

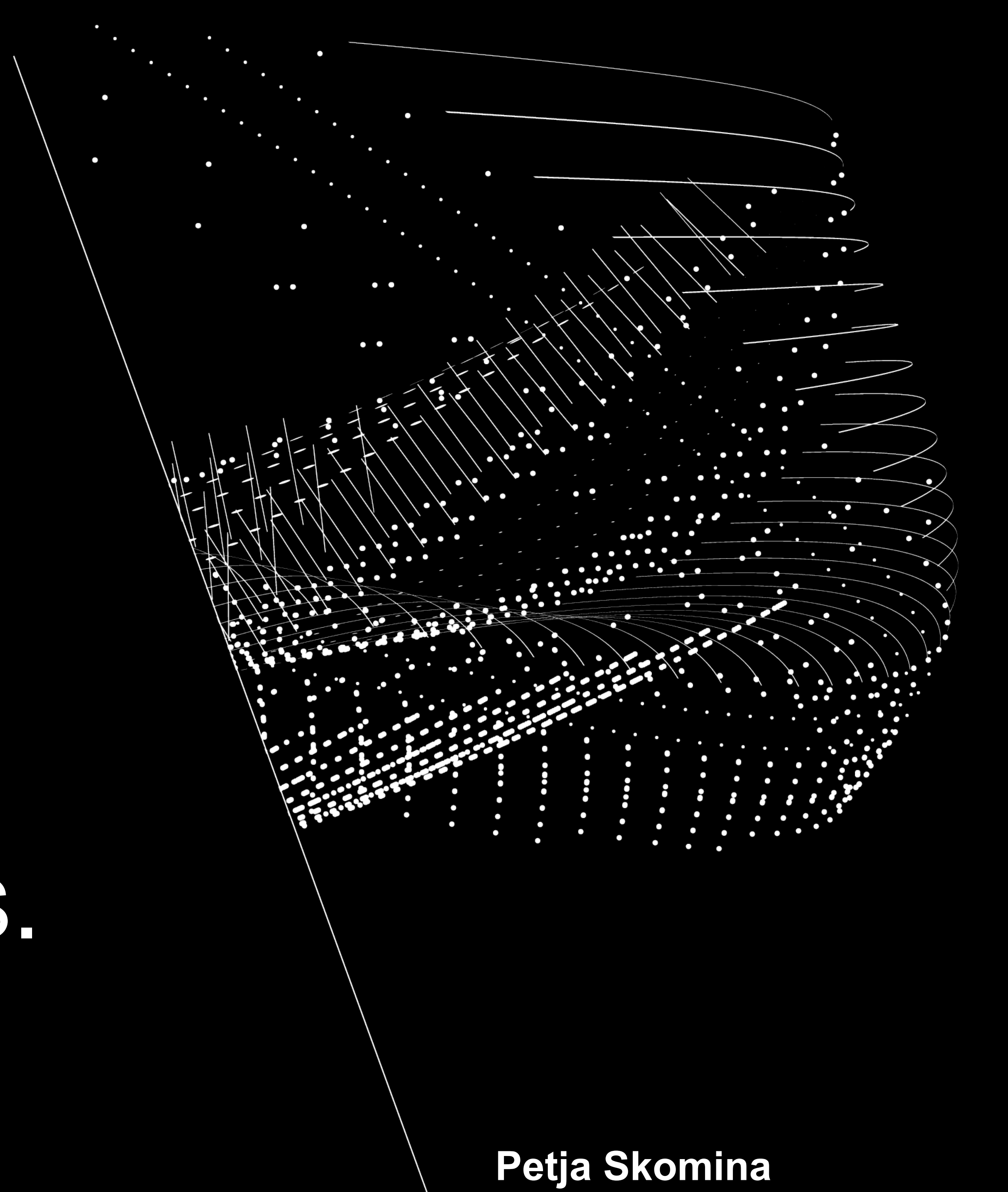
Nikhef



HGTD LGAD COLLECTED CHARGE VS. TEMPERATURE

JSI, JUNE 2026

Petja Skomina

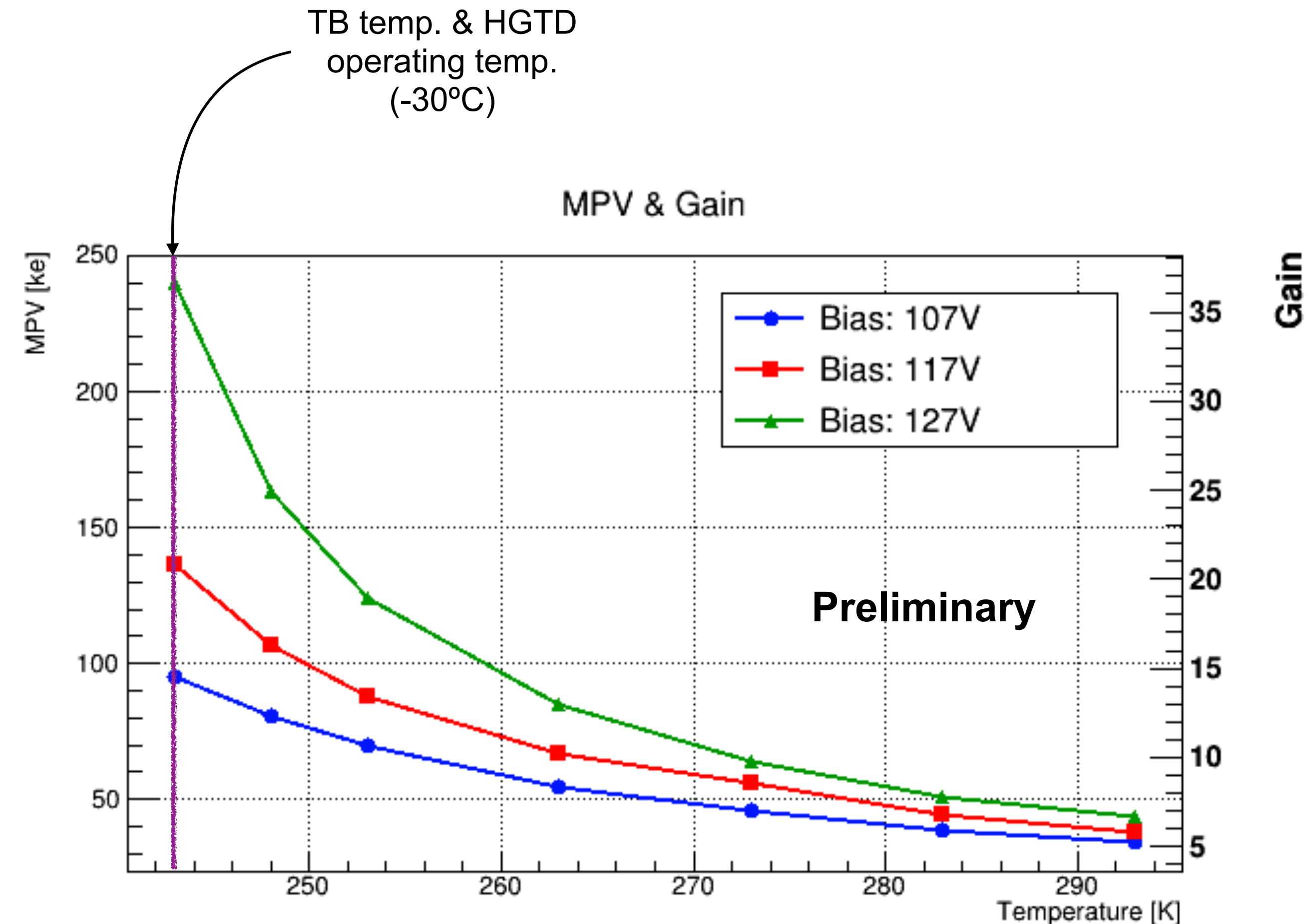


HGTD LGAD SIMULATION WITH ALLPIX²

- ▶ The goal: develop a model of the LGADs' response, to be able to predict the sensors' behaviour throughout their lifetime
- ▶ Using the Allpix Squared simulation framework and combining various inputs (e.g. sensor TCADs, electronics response function)
- ▶ Compare simulation output with results from test beam measurements
 - ▶ Develop gain model to be able to predict the sensors' timing resolution
 - ▶ Model electronics response
 - ▶ Produce efficiency maps

CHARGE MULTIPLICATION: TEMPERATURE DEPENDANCE

- ▶ Looked into temperature dependance of the Optimised Okuto-Crowell model
- ▶ Especially around the HGTD operating temperature the dependance is very steep
 - ▶ How can we validate this?



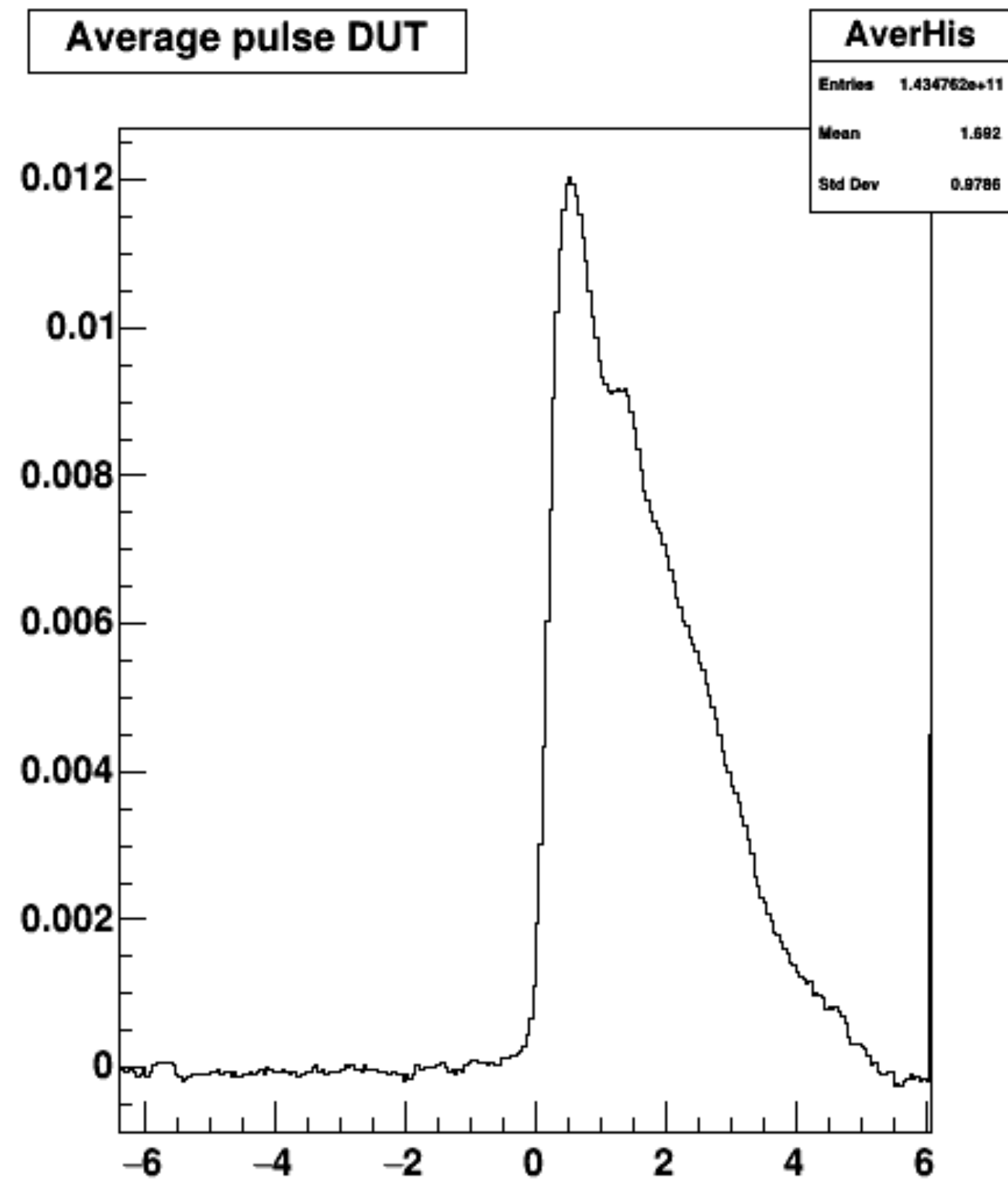
CHARGE CALIBRATION

Reference:

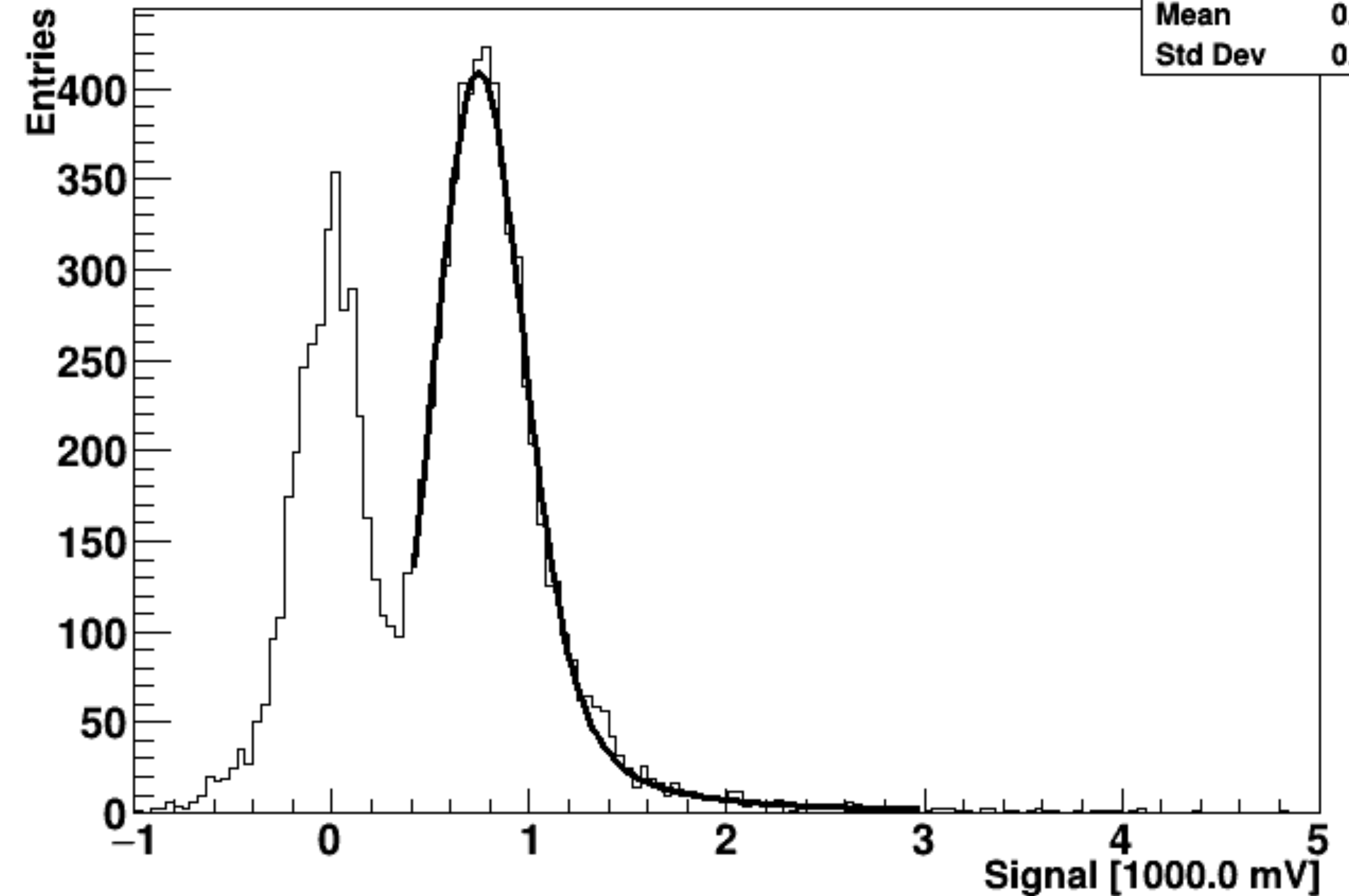
- ▶ CNM W7 V15 (285 μ m PiN diode)
- ▶ $V_B = 400V$
- ▶ Room temperature

Langau MPV: 0.682 Vns

Deposited charge (N. Cartiglia): 22.1ke (3.54fC)



Signal integral DUT $V_{bias} = -400 V$

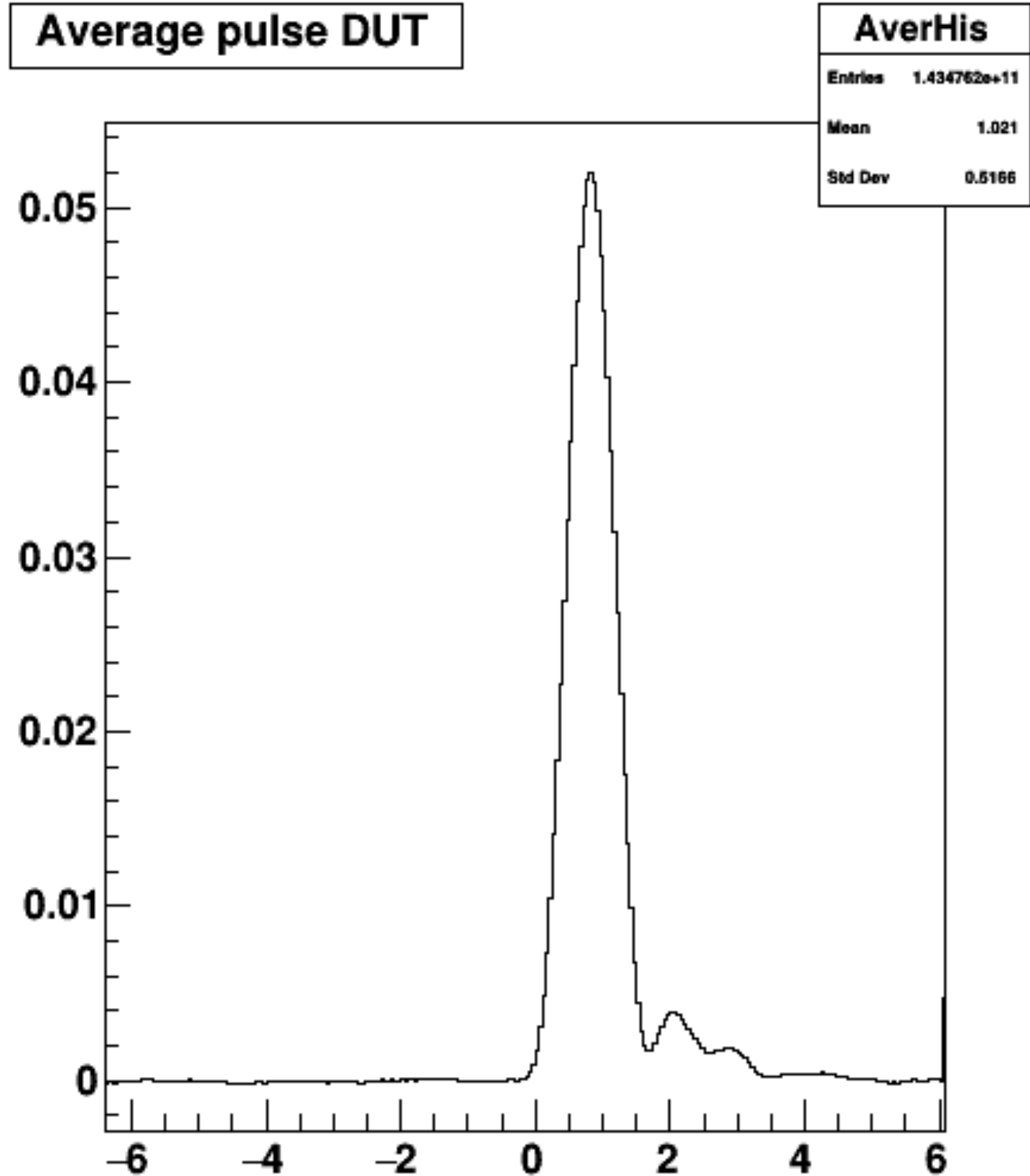


CHARGE CALIBRATION

DUT:

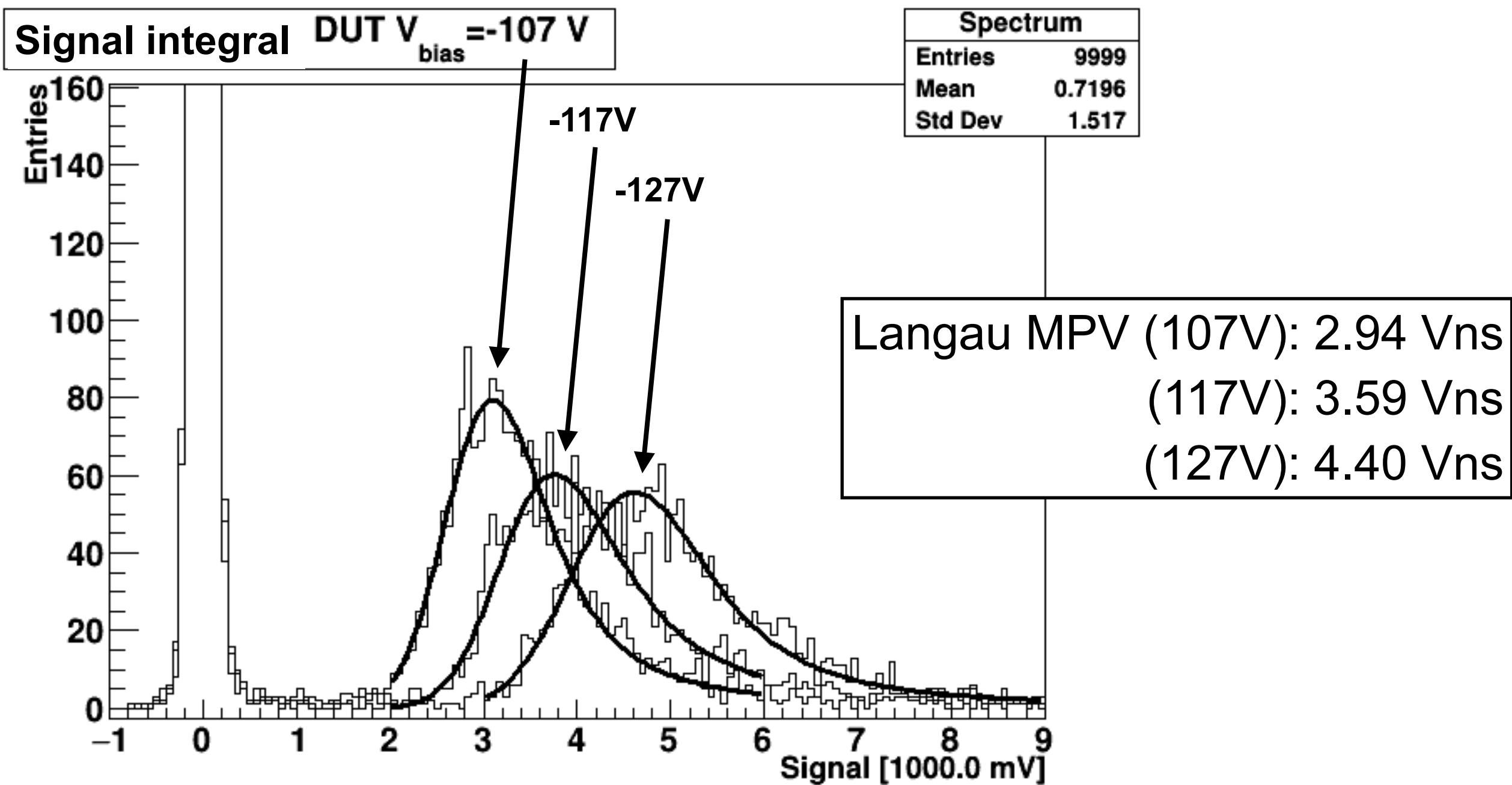
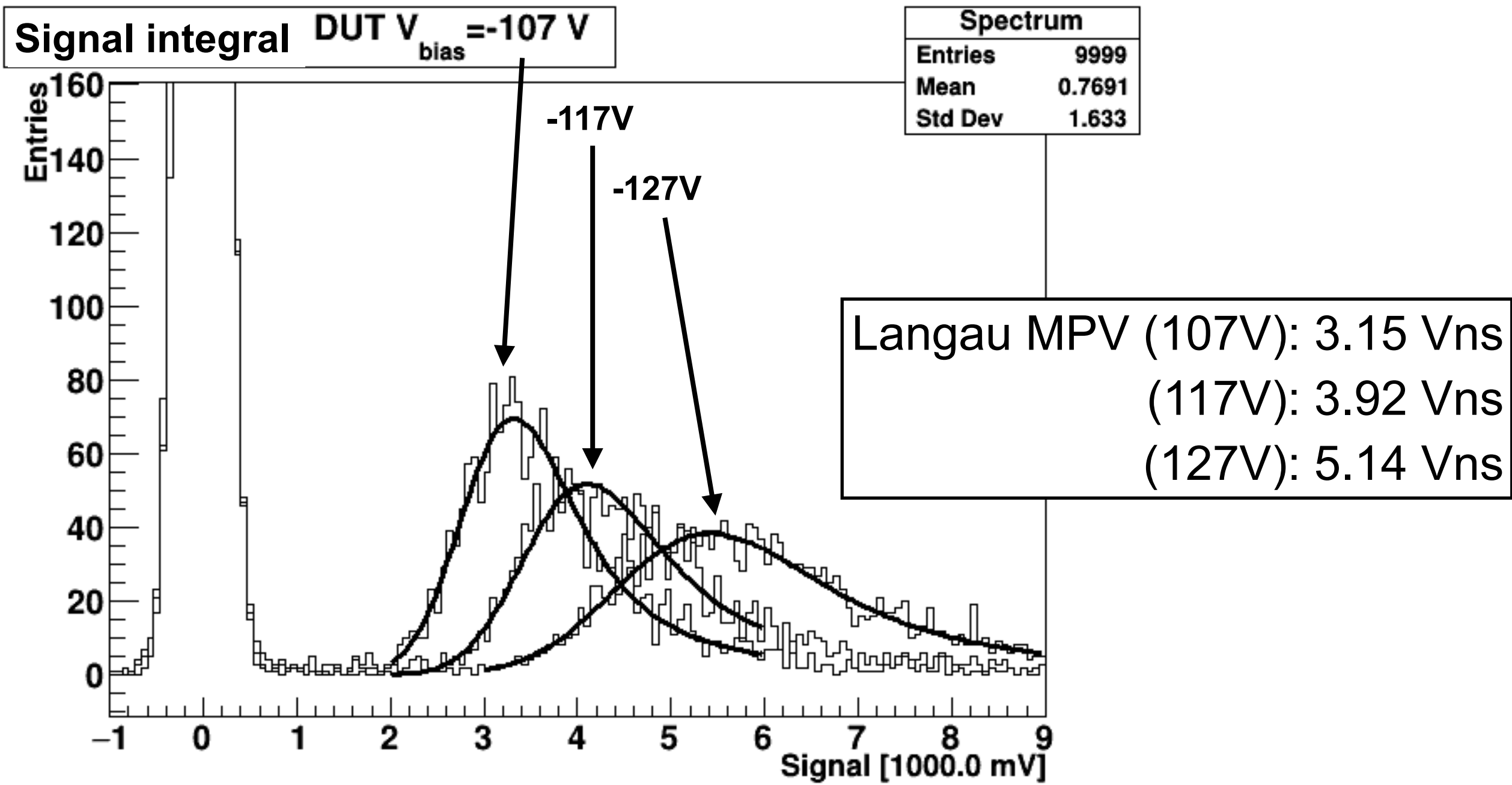
- ▶ USTC W7 P48 (50 μ m LGAD)
- ▶ $V_B = [(102), 107, (112), 117, (122), 127]$ V
- ▶ Temperature = -20 $^{\circ}$ C

Average pulse DUT



Integration time = 5ns

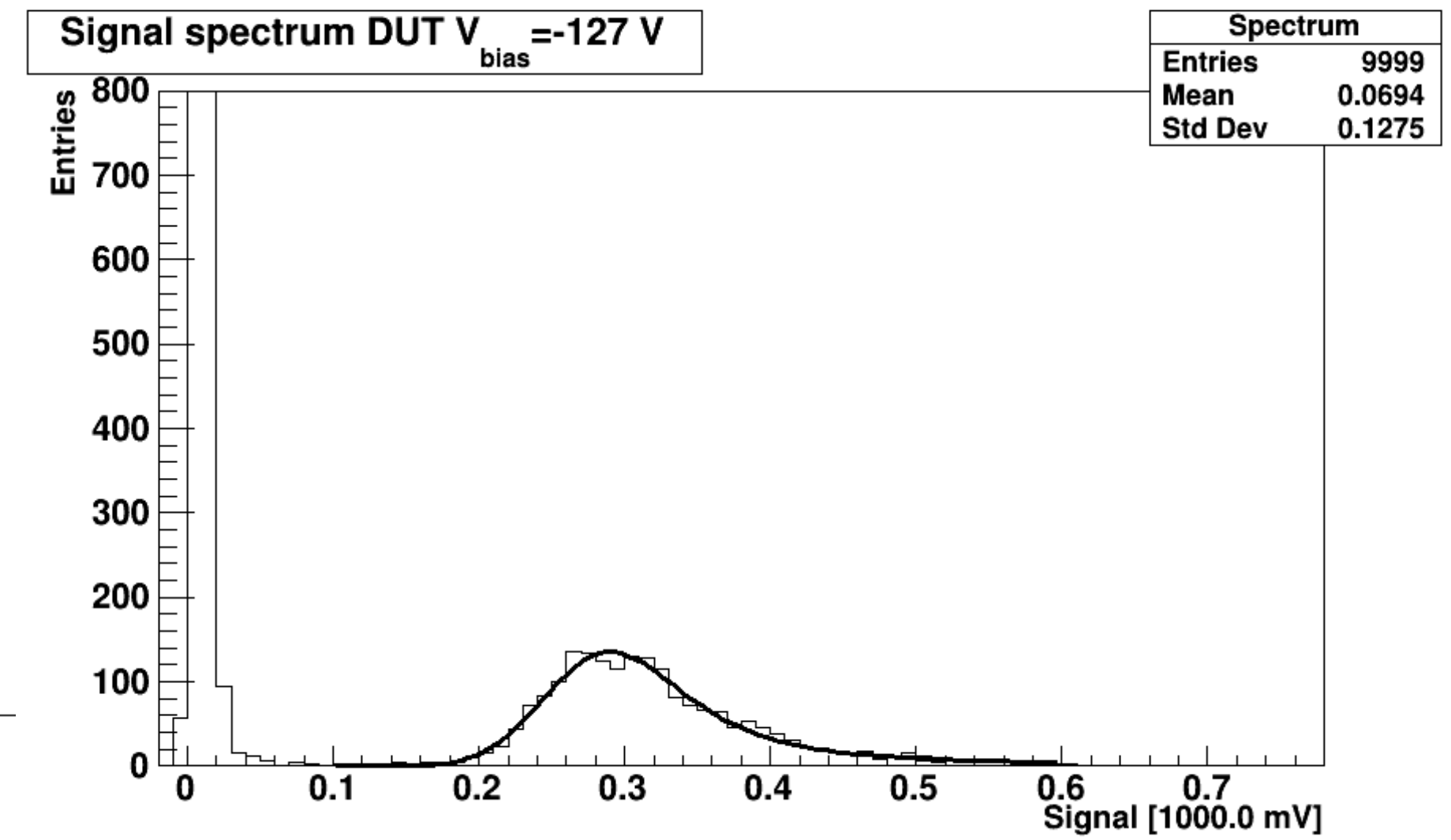
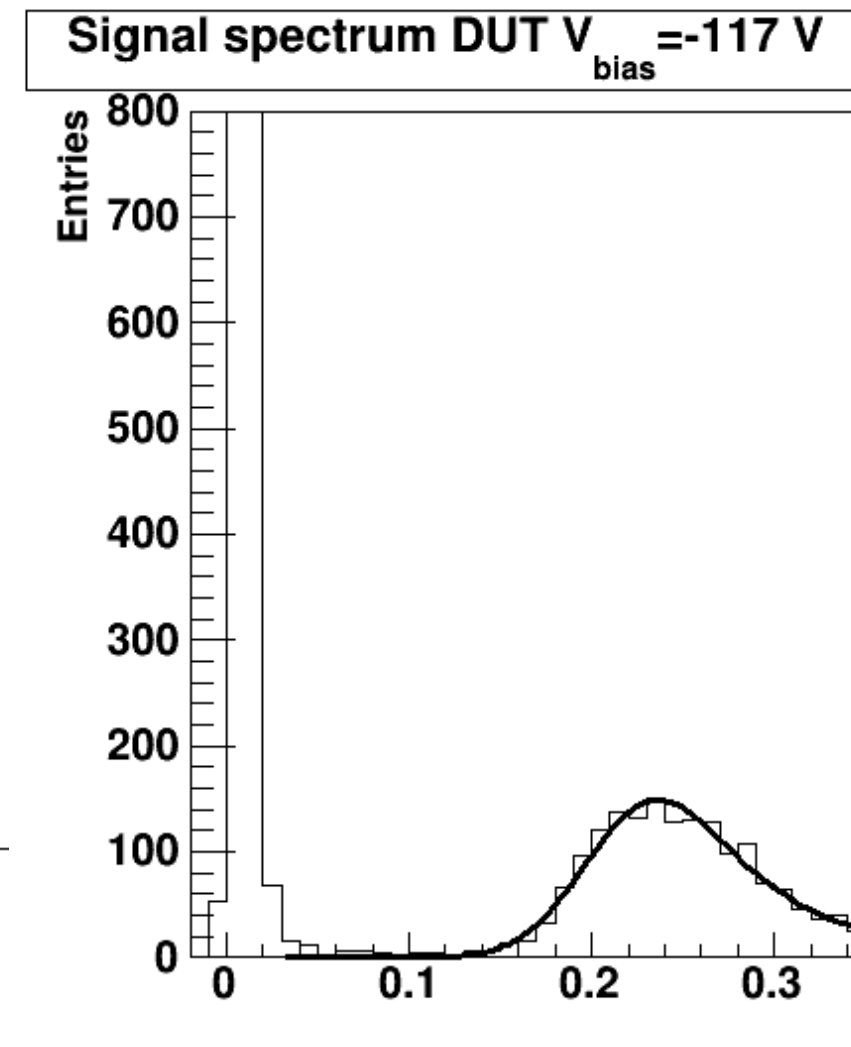
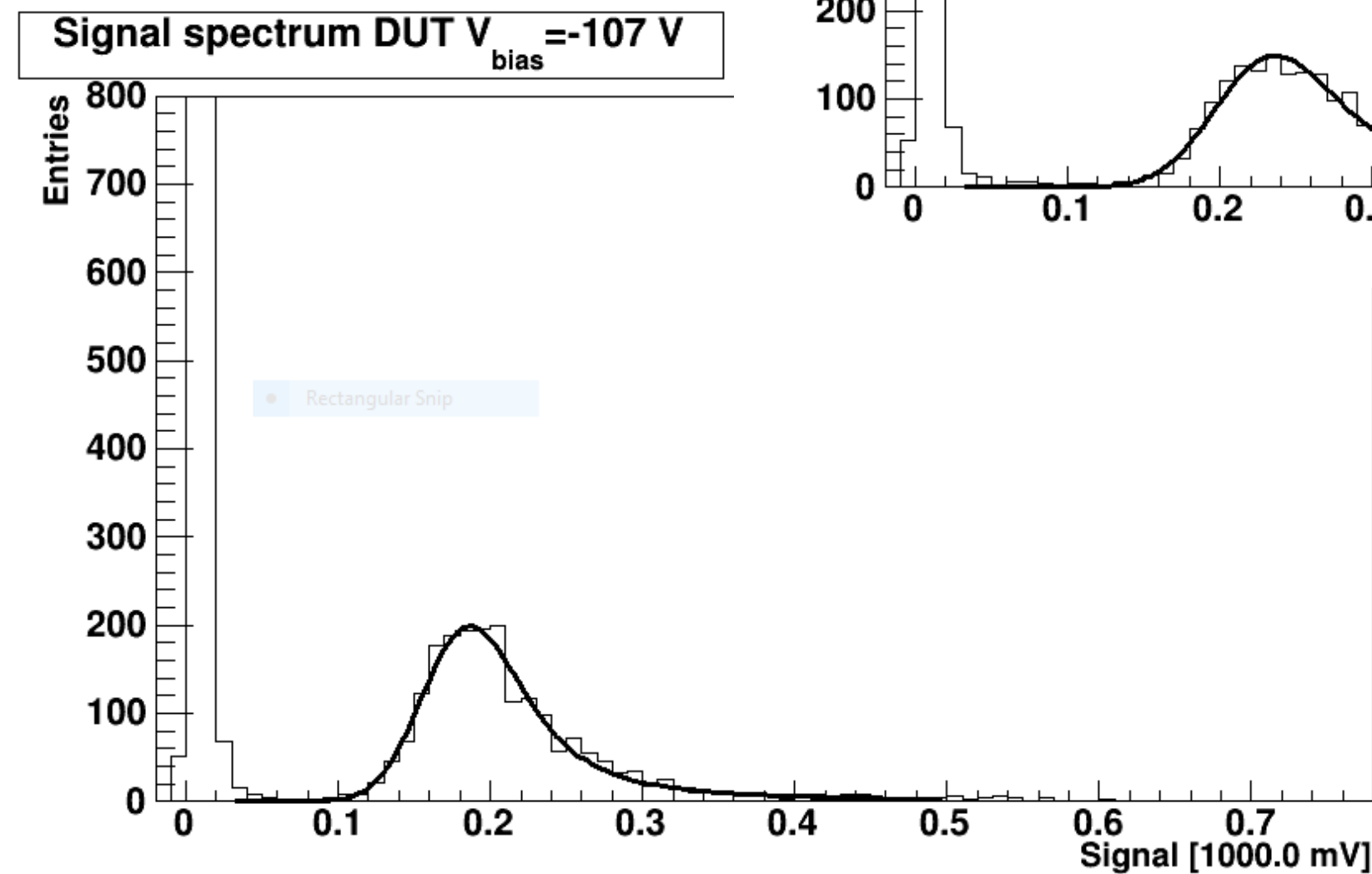
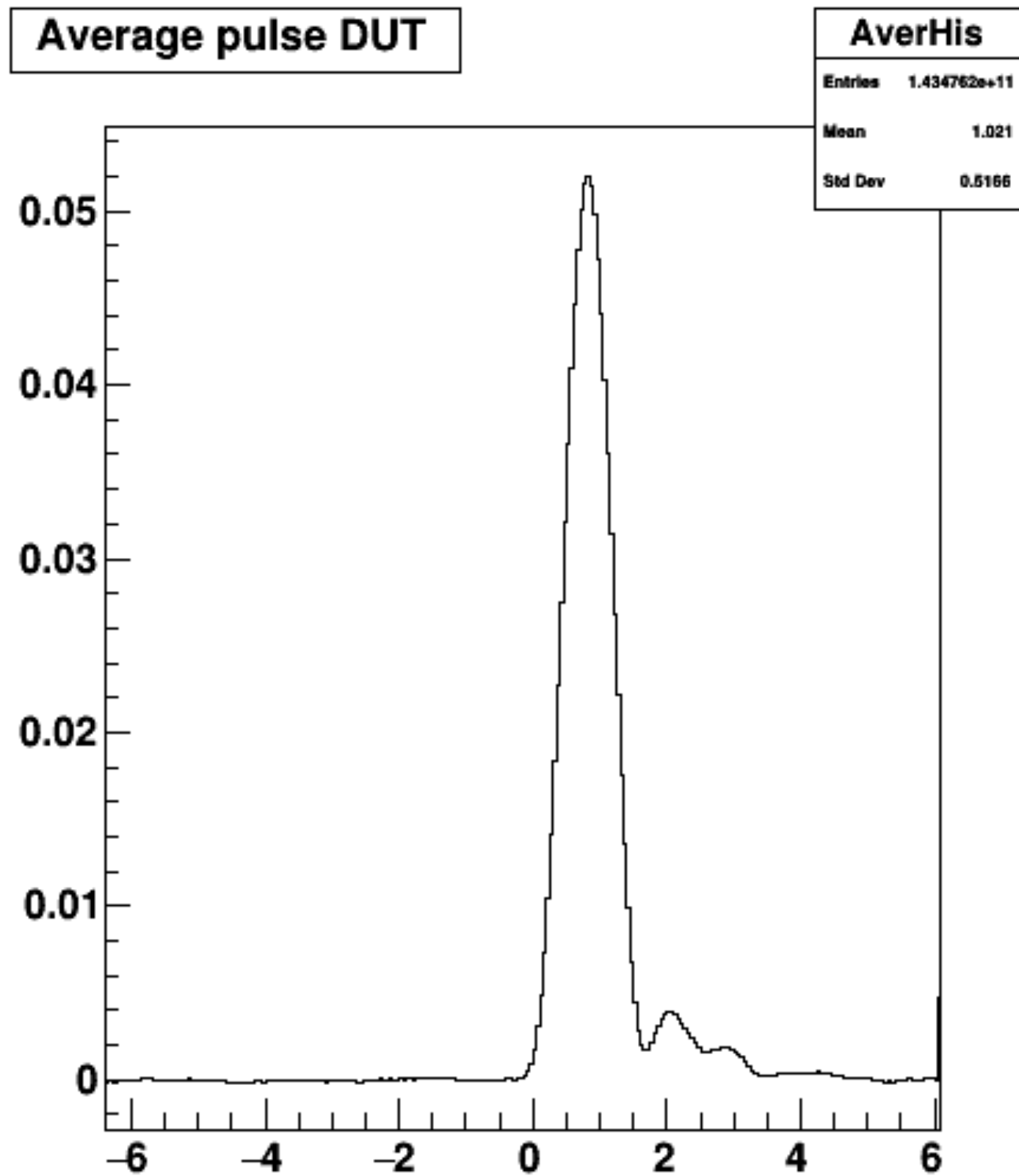
Integration time = 1.5ns



CHARGE CALIBRATION

DUT:

- ▶ USTC W7 P48 (50 μ m LGAD)
- ▶ $V_B = [(102), 107, (112), 117, (122), 127]$ V
- ▶ Temperature = -20 $^{\circ}$ C



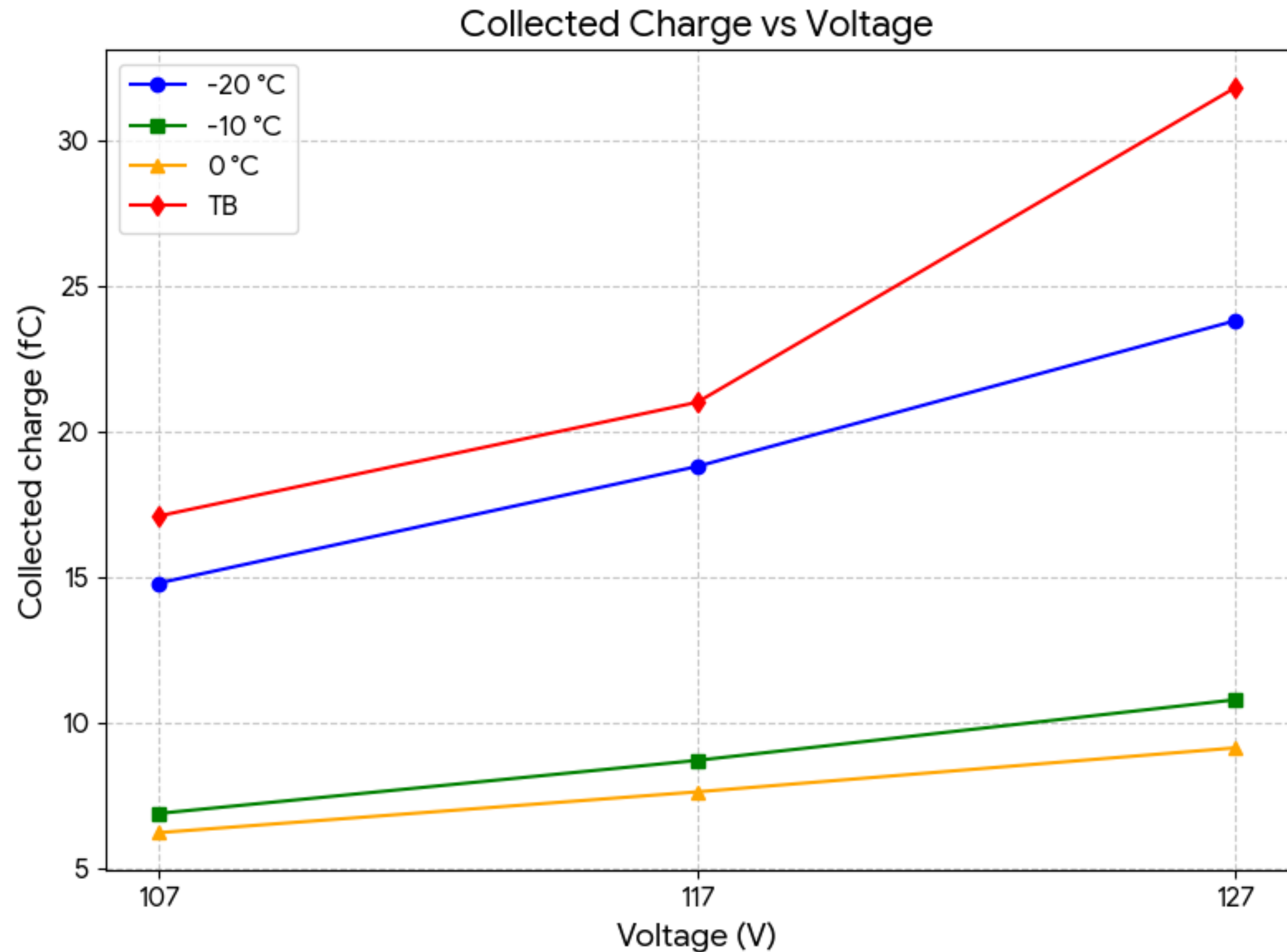
Langau MPV (107V): 0.177 V
 (117V): 0.224 V
 (127V): 0.277 V

CHARGE CALIBRATION

Conversion constant (peak Langau MPV to fC)

- ▶ Integration time 5ns:
 - ▶ 107V: 92.3
 - ▶ 117V: 90.7
 - ▶ 127V: 96.2
- ▶ Integration time 1.5ns:
 - ▶ 107V: 86.1
 - ▶ 117V: 83.1
 - ▶ 127V: 82.4

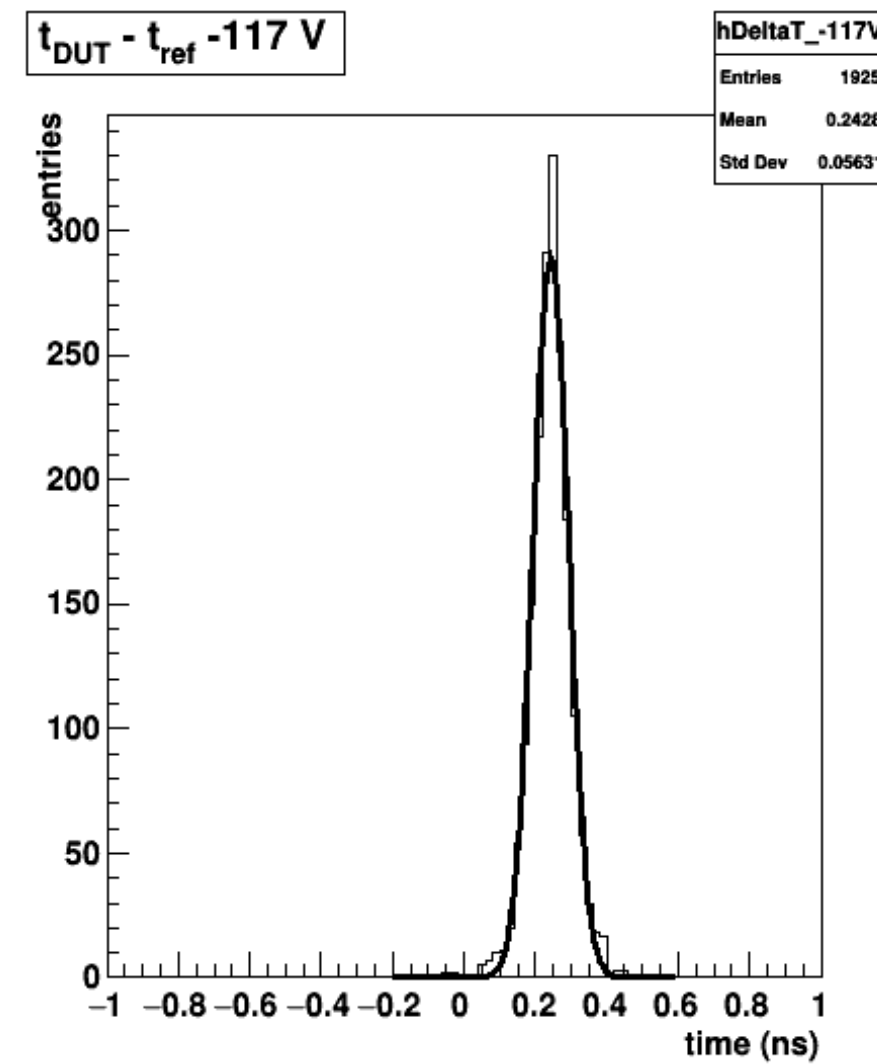
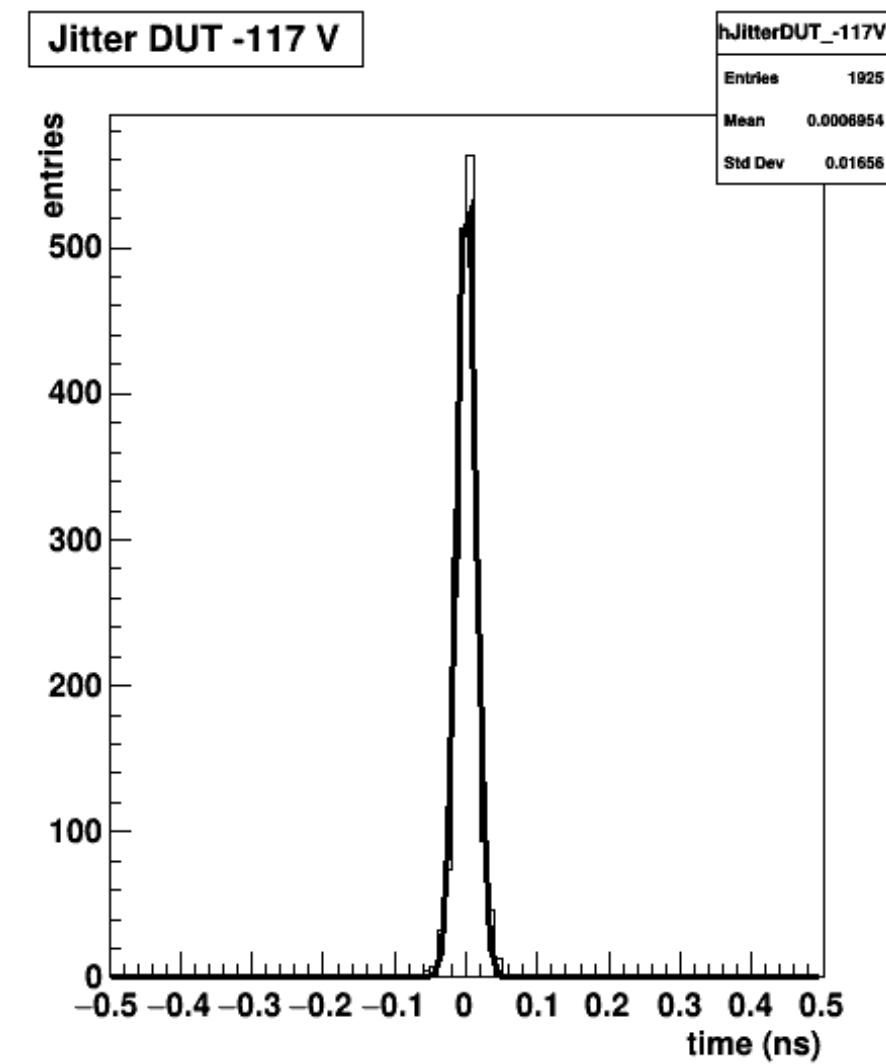
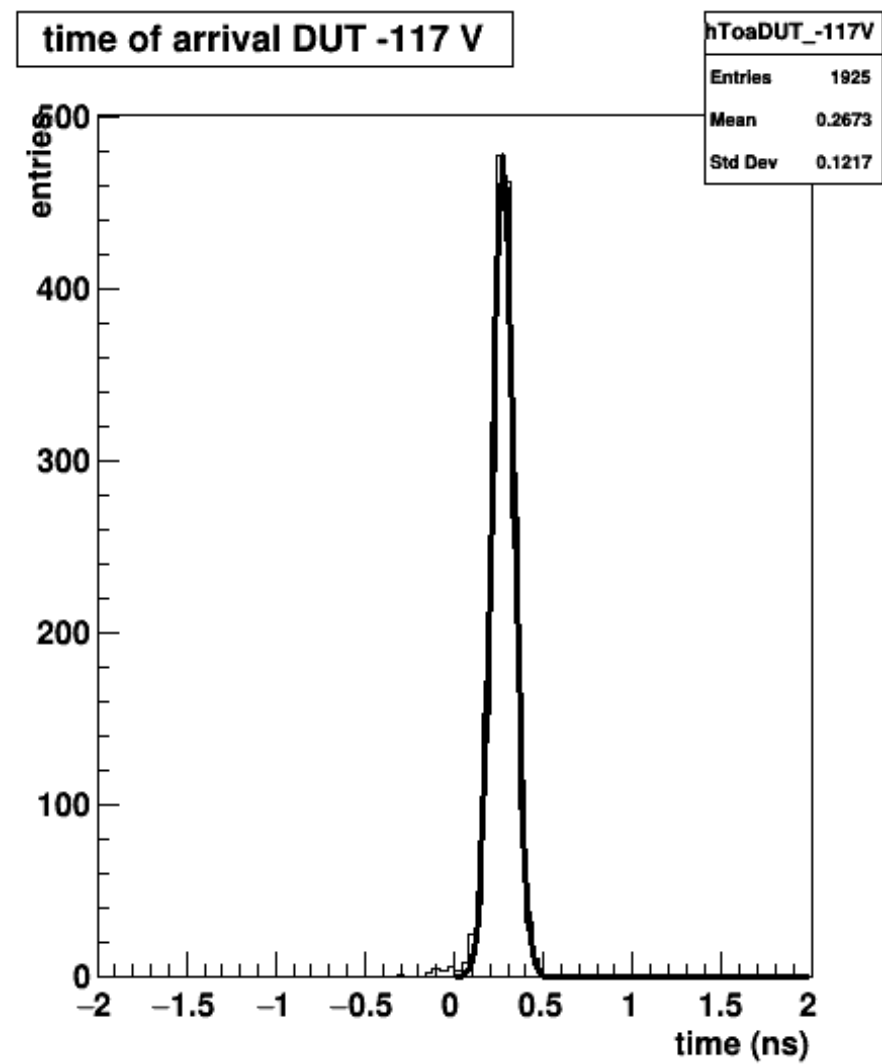
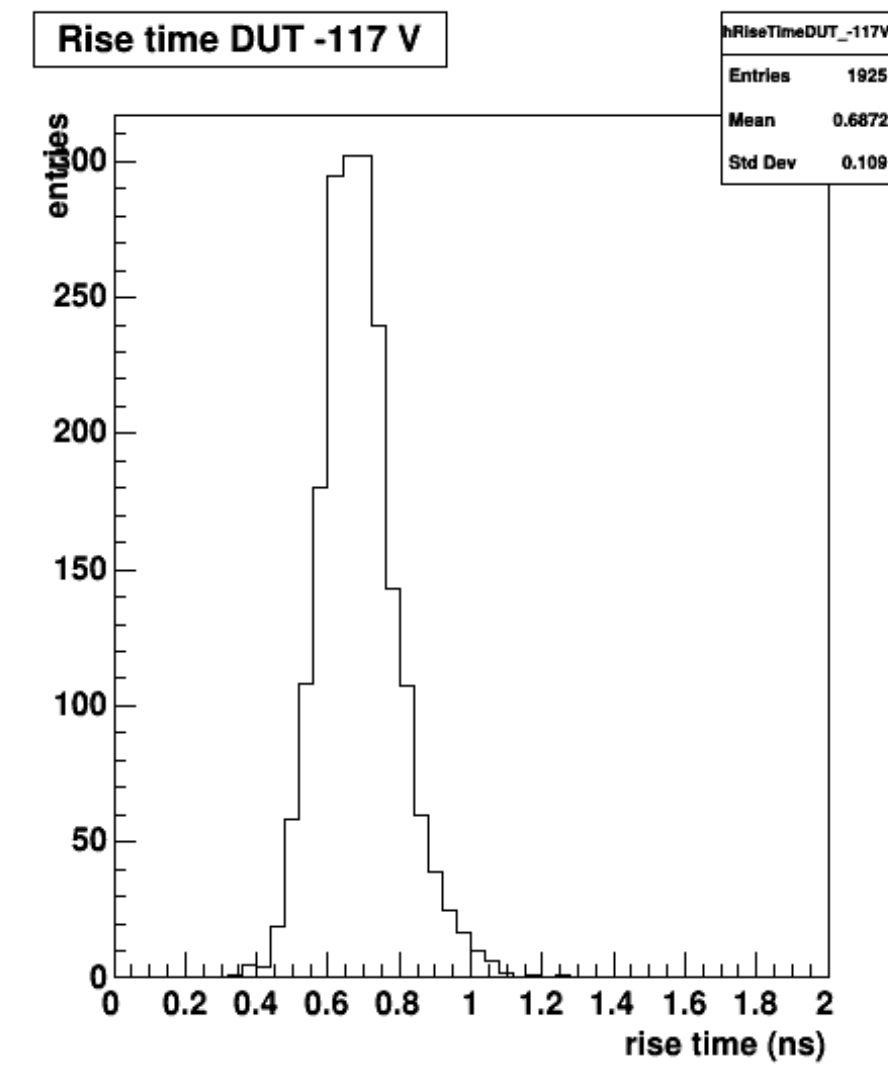
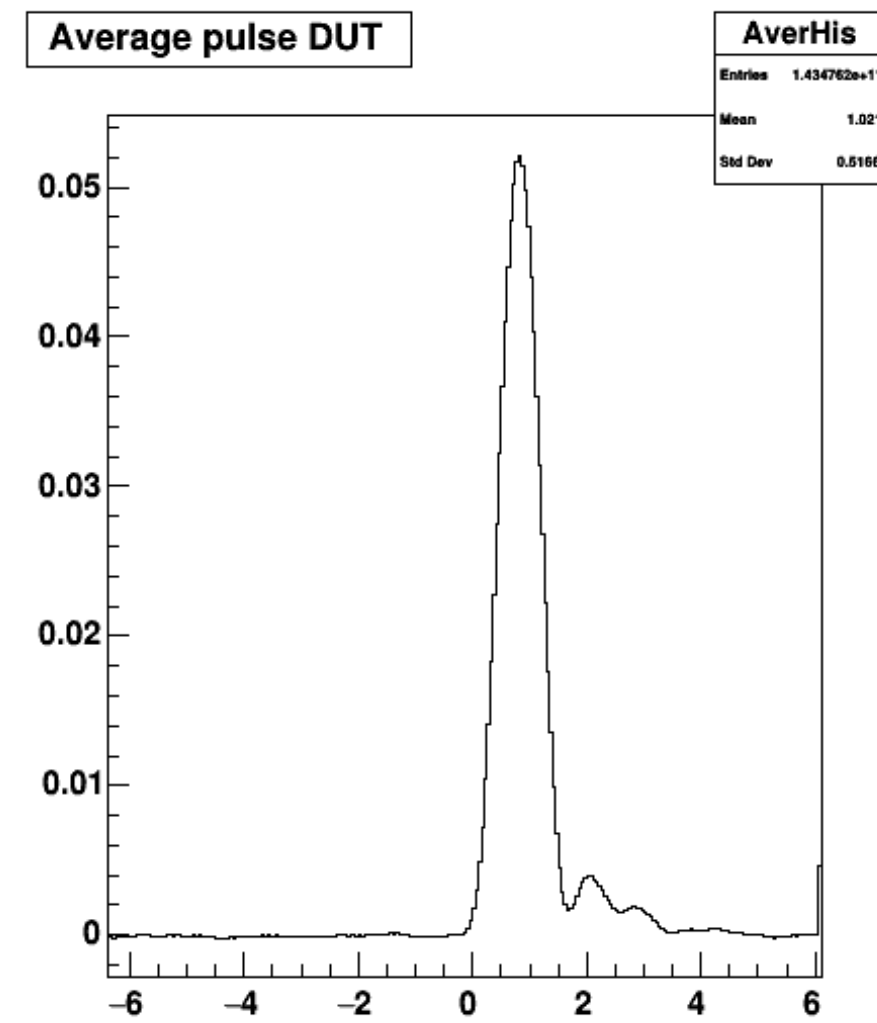
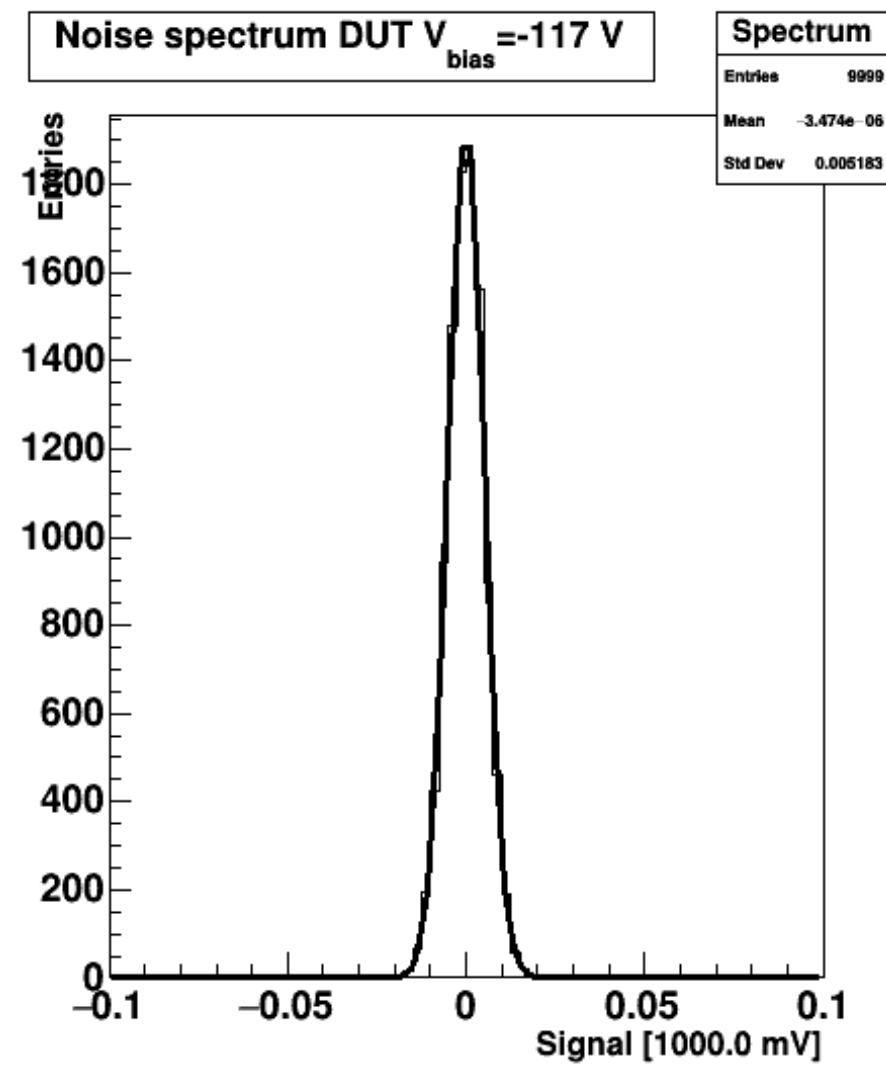
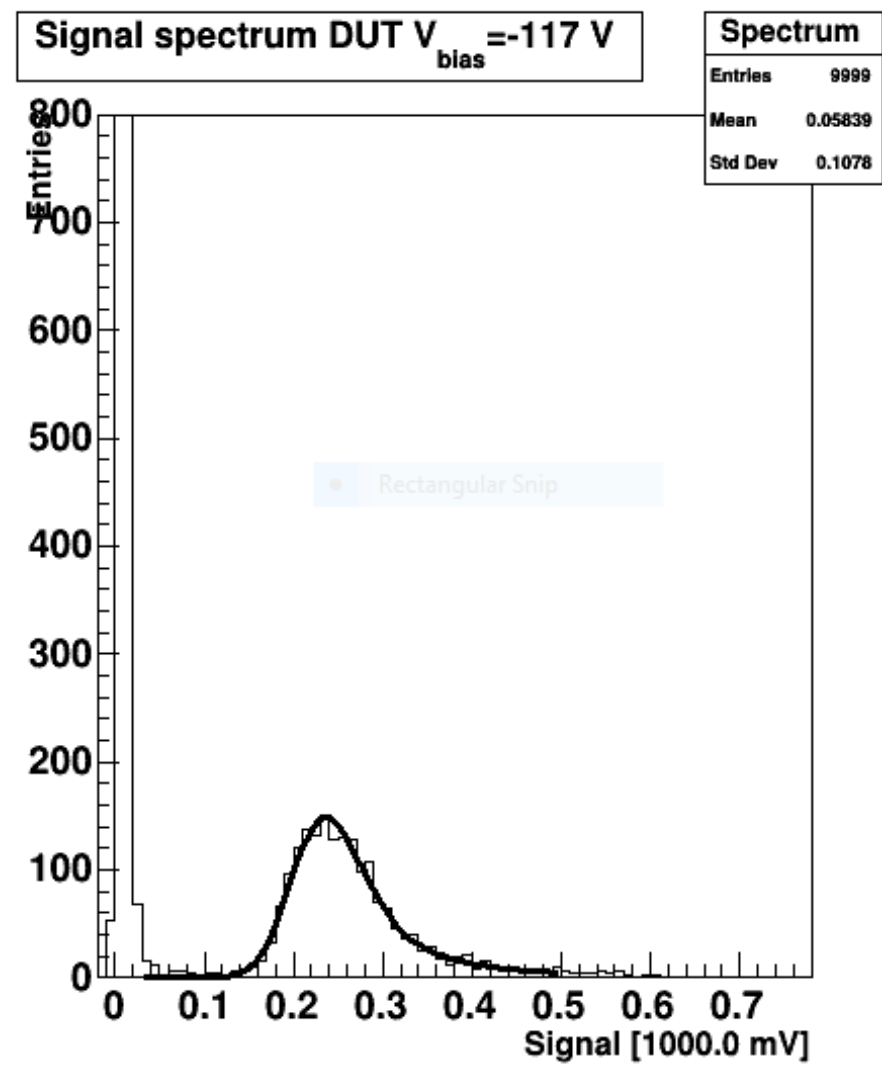
COLLECTED CHARGE VS. TEMPERATURE



Conversion constant
used: 83.9

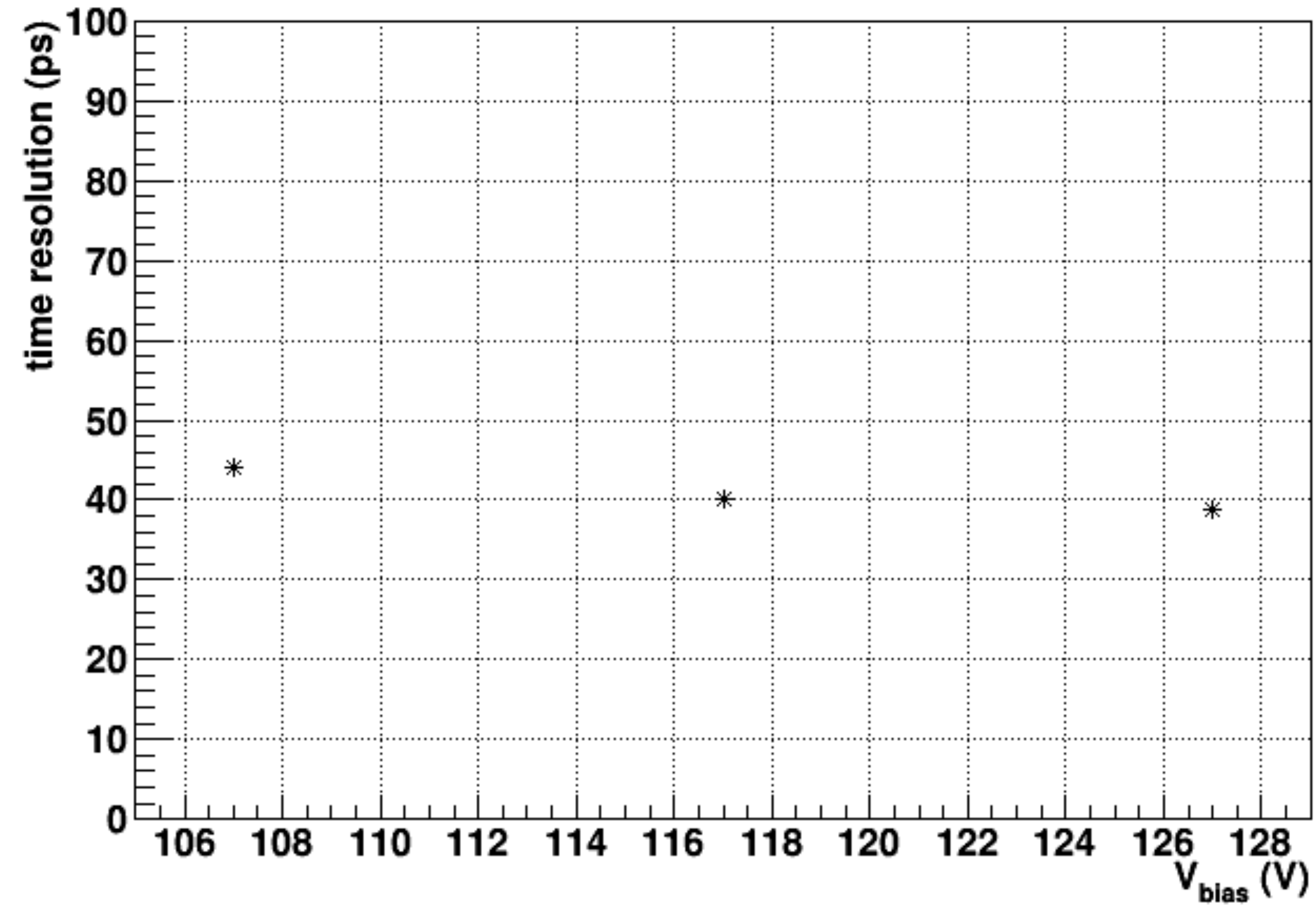
BACK-UP

DUT: 117V, -20°C



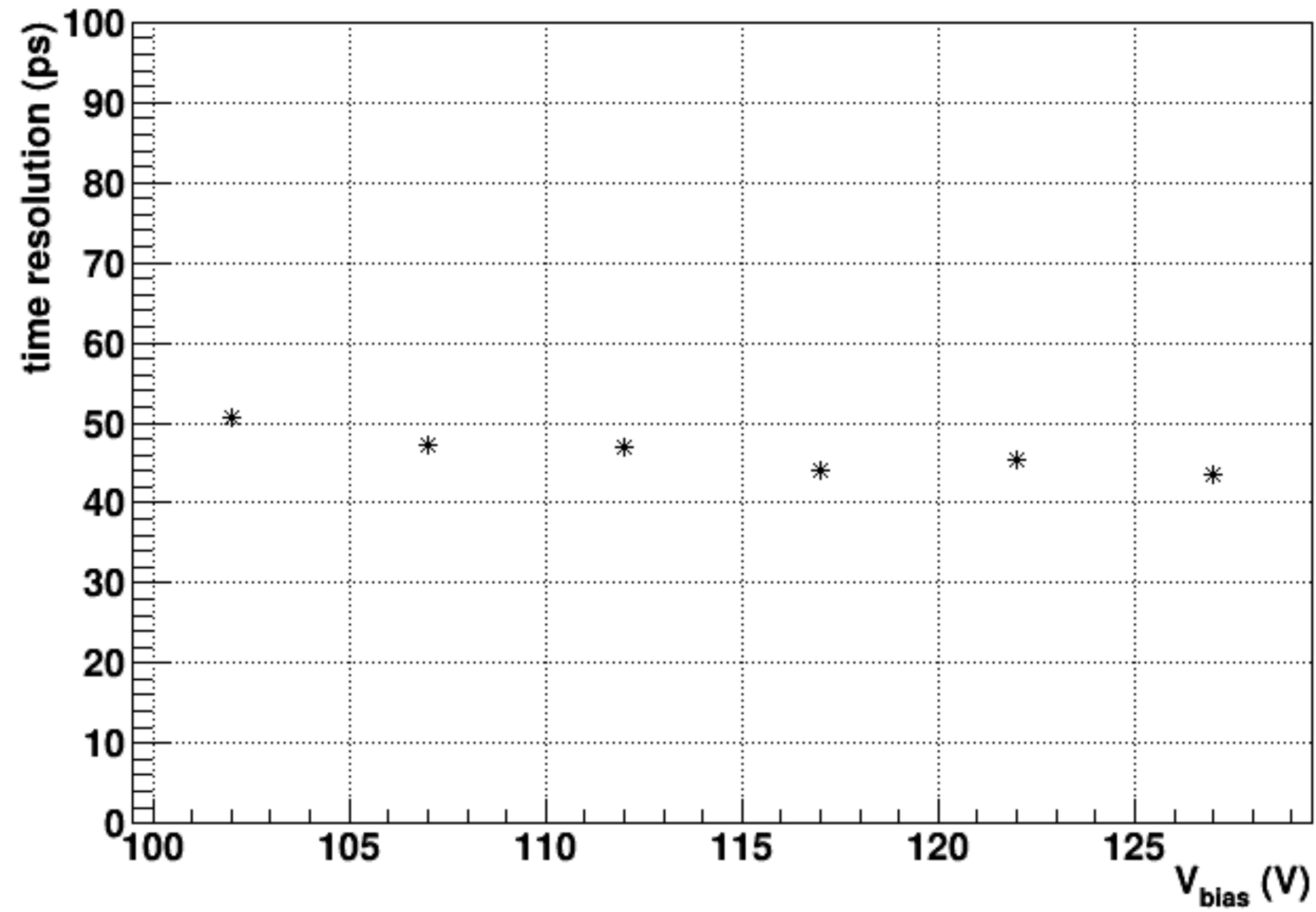
DUT: -20°C

USTC_W7_P48



DUT: -10°C

USTC_W7_P48



DUT: 0°C

USTC_W7_P48

