SuperKEKB Status

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on behalf of SuperKEKB Commissioning Group

Outline

Highlights of 2025c operation

Work during winter shutdown

2026ab operation schedule

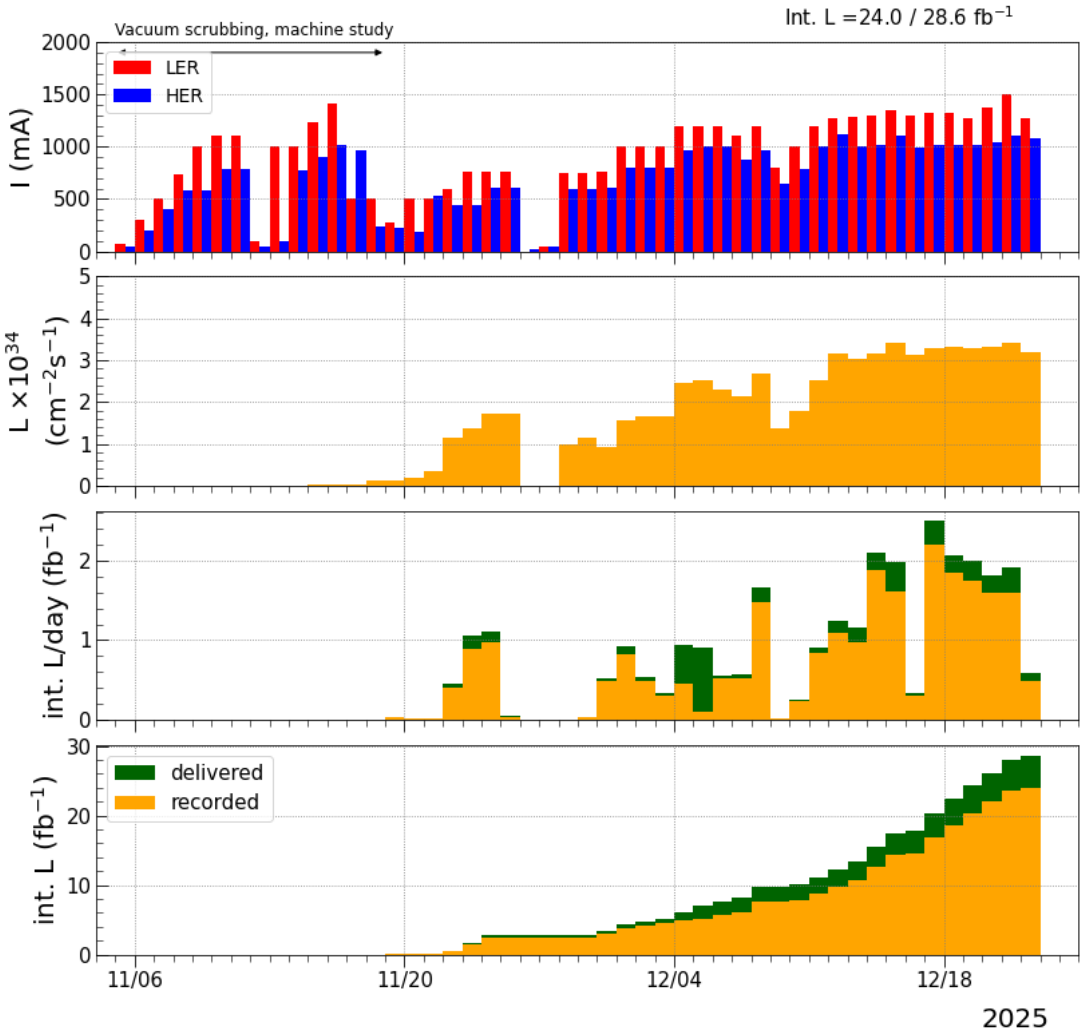
Overview of 2025c operation

Luminosity

- Peak Luminosity : **3.4×10^{34}cm^{-2}s^{-1}**
  - ⇒ ~ 67 % of the 2024c record (5.1×10^{34}cm^{-2}s^{-1})
- Integrated Luminosity / day
  - 2.49 fb^{-1} (delivered), 2.19 fb^{-1} (recorded)
- Integrated Luminosity / 2025c
  - 28.7 fb^{-1} (delivered), **24.0 fb^{-1} (recorded)**
  - ⇒ ~ 50 % of the original plan
- Integrated Luminosity from 2019
  - **599 fb^{-1} (recorded)**

Beam Current

- LER : 1.49 A / HER : 1.10 A
  - 88 % / 81 % of the 2024c operation, respectively



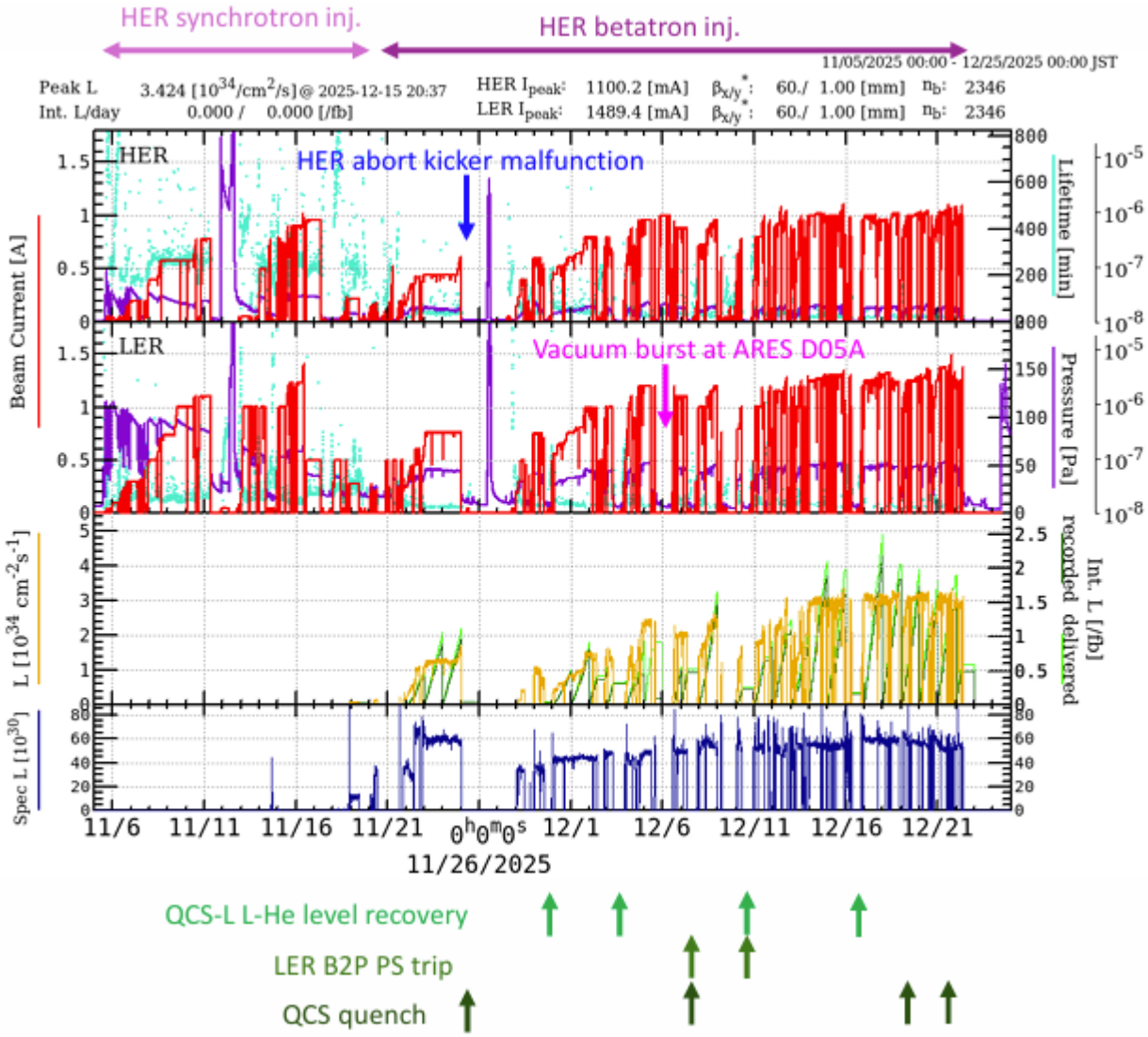
Operation in 2025c

Synchrotron Injection

- Conducted in HER from Nov. 6 to Nov. 20.
- It was found that some difficulties
  - Abort orbit tuning
  - Charge leakage into adjacent RF buckets
  - Low injection efficiency
- The injection method was switched to betatron injection

A total of four QCS quench was occurred

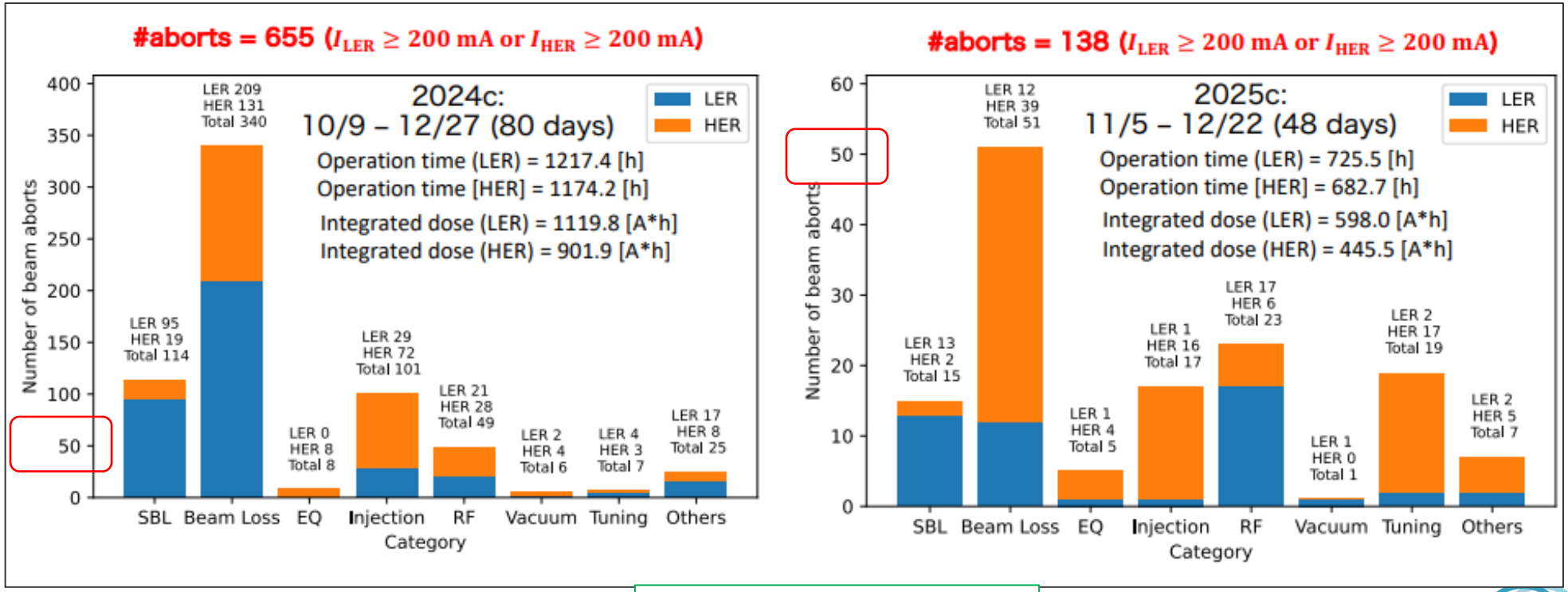
- weak-bend abort (Nov. 25),
- SBL (Dec. 9, 21),
- LER Kicker Misfire (Dec. 18)



Operation in 2025c

Sudden Beam Loss

- Compared to the 2024c run, the number of SBL events was significantly reduced.
  - Effect of VACSEAL removal
- Still occurred at LER wiggler sections(D11, D04)



K. Uno, SKEKB Commissioning Meeting (2026.01.14)

Major Troubles in 2025c

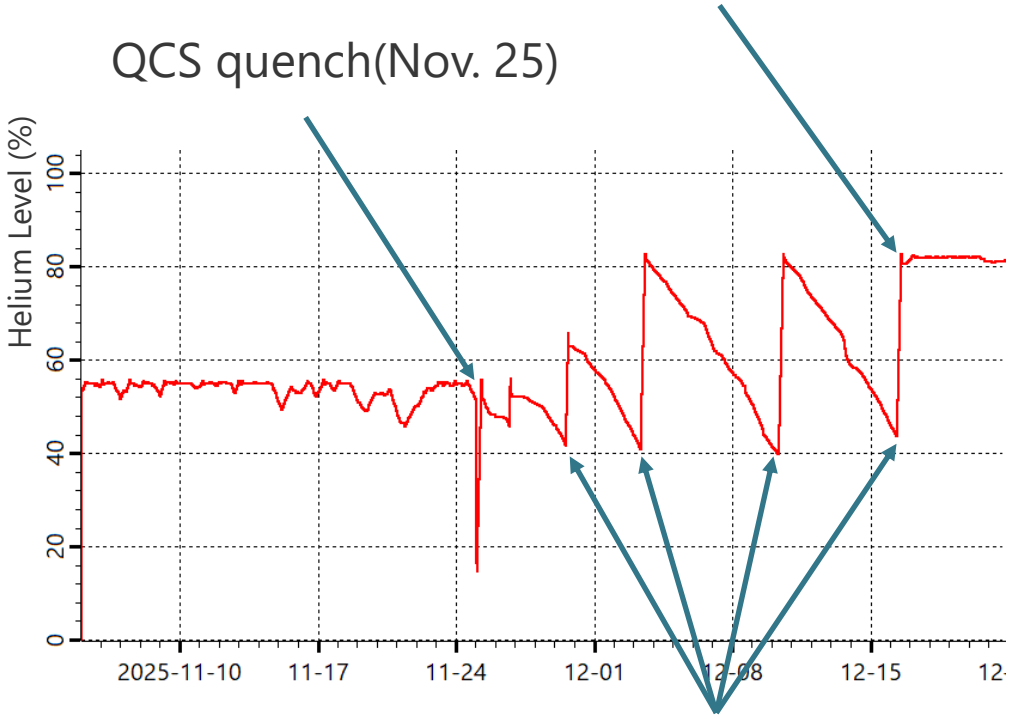
Malfunction of Kicker Power Supply (Nov. 25)

- Beam abort due to the weak-bend was occurred
- Large radiation dose to Belle II, QCS quench, and damaged to the D01V1 collimator

Decrease in the QCS-L liquid helium level

- After the weak-bend abort, the helium supply could not keep up.
- Level recovery work was conducted with QCS-L OFF.
- Helium gas flow of current leads was reduced for lower heat load on Dec. 16. Since then, the level has been kept.

12/16 : Reduced Helium flow of current leads



Level recovery work

Countermeasures for Issues and Work During Winter Shutdown

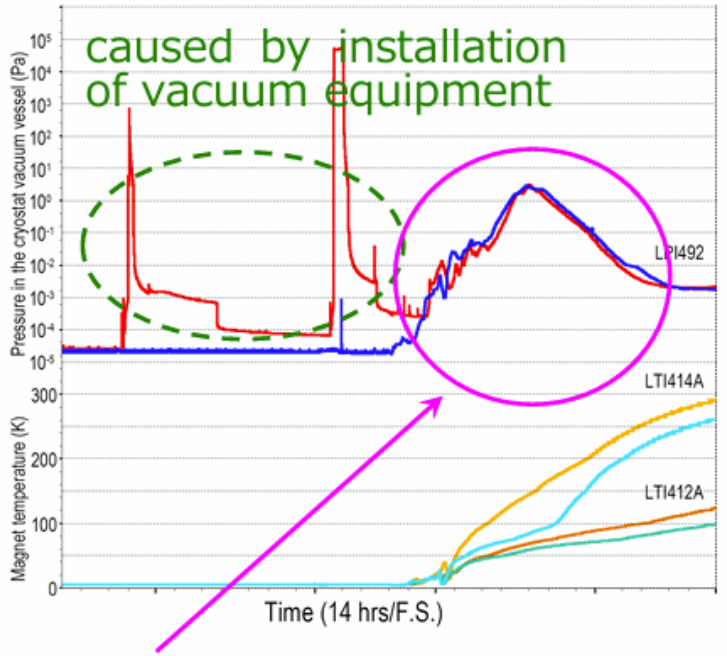
For HER Abort Kicker PS Malfunction Issue

- Short term countermeasure
  - Keep beam current as long as possible and Belle II detector HV off.
  - Try PS reset.
- Long term countermeasure ⇒ Under consideration

For QCS-L Liquid He Level adjustment Issue

- We were concerned that the beam might have damaged O-rings at the tip of the cryostat, causing air leak into the vacuum vessel
- Vacuum leak check was tested by warm up vacuum vessel
  - If leak is occurred, the pressure will rapidly increase
  - The result showed the pressure characteristic was same as obtained in 2024
  - ⇒ No Vacuum Leak
- The cause of the origin is unclear, but several other valves were opened and closed at the quench, so these may cause that.

Measured just after 2025c



No difference was observed between the measured results in 2025 and the reference data from 2024. Thus, no increase in matter captured by cryo-pump effect was detected.

Countermeasures for Issues and Work During Winter Shutdown

For SBL Issue

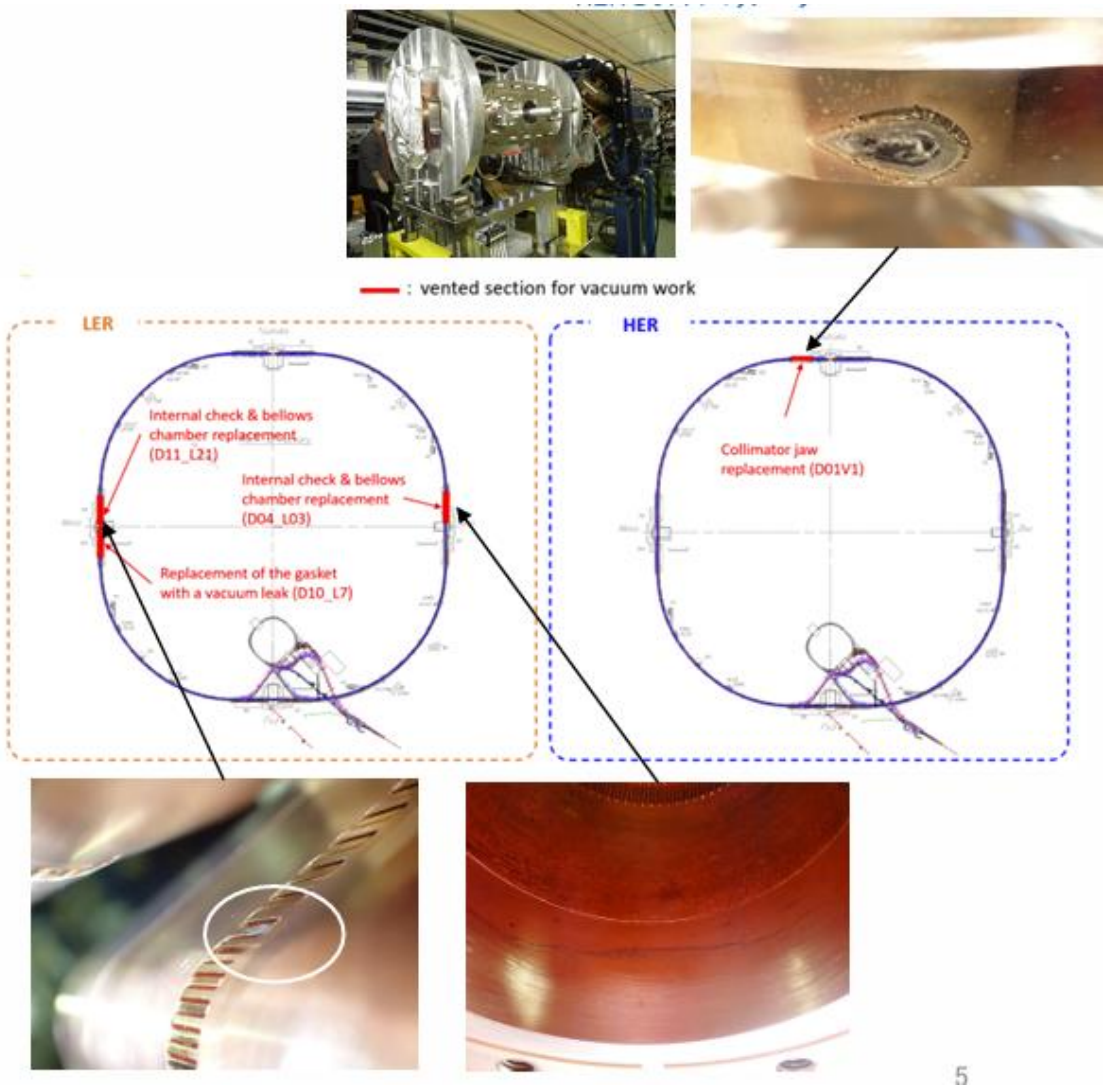
- Replaced Bellows Chamber at D04, D11 where vacuum spike was observed.

For Kicker Misfire Issue

- Optimization of parameters of thyratron

The other works

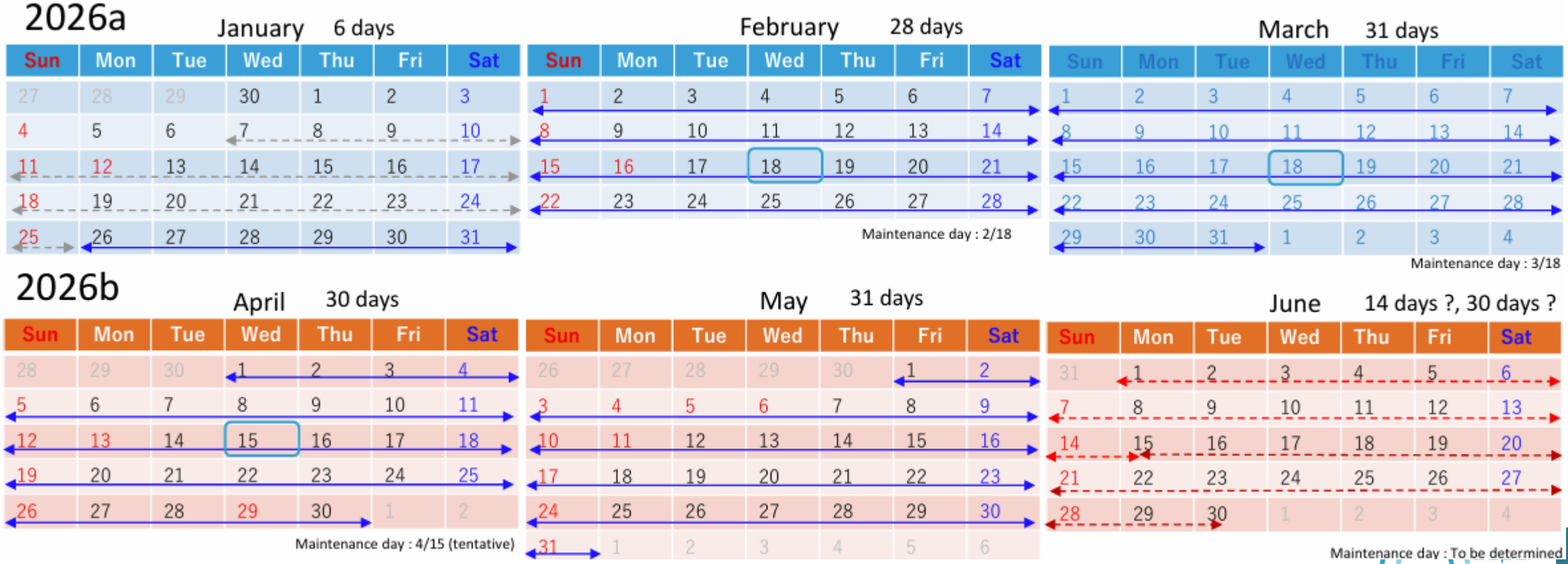
- Replace HER D01V1 Collimator jaw
- Replace gasket at LER D10 wiggler section



2026ab Operation Schedule

1/26 ~ 6/30

- Operation in June will be decided based on the conditions in May
  - To achieve an integrated luminosity of 1 ab^{-1}, we plan to operate as much as possible.



Operation Plan Based on SKB/B2 Joint Review

1. Establish a stable operation at 5×10^{34} $cm^{-2}s^{-1}$

2. Increase the beam current to reach 6×10^{34} $cm^{-2}s^{-1}$

3. Target an integrated luminosity of >400fb^{-1} in 2026ab

4. If achieving 400 fb^{-1} appears feasible, reduce β_y^* to target 10^{35} $cm^{-2}s^{-1}$

Target for Operation in 2026ab

Maximum Current

- **2.0 A (LER), 1.6 A (HER)**

Luminosity

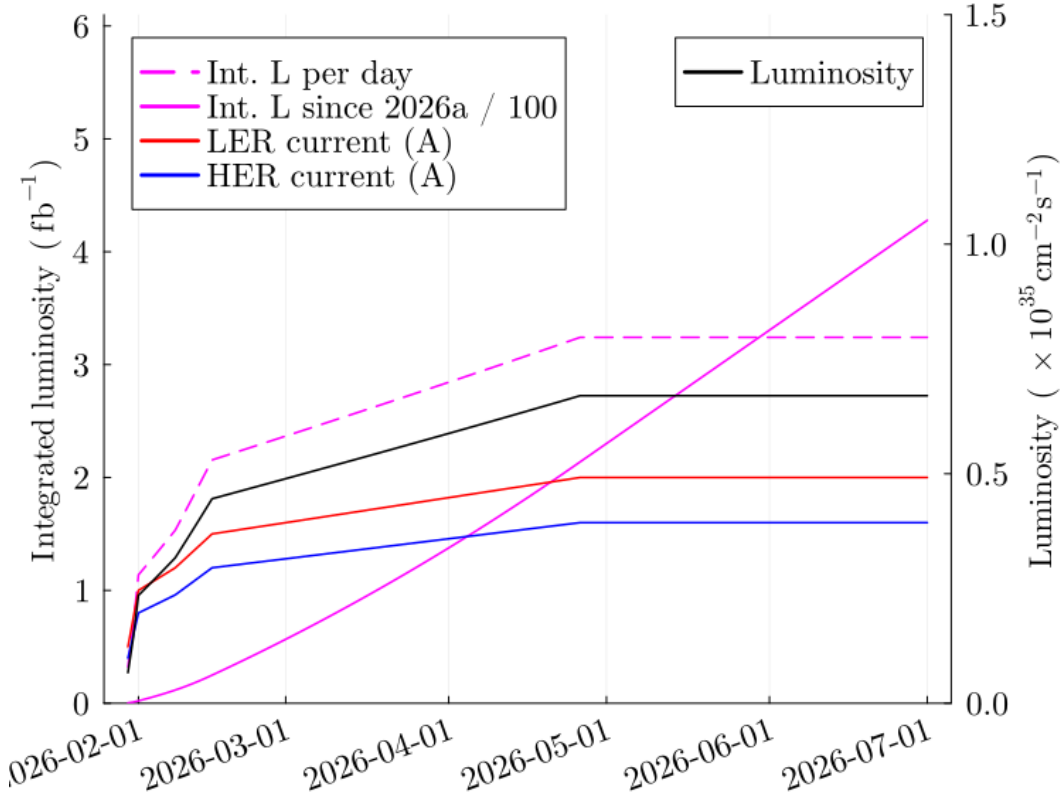
- **6.6×10^{34} $cm^{-2}s^{-1}$**

Ratio of Physics run

- 70%

Accelerator Efficiency in Physics Run

- 80%
  - ε_{acc} = Integrated luminosity / $\int L_{peak} dt$

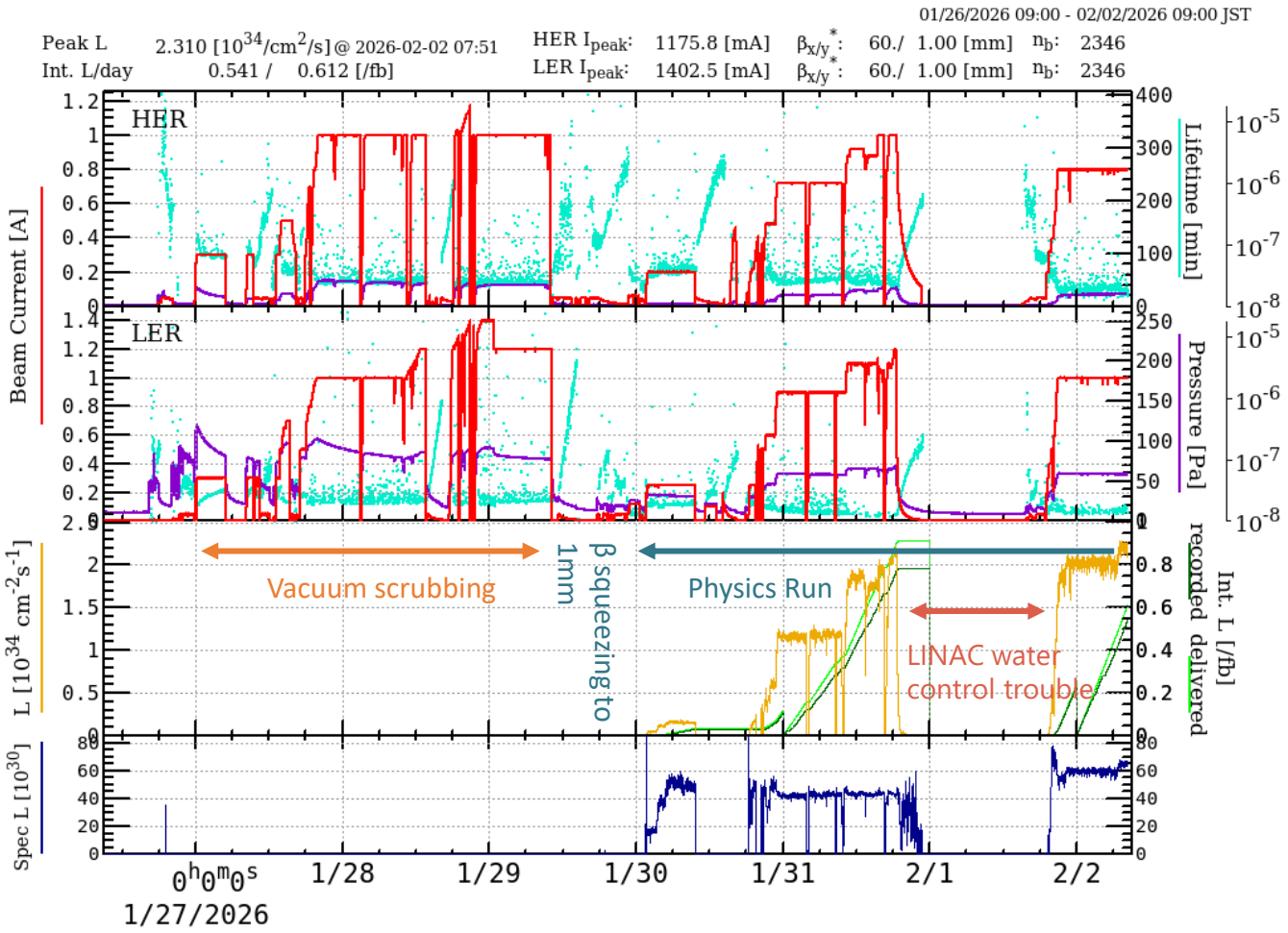


If all of the above conditions are satisfied,

an integrated luminosity of 428 fb-1 can be achieved

2026a run

Physics Run Started from Jan.30



Summary

Highlights of 2025c operation

- Due to various issues, including the weak-bend problem and QCS quenches,
  the accumulated integrated luminosity reached only about 50% of the originally planned value.

Work during winter shutdown

- Bellows were replaced as a countermeasure against SBL
- In addition, leak checks of the QCS-L were performed, and no issues were found.

2026ab operation schedule

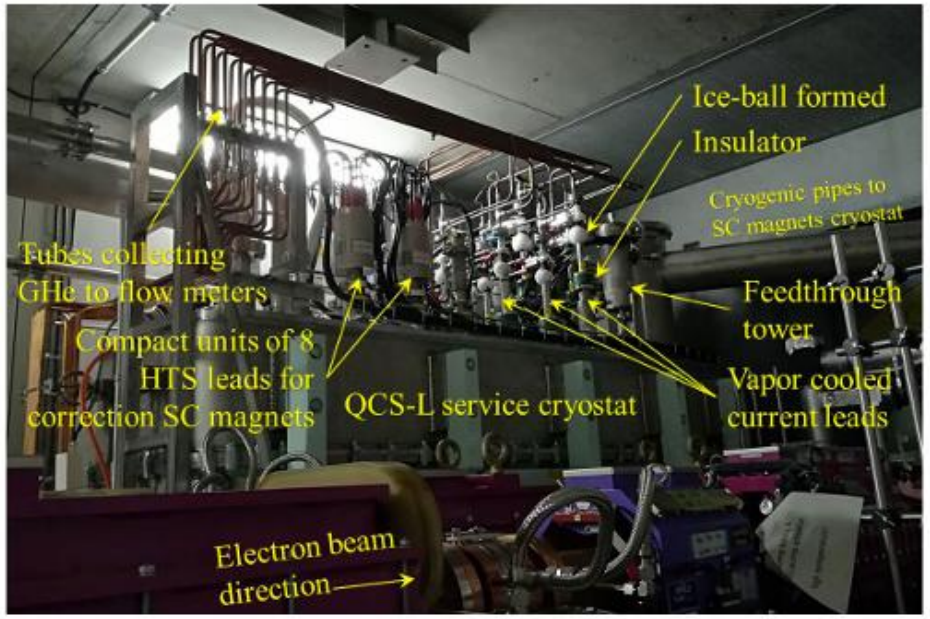
- For the current run period, we have established an operation plan to accumulate more than 400 fb^{-1} of integrated luminosity, aiming to ultimately achieve 1 ab^{-1}.

backups

Cause of problem and accelerator operation in 2026

- The cause of the imbalance between the liquefaction capacity and the heat load after Nov. 25th could not be identified, but any valve leaks may be suspected. There was no change in the recovery tank pressure cycle just before and after Nov. 25th, making a sheet leak in this system improbable. However, several other valves were opened and closed at the quench, so these may cause the additional heat load.

- Although the cause remains unclear, stable operation has been successfully maintained since Dec. 16th, because the gas flow for current lead was reduced to lower heat load.



One of the vapor cooled current lead

Room temp.

4.5 K