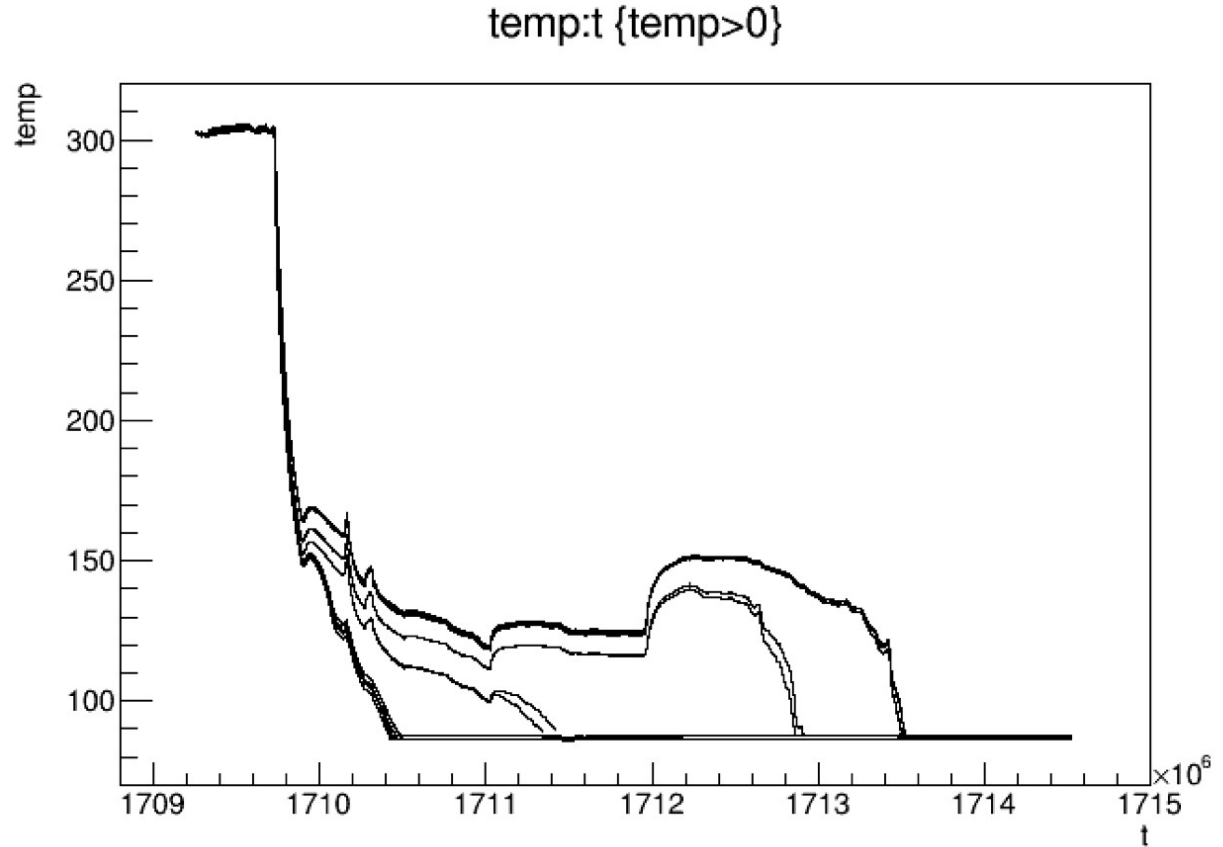


ProtoDUNE-II Cooldown and Commissioning

Cooldown

- Filling ran from March through to the first week of May
- Temperature sensors showed a smaller temperature differential between top & bottom than in ProtoDUNE-1: $\sim 60^{\circ}\text{C}$ rather than $\sim 100^{\circ}\text{C}$.

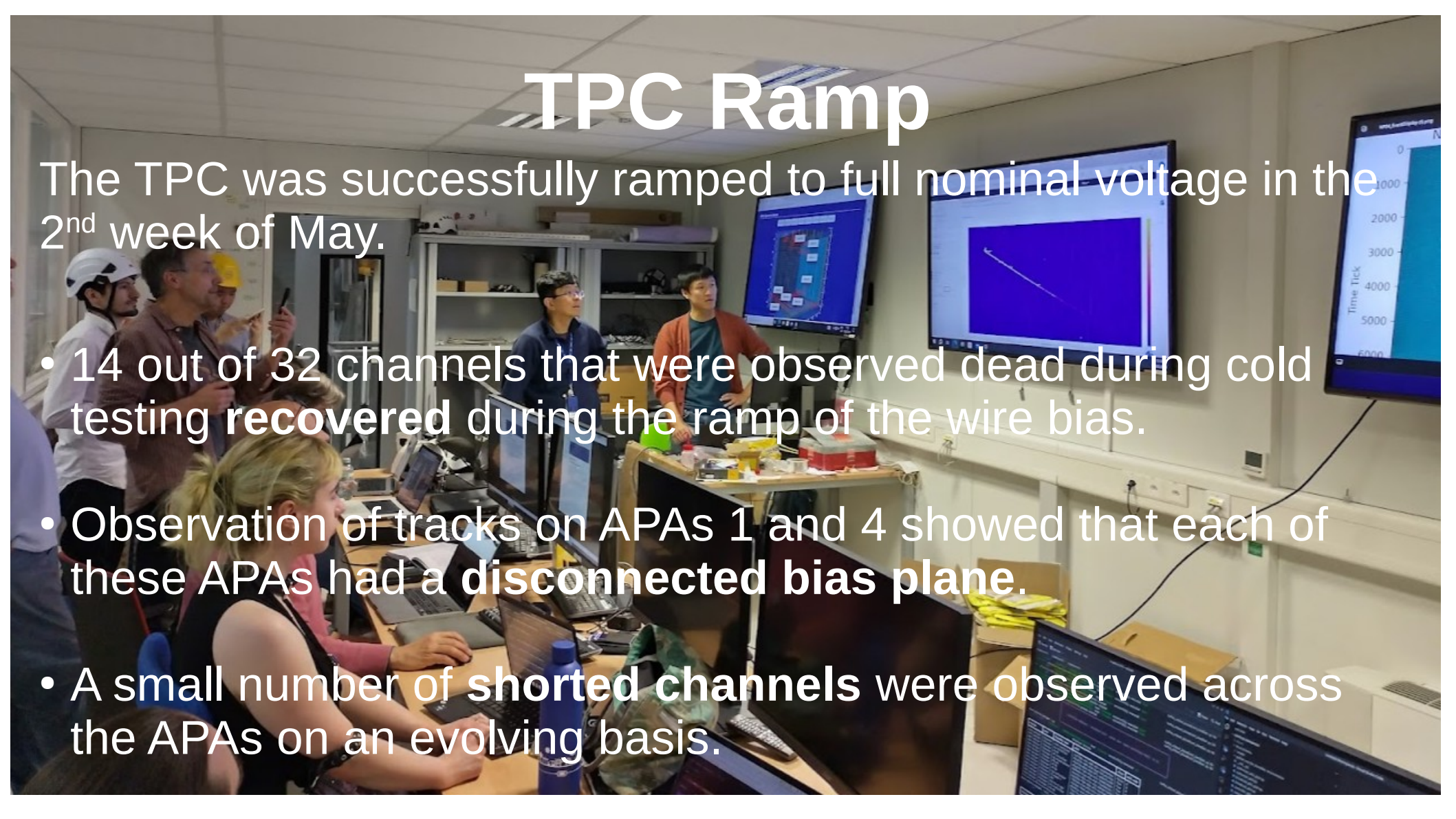


Pip Hamilton

TPC Ramp

The TPC was successfully ramped to full nominal voltage in the 2nd week of May.

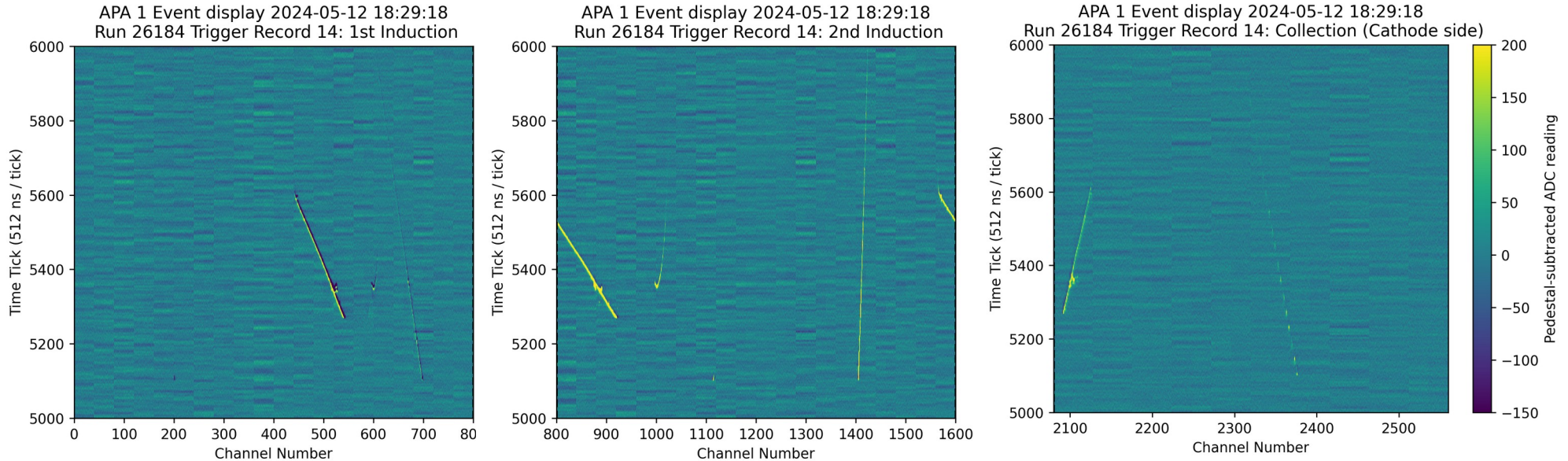
- 14 out of 32 channels that were observed dead during cold testing **recovered** during the ramp of the wire bias.
- Observation of tracks on APAs 1 and 4 showed that each of these APAs had a **disconnected bias plane**.
- A small number of **shorted channels** were observed across the APAs on an evolving basis.



Issue 1: APA1 Bias

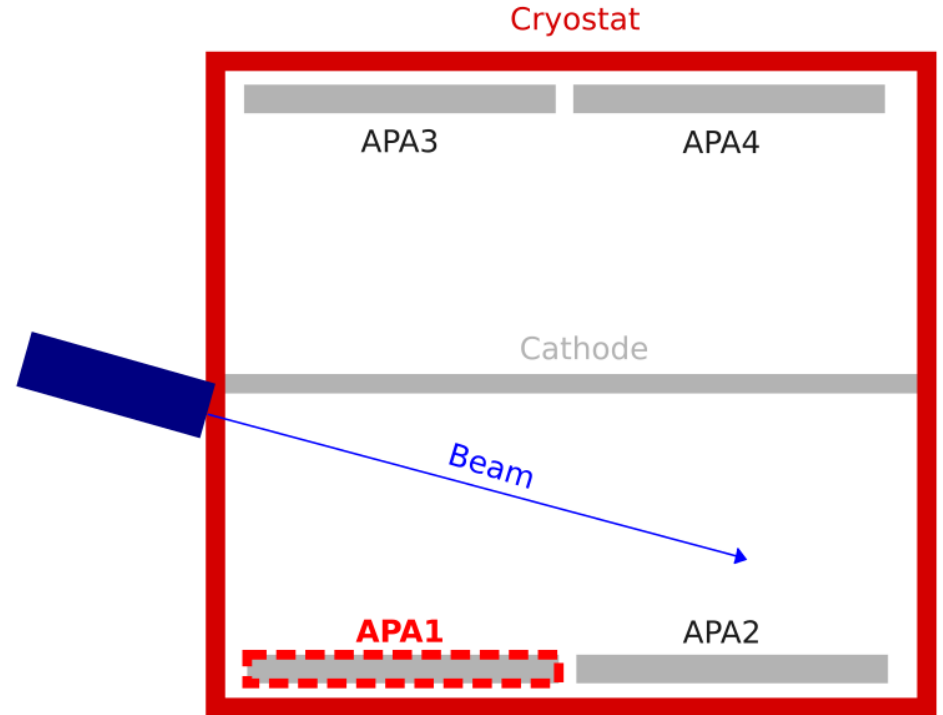
APA1 Bias Connection

Immediately after ramping the HV, 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.

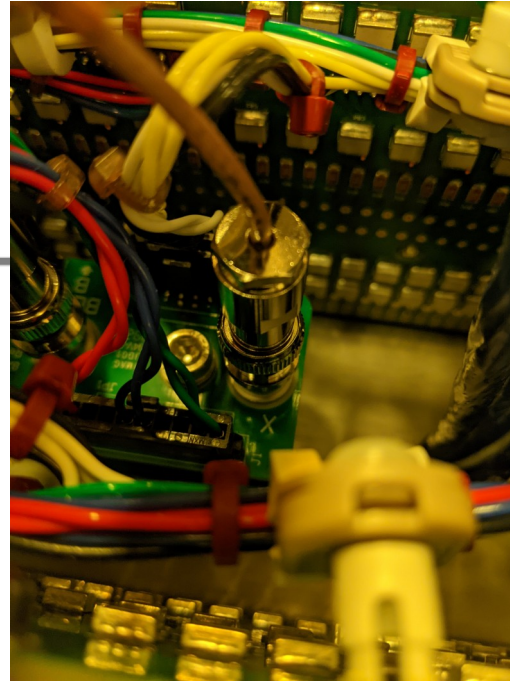
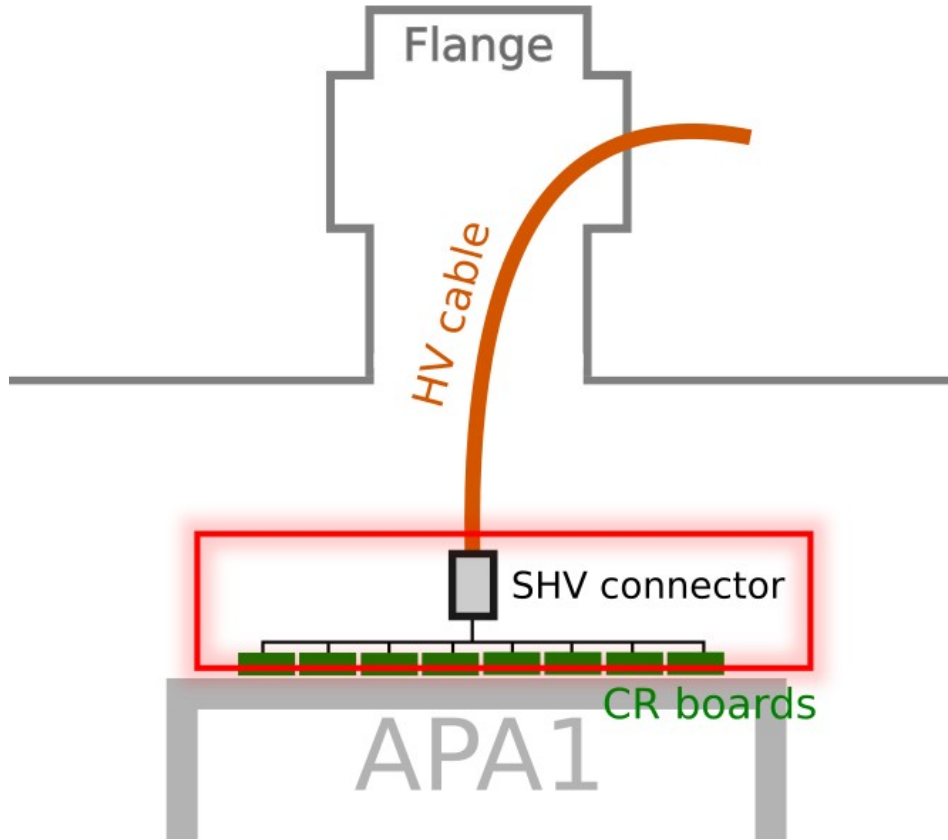


APA1 Bias Connection

- APA 4 was recovered by fixing a loose connection on the warm side.
- For APA1, the connection fault has been identified to be in the cold, between the HV cable and the APA itself.
- This could not be fixed without draining the LAr \Rightarrow not recoverable on the timescale of ProtoDUNE-II's beam run.
- Unfortunately the worst APA to fail.



APA1 Bias Connection

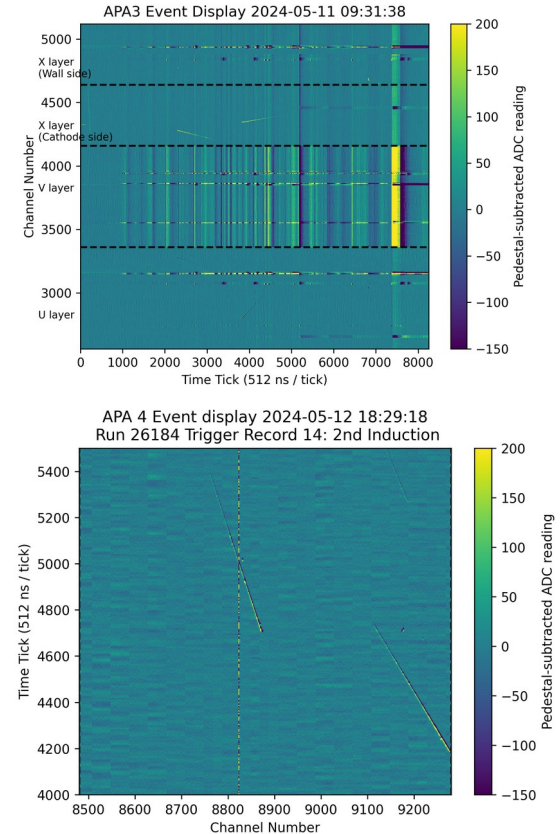


- Electrical measurements indicate the fault is somewhere between the SHV connector and the bias planes.
- A question of extreme interest for investigation after the beam run is concluded.
- Procedures (and possibly hardware) should be updated to minimise the chance of this connection failing in the FD.

Issue 2: Shorted Channels

Shorted Channels

- A small number of noisy, apparently shorted, channels were observed to appear and disappear on a timescale of days following the ramp.
- These channels had varying effects on their neighbouring channels.



Plots courtesy of R. Huang

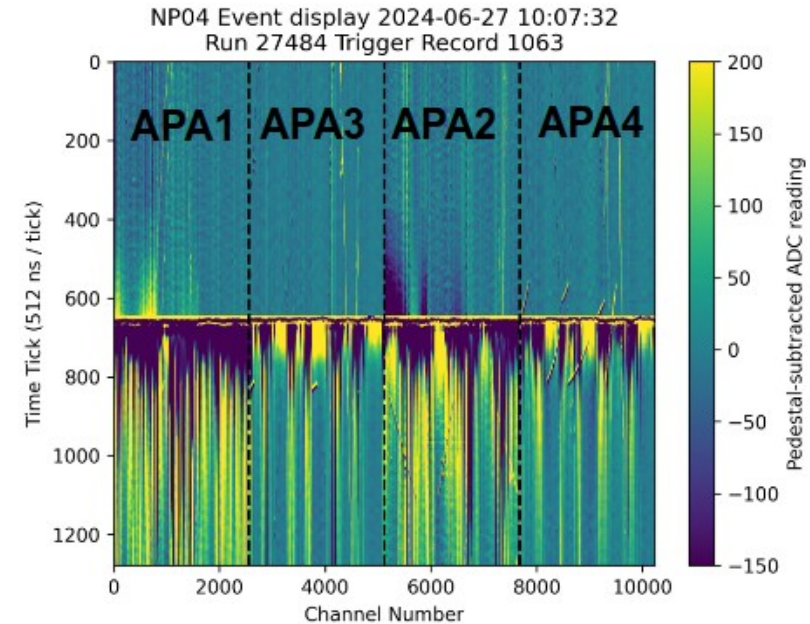
Shorted Channels

- A hypothesis for the cause of these apparent shorts is that there may be one or more small pieces of conductive debris moving in the LAr.
 - 2nd short was observed to clear after stopping & restarting the recirculation.
 - We know that such debris has been seen on the APAs during cleaning.
 - We also know that these APAs have been standing installed *in situ* for an unusually long time.
- The hope was that with time any such debris might settle.
- This has not happened: at the current time we have 2 persistent shorts (on APAs 1 and 4) and have seen shorts appearing and disappearing through June.
- Concerningly, there have also been two recent events which have resulted in **dead** channels.



Dead Channels

- On the 27th and 28th of June, discharge-like events were observed that led to the APA bias tripping.
- After each of these bias trips, a number of new unresponsive (dead) channels were observed on APA4 – 3 on the 27th and 4 on the 28th.
- Thought that the frontend amplifiers may have been damaged by discharge.
- Cause of discharge as yet unknown.



M. Rajaoalisoa, H. Razafinime – NP04 Shorted Channels Summary

Summary

Summary

- ProtoDUNE-II is online and seeing tracks.
- APA1 has no bias on its collection plane, but is still taking data on its two induction planes. The lack of the third plane can be compensated for offline.
- The evolving shorts are a cause for concern, and perhaps raise questions about the cleanliness of the cryostat interior. They are being continuously monitored.
- A thorough investigation of both issues once beam operations have concluded will be important to avoid these problems being repeated in the DUNE far detectors.