IV curves and Breakdown voltage status

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NP04 PDS Data Taking Planning Meeting

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- Script and file organization
- IV analysis algorithm
- Vbd monitoring
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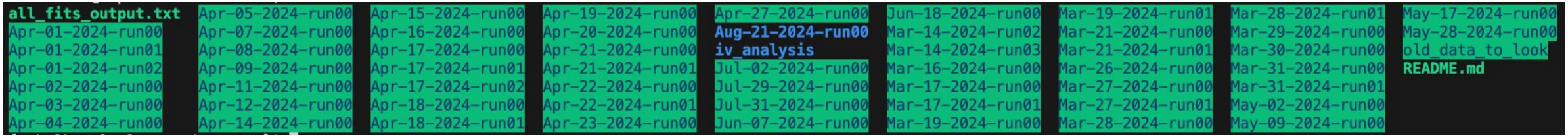
Data and script organization

- Acquired IV curves (now taken nearly twice a month) in:

  /eos/experiment/neutplatform/protodune/experiments/ProtoDUNE-II/PDS_Commissioning/ivcurves



- All scripts regarding IV curves are in:

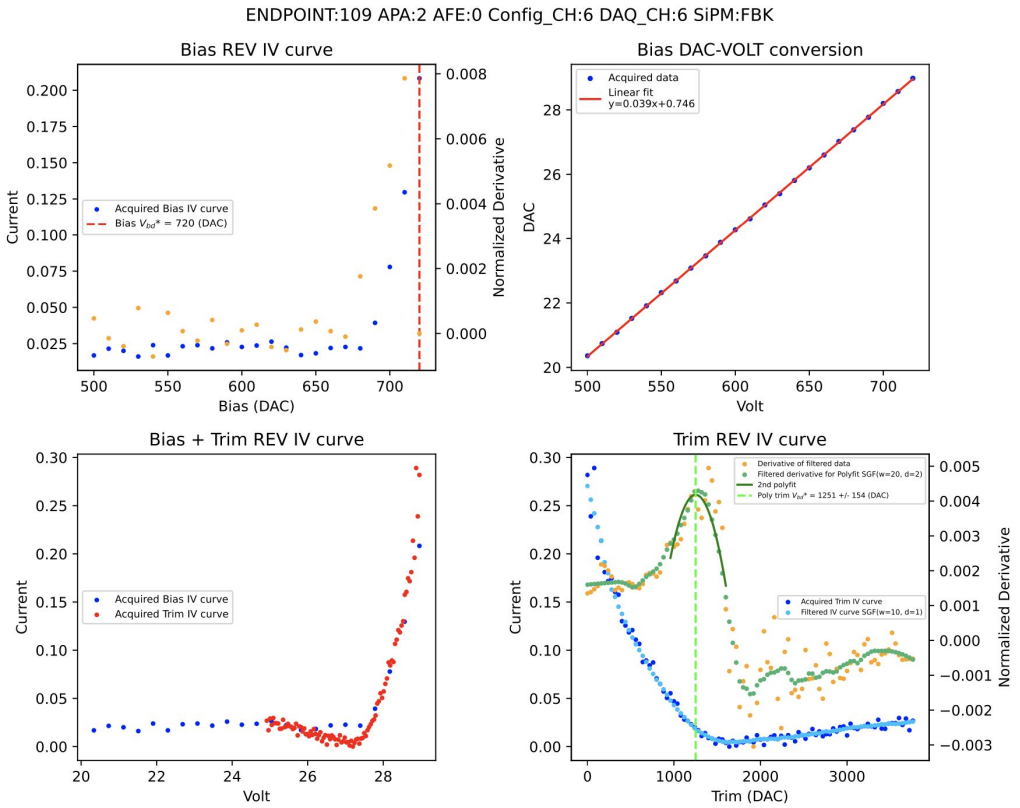
  https://github.com/DUNE/PDS/tree/main/scripts/iv_analysis

- Results of IV analysis are in:

  https://github.com/DUNE/PDS/tree/main/data/iv_analysis

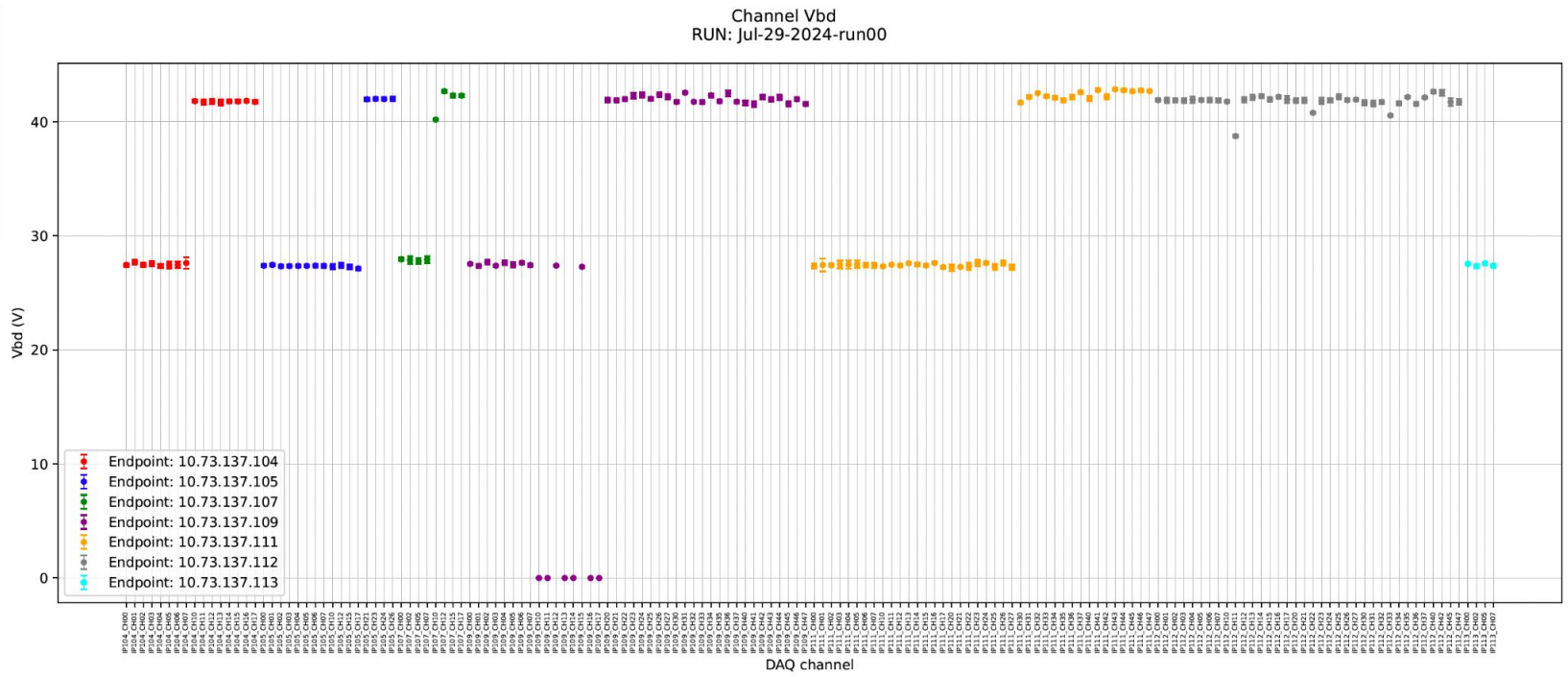
IV curve algorithm

- The program for IV analysis and breakdown determination is called: **Vbd_determination.py**
- It produces three output files (for each endpoint, of a given run):
  - XX.XX.XXX.XXX_plots.pdf
  - XX.XX.XXX.XXX_output.txt
  - XX.XX.XXX.XXX_Bias_IVplots_AFE.pdf



Vbd monitoring

- Check manually XX.XX.XXX.XXX_plots.pdf and note anomalies in this file
- **Vbd_quality.py** to compare current Vbd values with previous results
- **Vbd_plot_single_run.py** to produce plots to monitor Vbd of a single run:
  - VB_HIST_X_RUN : histogram with all ch
  - CH_VBD_X_RUN : scatter plot with Vbd of all channels

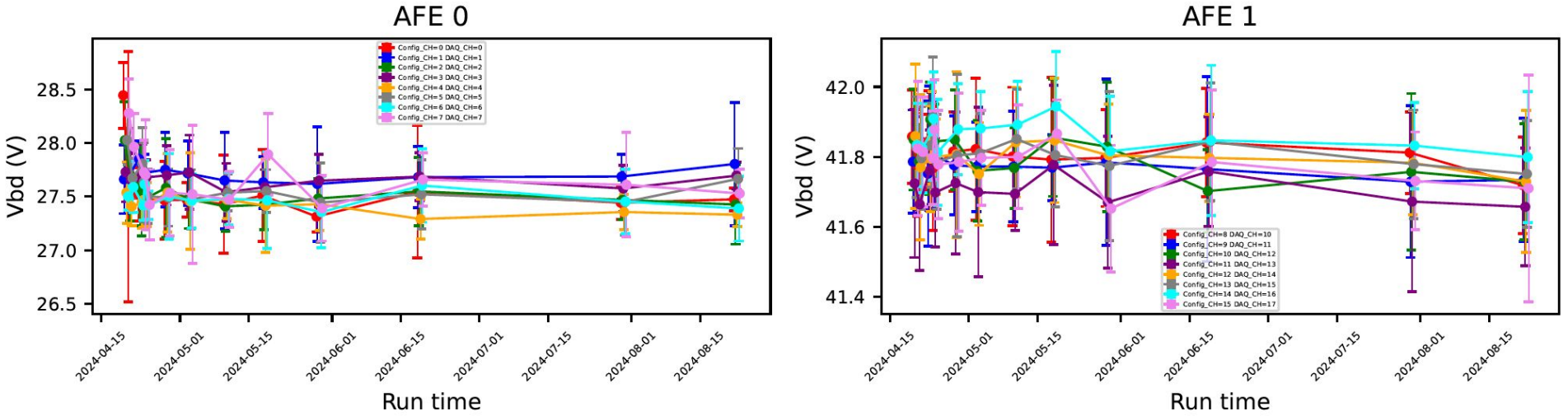


Vbd evolution in time

- **Vbd_plot_all_run.py** to plot Vbd evolution in time:
  - AFE_VBD_VS_RUN → a plot for endpoint with mean AFE Vbd as a function of time (see)
  - CH_VBD_VS_RUN → a plot for each AFE with the channel Vbd as a function of time (see)

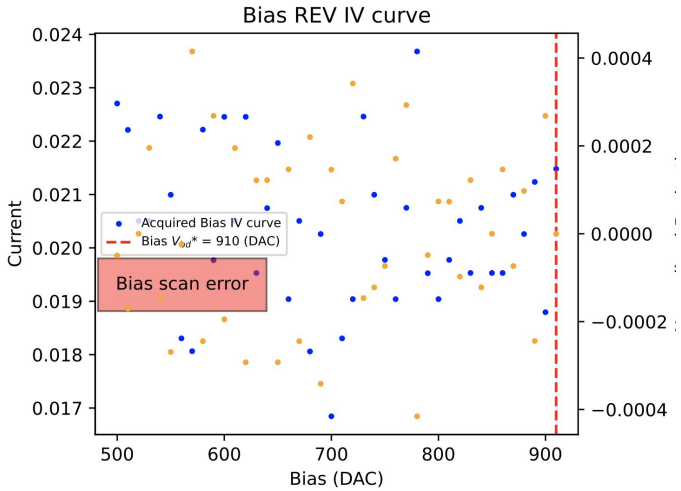
Constant Vbd evolution in time for all channels

ENDPOINT:104

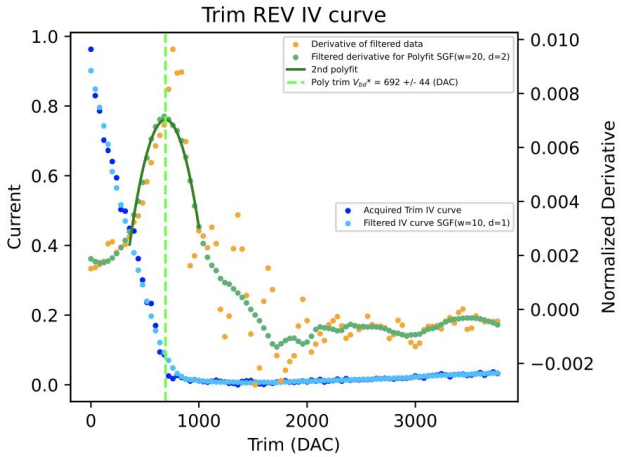


Vbd anomalies

- 6 disconnected channels in endpoint 109:
  - DAQ_ch 11, 13, 14, 16 → missing file
  - DAQ_ch 10, 17 → just noise

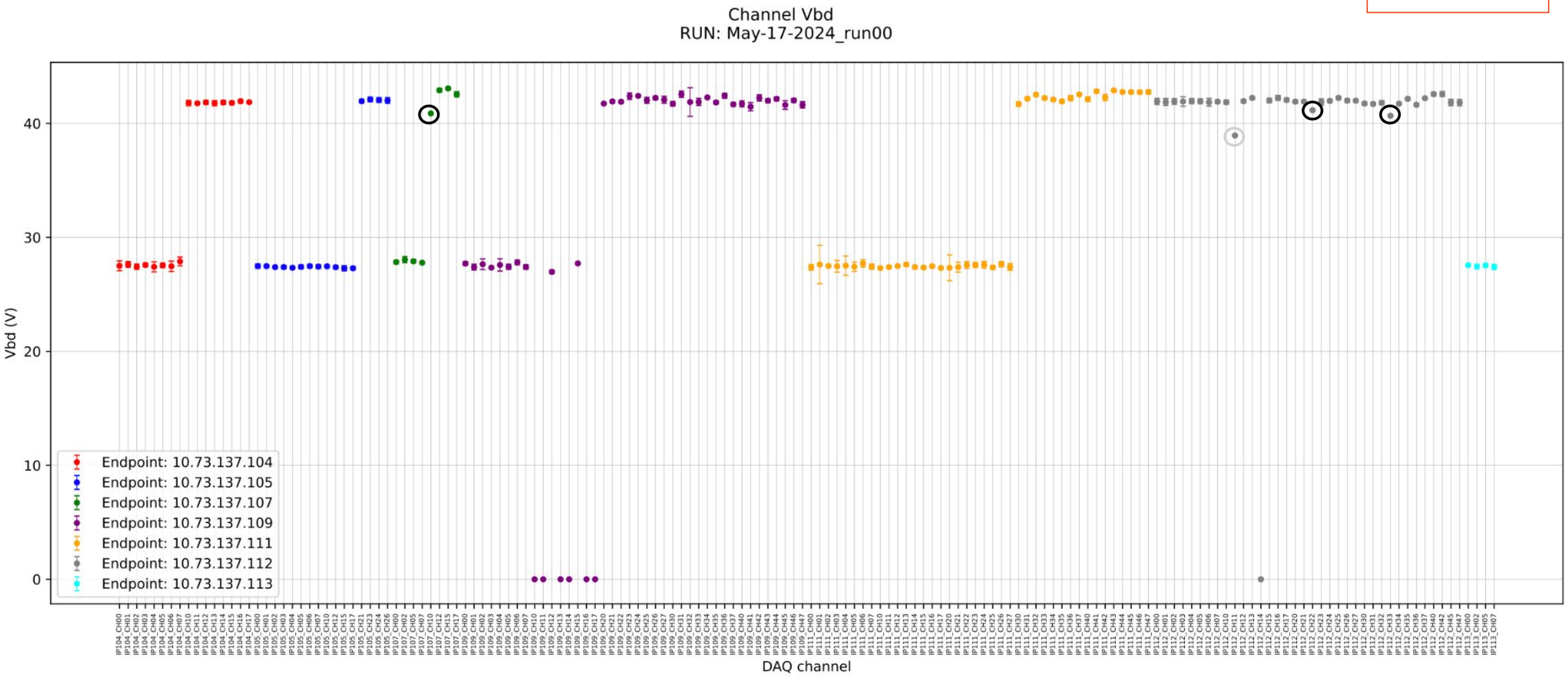


- 4 channels with *steep* IV curve, resulting in a low Vbd
  - DAQ_ch 10 in endpoint 107
  - DAQ_ch 11, 22, 33 in endpoint 112



To recover these channels, their Vbd was increase manually (*see next talk*)

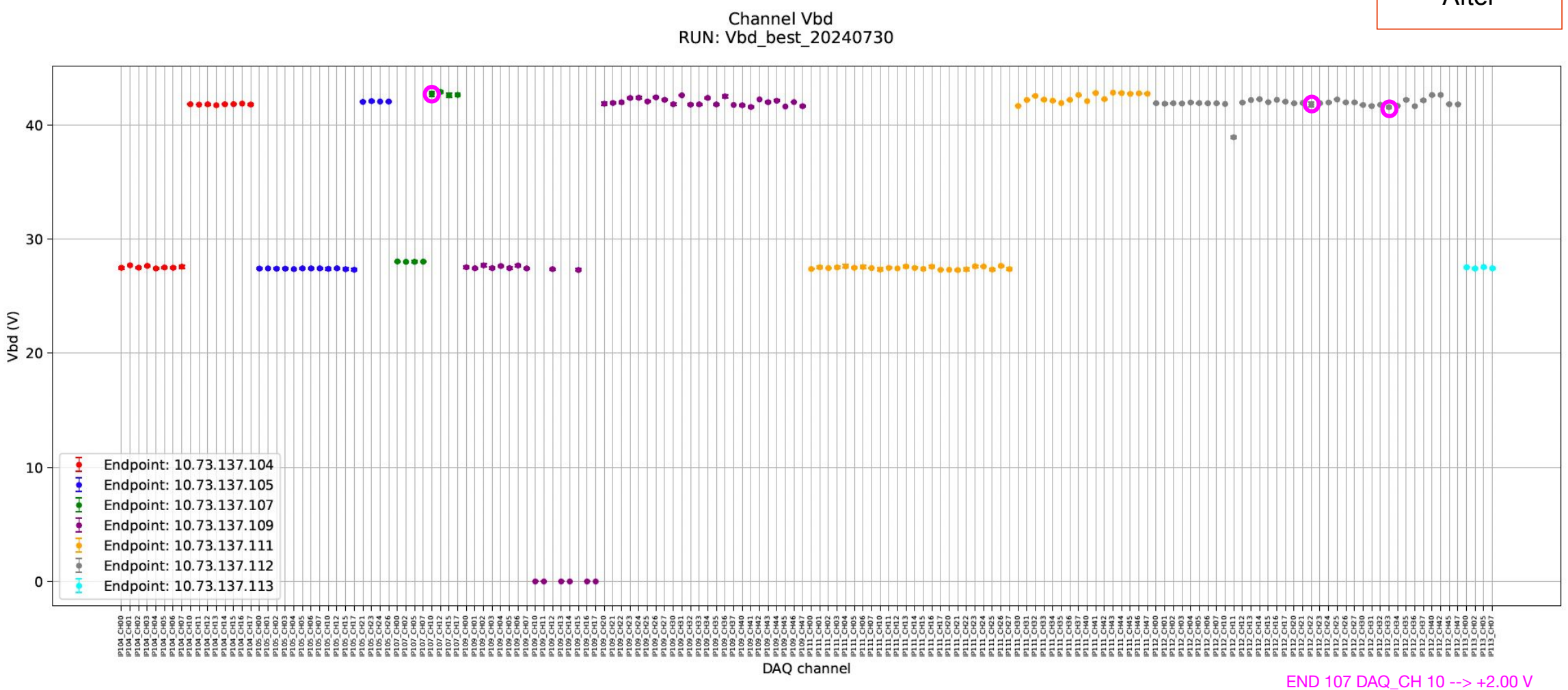
Before



DAQ_ch 11 in endpoint 112 can't be recovered

To recover these channels, their Vbd was increase manually (*see next talk*)

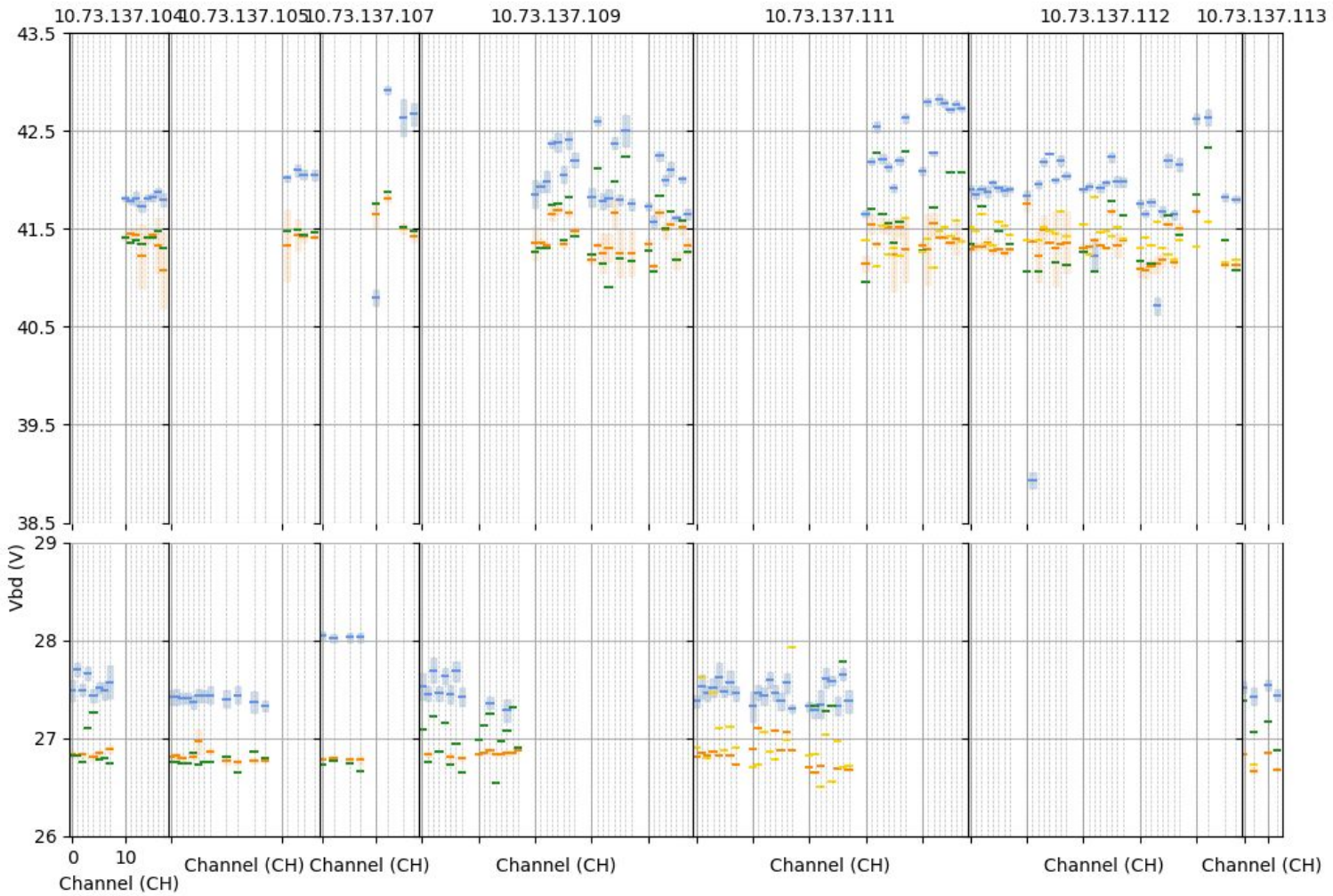
After



END 107 DAQ_CH 10 --> +2.00 V
END 112 DAQ_CH 22 --> +0.60 V
END 112 DAQ_CH 33 --> +0.86 V

These are the current Vbd values used

NP04 and lab Vbd comparison



- NP04 IVs
- CIEMAT + MiB
- CACTUS
- NP04 LEDs

A database with all Vbd info was create (here)

For more info, please ask

Alessandro

Vop determination

- **Vbd_best.py** to estimate the Vbd mean value of each channel, by using good runs data
- **Vop_determination.py** to produce the json map for daphne configuration, by specifying the dataset to use (produced by Vbd_best.py) and the OV for HPK and FBK to set


```
{
   "10.73.137.104": {
      "id": 4,
      "apa": "1",
      "ch": [0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15],
      "bias": [783, 1135, 0, 0, 0],
      "trim": [256, 56, 246, 97, 307, 228, 254, 166, 124, 154, 126, 204, 124, 116, 70, 146, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0],
      "ov": {"fbk": 4.5, "hpk": 3.0},
      "run": "Vbd_best_20240730"  },

   "10.73.137.105": {
      "id": 5,
      "apa": "1",
      "ch": [0, 1, 2, 3, 4, 5, 6, 7, 8, 10, 13, 15, 17, 19, 20, 22],
      "bias": [809, 806, 1156, 0, 0],
      "trim": [67, 53, 79, 76, 109, 50, 53, 48, 110, 0, 68, 0, 0, 144, 0, 189, 0, 116, 0, 46, 84, 0, 86, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0],
      "ov": {"fbk": 4.5, "hpk": 3.0},
      "run": "Vbd_best_20240730"  },
   …
}
```


Bias fixed per AFE

Trim fixed per CH

Summary

104-7	104-5	104-2	104-0	109-27	109-25	109-22	109-20	111-1	111-3	111-4	111-6	112-0	112-2	112-5	112-7
104-1	104-3	104-4	104-6	109-21	109-23	109-24	109-26	111-36	111-34	111-33	111-31	112-6	112-4	112-3	112-1
104-17	104-15	104-12	104-10	109-37	109-35	109-32	109-30	111-0	111-2	111-5	111-7	112-10	112-12	112-15	112-17
104-11	104-13	104-14	104-16	109-31	109-33	109-34	109-36	111-37	111-35	111-32	111-30	112-16	112-14*	112-13	112-11
105-7	105-5	105-2	105-0	109-7	109-5	109-2	109-0	111-41	111-43	111-44	111-46	113-0	113-2	113-5	113-7
105-1	105-3	105-4	105-6	109-1	109-3	109-4	109-6	111-16	111-14	111-13	111-11	112-27	112-25	112-22 +0.6V	112-20
105-26	105-24	105-23	105-21	109-17	109-15	109-12	109-10	111-10	111-12	111-15	111-17	112-26	112-24	112-23	112-21
105-10	105-12	105-15	105-17	109-11	109-13	109-14	109-16	111-26	111-24	111-23	111-21	112-37	112-35	112-32	112-30
107-17	107-15	107-12	107-10 +2.0V	109-47	109-45	109-42	109-40	111-40	111-42	111-45	111-47	112-31	112-33 +0.86V	112-34	112-36
107-0	107-2	107-5	107-7	109-41	109-43	109-44	109-46	111-27	111-25	111-22	111-20	112-40	112-42	112-45	112-47

APA 1 APA 2 APA 3 APA 4

LEGEND:

Green → Good IV curve and V_{bd}

Yellow → Noisy IV curve

Purple → Steep IV curve and low V_{bd}

Red → Disconnected channel

* → Hard to acquire IV curve (few data)

P.S. : endpoint 107 was replaced by 110

Thank you for the attention!