

# FBK IV analysis and first measurements

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DUNE photo-sensor meeting  
14/01/2025

## Last update (12/11/2024)

- Analysis of data from FBK HD pre-production
- Differences with CACTUS typical data
- Results and conclusions

Link to slides

[https://indico.fnal.gov/event/66999/contributions/303448/attachments/183172/251722/DUNE\\_meeting\\_Tommaso\\_Giammaria\\_12\\_11\\_2024.pdf](https://indico.fnal.gov/event/66999/contributions/303448/attachments/183172/251722/DUNE_meeting_Tommaso_Giammaria_12_11_2024.pdf)

# Last update - General info

## Aim

compare the IV characterization methods

- CACTUS : Normalized First Derivative (**NFD**)  $\rightarrow \frac{d}{dV} (\ln(I))$
- Vendor : 2<sup>nd</sup> logarithmic derivative (**SLD**)  $\rightarrow \frac{d^2}{dV^2} (\ln(I))$

## Samples

(HD pre-production)

- 100 SiPM strips
- FBK model



## Received from FBK:

1. IV Data
2. Results of NFD and SLD analyses
3. SiPMs (December)

# Last update - General info

## IV curve types (room T)

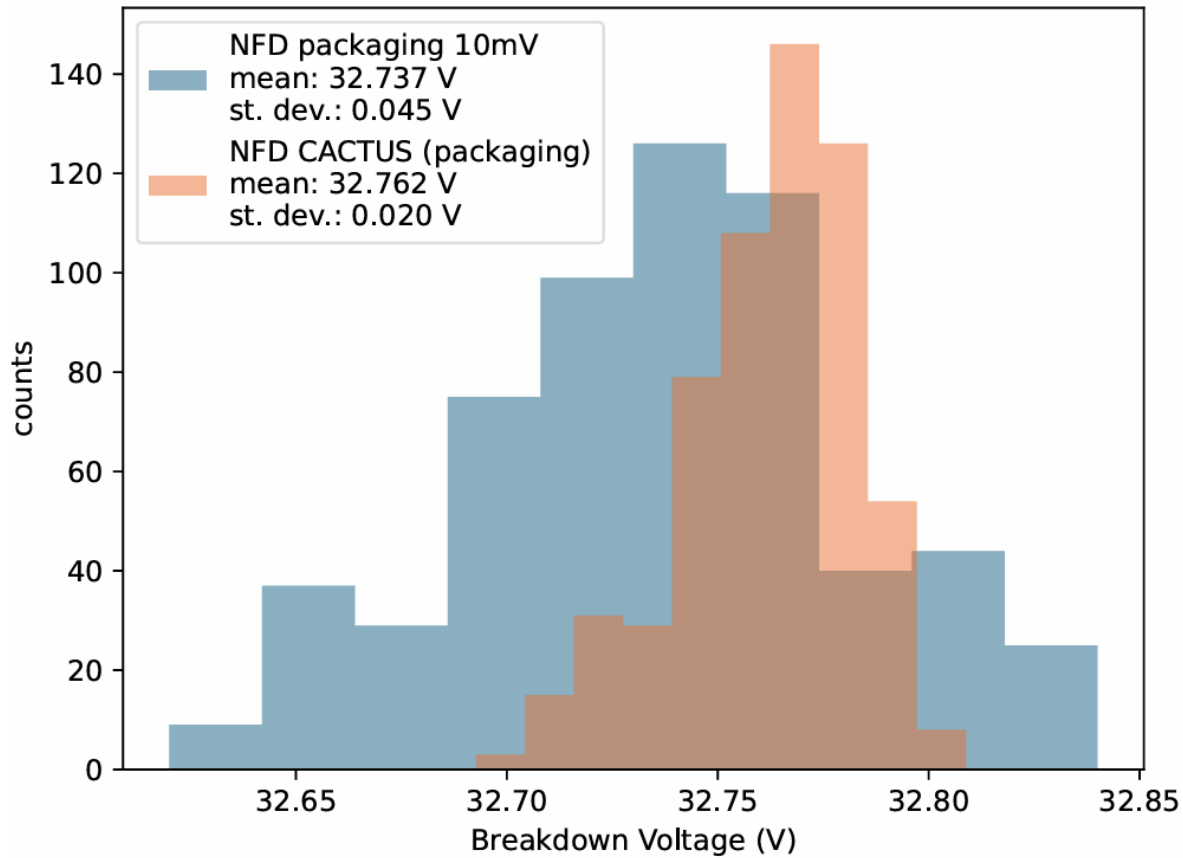
- Packaging IV:
  - Strip (or single SiPM ?) level
  - Large  $V_{\text{step}}$ : 50 mV (CACTUS: 20 mV)
- Parametric IV, also called Wafer Level (WL) IV:
  - WL  $\rightarrow$  same temperature for all the SiPMs  $\rightarrow$  more stable
  - Larger  $V_{\text{step}}$ : 100 mV (!!)

**Task:** analyze IV Data with the CACTUS algorithm, then compare the results with the ones provided by FBK

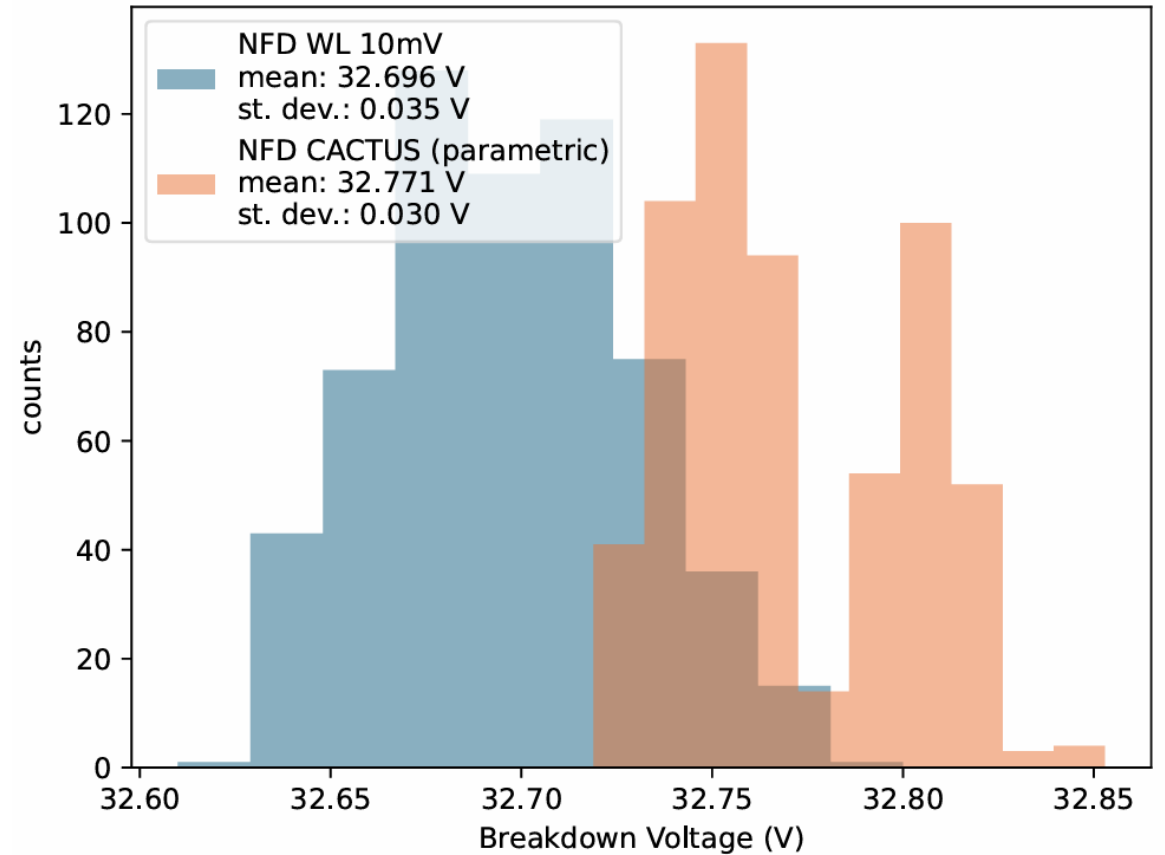
- NFD/SLD analyses
- Packaging/Parametric IV type

# Last update – Results - NFD

## Packaging

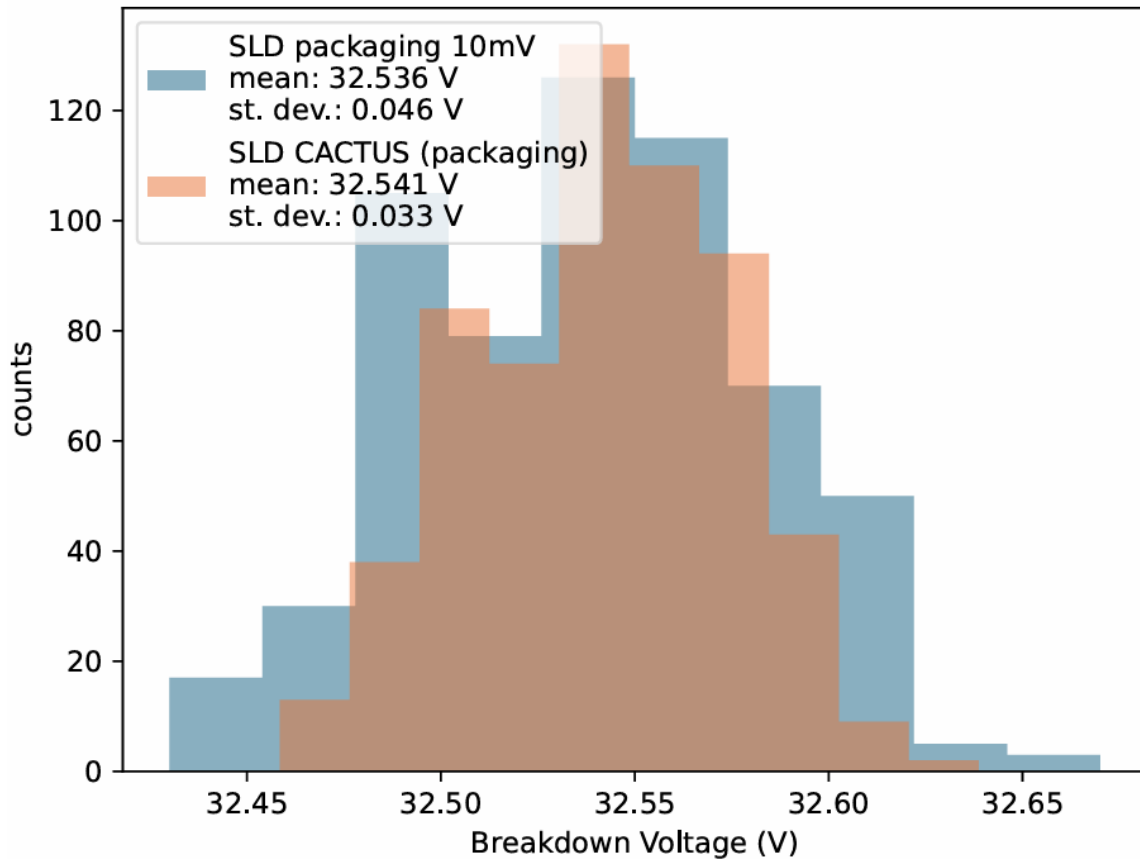


## Parametric

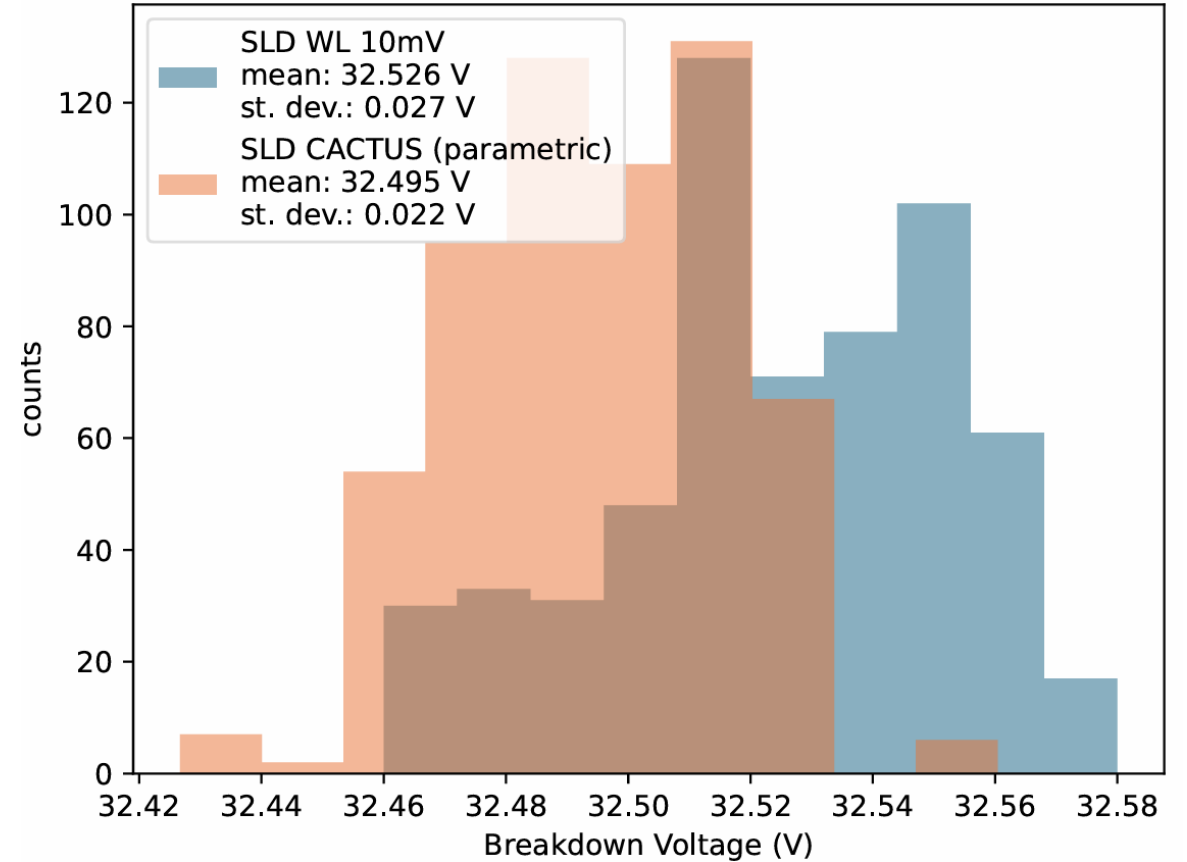


# Last update – Results - SLD

## Packaging



## Parametric



# Last update – Conclusions

- Comparison of CACTUS/FBK analyses on the same data set
  - Parametric (wafer level) IV (**100 mV step**)
  - Packaging IV (**50 mV step**)
- **Need a finer resolution for grouping SiPMs**
  - waiting for data with higher resolution\* from FBK

\*50 mV step and 10 mV step

# What's new?

- Strips arrived @Fe on December
  - Started first Tray (S0001, IV @RoomT)
  - Some differences w.r.t. HPK samples
  - Geometric mismatch issue: solved but lost 2 SiPMs
  
- Uploaded some data to DB
  - Currently working on automatization



# New - Measurements

Started tests with CACTUS (roomT only, no LN<sub>2</sub> until tomorrow)

- 1<sup>st</sup> test in December 2024 (Tray S0001) → OK
- Standby period
- Re-calibration of amplification cards and correction factor
- 2<sup>nd</sup> test (S0001) last week to check instrumentation → OK

Some differences w.r.t. HPK strips in (following slides)

# New – FBK/HPK differences

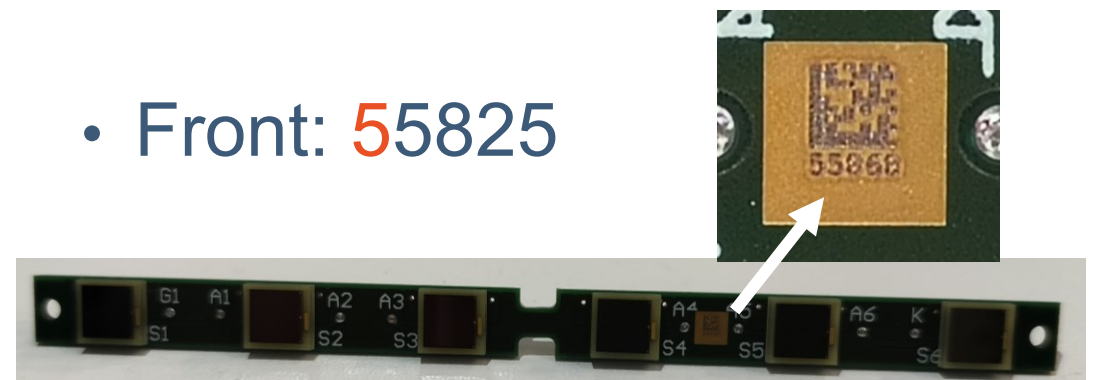
Differences between FBK and HPK samples:

- Different strip geometry (next slide)
- Char in Tray name (S000X), how many strips per tray??
- Each strip contains 2 QR codes, which one to use? And how?

- Back:  
SMB05825-FBK3T-07/24

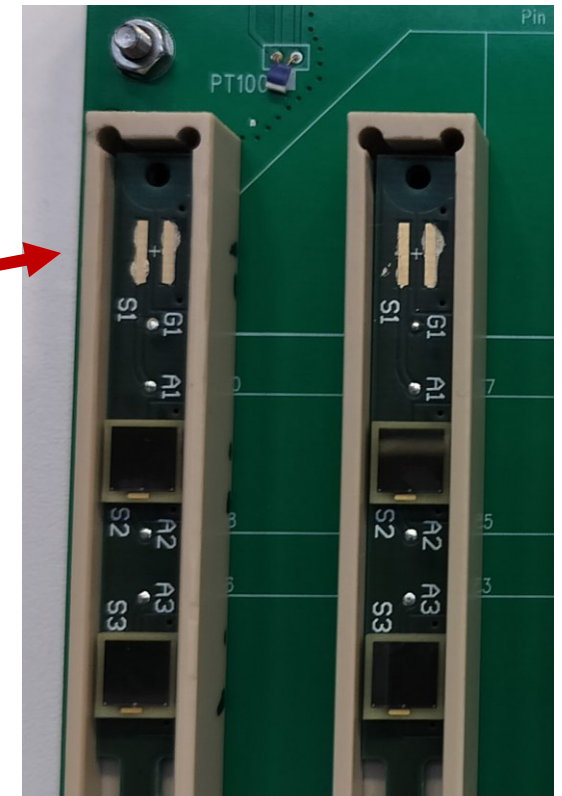
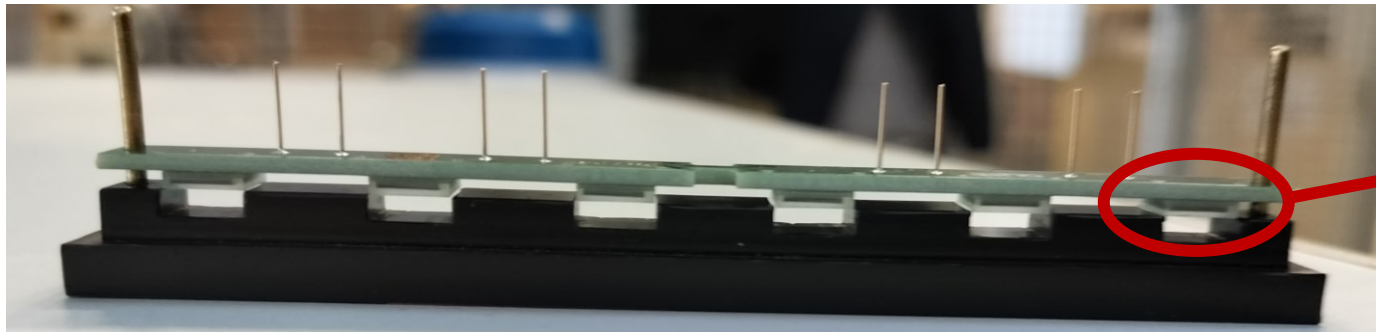


- Front: 55825



# New – issue in mounting procedure

SiPMs detached from the first two strips (one each) due to geometric mismatch with the mounting tool



Solution: change mounting tool



# New - Database

- Tested the new script to upload data on HWDB
- Uploaded data:
  - Delivery: I04, Box: 11, Batch: Fer13, Trays: 40, 41, 43, 44, 46, 47
- Currently working to automatize upload procedure with LabVIEW:
  1. Configuration and/or upload procedure will change?
  2. How to check a whole tray in DB?
  3. Additional info besides xlsx tables needed for the upload?
- Next step: implement as SubVI for the CACTUS main interface

# Conclusions

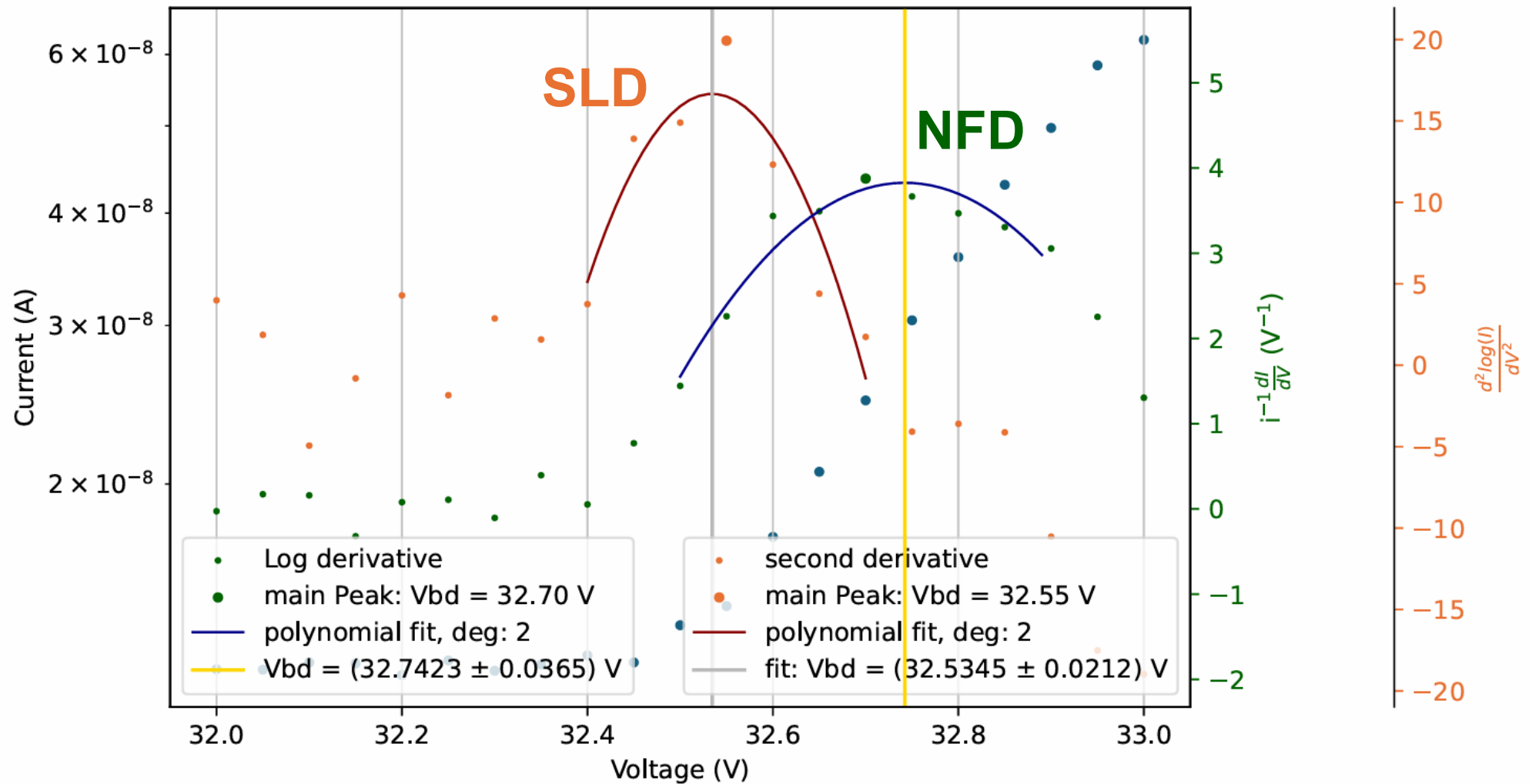
- **Comparison of IV data analysis with FBK**
- **Started measurements (Tray S0001, RoomT)**
- **Started uploading data on DB**

## QUESTIONS

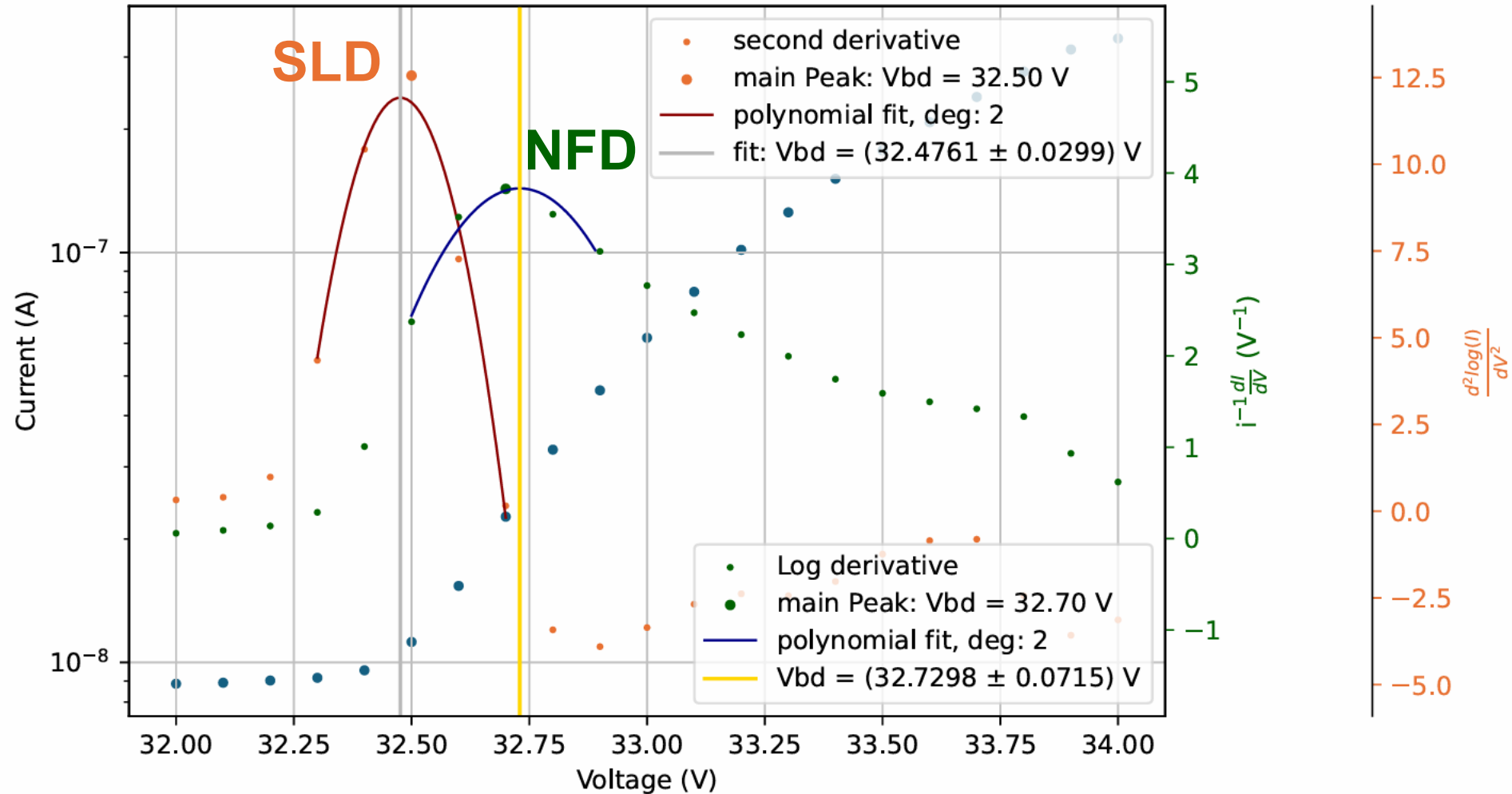
- **Measurements**
  - N strips per tray?
  - Front/back QR?
  - Trim QR?
- **Database:**
  - Procedure will change
  - How to check a whole tray?
  - Non-xlsx info?

# BACKUP

# Single IV curve – packaging



# Single IV curve – parametric (or WL)





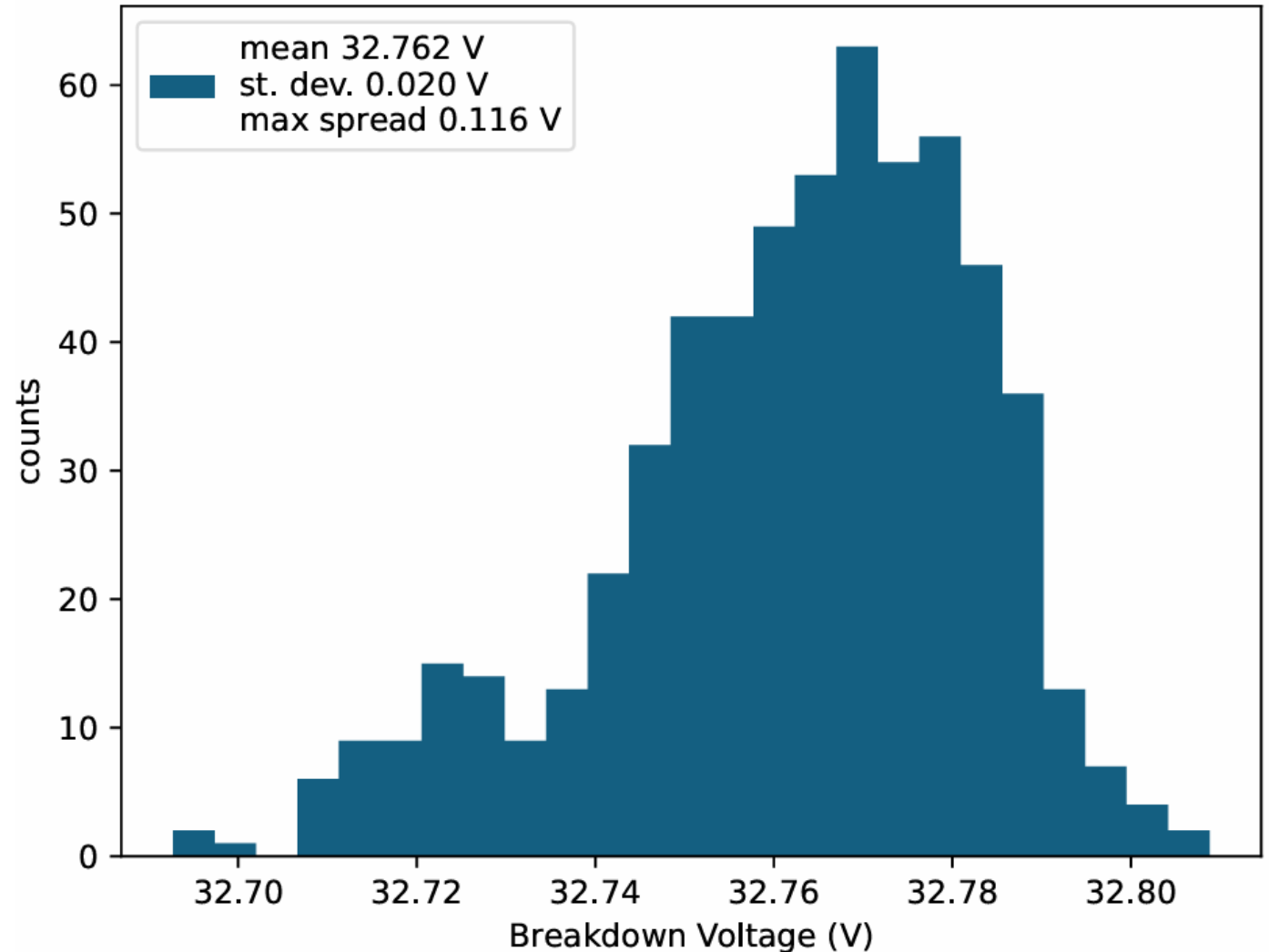
# Results – $V_{BD}$ distribution

## IV curve type

- Packaging IV
- Parametric IV

## Method

- NFD
- SLD



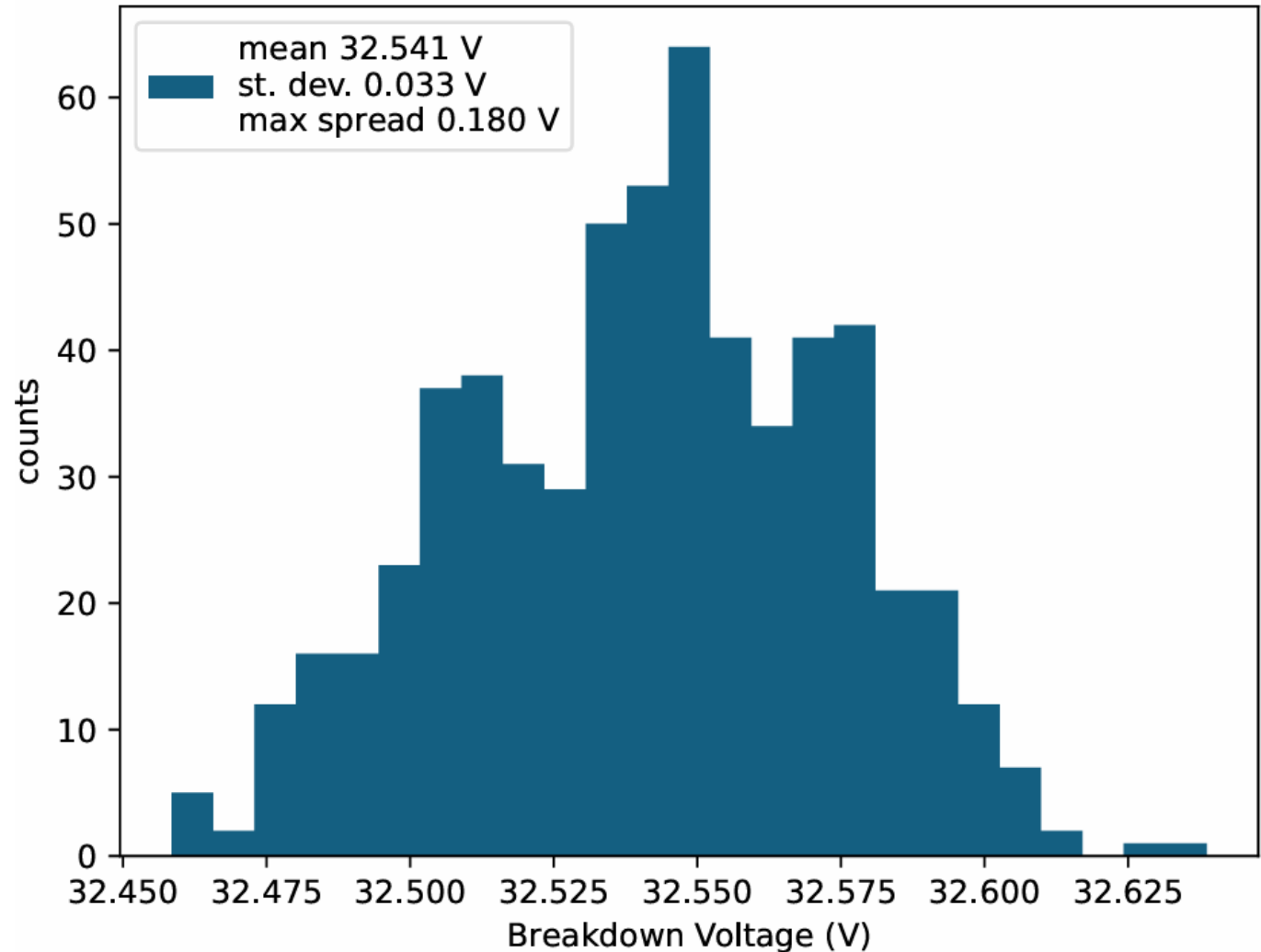
# Results – $V_{BD}$ distribution

## IV curve type

- Packaging IV
- Parametric IV

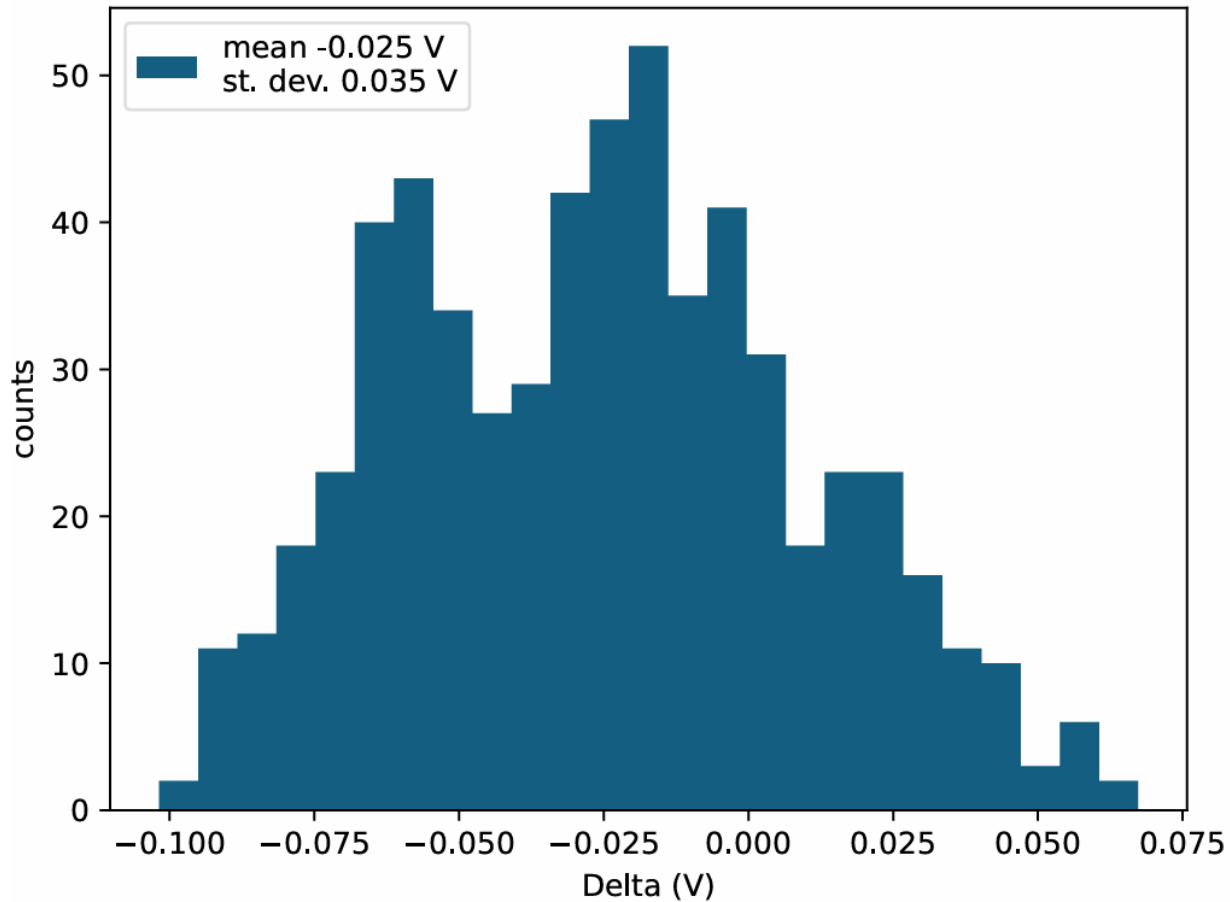
## Method

- NFD
- SLD

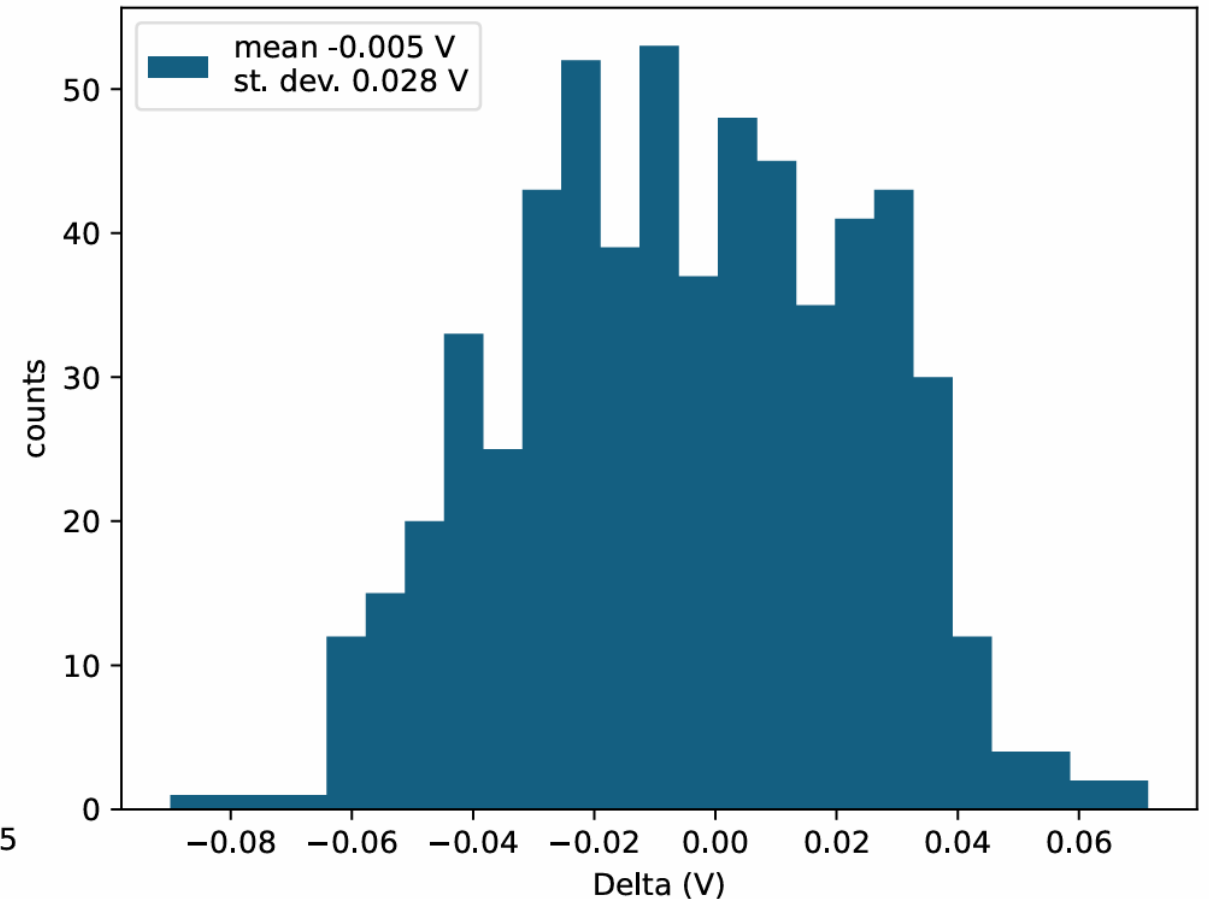


# Results – $V_{BD}$ distribution – packaging - differences

NFD differences (packaging)



SLD differences (packaging)



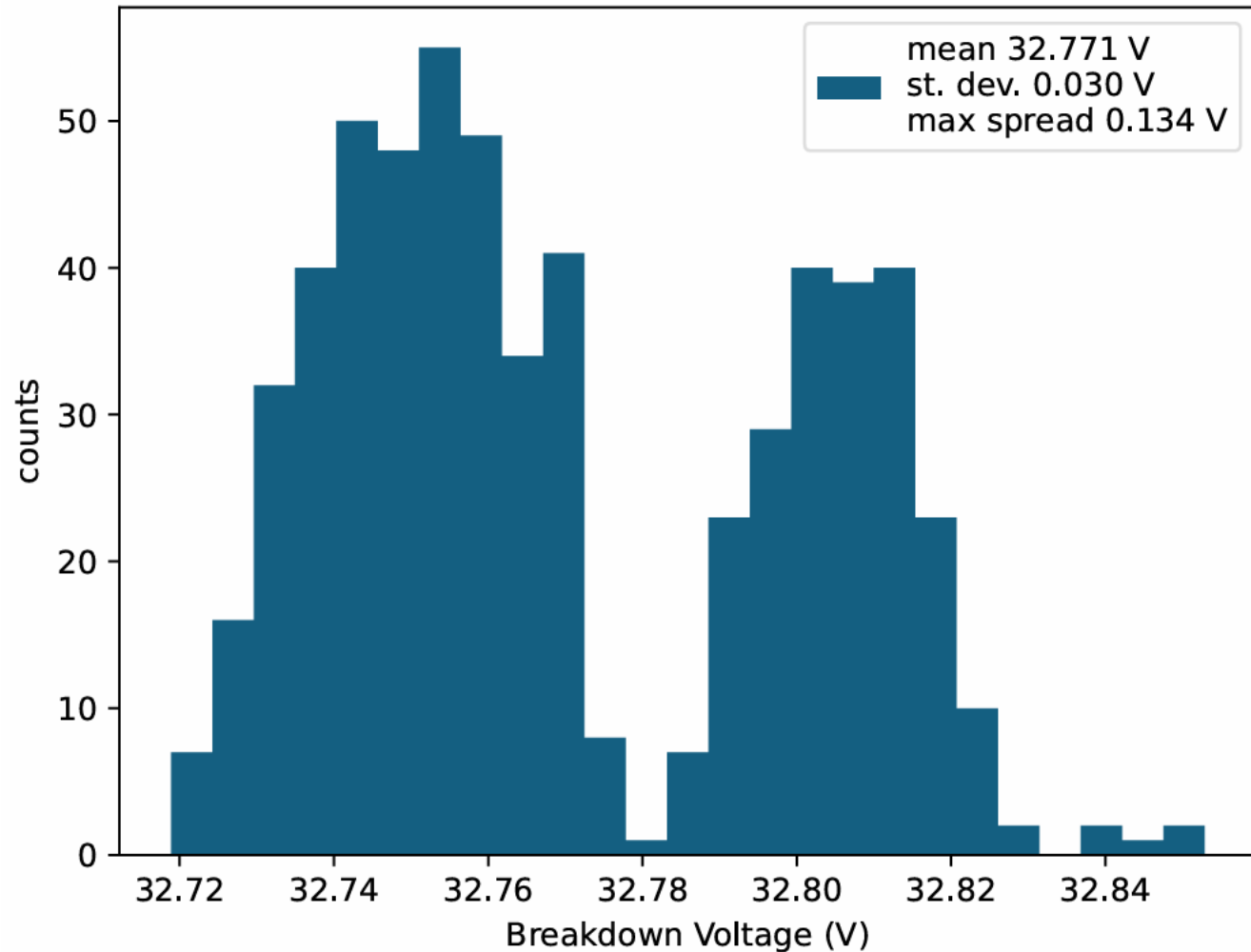
# Results – $V_{BD}$ distribution

## IV curve type

- Packaging IV
- Parametric IV

## Method

- NFD
- SLD



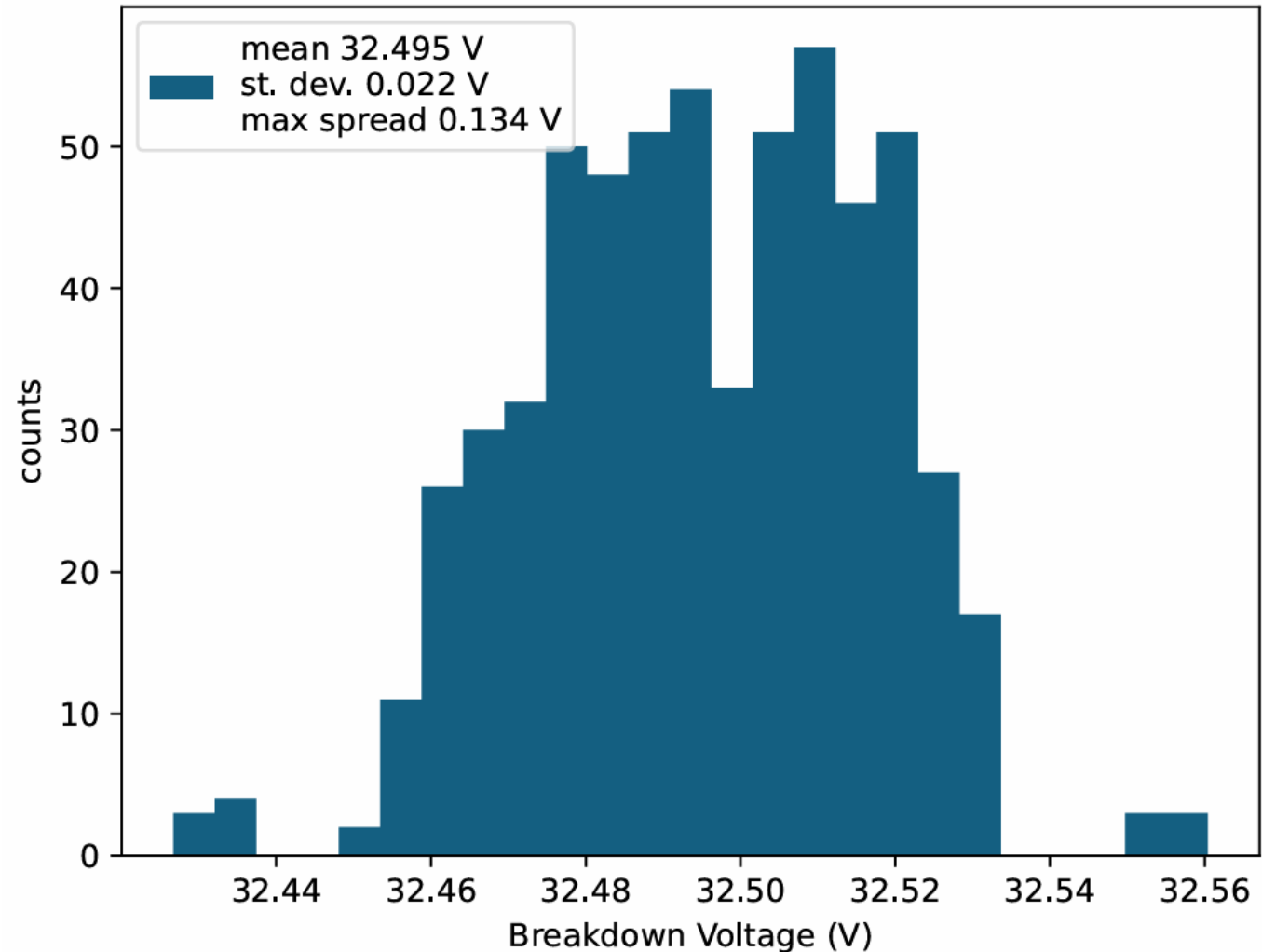
# Results – $V_{BD}$ distribution

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- Packaging IV
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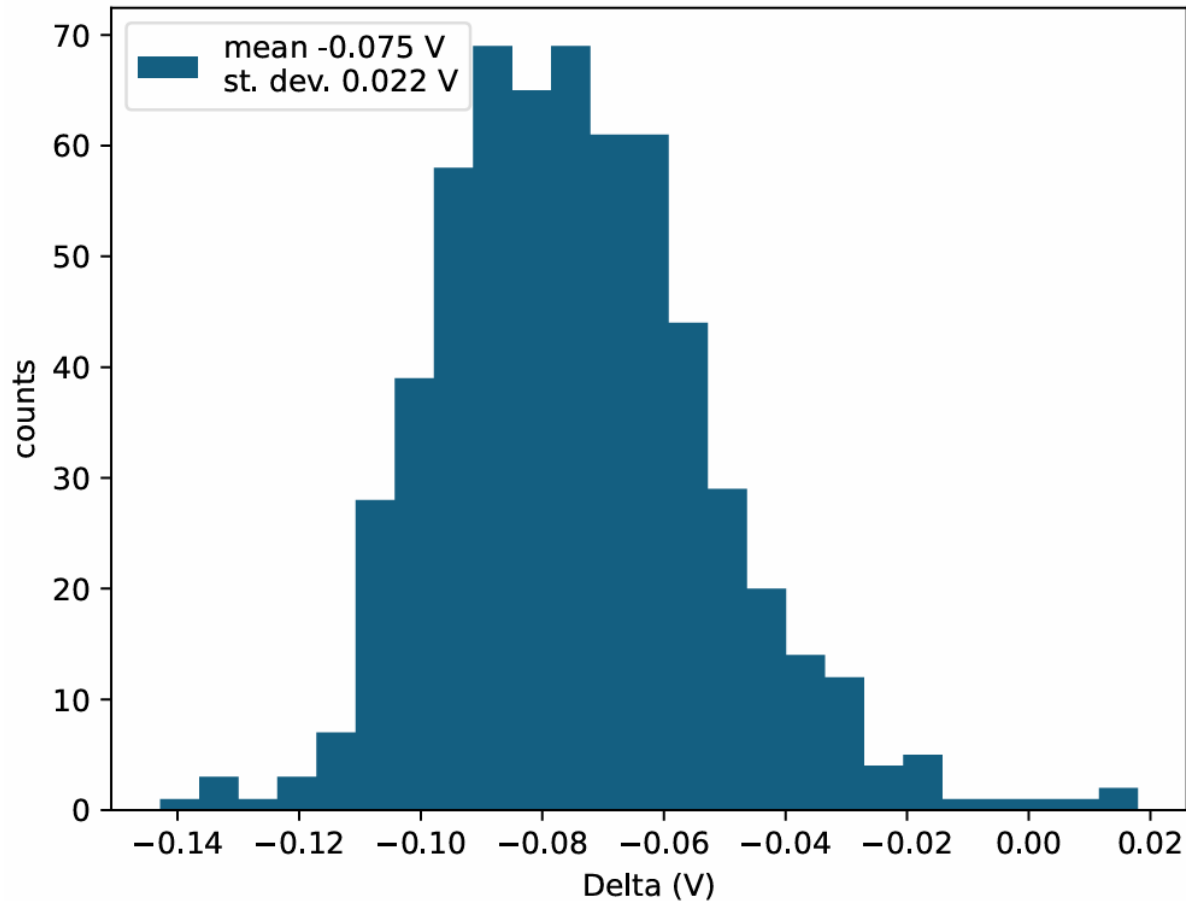
## Method

- NFD
- SLD

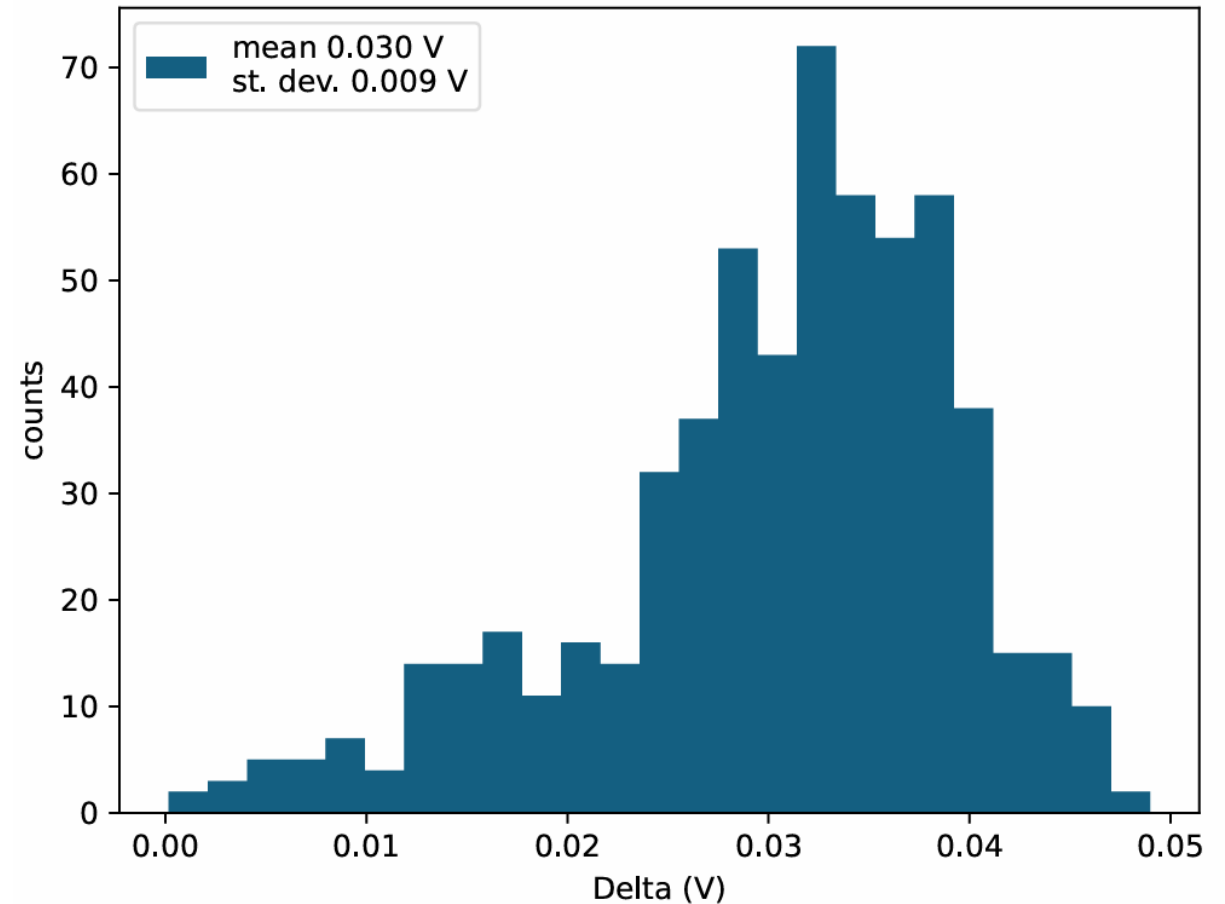


# Results – $V_{BD}$ distribution – parametric - differences

NFD differences (parametric)

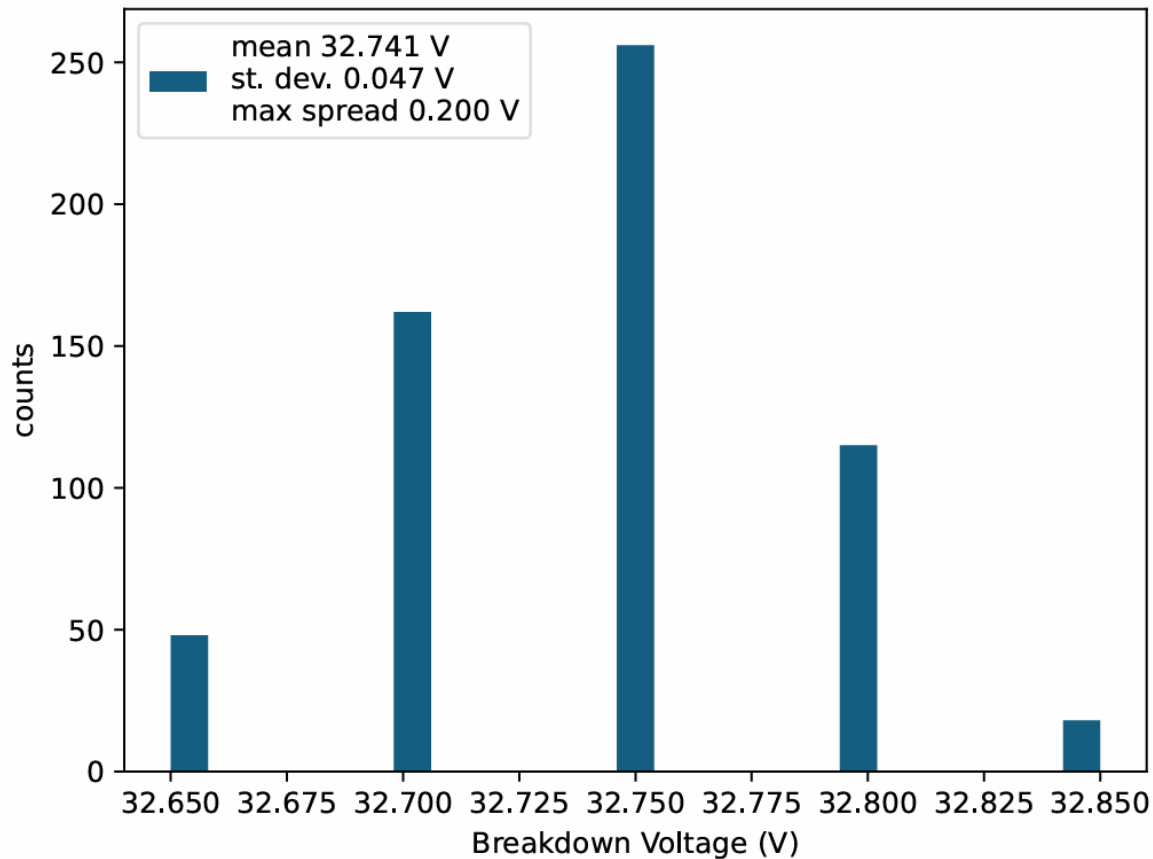


SLD differences (parametric)

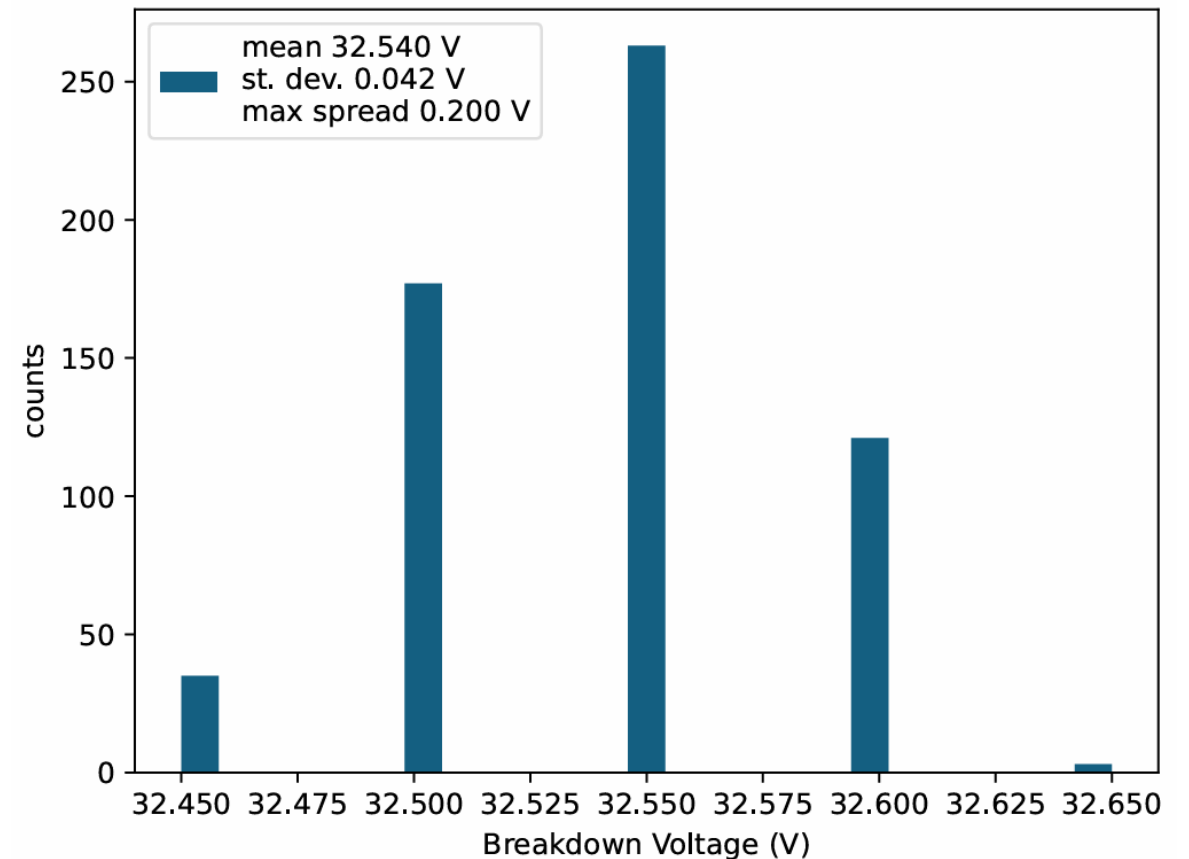


# Results – $V_{BD}$ distribution - packaging – max

$V_{bd}$  distribution NFD max

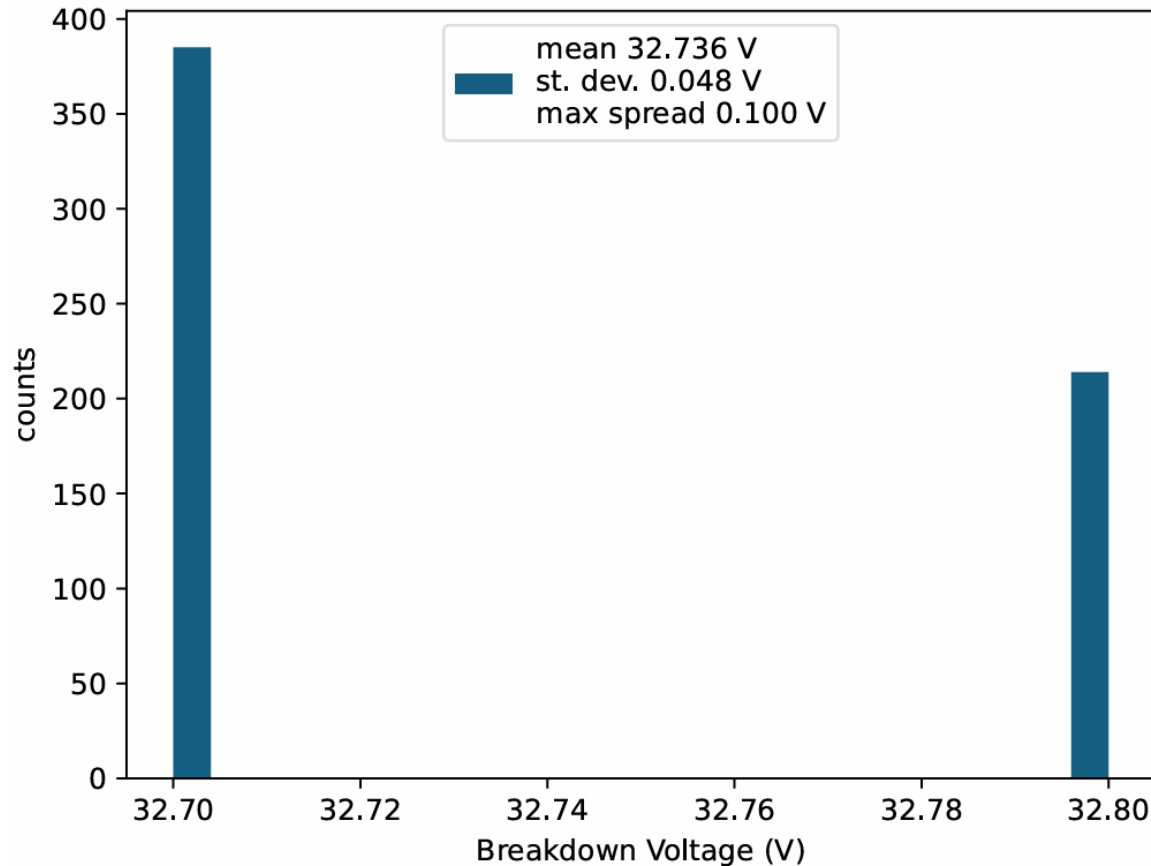


$V_{bd}$  distribution SLD max

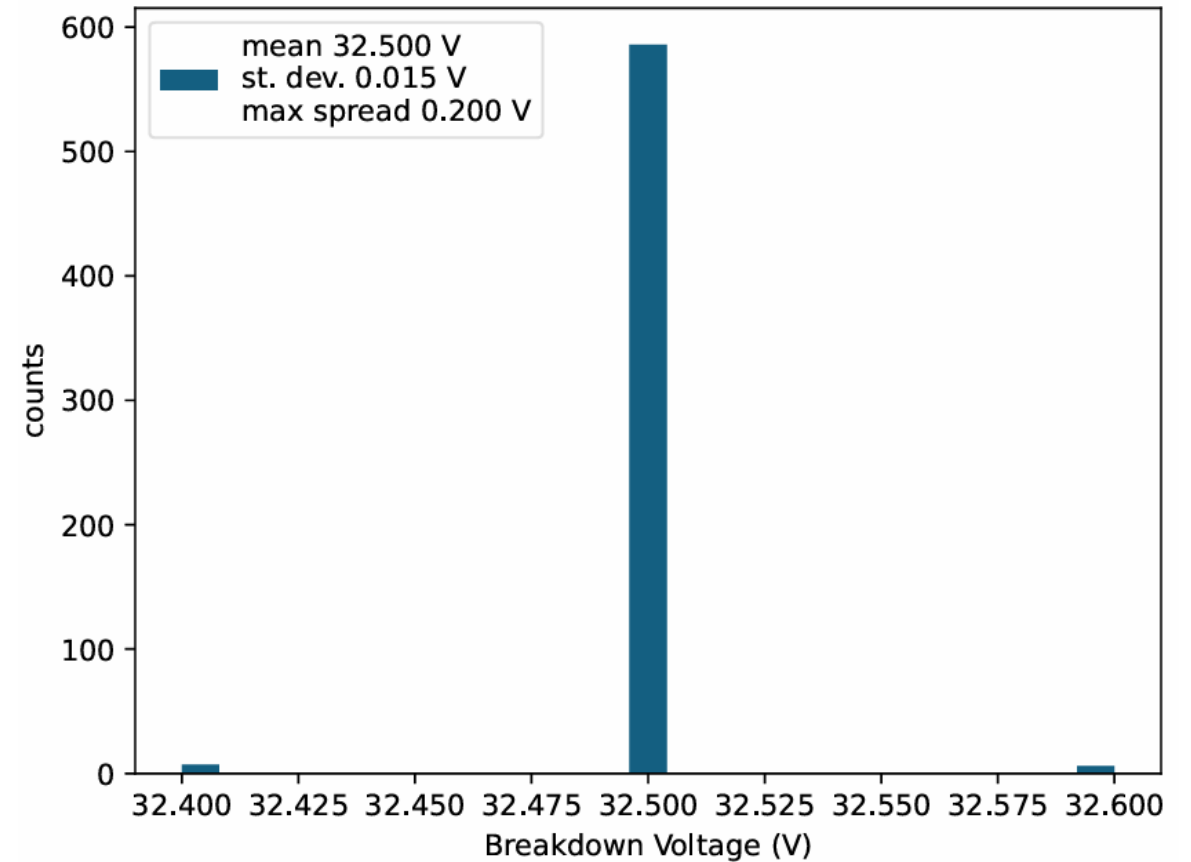


# Results – $V_{BD}$ distribution - parametric – max

$V_{bd}$  distribution NFD max

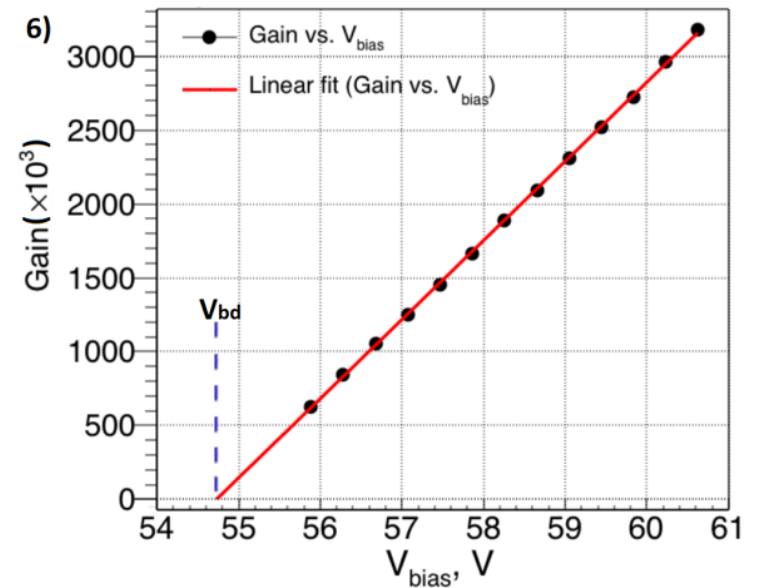
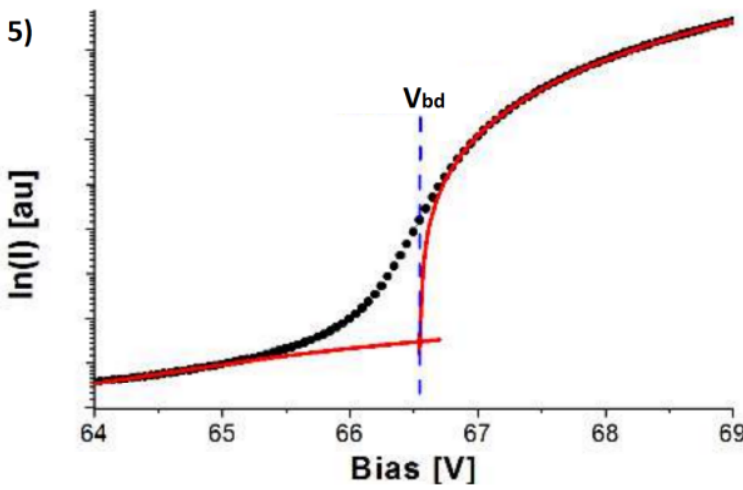
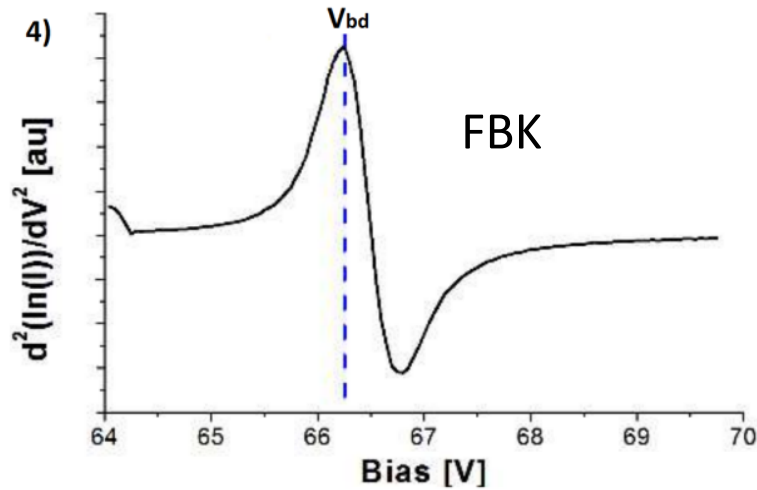
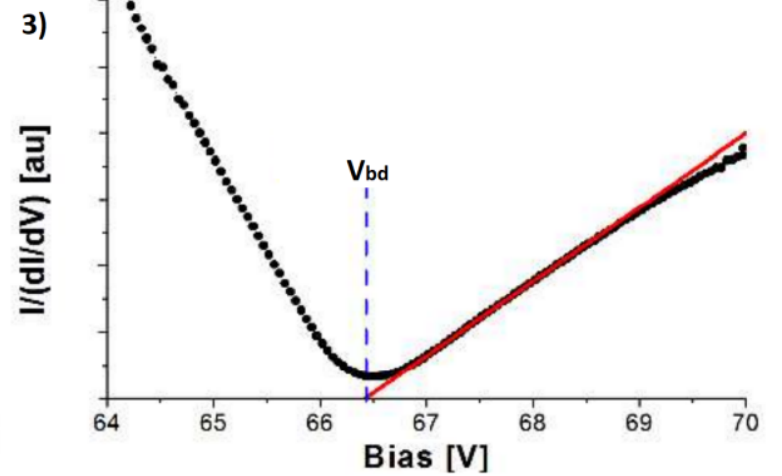
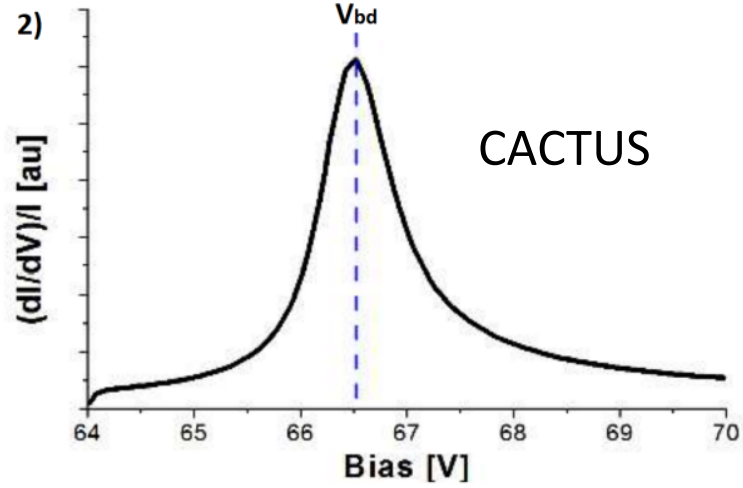
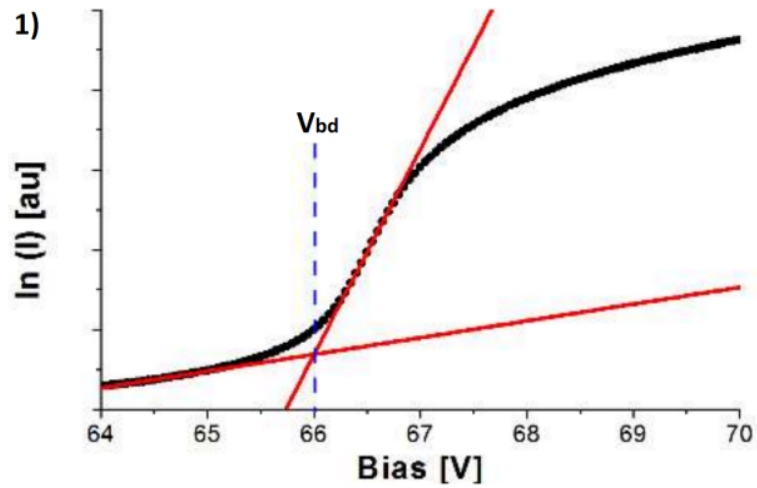


$V_{bd}$  distribution SLD max





# Reverse IV analysis methods



# 100 mV step, SLD maximum

