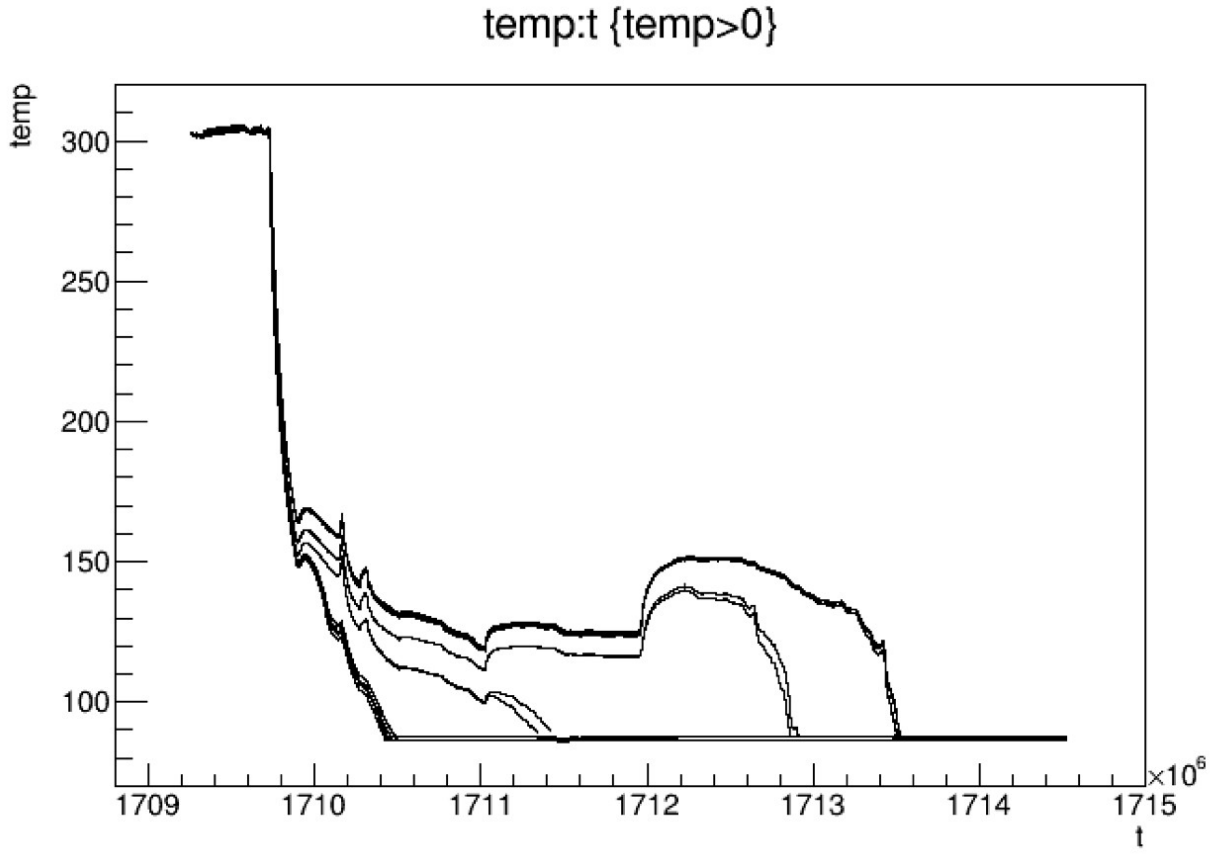
IMPERIAL

ProtoDUNE-II
APA Commissioning Report

Cooldown

- Filling finished Fri 03/05.
- Temperature sensors showed a smaller temperature differential between top & bottom than in ProtoDUNE-1: ~60°C rather than ~100°C.



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TPC Status

Last week's activities:

Bias ramp
Noise runs

Beam plug filling with N2

Bias +
HV ramp

- 14 (out of 32) channels that were observed to be open (i.e. dead) during coldbox testing were observed to recover during the wire bias ramps.
- ProtoDUNE-II is now at full operating voltage (180 kV) and seeing cosmic tracks!


Time Tick
0
1000
2000
3000
4000
5000
6000


However…
we have not come online without issues.
ISSUE 1: Bias connection on APA1
ISSUE 2: Shorted channels

Issue 1: APA1 Bias

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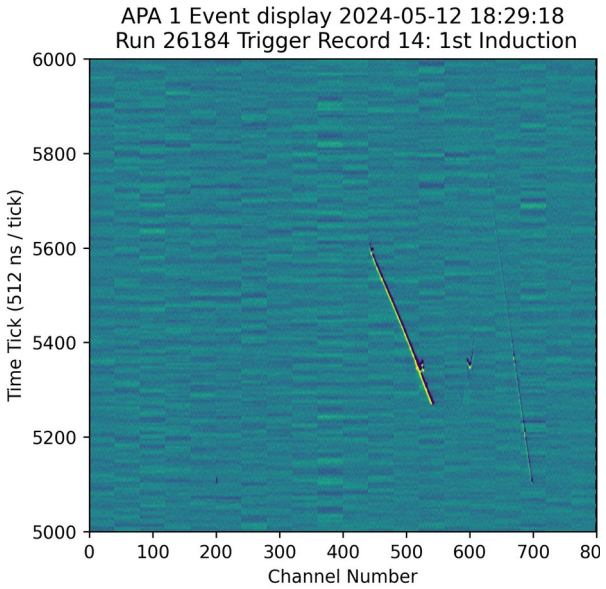
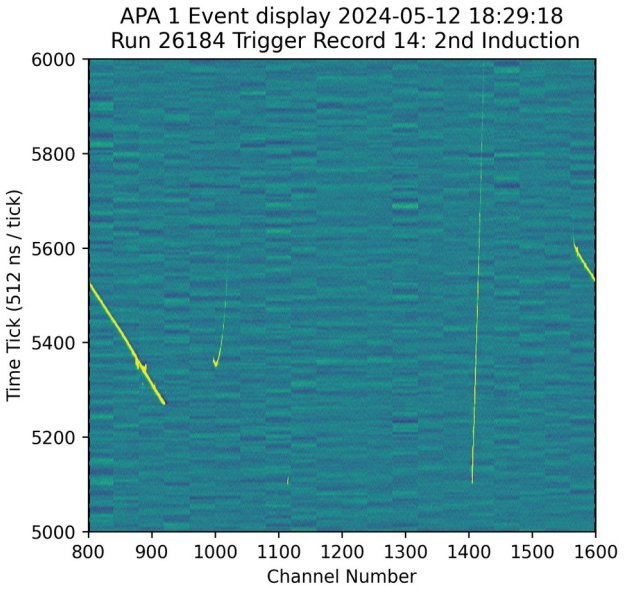
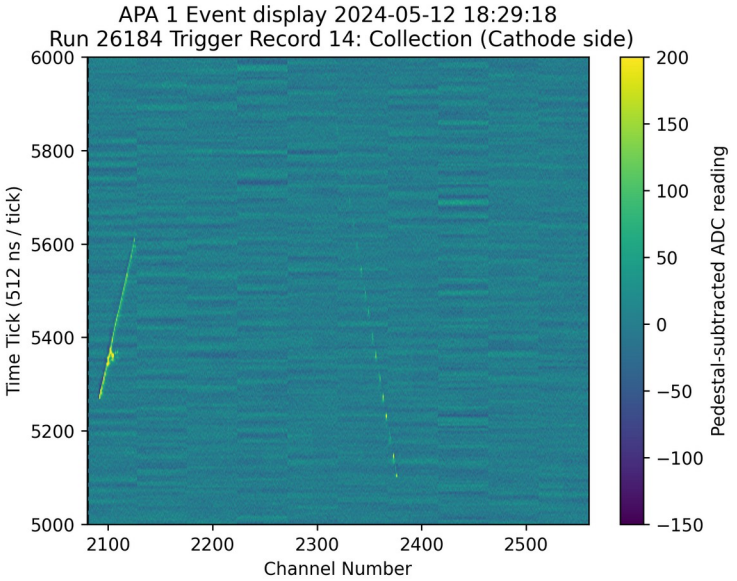
APA1 Bias Connection

Immediately after ramping the HV on Friday, it was observed in the control room that cosmic tracks in APA1 and 4 appeared faint in the collection plane & unipolar in the 2nd induction plane.







APA1 Bias Connection

- APA 4 was recovered by finding a loose connection.
- For APA1, the connection fault has been identified to be in the cold, between the HV cable and the APA itself.
  - Planned to open the flange to investigate, but electrical tests show the cable itself is connected.
  - **Unlikely to be recoverable**: there is no way to drain the LAr in time for the beam run.

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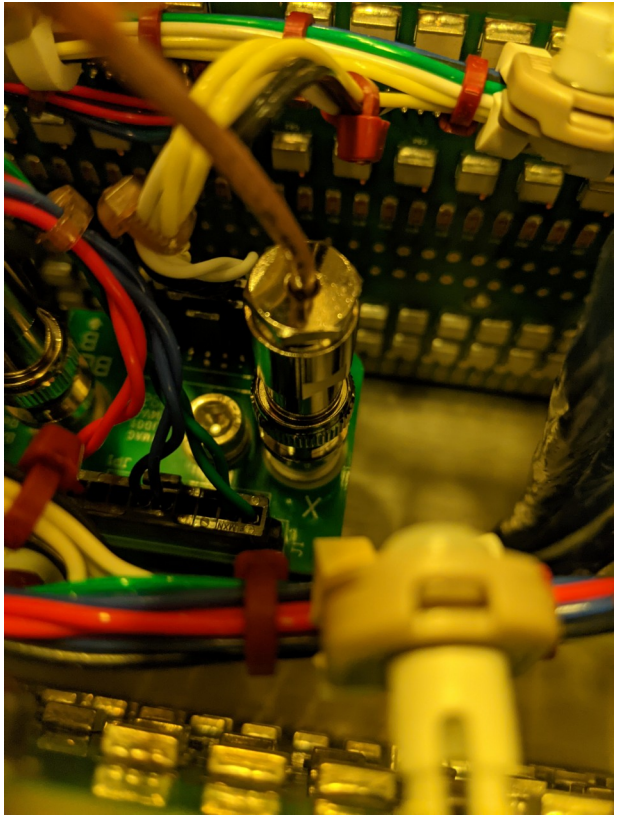
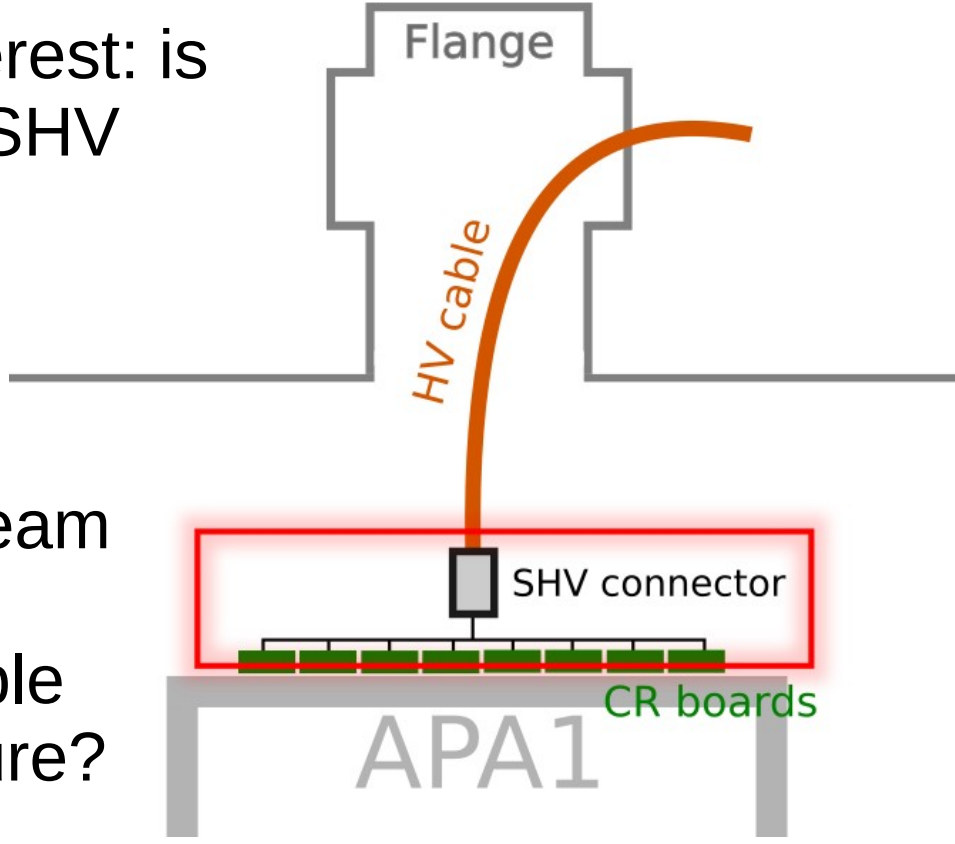
APA1 Bias Connection



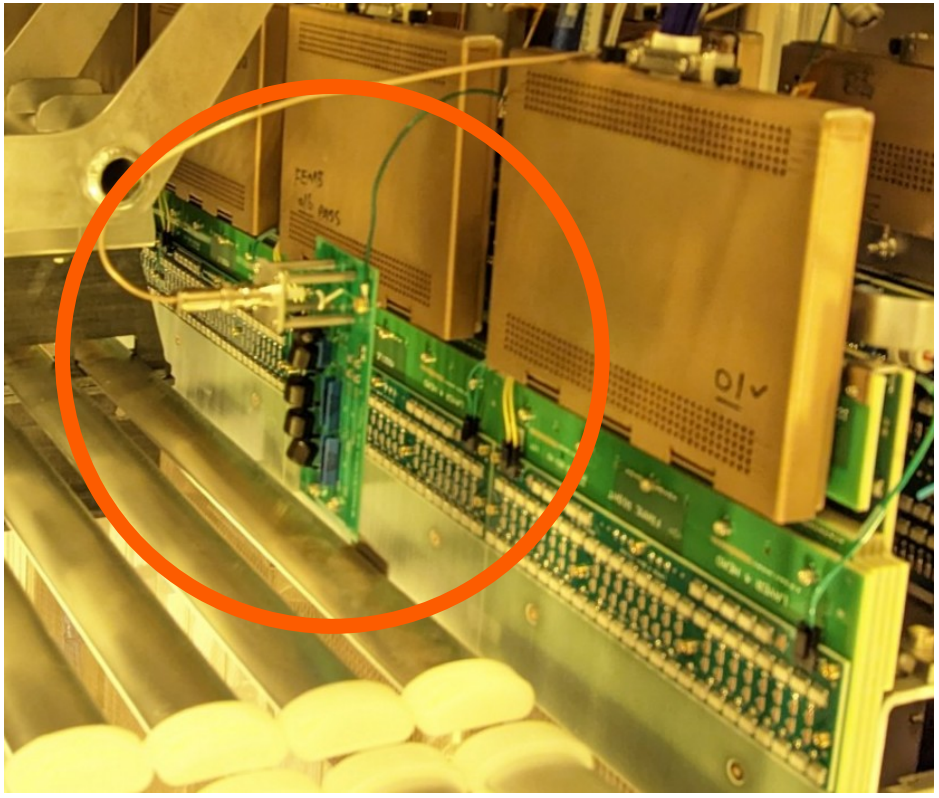
Question of interest: is the fault at the SHV connector, or downstream?

Do the downstream connections contain a possible single point failure?



Future Mitigation

- We should think how to avoid this happening again when repeated at scale in during FD installation.
- Procedural QC changes during installation – 2-person check on each connection.
- Hardware changes – the SHV connections for the field cage are not made directly to the boards but instead have a standoff, making them easy to connect with force.



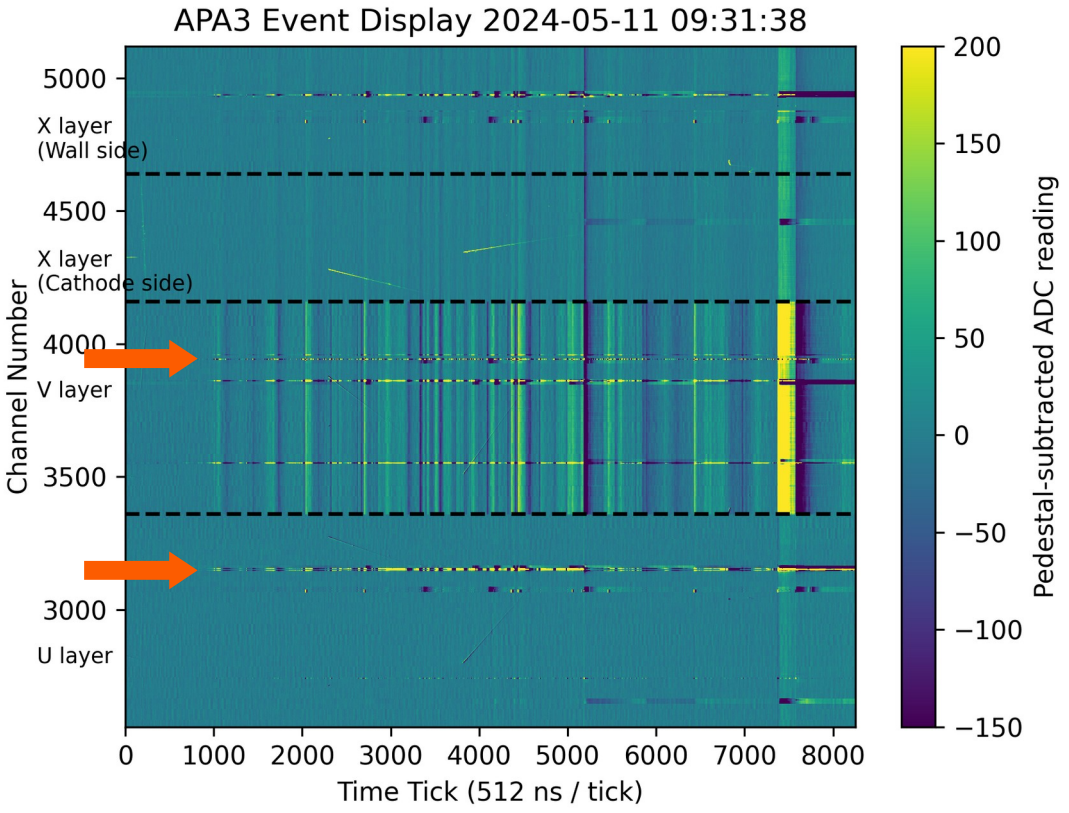
Issue 2: Shorted Channels

Shorted Channels

- We have seen a number of noisy, apparently shorted, channels appear and disappear.
- These channels have had varying effects on their neighbouring channels.
- The timescale of these problems developing and resolving has been days, so we cannot yet confidently say (4 days in) that the detector is stable.

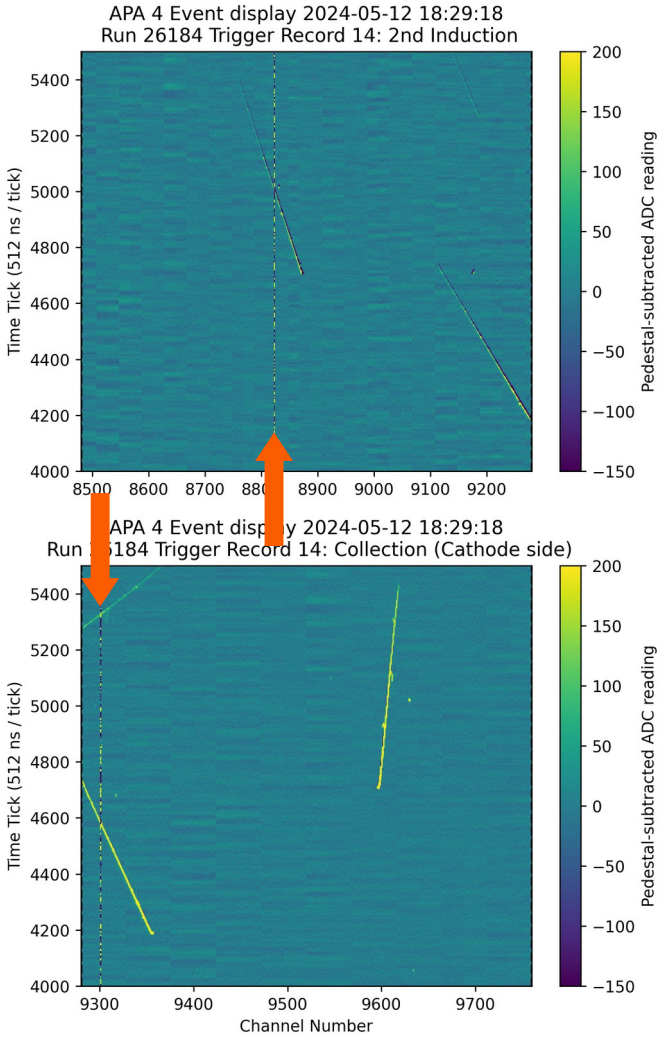
Short No. 1

- Developed during cathode ramp-up (in the 40-60 kV step), Friday 10/5. **Disappeared on Saturday 11/5 (~8pm)**
- U plane FEMB 7 channel 3153 (Single-APA channel 154) to (suspected) V plane FEMB 5 channel 3943 (Single-APA channel 964)
- Induced noise across U channel's FEMB, then whole V plane.

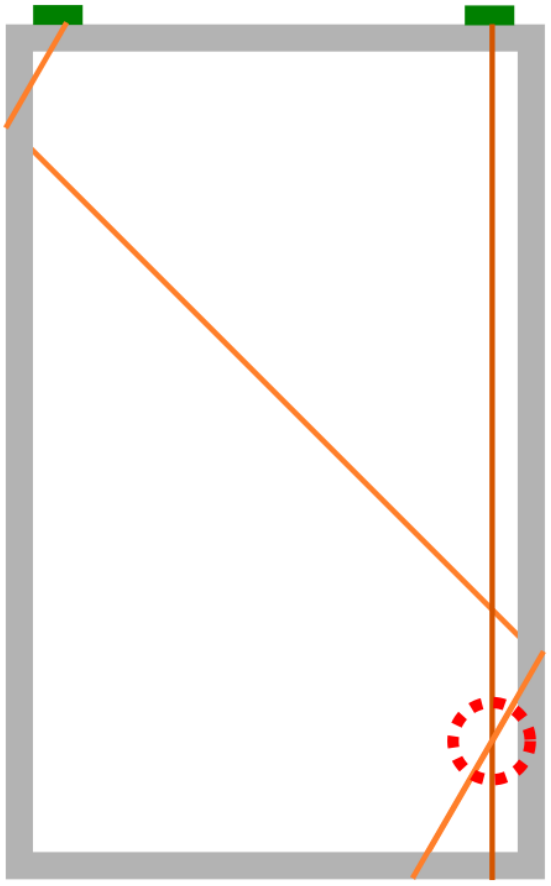


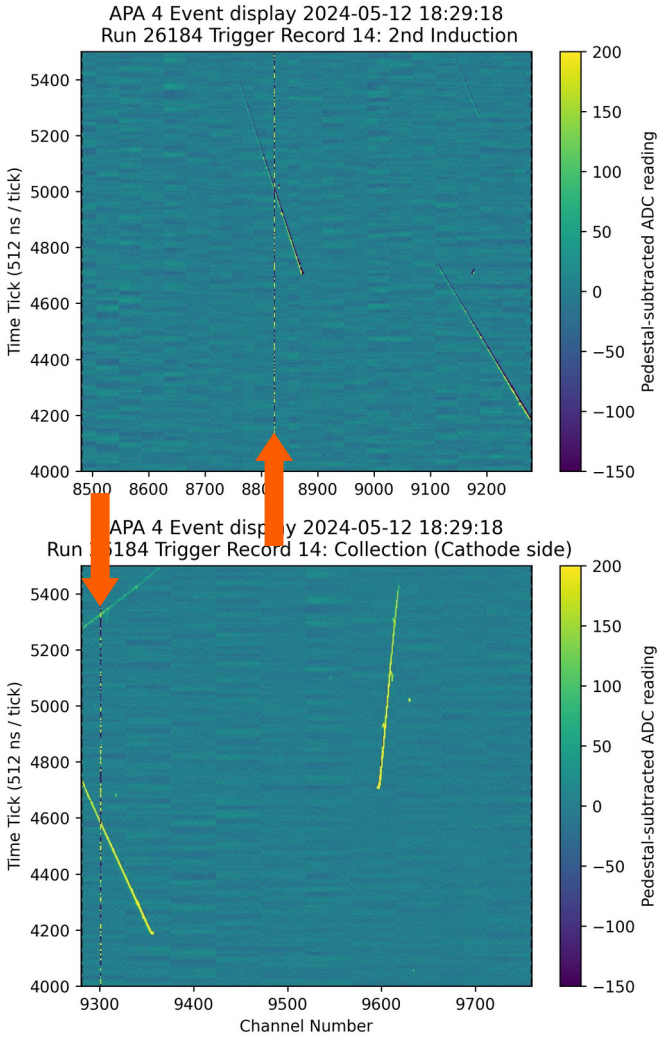
Short No. 2

- Developed Sunday 12/5 ~4am.
- X plane, FEMB 20 channel 9301 (SA 2101) to V plane FEMB 11 channel 8823 (SA 1204)
- No neighbouring channels affected.
- Currently still persisting.



Short 3




APA 4 Event display 2024-05-12 18:29:18
Run 26184 Trigger Record 14: 2nd Induction
Time Tick (512 ns / tick)
Pedestal-subtracted ADC reading
APA 4 Event display 2024-05-12 18:29:18
Run 26184 Trigger Record 14: Collection (Cathode side)
Time Tick (512 ns / tick)
Pedestal-subtracted ADC reading
Channel Number

Shorted Channels Summary

- We don’t yet know the cause of these shorts.
  - Debris?
  - Slack wires?
- Would be interesting to cross-reference them with the tension map.
- The current state is not a problem for physics (only 2 bad channels, no effects on neighbours) but we must continue to monitor to assure ourselves whether the situation is stable.

Summary

Summary

- ProtoDUNE-II is online and seeing tracks.
- We need to continue monitoring the evolution of shorted channels + deduce what we can about the causes, but (fingers crossed) these will not significantly impact performance.
- APA1 being without bias voltage on its collection plane will certainly impact performance, and while we may not be able to recover it for the test beam, we need to work out how to make this impossible in FD installation.