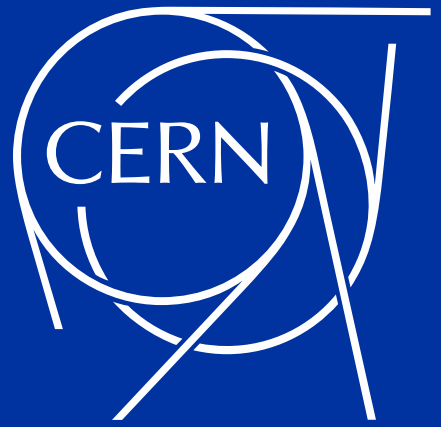


Accelerator Complex Status

Rende Steerenberg

Resources Review Board, 25 October 2021

Topics

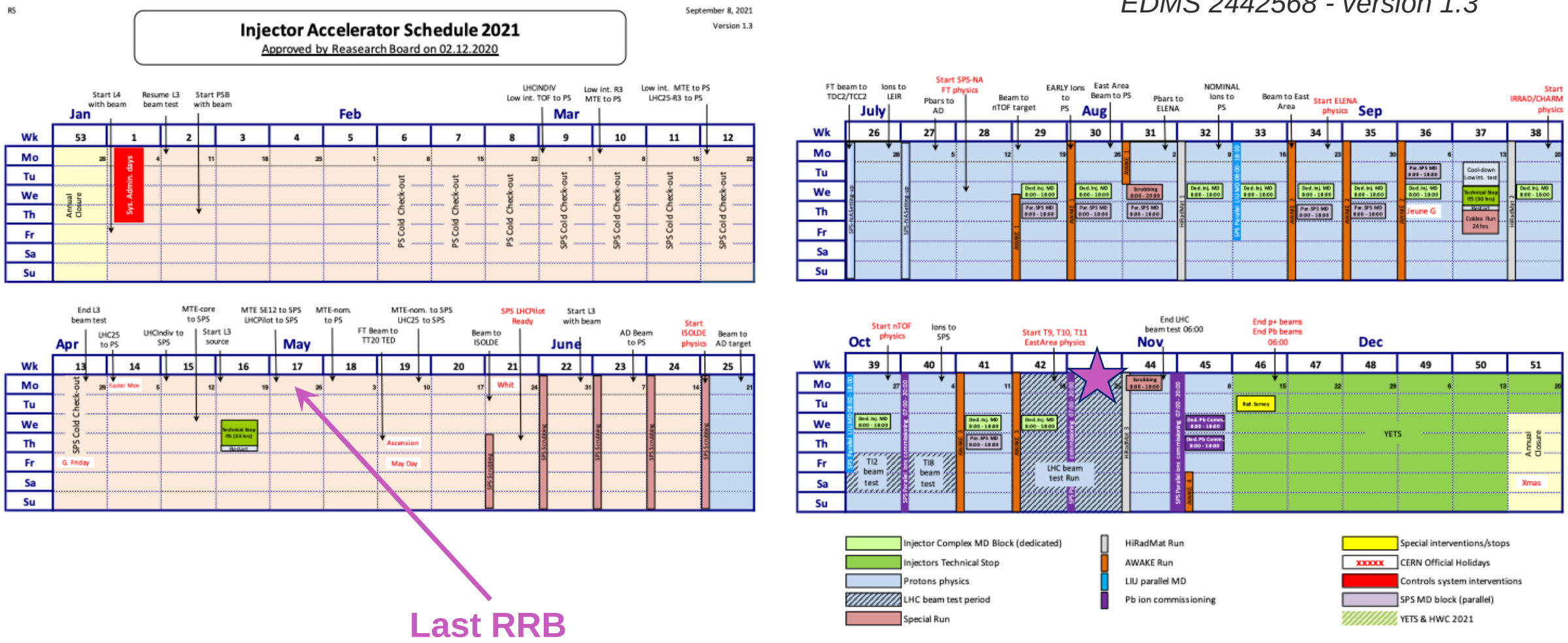
- **Accelerators Schedule Overview**
- **LHC Injectors Status**
- **LHC Status**
- **Conclusions / Summary**

Topics

- **Accelerators Schedule Overview**
- LHC Injectors Status
- LHC Status
- Conclusions / Summary

Approved and updated 2021 Injectors Schedule

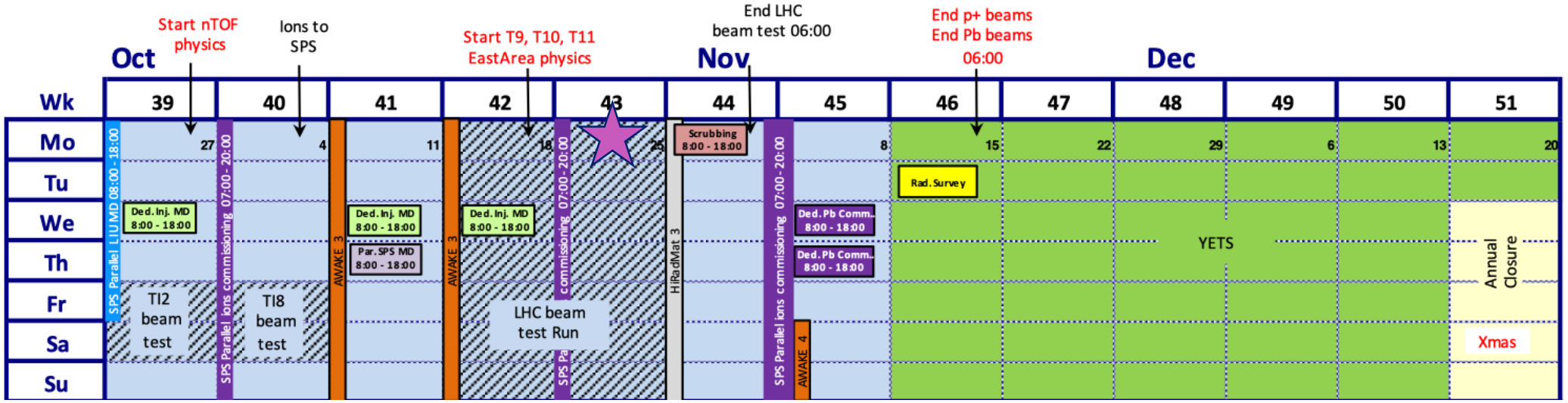
EDMS 2442568 - version 1.3



Last RRB

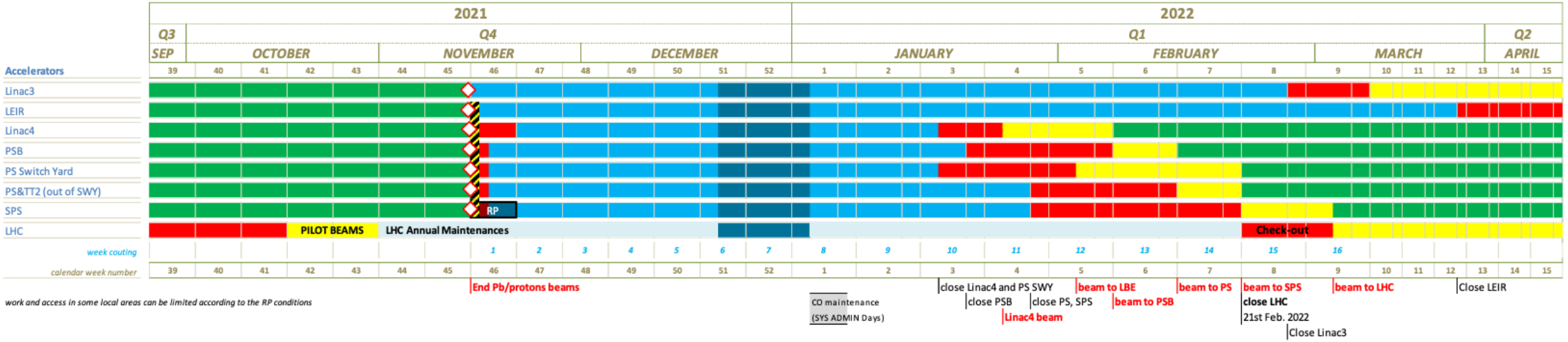
2021 - Q4: A very busy period

- **By now all fixed target physics facilities receive beam on a regular basis**
- **Pb ion commissioning in the SPS in preparation for the 2022 LHC and SPS North Area Pb ions run is progressing well.**
- **All beams will be stopped on 15 November at 06:00 for the Year-End-Technical-Stop (YETS)**
  - Only 3 weeks left



Year-End-Technical-Stop 2021-2022

- **All beam will be stopped, 15 November 2021 at 06:00**
- **First beam back in the injectors as of 7 February 2022**
- **LHC closure 21 February 2022 and first beam 7 March 2022**
  - Will be revisited at Nov 1st meeting with experiments



EDMS 2439145 - version 2.0

Topics

- Accelerators Schedule Overview
- **LHC Injectors Status**
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Beam Availability Overview
(since the start of SPS North Area physics)

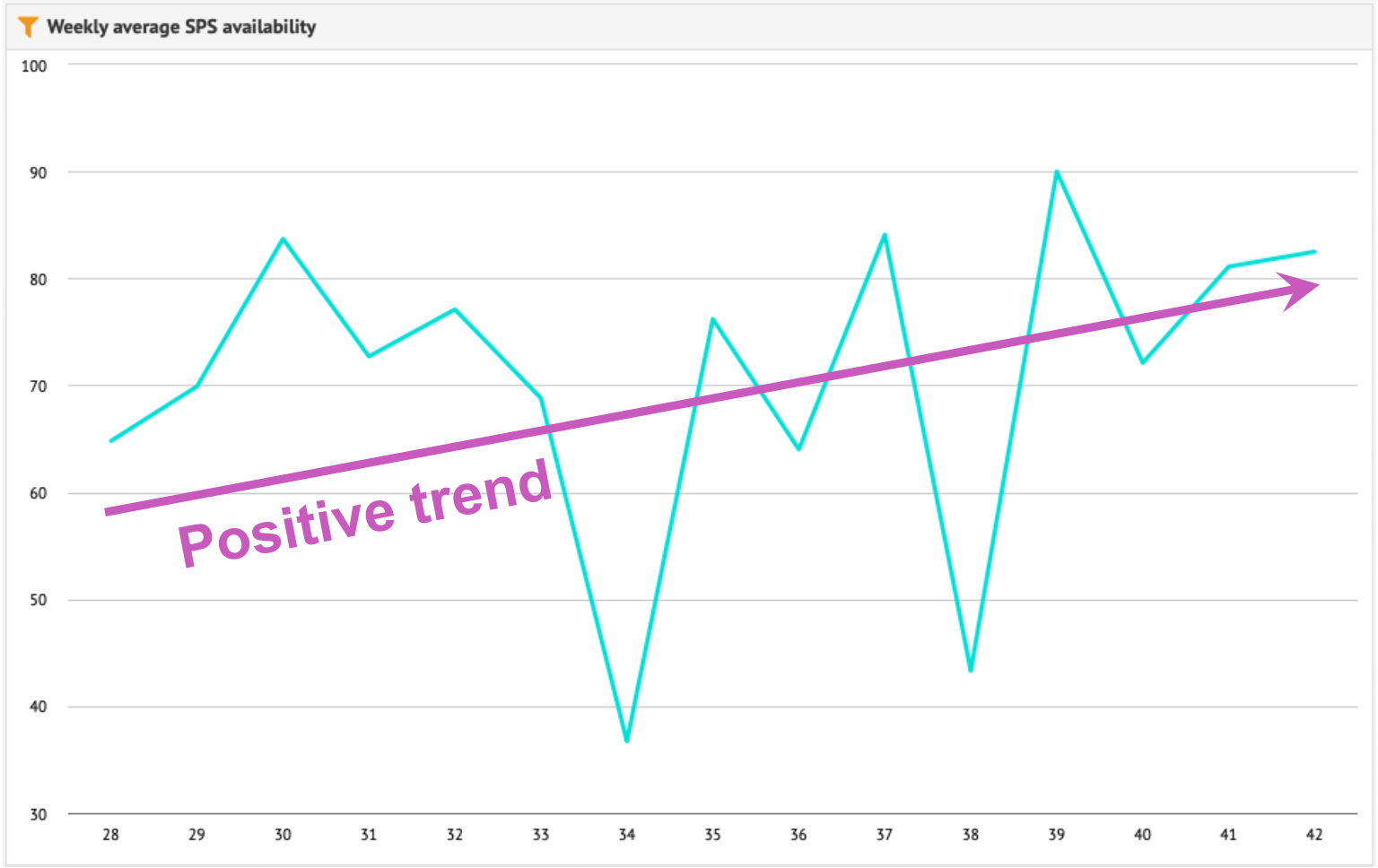
Facility	Destination	Expected 2021 Total [%]	Achieved 2021 Total [%]*
LINAC4	-	95	**97.2**
PSB	PS	90	**93.8**
	ISOLDE		
PS	SPS	87	**88.0**
	nTOF		
	AD		
	East Area		
SPS	LHC	84	**70.3**
	North Area		
	AWAKE		
	HiRadMat		

** Wed. 14.07 noon – Mon. 04.10 noon*
Source: Accelerator Fault Tracking

Note:

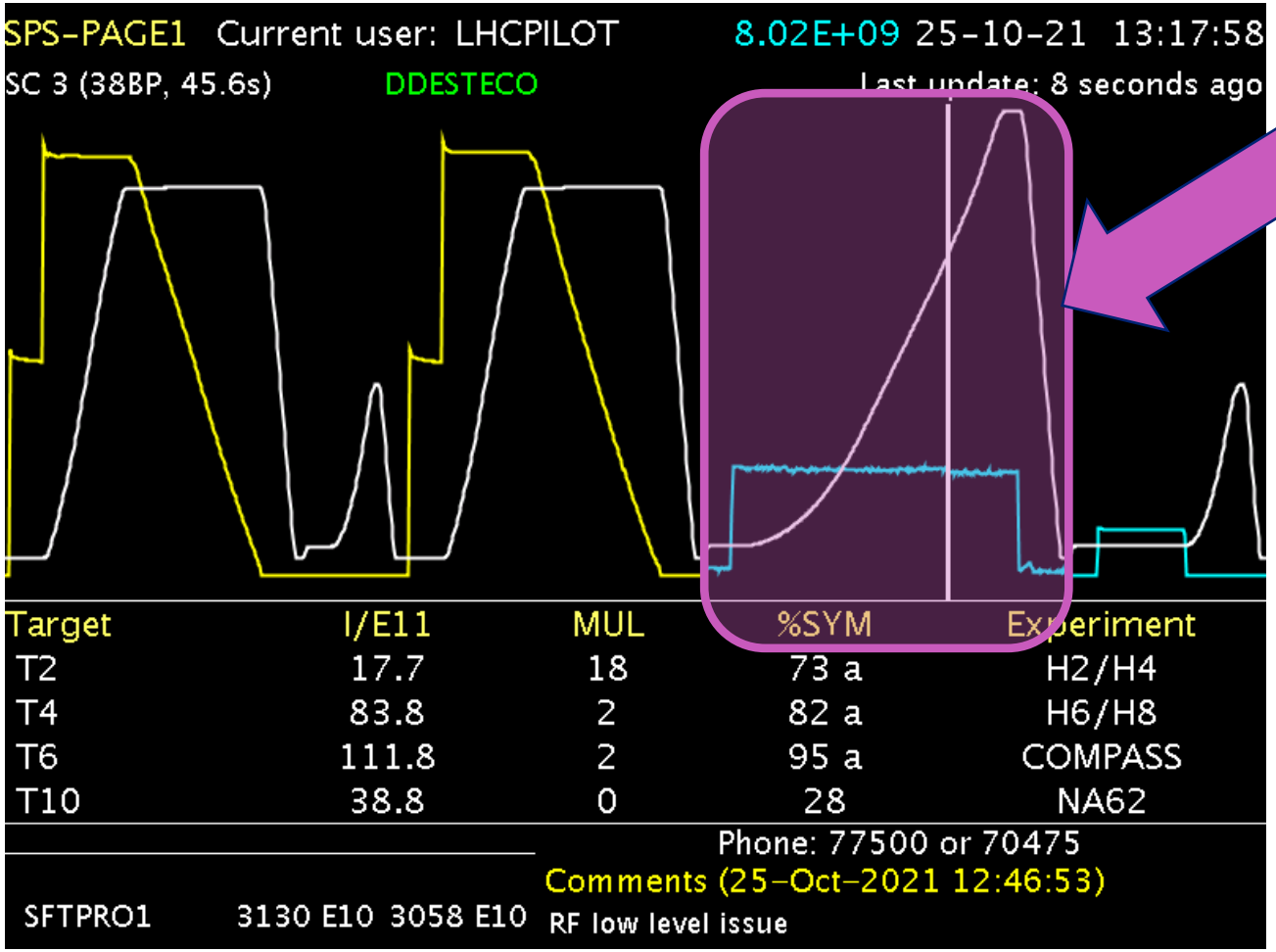
- *Expected availability was established from data prior to the Covid pandemic*
- *Time after commissioning for Linac 4 is substantially longer than for SPS, hence more teething problems have been solved.*

SPS Weekly Availability – a positive trend



Wed. 14.07 noon – Mon. 18.10 noon

SPS Delivering for Physics Since July 2021



LHC beam for the 2-week beam test

Routine operation for SPS North area fixed target physics

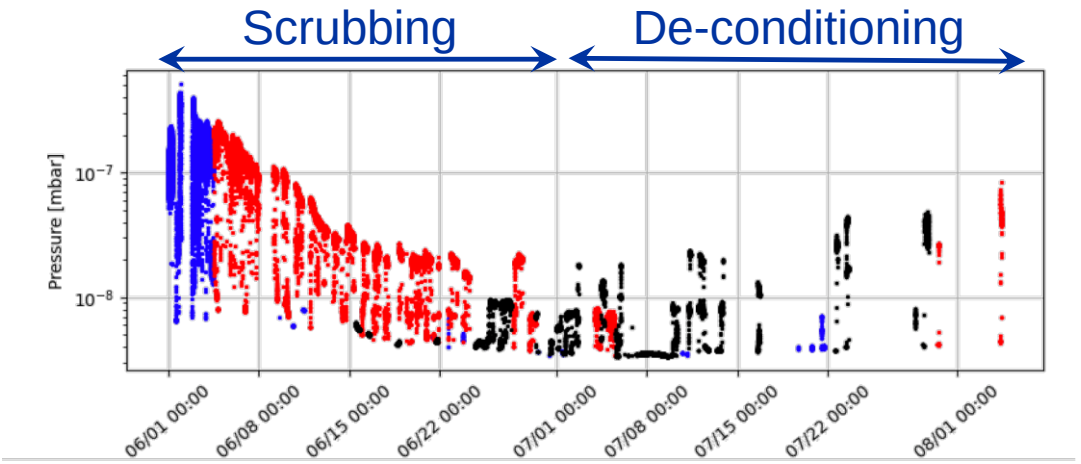
3 successful AWAKE runs

2 HiRadMat runs

- Need scrubbing each time – *impact on physics*
- LIU beams challenging for HiRadMat facility.
- Broke already 2 Be windows

SPS (Initial) difficulties

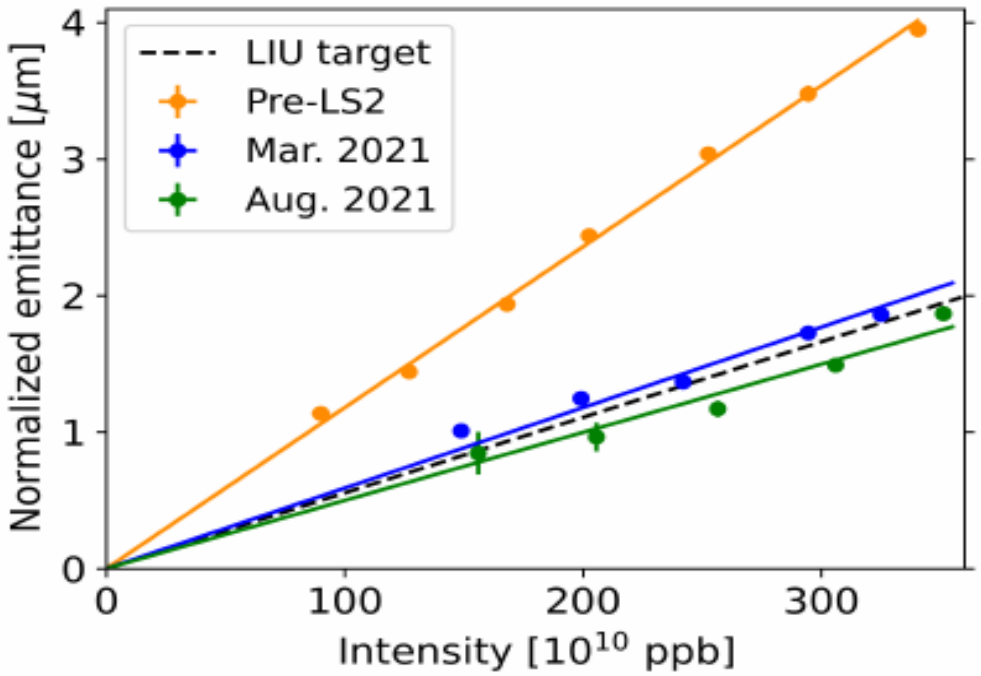
- **Vacuum de-conditioning of dump kicker**
  - Problem with quality of in vacuum ceramic
  - To be replaced during Year End Technical Stop (YETS)
- **RF Cavity conditioning not complete**
  - Major change to the system, no further changes needed



- **Access System electronics issues – *radiation to electronics***
  - Electronics changed and shielding added – moving electronics away from radiation areas during YETS
- **Optics SPS – NA transfer line**
  - New optimised optics together with smaller beam size caused more losses - *reverted to 2018 optics*
- **Spill ripple compensation**
  - Different ripple sources, initially had to compensate – now functional

LHC Beam Performance in the Injectors

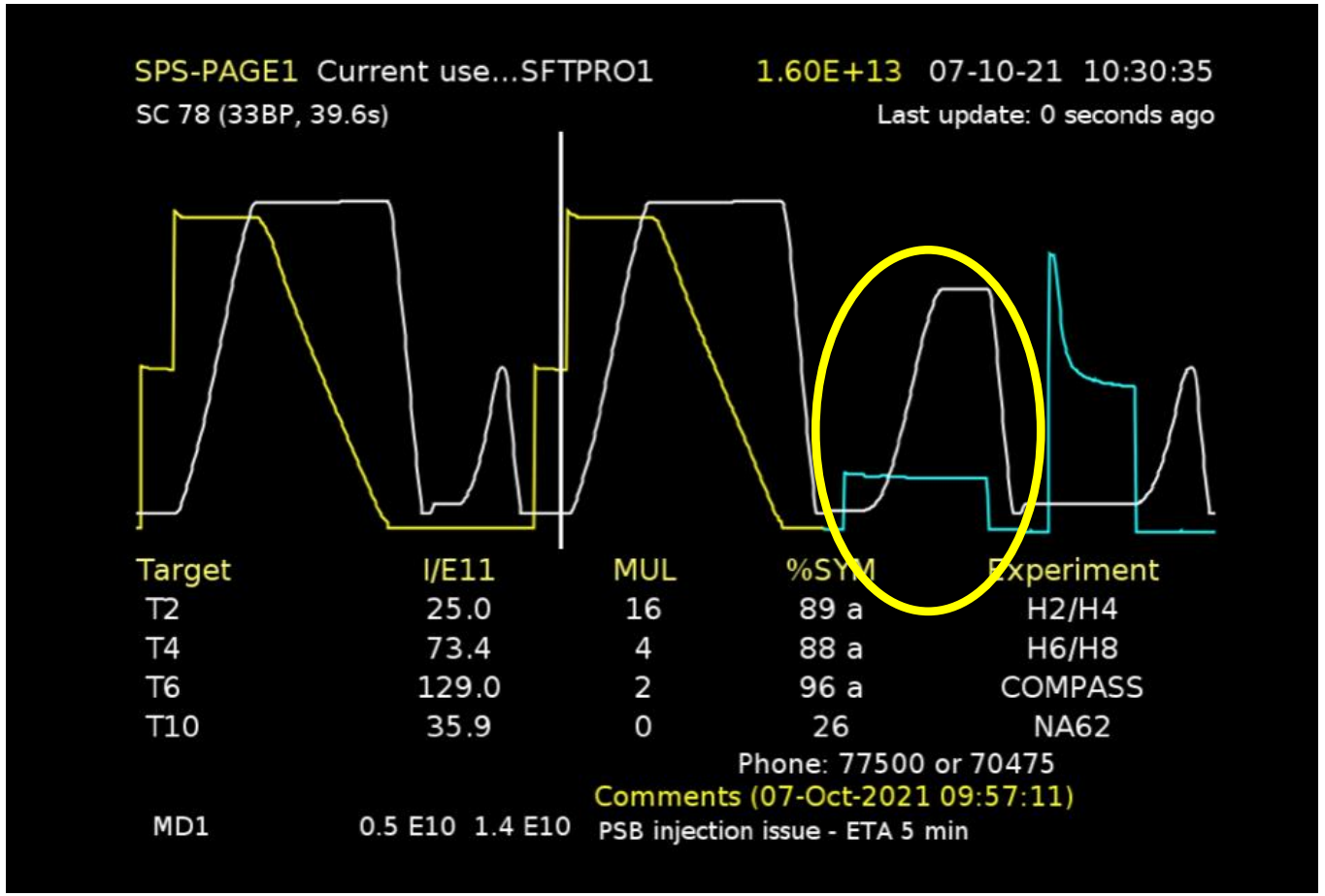
PSB beam brightness curves



- **SPS LHC bunch intensity presently limited by kicker de-conditioning for long bunch trains**
  - 1.1×10^{11} p/b with 4 x 72 bunches
  - 1.7×10^{11} p/b with 72 bunches

	Spec.	Pre-Ls2	Today
ε_h [mm mrad] 1σ norm.	< 3.5	2.6	2.1
ε_v [mm mrad] 1σ norm.	< 3.5	2.6	1.9
Intensity	1.15×10^{11} p/b @ 288 b	$1.x10^{11}$ p/b @ 288 b	1.55×10^{11} p/b @ 72 b

LHC ions being commissioned



Commissioning of new slip stacking process in the SPS for 50 ns bunch spacing in the LHC in 2022

Topics

- Accelerators Schedule Overview
- LHC Injectors Status
- **LHC Status**
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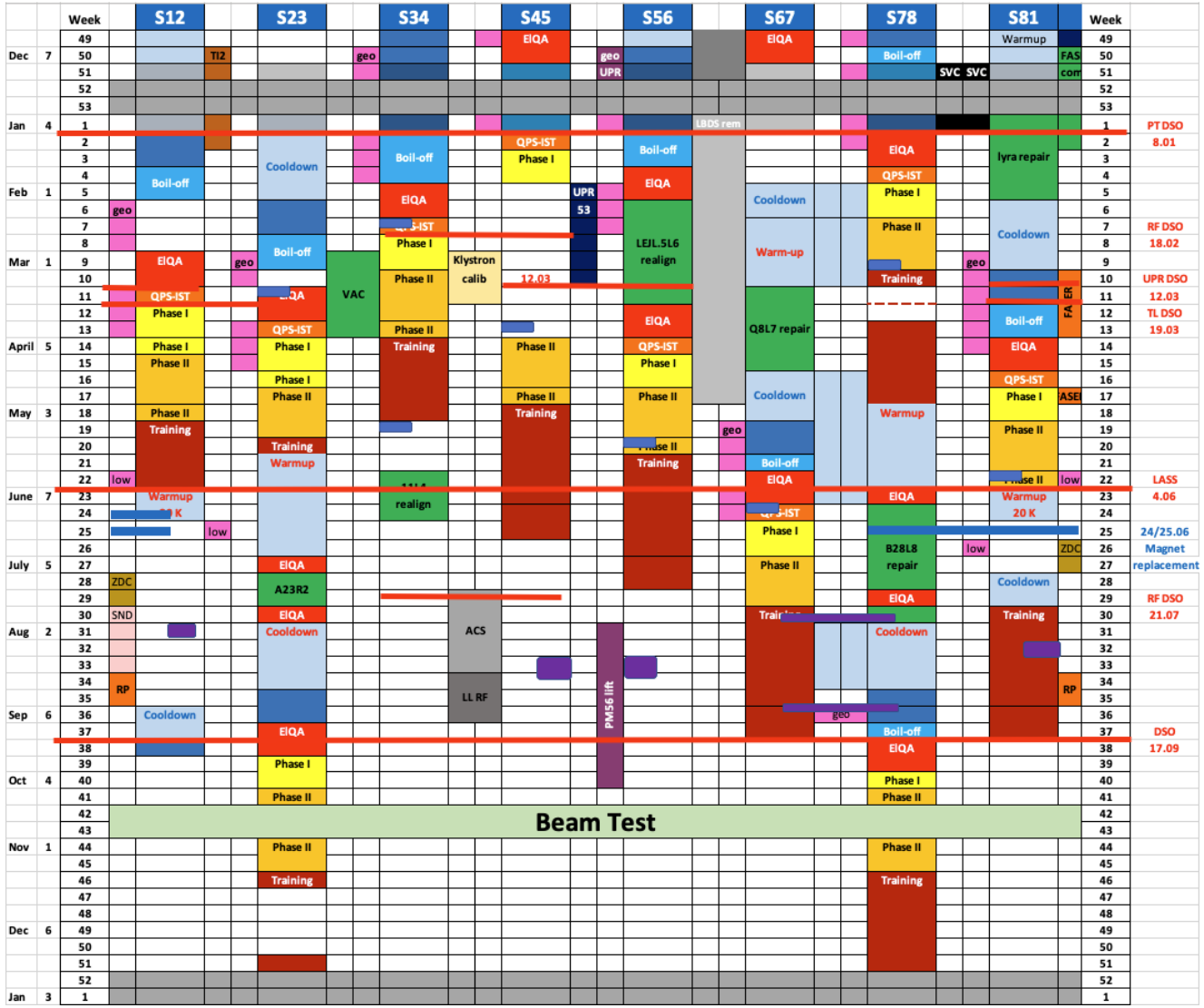
LHC Hardware Recommissioning

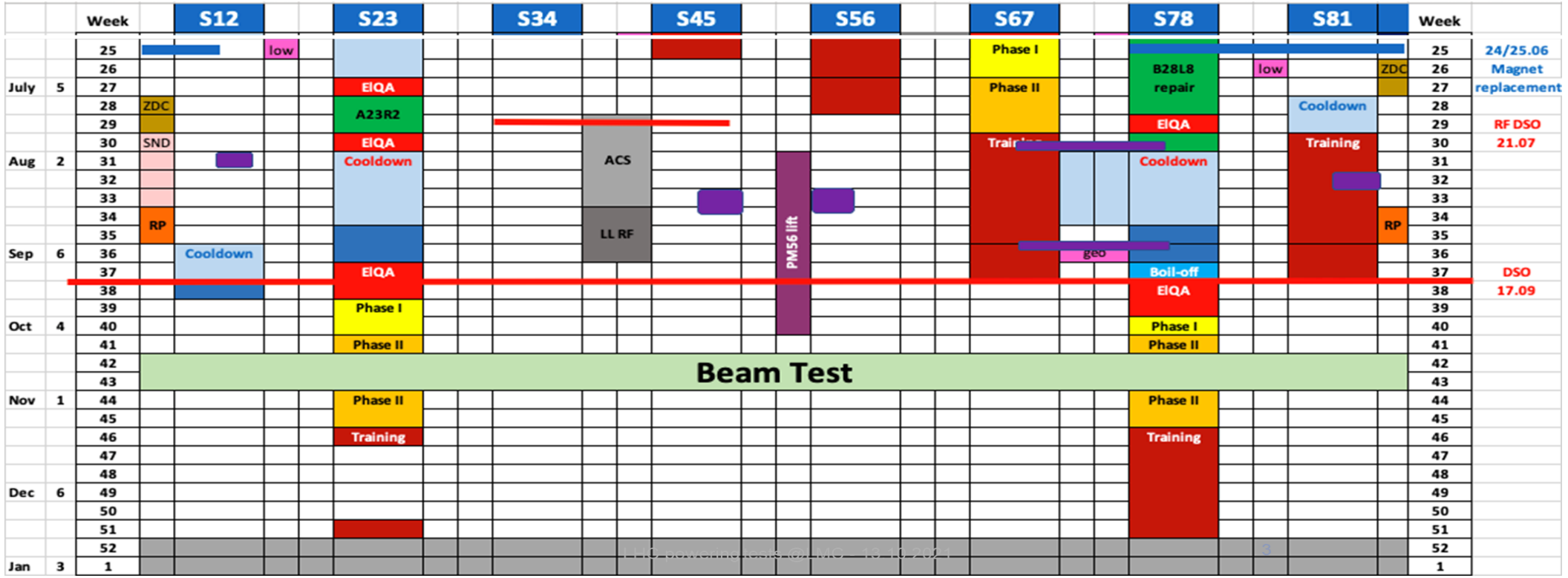
December 2020

A busy hardware commissioning schedule

Now: 2-week beam test



LHC Hardware Recommissioning



Today the 2nd week of the 2021 beam test has started

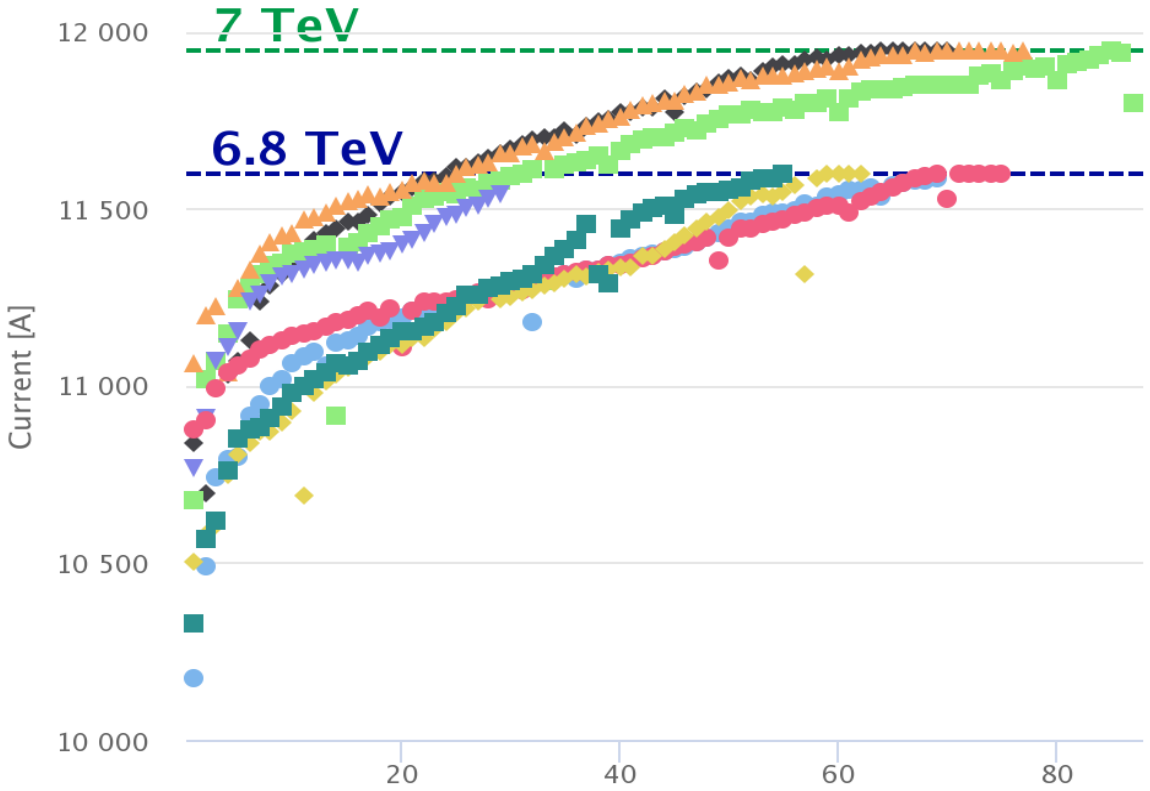
Magnet training in all sectors, except S23 and S78, has been completed

Main Dipole Training Status

Dipole training up to Run 3 target energy of 6.8 TeV has been decided

- 3 sectors trained to 7 TeV, 3 sectors trained to 6.8 TeV, 2 sectors to be completed

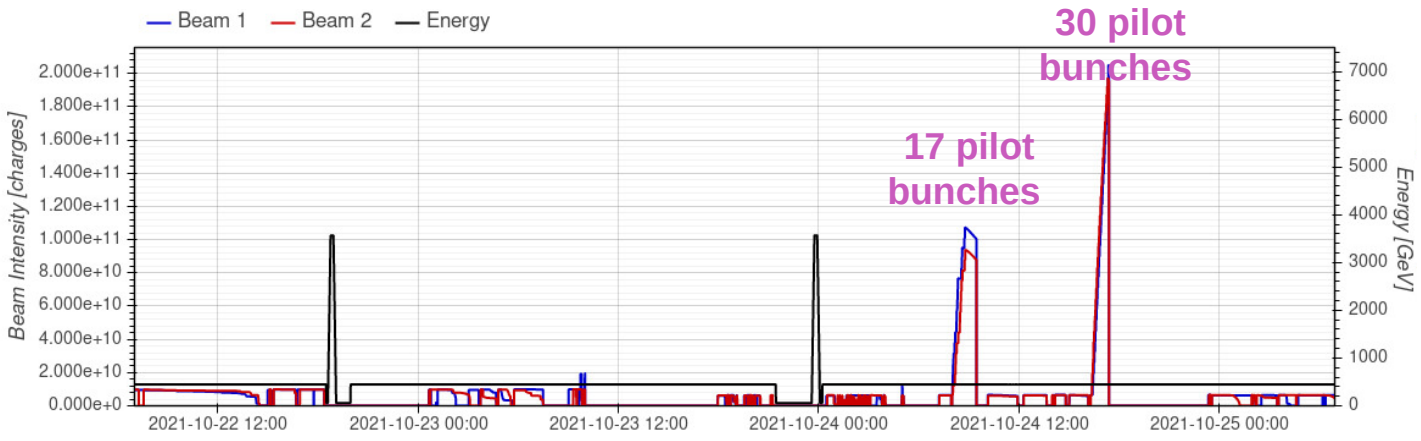
Sector	No. Circuit quenches	Current of last quench [A]	Energy [TeV]
1-2	77	11'950	7.0
2-3	29	11'538	6.8 - ε
3-4	70	11'950	7.0
4-5	87	11'950	7.0
5-6	75	11'600	6.8
6-7	62	11'600	6.8
7-8	69	11'585	6.8 - ε
8-1	55	11'600	6.8

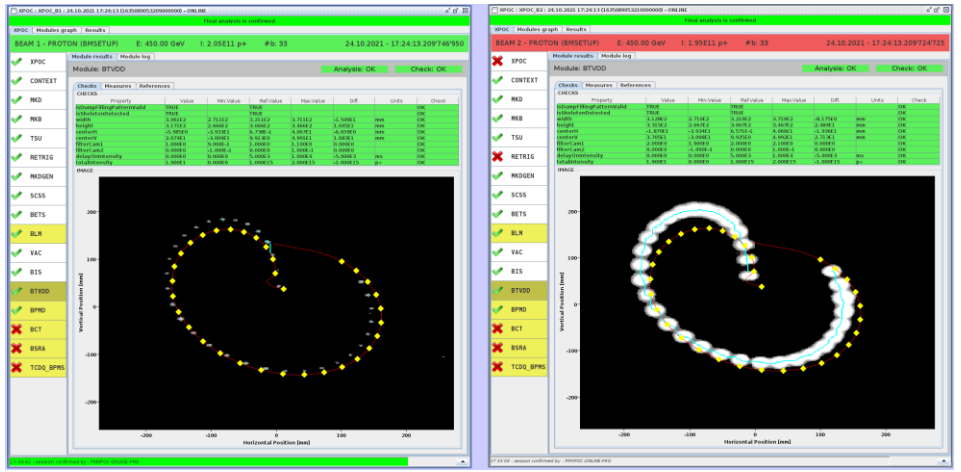


A total of ~ 65 magnet quenches are needed to bring S23 and S78 to 6.8 TeV
~ 340 magnet quenches would be needed to bring the remaining sectors to 7 TeV

2-week Beam Test 2021

- **Aim re-establish circulating beam at 450 GeV and debug machine systems**
  - Splash events are provided to the experiments
  - Collisions at injection energy are foreseen later this week
- **Excellent progress made on a dense programme – No major issues found**
  - Smaller issues being solved on the fly or before 2022 restart





Beam dump with 30 pilot bunches to verify dilution kickers

Topics

- Accelerators Schedule Overview
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- LHC Status
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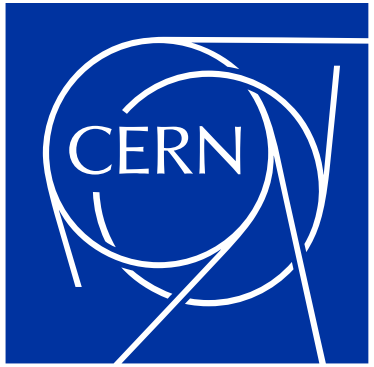
Conclusions / Summary

- **Injectors complex operational with good availability**
  - Initially a difficult start for the SPS – *good availability during the last weeks*
  - All required beams are within specification
- **De-conditioning SPS dump is presently limiting the LHC beam performance**
  - Kicker will be exchanged during the Year End Technical Stop (YETS) – *limitation will be lifted*
- **Pb ions commissioning in the injectors has started and is progressing well**
- **LHC hardware commissioning and magnet training well advance for 6.8 TeV**
- **2-week beam test at injection energy progressing successfully – *incl. splashes….***

A remarkable achievement by CERN-wide colleagues, despite the Covid limitations and measures

Thank you for your attention



Any questions...?

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Linac 4 Availability overview 14.07.2021 – 18.10.2021

Availability

97.2%

Blocking Faults

105

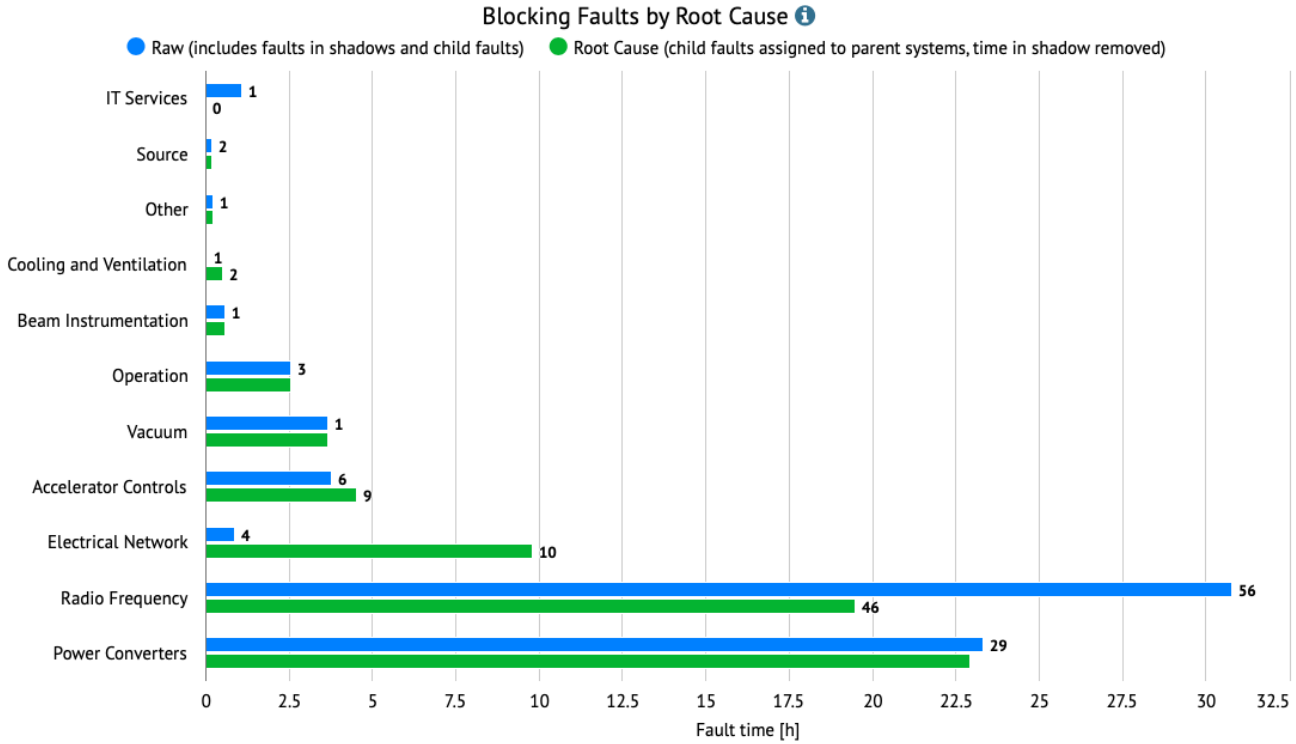
Total Faults

105

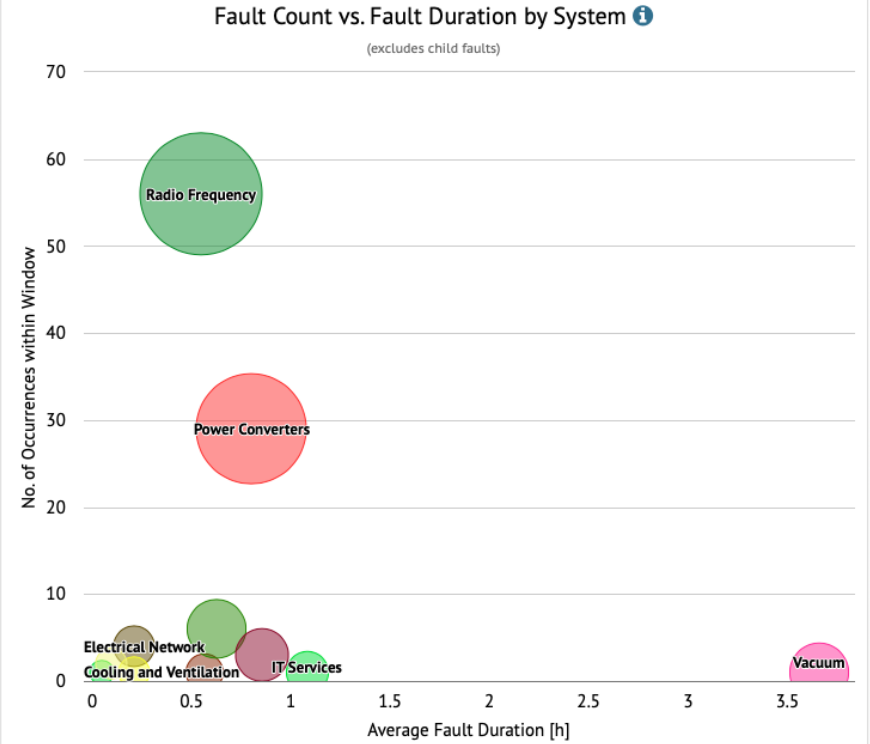
Fault Duration (overlap excluded)

64.5h

Blocking Faults by Root Cause



Fault Count vs. Fault Duration by System



PSB Availability overview 14.07.2021 – 18.10.2021

Availability

93.8%

Blocking Faults

314

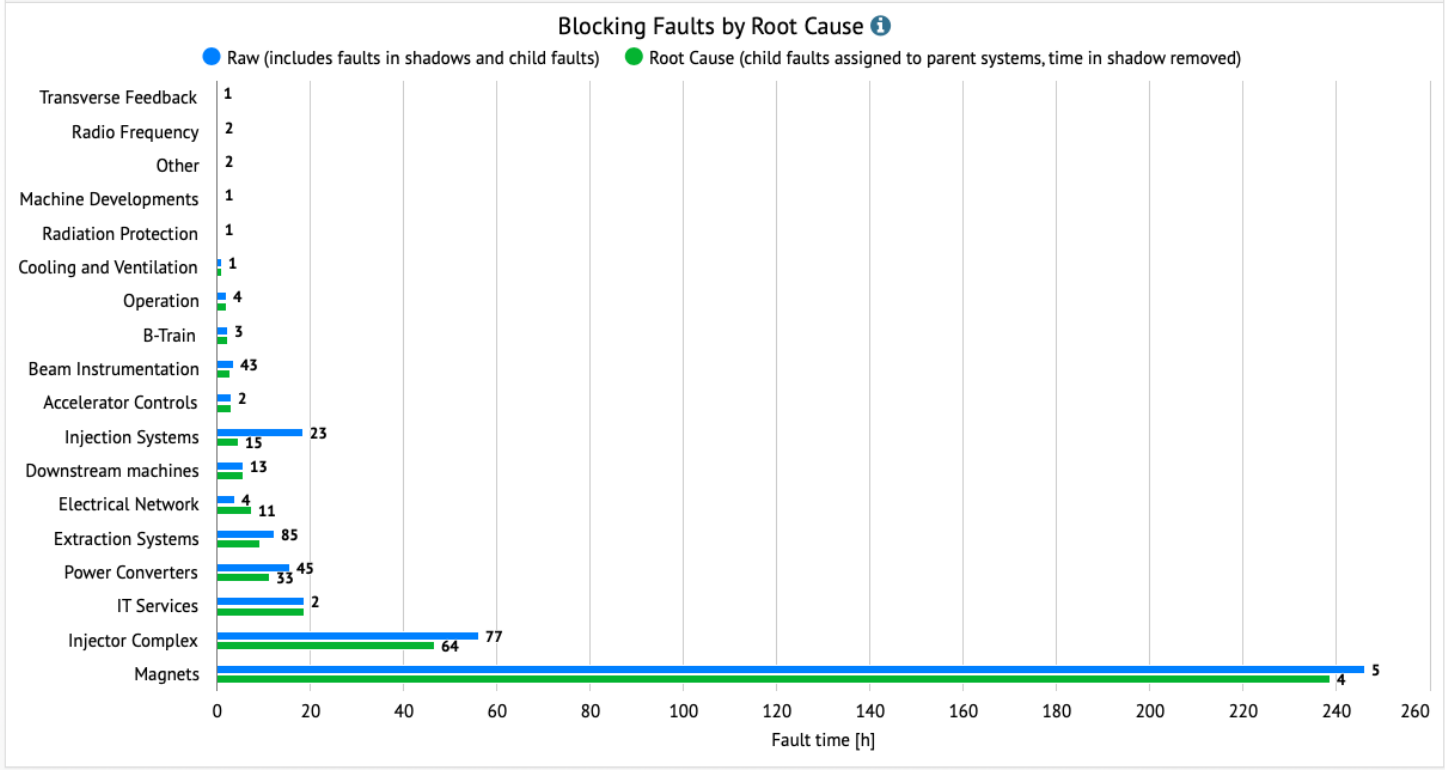
Total Faults

314

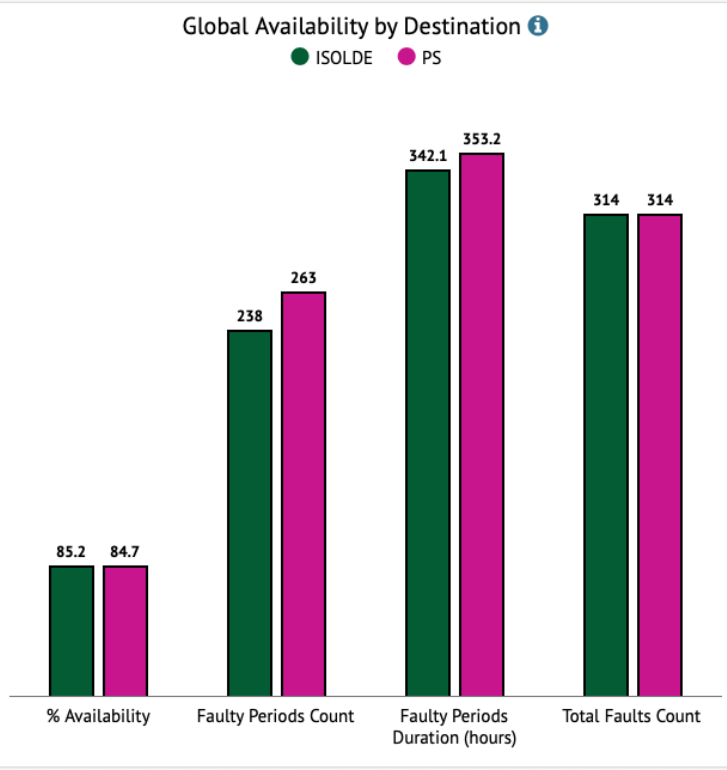
Fault Duration (overlap excluded)

354.1h

Blocking Faults by Root Cause



Global Availability by Destination



PS Availability overview 14.07.2021 – 18.10.2021

Availability

88.0%

Blocking Faults

323

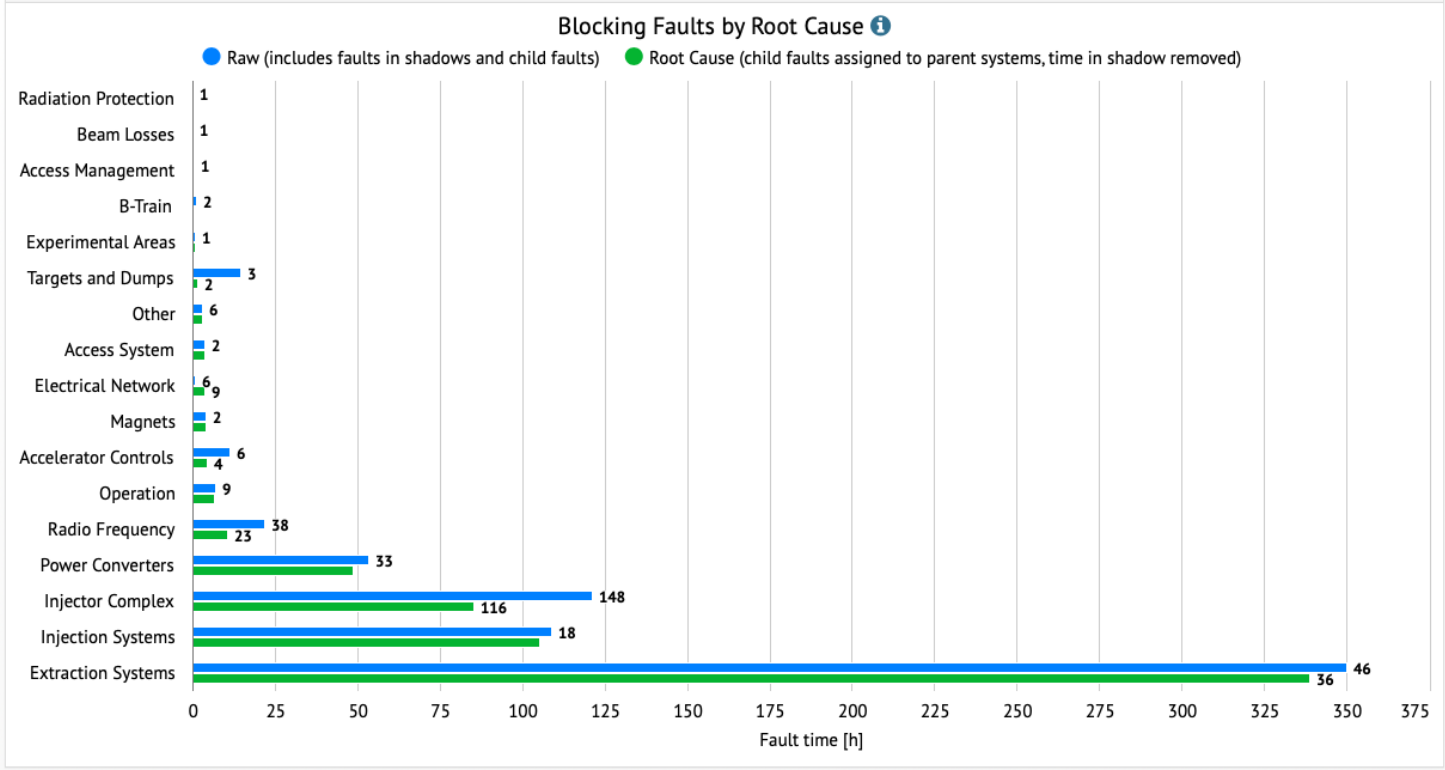
Total Faults

323

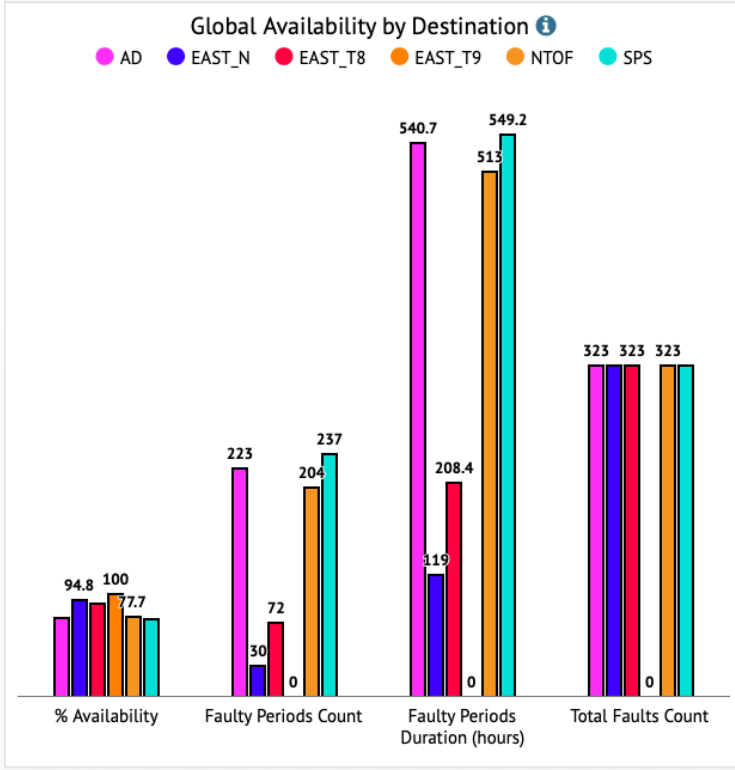
Fault Duration (overlap excluded)

616.1h

Blocking Faults by Root Cause



Global Availability by Destination



SPS Availability overview 14.07.2021 – 18.10.2021

Availability

70.3%

Blocking Faults

2052

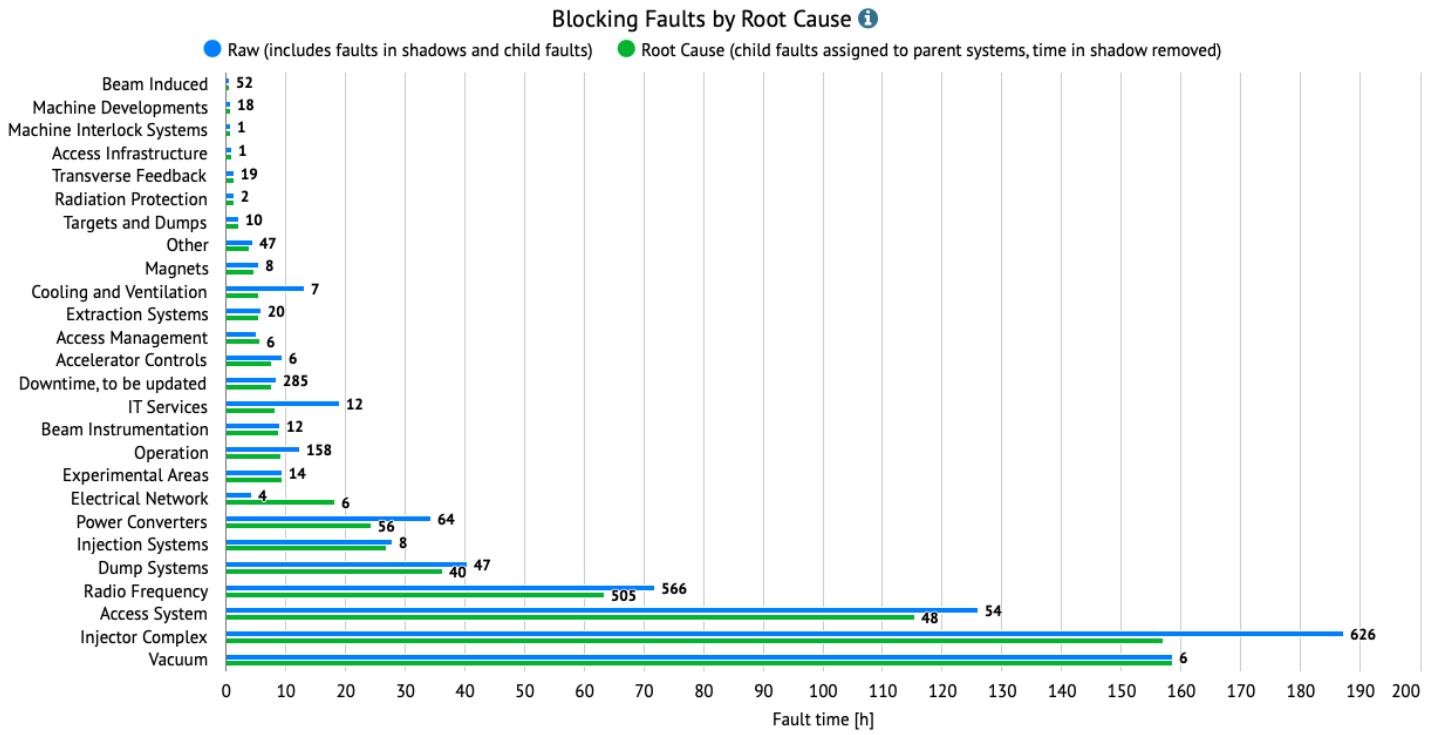
Total Faults

2052

Fault Duration (overlap excluded)

684.1h

Blocking Faults by Root Cause



Global Availability by Destination