Beam Test December 2025
SoM-CAM vs LogCAM interlocks

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SoM-CAM meeting

PSI, March 3rd, 2026

Outlook

Goals of the Strahlentwicklung:

1. Test if SHIFT signal arrives to SoM-CAM
2. Comparison of LogCAM and SoM-CAM beam interlock algorithms.

Limitations:

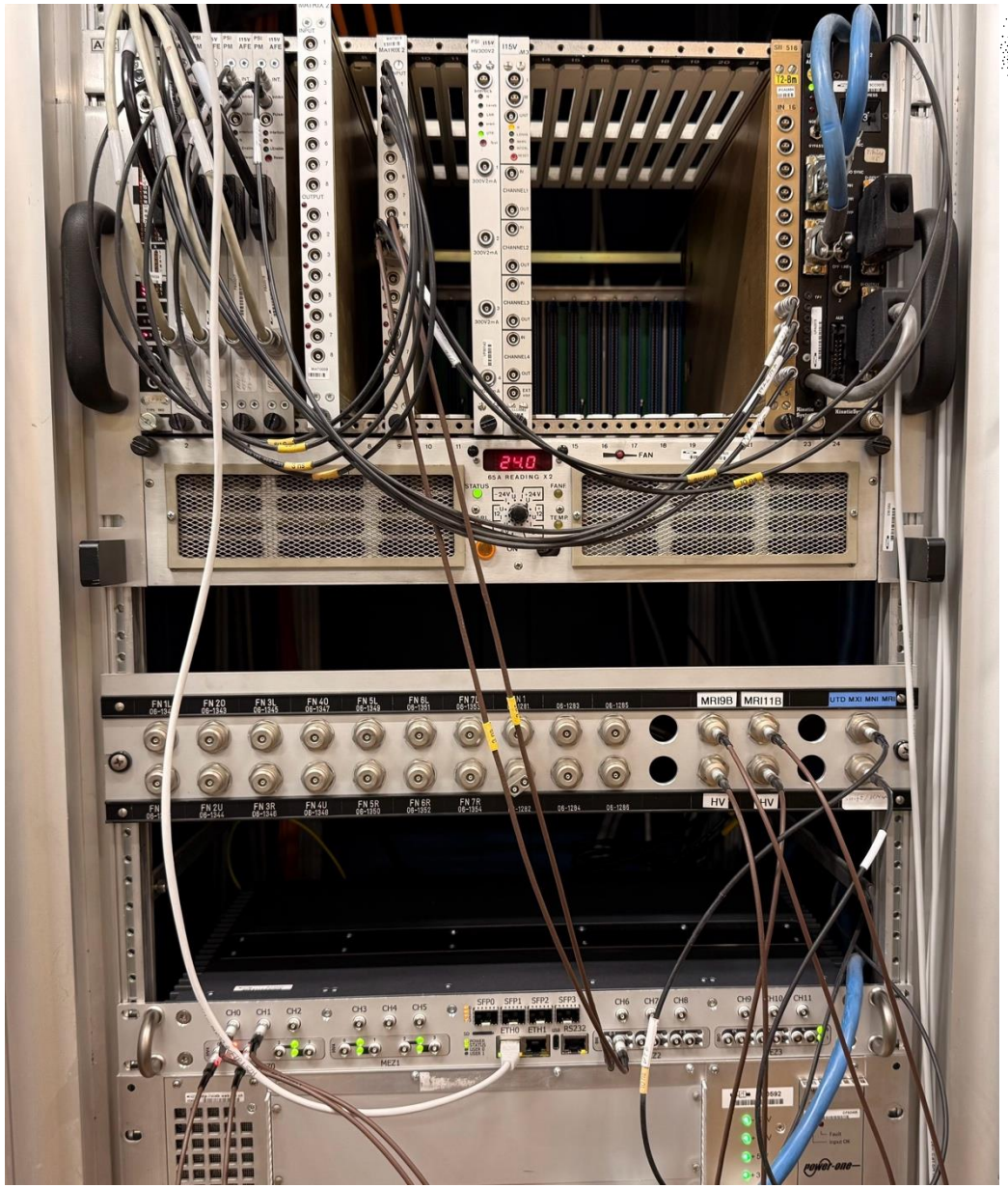
We were given one hour (11h-12h), experiments were ongoing so beam current 2200 μA, they asked NOT to generate too many interlocks, especially no interlocks during UCN kicks.

Sequence

1. Perform scans with MNP13 scanner, which generates SHIFT signal, observe if this signal arrives to SoM-CAM.
2. Perform MRI9/LogCAM test by lowering the bucket threshold to about 66% of the signal, increasing bucket size to maximum and measuring time to interlock.
3. Do the same exercise for SoM-CAM, also for various bucket sizes, see if the time to interlock is as foreseen.

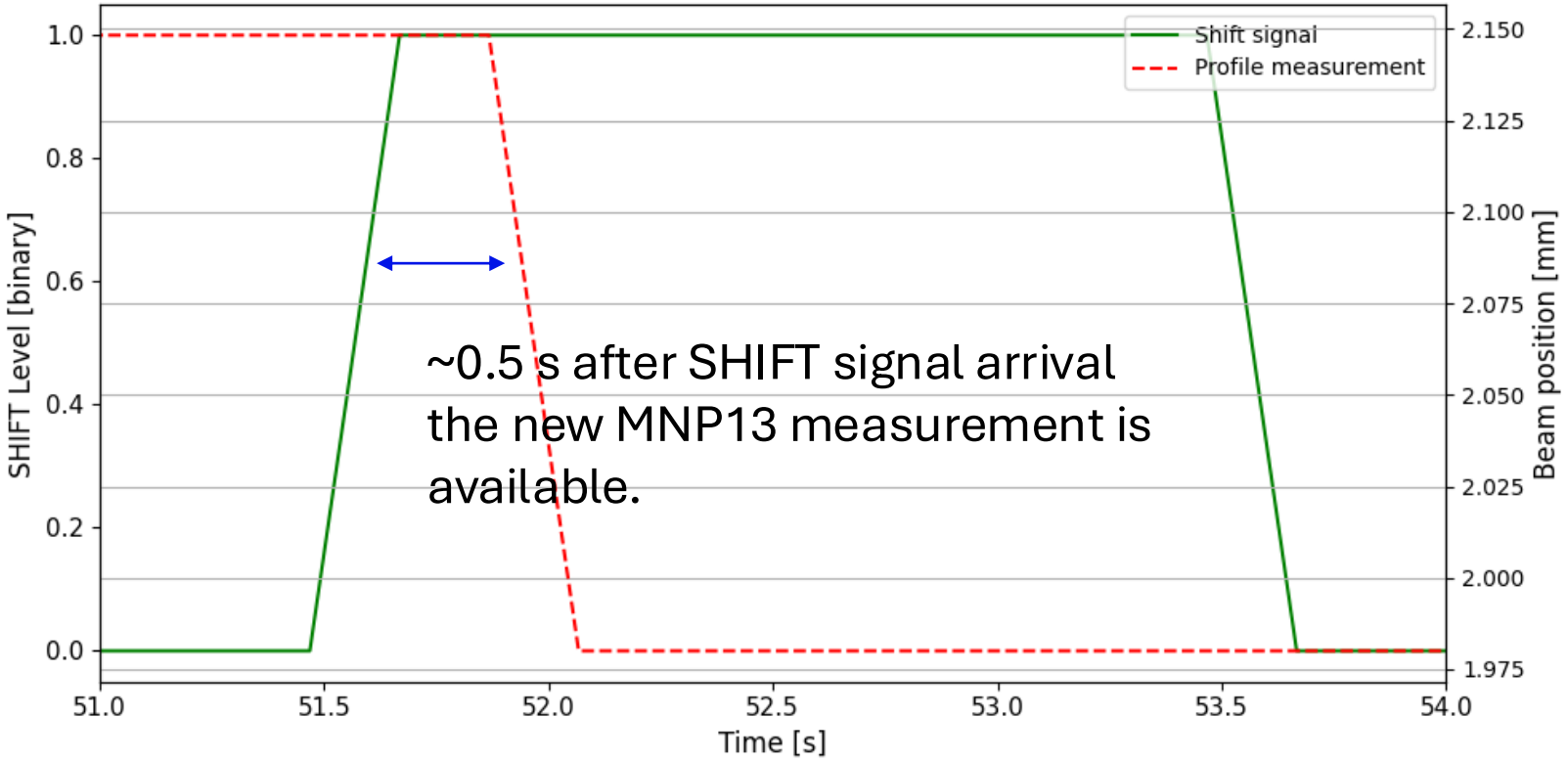
SHIFT signal wiring

Observation: disconnecting the SHIFT cables (in order to install T-) did not provoke interlock.



SHIFT signal capture

Dec 19



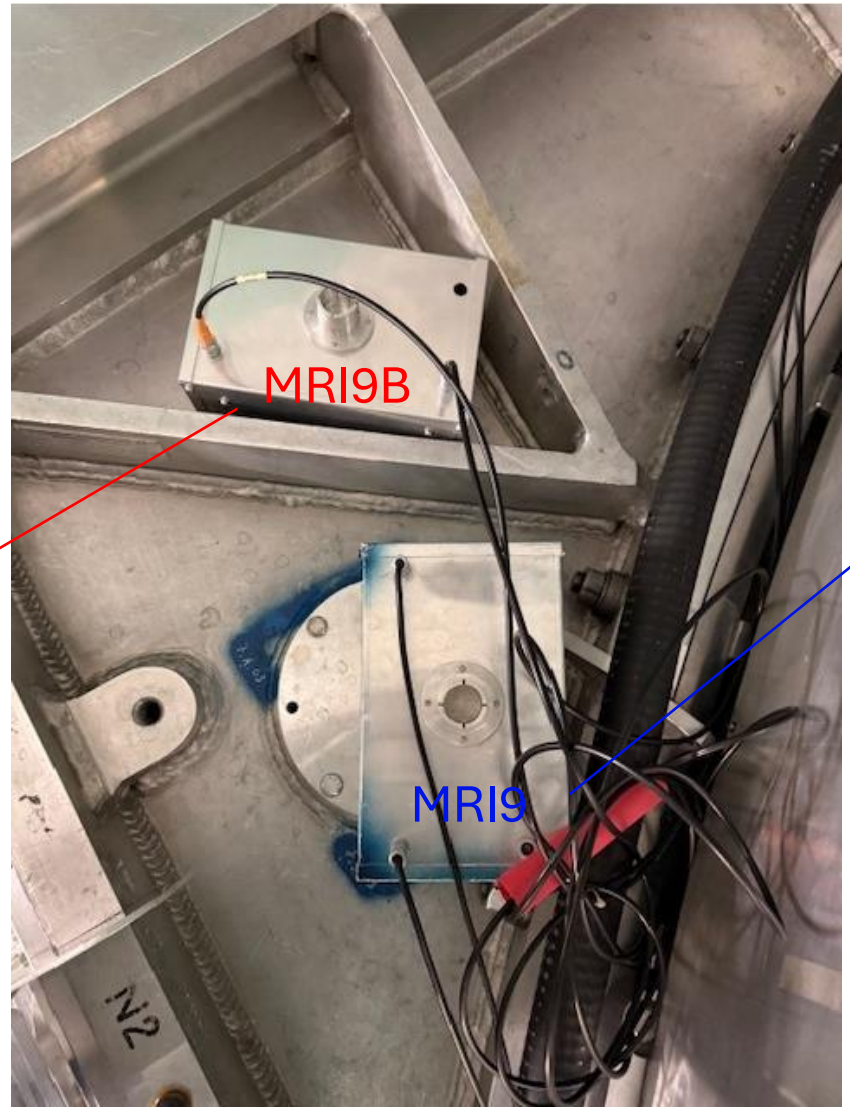
Shift signal: ZTEST-SOMCAM-DI02:ILK-EXTIN-SHIFT-LVL-0

Profile measurement: MNP13:BPOS:2

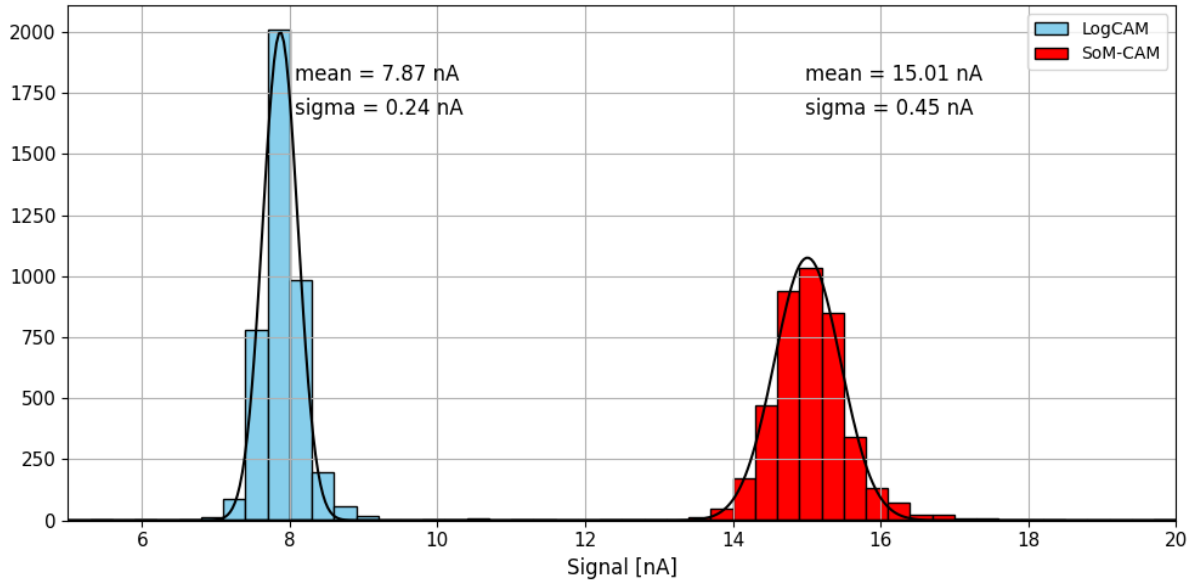
Observation: SHIFT signal is much longer than scan. Why?

Shift signal (TTL) captured correctly by SoM-CAM + BI6 mezzanine

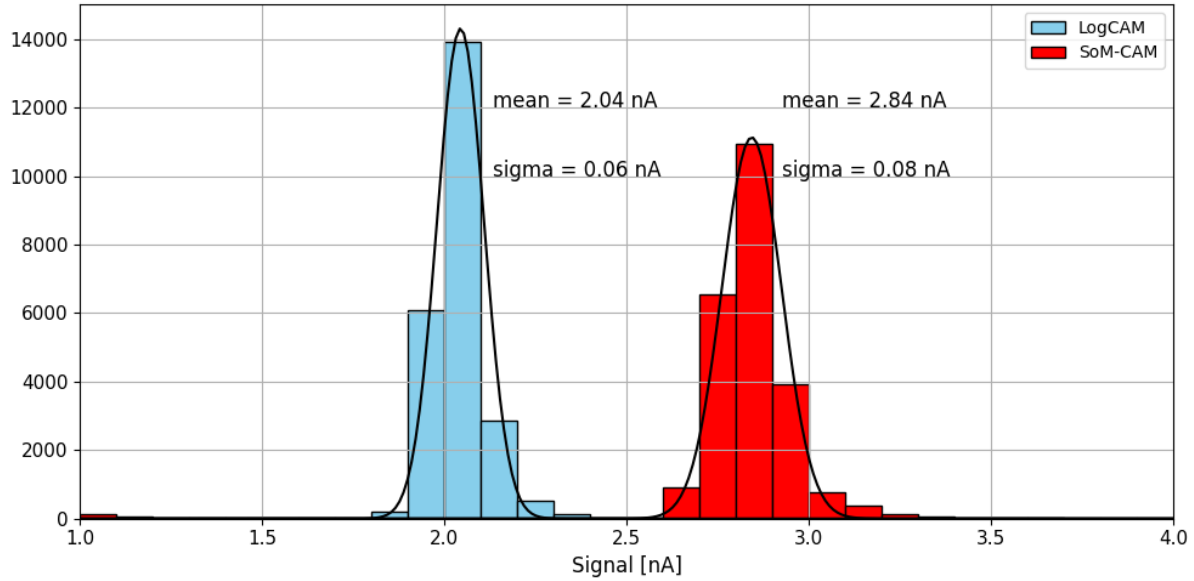
In the Ring bunker on top Surface of Main Ring



MRI9 (LogCAM) and MRI9B (SoM-CAM) signal distributions



Beam 500 µA
Nov 27



Beam 2200 µA
Dec 19

Leaky bucket interlock delay

The idea:
1. Have a stable beam, constant signal from ionization chamber (I_{input}).
2. Setup certain bucket size (AT1 parameter, max 4096).
3. Lower the threshold for the bucket filling (ISLV).
4. Time from this moment to interlock ($t_{trigger}$) can be calculated; we only need to know how frequently the bucket is updated in the firmware (t_{loop})

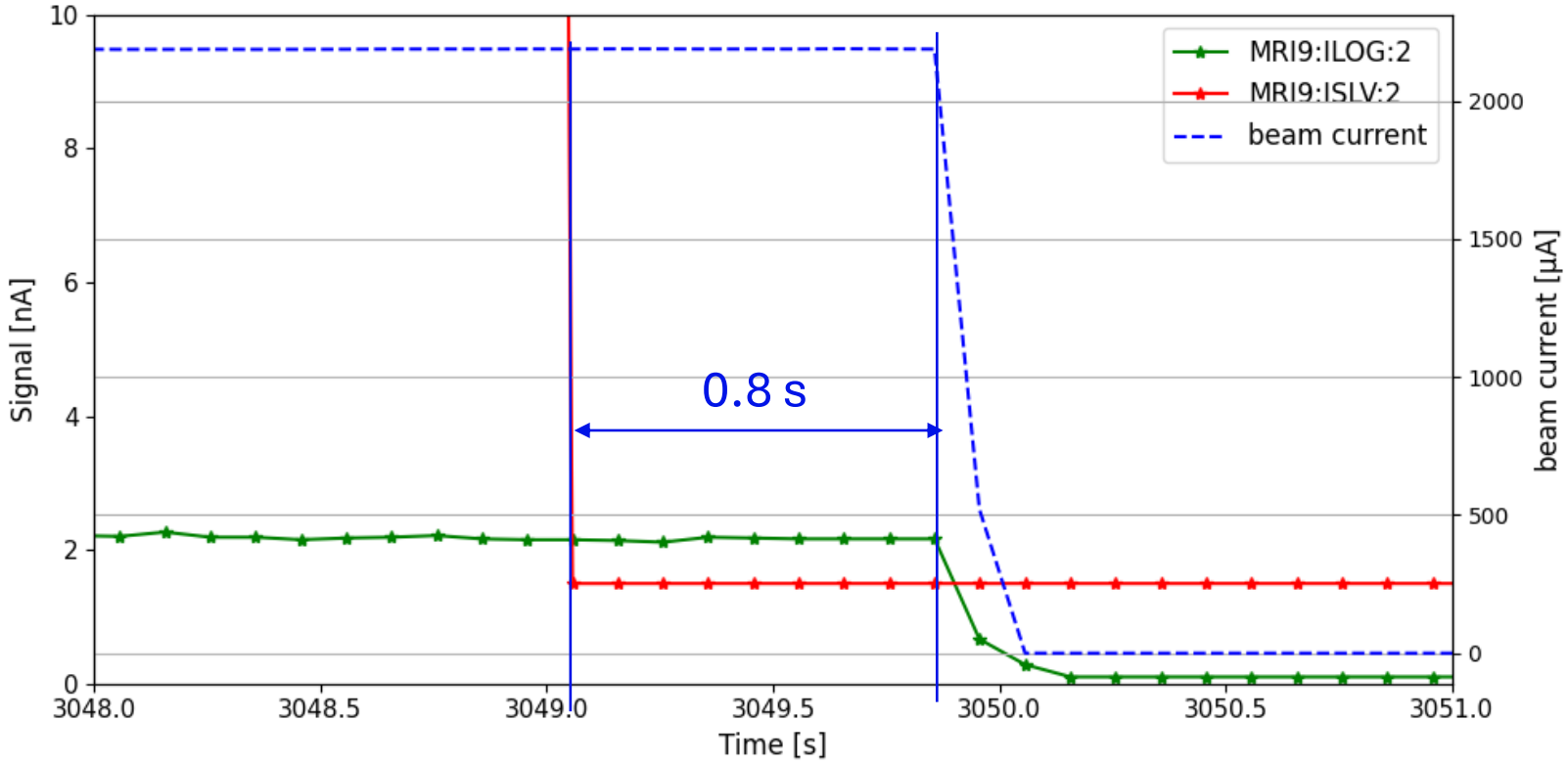
Pierre-Andre formula:

$$t_{trigger,LogCAM} = AT1 * \frac{ISLV}{I_{input}} * t_{loop}$$

Example:
AT1=4096
ISLV=I_{input}/1.3
t_{loop} = 0.2 ms (LogCAM 5kHz)

$t_{trigger,\ LogCAM}$= 4096*0.75*0.2 [ms] = 614 ms

LogCAM leaky bucket, maximum delay



Expected delay ($t_{trigger,LogCAM}$)is: 0.614 s, measured: 0.8 s

Beam 2200 µA

MRI9:ILOG:2 – ionization chamber signal <I_{input}>= 2 nA

MRI9:ISLV:2 – leaky bucket accumulation threshold
– set to: 1.5 nA

MRI8X:AT1:1 – bucket limit – at maximum (4096 units)

Calculate the corresponding bucket size in SoM-CAM

Knowing the time-to-trigger an interlock in LogCAM we can calculate the size of SoM-CAM leaky bucket:

(Pierre-Andre formula II)

$$t_{bucket} = (\frac{I_{input}}{ISLV} - 1) * t_{trigger}$$

General formula for SoM-CAM:

$$t_{trigger,SoM-CAM} = \frac{ISLV}{I_{input} - ISLV} * t_{bucket}$$

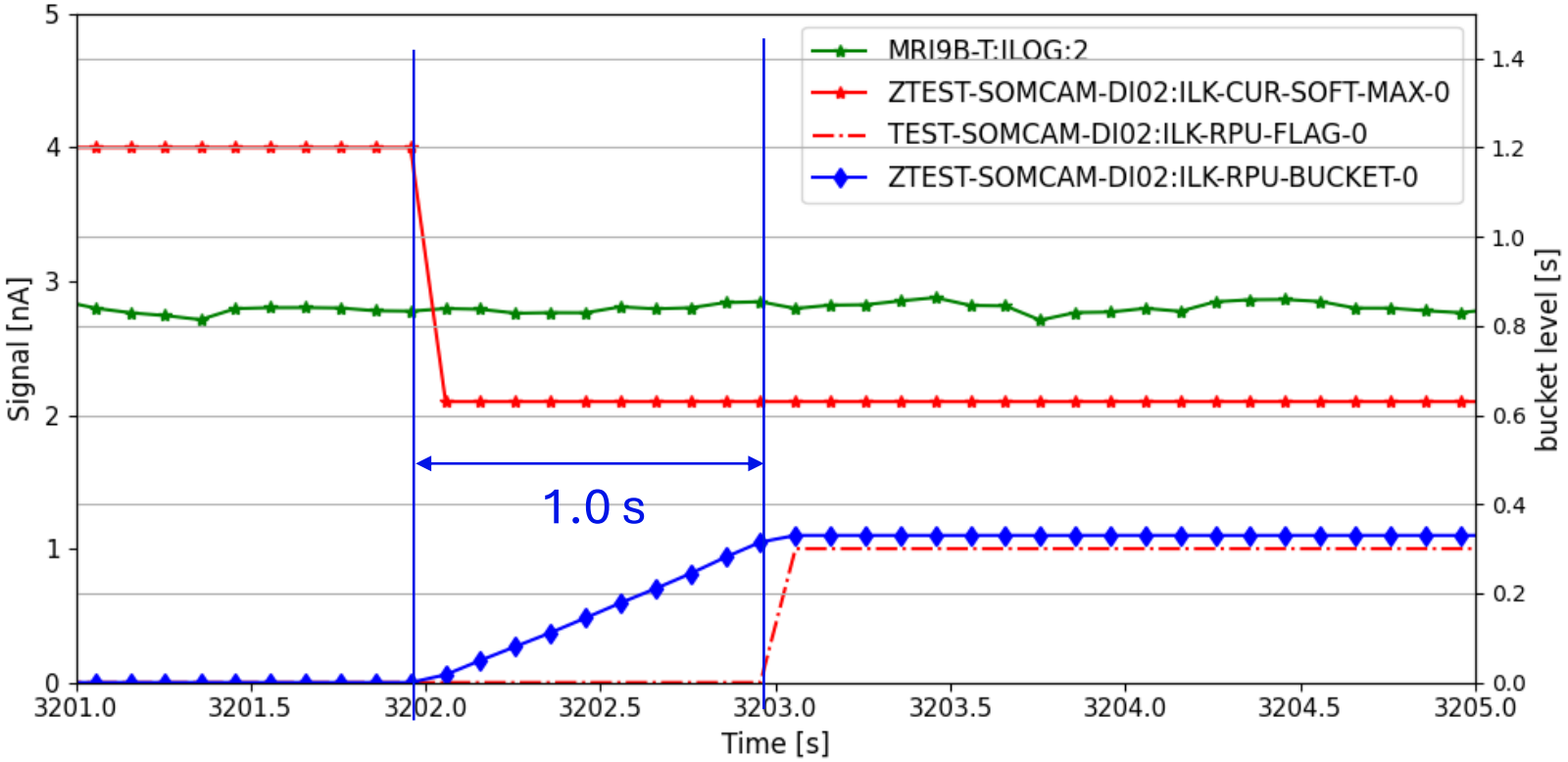
Example:

$I_{input}/ISLV = 1.33$

$t_{trigger} = 1.00$ s

$t_{bucket} = 0.33*1.00$ [s] = 0.33 s

Let’s try the same for SoM-CAM, 1s delay



Expected delay ($t_{trigger,SoM-CAM}$):1 s, measured: 1 s.

Beam 2200 µA

MRI9B-T:ILOG:2
$<I_{input}>$= 2.8 nA

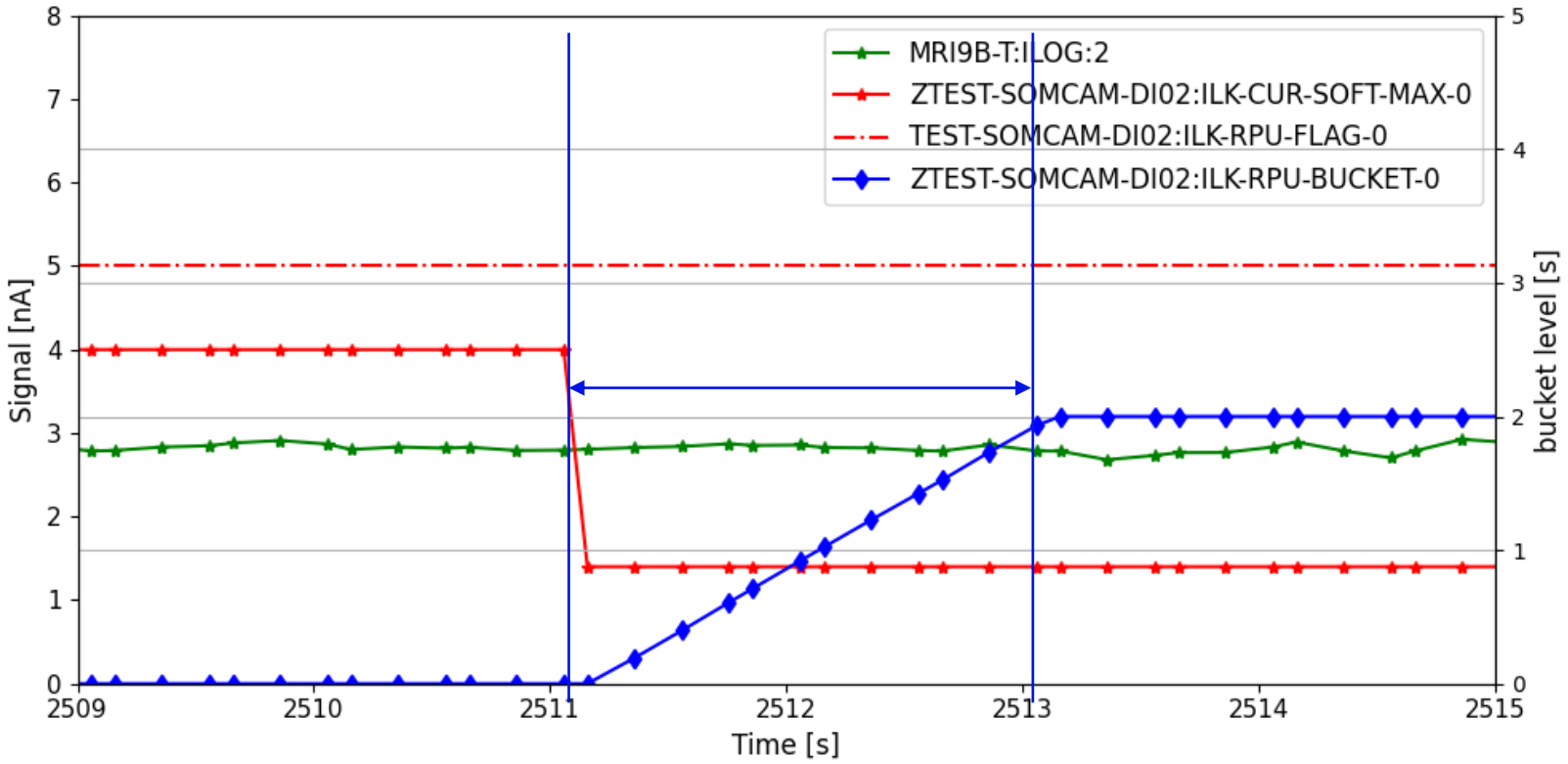
ILK-CUR-SOFT-MAX-0
(ISLV)=2.1 nA

I_{input}/ISLV = 1.333

ZTEST-SOMCAM-DI02:ILK-CPARAM-LIMIT-0 = t_{bucket} = 0.3 s

Delay $t_{trigger,SoM-CAM}$ = 1 s

Other examples for SoM-CAM, 2 s delay



Expected delay ($t_{trigger,SoM-CAM}$):2 s, measured: 2 s.

Beam 2200 µA

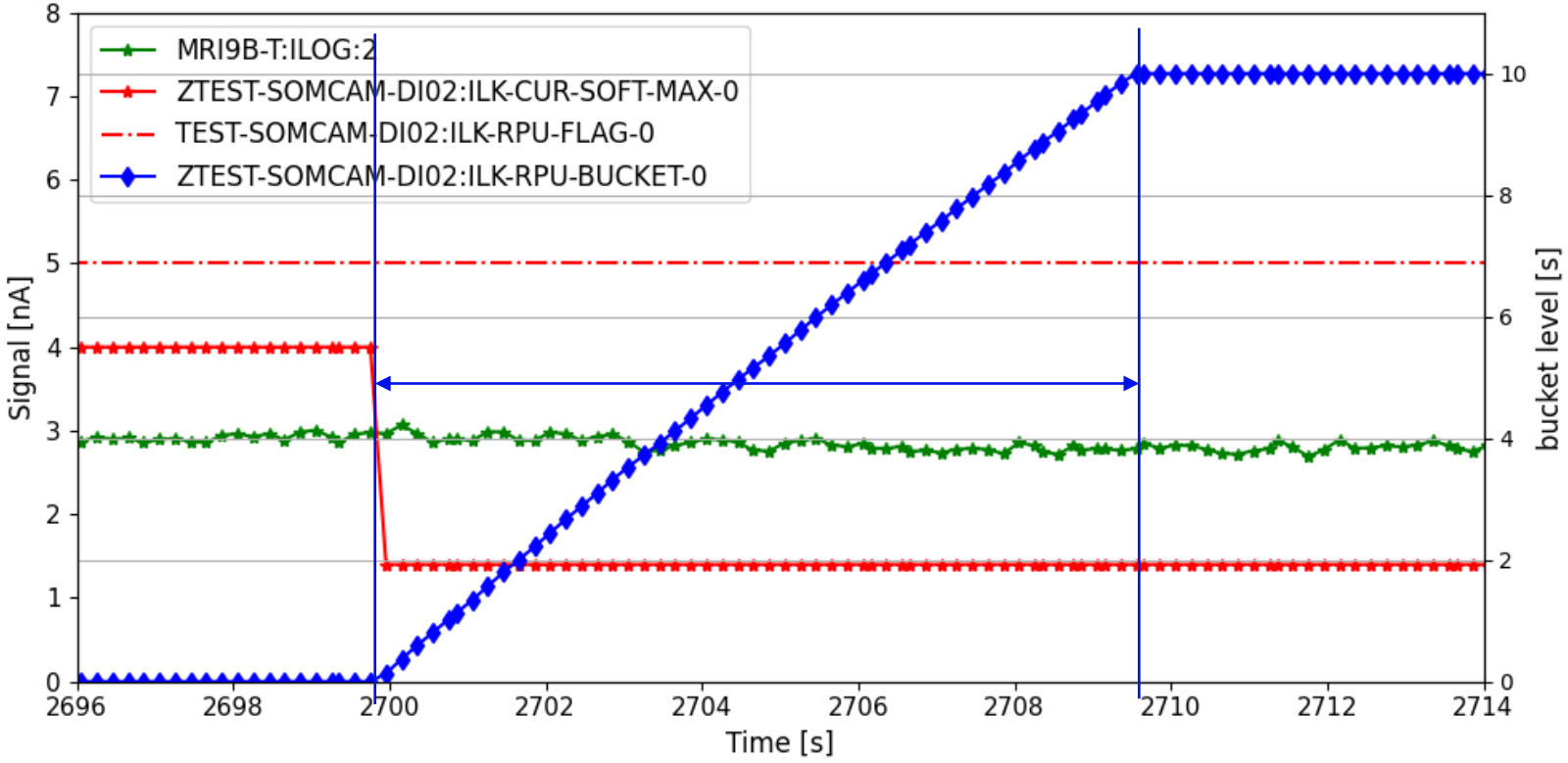
MRI9B-T:ILOG:2
$<I_{input}>$= 2.8 nA

ILK-CUR-SOFT-MAX-0 (ISLV)=1.4 nA

I_{input}/ISLV = 2.0

ZTEST-SOMCAM-DI02:ILK-CPARAM-LIMIT-0 = $t_{trigger}$ = 2.0 s

Other examples for SoM-CAM, 10 s delay



Expected delay ($t_{trigger,SoM-CAM}$):10 s, measured: 10 s.

Beam 2200 µA

MRI9B-T:ILOG:2
$<I_{input}>$ =2.8 nA

ILK-CUR-SOFT-MAX-0
(ISLV)=1.4 nA

I_{input}/ISLV = 2.0

ZTEST-SOMCAM-DI02:ILK-CPARAM-LIMIT-0 = $t_{trigger}$ = 10.0 s

Delay = ~10 s

Conclusions

1. SHIFT signal capture by SoM-CAM works as expected.
2. Leaky bucket interlock algorithm understood on both: LogCAM and SoM-CAM.
   - They work in a very similar ways
   - SoM-CAM allows for much larger accumulation in the bucket than LogCAM – can this be used?
3. Path to deploy SoM-CAM on MRI.G2 cleared.

Spare slides