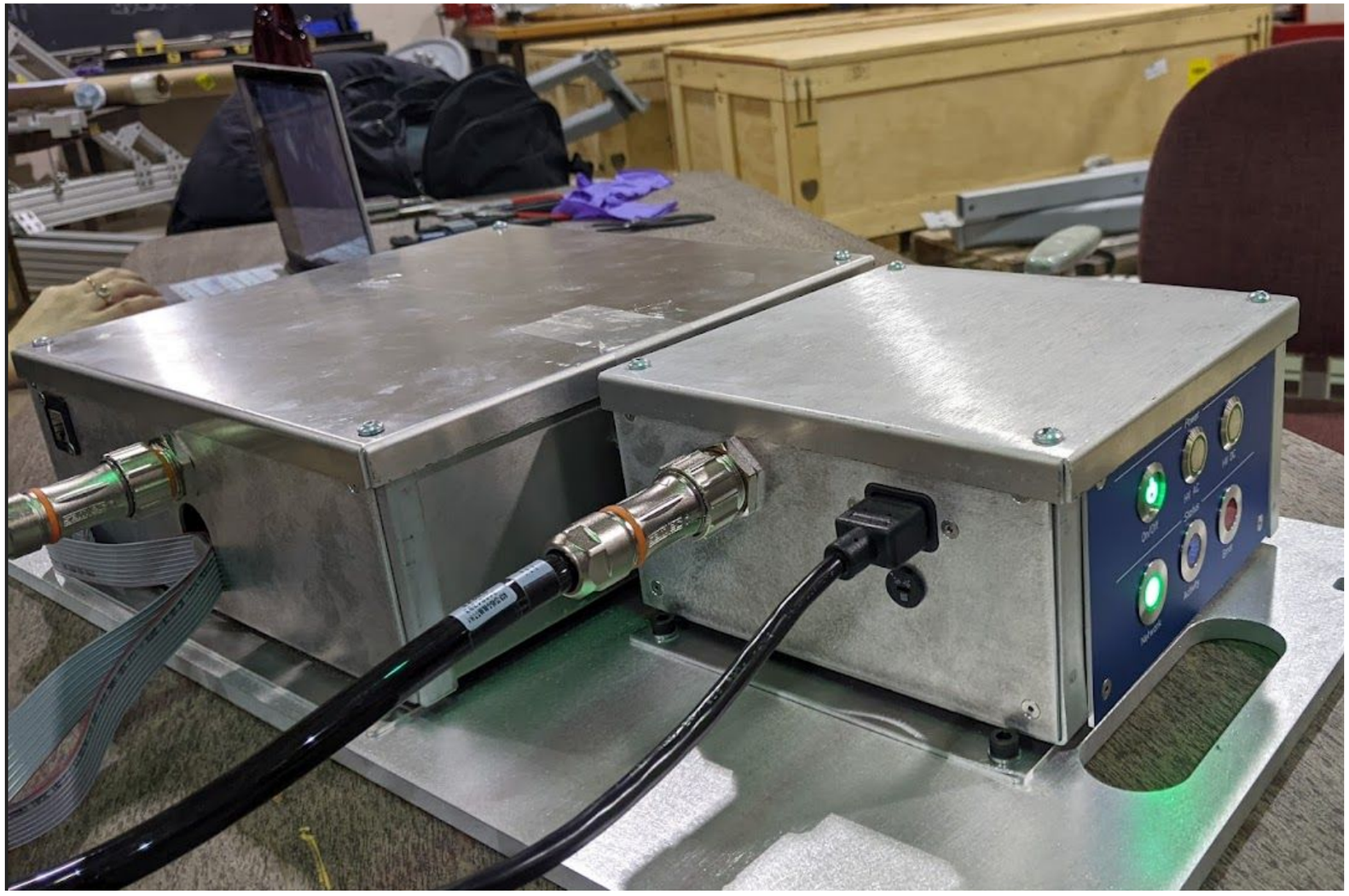

# Status of the DWA* operation

* Digital Wire Analyzer

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Roxanne Guenette for the DWA team

(Anyssa Navrer-Agasson, Josh Grocott, Shion Kubota, Nick Lane, Graham Miller, Guilherme Ruiz, Chris Stanford, John Waiton)



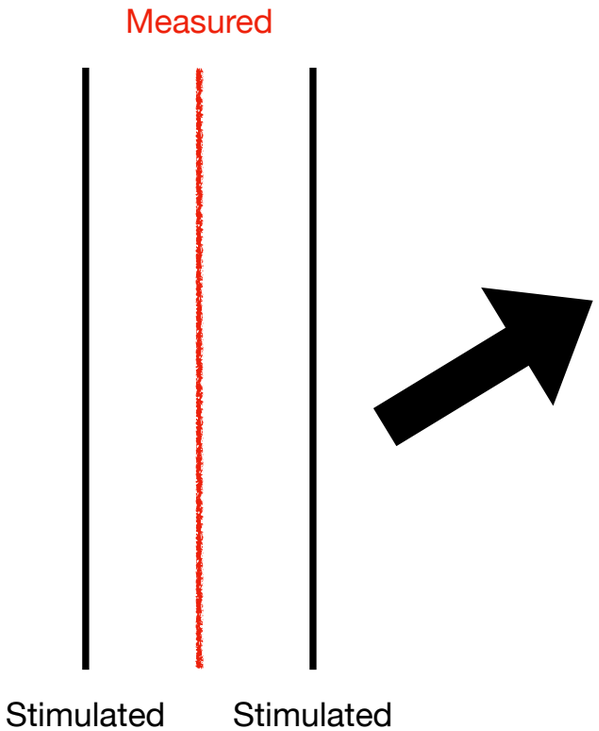
DUNE UK Meeting
11-12 January 2023


MANCHESTER 1824

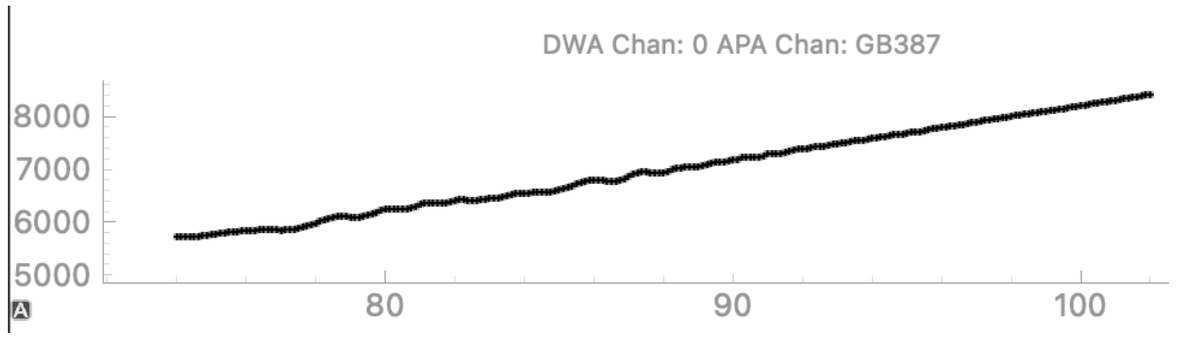
# Intro and reference

- For more details on DWA see Anyssa's talk at previous CM (https://indico.fnal.gov/event/53964/contributions/250684/attachments/159769/210119/dwa_cern_dune_cm_sep2022.pdf)

Tension is extracted by measuring the fundamental frequency of the wire

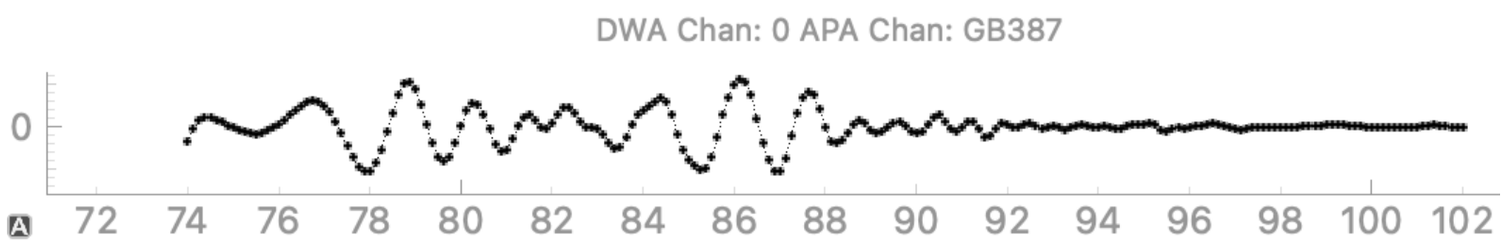



1. The two neighbouring wires are stimulated with a mix of AC and DC current.




2. Read out middle wire while sweeping frequency of AC current

3. Smooth and subtract the baseline

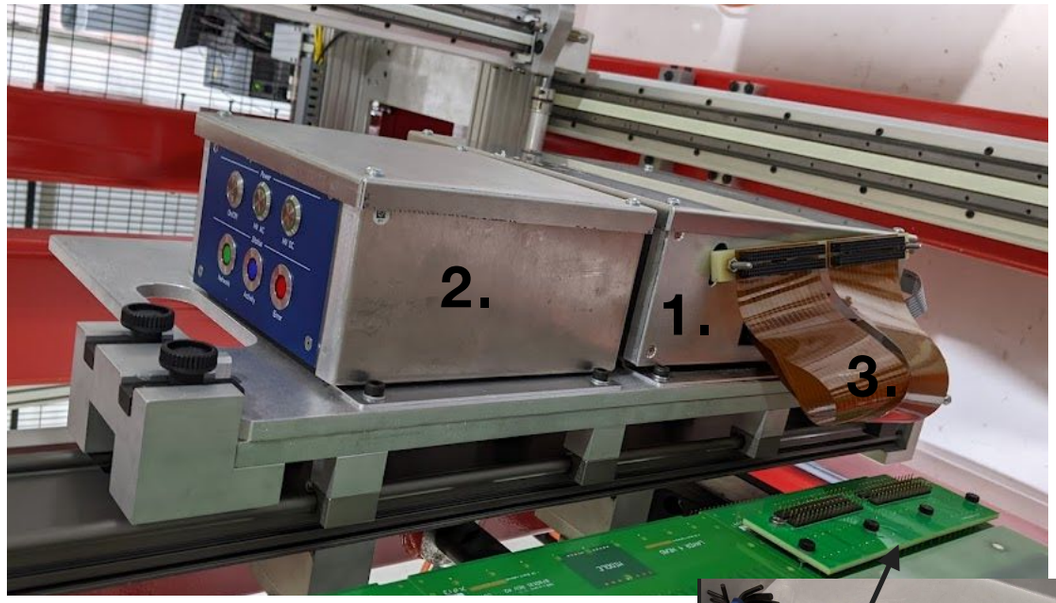


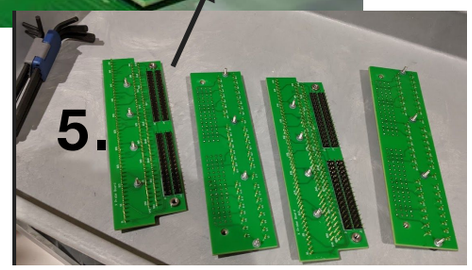

**From Anyssa's talk at previous CM**

# DWA Hardware

Parts:

1. DWA box
2. Power distribution box
3. Flex cable
4. Laptop
5. Probe boards
6. Support rail





| DWA # | Location | Status |
|---|---|---|
| 1 | CERN | Damaged flex cable (replacement being sent) |
| 2 | Daresbury | Functional |
| 3 | Fermilab | Functional |
| 4 | Daresbury | Functional |
| 5 | Fermilab | Functional |

| Power Supply # | Location | Status |
|---|---|---|
| 1 | CERN | Functional |
| 2 | Daresbury | Functional |
| 3 | Daresbury | Being repaired |
| 4 | Daresbury | Functional |
| 5 | Fermilab | Functional |

| Probe Boards | X | G | ProtoDUNE |
|---|---|---|---|
| Daresbury | 90 | 25 | |
| CERN | 25 | 25 | |
| Fermilab | 50 | 50 | 5 |

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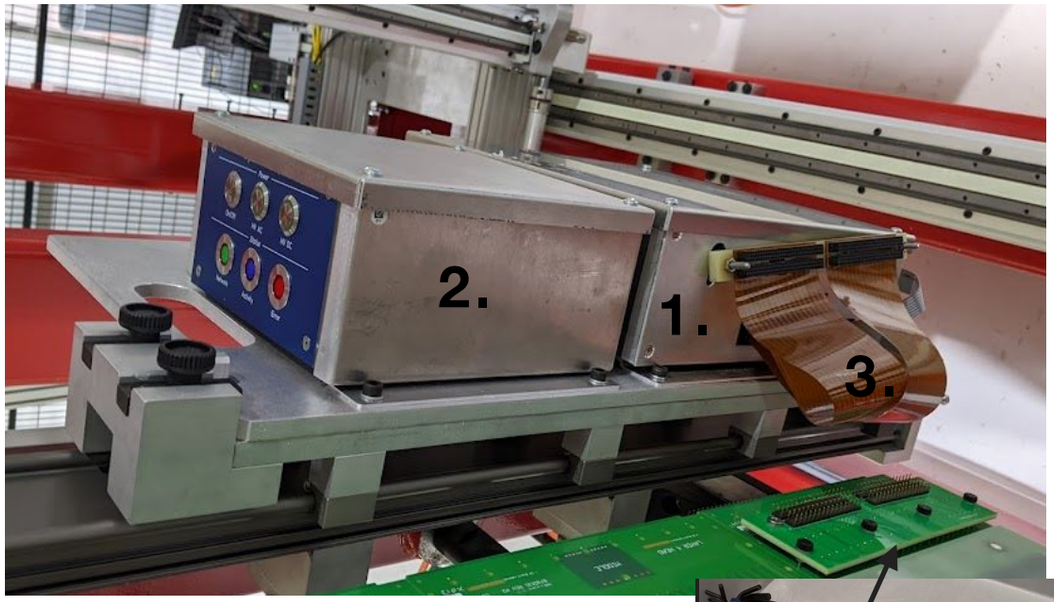


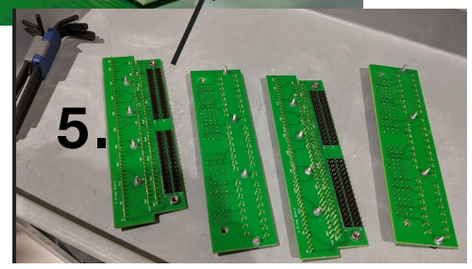



**3 new DWAs (+ spare parts) under construction!**

| DWA # | Location | Status |
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| Probe Boards | X | G | ProtoDUNE |
|---|---|---|---|
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| Fermilab | 50 | 50 | 5 |

# Recent updates

- Two fully functional DWAs at Daresbury
- Two postdocs and four PhD students trained to perform tension measurements
- Always two people on standby to travel to Daresbury to make tension measurements (when a layer is done)
- Several days of DWA measurements for testing and training at Daresbury in November and December
- Got some upgrades to the software to improve the *user-friendliness*

# Recent updates

- At Daresbury:

➡ APA #4: Tensions for X, V: waiting for U

➡ APA #5: waiting for U

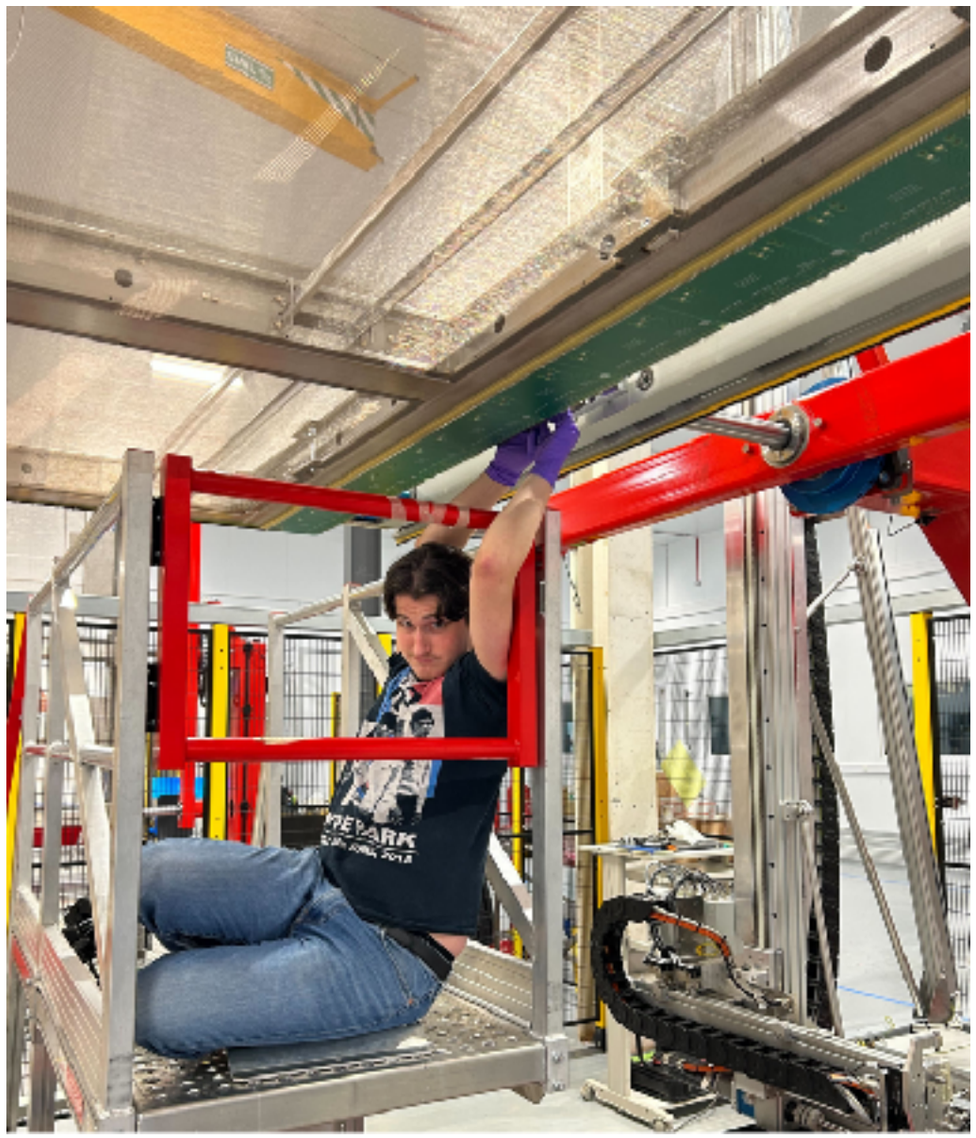
➡ APA #6: Waiting for U

# DWA operation

- User manual (https://edms.cern.ch/ui/#!master/navigator/document?P:100788027:101054576:subDocs)
- Probe boards installation (before APA is placed in winder!)
- Measure X, V, U layers (separately or at once)
- Install probe boards and measure G layer
- Measurement time:

Both sides

  - G: 50min
  - X, U, V together: 200min



# DWA operation

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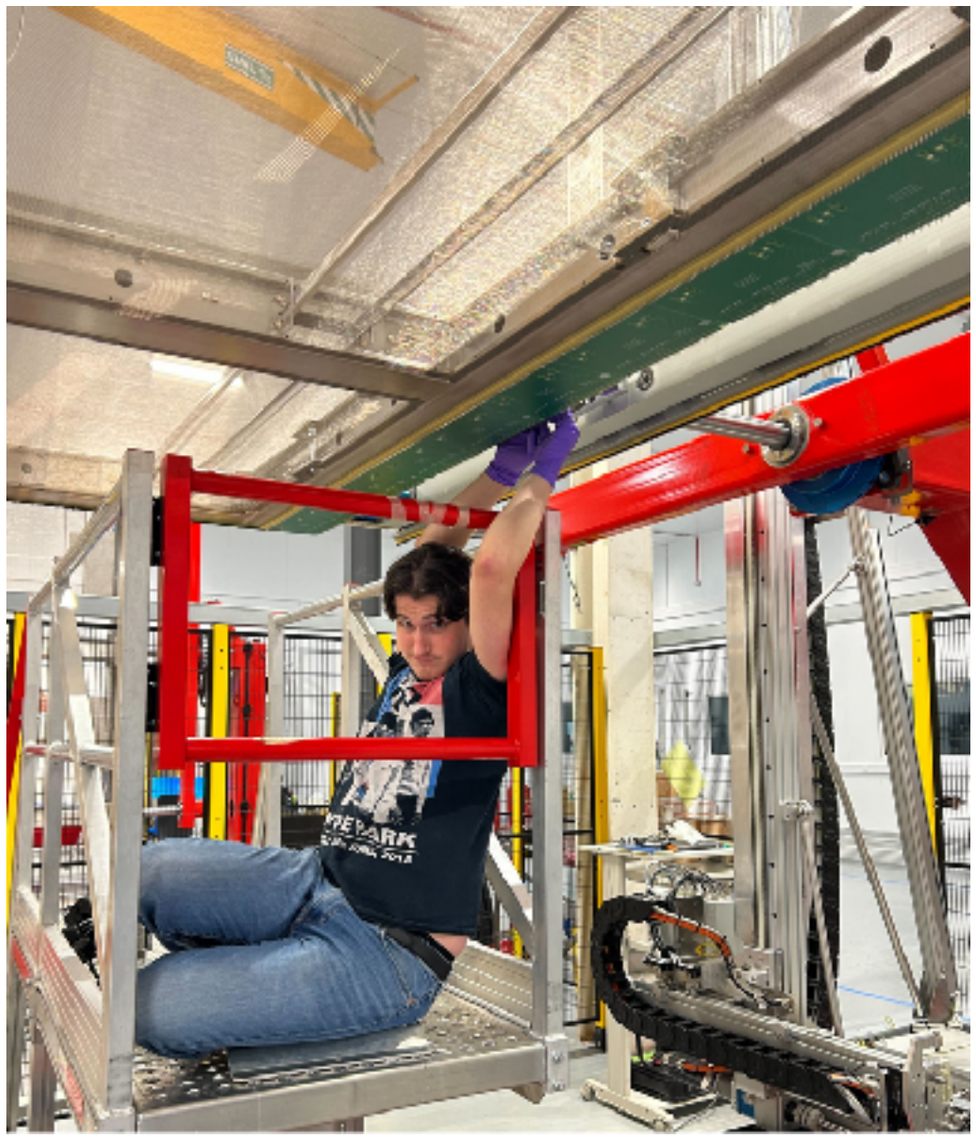
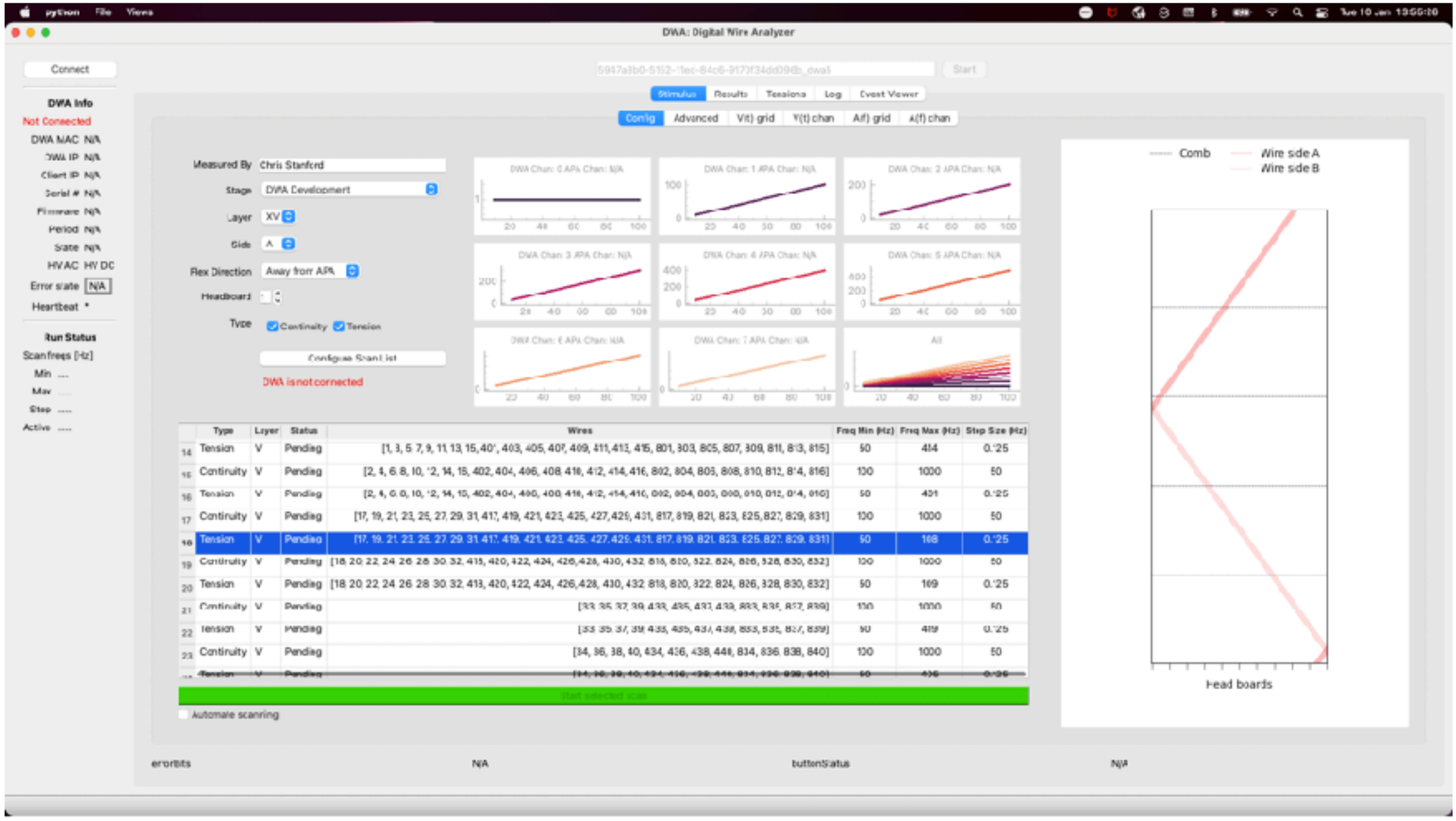


**Need ~1h after each layer to measure tension**

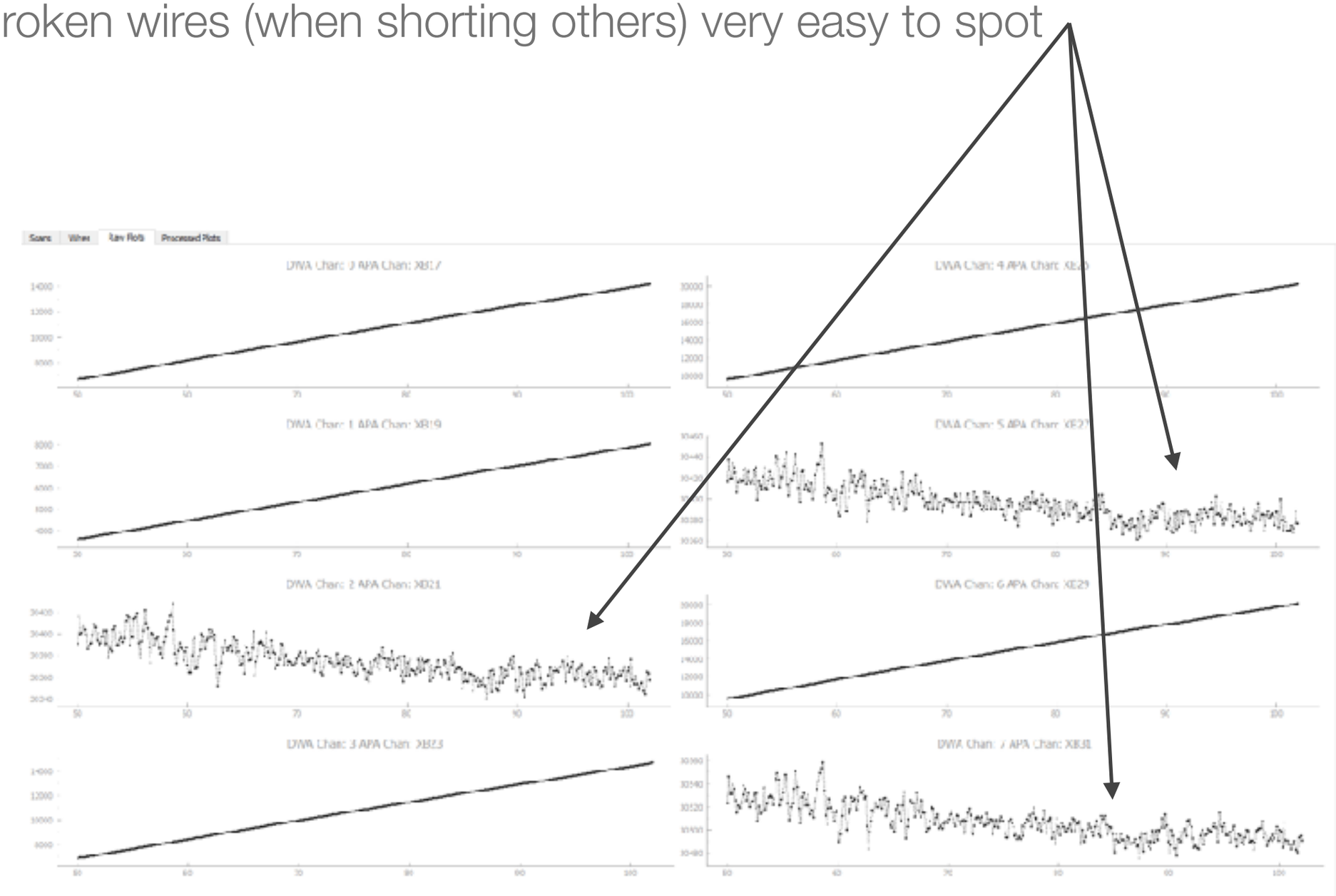
# Live operation and tension data analysis

- Many new improvements to the software
  - Visual indication when scan had issues (user can retake immediately the scan)



# Live operation and tension data analysis

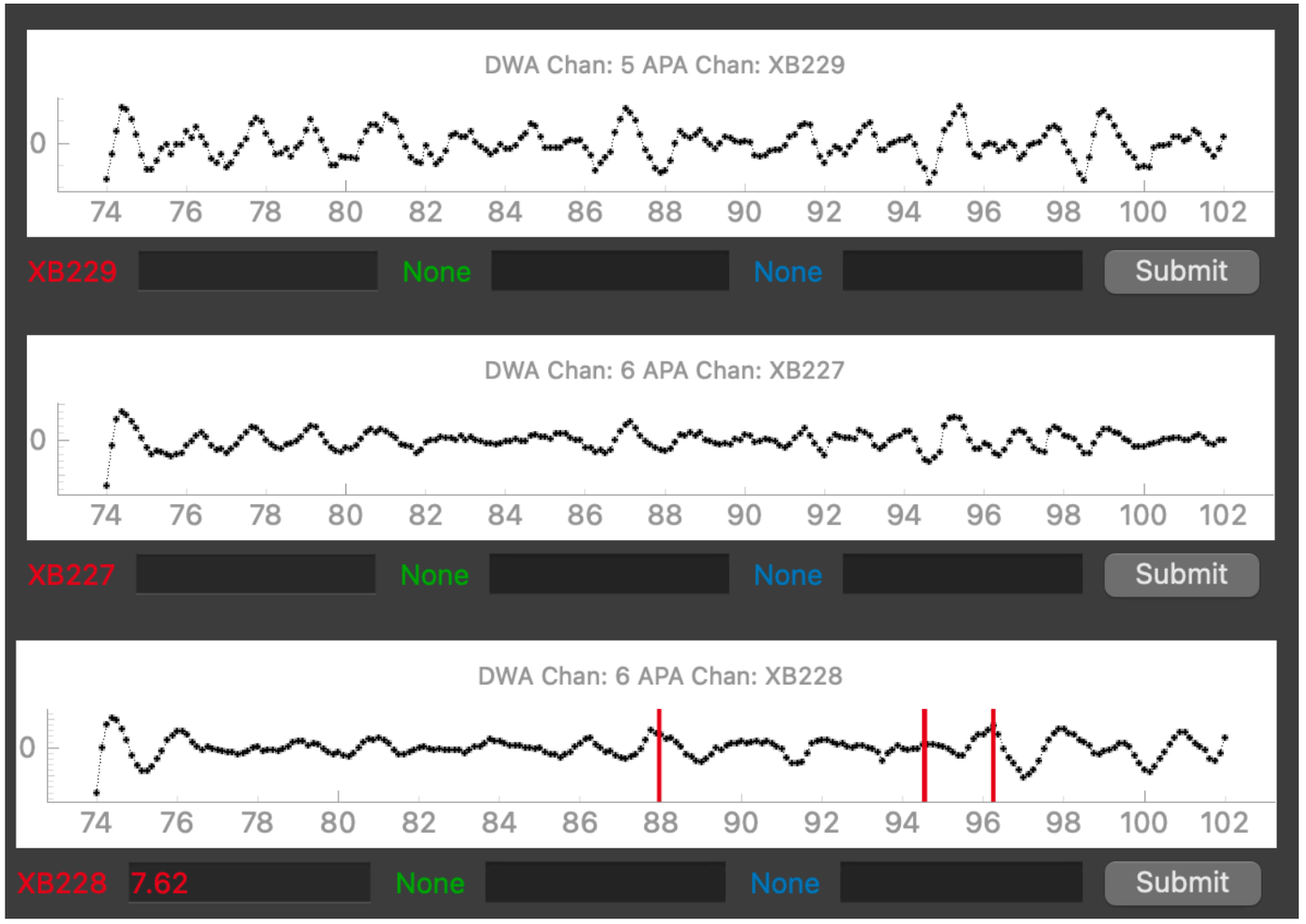
- Many new improvements to the software
  - Visual indication when scan had issues (user can retake immediately the scan)
  - Broken wires (when shorting others) very easy to spot




**These will be flagged automatically to the user**

# Live operation and tension data analysis

- Many new improvements to the software
  - Visual indication when scan had issues (user can retake immediately the scan)
  - Broken wires (when shorting others) very easy to spot
  - Missing wires are harder to identify for sure (requires to combine to a visual inspection during winding)

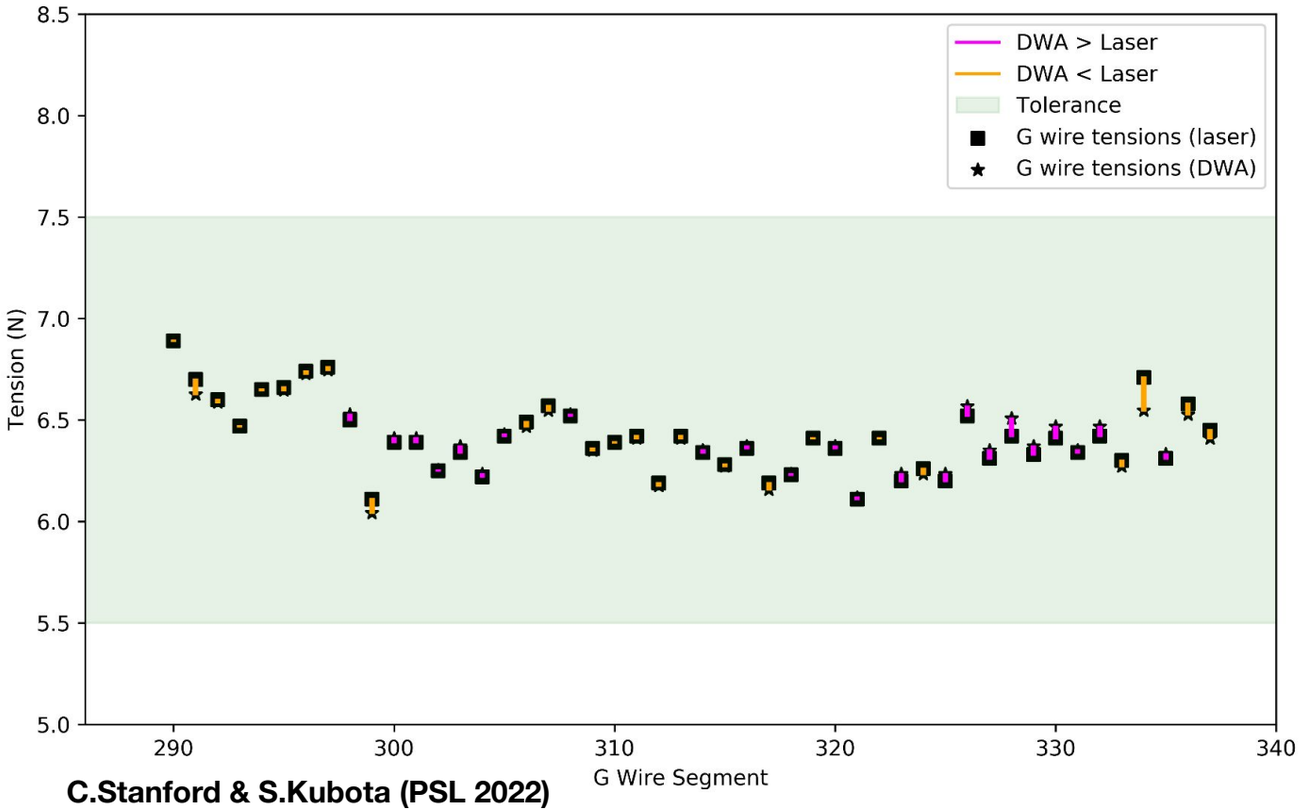



**Easy to address live**

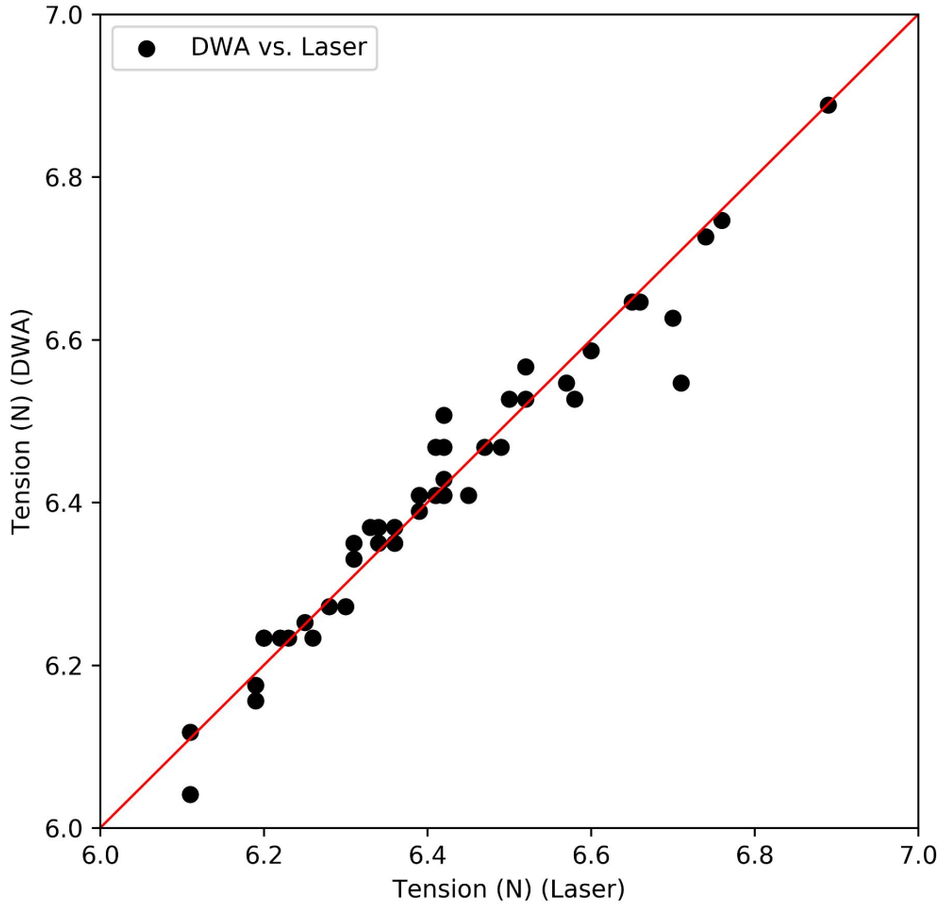
**Need to understand how many times the algorithm is failing this**

# Offline tension analysis

- Calibration is not an issue



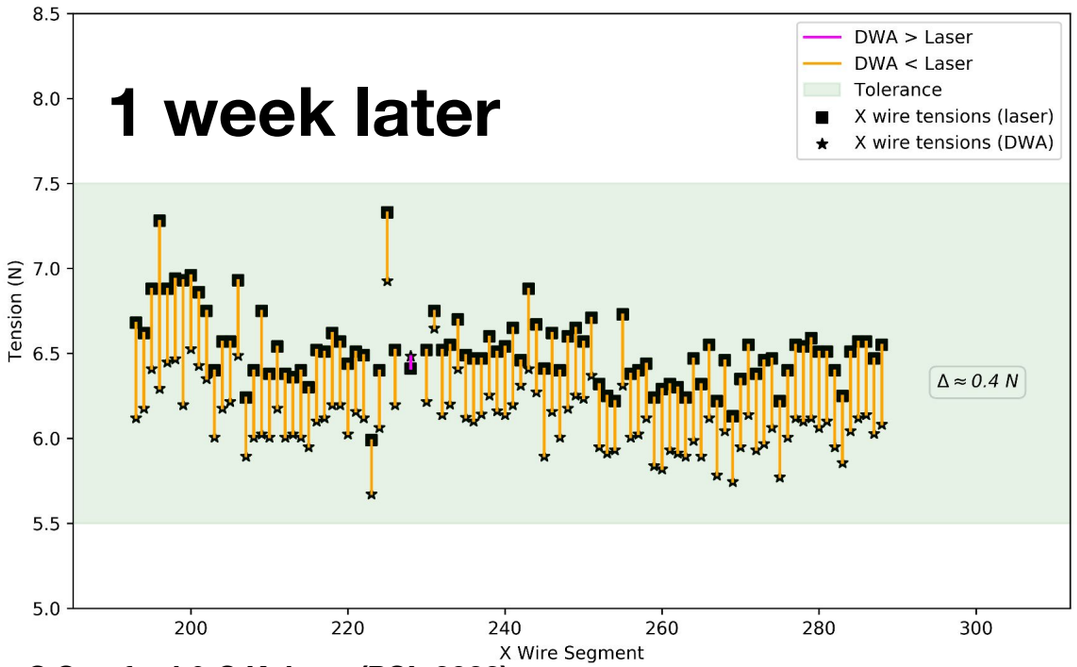

**C.Stanford & S.Kubota (PSL 2022)**



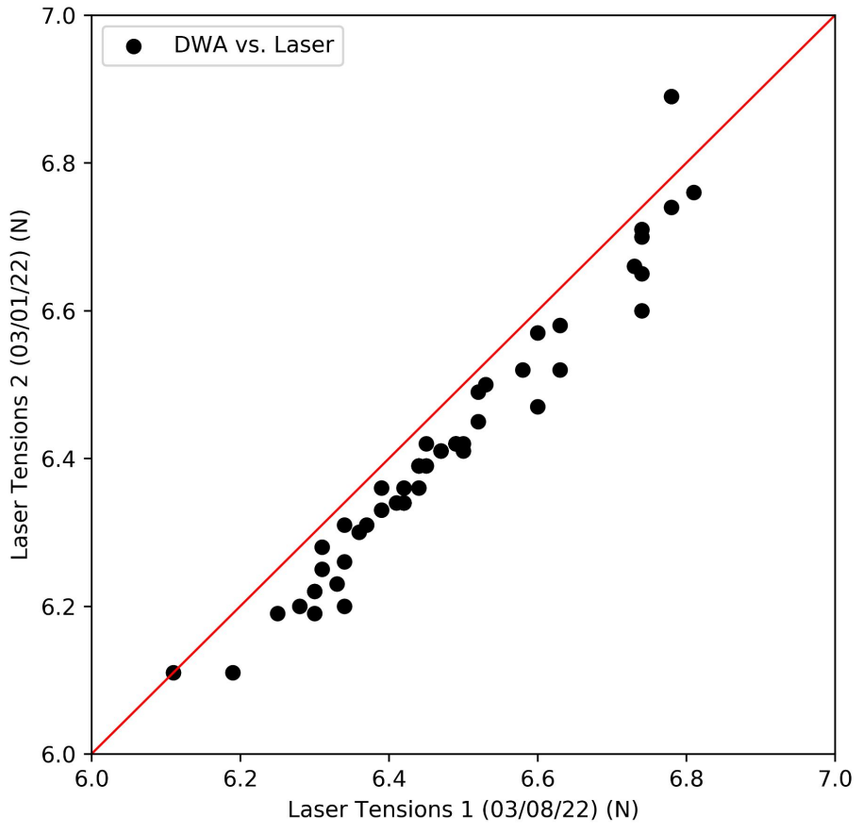
# Offline tension analysis

- Calibration is not an issue

- Note that the tension of a layer changes (slightly ≲ 0.5N) over time (even days)

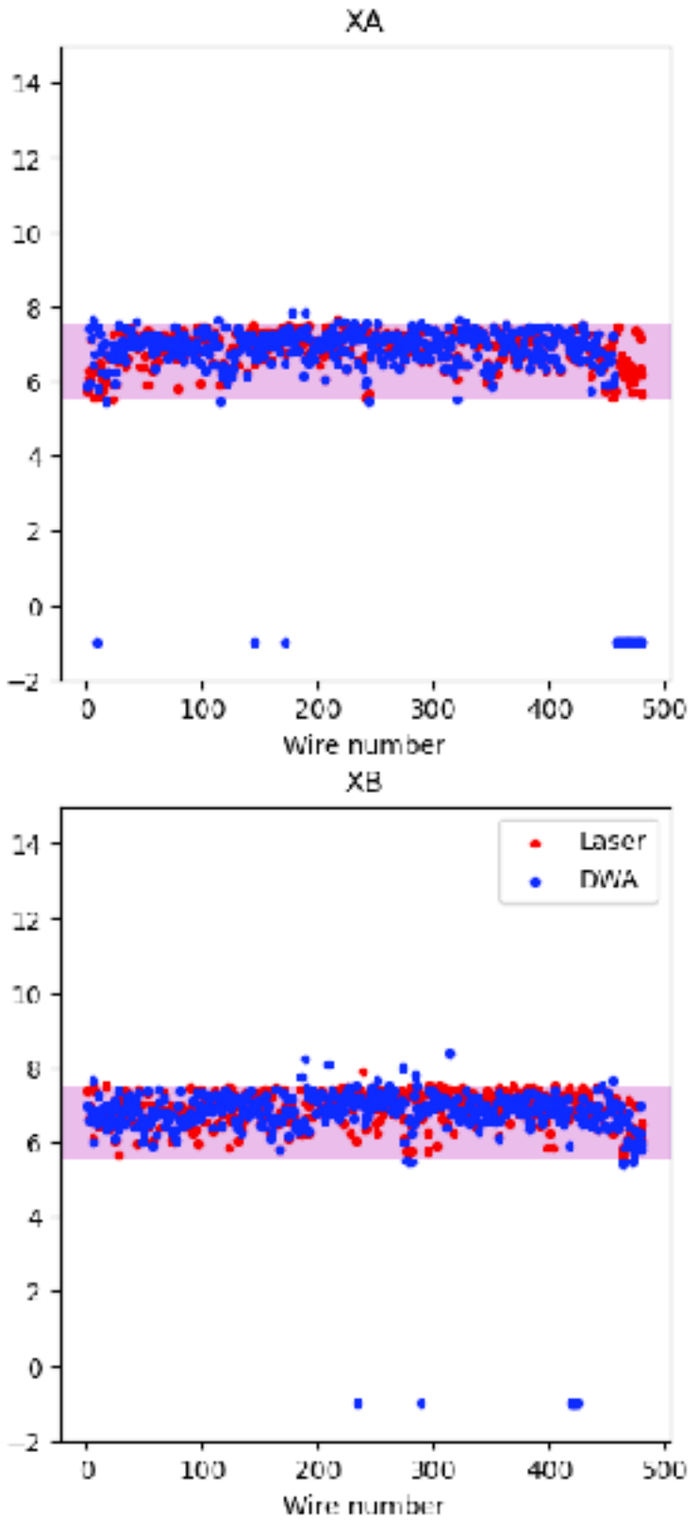



C.Stanford & S.Kubota (PSL 2022)

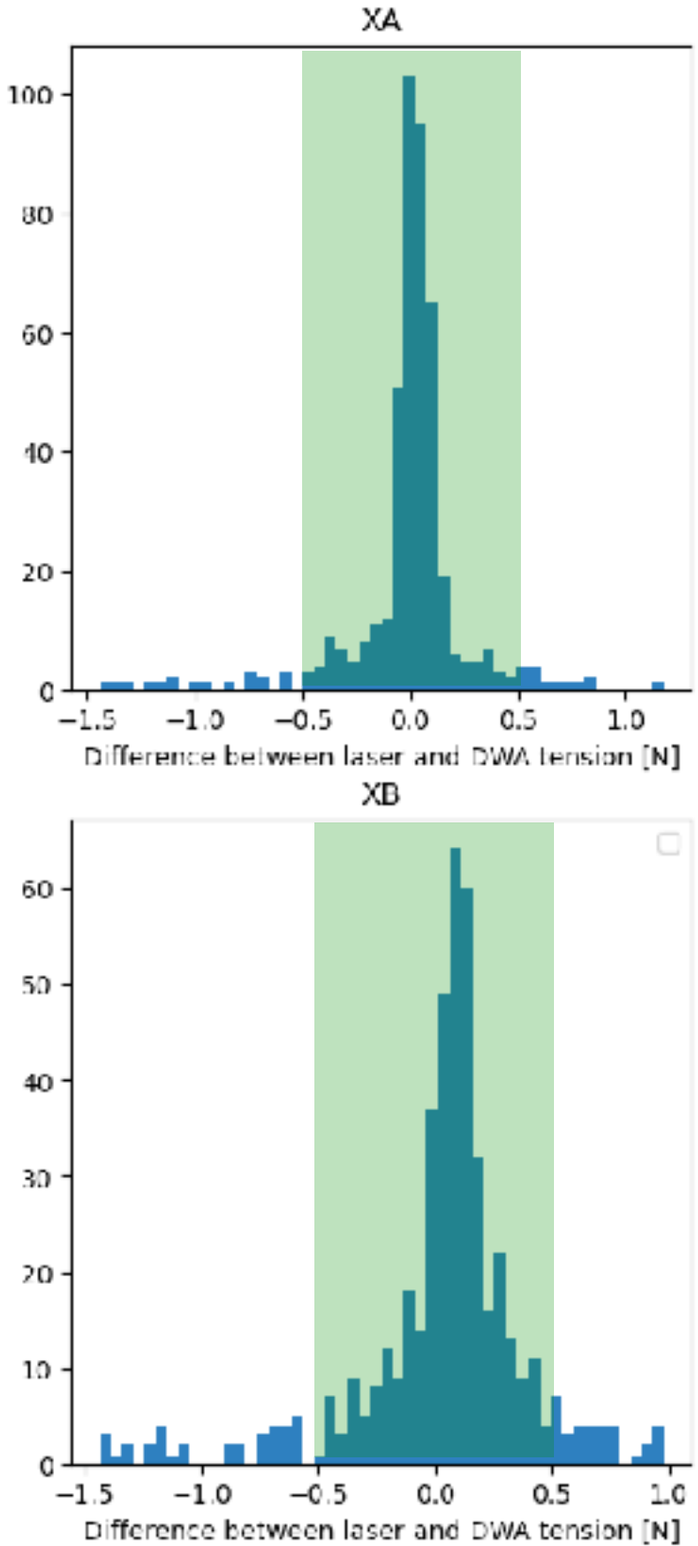


# Offline tension analysis

- Recent Daresbury analysis on APA #4 (X layer)




**Quite straightforward for X, G layers (Vertical wires)**

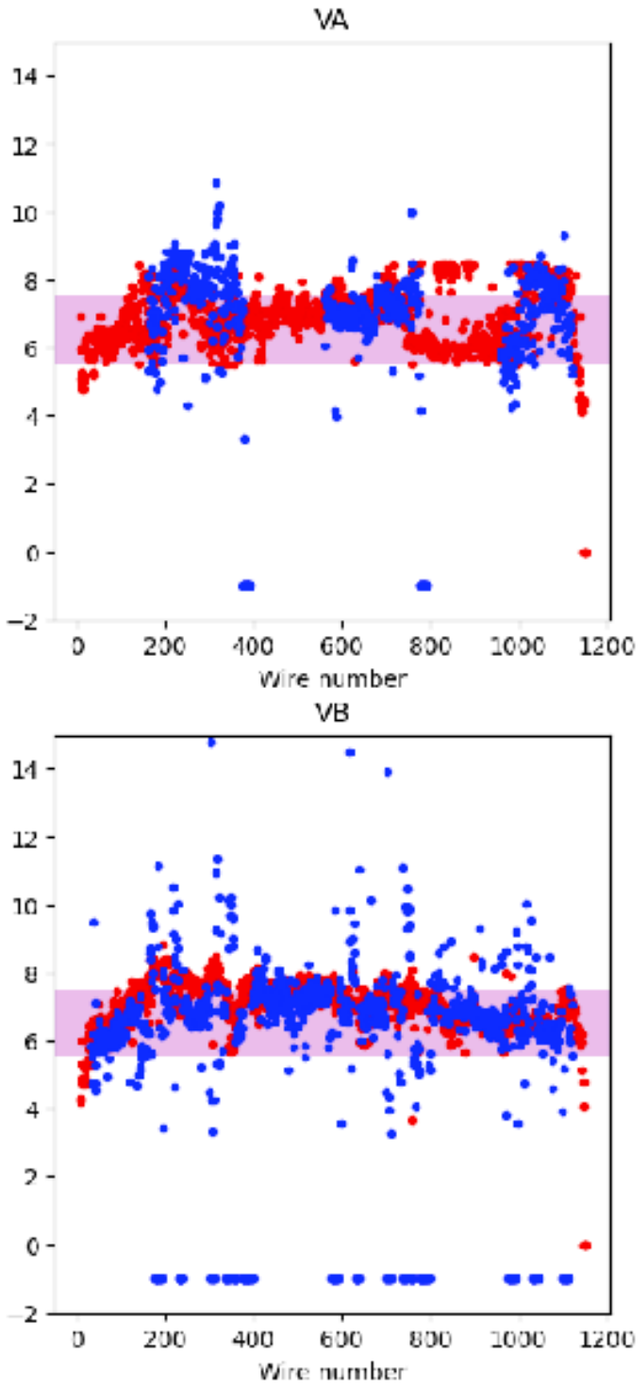


# Offline tension analysis

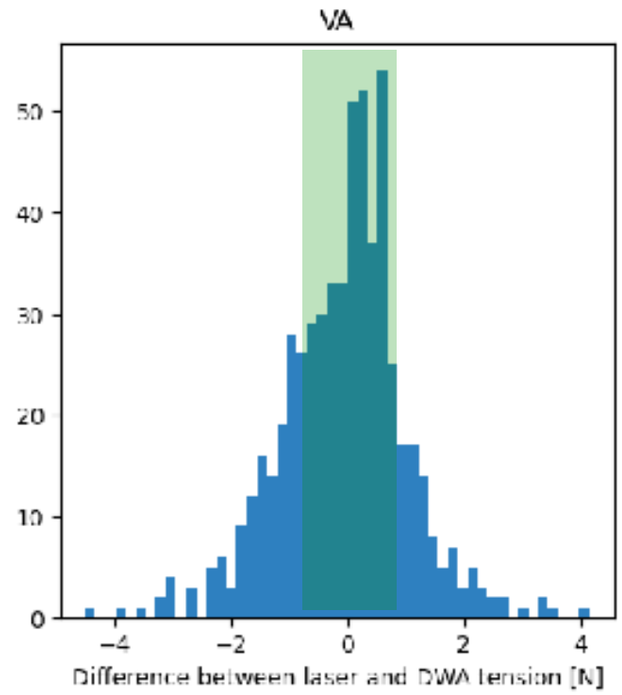
- Examples of manual correction (X layer)

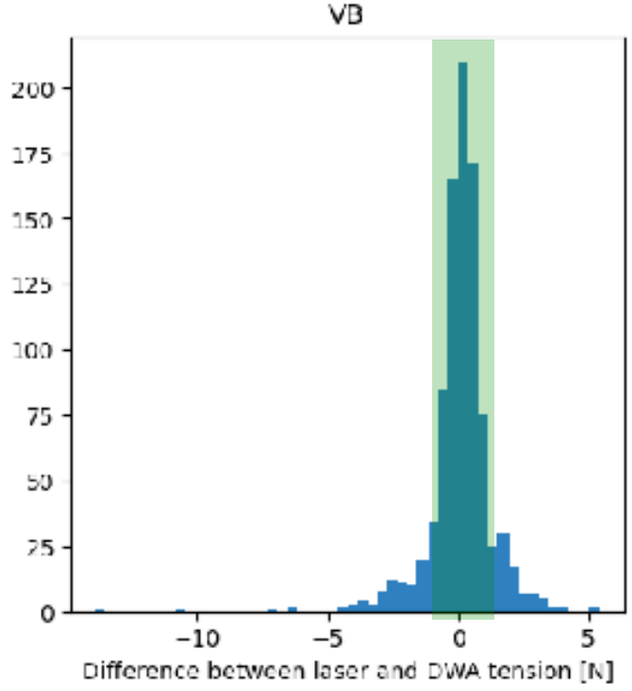
# Offline tension analysis

- Recent Daresbury analysis on APA #4 (V layer)



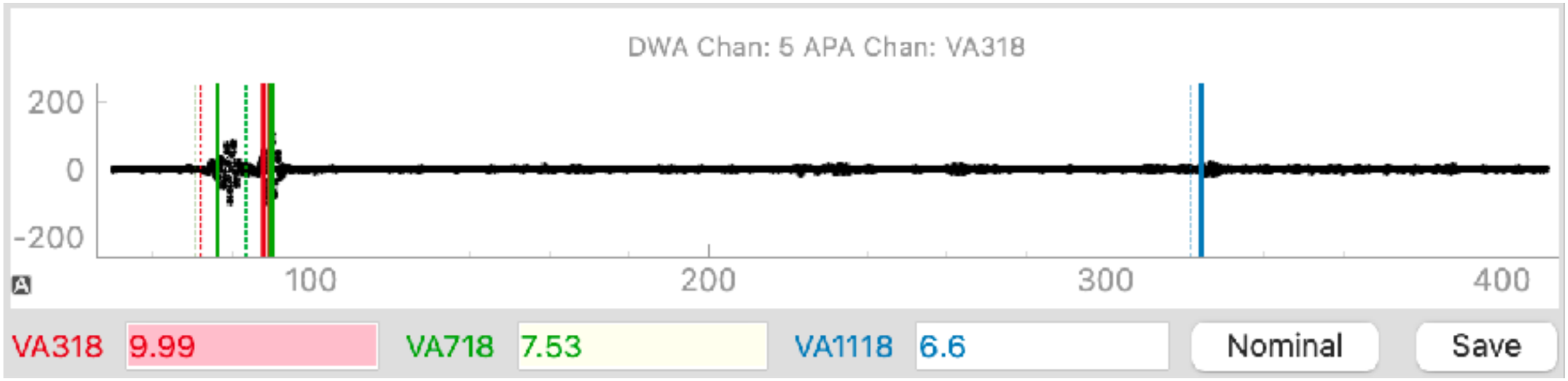

**Much more complicated for U, V layers (Multiple wire segments)**



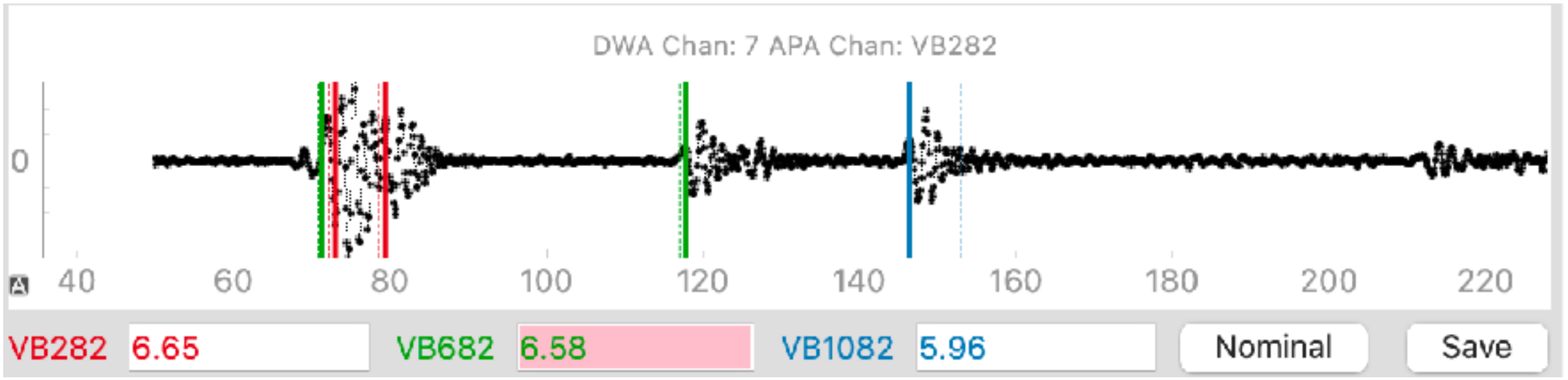



# Offline tension analysis

- Examples of manual correction (V layer)




Manual adjustment



# Summary and next steps

- DWA currently operated by trained experts from Manchester (and will be for the next months/year)

- DWAs are fully operational and almost completely user-friendly (more tests being done to ensure that)

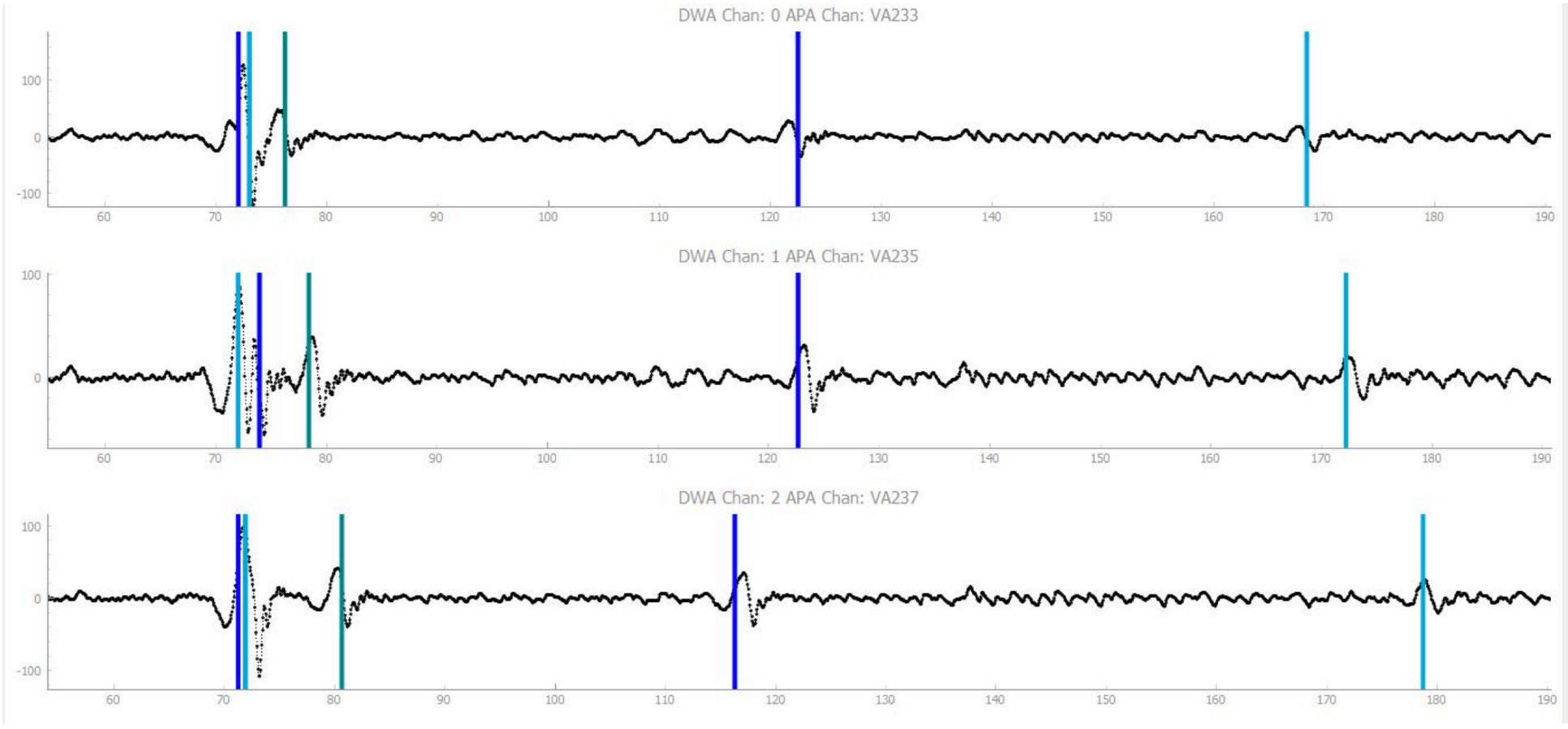
- Some challenges with analysis of U,V layers given the nature of the resonances that require manual inputs

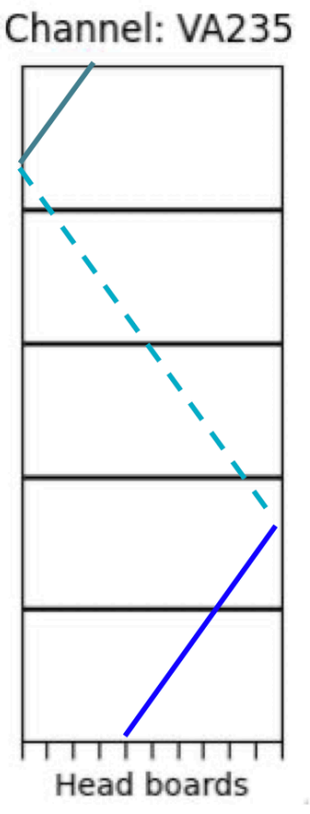
- The next APAs should be able to rely fully* on DWA

- Plan to test the DWA with storage box containing 2 APAs to ensure there is no difference than with 1 APA.

* except for the 412 (-46) short wires that need laser

The DWA uses an algorithm to identify resonances and assign them to different wire segments




Slide by Chris Stanford