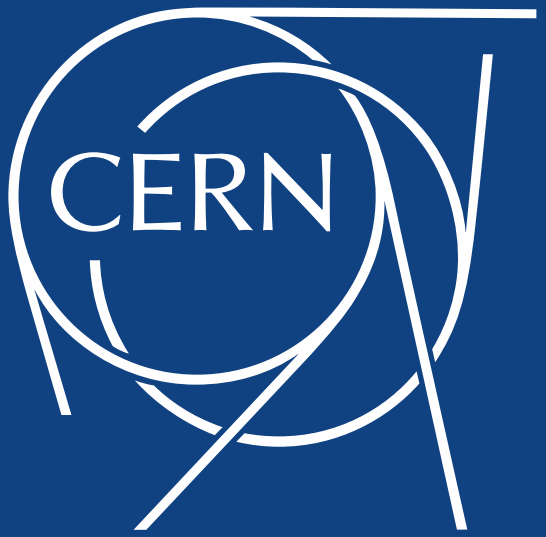

CERN

2015 Availability Summary

Andrea Apollonio, TE-MPE-PE

On behalf of the Availability Working Group (AWG) - L. Ponce, B. Todd

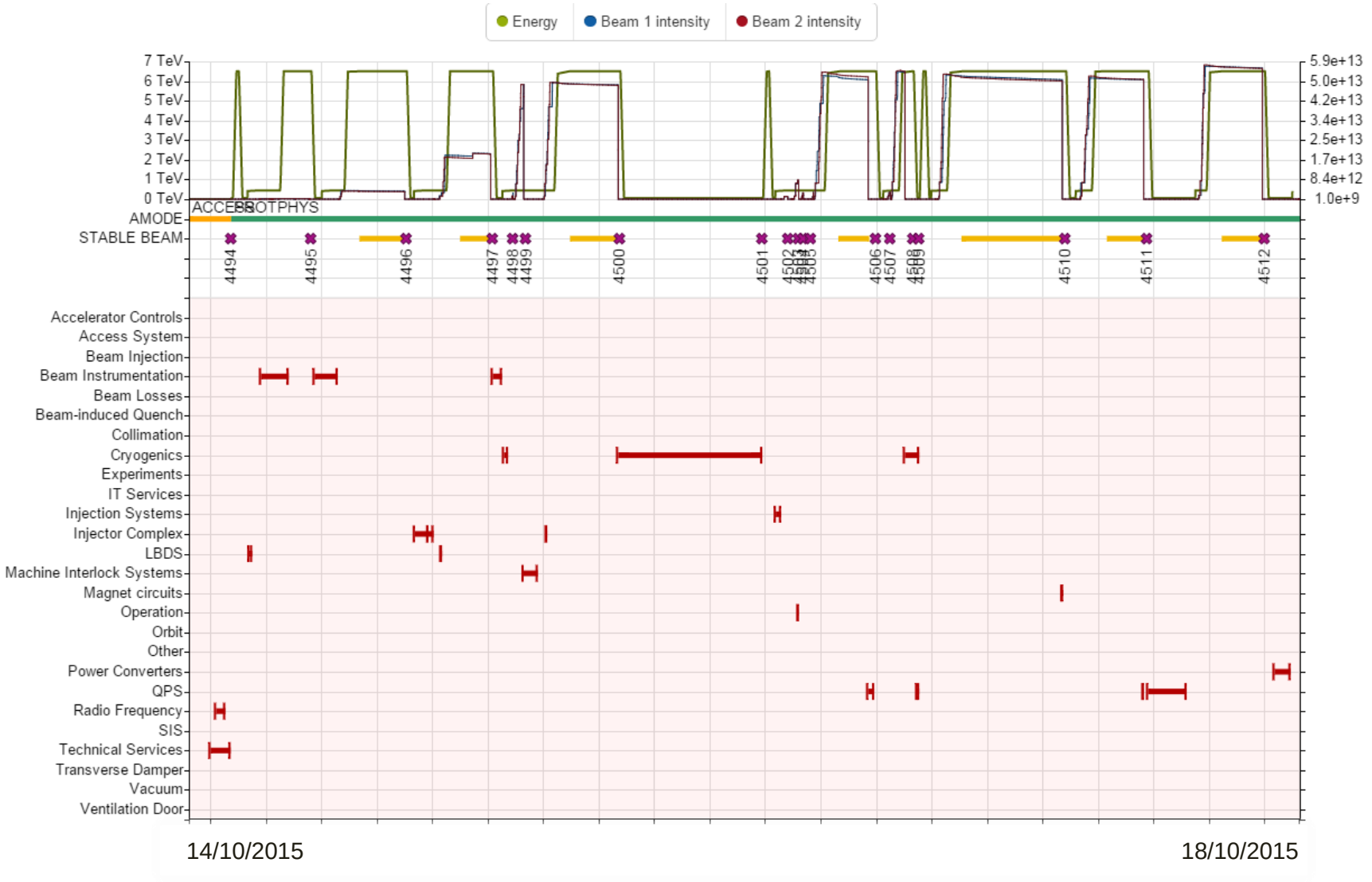
6th Evian Workshop, 15/12/2015

Acknowledgements: AWG-members, C. Roderick & AFT team, R. Schmidt, D. Wollmann, M. Zerlauth, A. Niemi, A. Siemko, T. Griesemer, B. Auchmann, R. Denz, A. Verweij, O. Rey Orozco, M. Jonker, F. Rodriguez Mateos.

Fault Review in 2015

- The **Accelerator Fault Tracker** (AFT) is operational from the beginning of 2015
- Members of the AWG (A. Apollonio, L. Ponce, B. Todd) in charge of the **weekly fault review**
- **Aim**: identify ALL possible causes of LHC downtime (i.e. not only “faults”)
- Ensure **consistency** of availability data
  - Identify of downtime root cause
  - Identify consequences of faults (precycle, access, RP)
  - Identify fault dependencies, parent/child relationships
    (e.g. UFO → quench → quench recovery)

Standardized Availability Summary

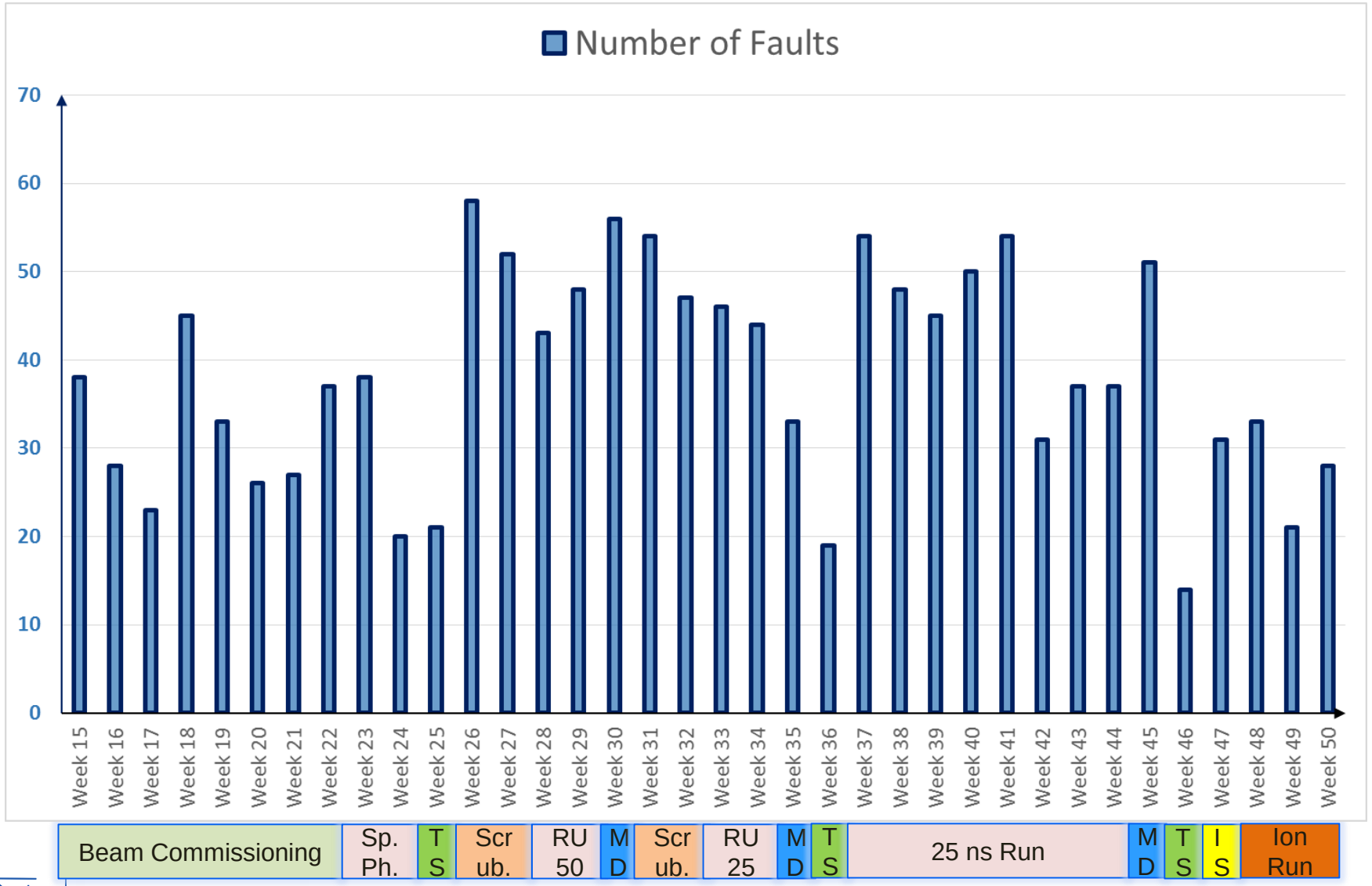


"Cardiogram" of LHC operation

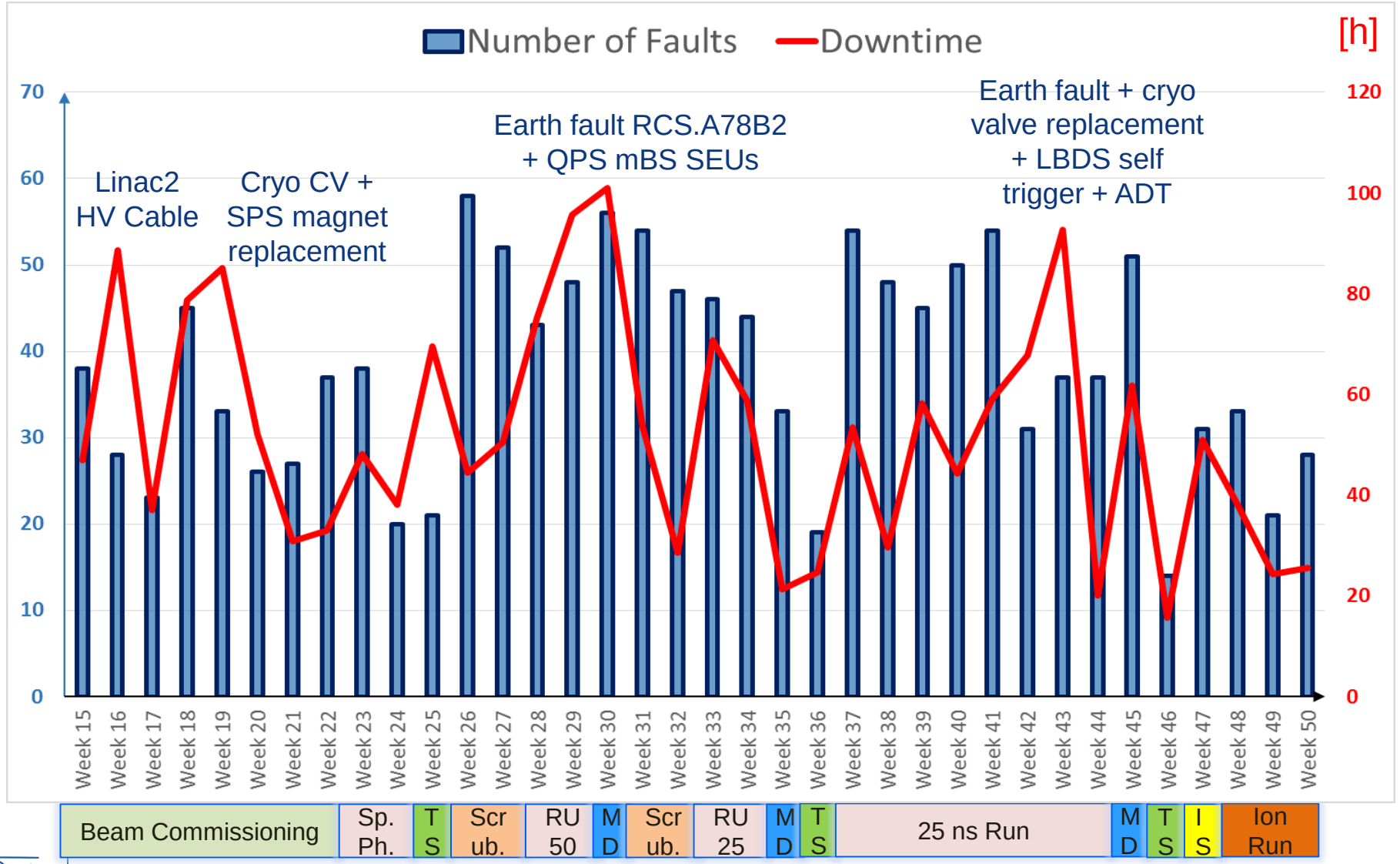
Some Statistics…

- Reference period: 6/4/2015 to 13/12/2015 (weeks 15 to 50)
- **1375 faults** recorded and analysed (761 in 2012)
- ~ 90 relevant **parent/child relationships** identified
- ~ 20 modifications in the eLogbook required per week
- ~ 5 h, 2 people per week for fault review + collaboration on tool development
- Consistent picture of **‘operational modes’** (loss maps, measurements, MDs, etc.)

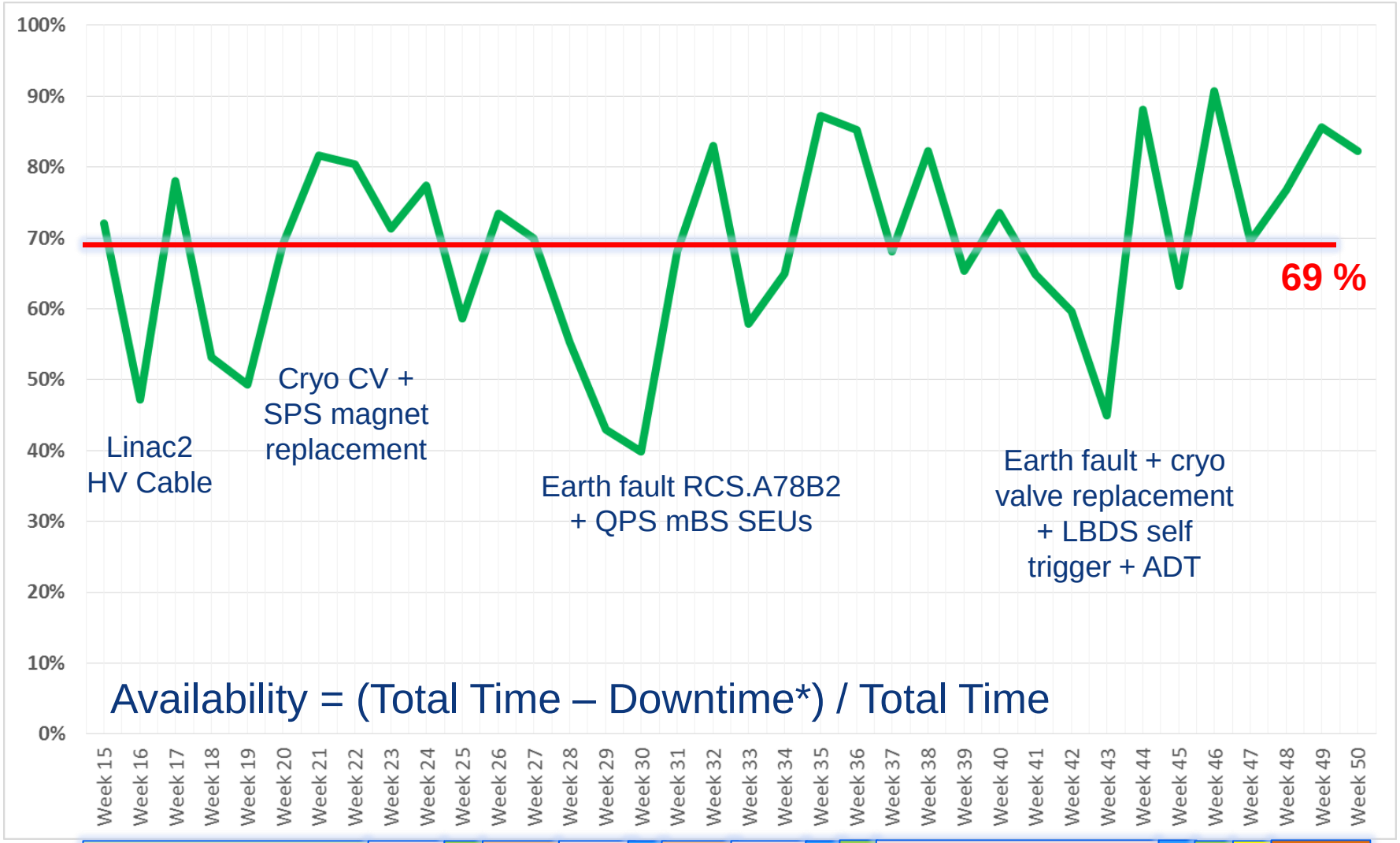
2015 Fault Overview



2015 Fault + Downtime Overview



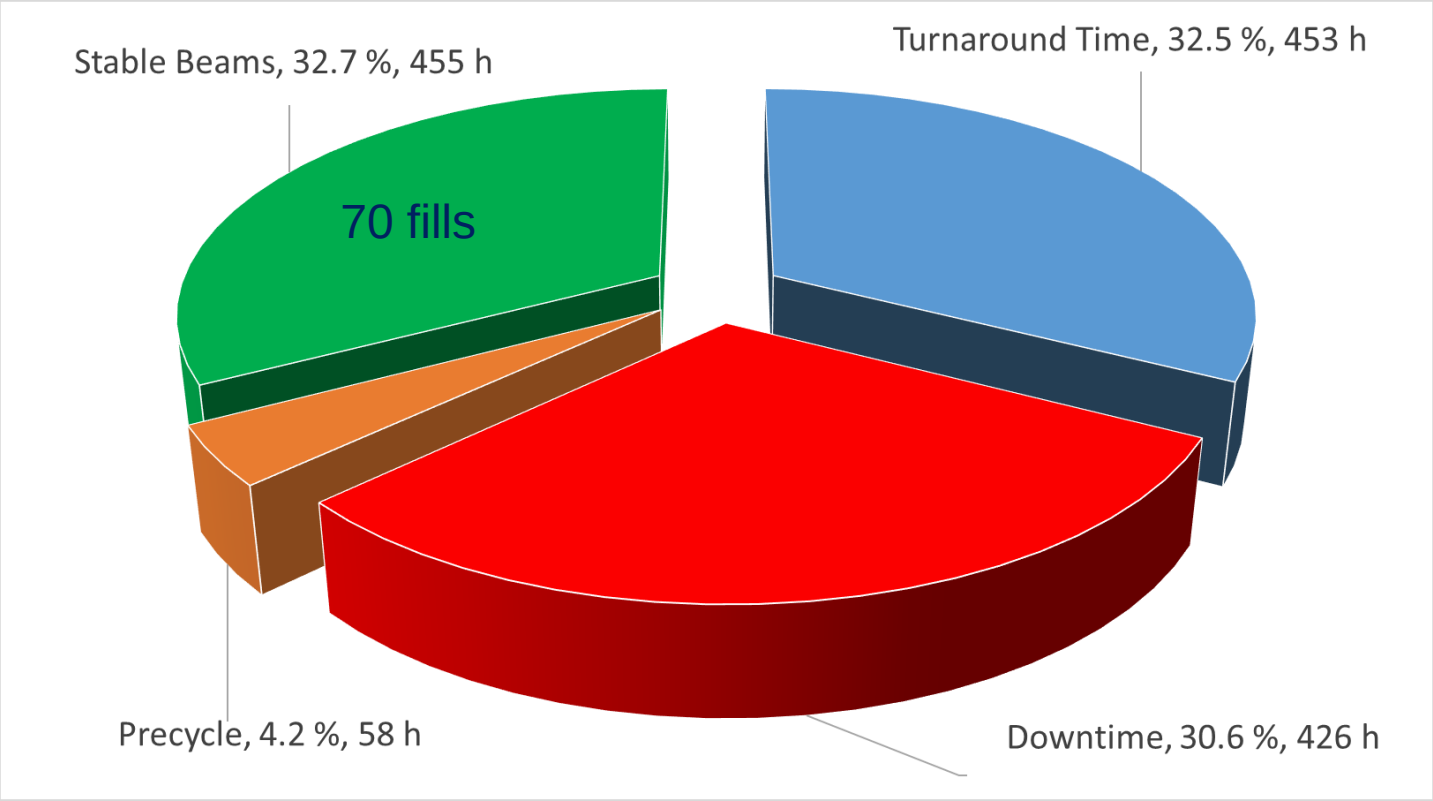
2015 Availability



* Downtime does not include precycles due to faults

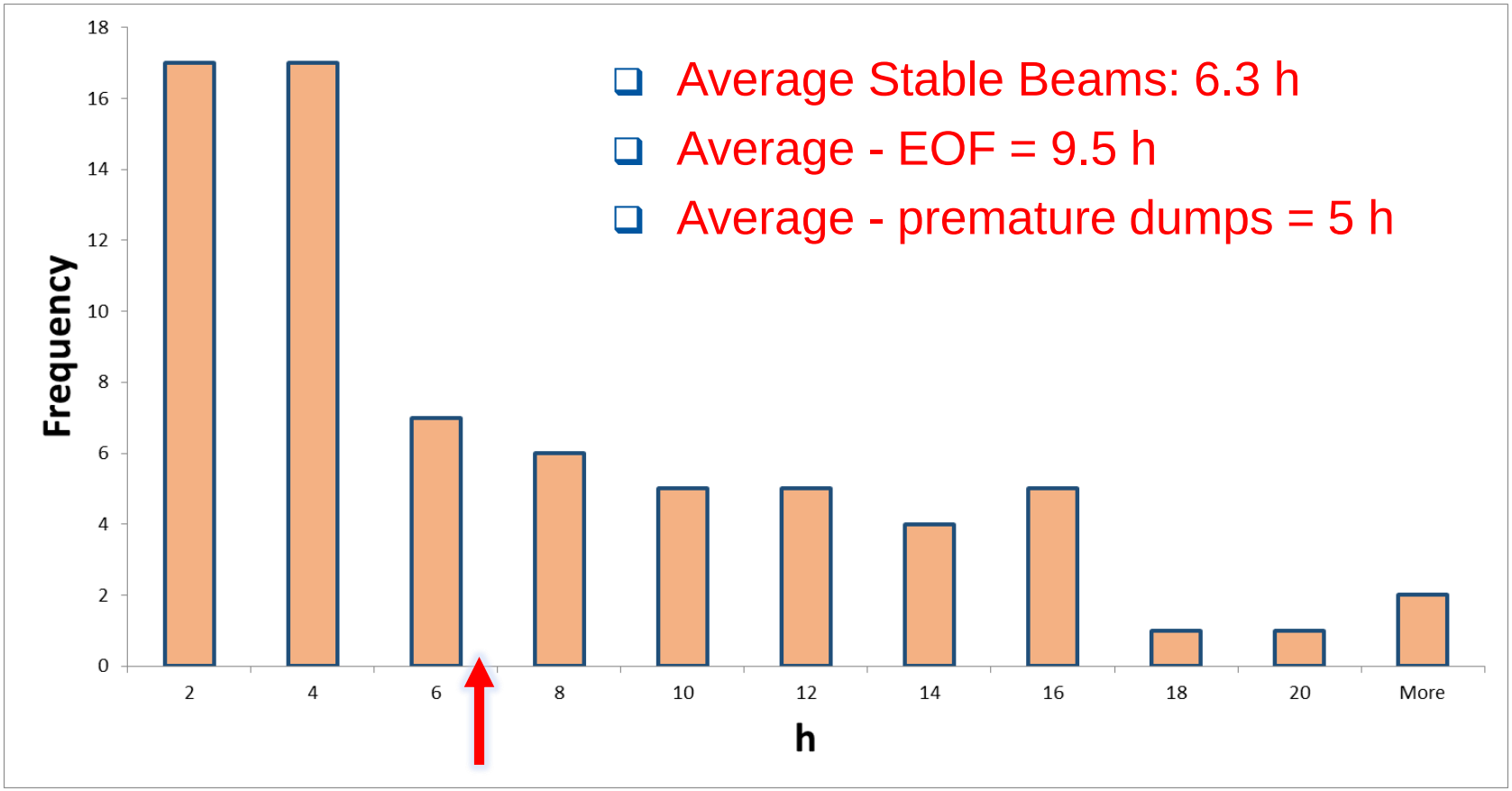
FOCUS: 25 ns Run (7/9 to 3/11)

Availability for Physics – 25 ns Run

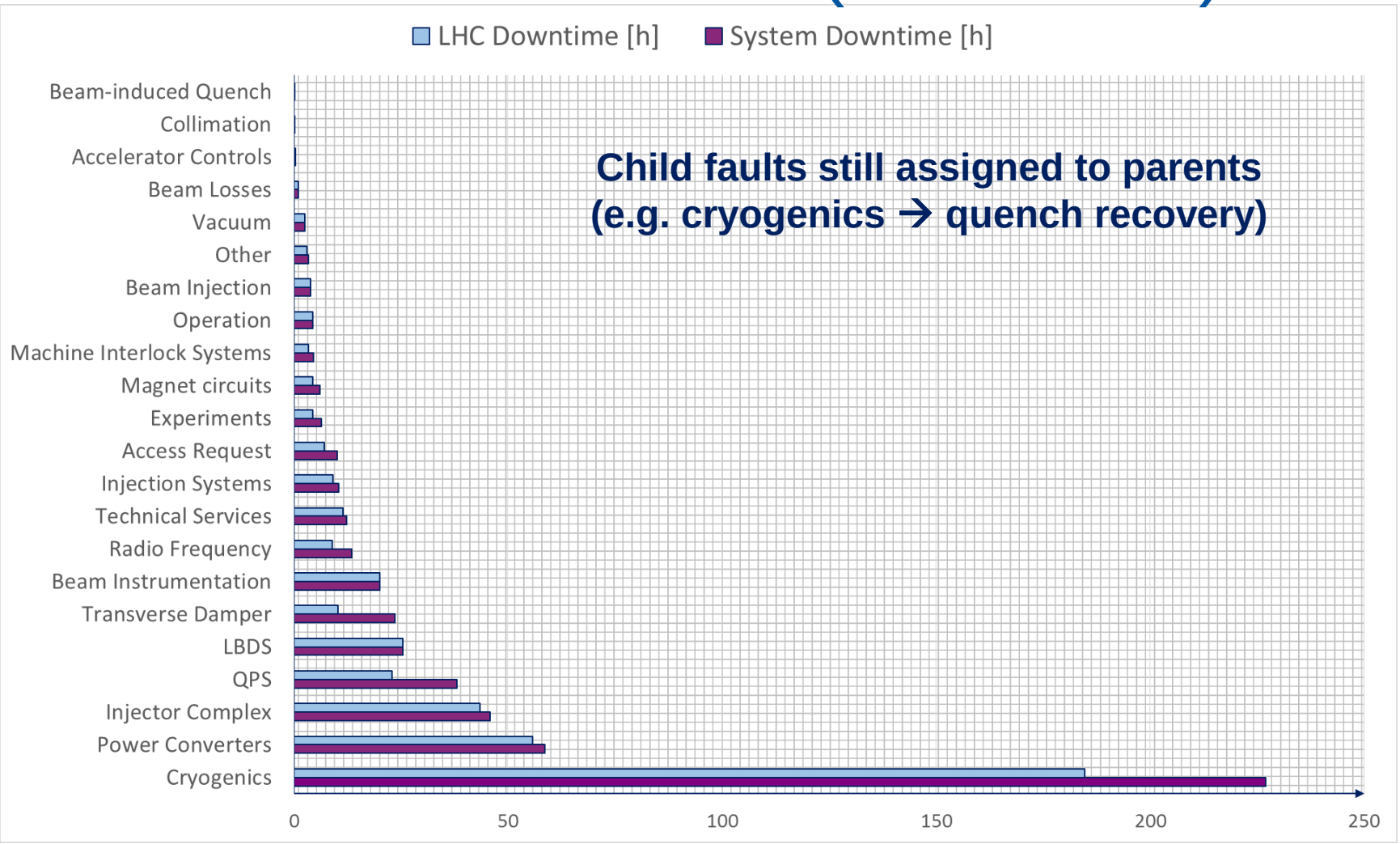


- 22 End Of Fill, 48 dumped due to faults
- Fraction of premature dumps: 48/70 = 68.6 %
- Average turnaround (per SB) = 453/70 = 6.5 h
- Average Fault time (per SB) = 426/70 = 6 h

Stable Beams Distribution – 25 ns Run

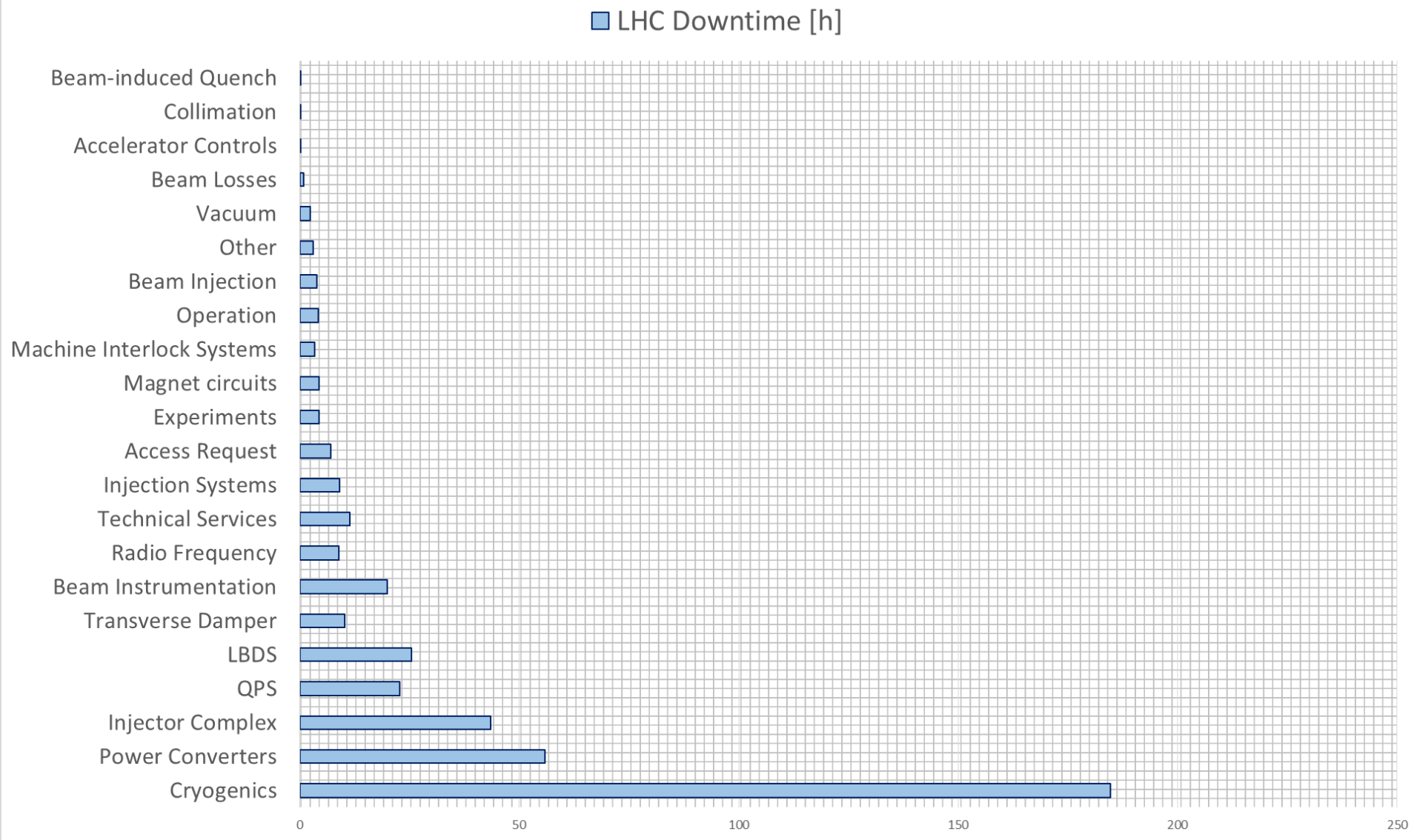


Downtime Distribution (25 ns Run)

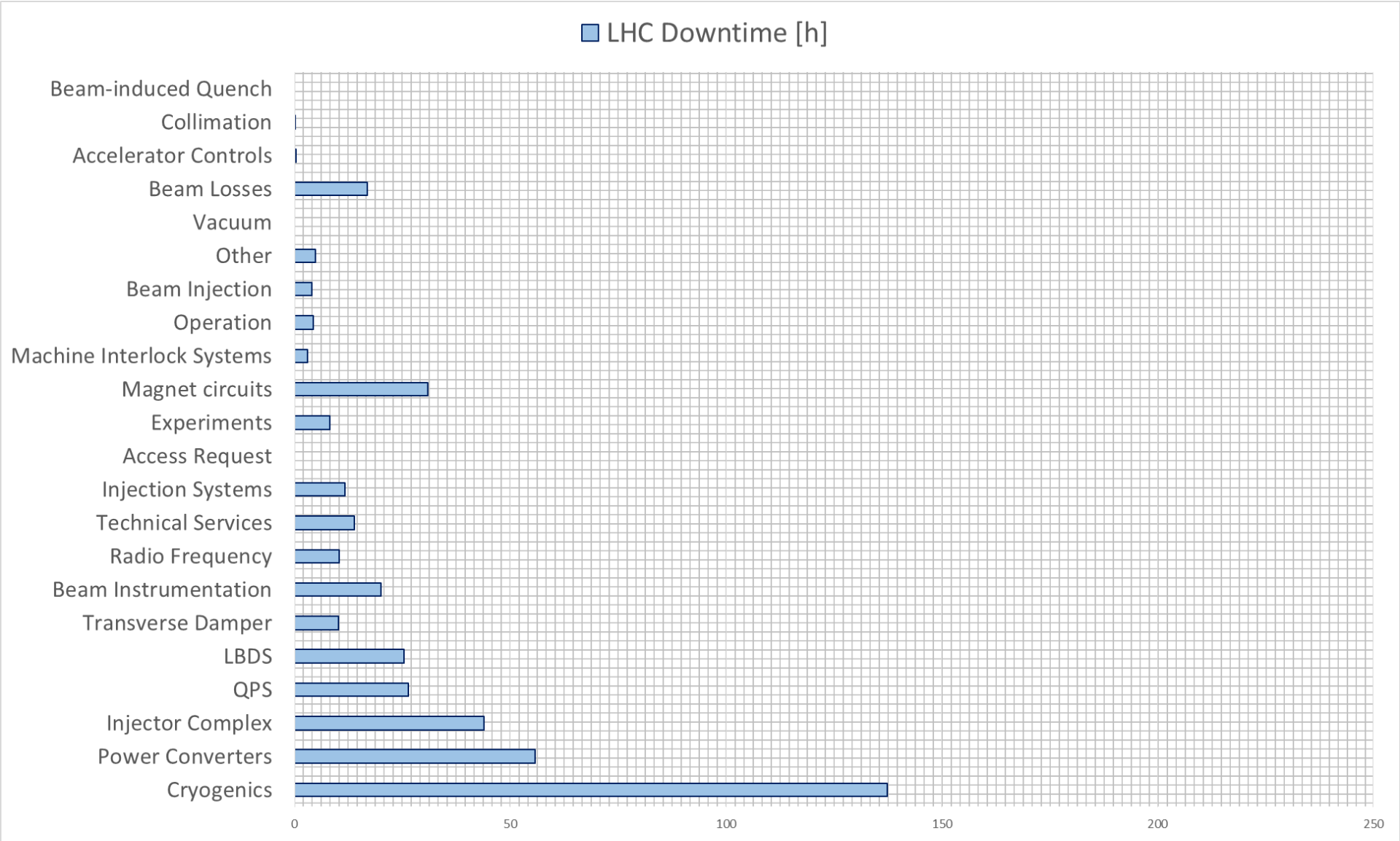


- **LHC Fault Time**: filtering faults occurred in the shadow of others
- **System Fault Time**: NOT filtering faults occurred in the shadow of others

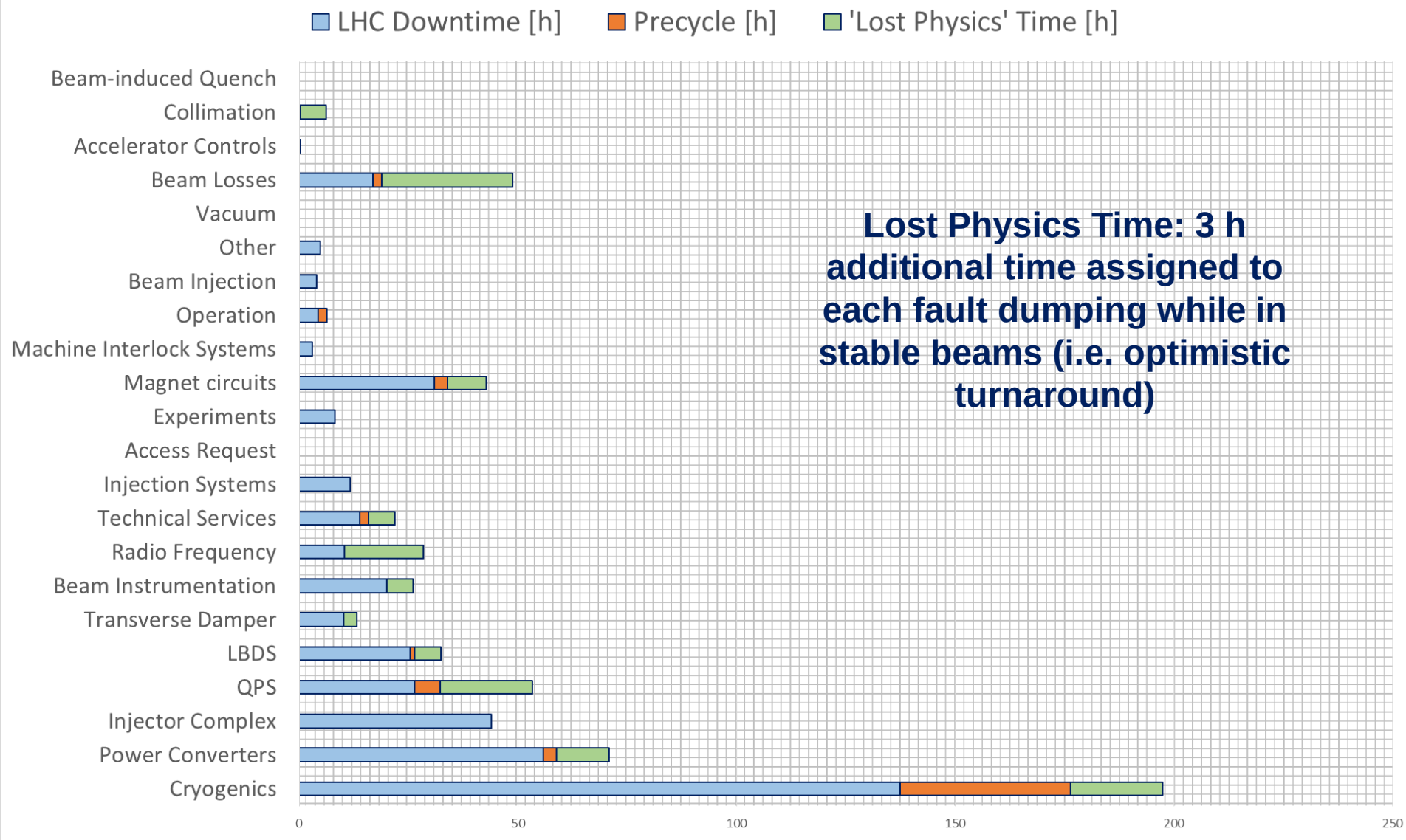
Consider Only LHC Downtime…



…Accounting for Parent/Child Relationships

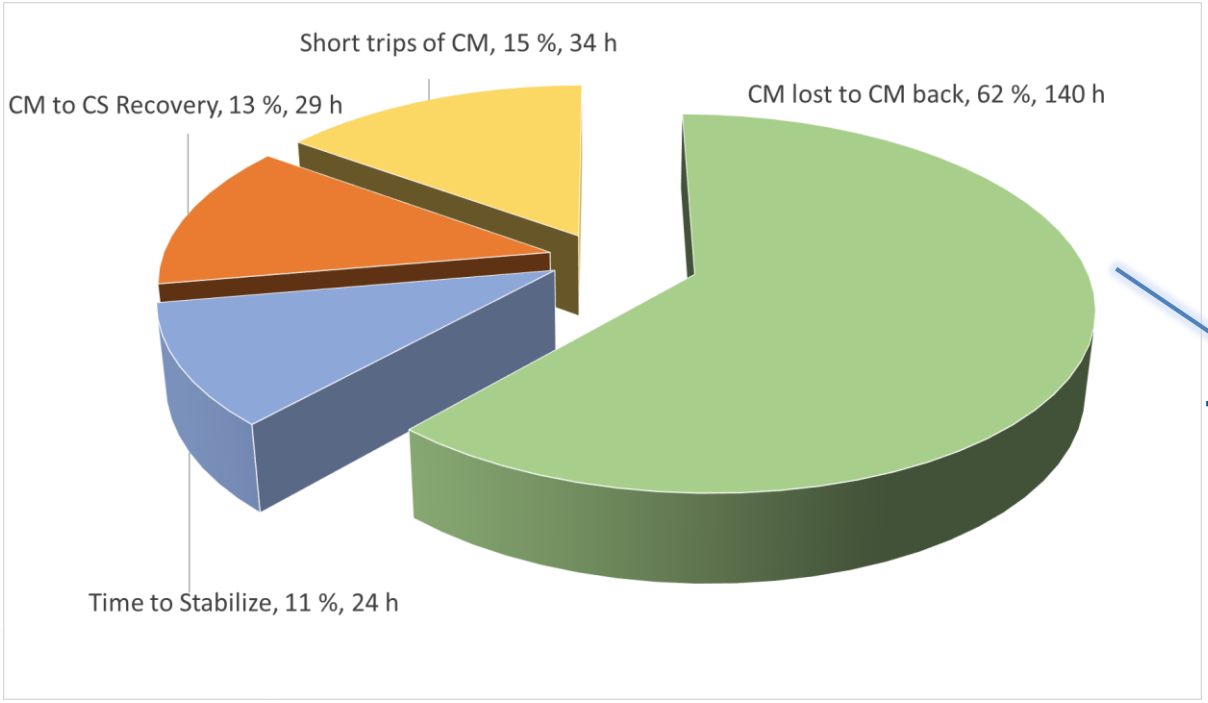


…Impact on LHC Operation (25 ns Run)



Cryogenic System (25 ns Run)

- Total system downtime: 227 h
- Total LHC downtime: 185 h
- Total time as ‘child’: 52 h
- Total time as ‘parent’: 4.4 h
- Number of dumps in stable beams: 7
- Number of precycles required: 39



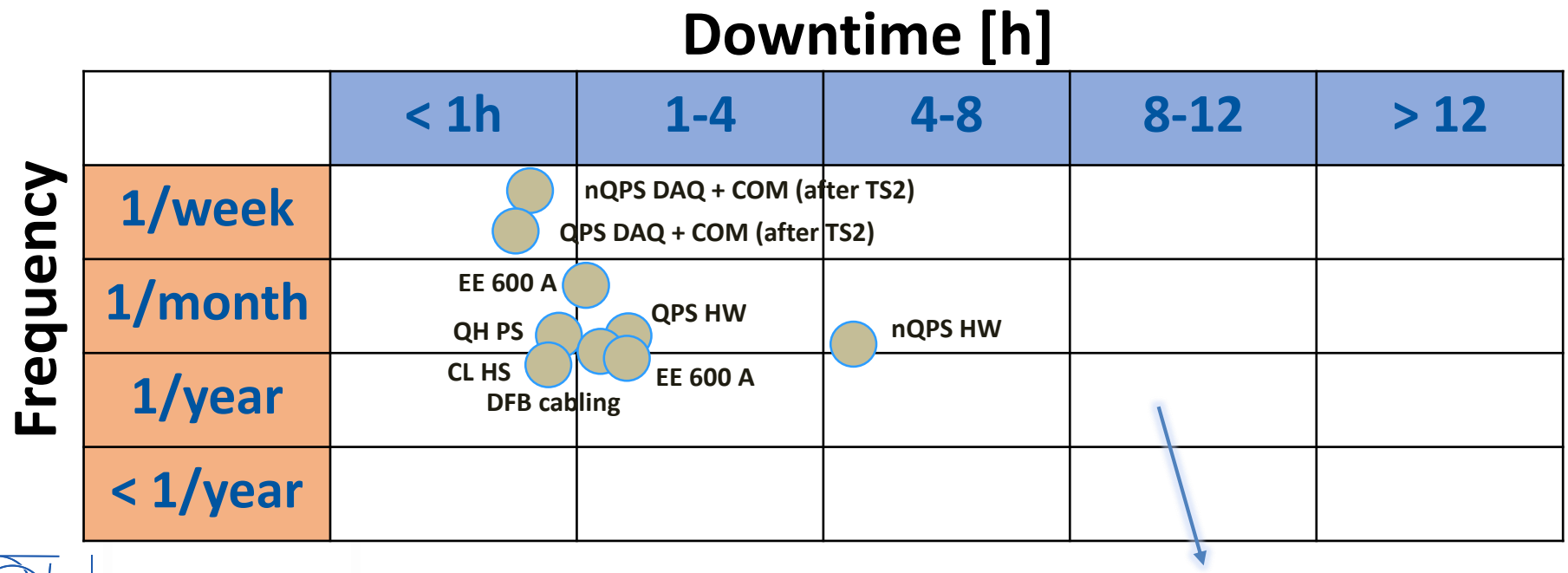
Talk by K. Brodzinski

Power Converters (25 ns Run)

- Total system downtime: 53.5 h
- Total LHC downtime: 50.5 h
- Total time as ‘child’: 0 h
- Total time as ‘parent’: 0 h
- Number of dumps in stable beams: 4
- Number of precycles required: 3

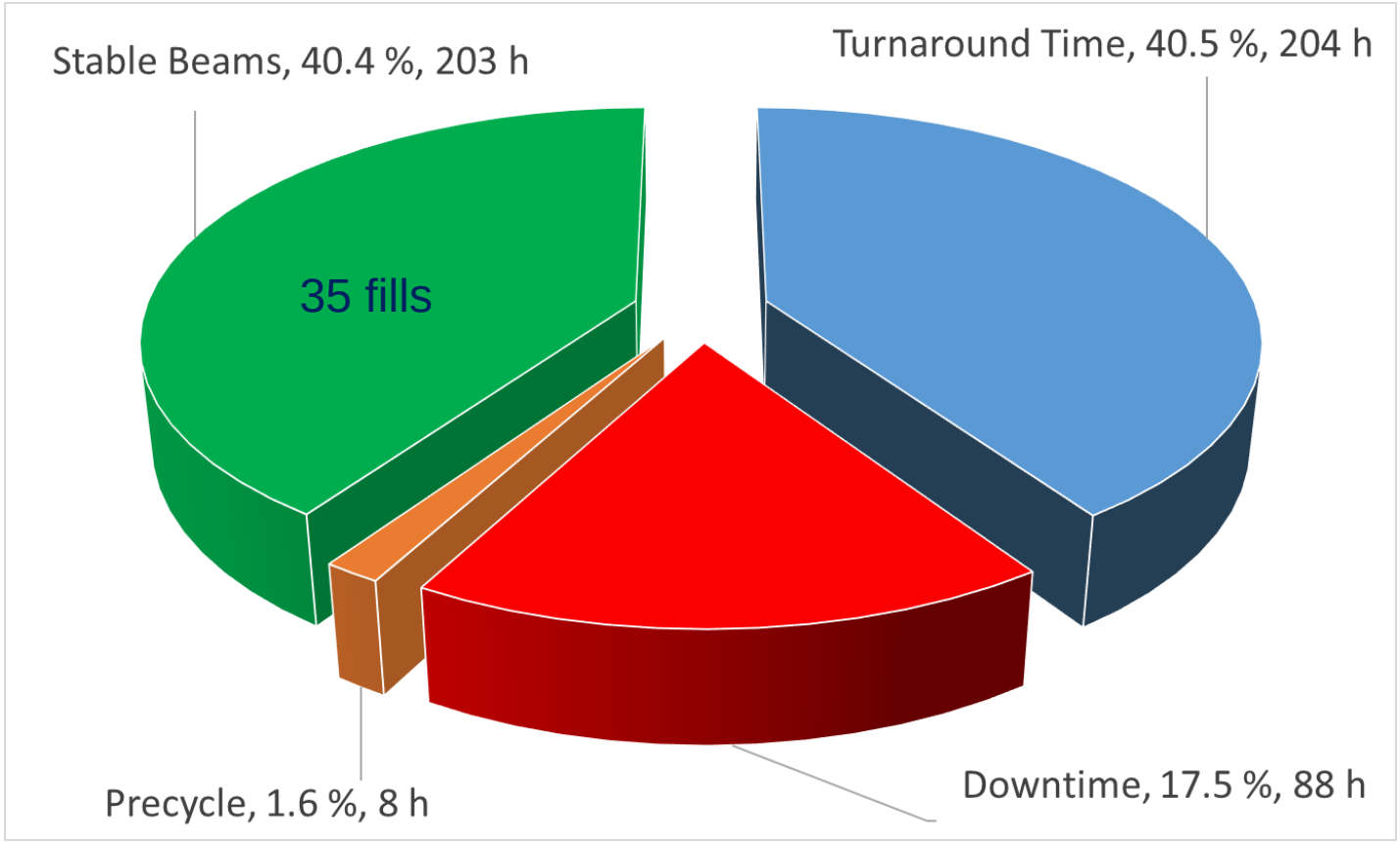
Quench Protection System (25 ns Run)

- Total system downtime: 38 h
- Total LHC downtime: 23 h
- Total time as ‘child’: 5.5 h
- Total time as ‘parent’: 9 h
- Number of dumps in stable beams: 7
- Number of precycles required: 6



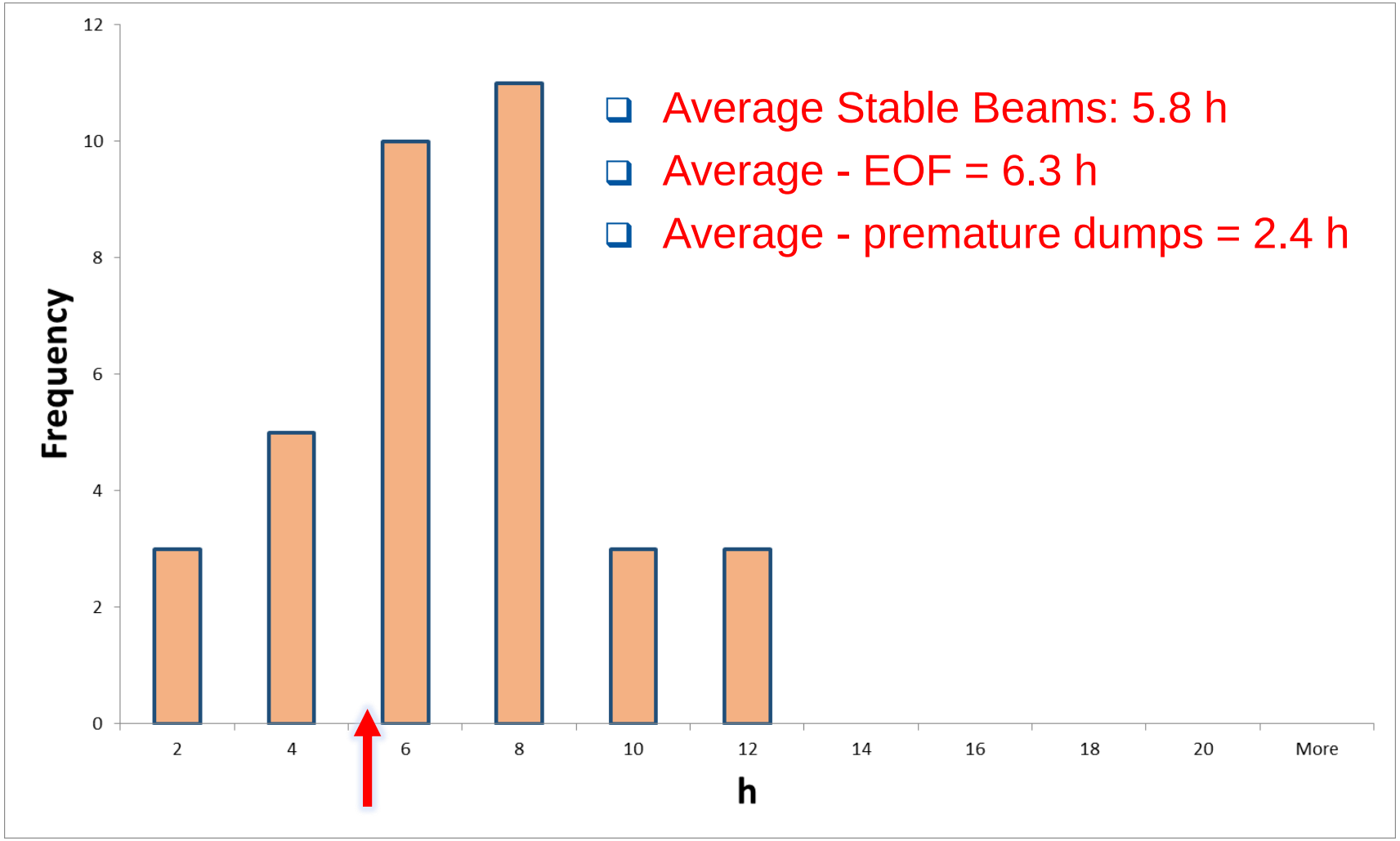
FOCUS: Ion Run (23/11 to 13/12)

Availability for Physics – Ion Run



- 30 End Of Fill, 5 dumped due to faults
- Fraction of premature dumps: 5/35 = 14.3 %
- Average turnaround (per SB) = 204/35 = 5.8 h
- Average Fault time (per SB) = 88/35 = 2.5 h

Stable Beams Distribution – Ion Run



Additional Considerations (all 2015)

- Impact of **UFOs** (21 UFO dumps), talk by B. Auchmann
  - Significant effort to optimize BLM thresholds in terms of MPS and availability
  - Number of quenches: 3
- 7 **Training quenches**
- Unidentified Lying Object (**ULO**), talk by D. Mirarchi
  - 14 dumps
  - Number of quenches: 3
- **Single Event Upsets (SEUs)**, talk by S. Danzeca
  - QPS: 2 confirmed SEUs - on top of mBS SEUs, solved during TS2
  - Power Converters: 6 candidate SEUs
  - RF: 4 candidate SEUs
- **LHC Injection**, talk by D. Jacquet
  - 49 dumps (losses, oscillations, other)

Conclusions

- Remarkable availability during Ion Run – 81 %!
- 65.3 % availability during 25 ns Run (close to 2012)
- Cryogenic system is the biggest contributor to LHC unavailability (~ 25 % as ‘child’ due to quench recovery)

Outlook

- Successful deployment of AFT and improvement of fault review process (even better in 2016!)
- Going forward…availability: hot topic!
- Enforce the ‘availability and reliability culture’ in the accelerator domain
- Dedicated session in Chamonix 2016
- Reliability trainings for CERN staff members
  - (if interested contact A. Apollonio / R. Schmidt / J. Gutleber, first test training 29th Feb – 3rd Mar 2016)

Thanks a lot for your attention!

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