Sorry for the incomplete slides.
It's my fault..
I got request to include ARICH.. is it fine to keep it?

Belle II operation status and plan

Kenta Uno (KEK)

ARC-BPAC

18th December, 2025

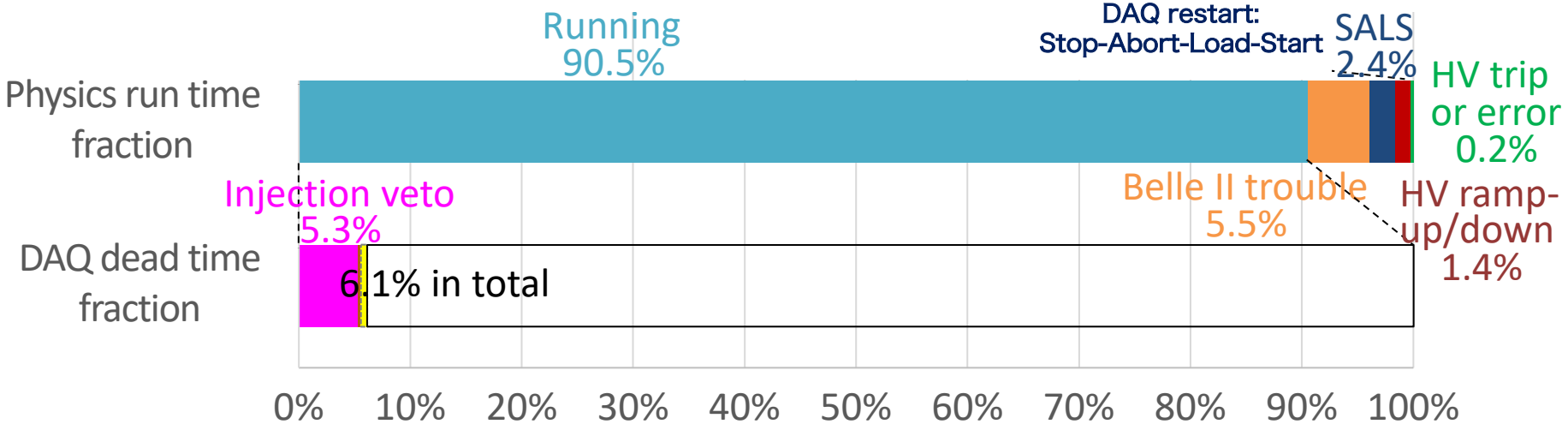
Objectives in 2025c

Accumulate the data of 425 fb^{-1} with acceptable background level

- Higher data-taking efficiency is important! (target: 90%)
  - Key: DAQ stability, Quick recovery from DAQ error

Summary of the work is covered by K. Nakamura

Reminder: 2024c operation status



We had been struggling with high background since the beginning of 2024c
→ overall data-taking efficiency = 85%

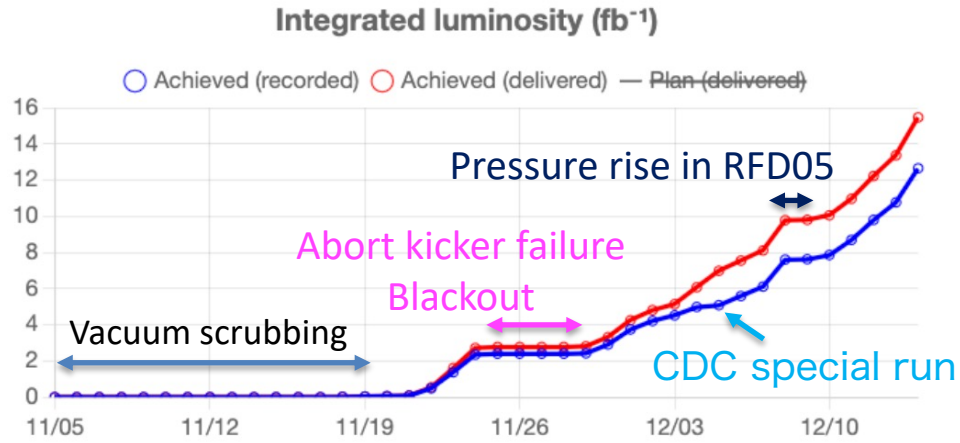
Our data taking efficiency depends on the beam background level

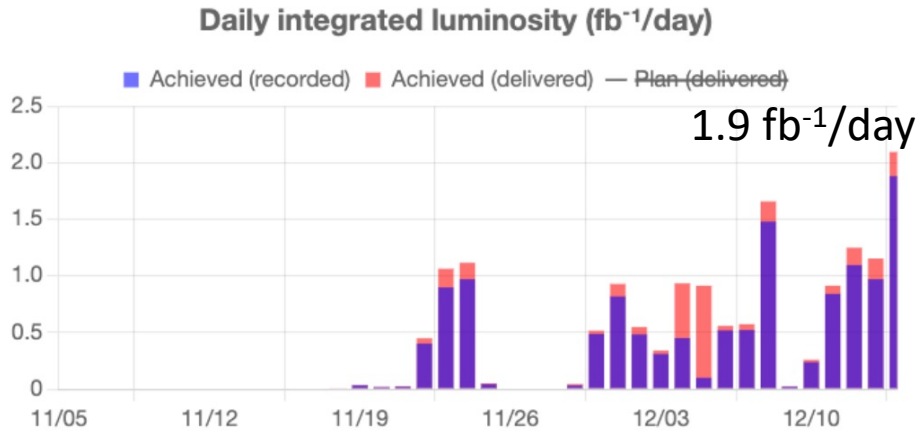
→ **Mitigation of the background in cooperation with the SKB team is crucial**

covered by H. Nakayama

Physics run in 2025c

We started physics runs on November 18



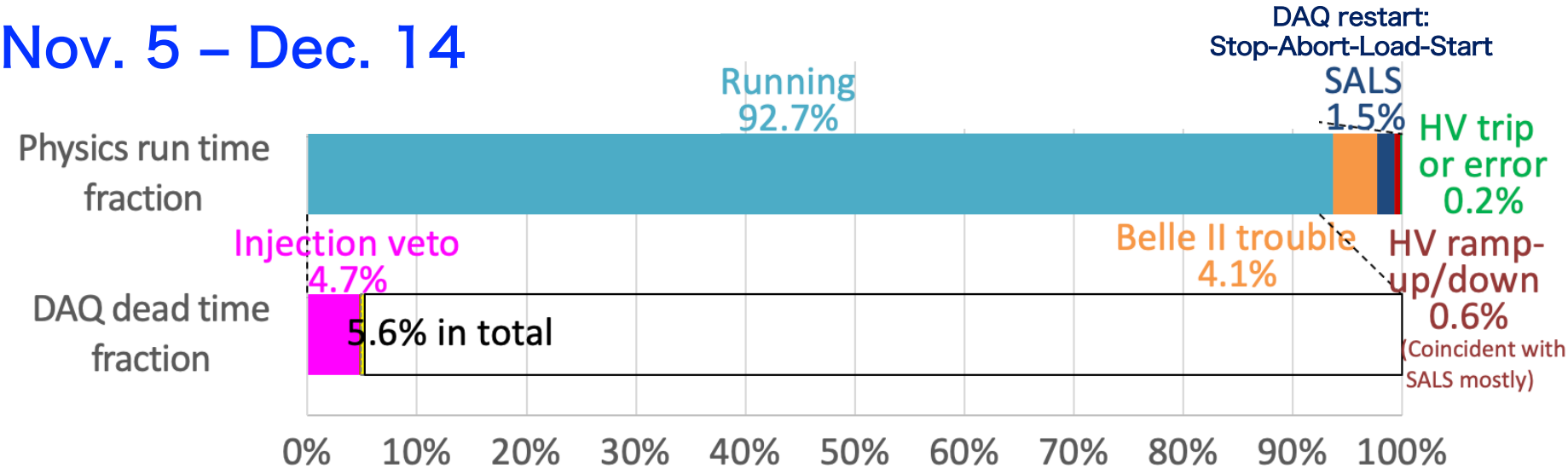


Delivered: 15.5 fb^{-1}
Recorded: 12.7 fb^{-1} + 1.0 fb^{-1} (for CDC special run)

- Many machine troubles → lower physics run time
- Challenges in reaching high luminosity → lower peak luminosity
  - $L \sim 3.0\times10^{34}$ cm^{-2} s^{-1} during this weekend

2025c operation status

Nov. 5 – Dec. 14

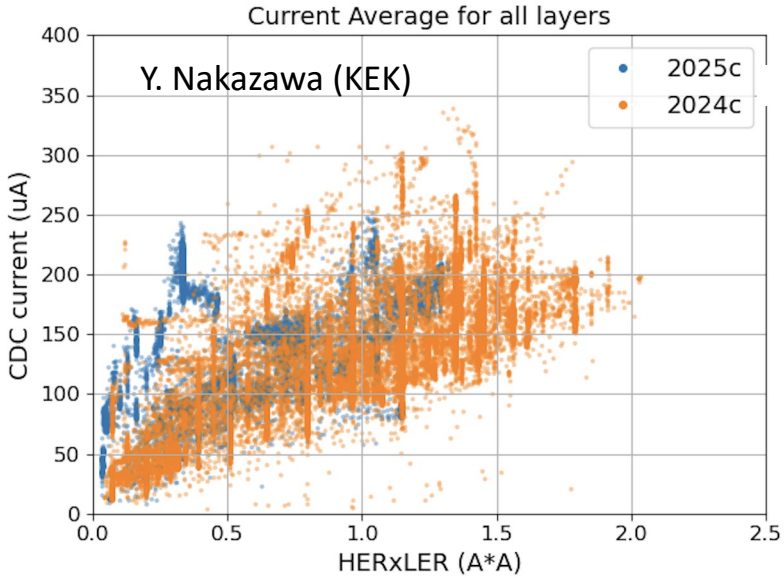


2024c → 2025c

- Belle II trouble: 5.5% → 4.1%
- SALS: 2.4% → 1.5%

Overall data taking efficiency is 91.8%

※ The bkg level in 2025c is comparable to that in 2024c.



Our DAQ stability is more robust, even under high bkg conditions

Improvement: auto subrun restart

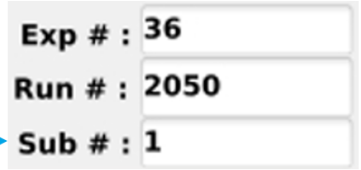
The new scheme helps to improve our data-taking efficiency

AUTO SUBRUN RESTART: QUICK RECOVERY WITHIN A RUN

S. Yamada (KEK)

- In data-taking, link errors between modules have occurred rather frequently :
  - b2llost: link lost between FEE and readout board(PCIe40)
  - ttlost : link lost between FEE and Trigger/Timing distribution modules(FTSW)

- In 2025c run, we implemented a feature to resume data-taking within a few sec. by only issuing an error reset signal to the FEEs. (A usual run restart takes 20-90sec. for software initialization.)
  - The same run continues with an incremented subrun number.



- Since a link can be lost at arbitrary timing, recovery sometimes ends in data corruption or buffer full. Nevertheless, this mechanism has clearly contributed to reducing downtime. Efforts for the improvement is ongoing.

Success rate of subrun restarts from Nov. 20 to Dec. 3

Errors type	# of subrun restarts	Success	Failure	Success rate
CDC ttlost	31	22	9	71%
CDC b2llost	52	22	30	42%
TOP b2llost	2	2	0	100%
ARICH ttlost	2	2	0	100%
KLM b2llost	12	0	12	0%

Note: For specific error types, such as TOP ttlost (20 occurrences during the period, not listed in the table), subrun incrementation did not occur because the error reset failed beforehand. This is also an item to be improved.

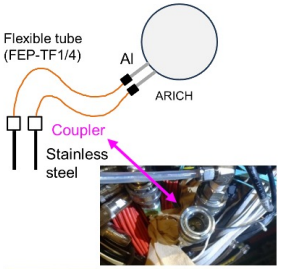
Other improvement: ARICH

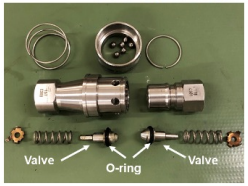
S. Nishida (KEK)

BPAC report on June [Link]

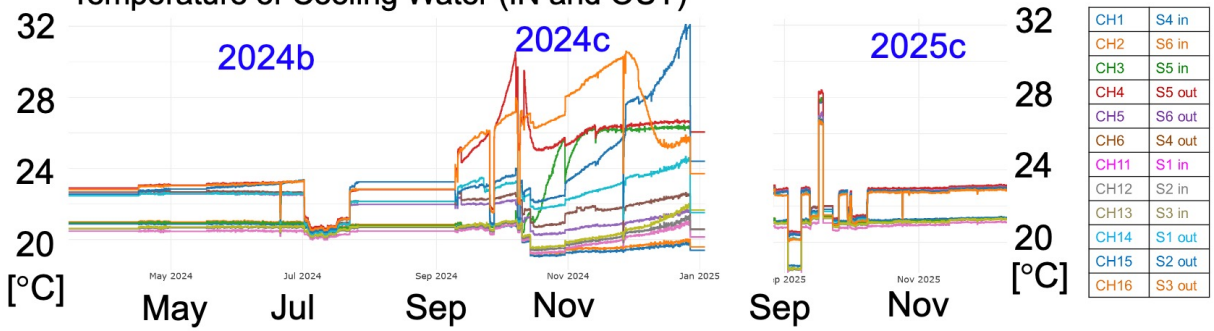
ARICH Cooling Problem Solved

- Flow of the ARICH cooling water decreased in 2024c operation.
  - ✓ 10-20% of channels were needed to be off in 2024c.
- Green muddy water was found in the pipe; we suspected that pipes were clogged.
  - ✓ We thought the new chiller with copper and anti-corrosion agent were related.
- We opened the forward end yoke to access the ARICH pipes in summer 2025.
- Found that the couplers were clogged due to swelling of O-ring.
- We removed the couplers.
- In 2025c, the flow is recovered and ARICH is fully operated.

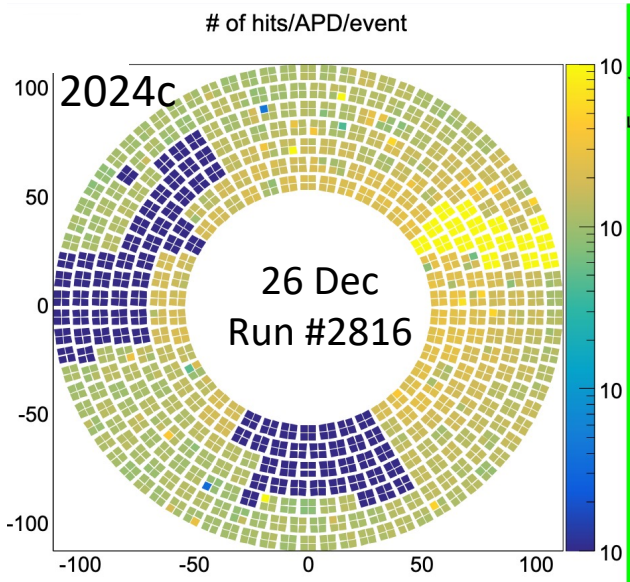


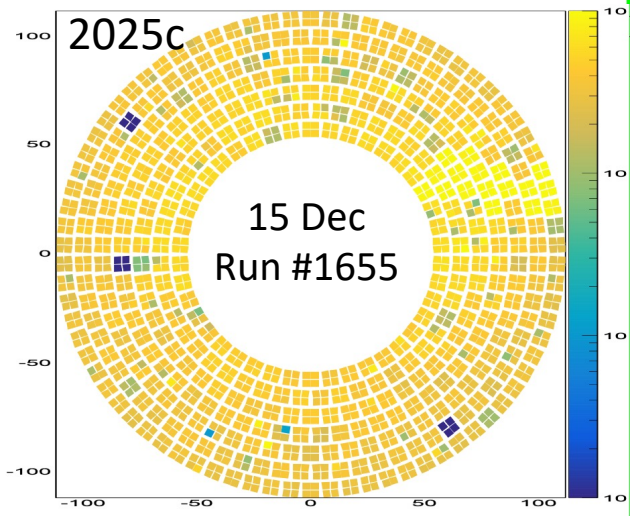


Temperature of Cooling Water (IN and OUT)



CH1	S4 in
CH2	S6 in
CH3	S5 in
CH4	S5 out
CH5	S6 out
CH6	S4 out
CH11	S1 in
CH12	S2 in
CH13	S3 in
CH14	S1 out
CH15	S2 out
CH16	S3 out



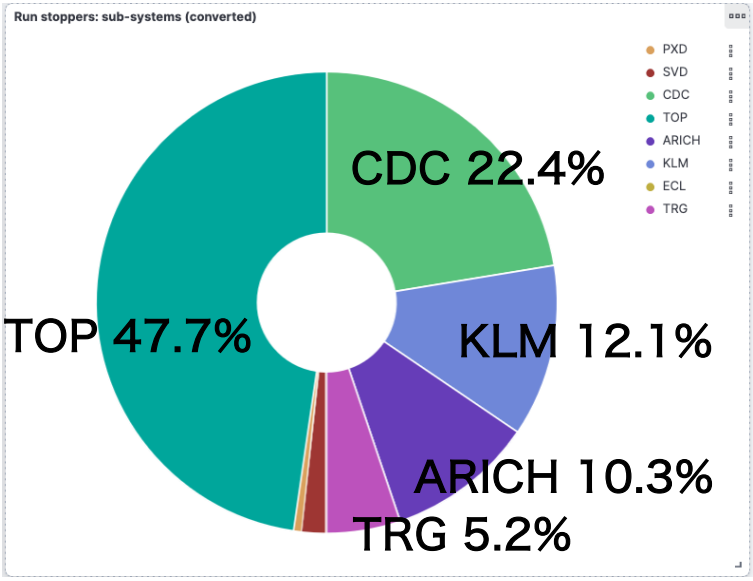


The data quality has returned to nominal.

Run stop reason in 2025c

47.7% of the run stoppers were caused by TOP

Nov.5 – Dec.14, 2025

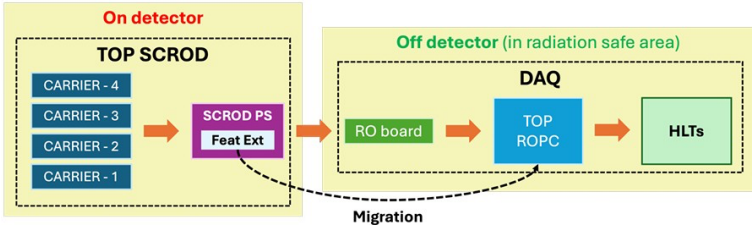


- Stopped the front-end electronics from SEU

M. Bessner (Hawaii)

Feature extraction on computers

- Single event upsets interrupt feature extraction on frontend electronics
  - Stop run, mask, resume run. Downtime from run restart process
  - Reprogram in background and include back in next run
- Most common run stop reason in Belle II at the moment
- New firmware sends full waveforms to readout PC instead
  - Feature extraction in ehut, away from single event upsets
  - Concept has been demonstrated, debugging some issues seen in physics runs



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The original schedule was to use the firmware in 2025c, but not ready yet.

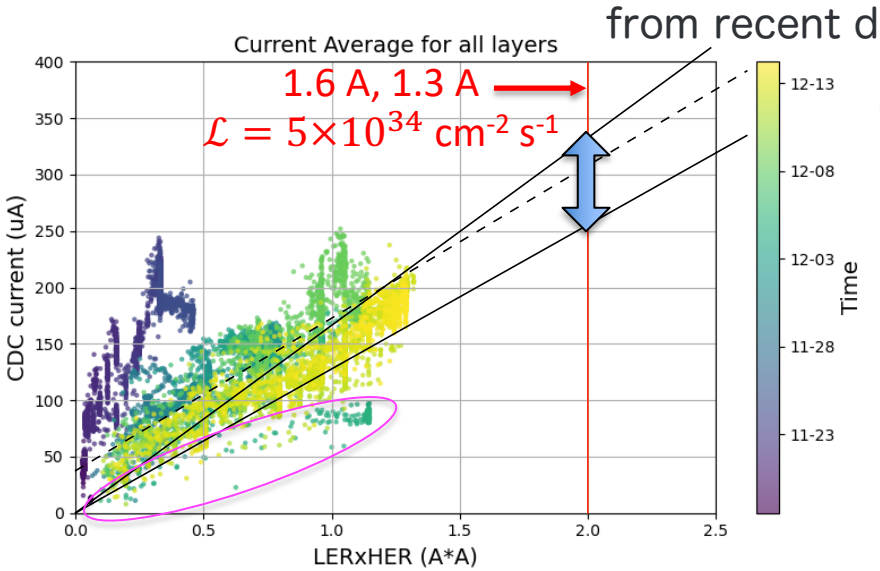
- Still debugging. Aim to be ready by 2026a

→ Most of the TOP-related errors would be eliminated.

Status of the beam bkg

In this shutdown, several beam pipes were opened/cleaned

- Higher pressure level is expected → higher beam-gas induced bkg



The background level has decreased

- Pressure level has gradually improved.
- The collimator optimization helps.

→ The leak current would reach 260 – 300 uA for $I_{\mathrm{LER}}\times I_{\mathrm{HER}} = 2.0\ \mathrm{A}^2$

Countermeasure: CDC operation with lower HV

- The leak current is reduced, but the performance degradation is expected
  - We took the data of ~1 fb^{-1} with lower HV in all layers
  - Additional data with lower HV in SL0 and SL1 will be taken this week

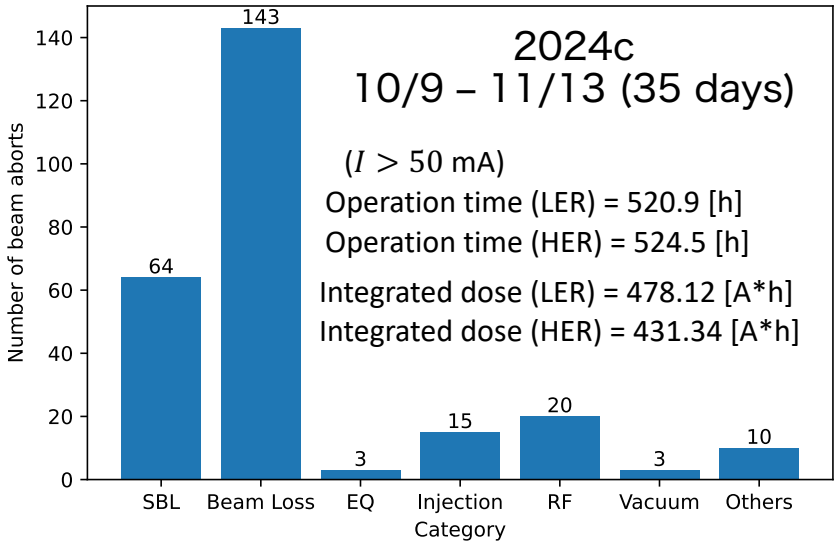
→ Evaluation of physics performance is ongoing

Sudden Beam Loss

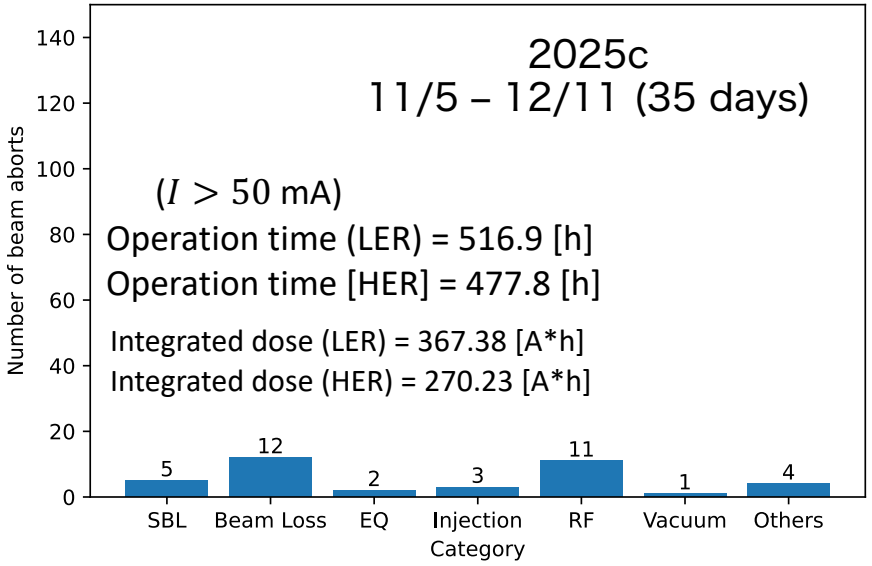
Number/figure should be updated..

http://bgnet.kek.jp/

#aborts = 258



#aborts = 38



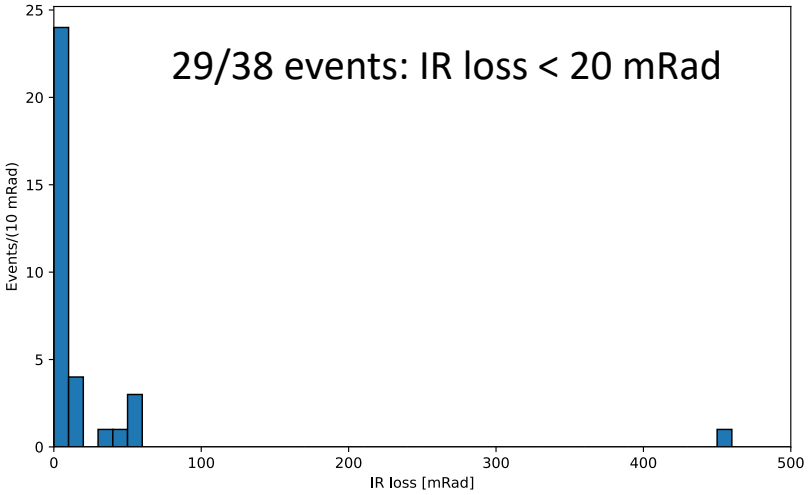
- **#of beam aborts is much reduced.**

→ #of SBLs is also reduced.

Keep monitoring the situation in higher current

SBL in 2025c

- Observed pressure bursts at D11..
  - Need to investigate the region during this winter shutdown.



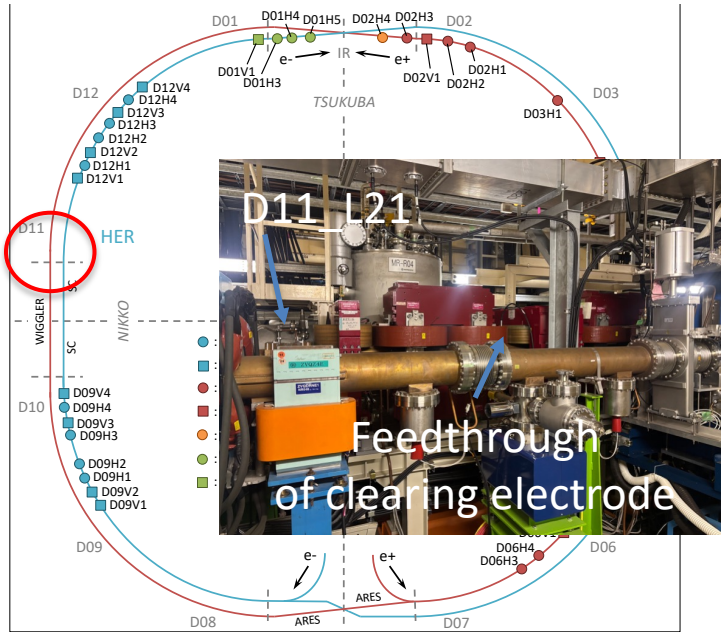
Sudden Beam Loss

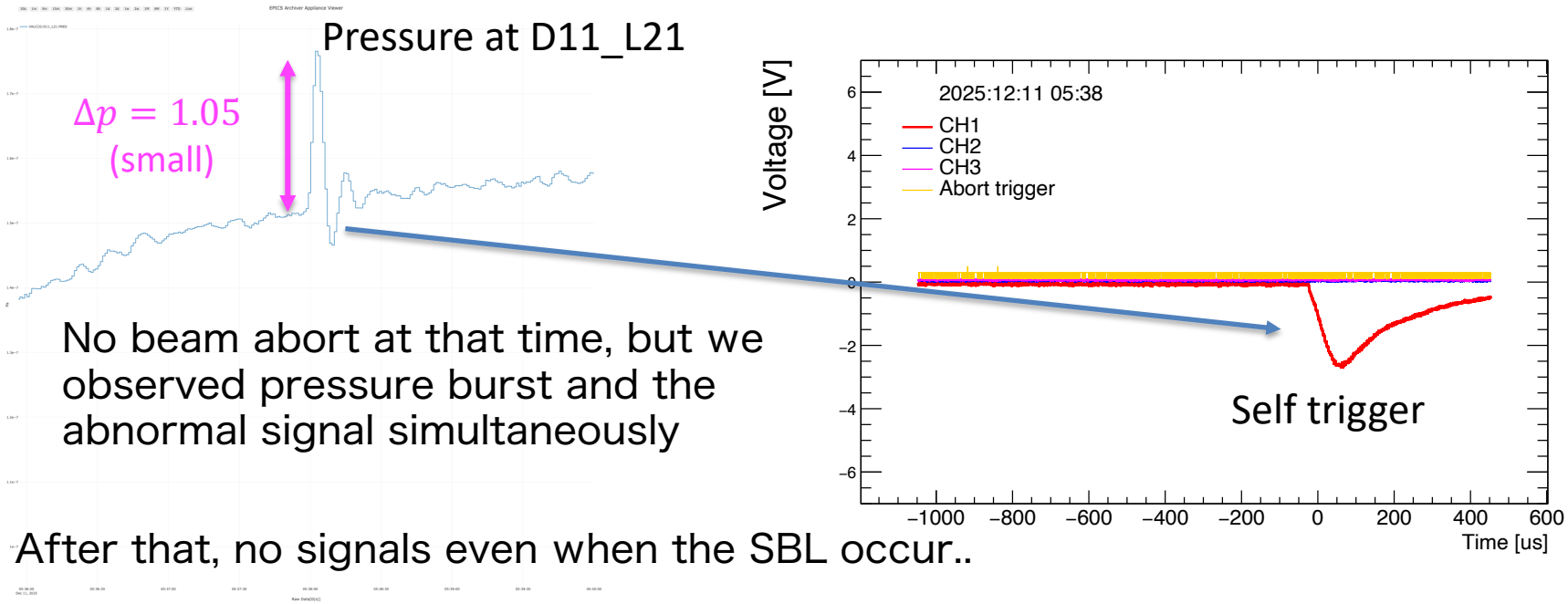
need time to double-check

7 LER SBLs so far

- 6 SBLs with pressure burst at D11_L21
- 1 SBL without any pressure burst
  - detuned optics

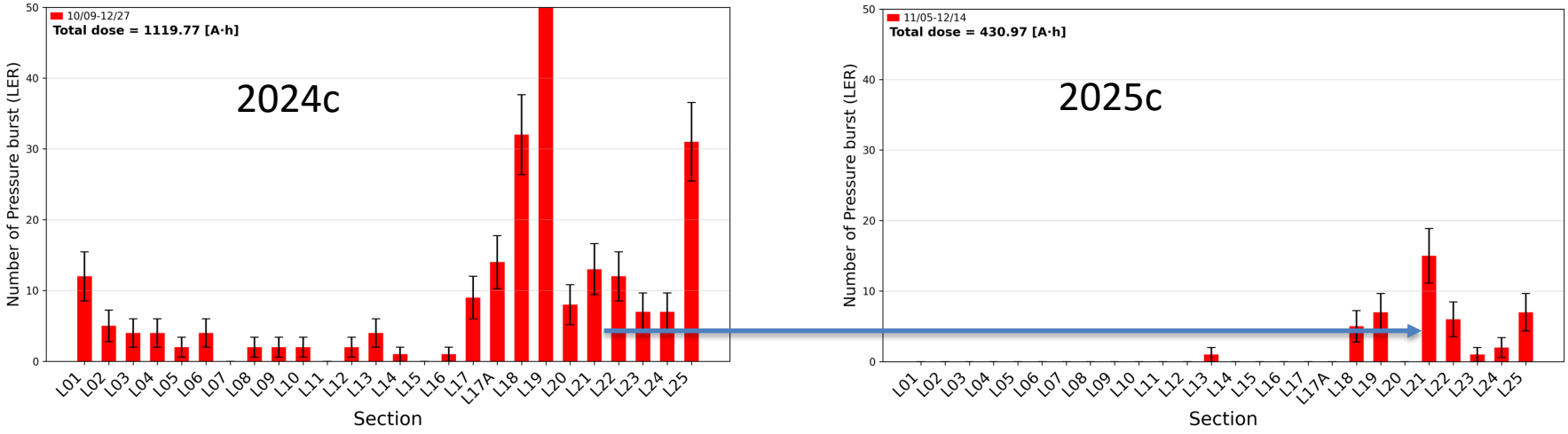
1 HER SBLs so far





Checking the beam pipes should be done in the shutdown

Pressure bursts at D11



Freq: $0.01 \pm 0.01\ [1/(A \cdot h)] \rightarrow 0.XX \pm 0.01[1/(A \cdot h)]$

They opened the beam pipe during the shutdown,
but found no indication that VACSEAL had been used. They cleared it.

However, we saw the pressure burst and SBLs..
Checking the beam pipes should be done in the shutdown

Strategy to turn on PXD

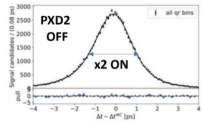
We had discussion on December 12

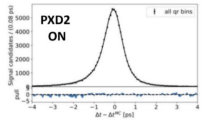
- **Importance of PXD for physics analysis**

Jim Libby @ September 2024 BPAC meeting

Studies with PXD2 off

- Given 2024c data taking likely to be without PXD2 the time-dependent WG has investigated the impact on lifetime resolution and sin 2β
- B-lifetime resolution ~40% worse
  - Two different beam background scenarios tested – similar results
- For sin 2β from B→J/ψK$_S$ the preliminary studies show a ~20% degradation
  - Study with sample with comparable size to current data





sin 2β value and uncertainty with and without PXD

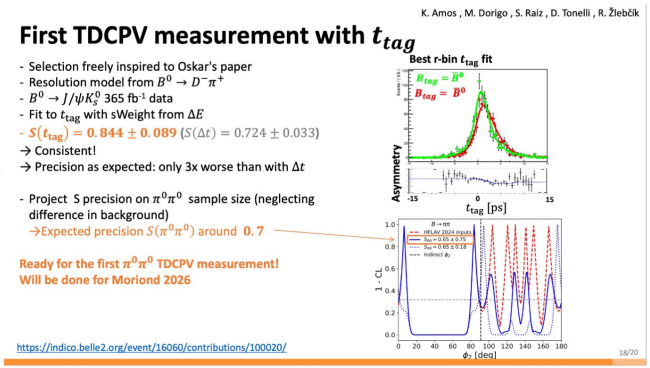
Exp 0	PXD ON	PXD OFF
mean	0.715 ± 0.003	0.713 ± 0.003
width	0.035 ± 0.002	0.042 ± 0.002

Physics September 2024 BPAC 15

Based on study in TDCPV WG

Also … novel tag-side decay time CPV measurements

- ϕ_2 measurement from $S_{\pi^0\pi^0}$
  - Uses only B_{tag} decay vertex and nano beam spot
  - 20x better sensitivity than method in Belle II Physics Book
  - Resolves discrete ambiguities
- Vertex resolution from PXD is crucial !



R. Okubo, October 2025 B2GM TDCPV WG summary

- **The machine stability and frequency of SBLs**
  - The situation is much improved, but 7 SBLs events occurred in 2025c

No conclusion yet. Need more discussion to determine the criteria

Summary

2025c started:

- Integrated luminosity: 12.7 fb^{-1} (delivered)
  - Several machine troubles, peak luminosity lower than planned
- Data taking efficiency 91.8% under bkg conditions similar to 2024c
  - Eg. Auto-subrun restart works well.
  - Further improvements are expected with the new TOP firmware.

Machine stability improved:

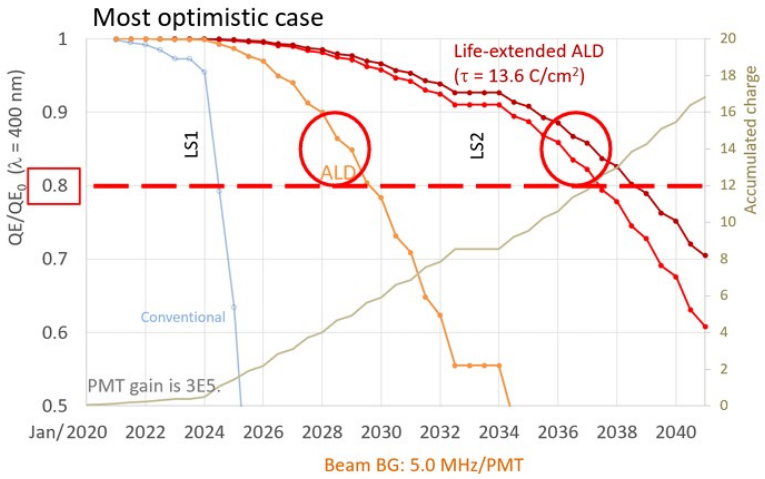
- Number of SBLs is much reduced.., but 7 SBLs are observed

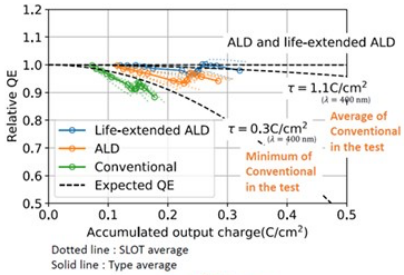
→ We have to determine the criteria to turn on PXD as soon as possible.

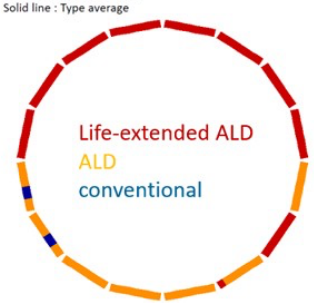
Backup

QE projection

- Estimated with lifetime obtained in the test bench
  - Note that PMTs show faster degradation.
- Will replace ALD PMTs in 2028-2029, life-extended ALD PMTs in 2036-2037
  - In most optimistic case.
  - Need additional budget for later PMTs.
    - ~320 PMTs for all life-extended.







K. Inami
TOP parallel session
of Feb 2025 B2GM

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