributes

**Data source:** fcc\_rams.lhclog\_cryo  
**Data source type:** Hive  
**Hive Table name:** fcc\_rams.lhclog\_cryo  
**Created on:** 1/17/2016 4:52:14 PM (UTC)  
**Access:** Public [edit](#)  
**Data set key:** edp\_dil\_edp\_bfb0688b-3280-4bcf-a107-87a3d4ef7e04

## Actions

[Explore](#)  
[Add to project](#)  
[Edit tags](#)  
[Reload data set](#)  
[Delete](#)

## Summary

**0 Views**  
**Last Updated**  
1/17/2016 4:52:16 PM (UTC)

## Newly Added Data Sets [View More](#)

**lhclog\_cryo**

Data Source: fcc\_rams.lhclog\_cryo  
(1.1B records)   
[Preview](#) New

**op\_logbook**

Data Source: fcc\_rams.op\_logbook  
(1.1M records)   
[Preview](#)


**apache\_mwctl\_prod\_db...**

Data Source: apache-mwctl-test-db-a0...  
(745 records)  
[Preview](#)

**apache\_mwctl\_prod\_db...**

Data Source: apache-mwctl-test-db-a0...  
(183 records)  
[Preview](#)


**cms\_tmb\_rates**

Data Source: cms\_tmb\_rates.csv  
(820.8k records)   
[Preview](#)

**cms\_runs\_for\_fill**

Data Source: cms\_runs\_for\_fill.csv  
(2.5k records)  
[Preview](#)

**cms\_lhcfills**

Data Source: cms\_lhcfills.csv  
(621 records)   
[Preview](#)

# Data Visualization

## FCC RAMS v1: Extended Charts

Explore Transform Discover

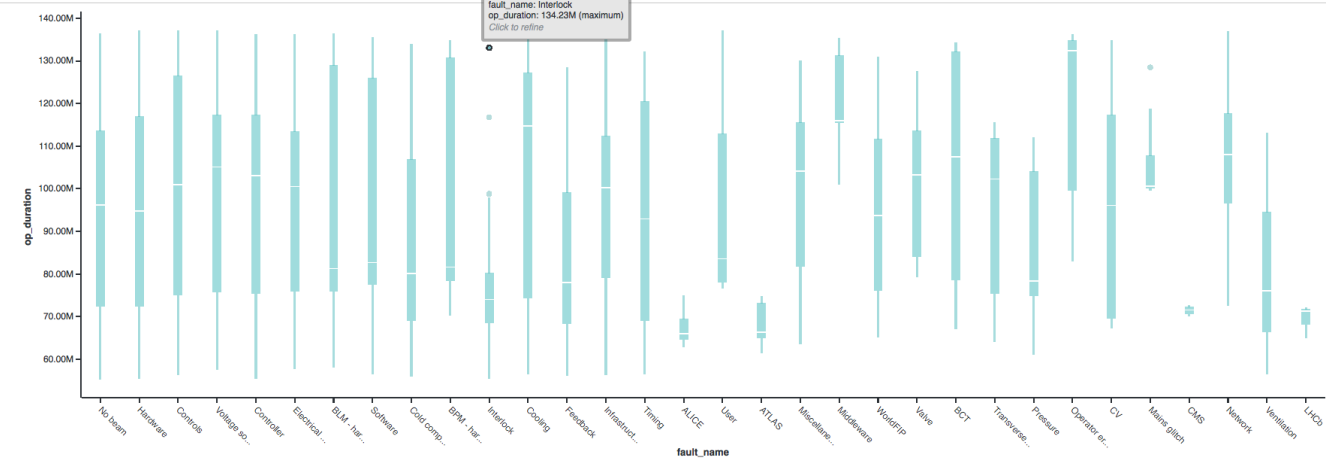
AFT\_FAULTS OP\_LOGBOOK Clear All

faultname VOID

REFINE BY

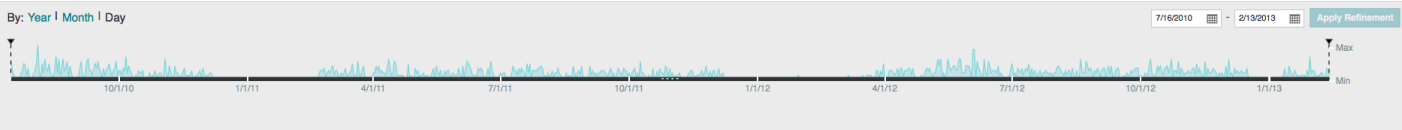
- AFT\_CARDIOGRAM
- AFT\_FAULTS
  - creation\_time\_utc
  - description
  - element
  - eologbook\_fault\_id
  - fault\_classification\_id
  - fault\_classification\_name
  - fault\_creation\_source\_name
  - fault\_description
  - fault\_id
  - fault\_name
    - Filter...
    - No beam
    - Hardware
    - Controls
    - Voltage source
    - Controller
    - Electrical Services
    - BLM - hardware
    - Software
    - Cold compressor
    - BPM - hardware
    - Interlock
    - Cooling
    - Feedback
    - Infrastructure
    - Timing
    - ALICE
    - User
    - ATLAS
    - Miscellaneous
    - Middleware
- fault\_state
- group\_name
- is\_root\_cause
- op\_duration
- op\_end\_time
- prevents\_beam\_op
- prevents\_injection
- HIGH\_LEVEL\_SUMMARY\_SCHEDULE
- LHCLOG\_CRYO
- OP\_LOGBOOK

BOX PLOT

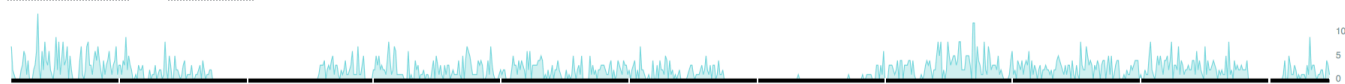


VIEW METRIC DIMENSION  
aft\_faults op\_duration fault\_name

TIMELINE



Record Count by start\_time : 1,701 records



ADD COMPONENT

- Filter...
- Box Plot
- Chart
- Column Container
- Histogram Plot
- IFrame
- Map
- Parallel Coordinates Plot
- Pivot Table
- Results List
- Results Table
- Summarization Bar
- Tabbed Container
- Tag Cloud
- Thematic Map
- Timeline
- Web Content Display
- Donut Pie (Unpublished)



```

select * from fcc_rams.lhclog_cryo
where variable_name like 'QSCB_6_2CV120%'
and utc_timestamp >= '2015-01-14' and utc_timestamp <= '2015-03-14'
order by utc_timestamp
    
```

	variable_name	utc_timestamp	value
2	QSCB_6_2CV120.POSSI	2015-01-22 08:53:12.590000000	101
3	QSCB_6_2CV120.POSRST	2015-01-22 08:53:12.590000000	100
4	QSCB_6_2CV120.POSST	2015-01-22 11:06:13.220000000	101.0199966430664
5	QSCB_6_2CV120.POSST	2015-01-22 18:13:33.660000000	100.98999786376953
6	QSCB_6_2CV120.POSST	2015-01-23 21:38:06.740000000	101.0199966430664
7	QSCB_6_2CV120.POSST	2015-01-26 13:36:23.310000000	100.98999786376953
8	QSCB_6_2CV120.POSST	2015-01-26 14:05:11.330000000	101.0199966430664
9	QSCB_6_2CV120.POSST	2015-01-29 19:37:48.420000000	100.98999786376953
10	QSCB_6_2CV120.POSST	2015-01-30 04:47:39.130000000	101.0199966430664
11	QSCB_6_2CV120.POSST	2015-01-30 13:08:20.340000000	100.98999786376953
12	QSCB_6_2CV120.POSST	2015-01-31 03:07:03.550000000	101.0199966430664

```

from pyspark.sql import HiveContext
sqlContext = HiveContext(sc)

query = ("select * from fcc_rams.lhclog_cryo "
"where variable_name like 'QSCB_6_2CV120%' "
"and utc_timestamp >= '2015-01-14' and utc_timestamp <= '2015-03-14' "
"order by utc_timestamp") #Greater than startDate

#Query SB Times
data = sqlContext.sql(query)
    
```