



Update on DPTS temperature studies

First Results of the source data

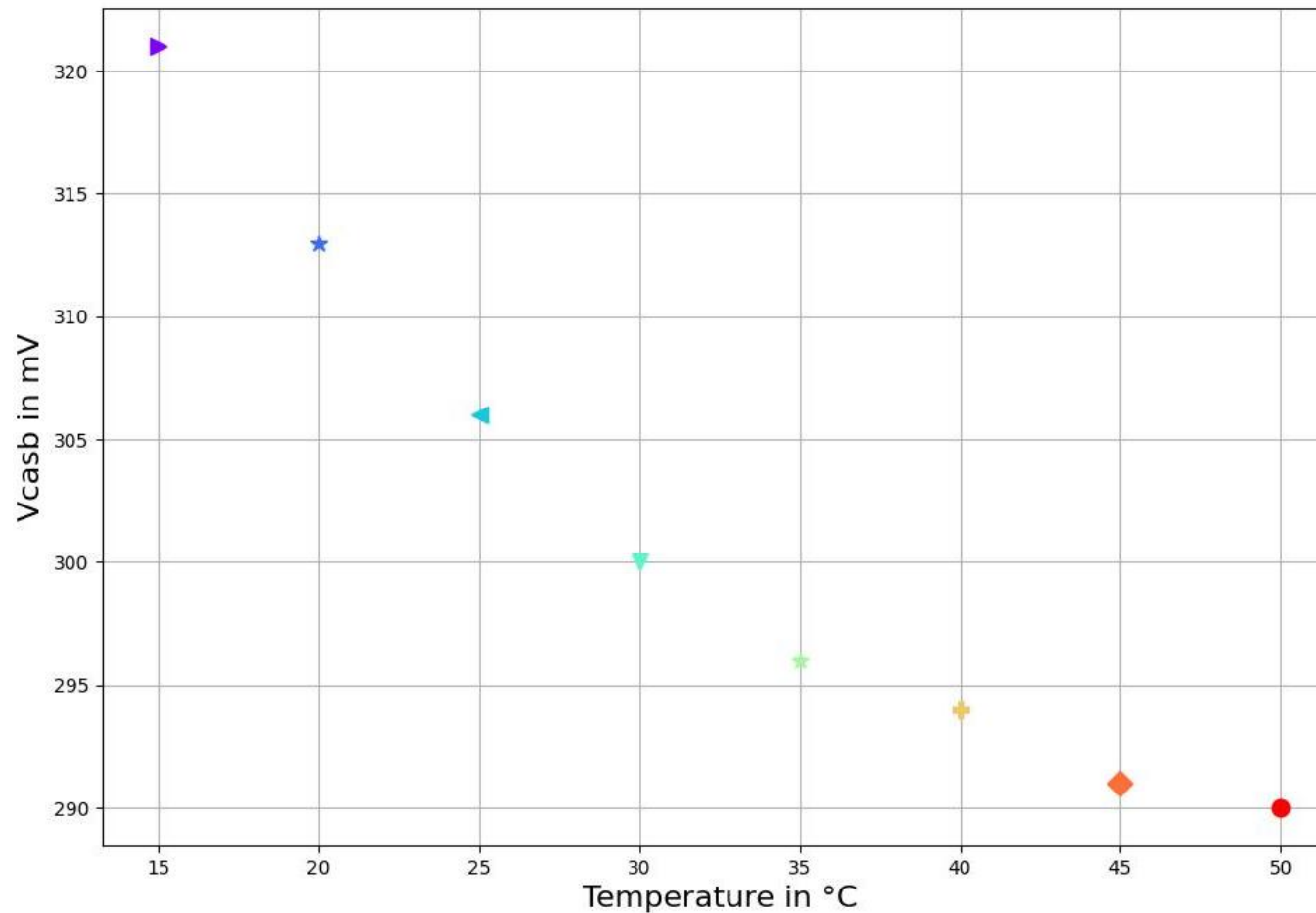
Vcasb vs Temperature for fixed threshold



Vcasb vs temperature for fixed threshold at 110 +/- 1%

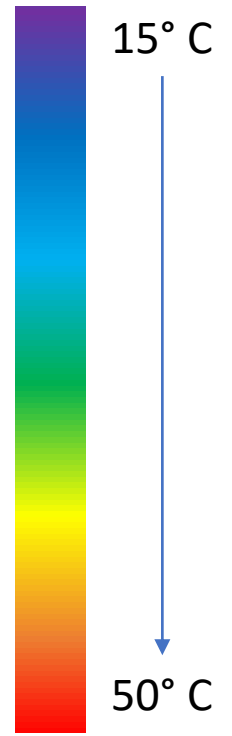
-> Vcasb decreases with increasing temperature

-> Nonlinear towards Min Value



LBNL Setup
DPTSXW22B33
wafer: 22
chip: 33
version: X
split: 4 (opt.)
 $T = 15^\circ\text{C}$
 $I_{reset} = 10\text{ pA}$
 $I_{bias} = 100\text{ nA}$
 $I_{db} = 10\text{ nA}$
 $I_{db} = 100\text{ nA}$
 $V_{casn} = 300\text{ mV}$
 $V_{pwell} = V_{sub} = -1.2\text{ V}$

- Temp. 15.0°C, Thresh. 110.5mV
- Temp. 20.0°C, Thresh. 110.55mV
- Temp. 25.0°C, Thresh. 110.5mV
- Temp. 30.0°C, Thresh. 110.38mV
- Temp. 35.0°C, Thresh. 110.29mV
- Temp. 40.0°C, Thresh. 110.18mV
- Temp. 45.0°C, Thresh. 110.3mV
- Temp. 50.0°C, Thresh. 109.97mV





Mean Threshold

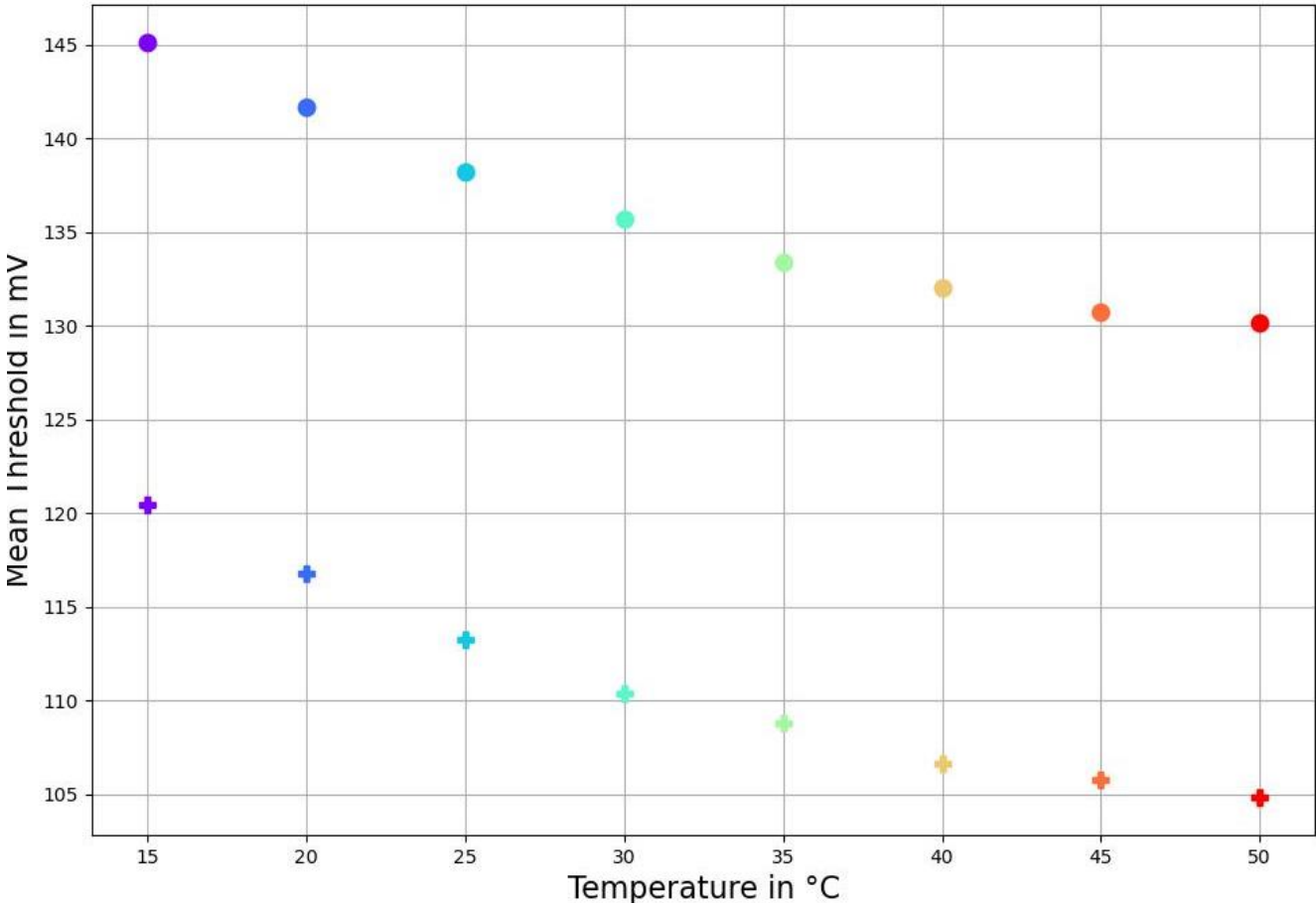
Mean Threshold vs Temperature

-> Mean threshold decreases with increasing temperature

-> Not Linear

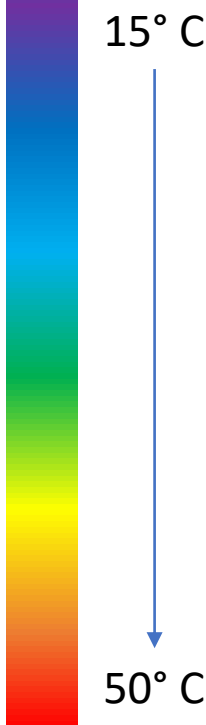
-> Consistent with trend in DPTS paper

Between 15-40°C:
~0.5mV/° in paper
~0.56 mV/° calc.



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 I_{biasn} = 10 nA
 I_{db} = 100 nA
 V_{casn} = 300 mV
 V_{pwell} = V_{sub} = -1.2 V

- Temperature 15.0°C, vcasb 250mV
- ✦ Temperature 15.0°C, vcasb 300mV
- Temperature 20.0°C, vcasb 250mV
- ✦ Temperature 20.0°C, vcasb 300mV
- Temperature 25.0°C, vcasb 250mV
- ✦ Temperature 25.0°C, vcasb 300mV
- Temperature 30.0°C, vcasb 250mV
- ✦ Temperature 30.0°C, vcasb 300mV
- Temperature 35.0°C, vcasb 250mV
- ✦ Temperature 35.0°C, vcasb 300mV
- Temperature 40.0°C, vcasb 250mV
- ✦ Temperature 40.0°C, vcasb 300mV
- Temperature 45.0°C, vcasb 250mV
- ✦ Temperature 45.0°C, vcasb 300mV
- Temperature 50.0°C, vcasb 250mV
- ✦ Temperature 50.0°C, vcasb 300mV



- vcasb 250mV
- ✦ vcasb 300mV

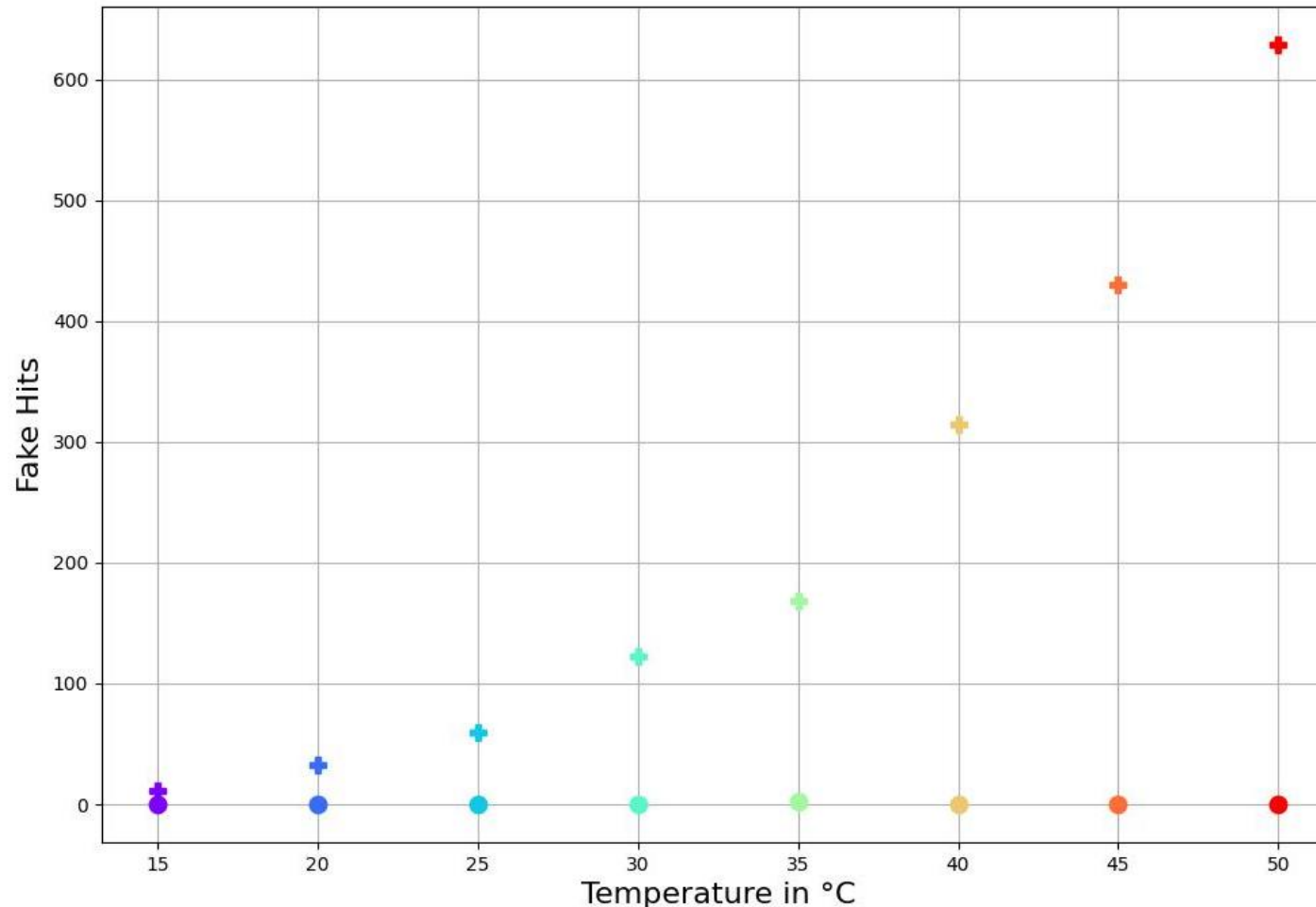
Fake Hit Rate vs temperature



Fake Hits vs Temperature for Scan with n = 100000

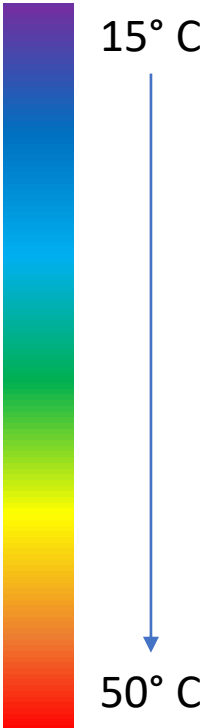
-> Fake Hit Rate **increases** with increasing temperature

-> Non-Linear increase



LBL Setup
DPTSXW22B33
wafer: 22
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T = 15 °C
I_{reset} = 10 pA
I_{bias} = 100 nA
I_{biasn} = 10 nA
I_{db} = 100 nA
V_{casn} = 300 mV
V_{pwell} = V_{sub} = -1.2V

- Temperature 15.0°C, vcasb 250mV
- ✚ Temperature 15.0°C, vcasb 300mV
- Temperature 20.0°C, vcasb 250mV
- ✚ Temperature 20.0°C, vcasb 300mV
- Temperature 25.0°C, vcasb 250mV
- ✚ Temperature 25.0°C, vcasb 300mV
- Temperature 30.0°C, vcasb 250mV
- ✚ Temperature 30.0°C, vcasb 300mV
- Temperature 35.0°C, vcasb 250mV
- ✚ Temperature 35.0°C, vcasb 300mV
- Temperature 40.0°C, vcasb 250mV
- ✚ Temperature 40.0°C, vcasb 300mV
- Temperature 45.0°C, vcasb 250mV
- ✚ Temperature 45.0°C, vcasb 300mV
- Temperature 50.0°C, vcasb 250mV
- ✚ Temperature 50.0°C, vcasb 300mV



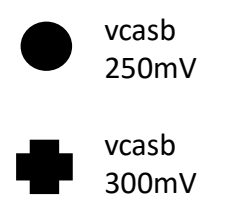
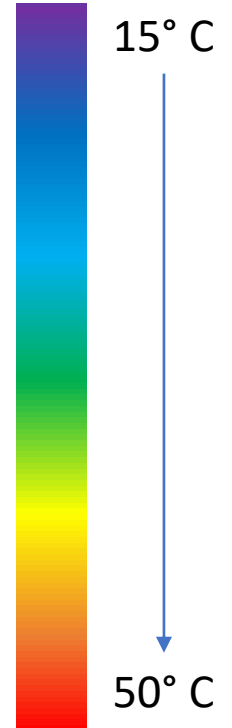
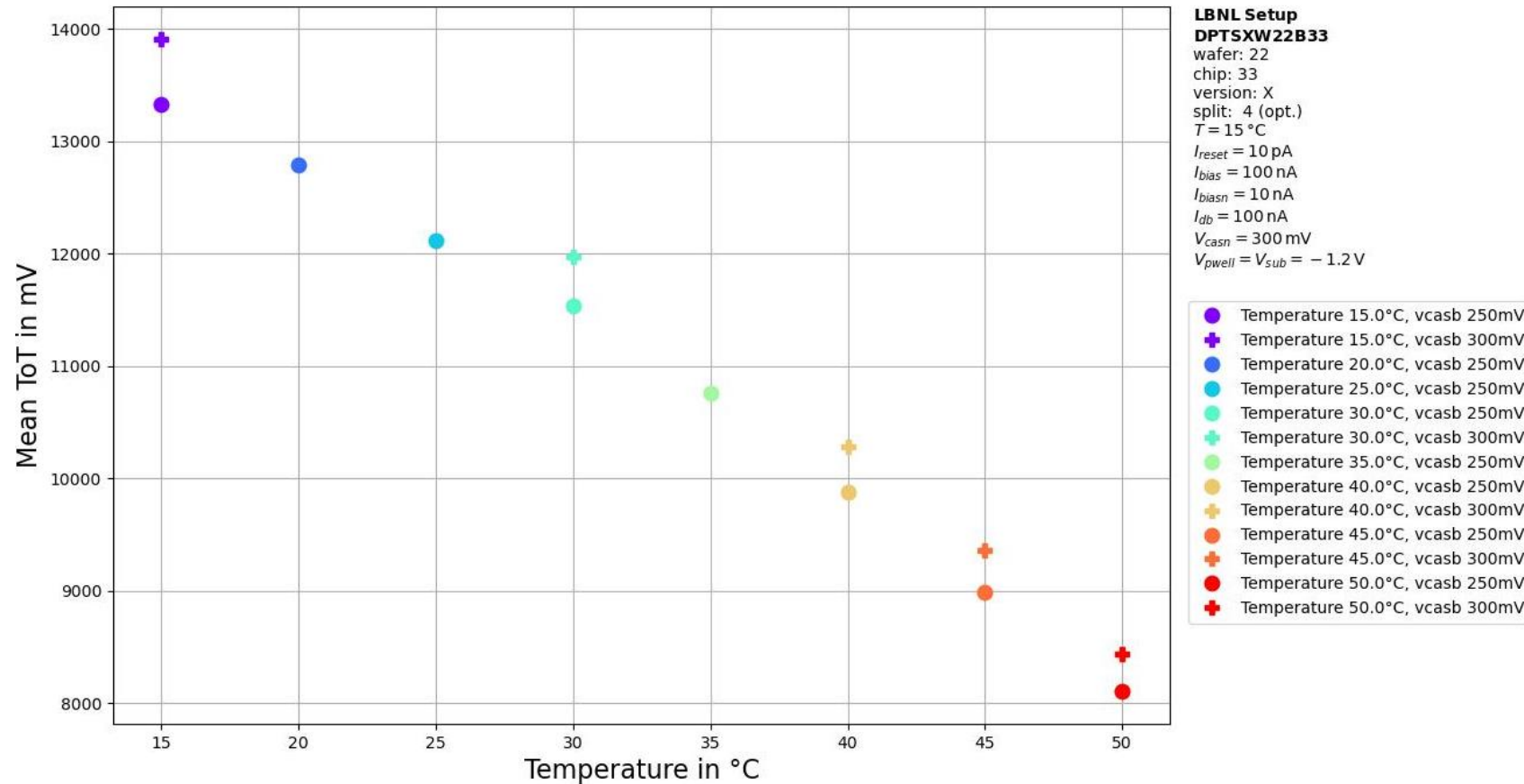
- vcasb 250mV
- ✚ vcasb 300mV

Time over Threshold vs Temperature



-> ToT
decreases linear
with increasing
temperature

Mean ToT vs Temperatures at vH = 600





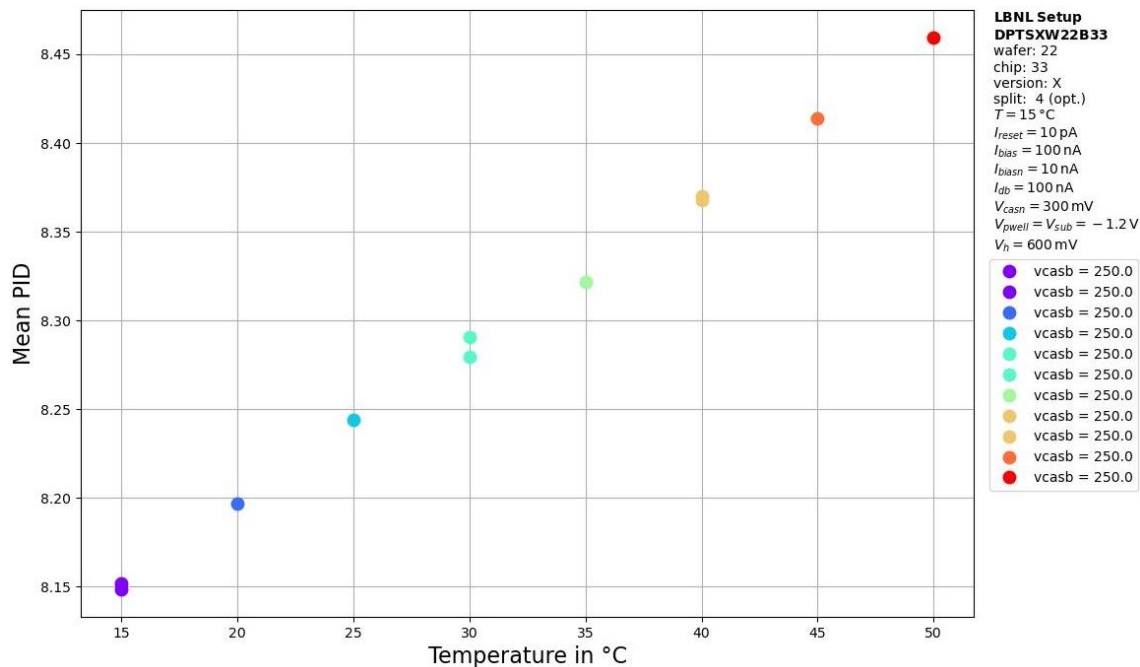
PID/GID Calibration

Mean Values stable, Temperature behaviour as in DPTS paper

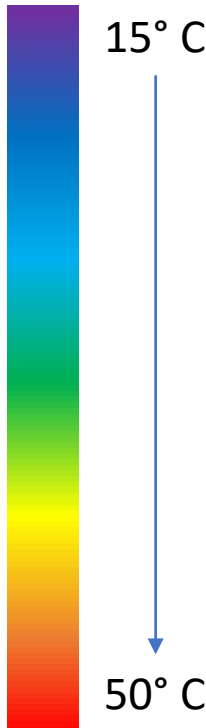
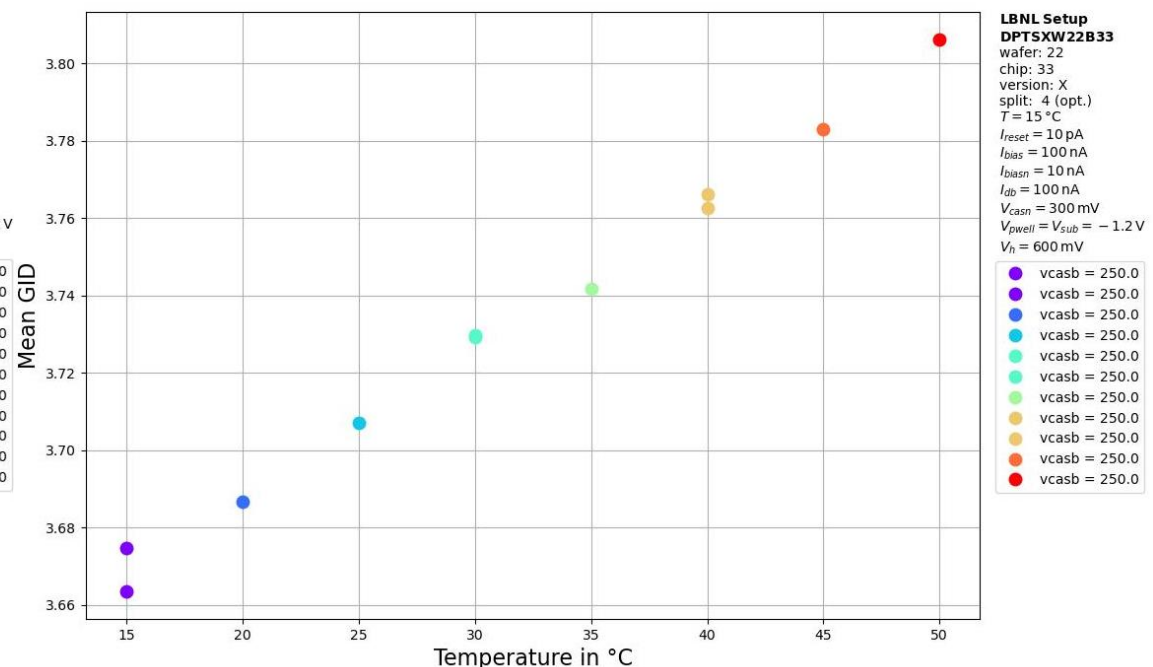
(15-40°C: PID 8.8 ps/° vs ~8 ps/° in paper, GID 4 ps/° vs 4 ps/°)

Some variations -> further studies needed

Mean PID vs Temperature



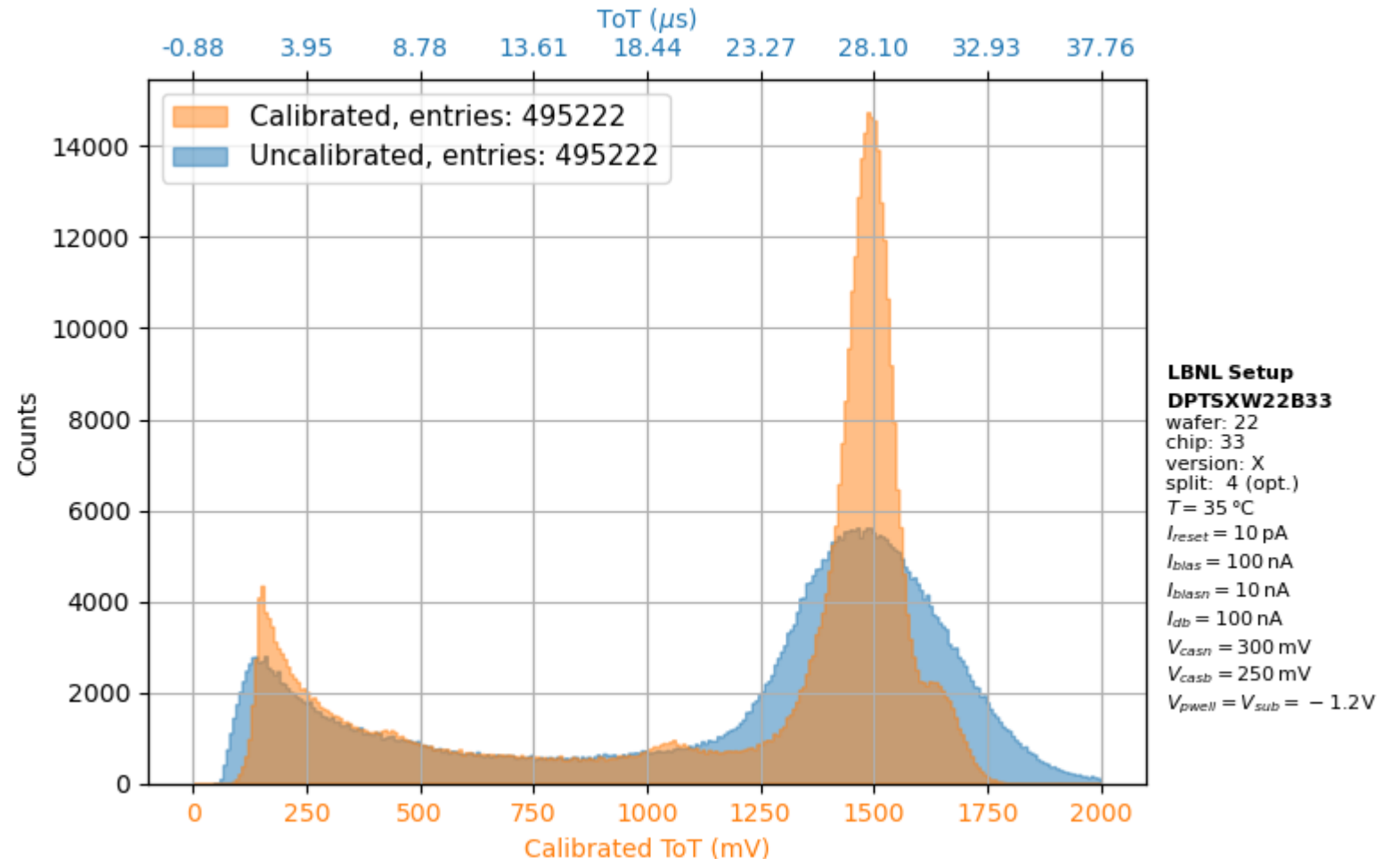
Mean GID vs Temperature





Fe55 Source Spectrum

- $V_{casb} = 250\text{mV}$
- Known K-alpha peak
→ Energy calibration
- High Statistics
 - Good resolution
- Multiple-Peak fitting possible

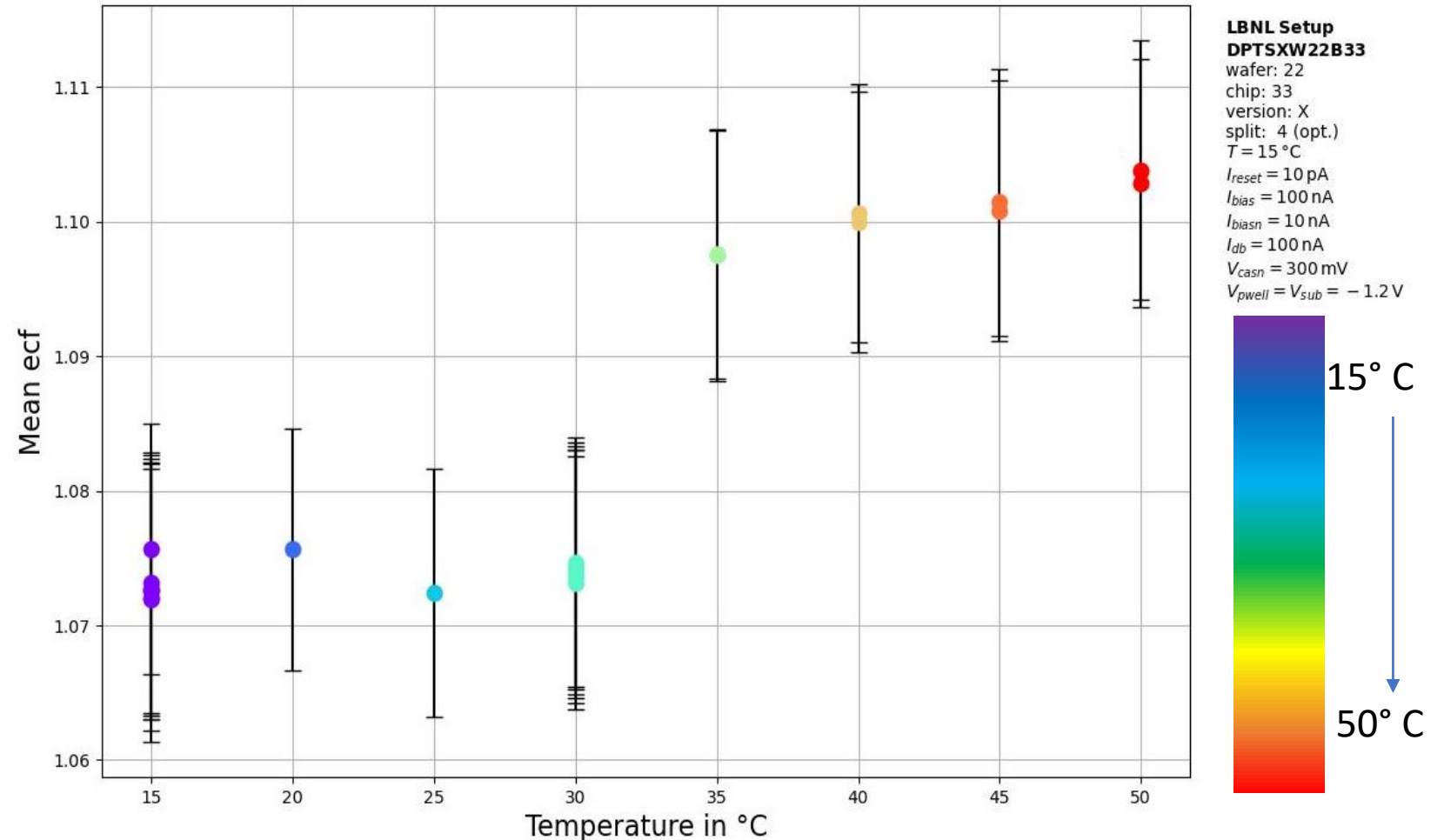


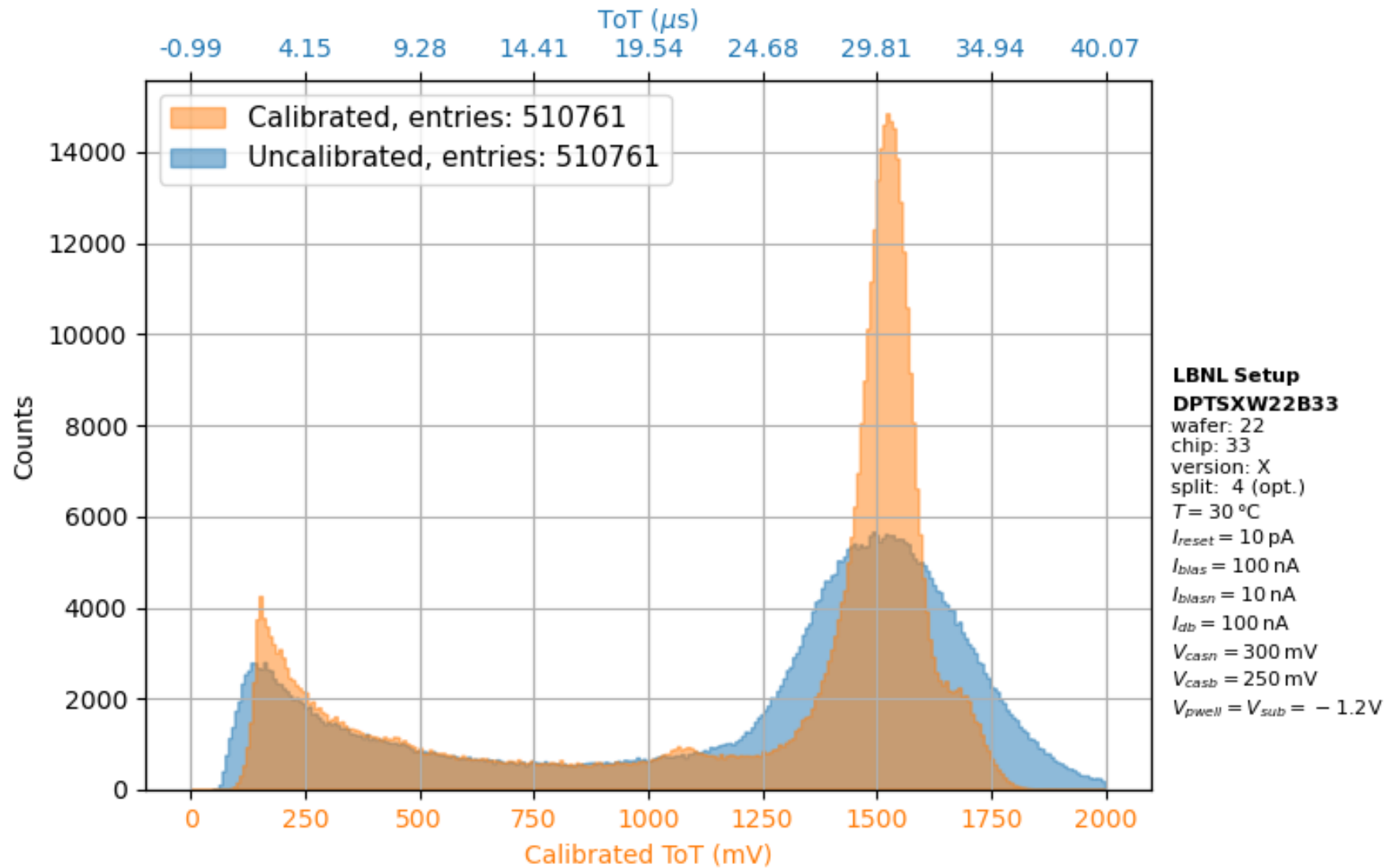
Conversion factor vs temperature

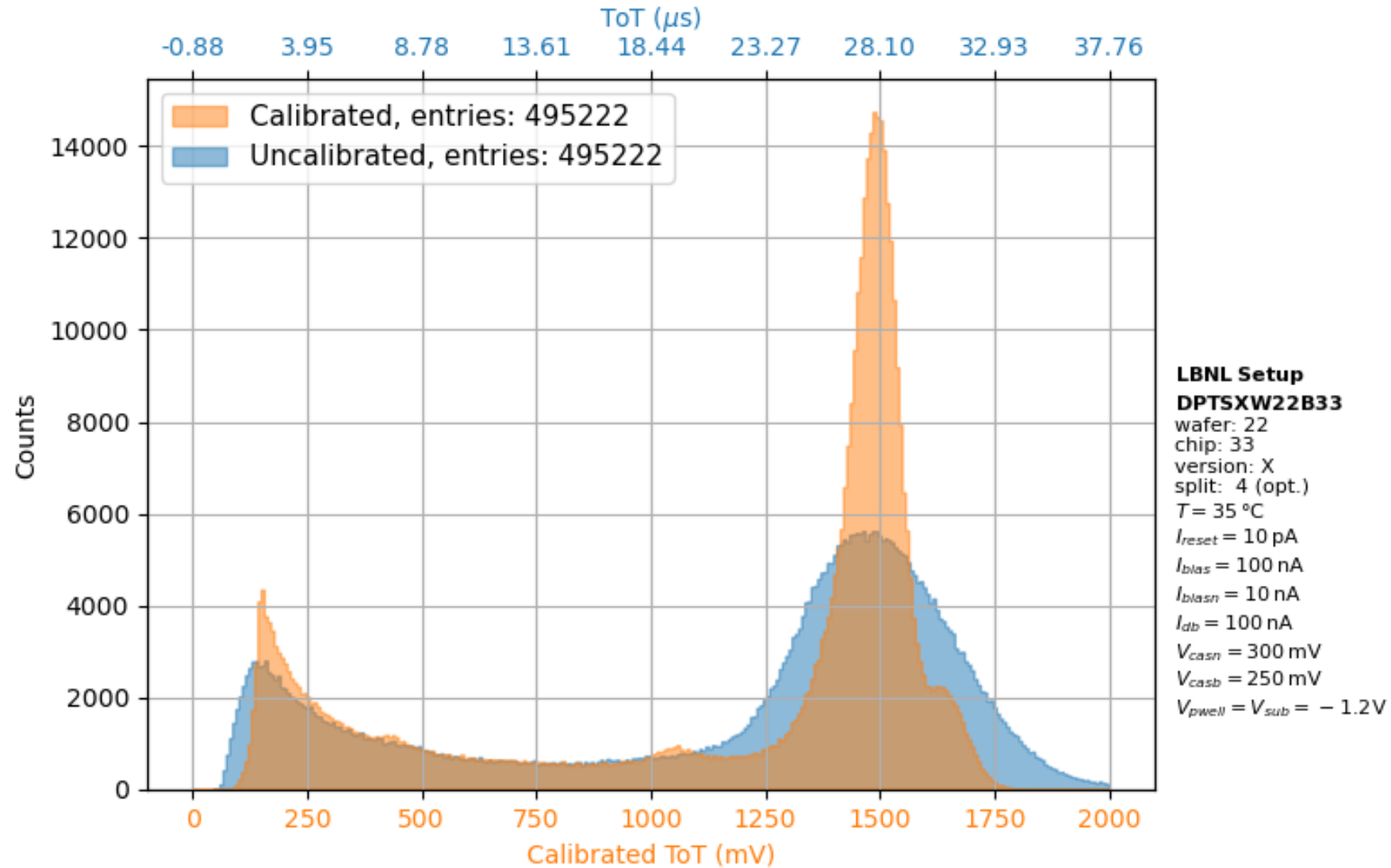


Mean Energy Calibration Factor vs Temperature

- Big Jump between 30°C and 35°C

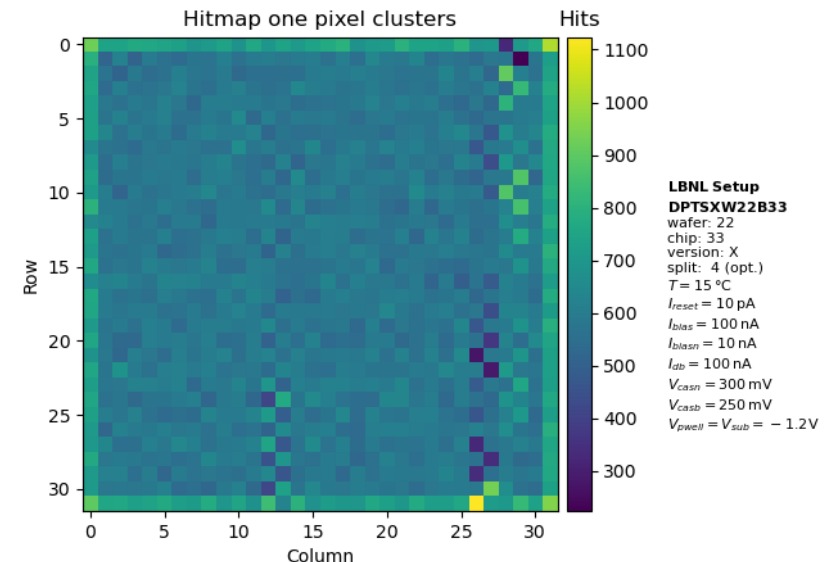
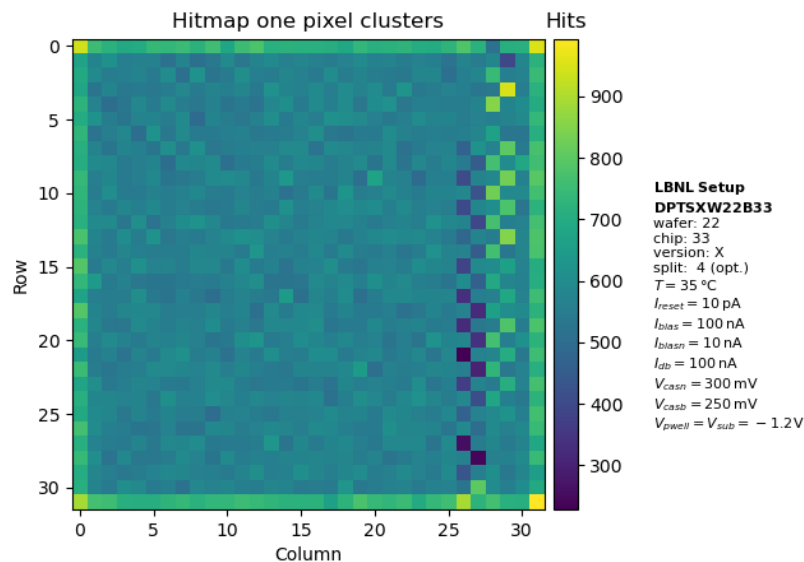
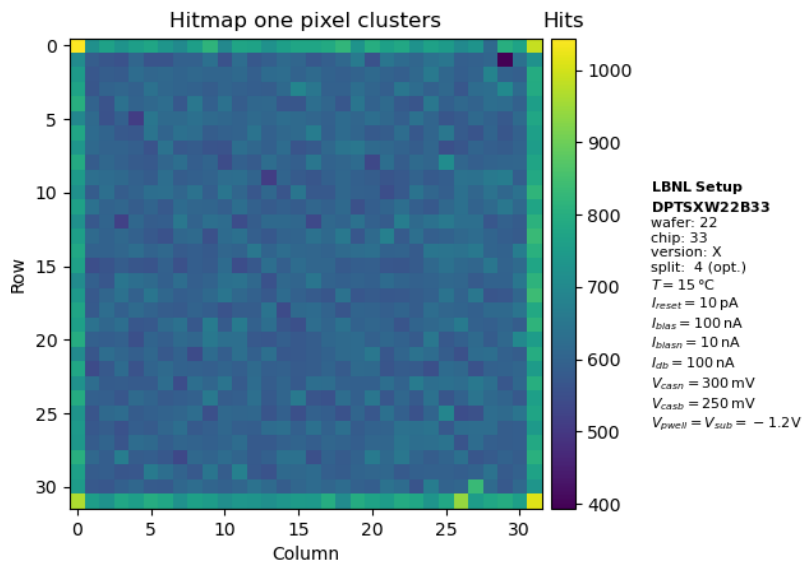






Discussion

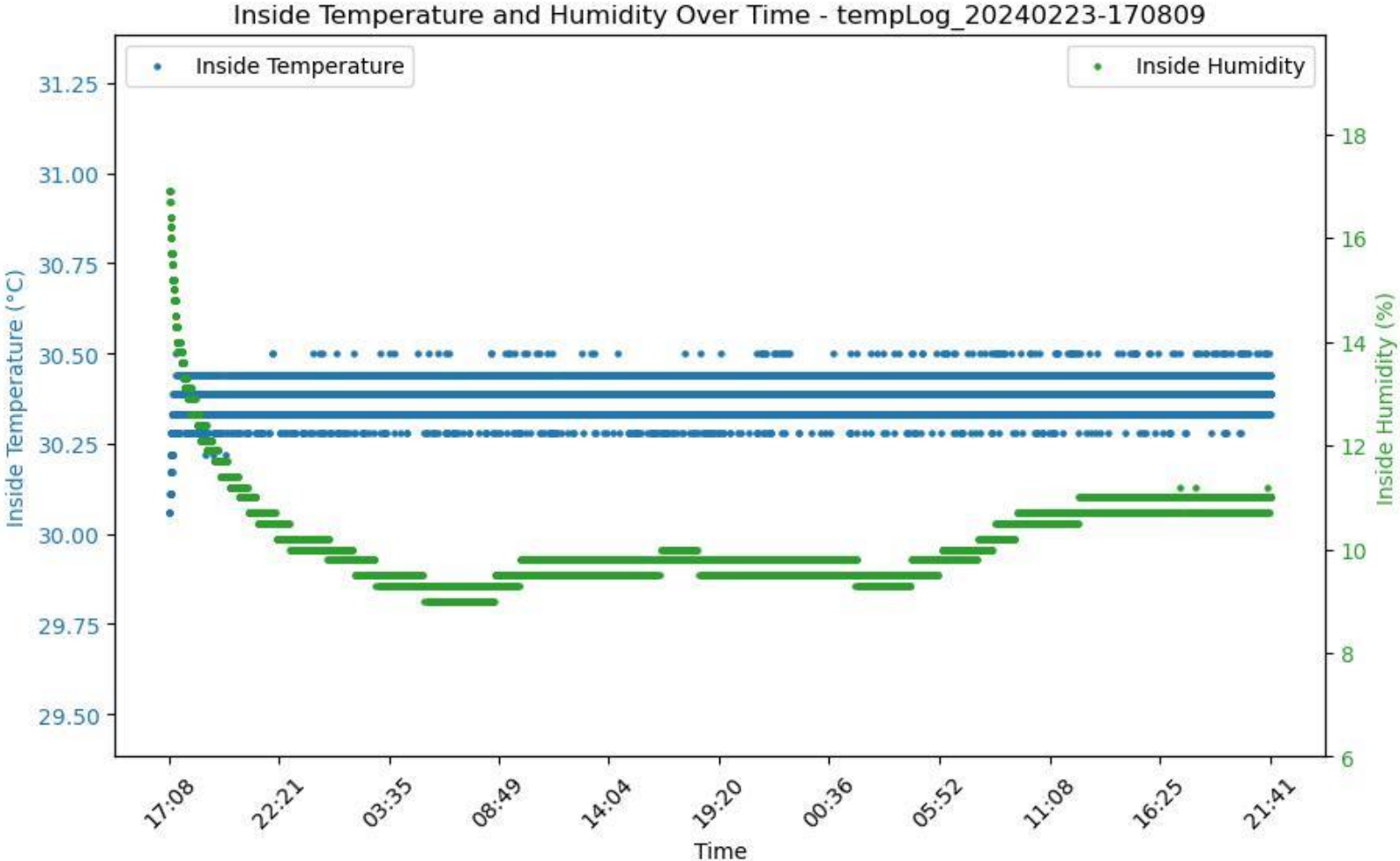
- Possible Explanations:
 - PID/GID calibration
 - Just 1 Set per Temperature -> visible fluctuations in Hitmap
 - Humidity/Temperature fluctuations
 - Higher Noise/Fake Hits





Humidity / Temperature

- Temperature stable within $\pm 0.5^\circ\text{C}$
- Humidity decreasing but mostly within 10% variations

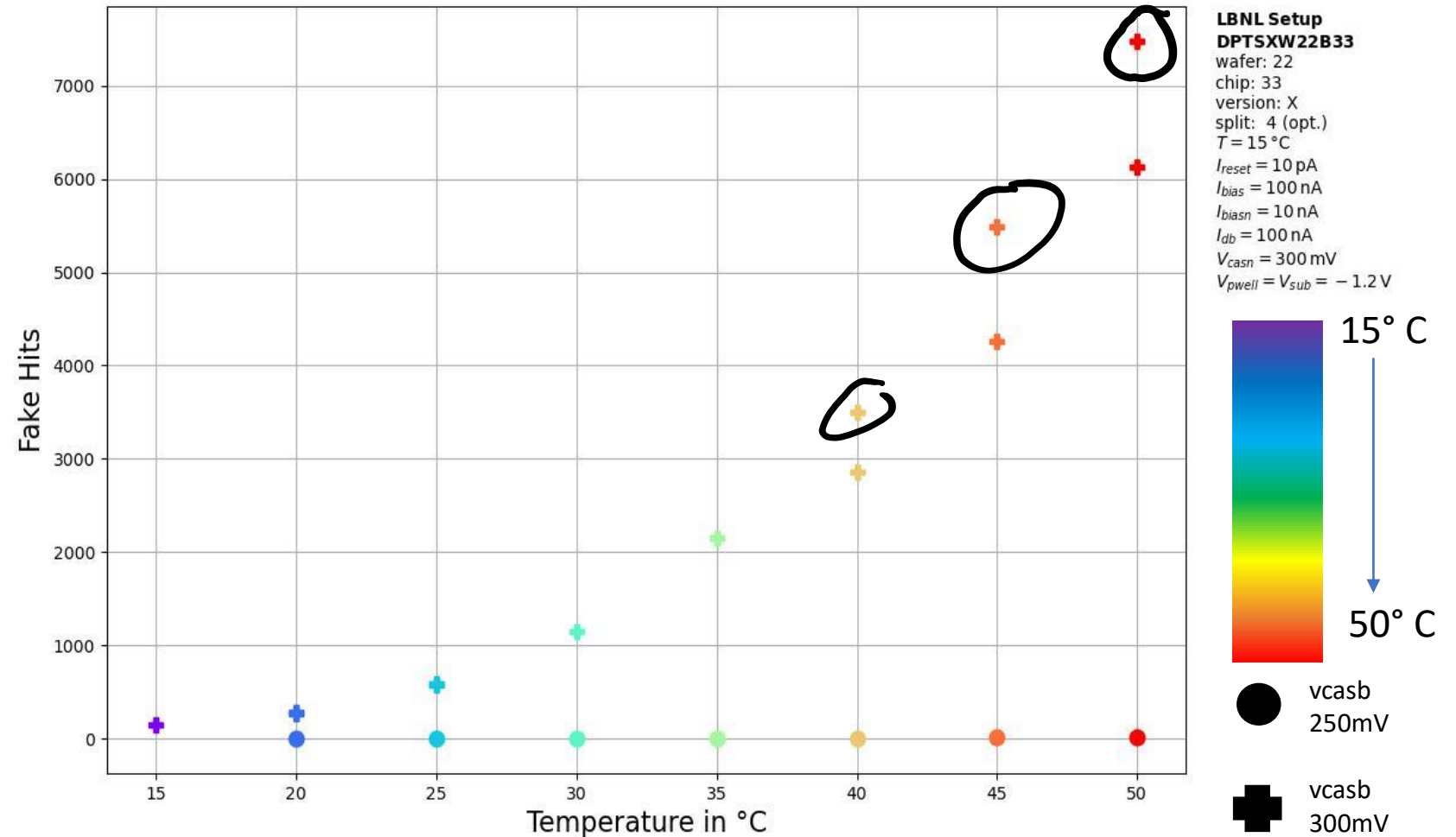




Fake Hit Rate

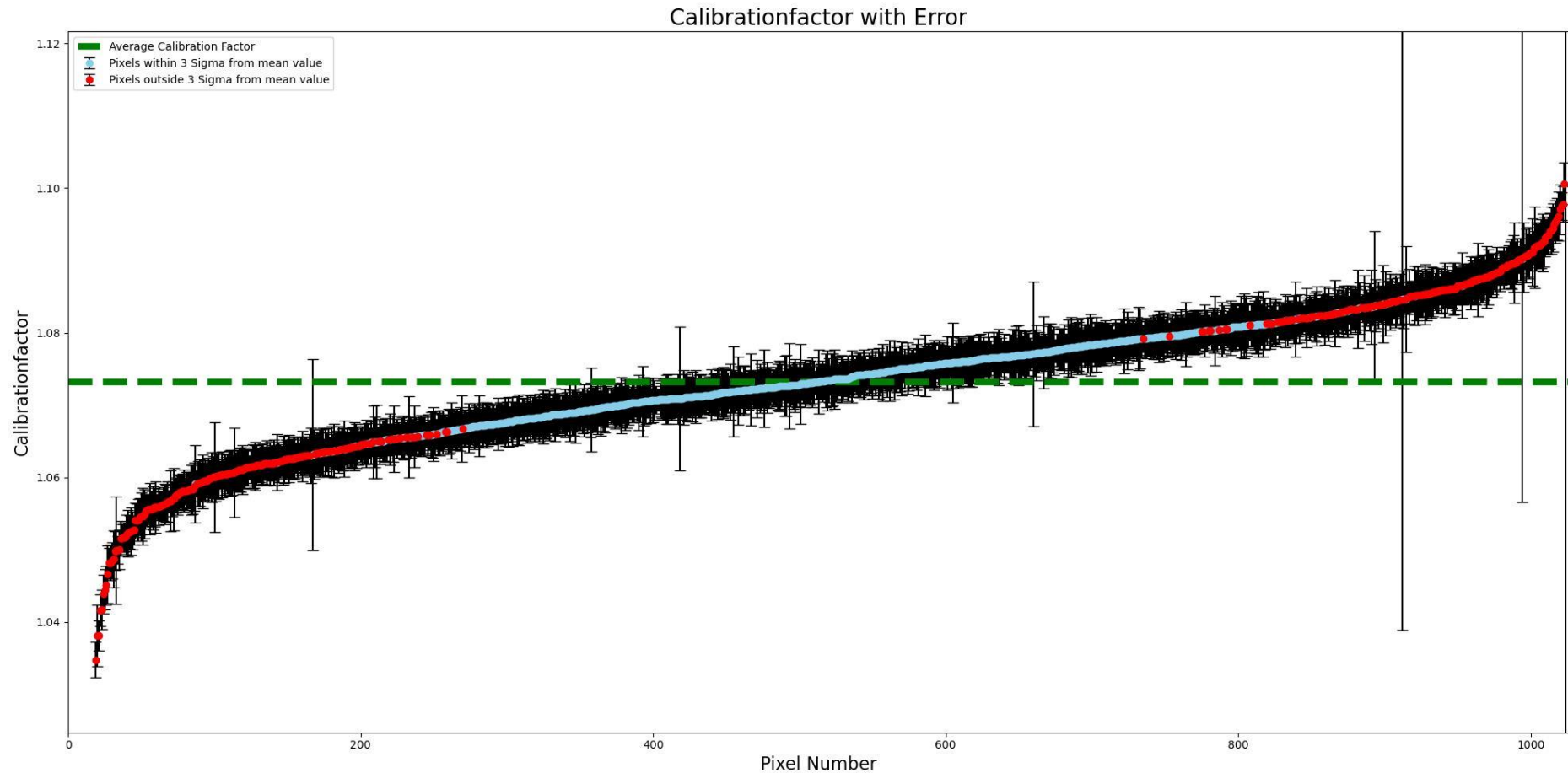
Fake Hits vs Temperature for Scan with $n = 1000000$

- New and old datasets differ above 35°C
- Specific pixels?
- Further studies needed



Pixel to Pixel variations

- For all temperatures, high pixel to pixel variations of the energy calibration factor

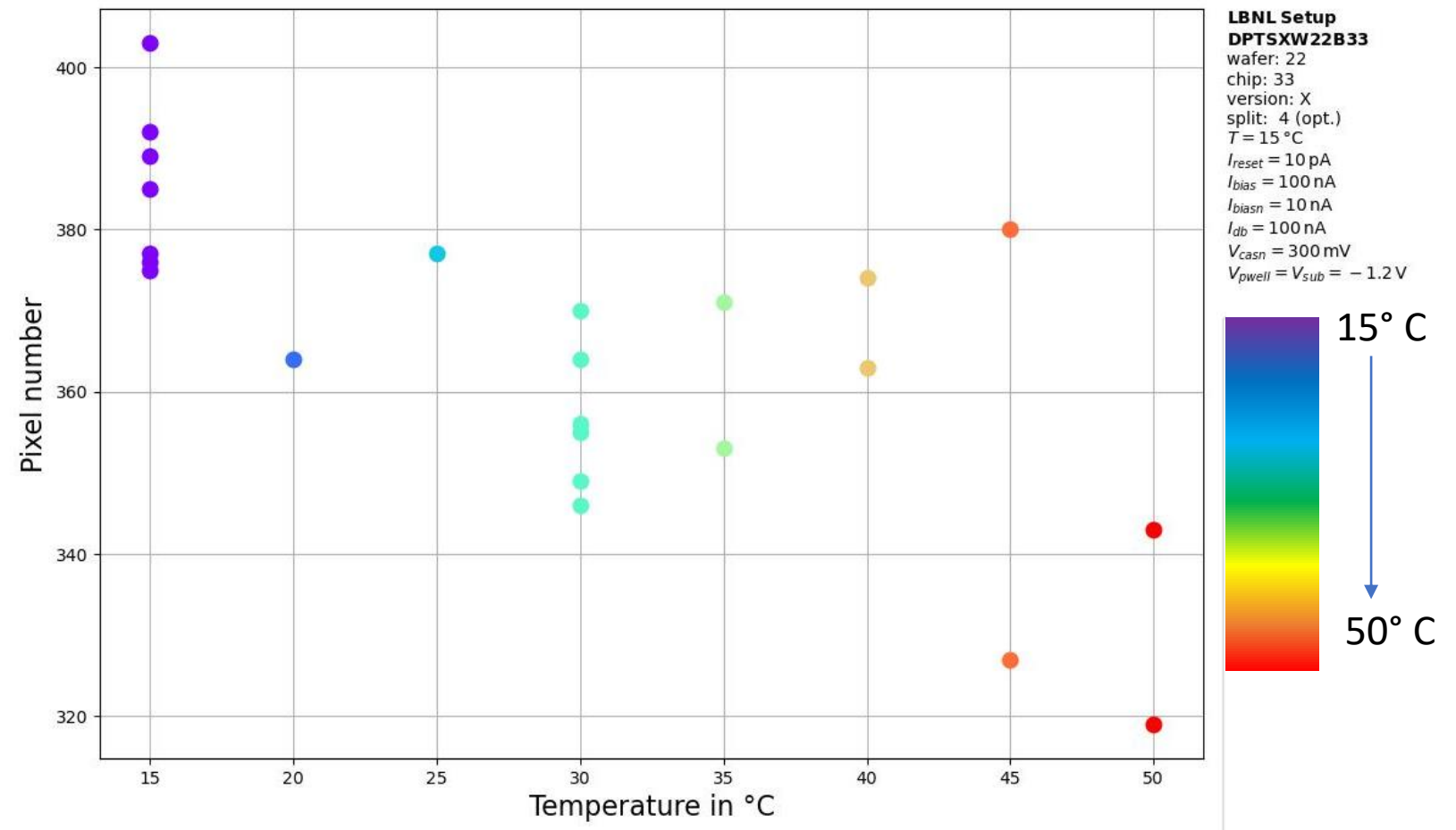


Pixel with 3 σ deviation from mean



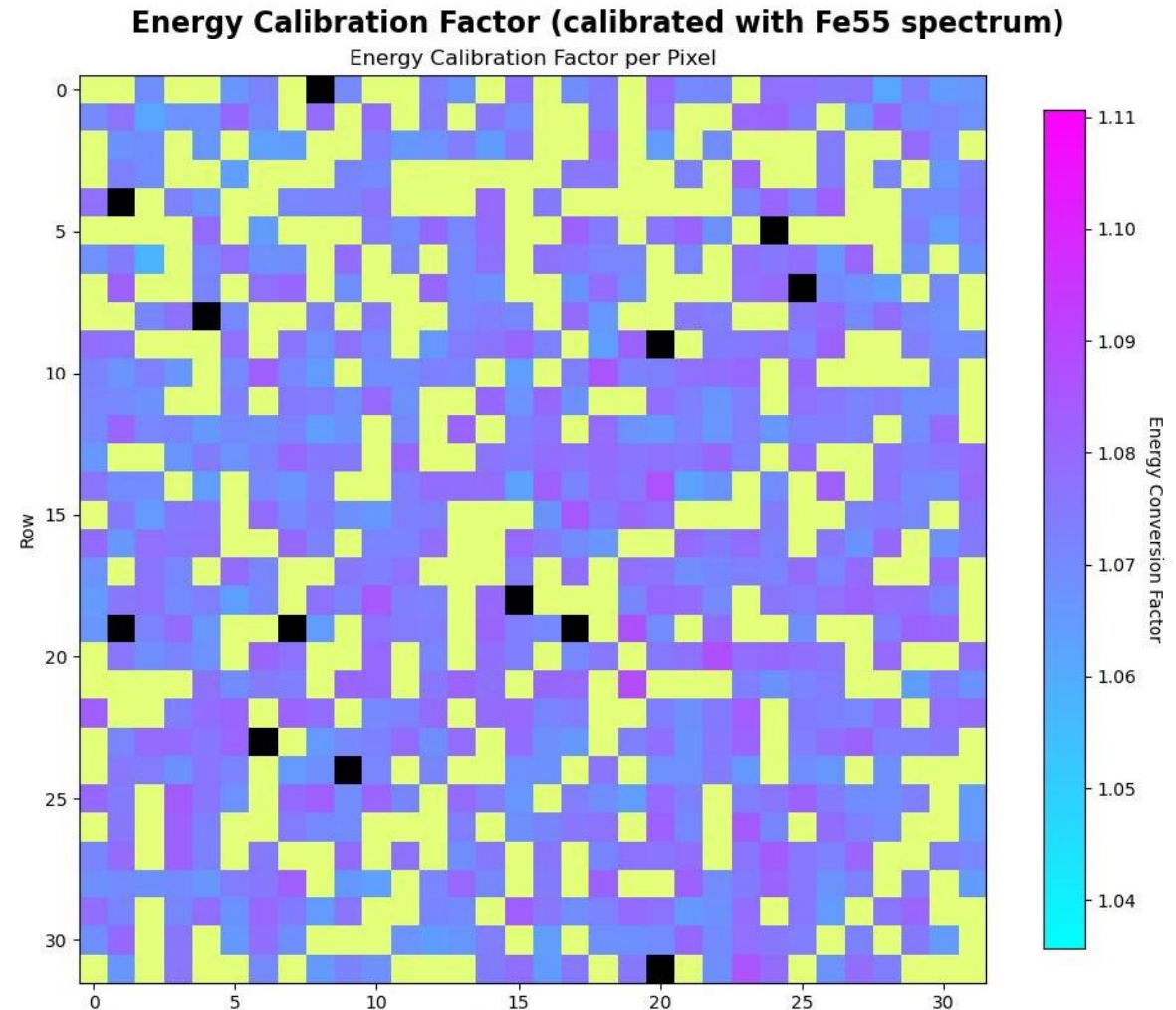
Number of pixels with mean value outside their 3 sigma vs Temperature

- Vary between datasets
- Decreasing trend
- Min. 30% outside



Distribution in Pixel Matrix

- No fixed pattern
- For each temperature fixed pixel don't collect a fittable spectrum
- Conversion factor random distributed
- Black mask = fitting error
- Yellow mask = outside 3σ



Summary

- We took Source Data with high statistics at all temperatures
- Also Fake Hit Rate Scans for vcasbs 200-350 and high statistics

- The Energy Calibration is itself temperature dependent
- The Pixel to Pixel variation is strong at all temperatures
- We still don't fully understand the PID/GID decoding variations

Next Steps

- Check how the wrong assigned events effect the energy calibration
- Take source data at 30°C and 35°C again
- Do energy calibration fit with more peaks
- Investigate Matrix distribution of Fake Hits