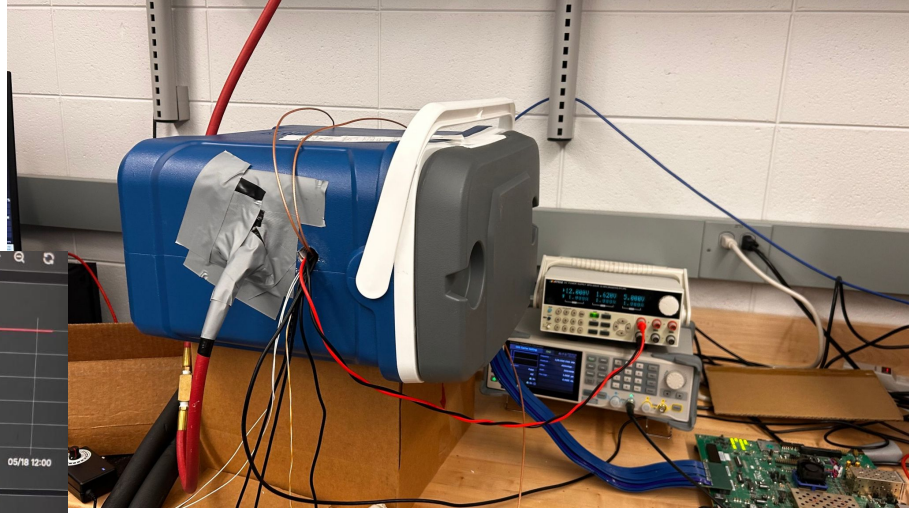
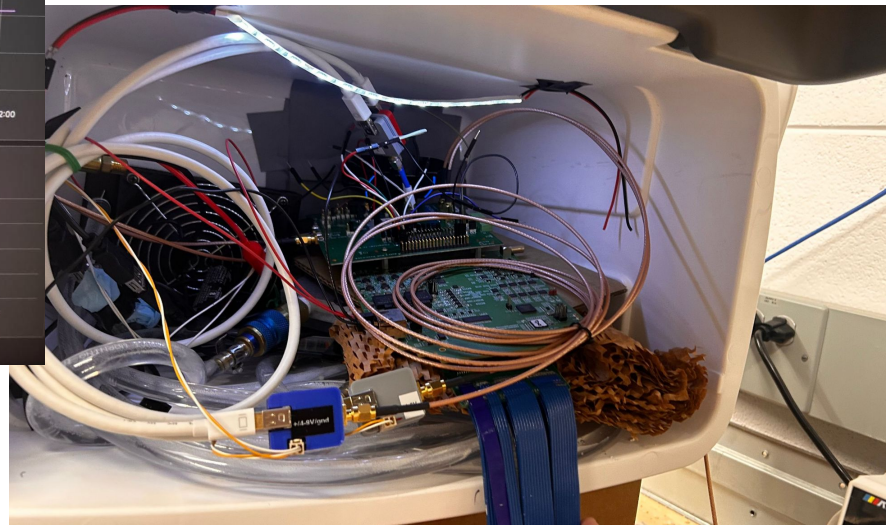
Cold Testing

- We further tested the cold setup until confident that we could run for a long time
- Now using RS232 connection to the power supply to turn off the power supply when dew point rises above temperature
- Using 40-50 psi/hour of nitrogen
  - If fine tune the nitrogen it was closer to 50, but when switched out nitrogen tanks didn't spend as long adjusting the knob, but wanted to err on the side of decreasing humidity, so higher usage with the second tank
  - We have 1000 + 1300 psi = ~45-55 hrs of cold runtime remaining
- Measured SCurves and CvG curves
  - Compare to old chip scurves, new chip scurves, new chip CvG curves
- For DNN test, need 92 hours of runtime = 1 more tank (assuming we get there)

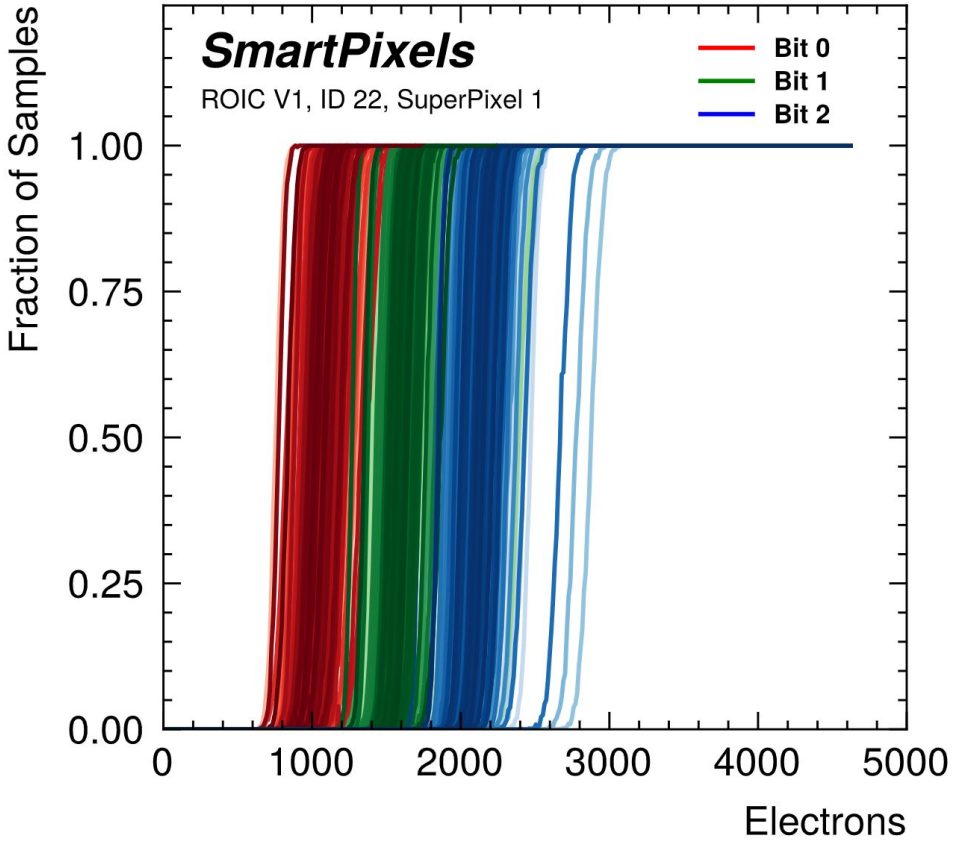
Cold testing



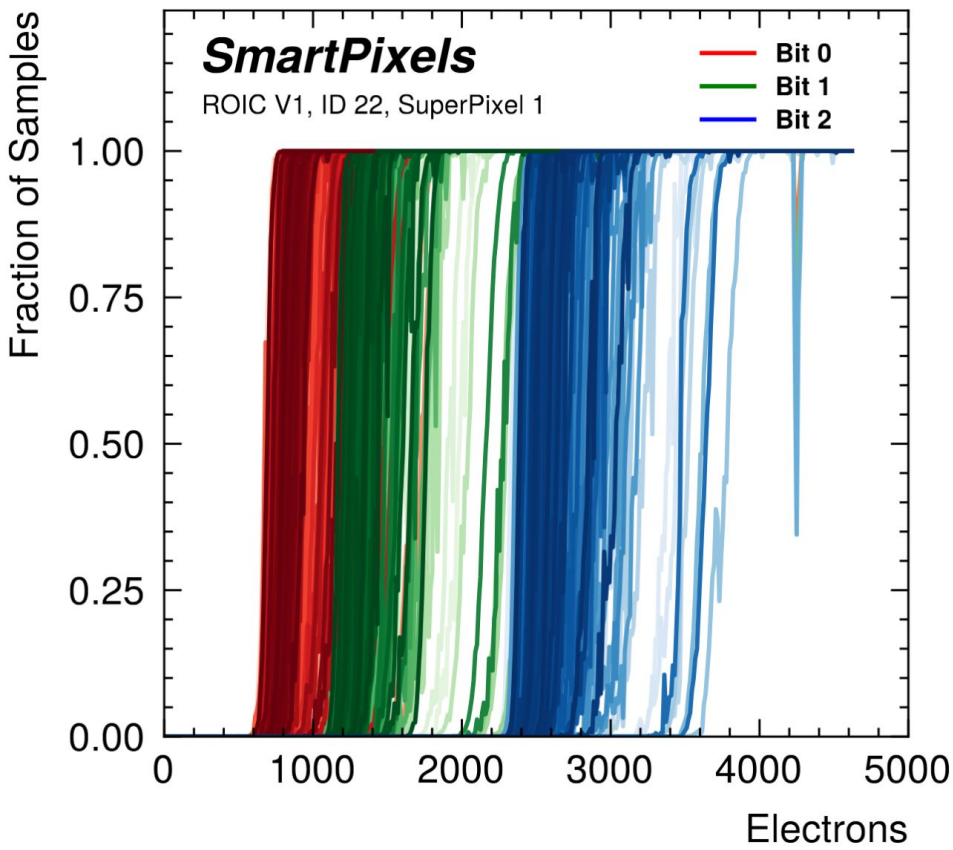


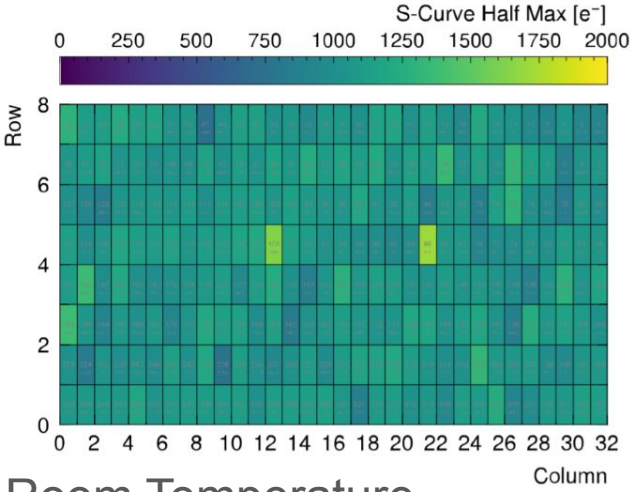
SCurves

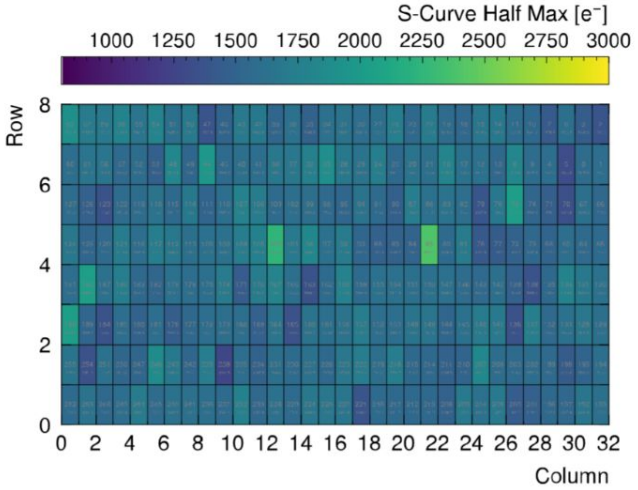
Room Temperature

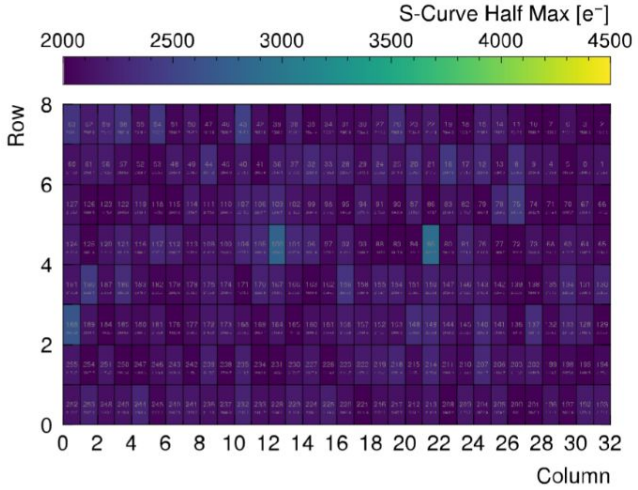


Cold (-20+-1 C)

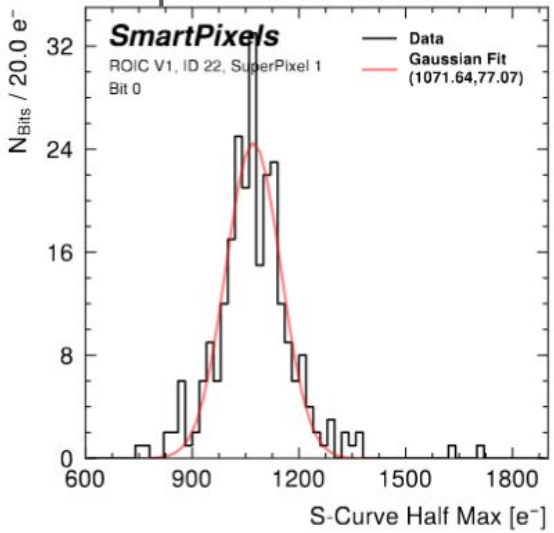


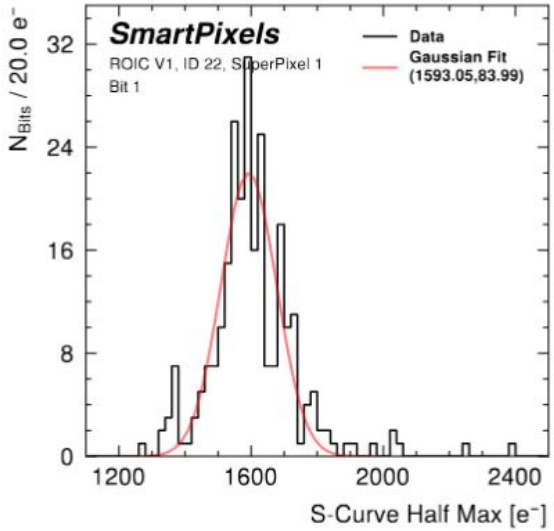


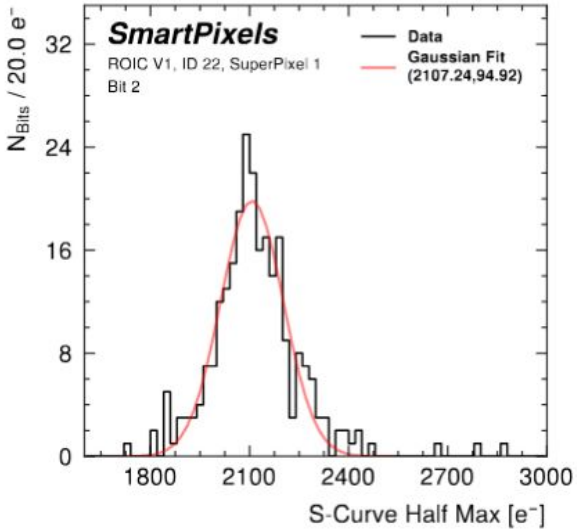


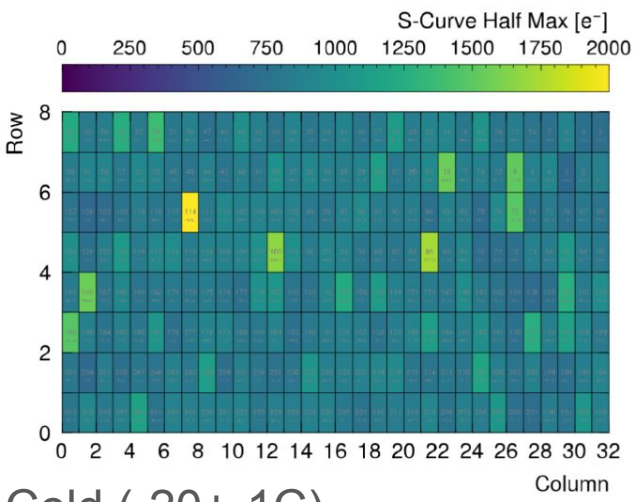


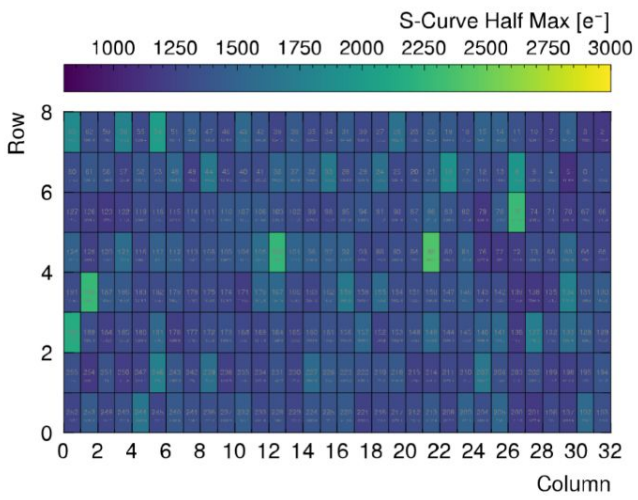
Room Temperature

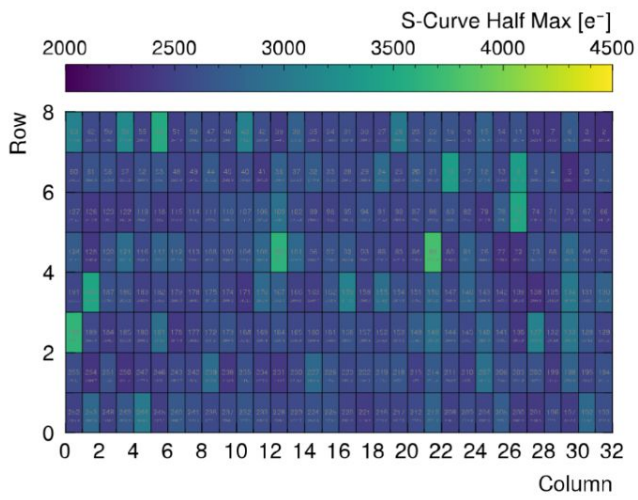




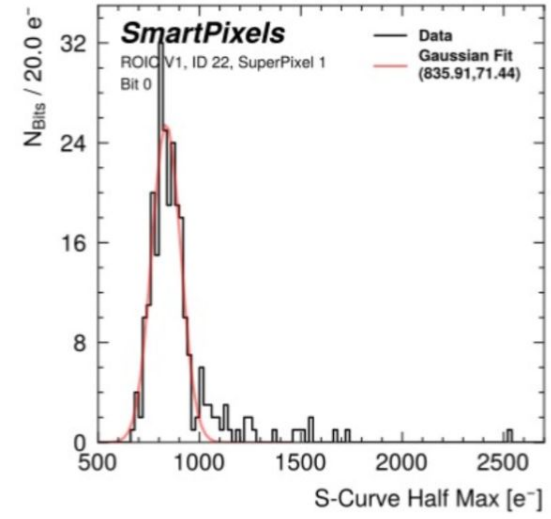


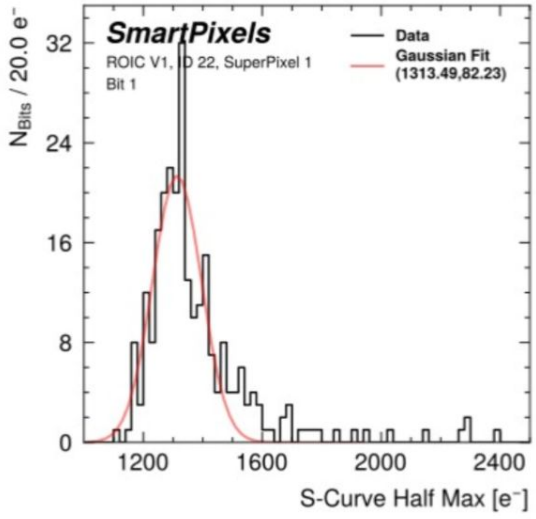

S-Curve Half Max [e⁻]
0 250 500 750 1000 1250 1500 1750 2000
Row
Column

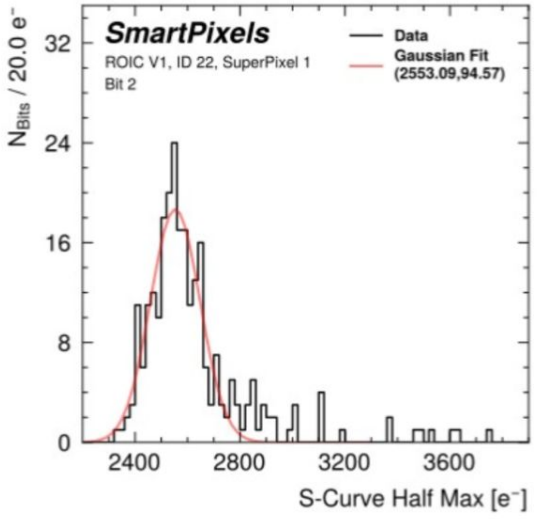

S-Curve Half Max [e⁻]
1000 1250 1500 1750 2000 2250 2500 2750 3000
Row
Column

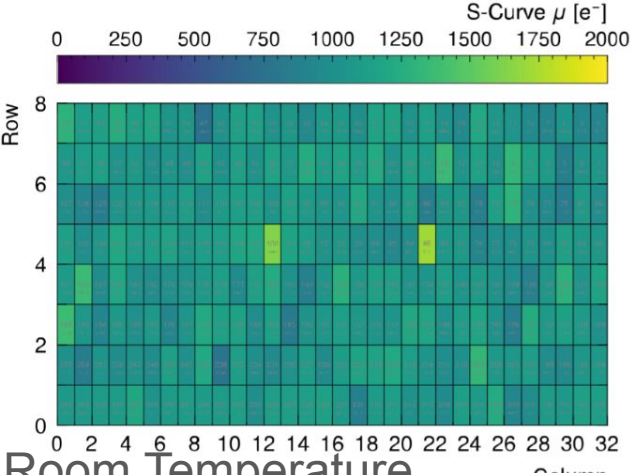

S-Curve Half Max [e⁻]
2000 2500 3000 3500 4000 4500
Row
Column

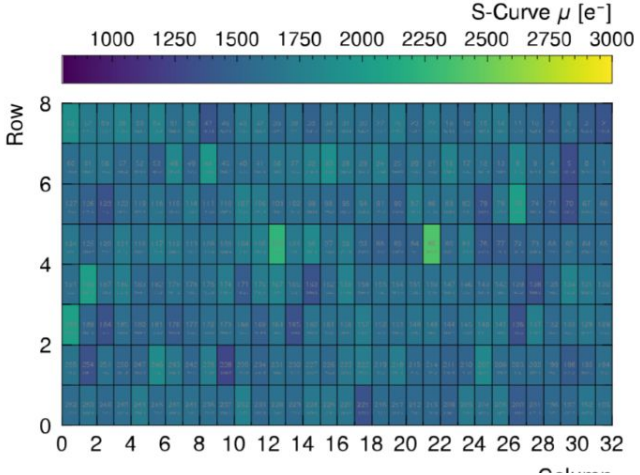
Cold (-20+-1C)

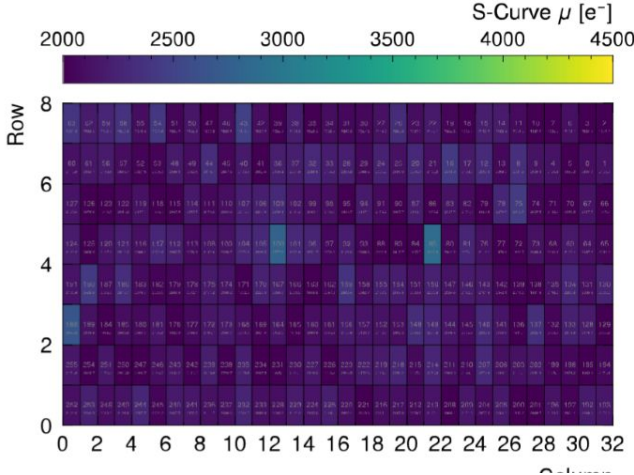

SmartPixels
ROIC V1, ID 22, SuperPixel 1
Bit 0
Data
Gaussian Fit
(835.91,71.44)
N_Bits / 20.0 e⁻
S-Curve Half Max [e⁻]


SmartPixels
ROIC V1, ID 22, SuperPixel 1
Bit 1
Data
Gaussian Fit
(1313.49,82.23)
N_Bits / 20.0 e⁻
S-Curve Half Max [e⁻]

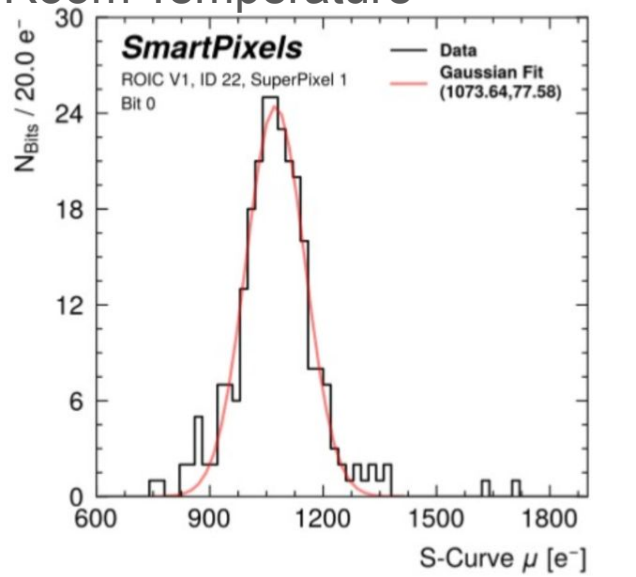

SmartPixels
ROIC V1, ID 22, SuperPixel 1
Bit 2
Data
Gaussian Fit
(2553.09,94.57)
N_Bits / 20.0 e⁻
S-Curve Half Max [e⁻]

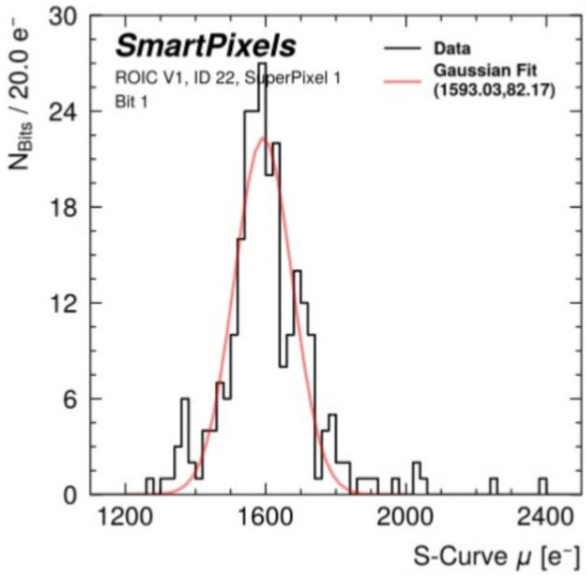


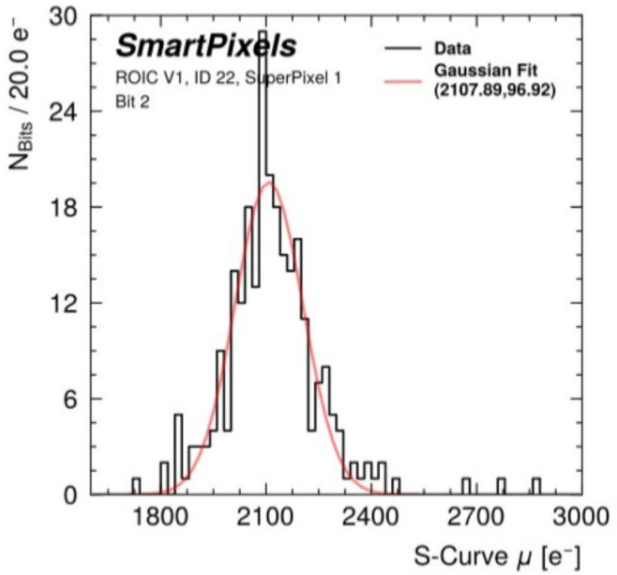


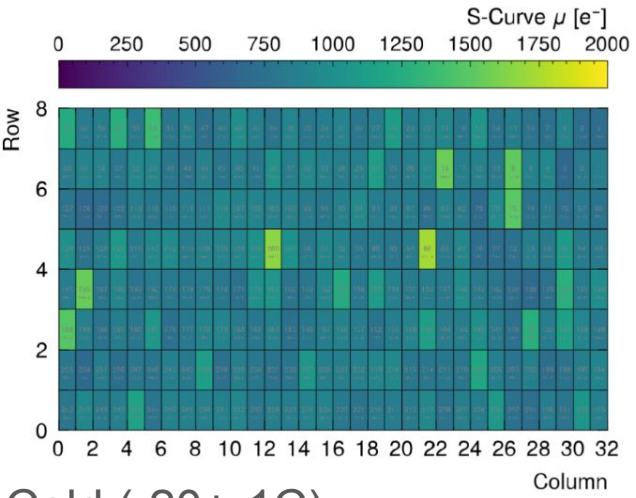


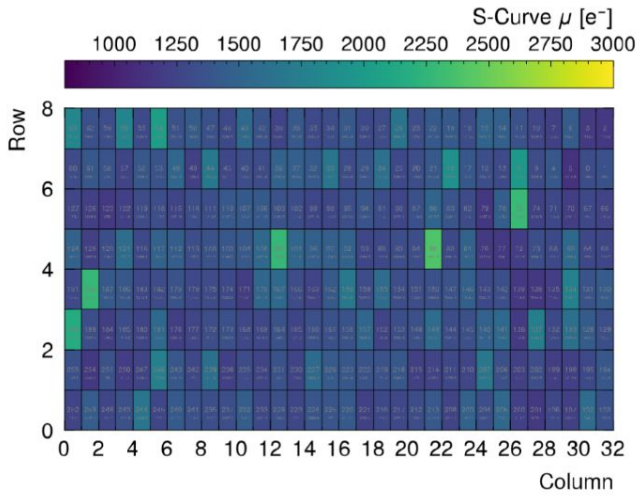
Room Temperature

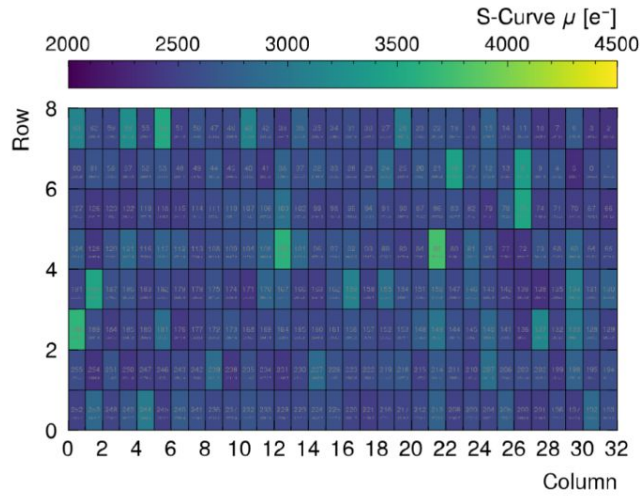




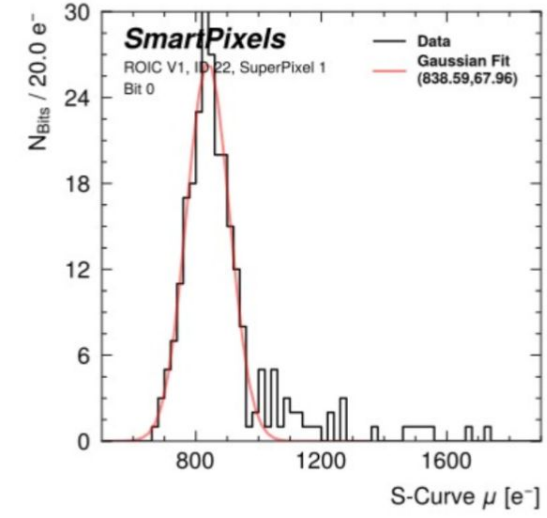


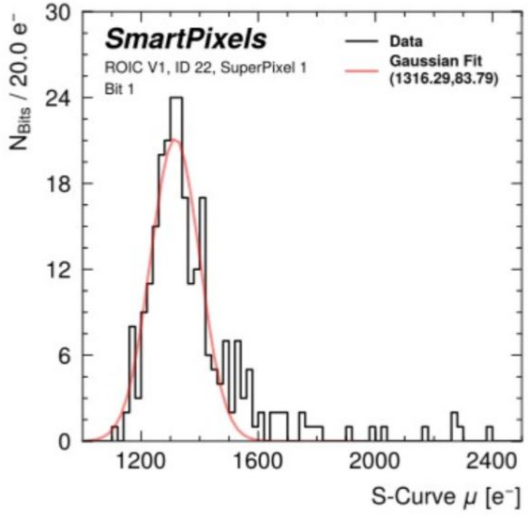

S-Curve μ [e⁻]
0 250 500 750 1000 1250 1500 1750 2000
Row
Column

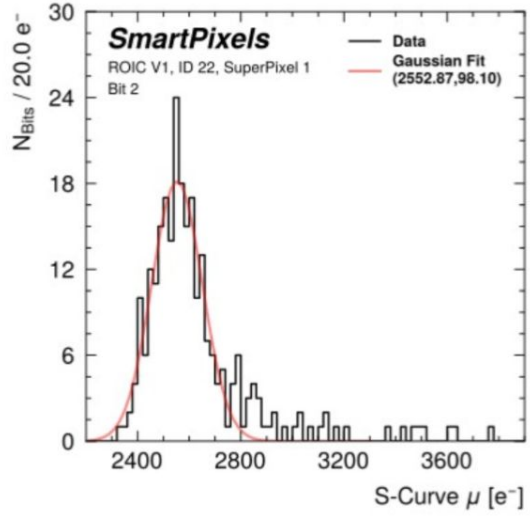

S-Curve μ [e⁻]
1000 1250 1500 1750 2000 2250 2500 2750 3000
Row
Column

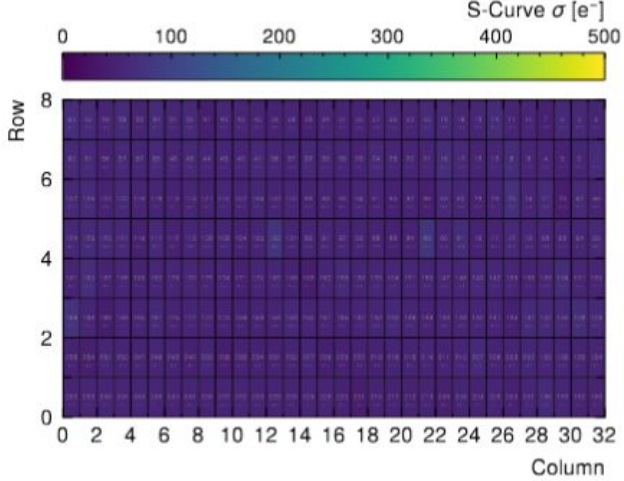

S-Curve μ [e⁻]
2000 2500 3000 3500 4000 4500
Row
Column

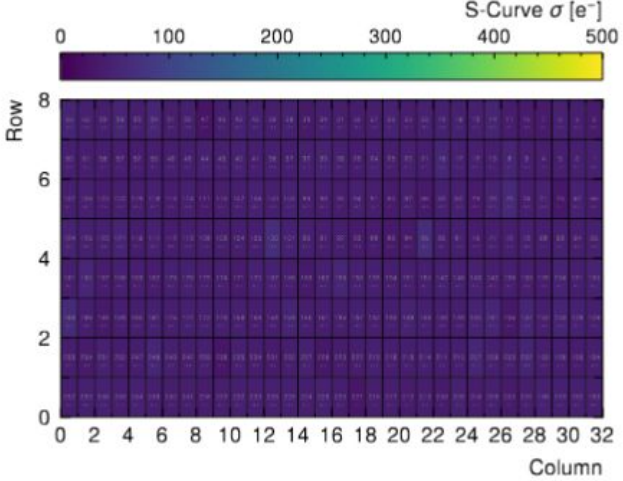
Cold (-20+-1C)

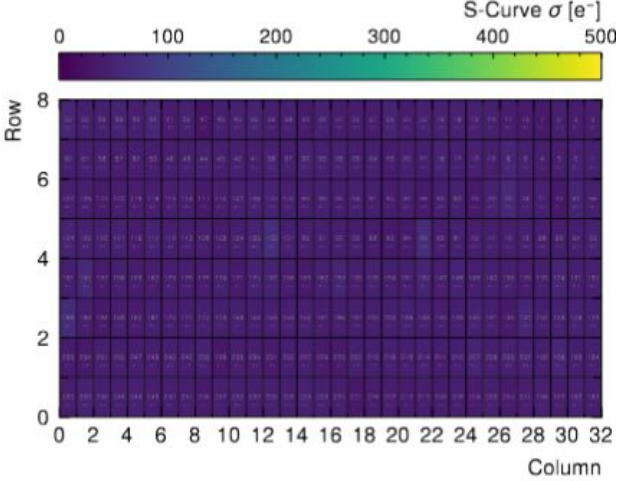

SmartPixels
ROIC V1, ID 22, SuperPixel 1
Bit 0
Data
Gaussian Fit
(838.59,67.96)
N_Bits / 20.0 e⁻
S-Curve μ [e⁻]


SmartPixels
ROIC V1, ID 22, SuperPixel 1
Bit 1
Data
Gaussian Fit
(1316.29,83.79)
N_Bits / 20.0 e⁻
S-Curve μ [e⁻]

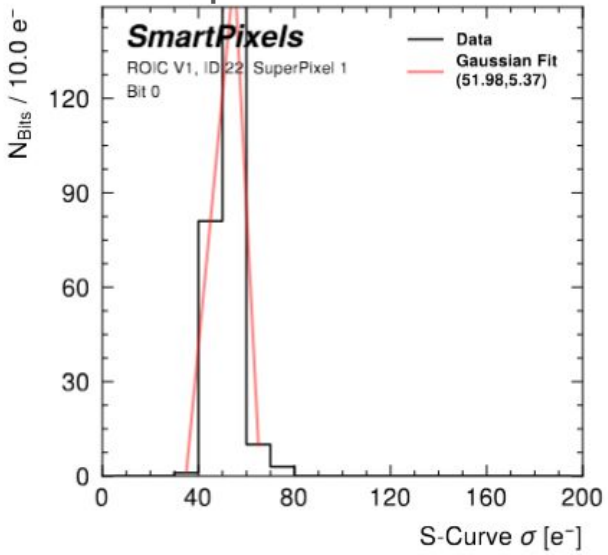

SmartPixels
ROIC V1, ID 22, SuperPixel 1
Bit 2
Data
Gaussian Fit
(2552.87,98.10)
N_Bits / 20.0 e⁻
S-Curve μ [e⁻]

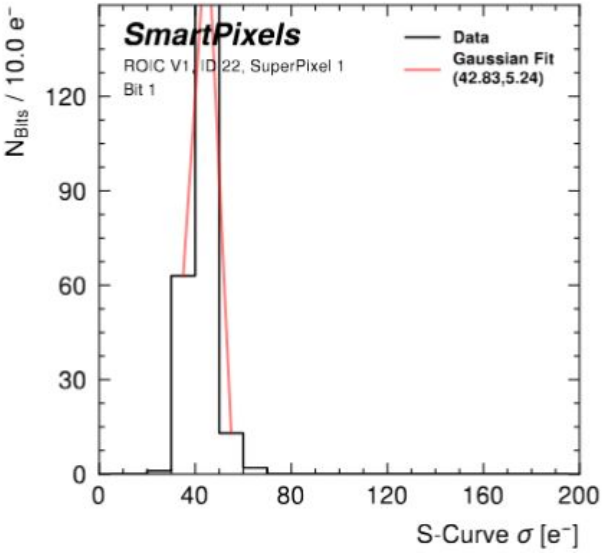


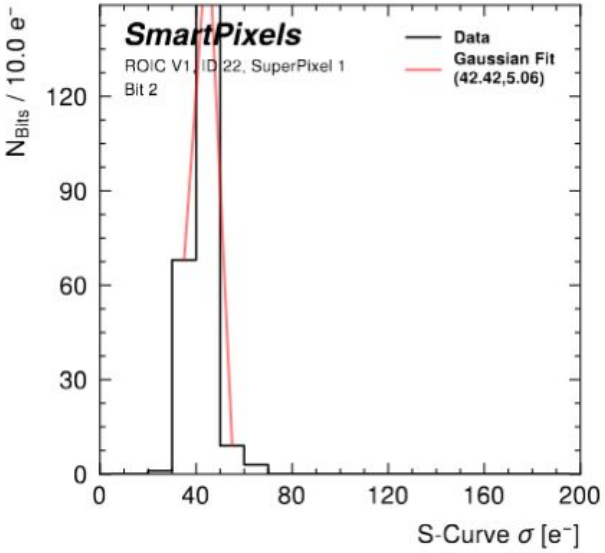


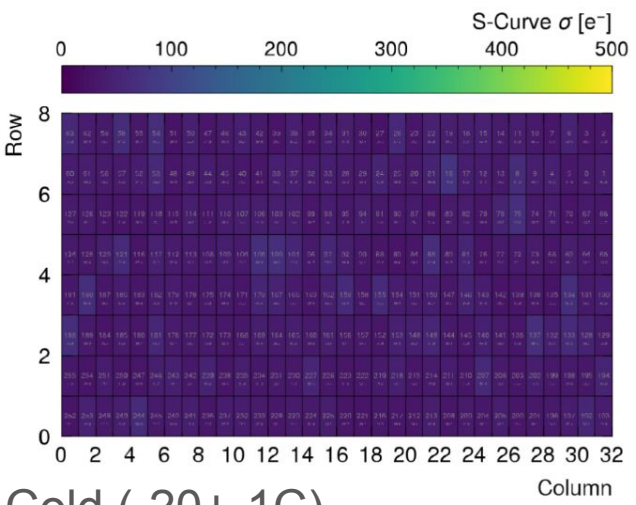


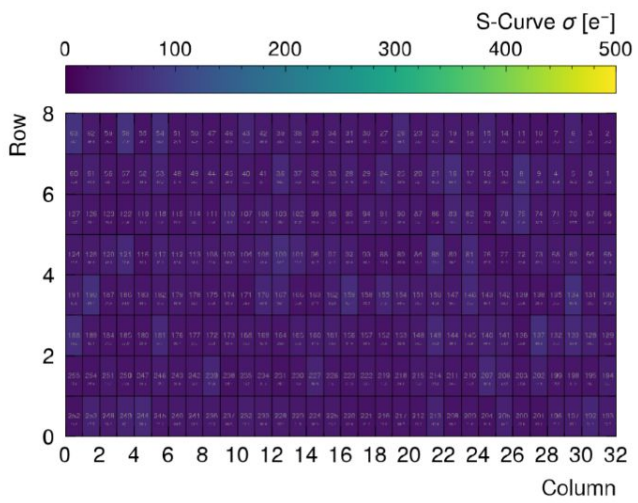
Room Temperature

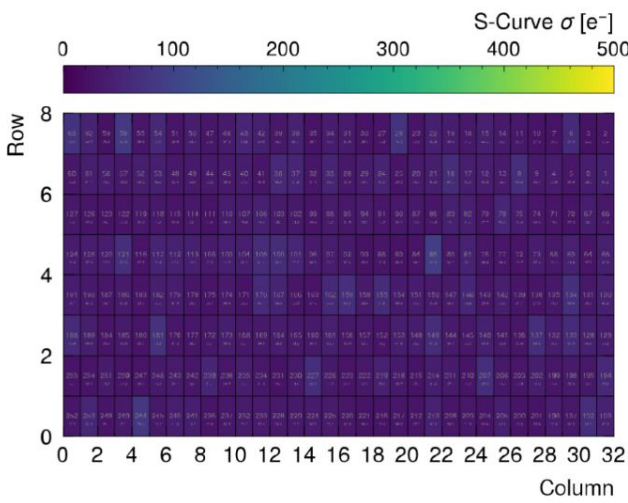




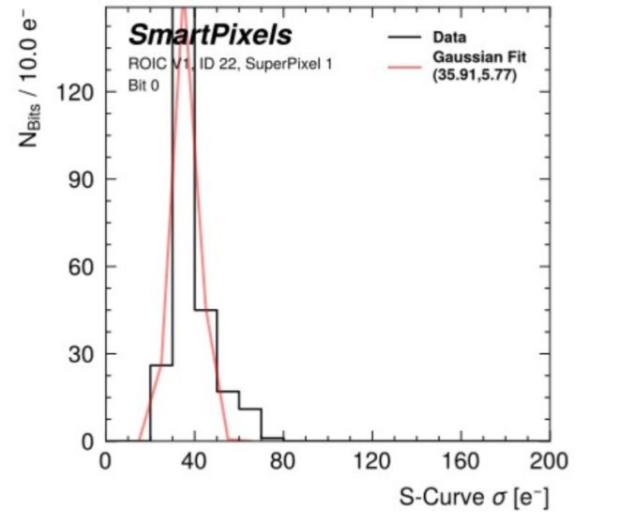


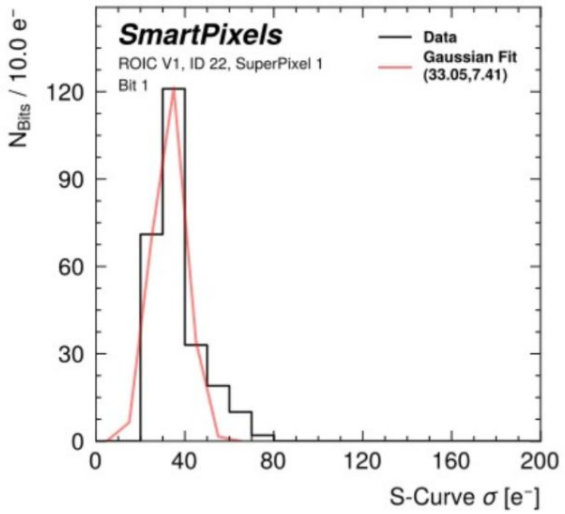

S-Curve σ [e⁻]
0 100 200 300 400 500
Row
Column

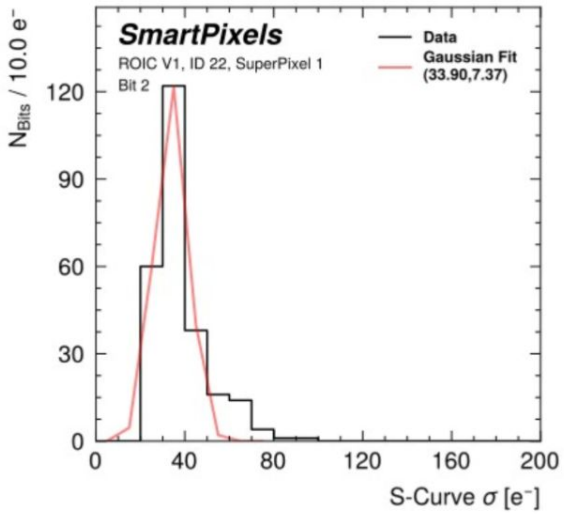

S-Curve σ [e⁻]
0 100 200 300 400 500
Row
Column


S-Curve σ [e⁻]
0 100 200 300 400 500
Row
Column

Cold (-20+-1C)


SmartPixels
ROIC V1, ID 22, SuperPixel 1
Bit 0
Data
Gaussian Fit
(35.91,5.77)
N_Bits / 10.0 e⁻
S-Curve σ [e⁻]


SmartPixels
ROIC V1, ID 22, SuperPixel 1
Bit 1
Data
Gaussian Fit
(33.05,7.41)
N_Bits / 10.0 e⁻
S-Curve σ [e⁻]


SmartPixels
ROIC V1, ID 22, SuperPixel 1
Bit 2
Data
Gaussian Fit
(33.90,7.37)
N_Bits / 10.0 e⁻
S-Curve σ [e⁻]

- Why are the Scurves at cold so jagged?
  - With old chip, Scurves looked cleaner at cold, now they look worse
- Why is the threshold dispersion worse at cold than with previous chip?

Room Temperuture:
/local/d1/smartpixLab/scurveData/ChipVersion1_ChipID22_SuperPix1/2026.02.18_16.09.49_MatrixNPix_vMin0.001_vMax0.400_vStep0.00100_nSample1365.000_vdda0.900_BXCLKf10.00_BxCLKDly45.00_injDly30.00_vth0-0.050_vth1-0.080_vth2-0.110_Ibias0.600

Cold:
/local/d1/smartpixLab/scurveData/ChipVersion1_ChipID22_SuperPix1/2026.05.15_13.01.36_MatrixNPix_vMin0.001_vMax0.400_vStep0.00100_nSample1365.000_vdda0.900_BXCLKf10.00_BxCLKDly45.00_injDly30.00_vth0-0.050_vth1-0.080_vth2-0.160_Ibias0.600

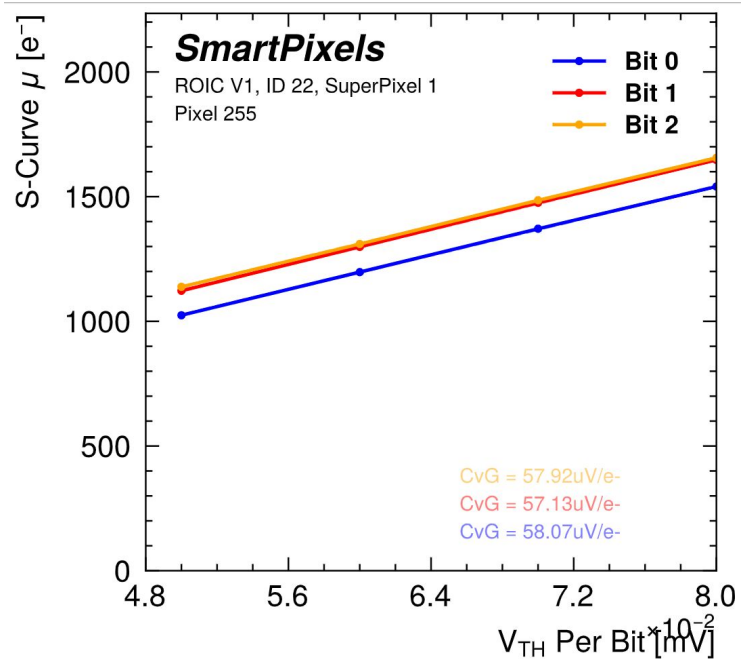
Room temp: /local/d1/smartpixLab/scurveData/ChipVersion1_ChipID22_SuperPix1/2025.12.05__MatrixCvG_vMin0.001_vMax0.400_vStep0.00100_nSample1365.000_vdda0.900_BXCLKf10.00_BxCLKDly45.00_injDly30.00_Ibias0.600

Cold: /local/d1/smartpixLab/scurveData/ChipVersion1_ChipID22_SuperPix1/2026.05.16__MatrixCvG_vMin0.001_vMax0.400_vStep0.00100_nSample1365.000_vdda0.900_BXCLKf10.00_BxCLKDly45.00_injDly30.00_Ibias0.600

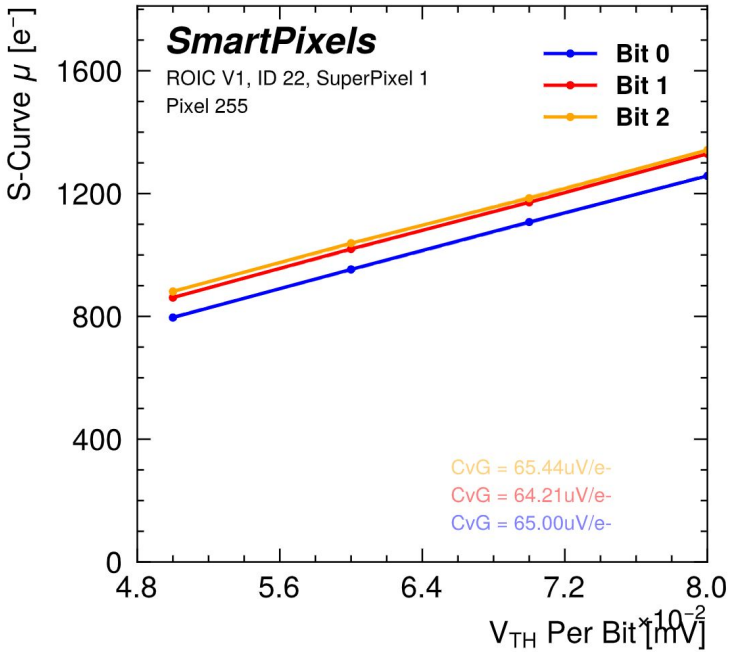
CvG curve scan

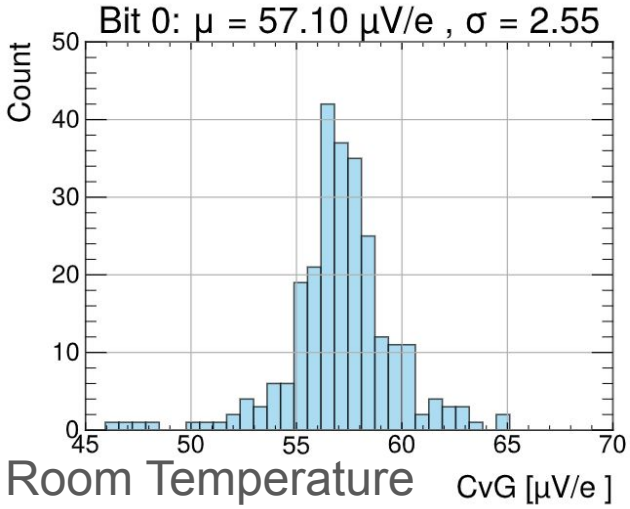
- The conversion of input voltage threshold (vth) into electron count is calculated with a CvG curve

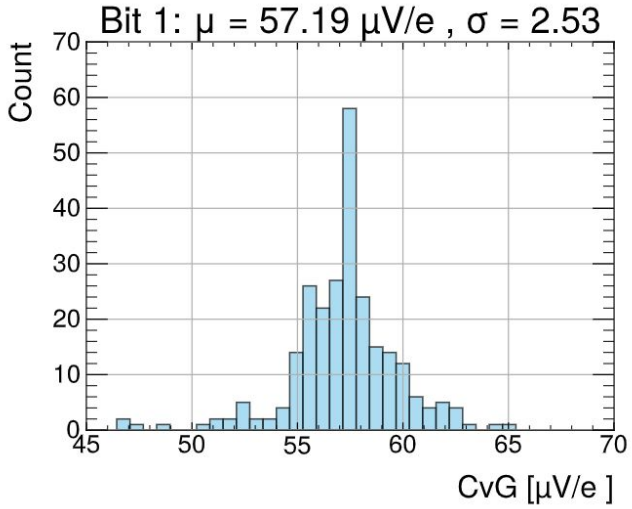
Room Temperature

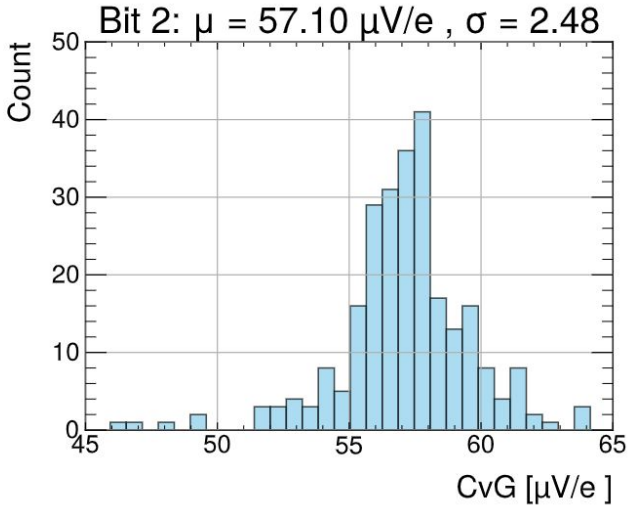


Cold (-20+-1 C)

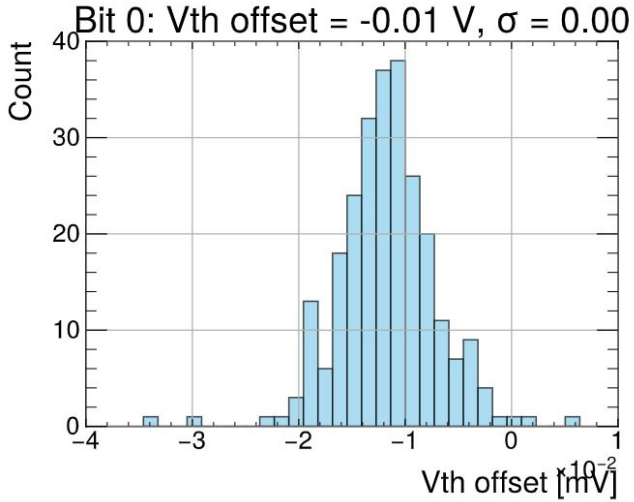


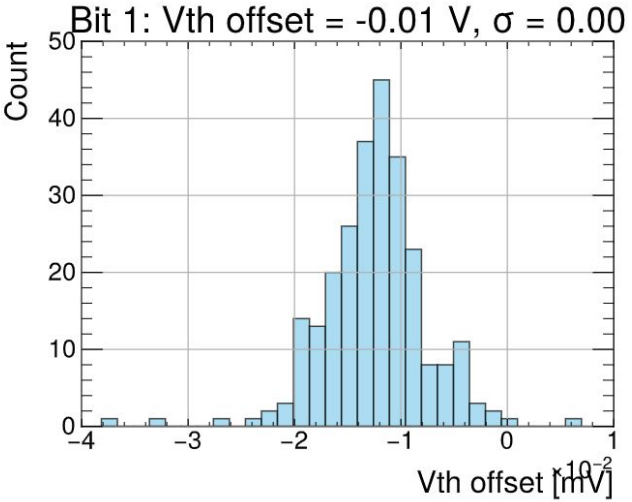


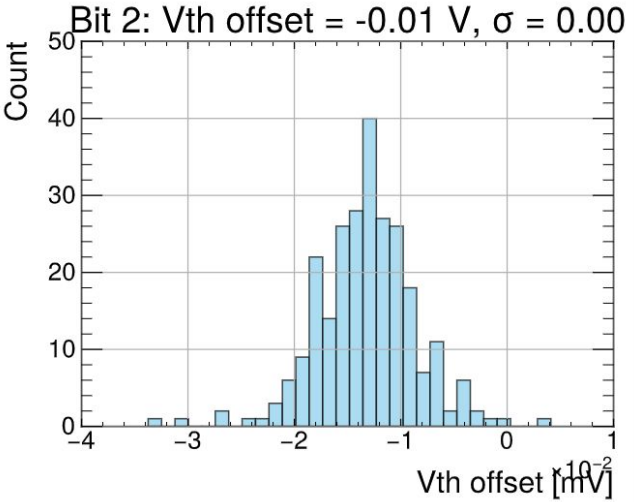


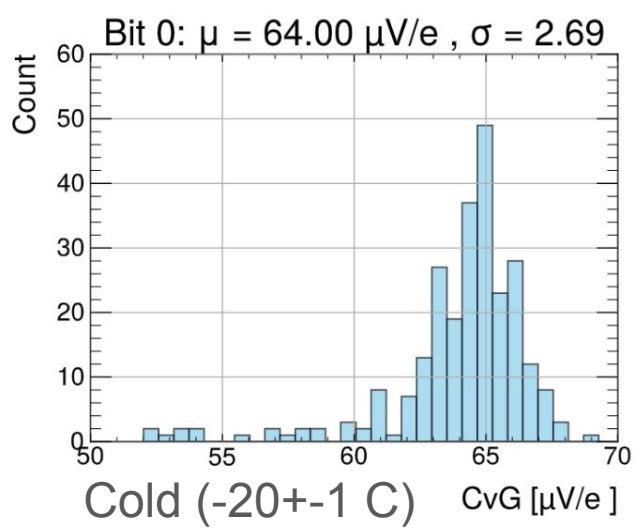


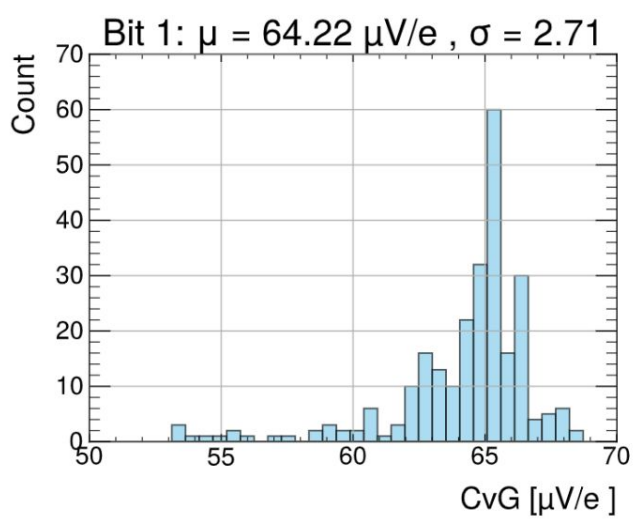
Room Temperature

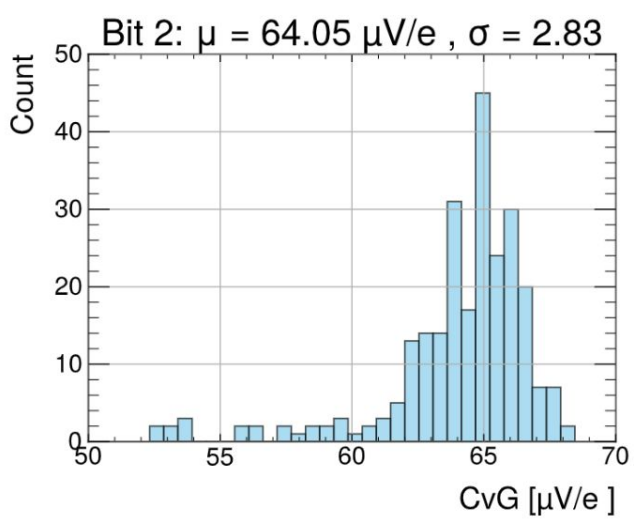




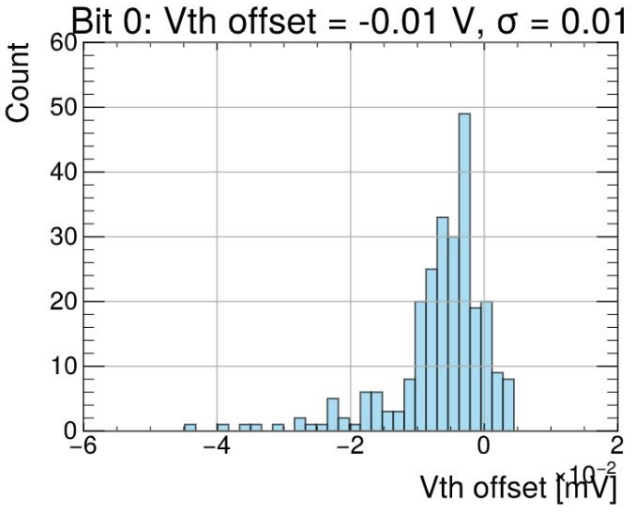


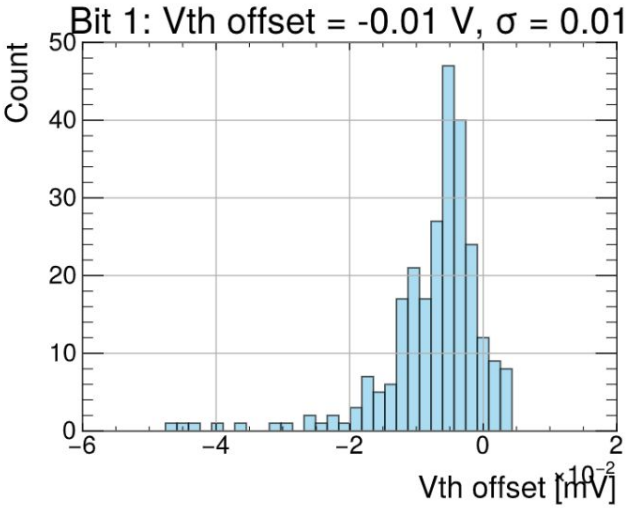

Bit 0: μ = 64.00 μV/e , σ = 2.69
Count
CvG [μV/e]

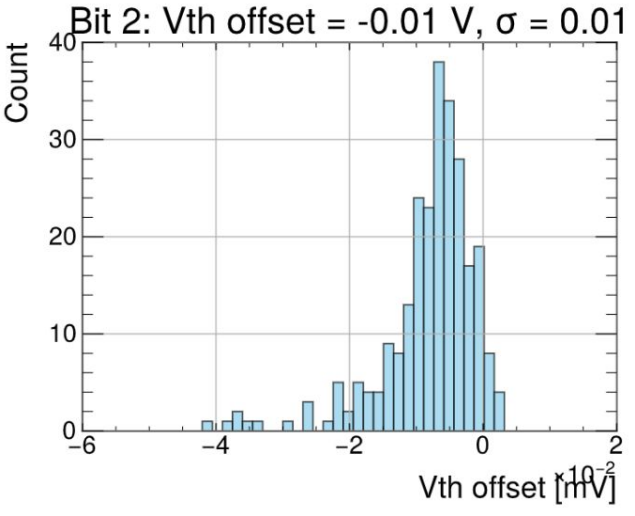

Bit 1: μ = 64.22 μV/e , σ = 2.71
Count
CvG [μV/e]


Bit 2: μ = 64.05 μV/e , σ = 2.83
Count
CvG [μV/e]

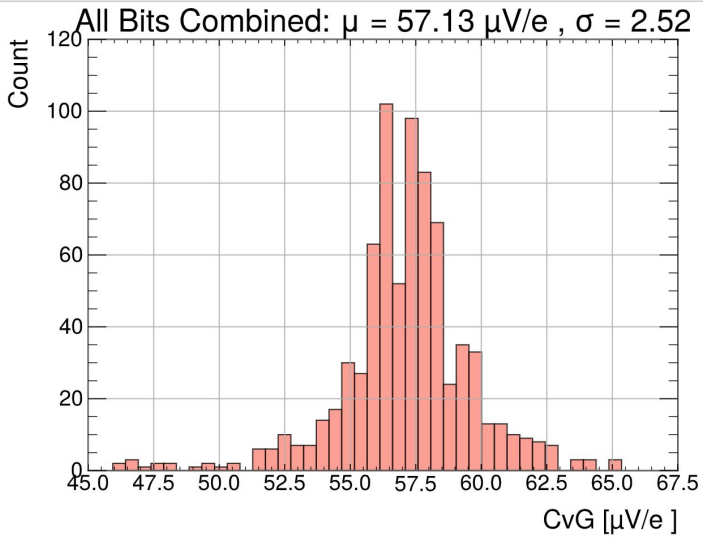
Cold (-20+-1 C)

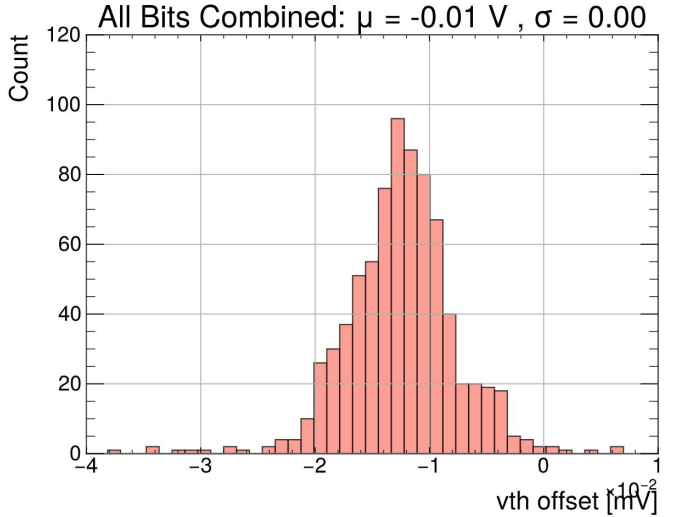

Bit 0: Vth offset = -0.01 V, σ = 0.01
Count
Vth offset [mV]
×10⁻²


Bit 1: Vth offset = -0.01 V, σ = 0.01
Count
Vth offset [mV]
×10⁻²

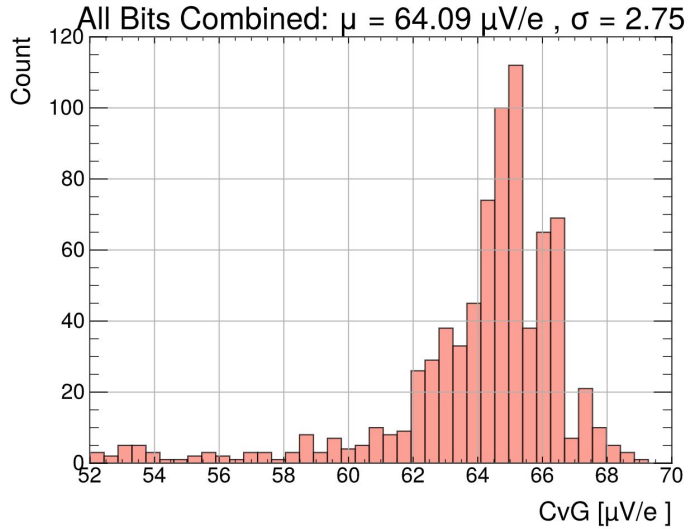

Bit 2: Vth offset = -0.01 V, σ = 0.01
Count
Vth offset [mV]
×10⁻²

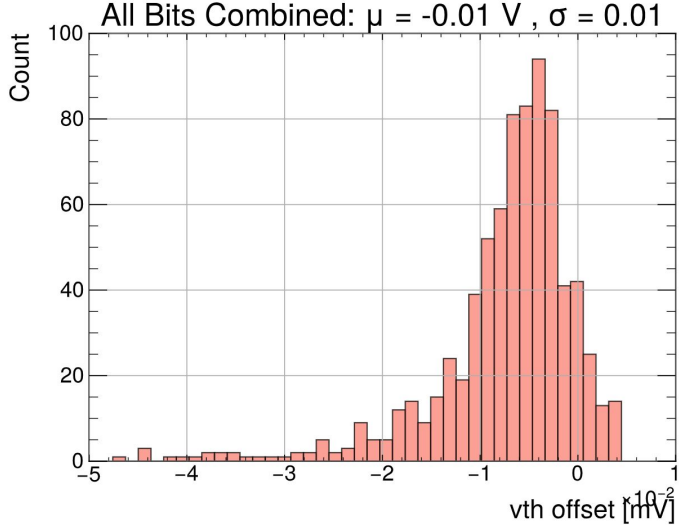
Room Temperature

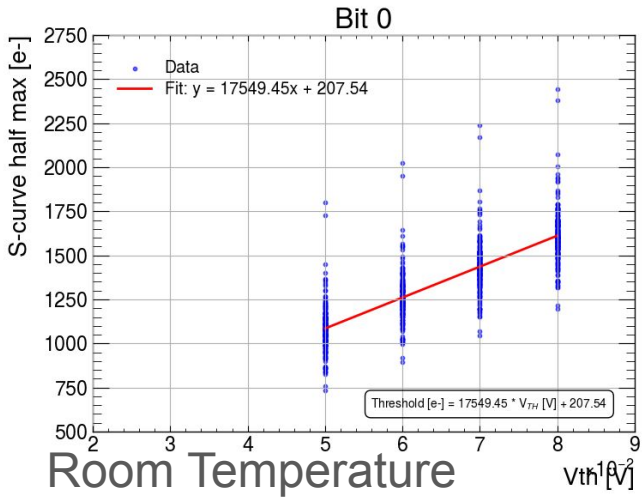


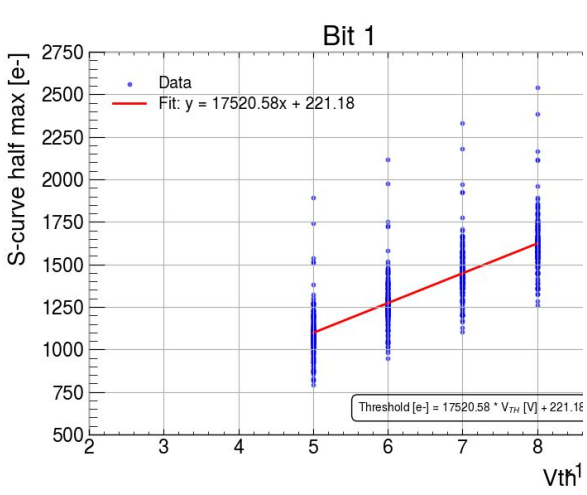


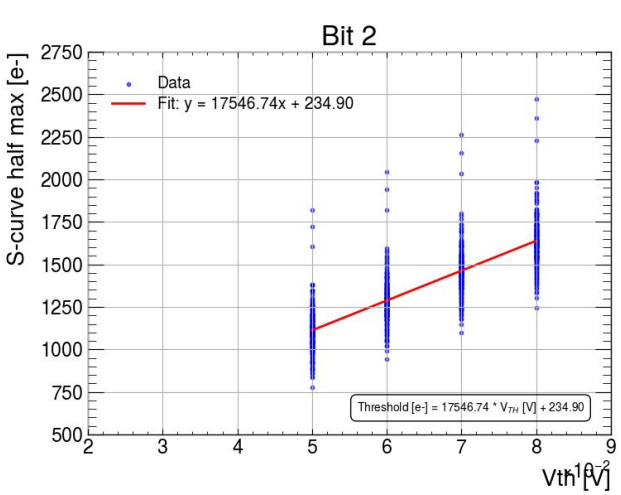
Cold (-20 +- 1 C)



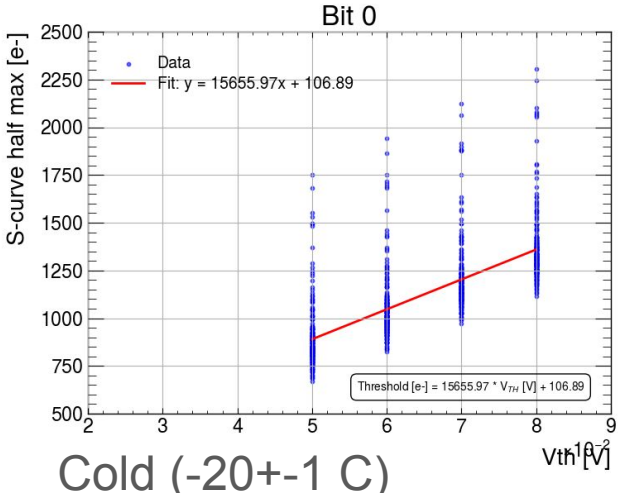


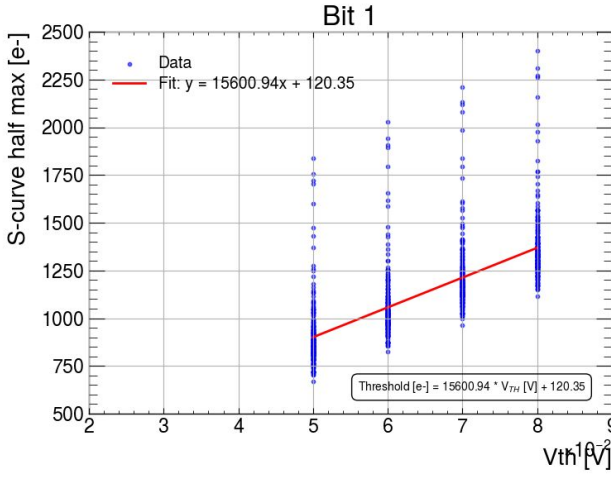


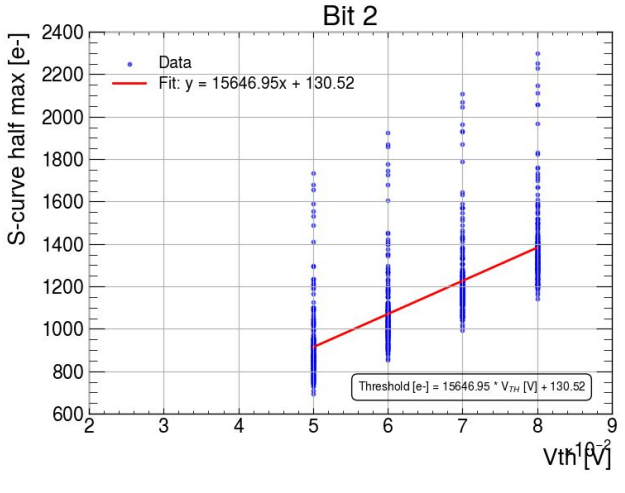




Room Temperature







Cold (-20+-1 C)