

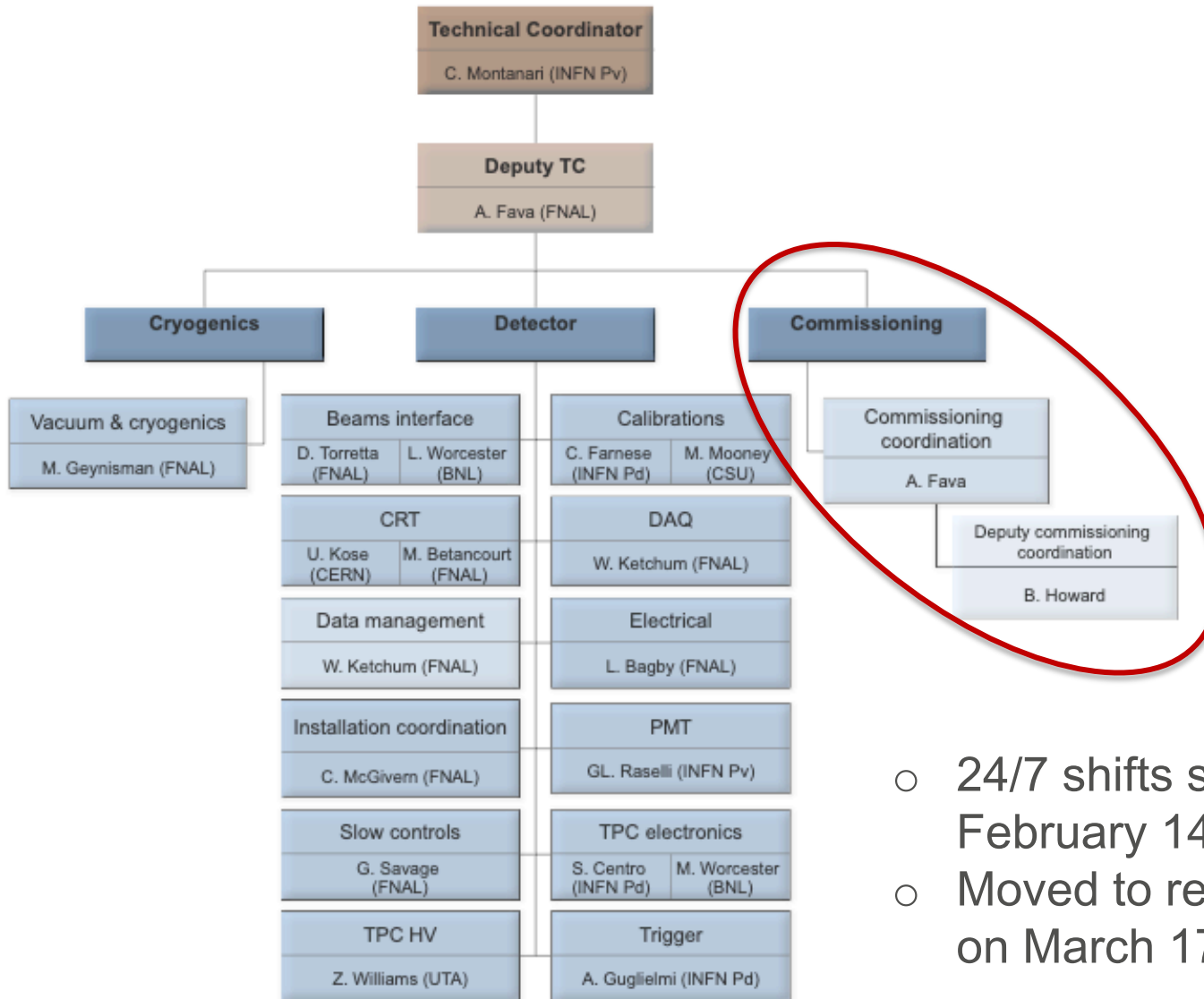


Icarus commissioning

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SBN Oversight Board Meeting 09/11/2020

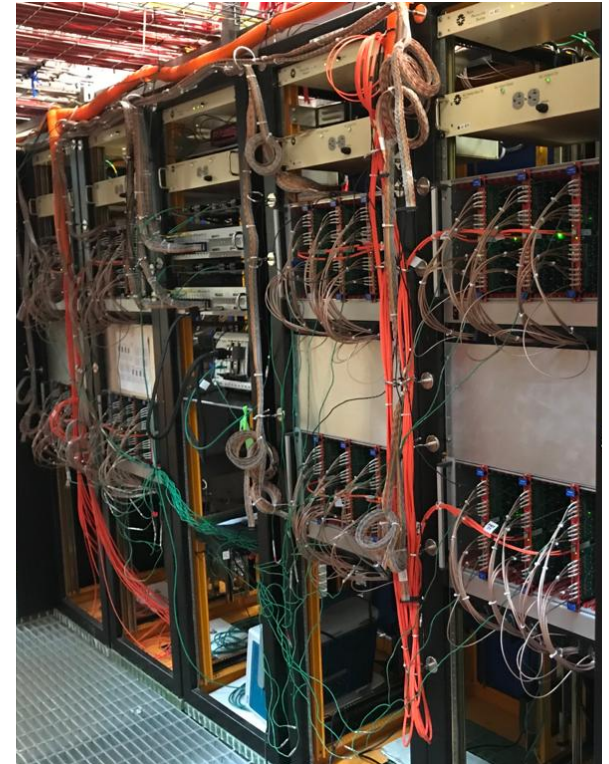
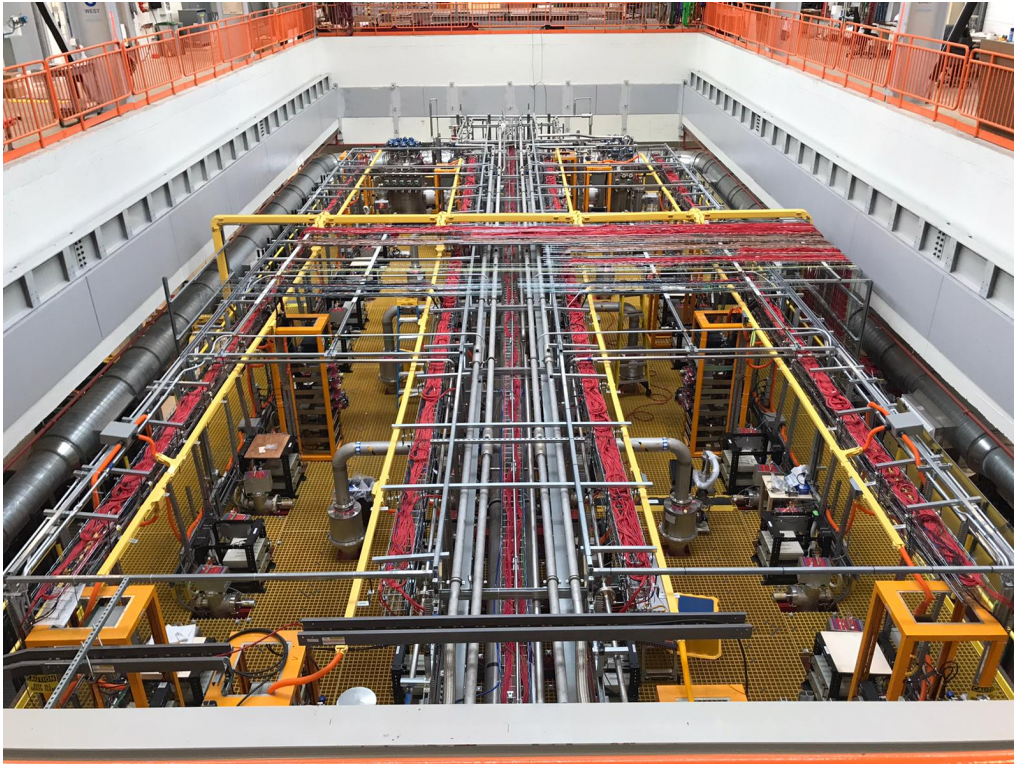
Icarus technical organisation



- 24/7 shifts since February 14th.
- Moved to remote shifts on March 17th.

Installation status

- TPC, PMT and DAQ installation activities complete, with latest achievements during Covid-19 restricted operations: cabling of TPC wire bias and DAQ, computing racks ORC, test of cathode HV system, identification of ground short.
- Hardware for the trigger distribution system almost final.



CRT installation

- Installation of the side CRT walls progressing as planned.
- Performed by FNAL techs and collaborators from several US institutions (CSU, University of Pittsburgh and Southern Methodist University).
New procedures to adjust to Covid.
- Top CRT modules are ready for delivery to US: dates yet to be defined.

Transporting the modules



East walls complete

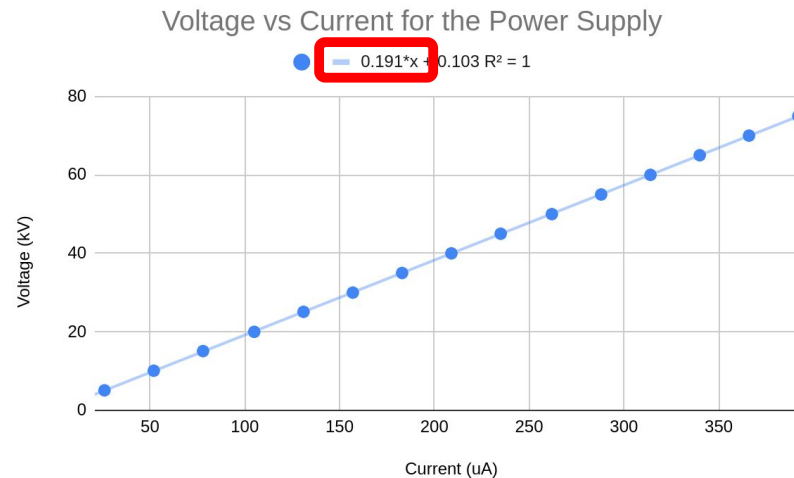


Cryogenic commissioning

- Started on Feb 13th, 2020 by breaking the vacuum in the two main cold vessels.
- Cooldown started on Feb 14th by injecting liquid nitrogen in the cold shields. 4 days duration, maximum temperature gradient on the TPC chambers 35 K.
- Gas recirculation units activated on Feb 18th for purification of Ar gas before filling.
- Filling started on Feb 24th, interrupted at around 50% to regenerate the filters, and stopped again when the liquid reached 6 cm below the nominal level to perform the final pressure test of the two cold vessels.
- Filling completed on April 19th.
- Liquid recirculation started on April 21st, at 1.85 m³/hr in the West cryostat and 2.25 m³/hr in the East.
- Cryogenic stabilization completed around end of May. Steady performance since then, apart from one of the gas recirculation unit not working continuously; no cold spots observed in the external surface of the warm vessel.
- Common effort of CERN/Fermilab teams.

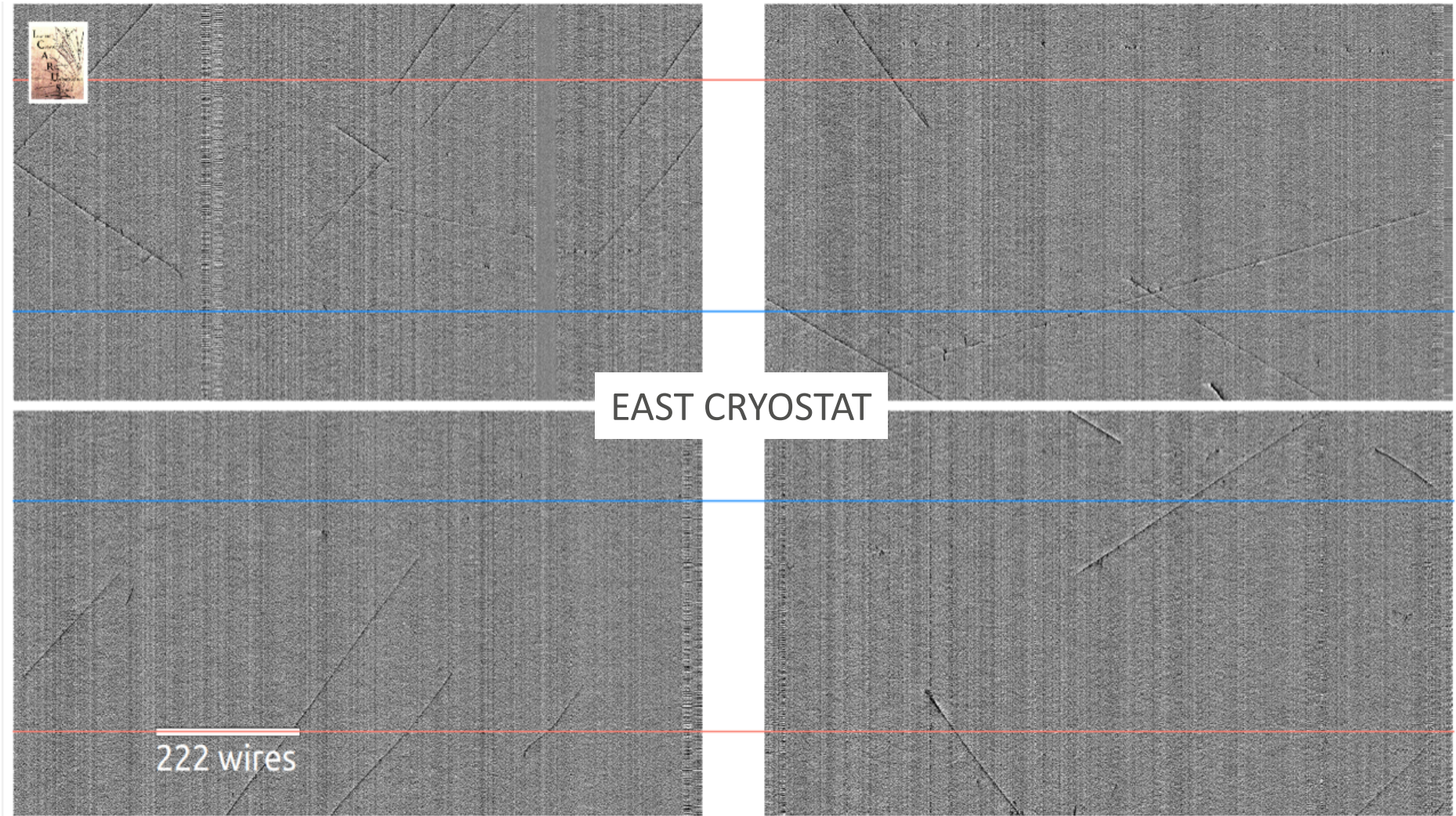
Test for detector activation

- Cathode HV operated at -40 kV for 1 week, starting on July 30th. Upon verification of stability, raised to -75 kV on August 11th and maintained for 3 days.
- Smooth ramping, perfectly linear and in agreement with expected resistance.



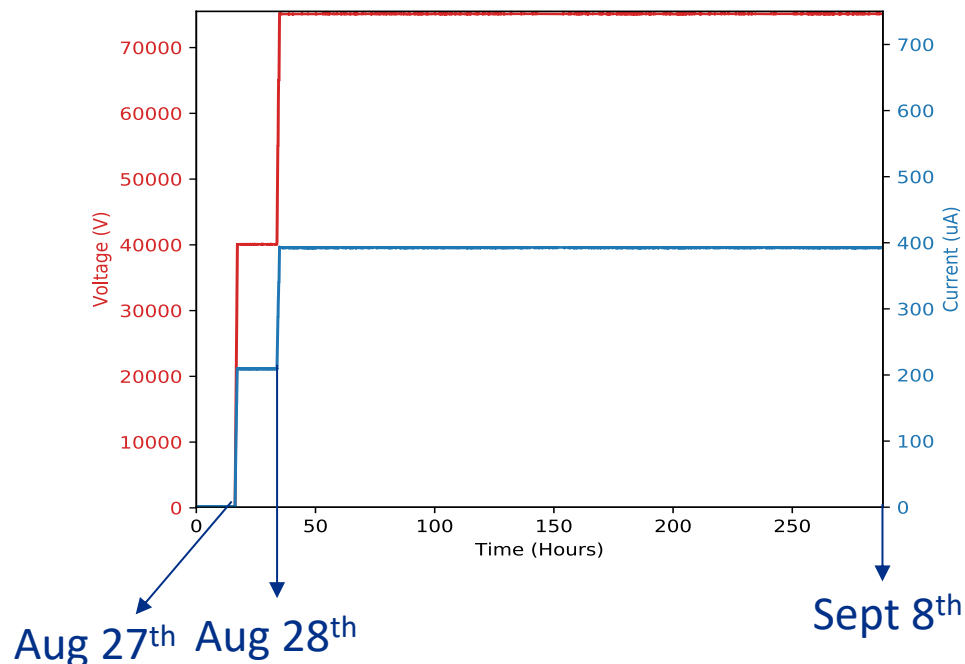
- PMTs switched on at nominal voltages, 357 out of 360 total properly working.
- All TPC wires shorted to ground through 50 Ohm terminators in this phase -> first induction plane working in semi-collection mode.
- Data taking with cosmic rays, with random 5 Hz trigger.

First events @ 267 V/cm

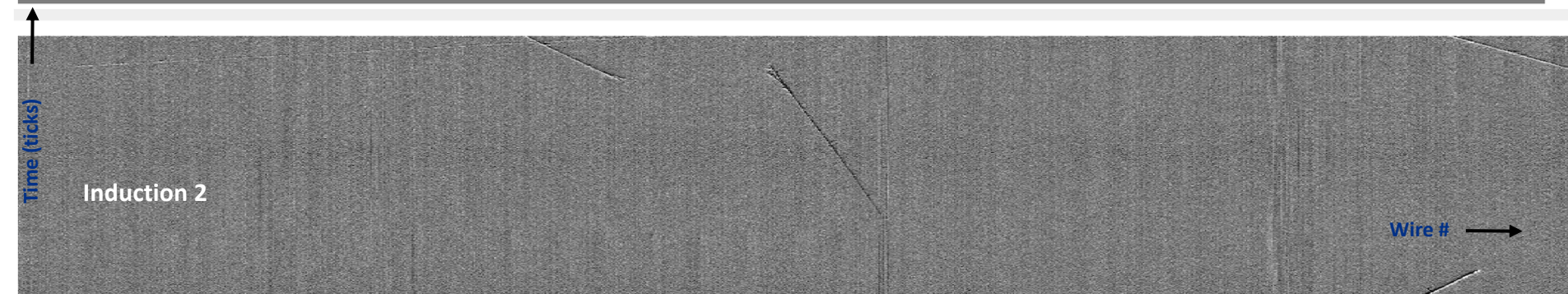
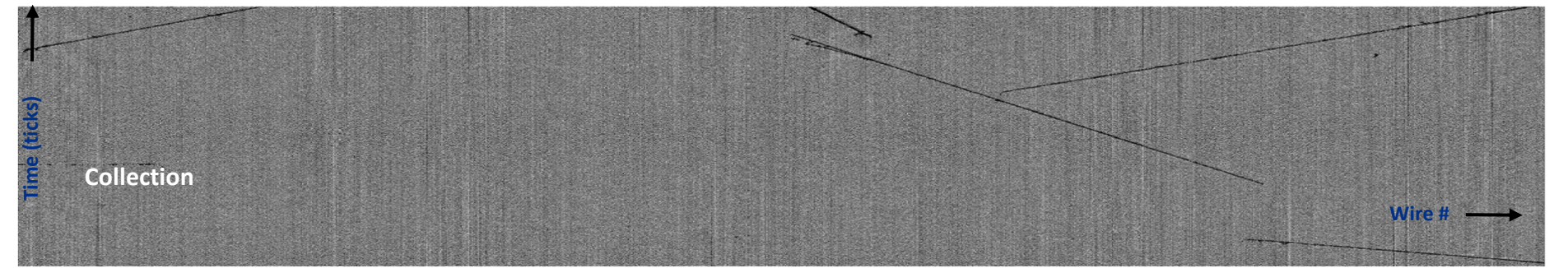
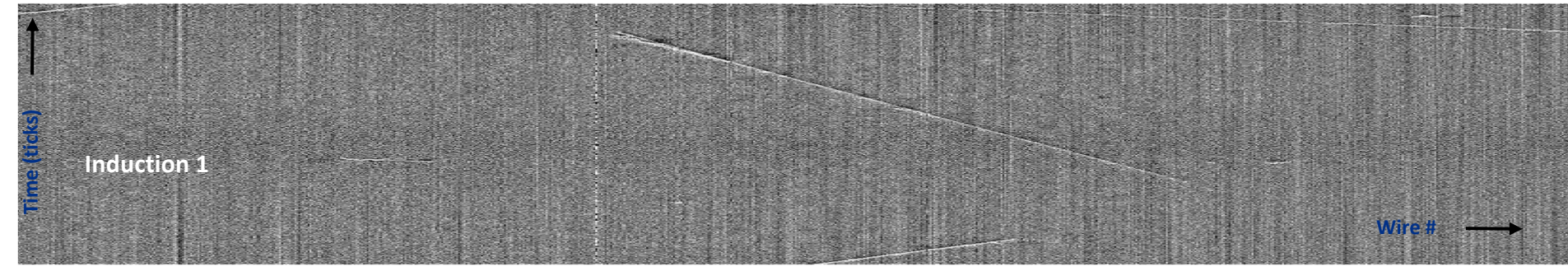


Detector activation

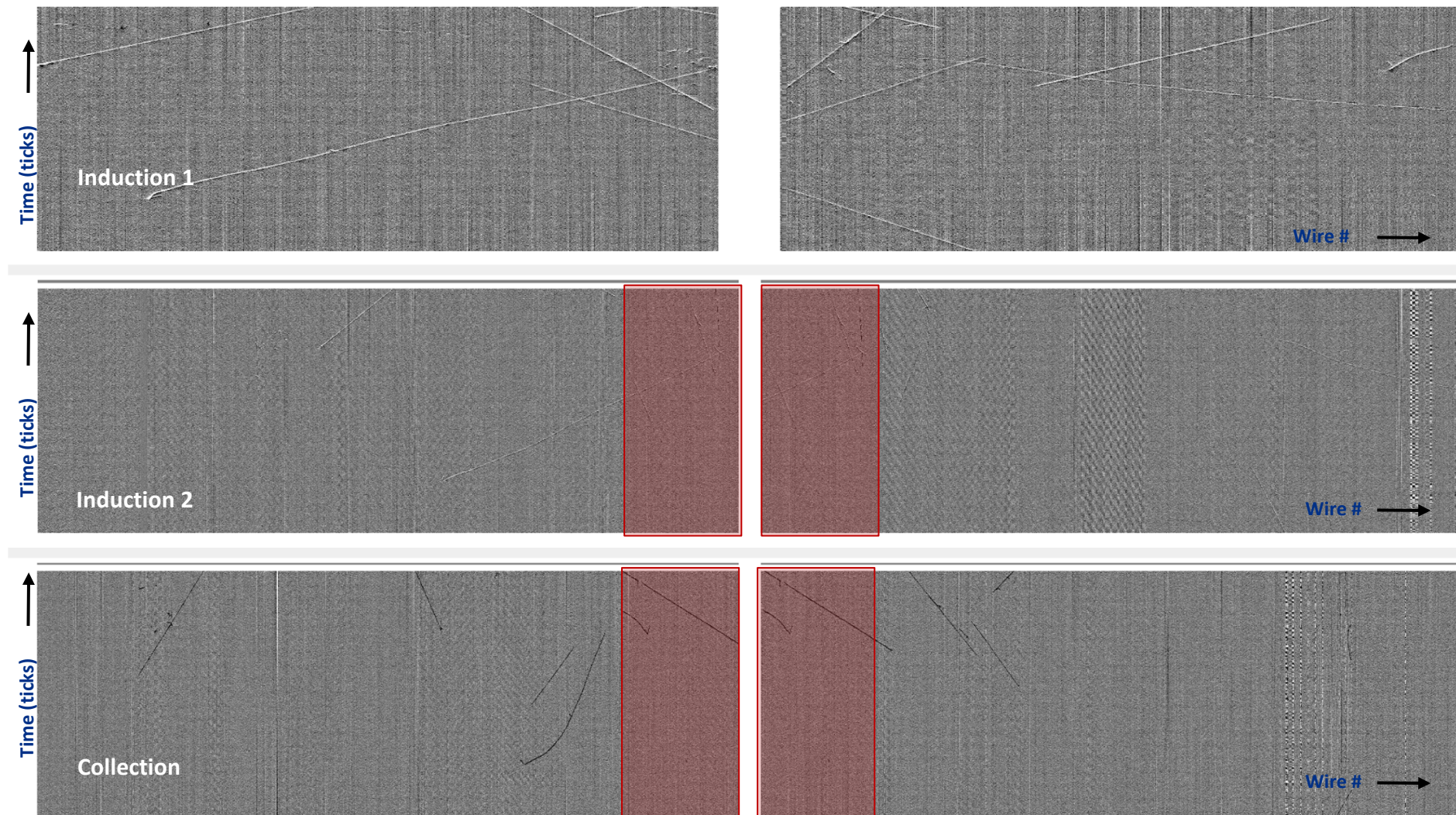
- TPC wire bias ramped to nominal conditions on Thursday, August 27th: Induction 1 -250 V, Induction 2 -30 V, Collection +250 V.
- Cathode HV ramped to nominal -75 kV in 2 steps: first at -40 kV, on Thursday, August 27th, and then all the way to -75 kV (corresponding to a drift electric field of 500 V/cm) the following day.
- Excellent stability since then.



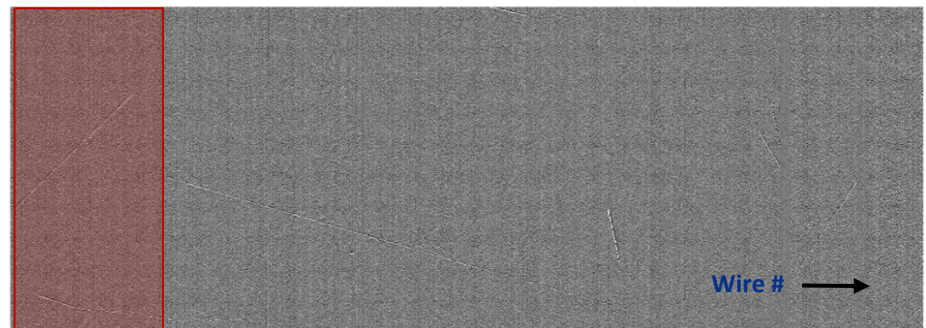
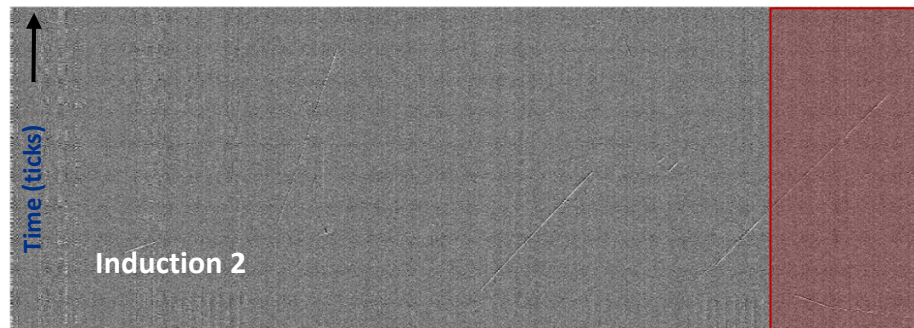
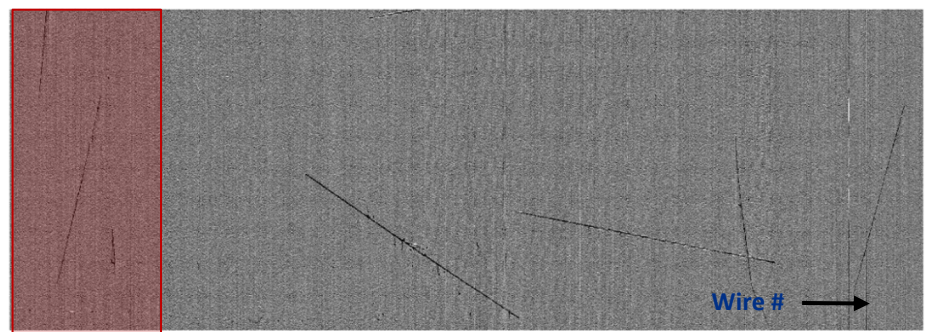
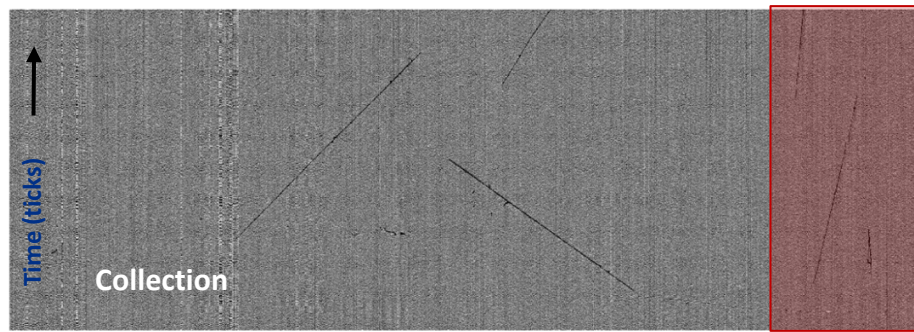
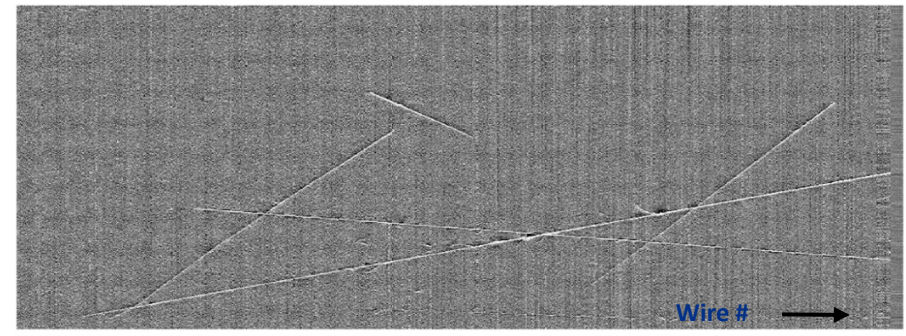
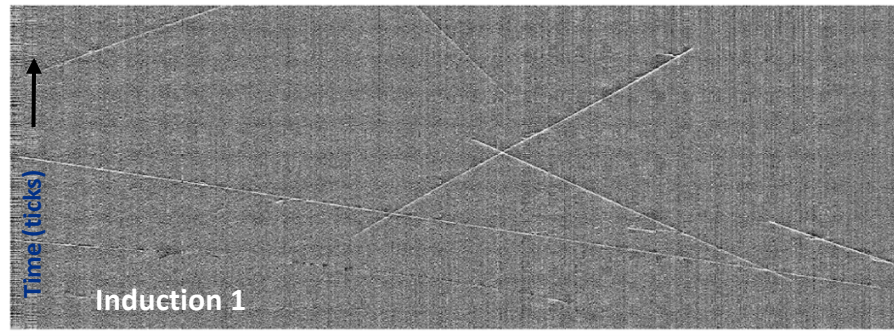
- Sample event WW TPC: Run 2269 Event 10 (Monday, Sept 7th).
- Time window is 1.6 ms. Each box represents a zoomed-in display: Ind1 is 2.7 m, Coll 3.6 m and Ind2 2.9 m.



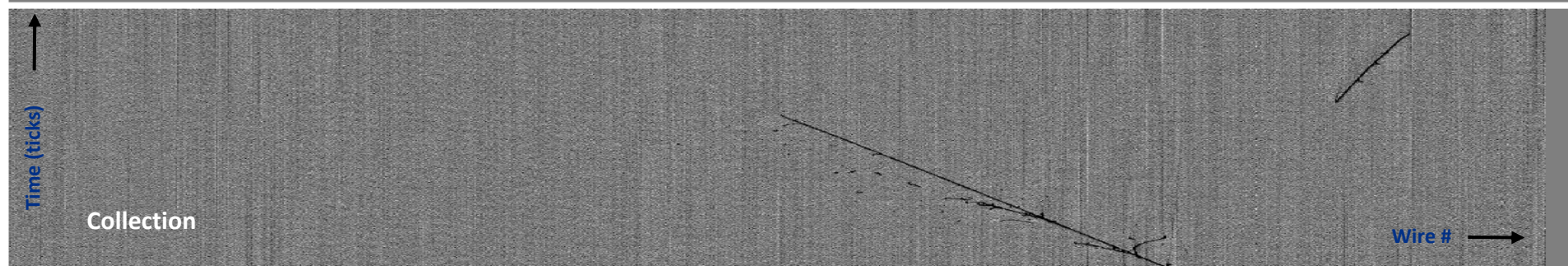
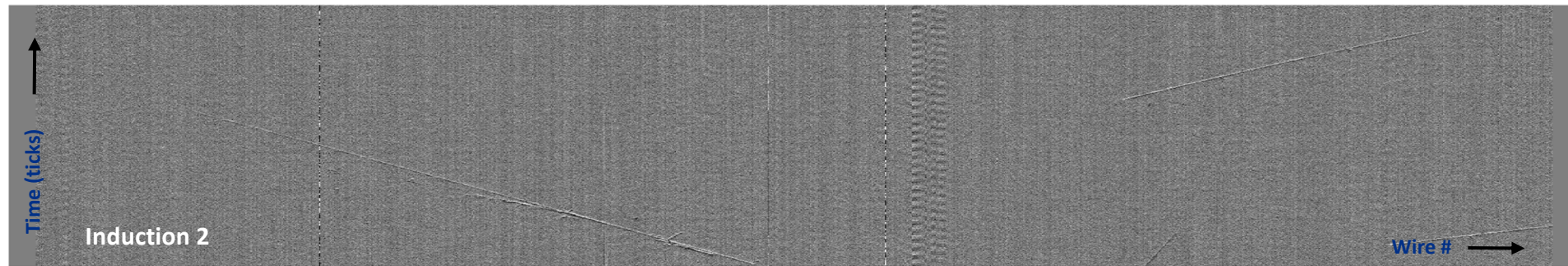
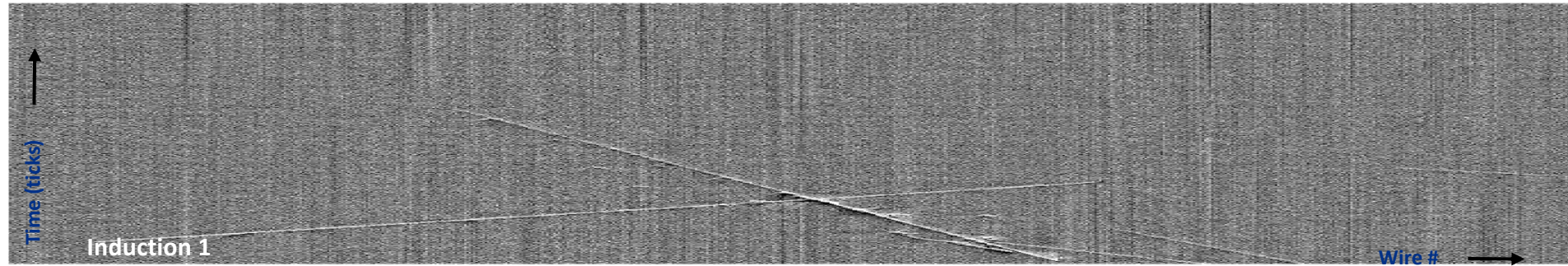
- Sample event EW TPC: Run 2270 Event 3540 (Monday, Sept 7th).
- Time window is 1.6 ms. Each box represents half-TPC. For Collection and Induction 2 views there is an overlap region in the middle, highlighted in the red boxes.



- Sample event EW TPC: Run 2272 Event 4500 (Monday, Sept 7th).
- Time window is 1.6 ms. Each box represents half-TPC. For Collection and Induction 2 views there is an overlap region in the middle, highlighted in the red boxes.



- Sample event EE TPC: Run 2275 Event 1520 (Monday, Sept 7th).
- Each box represents a zoomed-in display: Ind1 is 2.0 m x 1.2 ms, Coll 3.1 m x 1.4 ms, and Ind2 3.9 m x 1.4 ms.



Next steps

- Activities remaining to be ready for data taking with BNB in November:
 - calibrations of the PMTs with the laser;
 - optimization and calibration of TPC wire signals;
 - deployment of the trigger system;
 - commissioning of slow controls for components still missing.
- Additional activities remaining to be ready for physics:
 - installation and commissioning of the remaining parts of the side CRT;
 - installation and commissioning of services on top of the detector (ventilation, fire protection system, ODH sensors);
 - delivery onsite, installation and commissioning of the top CRT;
 - installation of the overburden.
- Most of these activities require the presence onsite of experts from Europe.