



Service Work on LumiBelle2

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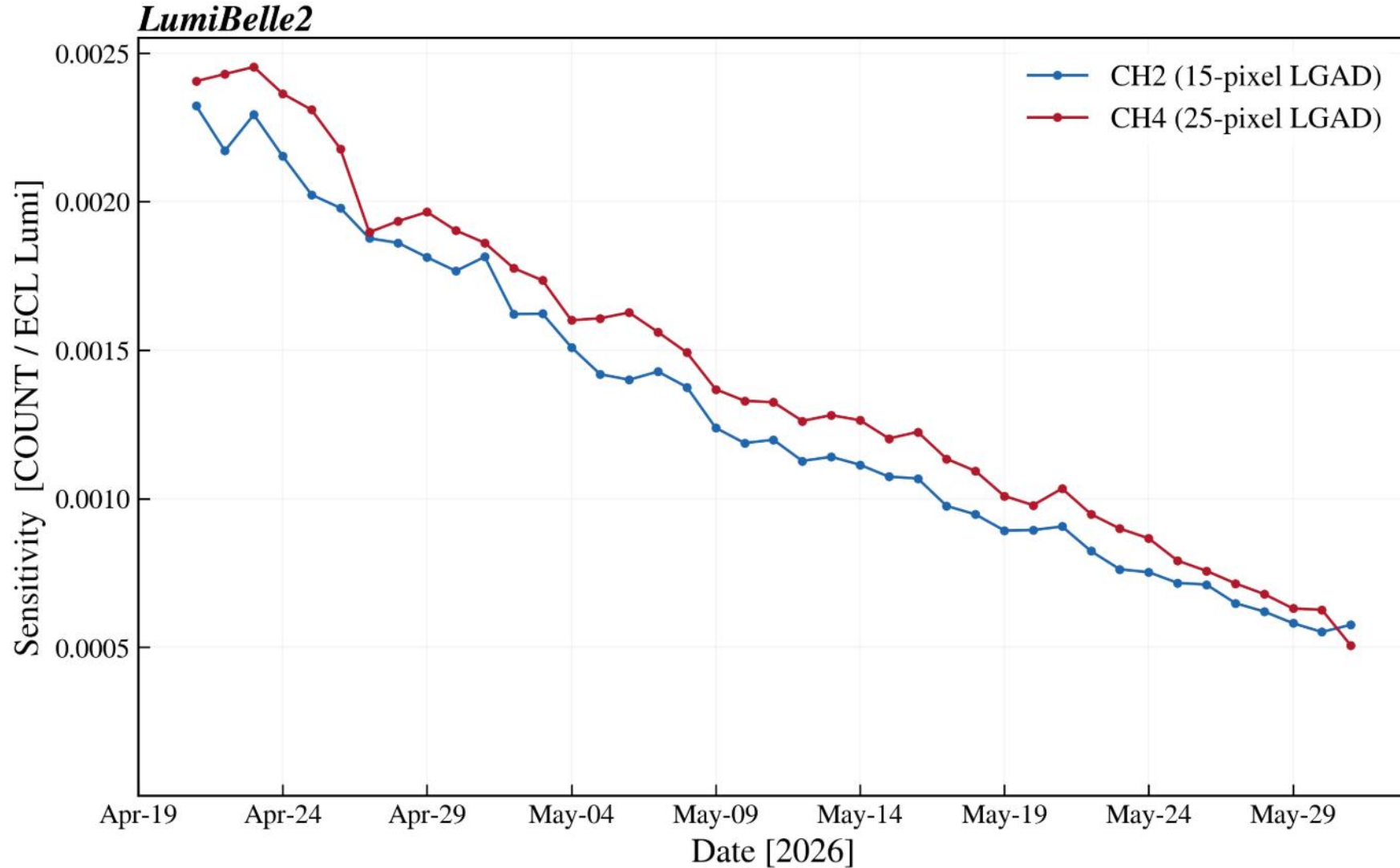
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Sensitivity Time Evolution

since Threshold Adjustment

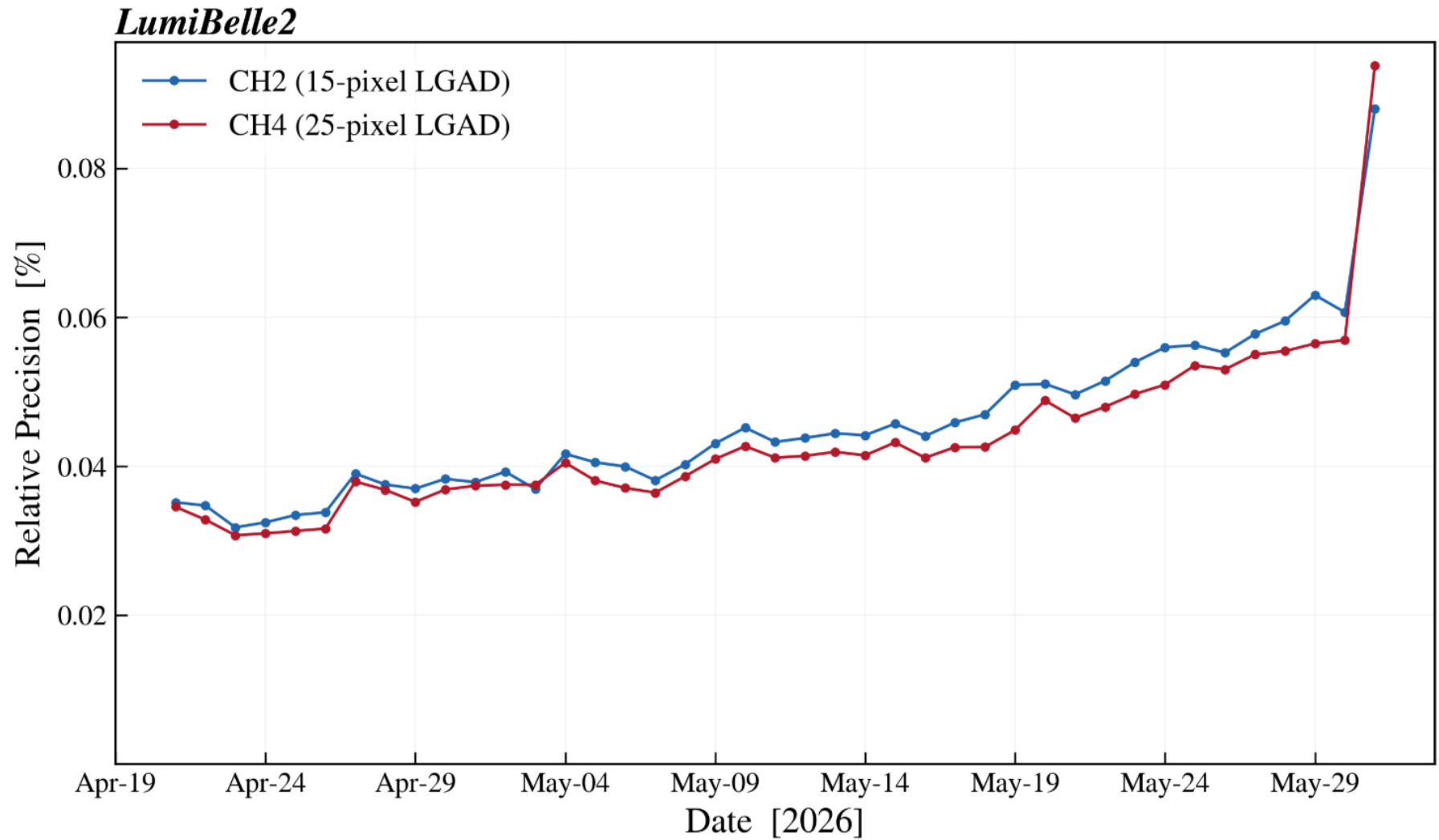
$$\text{Sensitivity} = \frac{\text{mean}(\text{COUNT in 120s})}{\text{mean}(\text{ECL in 120s})}$$



Relative Precision Time Evolution

since Threshold Adjustment

$$\text{Relative Precision in 1s} = \frac{1}{\sqrt{\text{COUNT in 1s}}}$$



Study of Bunch by Bunch Integrated Luminosity

About 2300 bunches circulated in each ring and the time gap between two bunches is ~4ns. LumiBelle2's good time resolution (LGAD ~2ns) makes it possible to measure the BIL @ 1Hz

Analysis Strategy

- Calculate the average bunch-by-bunch (BbB) luminosity for different integration time windows.
- Study the dependence of **RMS(BIL)** on the averaging duration.
- Determine the minimum time window required to reveal the **intrinsic bunch-to-bunch variations**, rather than fluctuations dominated by the LumiBelle2 measurement resolution.
- Estimate the **BIL precision** of LumiBelle2 from the RMS evolution.
- The same analysis can also be applied to

✓ **Specific Luminosity** $\frac{L(t)}{I_{HER}(t) * I_{LER}(t)}$

Bunch Current Product ($I_{HER} * I_{LER}$)

to compare their fluctuation behaviors and understand their contributions to the observed BbB luminosity variations.

Study of BbB Integrated Luminosity

Data Set

➤ **BIL_202605*.root**

Provide bunch by bunch integrated luminosity at 1Hz recorded by LumiBelle2, from May 1st to 31st

➤ **BunchCurrent_202605*.root**

Provide bunch current both HER and LER side, from May 1st to 31st

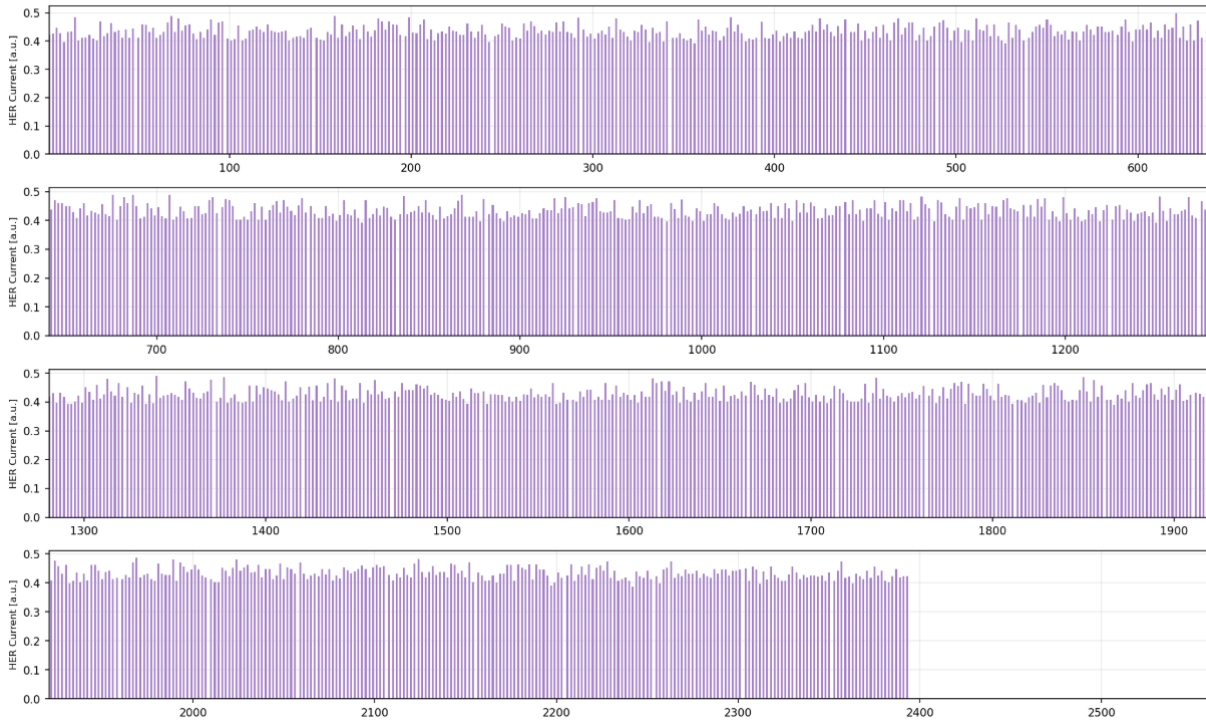
➤ **simple_all_PV_1Hz_2026-05-*.root**

To select stable time periods

Study of BbB Integrated Luminosity

Quick Look at the Data BunchCurrent_202605*.root

HER Current per Bucket (avg. per second)
2026-05-10 13:40:00 JST → 2026-05-10 13:40:10 JST



HER Bunch Current

LER Current per Bucket (avg. per second)
2026-05-10 13:40:00 JST → 2026-05-10 13:40:10 JST

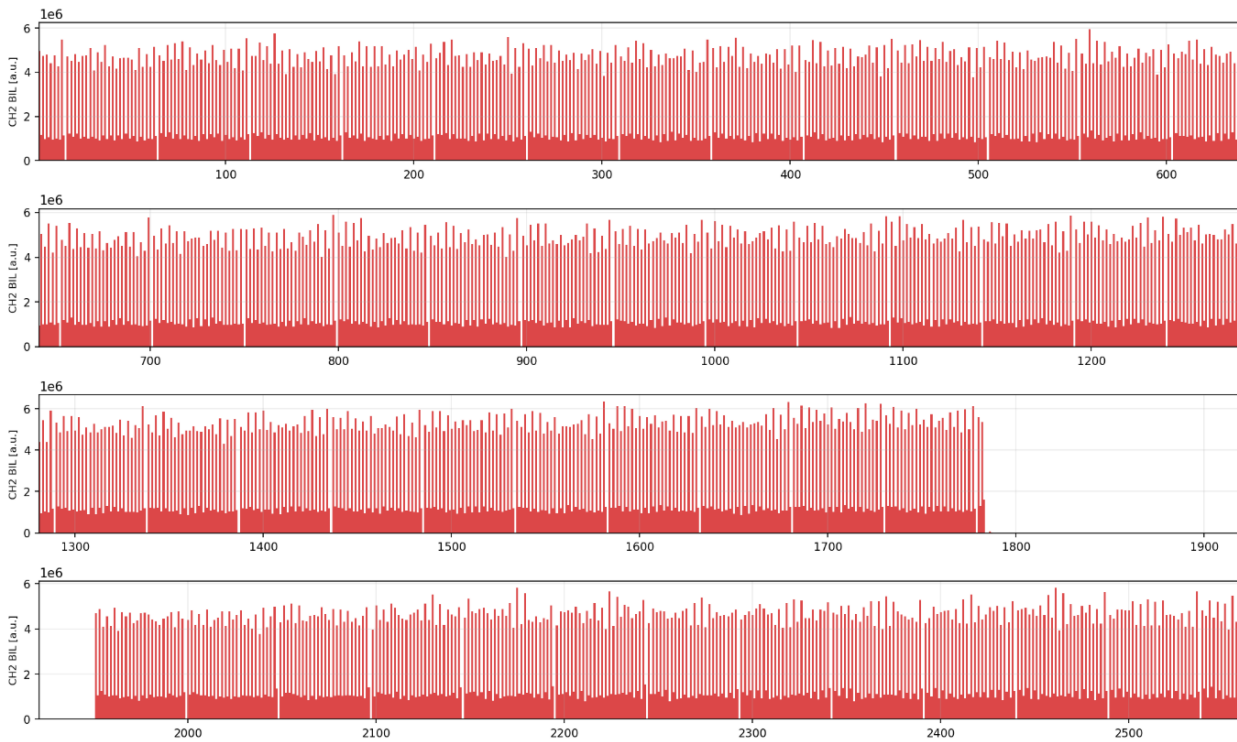


LER Bunch Current

Study of BbB Integrated Luminosity

Quick Look at the Data [BIL_202605*.root](#)

CH2 BIL Integrated per Bucket
2026-05-10 13:40:00 JST → 2026-05-10 13:41:40 JST [stable_periods_100s.csv]



(CH2) 15 pixel LGAD

CH4 BIL Integrated per Bucket
2026-05-10 13:40:00 JST → 2026-05-10 13:41:40 JST [stable_periods_100s.csv]



(CH4) 25 pixel LGAD

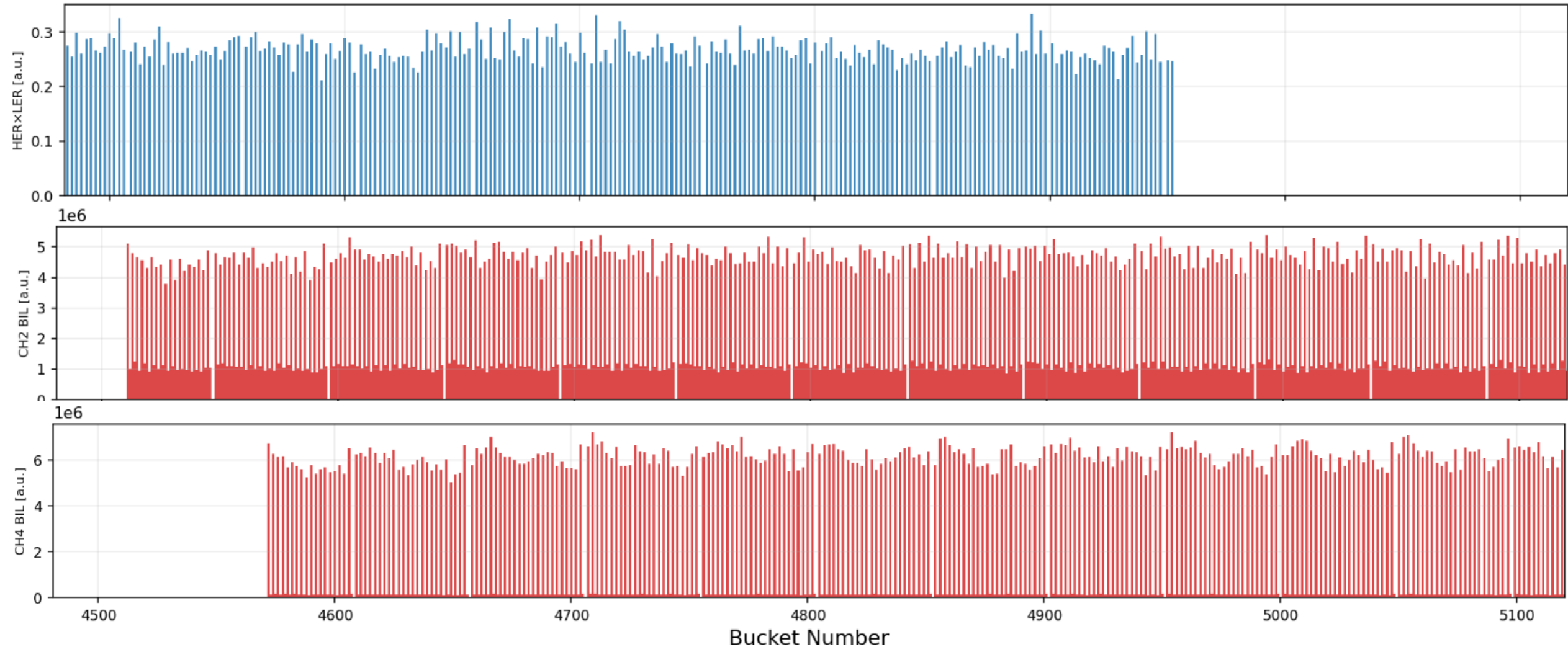
Study of BbB Integrated Luminosity

Preparation before analyzing the Data

➤ Re-define bucket number of BIL Data

$BC[i] \leftarrow CH2[(i + 1950) \% 5120]$

$BC[i] \leftarrow CH4[(i + 2011) \% 5120]$



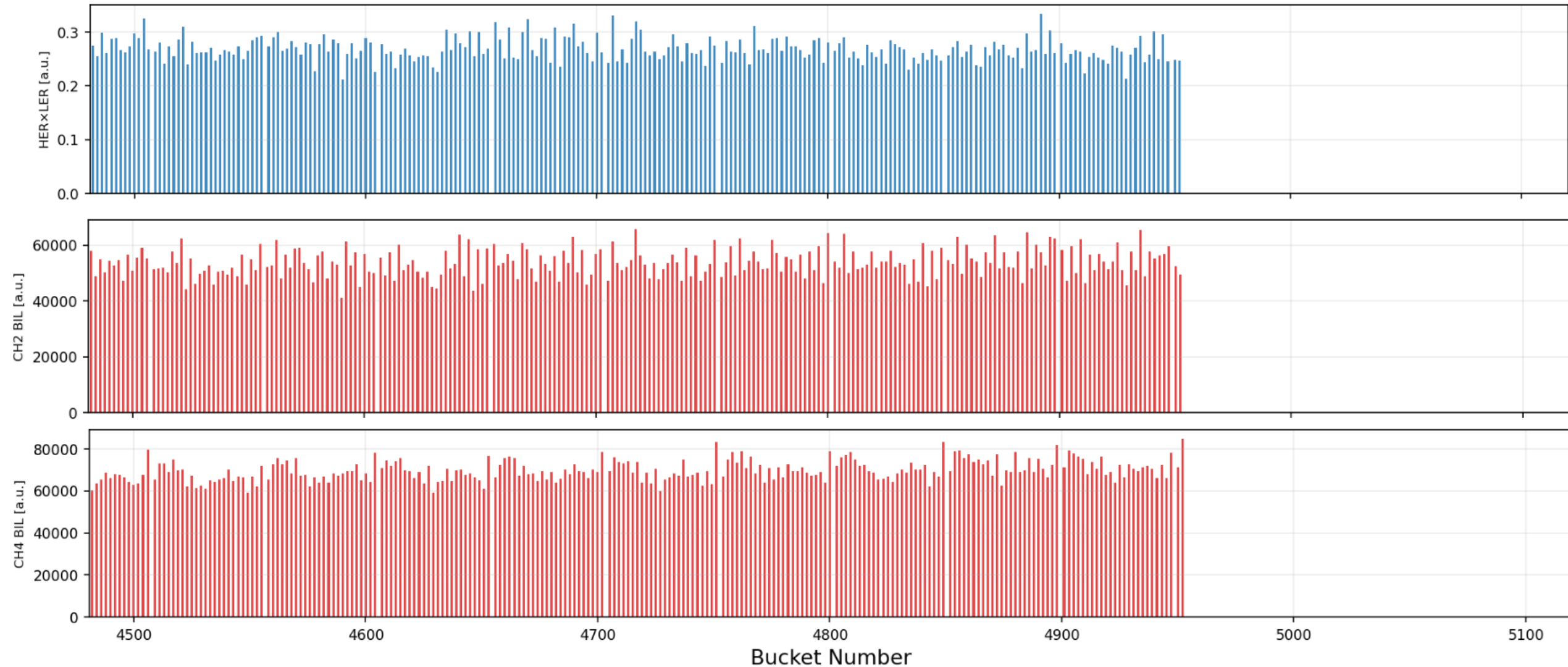
Study of BbB Integrated Luminosity

Preparation before analyzing the Data

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Study of BbB Integrated Luminosity

Study the RMS with Respect to Averaged Time Duration

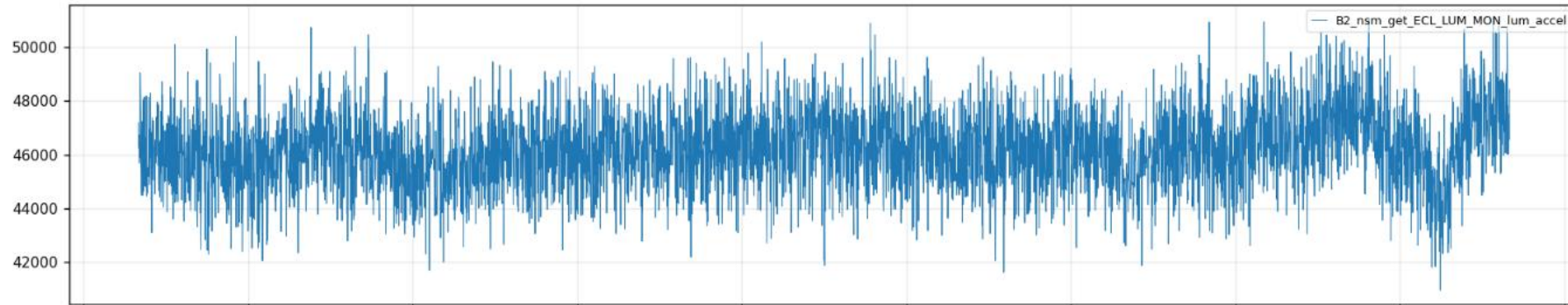
- Select a long time interval (5000s) based on Anass's criteria
- Slice this interval into different tiny time intervals like 5s, 10s, ..., 1000s
- Calculate the averaged BIL or BbB specific Luminosity per tiny time interval
- Fit to the distribution of RMS of BIL or BbB specific Luminosity and show the evolution of RMS with respect to the averaged time durations.

Study of BbB Integrated Luminosity

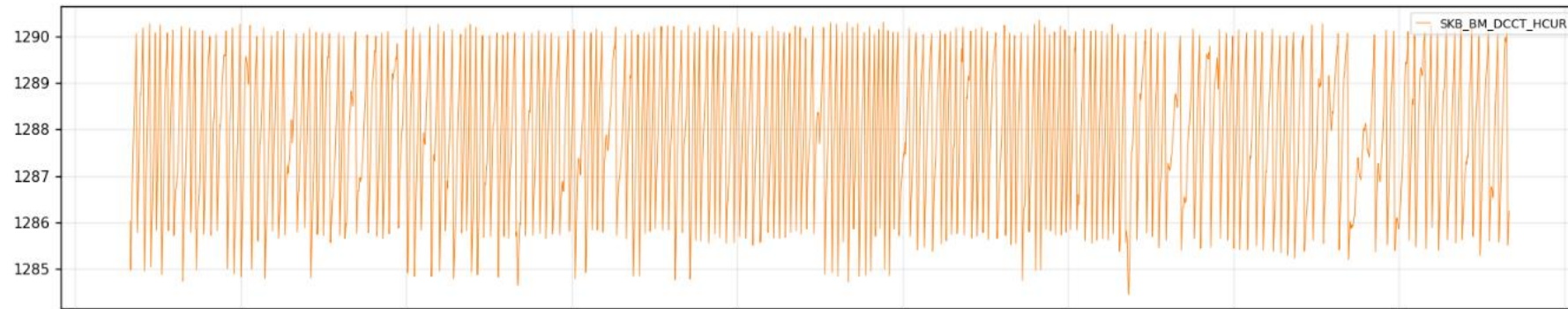
Selection of stable time interval

5000s begin with 2026-05-06 02:23:20

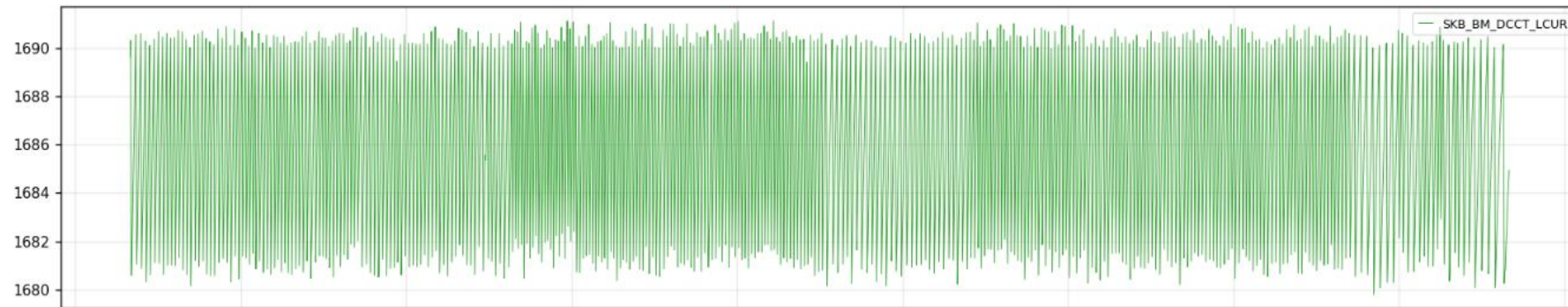
ECL Lumi



I_HER

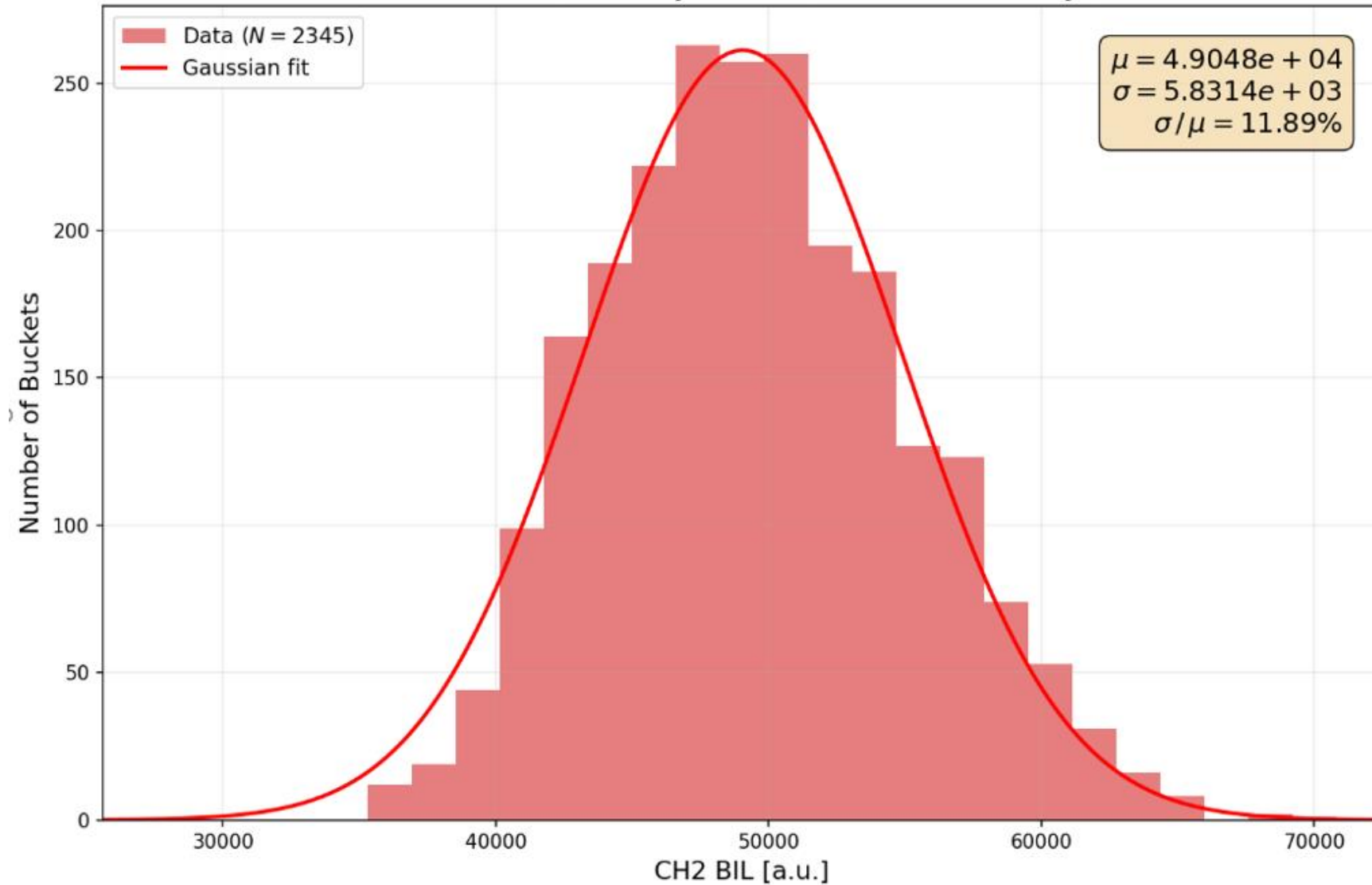


I_LER

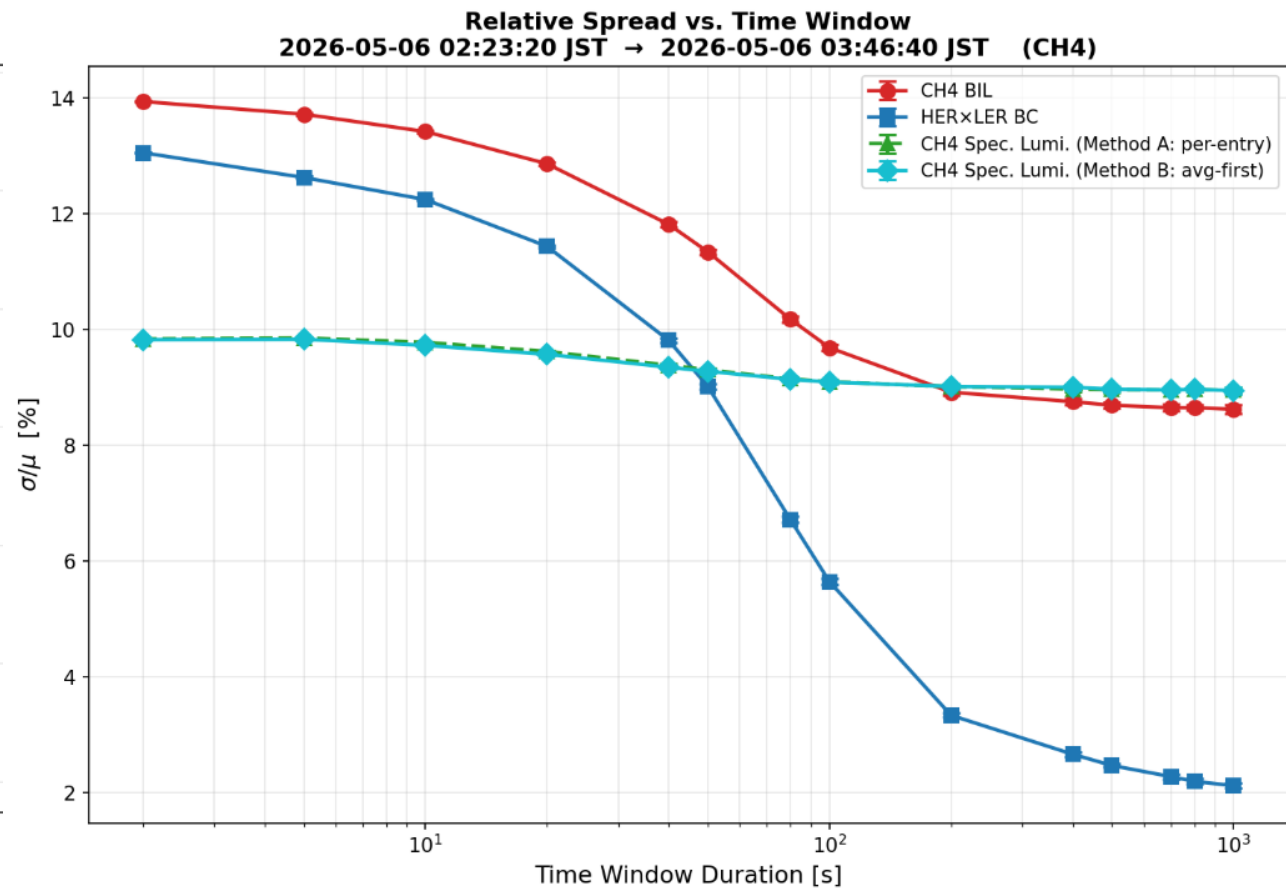
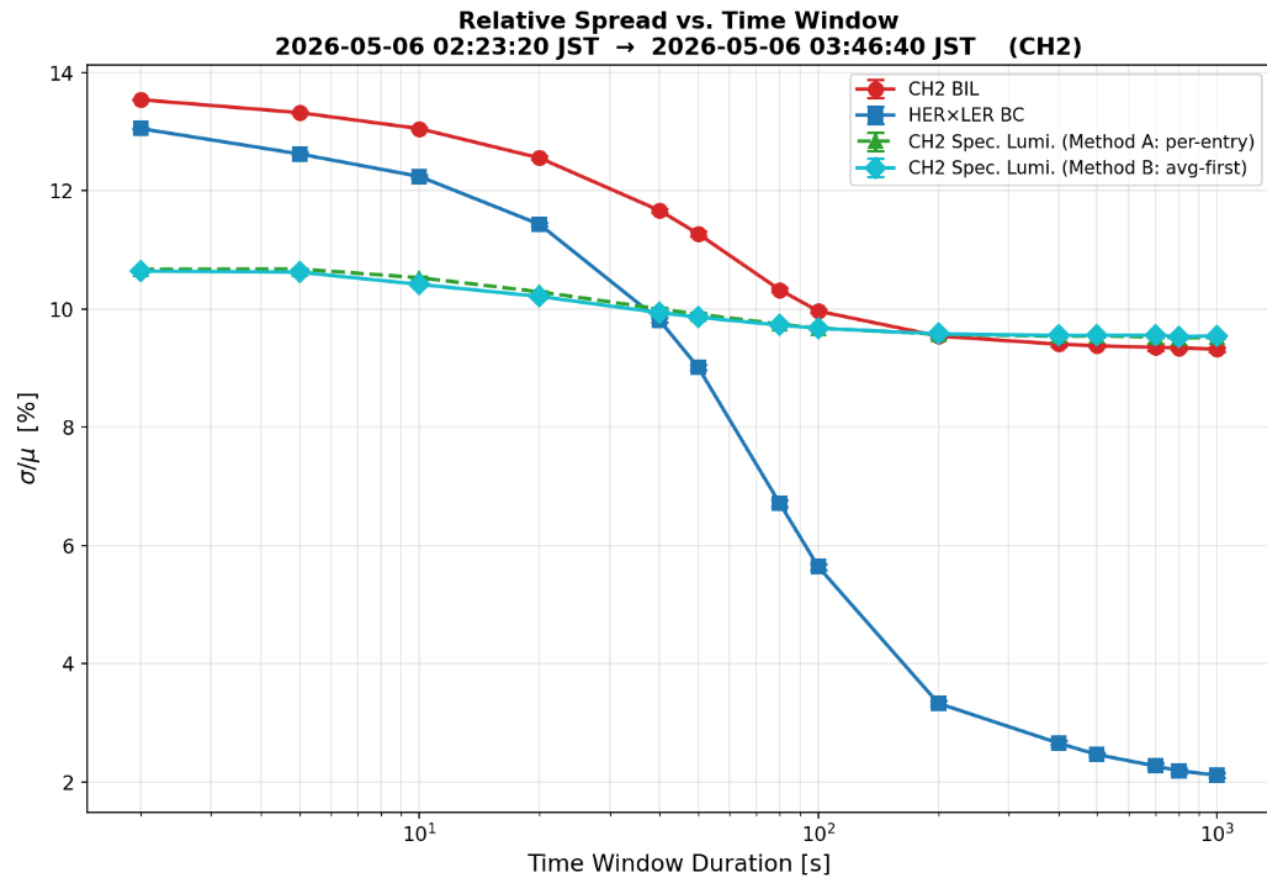


Study of BbB Integrated Luminosity

Fit to the BIL distribution: An example



Study of BbB Integrated Luminosity

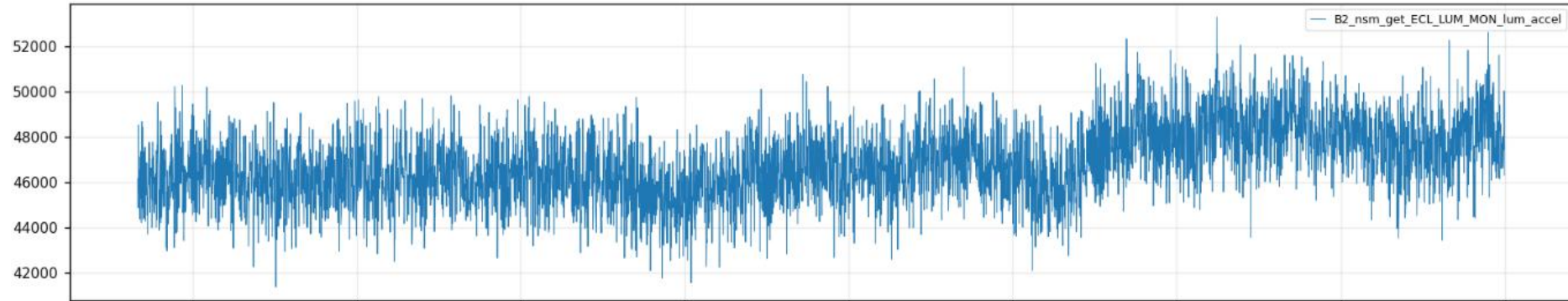


Study of BbB Integrated Luminosity

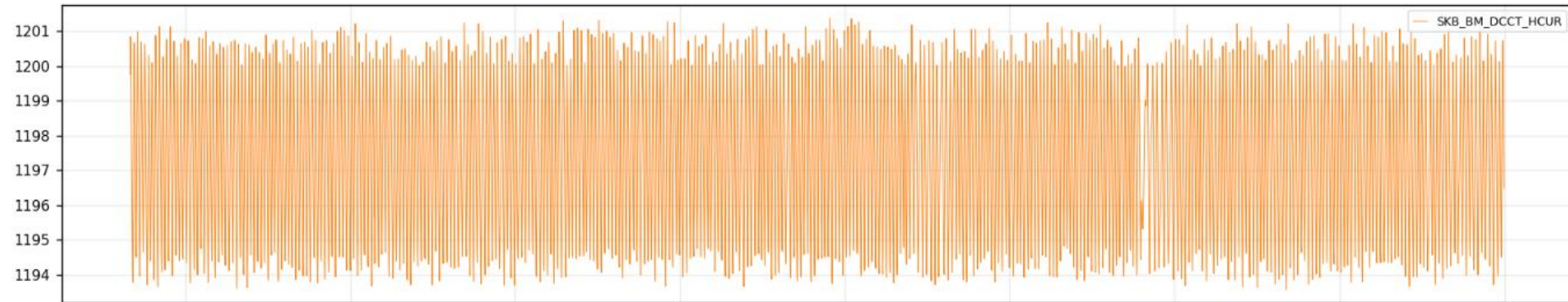
Selection of stable time interval

5000s begin with 2026-05-26 10:16:40 JST

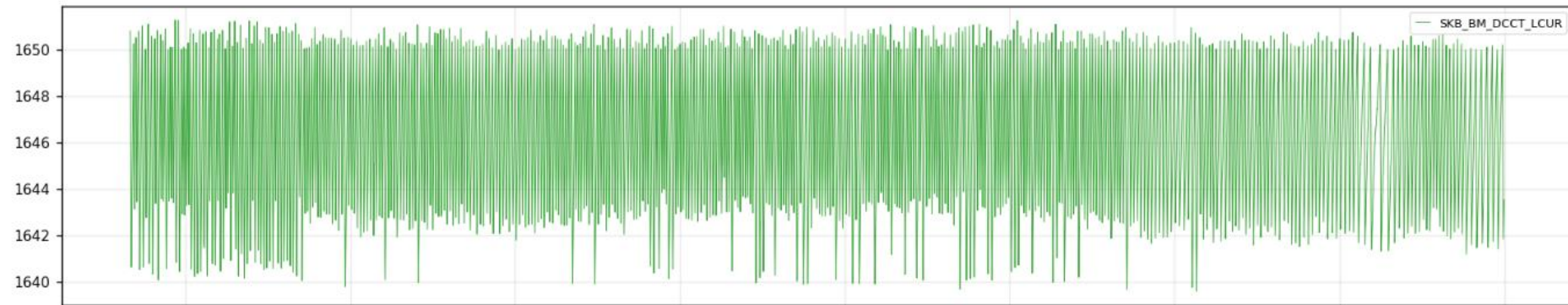
ECL Lumi



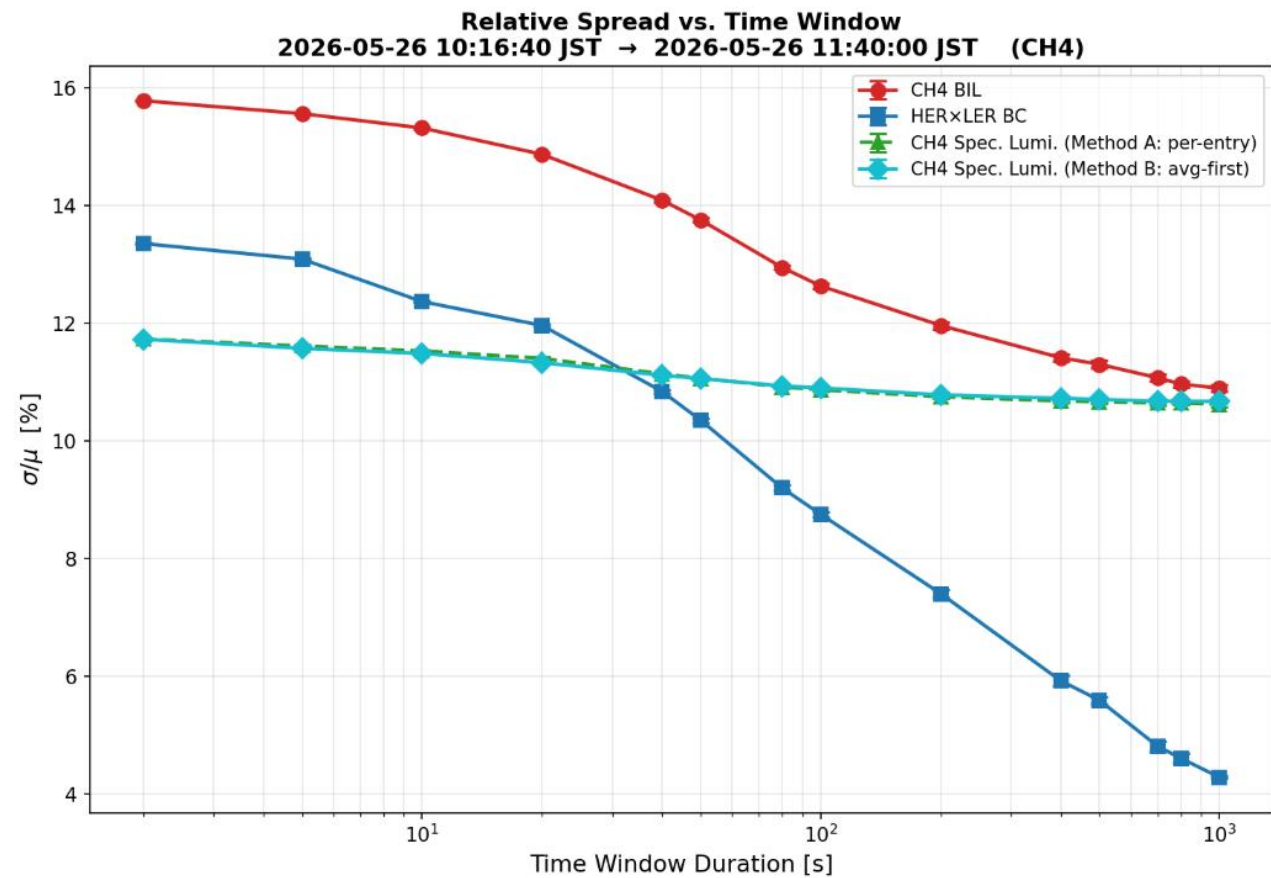
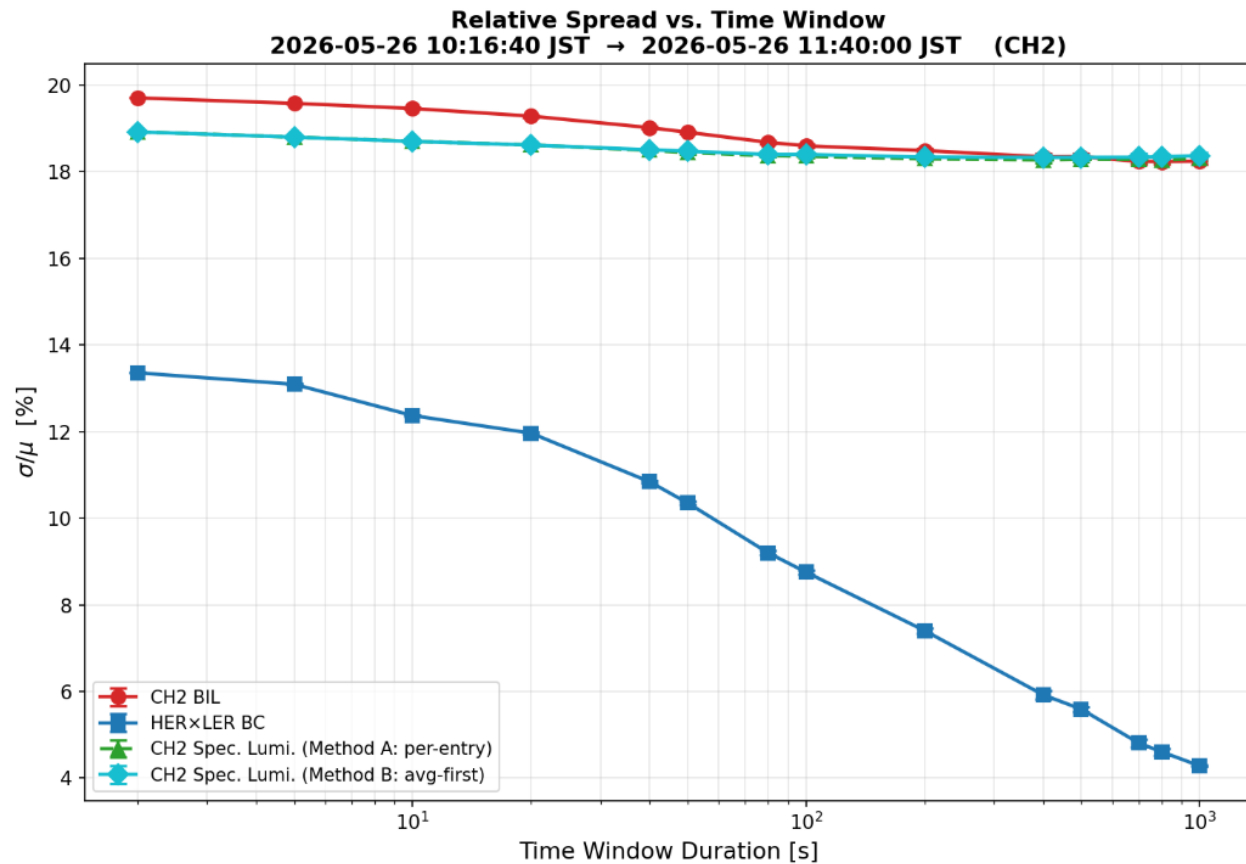
I_HER



I_LER



Study of BbB Integrated Luminosity

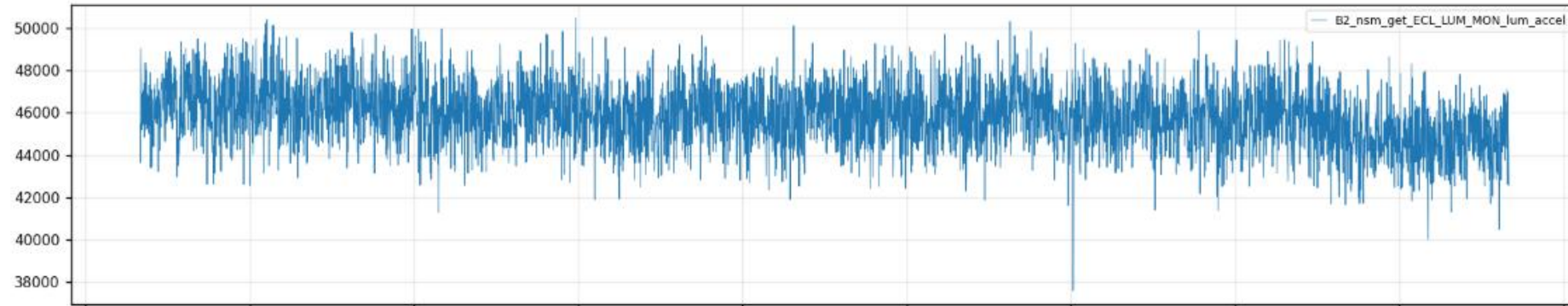


Study of BbB Integrated Luminosity

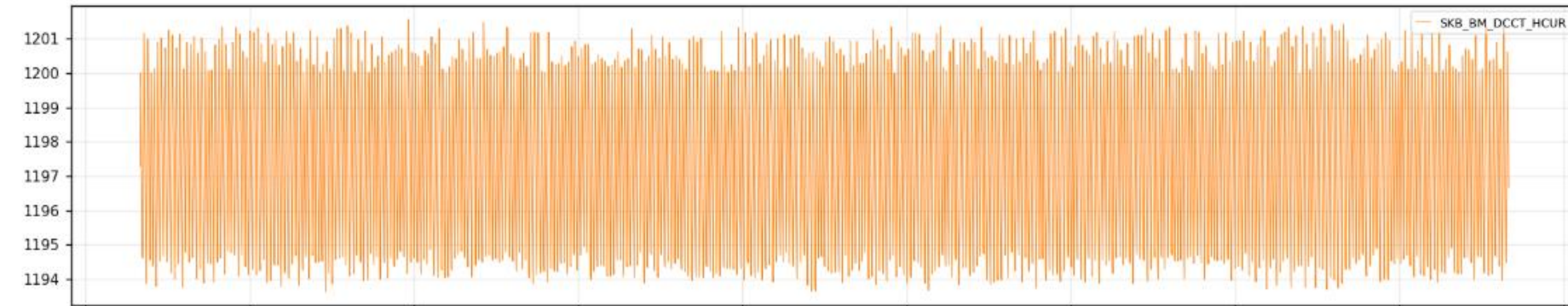
Selection of stable time interval

5000s begin with 2026-05-28 15:33:20 JST

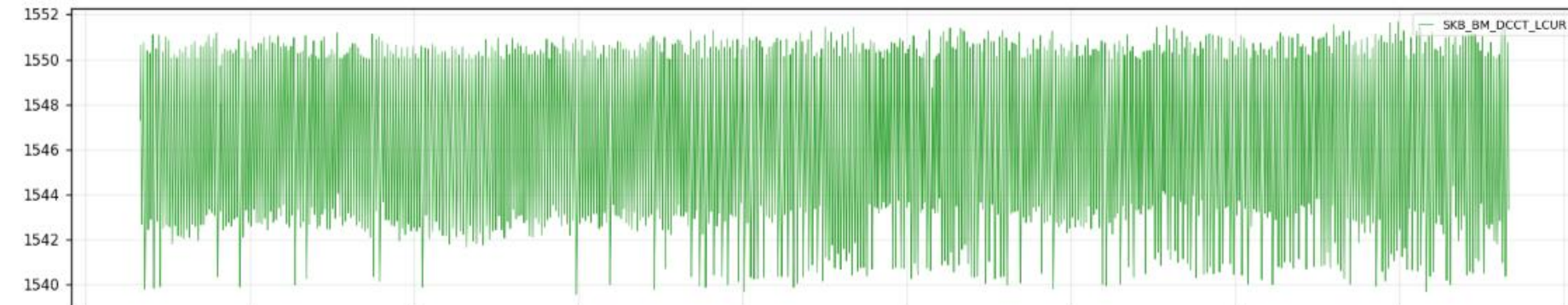
ECL Lumi



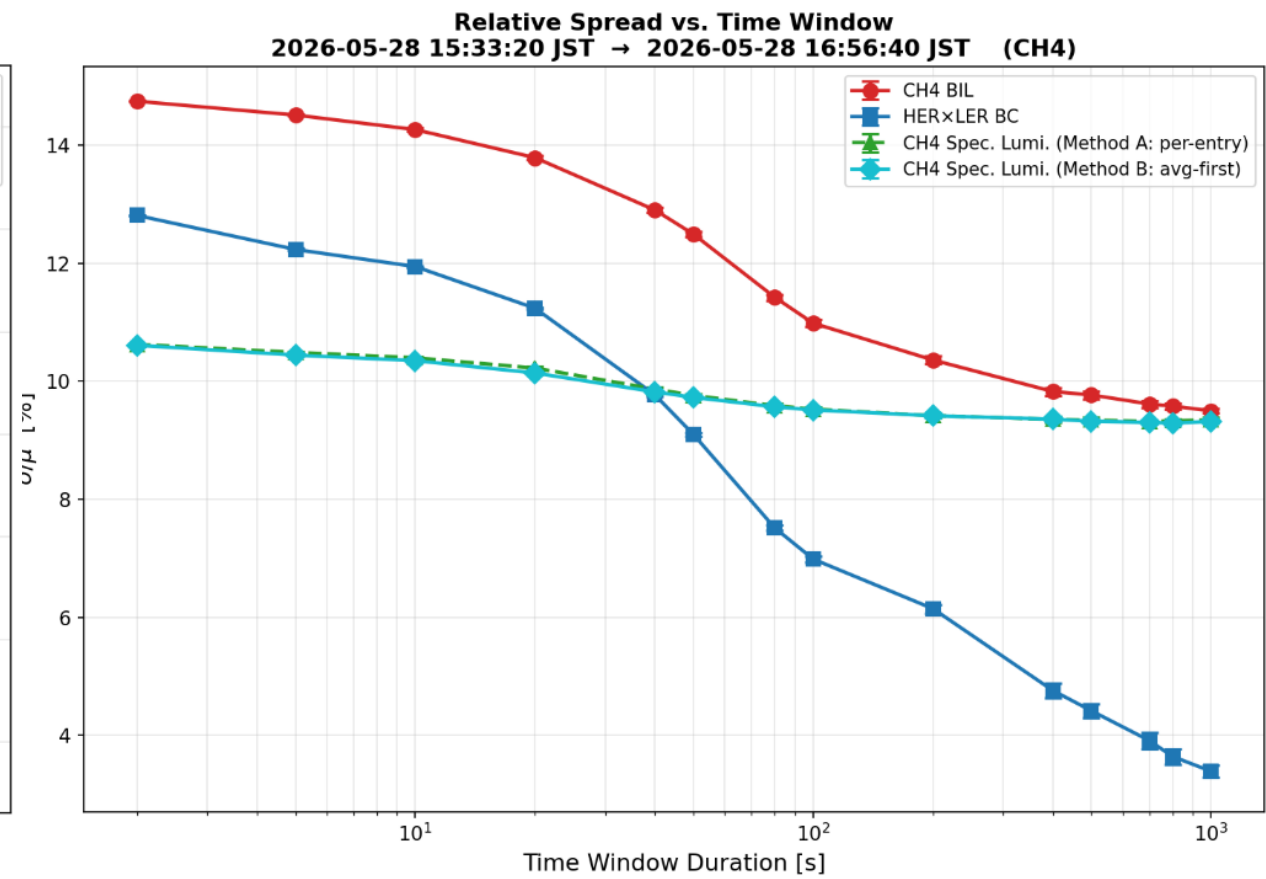
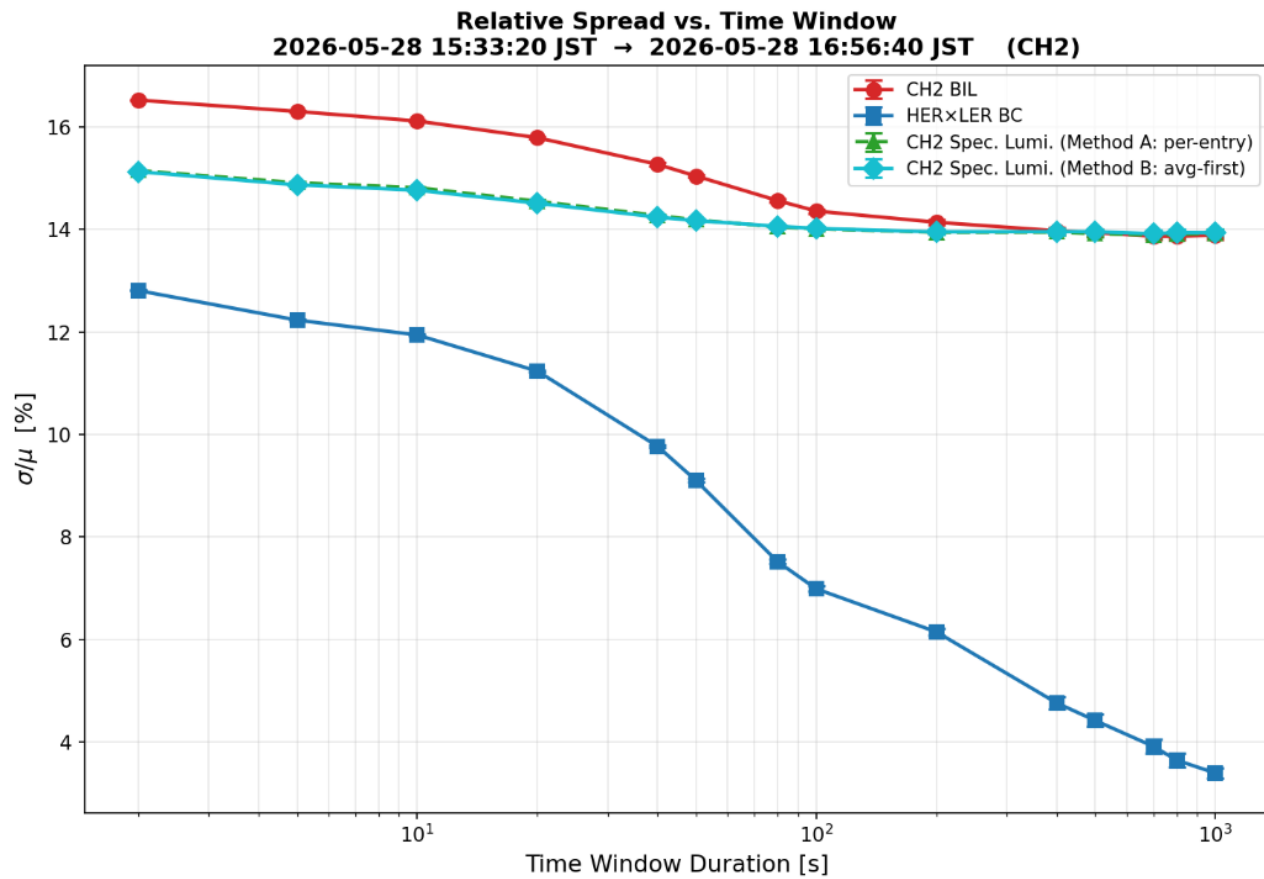
I_HER



I_LER



Study of BbB Integrated Luminosity



Summary

- **The variations of BIL、 BunchCurrent、 Specific luminosity with respect to the time window duration are studied.**

To-do List

- **The difference between CH2 and CH4 need to be understood.**
- **Try to determine the BIL precision of LumiBelle2.**