

LHC 1st shutdown

K. Foraz, CERN

Accelerator Reliability Workshop 2015

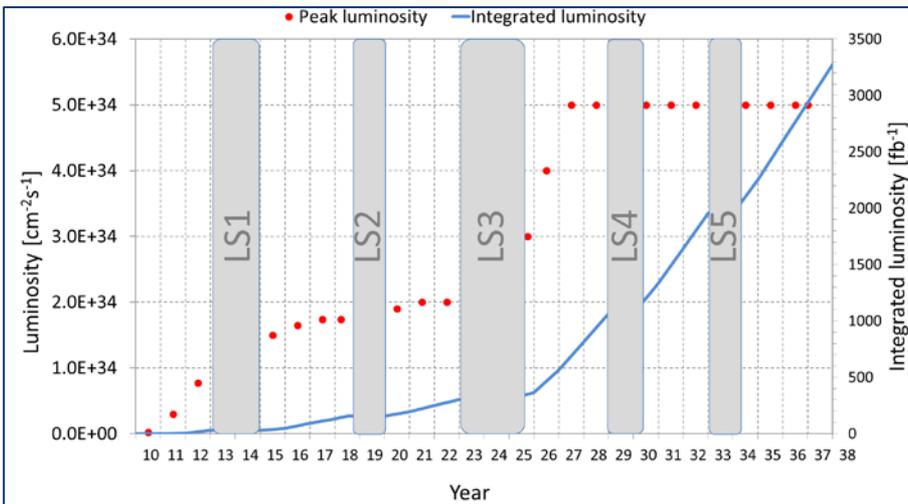
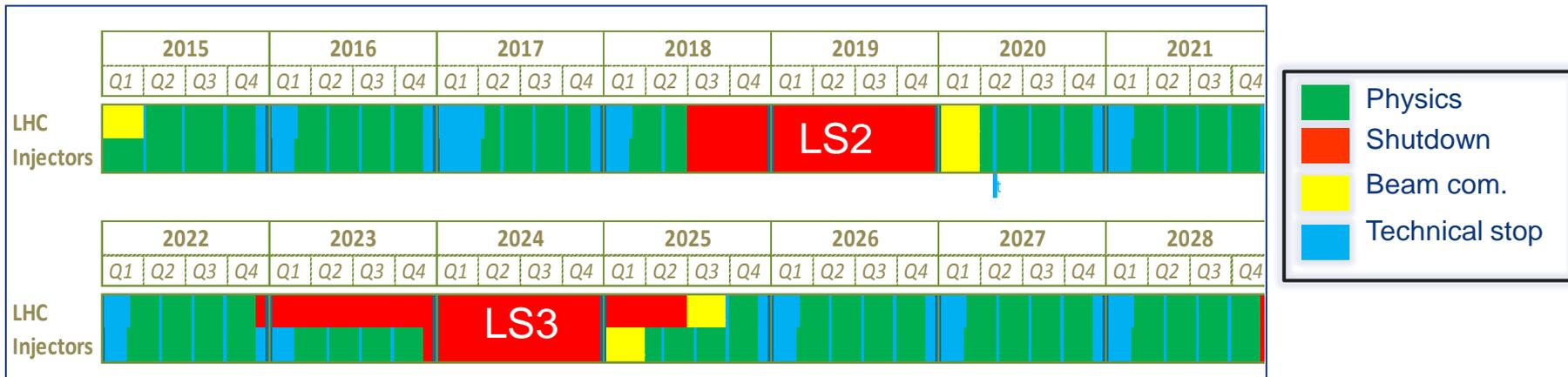


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Contents

- Life-cycle of the CERN accelerator complex
- Goal of Long Shutdown 1 (LS1)
- Phases
 - Scoping
 - Preparation
 - Implementation
 - Closure
- Conclusions

Life-cycle of CERN accelerator complex



- Run2 ▶ 30fb⁻¹
- LS2 ▶ LIU
- Run3 ▶ 300fb⁻¹
- LS3 ▶ HL-LHC
- Run4&5&6 ▶ 3000fb⁻¹

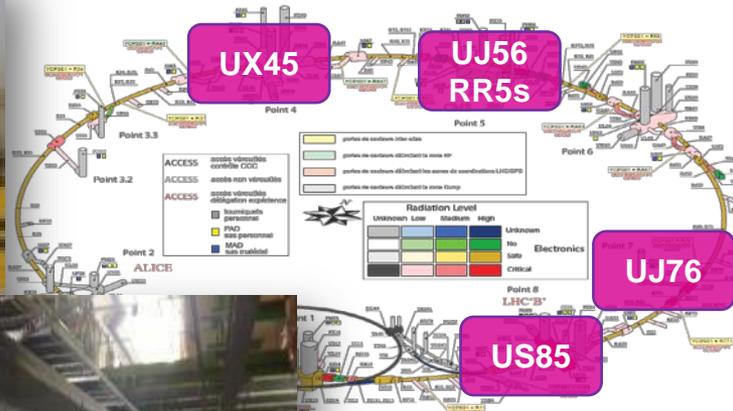
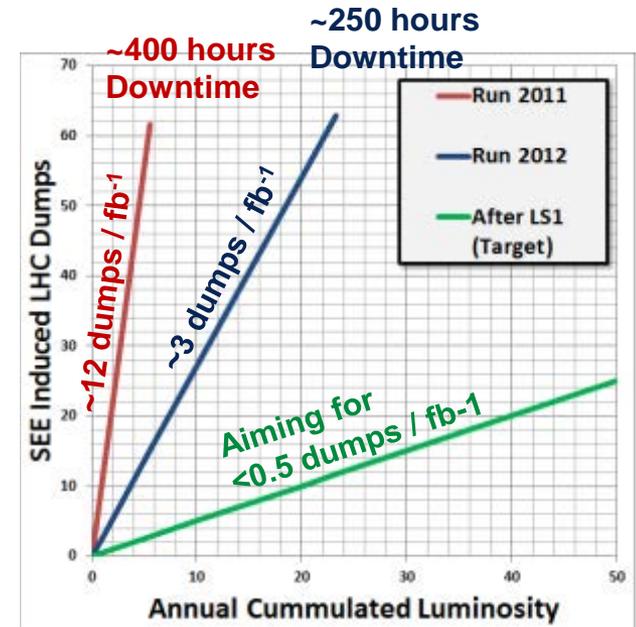
LHC LS1 goal

- Take all measures for a **safe** and **reliable** operation of LHC @ **6.5TeV/beam**
 - Consolidate superconducting magnets and circuits ➔ SMACC
 - See M. Solfaroli's presentation
 - Relocate radiation sensitive electronics ➔ R2E
 - Perform full maintenance of all equipment's
 - Consolidate and upgrade the equipment

LHC LS1 – R2E project

R2E: Radiation to Electronics

- Relocate and protect the SEE sensitive equipment
- More than 100 racks relocated, Additional shielding



Courtesy of M. Brugger & A.-L-Perrot

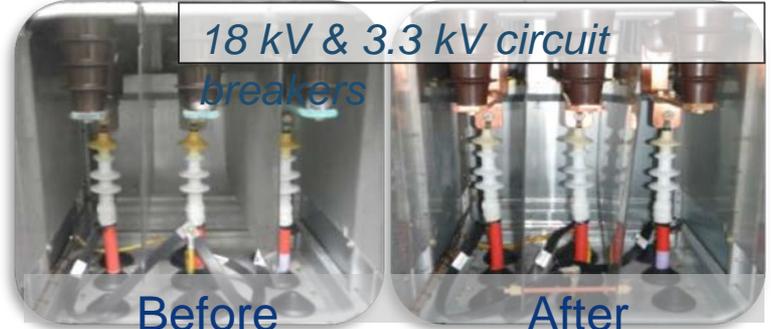
LHC LS1 a huge amount of activities



Vacuum



UPS-RE82



18 kV & 3.3 kV circuit breakers

Before

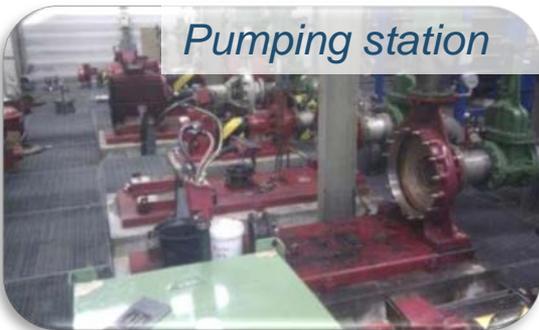
After



Cryo plant



P7 enclosure



Pumping station



Helium spill test



ACS transport

LS1 phases



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LS1 Scoping phase

- LS1 concerned not only the LHC, but all the accelerator complex
- Activities to be prioritized and approved according to the following priorities:
 - P0: Safety
 - P1: Beam to 7TeV, nominal performance
 - P2: Reliable operation improvement
 - P3: CERN approved projects
 - P4: CERN non approved projects
- Arbitration between requests w.r.t resources & priorities
➔ plan.cern.ch
- Results presented during LS1 day

The screenshot displays the 'Plan View' interface for a project named 'TC22 electronics and services upgrade (LHC)'. The interface is divided into several sections:

- General:** Contains fields for 'Proposed Project', 'Proposed Priority', 'Location', 'Goal', 'Impact if not done / postponed', and 'Comments'. A note states: 'The project goal for the energy side can be absorbed by the TC22 budget'.
- Schedule:** Includes 'Proposed Period Start' (01/01/2015), 'Creation Level', and a 'Schedule' section with a 'Start' date of 01/01/2015.
- Resources and budget:** Shows a table for 'Resource Details' with columns for 'Name', 'Budget (MCHF)', 'P100%', 'P100%', and 'Availability'. It lists resources for '2013' and '2014'.
- Group contributions:** Shows a table for 'Group Contributions' with columns for 'Group Number', 'Name', 'Restriction', 'Delivery of P100%', and 'P100%'. It lists contributions for '2013' and '2014'.

Preparation phase

"By failing to prepare you are preparing to fail."

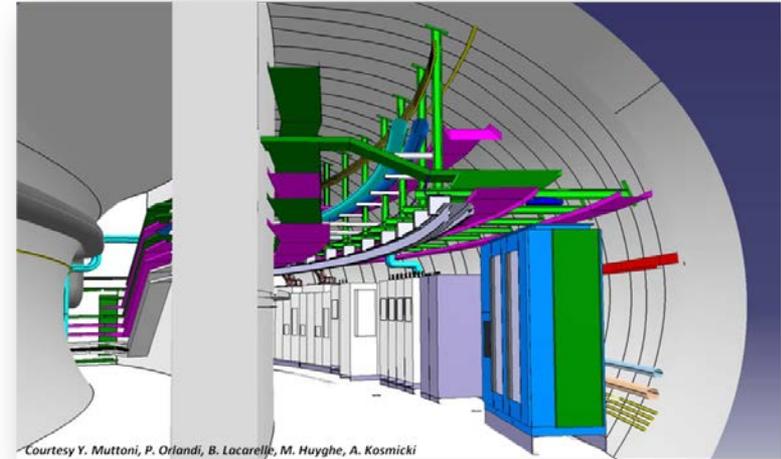
B. Franklin

For the 1st time in my life
I'm feeling I should've done
something about my weight



LS1 Preparation phase - What

- Integration studies
 - Mandatory step for any change of the external envelopes of underground equipment.



- Procedures
 - Engineering Change Requests, Engineering Specifications...



LS1 Preparation phase - How

- Work Package Analysis meetings
- Reviews
 - External review of SMACC
 - Internal reviews
- Safety
 - General safety: procedures, prevention plans, joint inspections
 - ALARA (As Low As Reasonably Achievable)
 - Optimization of interventions to optimize the dose received ➔ reduction of doses by at least a factor 3

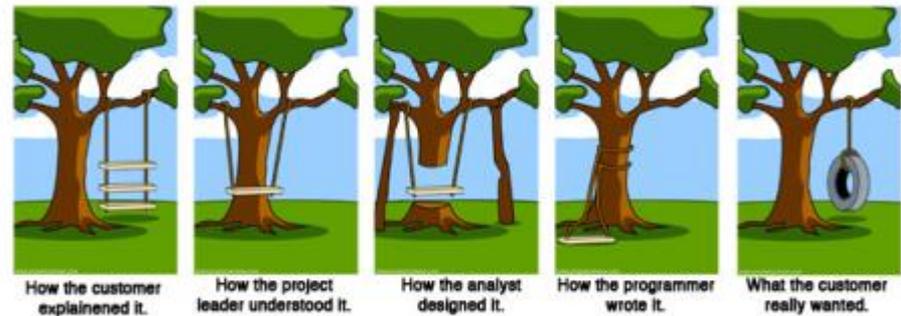
Items covered:

- ✓ Description
- ✓ Conditions prior to start
- ✓ Schedule
- ✓ Perimeter of worksites
- ✓ Storage areas
- ✓ Logistics
- ✓ Risks and compensatory measures
- ✓ Radiological management

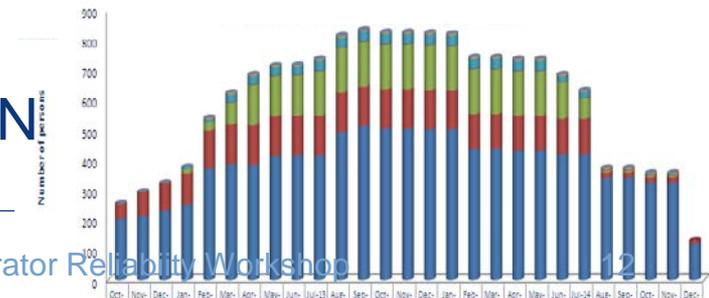
LS1 Preparation phase - When

- Main projects
 - SMACC project: 4 years of preparation
 - R2E: 3 years of preparation

- Contracts: ~ 9 months



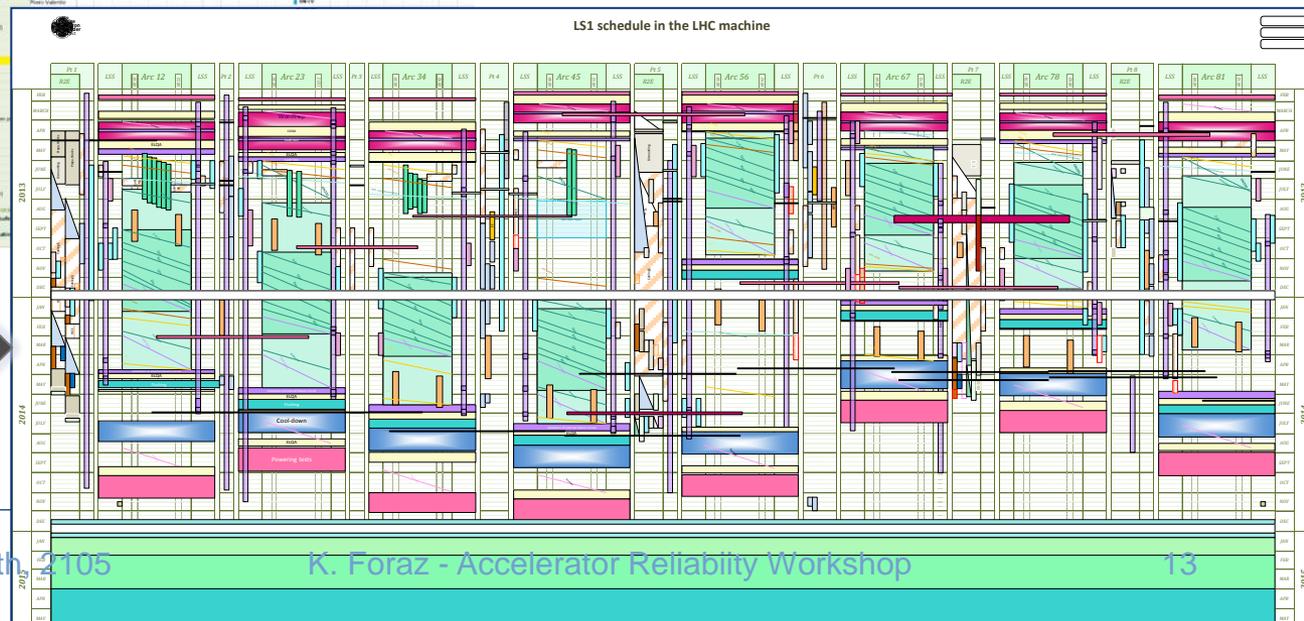
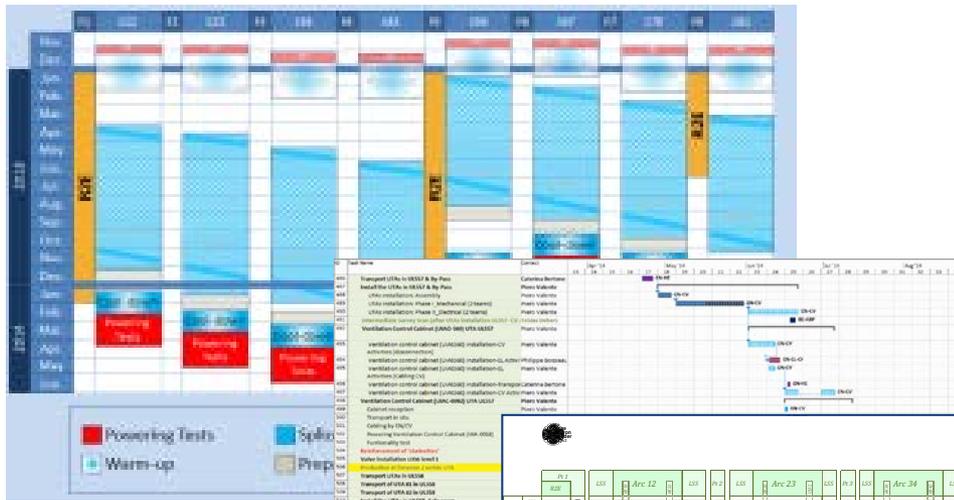
- Organize human resources
 - ~ 800 additional collaborators contracts or collaboration
 - Training, equipment, logistics
 - Temporary detachment within CERN



LS1 Preparation phase – baseline schedule

From big blocks to detailed schedules

Resources leveling
Logistics
Safety



Automated

LS1 Implementation phase

- Coordination

- Weekly Coordination meetings
- Dedicated project meetings (SMACC, R2E)
- Long Shutdown Committee



- Progress of works
- Additional activities & impact on resources
- Issues: delay, safety, logistics....

- Strong field coordination

LS1 Implementation phase

IMPACT system

- *Intervention Management Planning And Coordination Tool*
- *Mandatory for any intervention at CERN*
- *Integrated with existing systems: access system, location database, Radio Protection database, InforEAM...*

★ 63853 - Waiting for Approval

Cancel Reject Approve Save Refresh Clone Split

New Approval New Meeting Approval Forward For Information

Title*: Facility*:

Responsible*: 62078 , 166129 Activity Type*:

Priority*:

WHAT **WHO** **WHEN** **WHERE** **HOW** **SAFETY** **IMPACT & TESTS** **COMMENTS** **APPROVAL** **HISTORY** **EXTERNAL REFERENCES**

LS1 Implementation phase

IMPACT system

What

Description: Mise en place de Vannes Prise Echantillon sur les circuits : BUSS BAR, YOKI

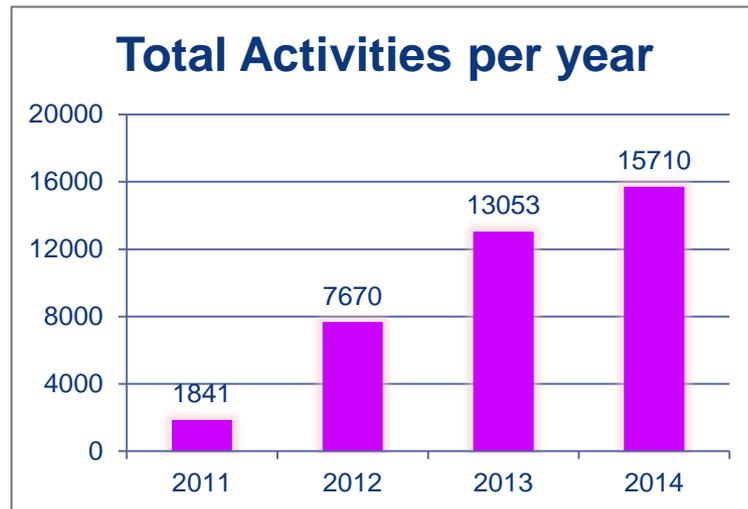
System: F - Fluids

Where

Locations

Location: USC55 Service Ca

Access points: YCA01=UP55|X
YCA01=UPX56|X



Safety Procedures

Documents

Type: Fire Permit Doc. number: 481751

Type: VIC Doc. number: 103

Comments:

Lockouts

Activity Hazards

Type: Hot work (ex.: welding, grinding, etc.)

Comments:

Compensatory Measure list not exhaustive

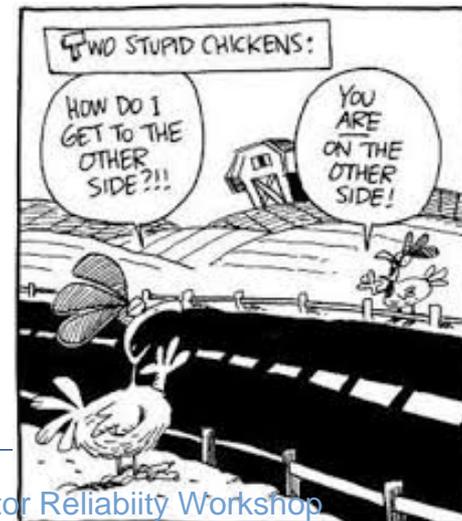
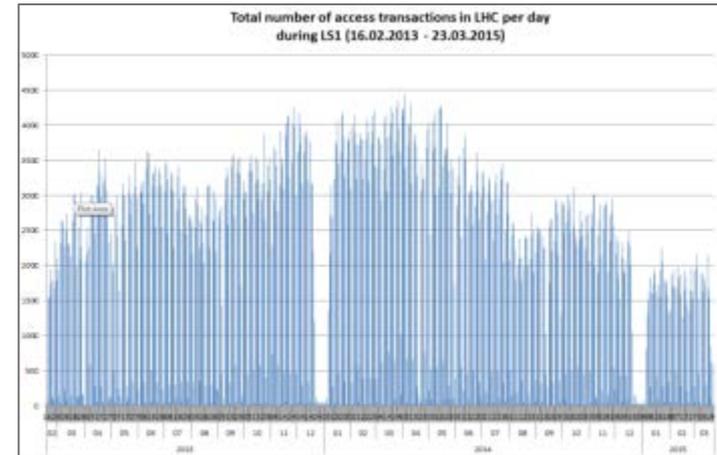
Compensatory Measures:

Type: Fire permit prepared

Comments:

LS1 Implementation phase

- Access ... sinew of war
 - 100m underground machine
 - Peak of entries & exits per day in LHC (incl. experiments) : 4'434
- 10 surface access points, 2 critical systems
 - Material Access Devices
 - Lifts



LS1 Implementation phase

Additional activities

- Inherent to such a Shutdown ... there were
 - Those unexpected :
 - LHC QRL leaks, 15% ► 50% of splices...
 - Those who «somebody» knew but forgot to inform the community !!
 - ➔ induced additional workload to the usual support groups
- Schedule was reviewed accordingly and resources reallocated
 - A 2nd baseline was edited in September 2014, and few weeks were added

LS1 Closure phase

- LS1 Debriefing day held in March 31st
 - key intervening teams have presented their feedback, especially in terms of safety, access conditions, support given and obtained, infrastructure. This accumulated experience will be useful to prepare the LS2 and identify possible bottlenecks and critical issues.

LS1 – 1st feedbacks on organization

- Scoping phase - Plan tool
 - 😊 Unique repository, useful for communication between groups
 - 😞 To be reviewed regularly
- Preparation & Implementation phase
 - 😊 Work Package Analysis
 - 😊 ALARA as low as Reasonably Achievable ➡ 😞 Activities scheduled as Late as possible....no margin = stress
 - 😊 General Organization: Long Shutdown Committee and coordination meetings
 - 😞 Additional activities and resources reshuffling
... effects on other facilities



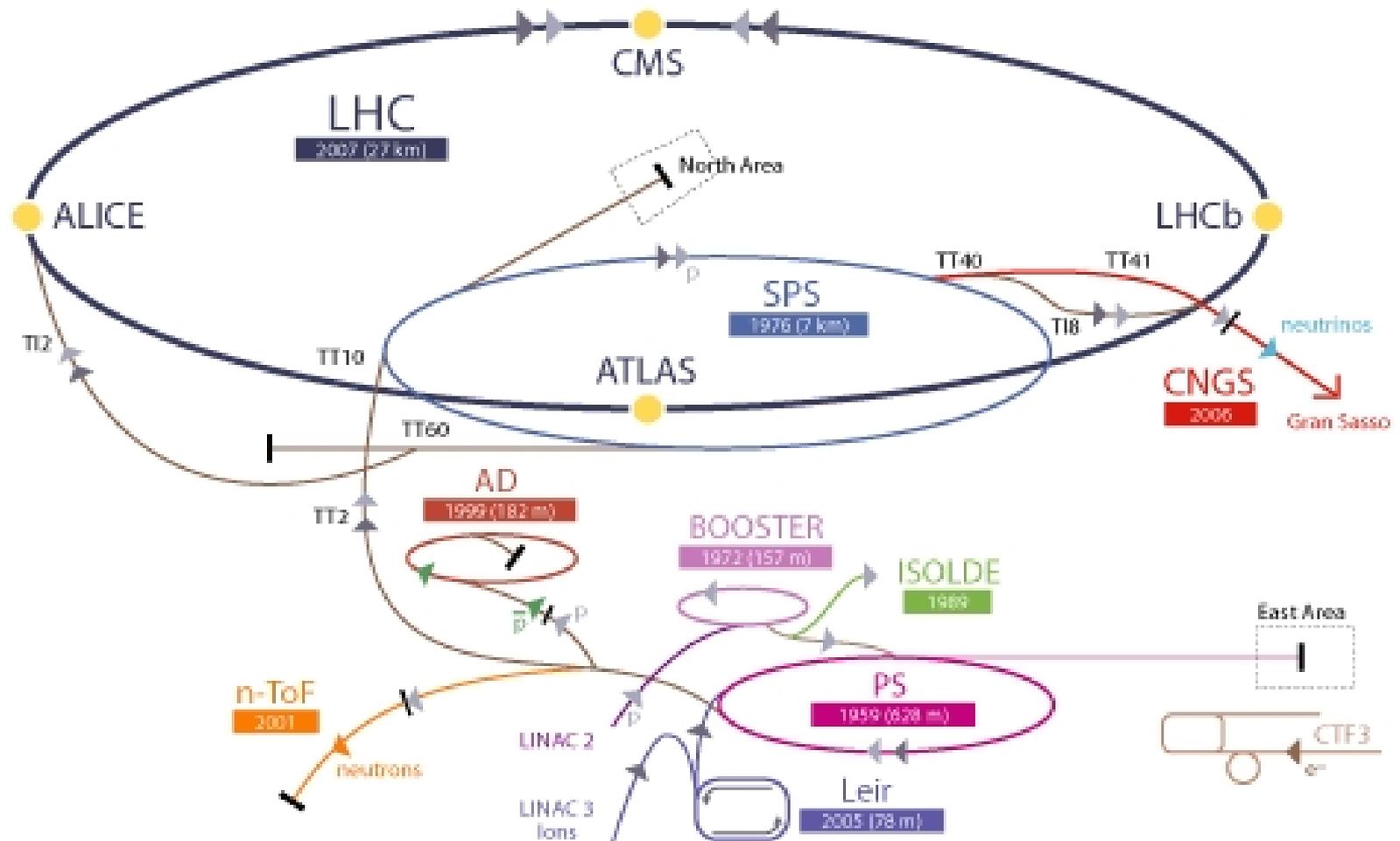
Conclusions

- Thanks to the tremendous effort of each from the preparation phase to the closure phase, LS1 was a success.
- Nevertheless, as we can always improve ourselves, strong and weak points are being analysed



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Thank you for your attention



2015 version 1.4

Phase	Days
Initial Commissioning	57
Scrubbing	23
Special physics run 1 (LHCf/VdM)	5
Proton physics 50 ns	9 + 21
Proton physics 25 ns	70
Special physics run 2 (TOTEM/VdM)	7
MD	15
Technical stops	15
Technical stop recovery	3
Ion setup/Ion run	4 + 24
Total	253 (36 weeks)

Safety Performance: Accidents

- Approximately 3.4 million hours of LS1 work
- 64 minor accidents (no absence)
- 31 accidents with 273 days of absence

	Frequency rate		Severity rate	
Year	MPE	Contractor	MPE	Contractor
2009	4.78	29	0.1	0.53
2010	2.93	23.33	0.05	0.52
2011	2.5	21.33	0.04	0.45
2012	2.86	24.62	0.08	0.60
2013	4.9	17.67	0.17	0.38
2013-14 (LS1)	9.1		0.08	