35T Phase 1 and the PrMs

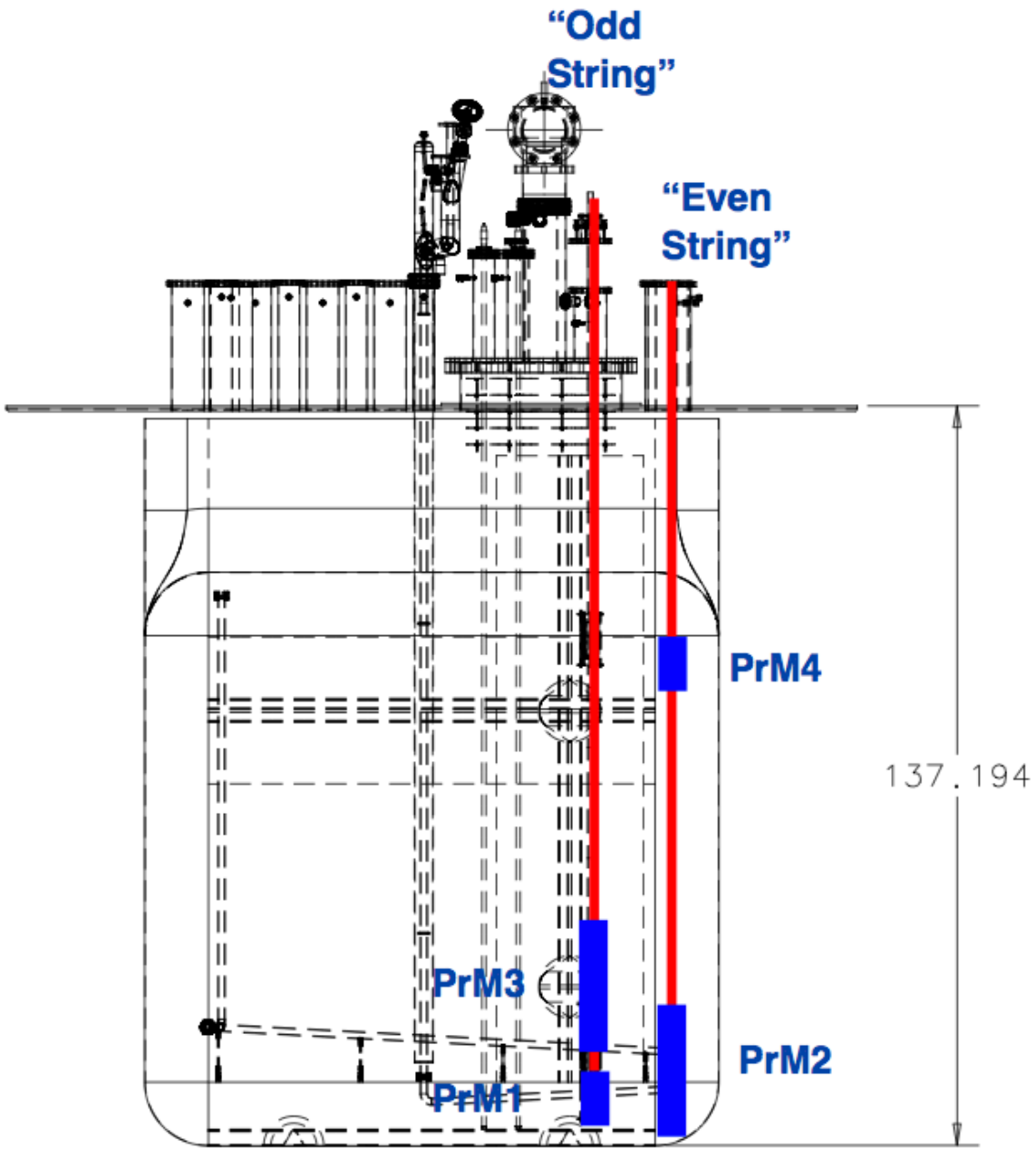
AHahn

PAB Meeting, 4/9/14

Outline

- PrM setup in 35T Phase1 run
- PrM timeline
- PrM raw results
- Issues found
- Summary
- Success stories
- Future

LBNE 35T as installed purity monitor details



PrM0 is the inline PrM in its Normal location just after the Filters

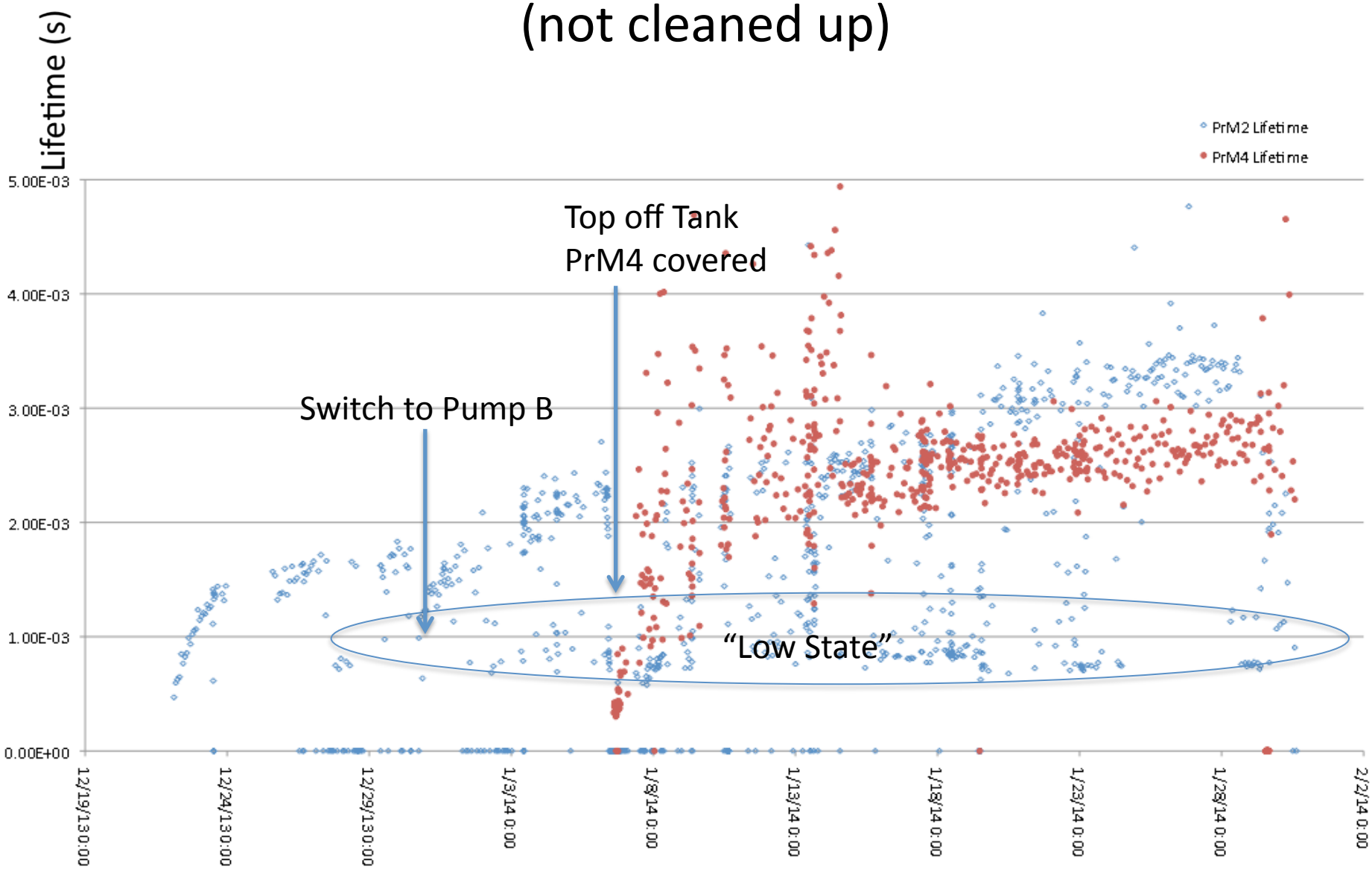
External Setup

- PrMs (1->4)
  - Single Flashlamp Located in WJ “Oscar-Style” Faraday cage
    - ~25 feet optical fiber from FL to PrM Flange
      - 3 fibers/PrM
  - NIM Bins with W-J electronics &HV ~25 feet of cable away from PrM Flange
  - Rack included Multiplexor, WindowsXP PC with Alazar 2ch digitizer
- PrM had its own FL in same location as in LAPD run.
  - NIM bin with W-J electronics & HV in same LAPD location
  - ~200 feet cable runs to Multiplexor in 35 T PrM Rack
- DAQ was LabVIEW based
  - Included Spooler Application with token control
  - Raw Data files of each flash stored locally, summary data to IFIX (like LAPD)

Coarse Timeline

- Aug-Oct 2013: PrMs refurbished and tested at PAB
  - Included new cathodes and internal re-fibering.
  - Walter J. worked on tightening up the PrM to fix HV breakdown problems due to loose lugs on PEEK spacers rotating into grounded Faraday cage
- Nov 1, 4, 11, PrMs(0-4) inserted into 35T Cryostat
  - Walt checked out the installation and everything appeared fine.
  - Terry T. put dry air purge on system.
- Nov 19—Ar Purge started
  - GAr signals on PrM0, PrM (1-4) not hooked up
- Nov 27—PrM(1-4) fibered up and cables to Electronics
- Dec 2 – PrM (1-4) operational in GAr.
- Dec 16– See first LAr Cathode and Anode Signals on PrM0
- Dec 17– Cryostat Cooldown starts
- Dec 18– Cryostat filling starts, see lower PrM cathodes covered by LAr (cathode signal drops)
  - First fill leaves upper short PrM4 uncovered, so still operating in GAr.
- Dec 20—LAr Pump start, now filtering.
  - Initially things look fine, but then start seeing noise on PrM 1&3, mainly anode looking very bad.
- Dec 22—See anode signal on PrM2 (lifetime ~700us)
- Jan 6– Top off 35T cryostat with LAr, PrM 4 is now covered—see PrM 4 anode signal
- Feb7—turn off pump, end filtering of LAr.
- Feb 13—Begin pumping LAr out to tanker to send to MicroBoone—PrM 4 now in Gar
- Feb 21– Fill second tanker for MicroBoone
- Mar 3—Begin GN2 bubbling through remaining LAr to warm up cryostat.
- Mar 10---See Cathode signals on both lower PrMs, 1&2

Purity during run
(not cleaned up)

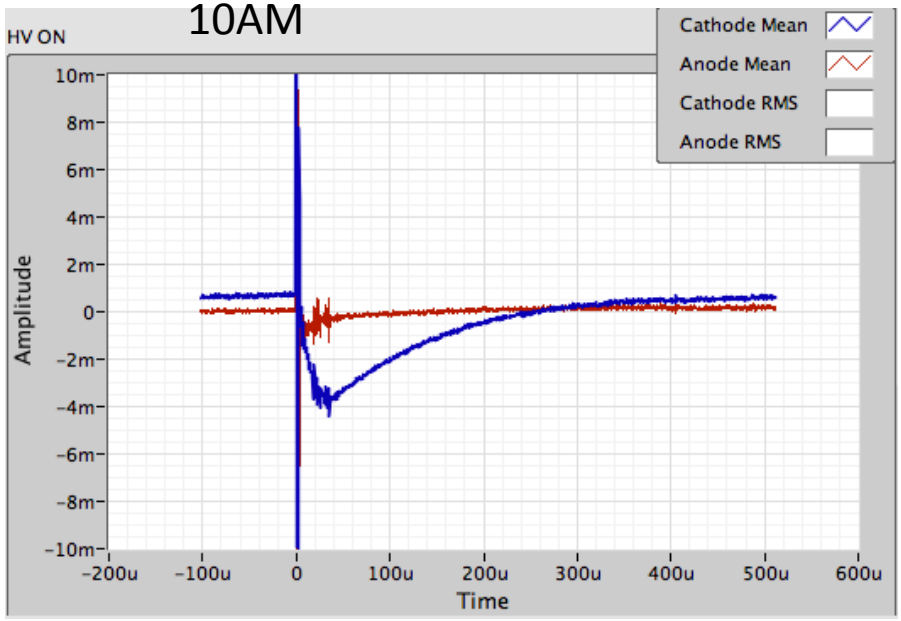


Issues Found

- PrM 1& 3 anodes signals very susceptible to LAr Pump noise (microphonics) (slide 8)
  - Took (me) longer to realize that PrM1&3 didn't have anode pulse signals at all during the LAr period(slide 9, 10)
- PrM 2 had two states for the anode (slide 11)
  - Large anode signal<---- believe this was "true value)
  - Small anode signal<---- believe this was due to some fault in drift field "optics"
  - Occasionally intermediate size anode
    - In this case, looking at individual flashes showed a combination of large and small anode signals

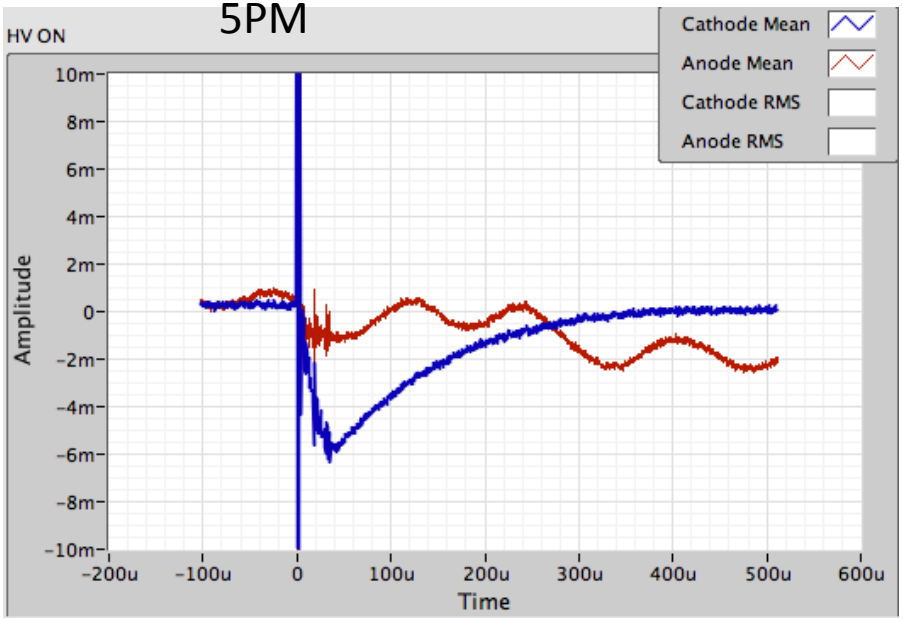
Anode Noise (12/20)

10AM



Pump turned on @8:15AM

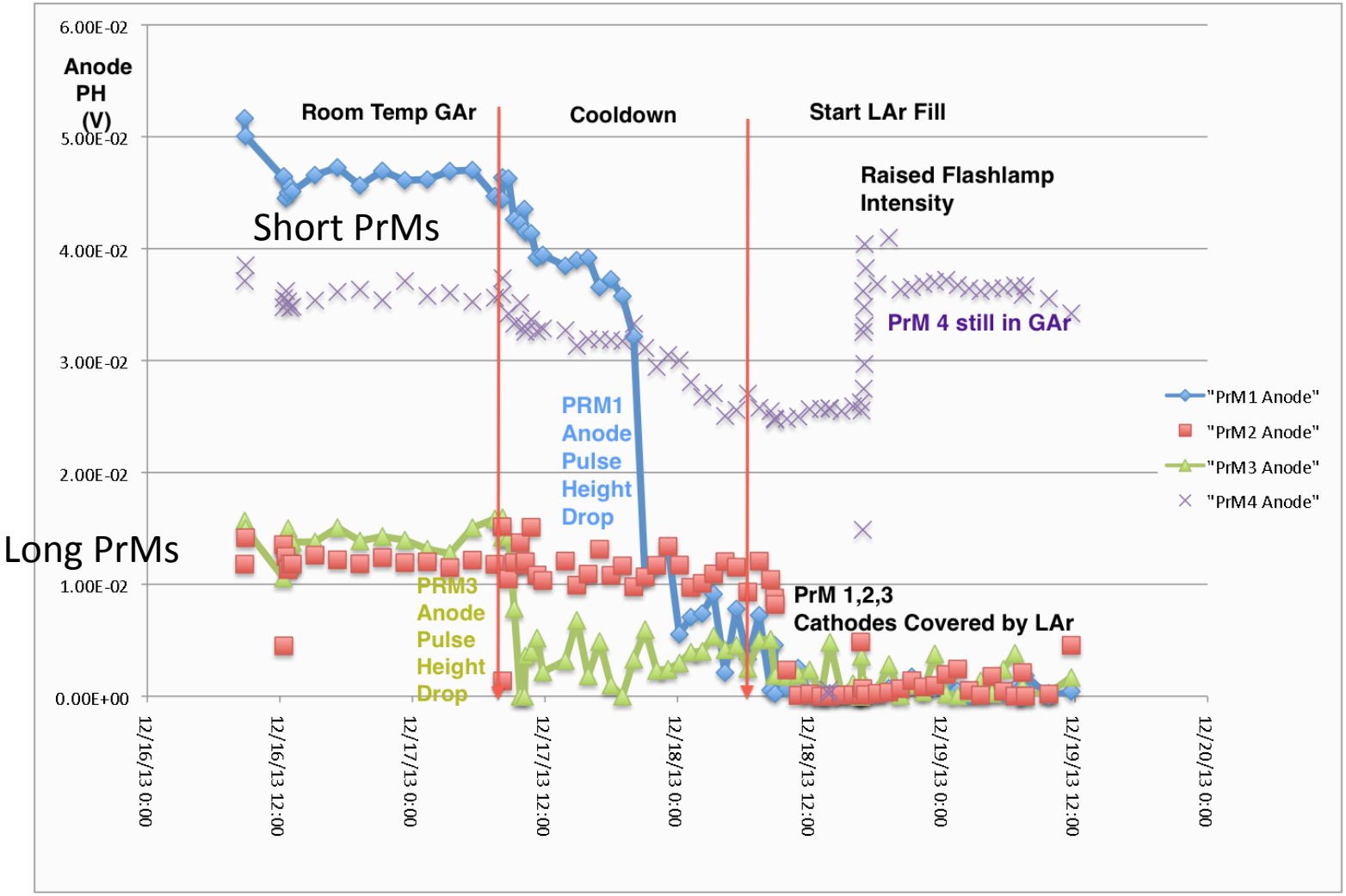
5PM



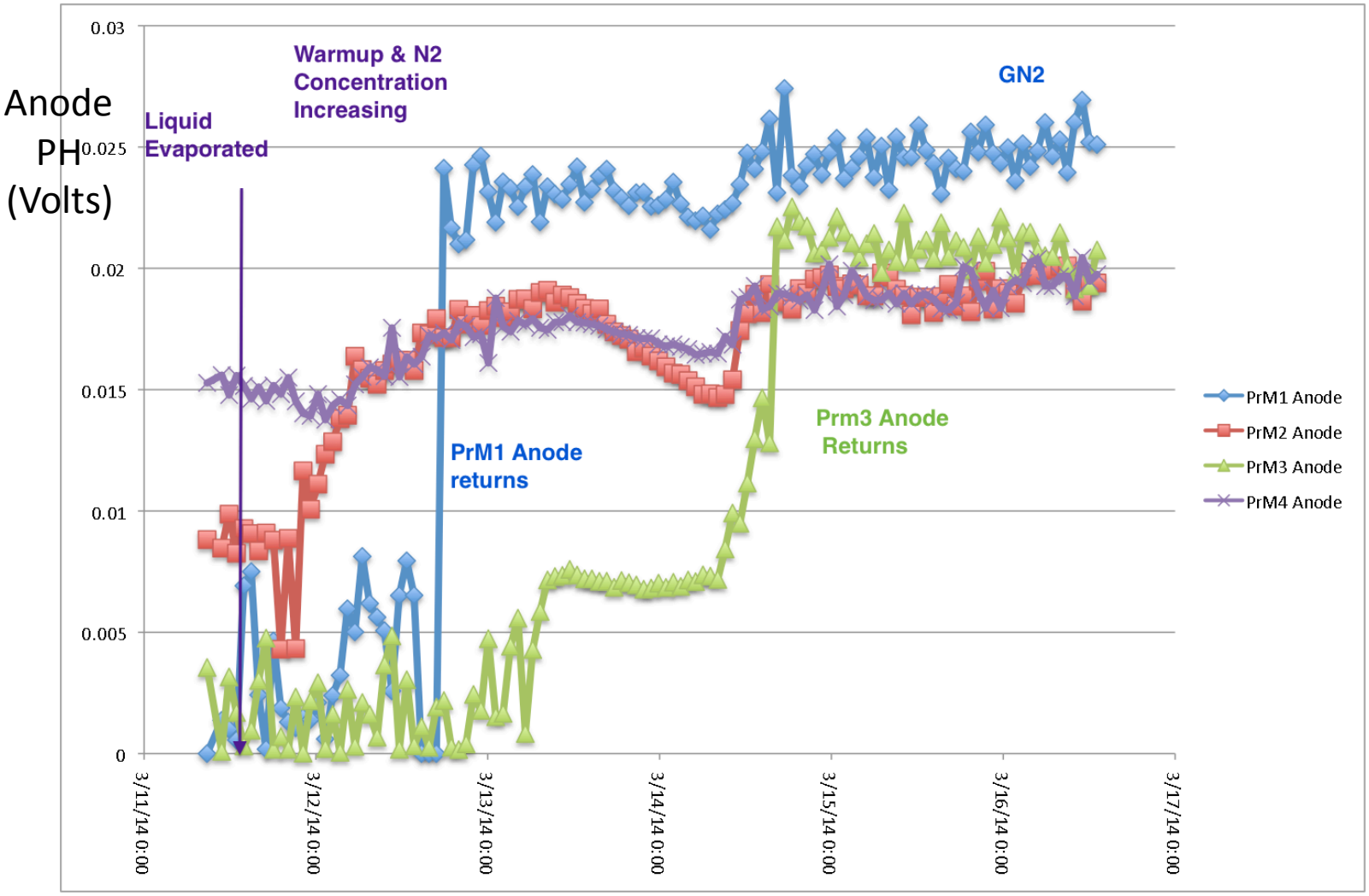
Pump On

Black Trace is Anode Signal-Cathode Signal
Red is Cathode Signal, Blue is Anode Signal
(Note there is no anode peak on either plot, lifetime is still very short)

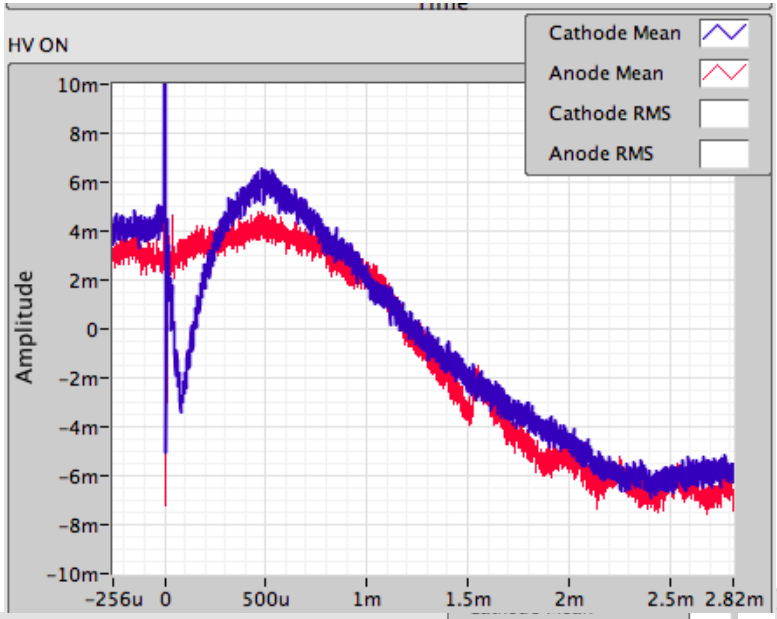
Disappearance of PrM1&3 Anode signals (after the fact discovery)

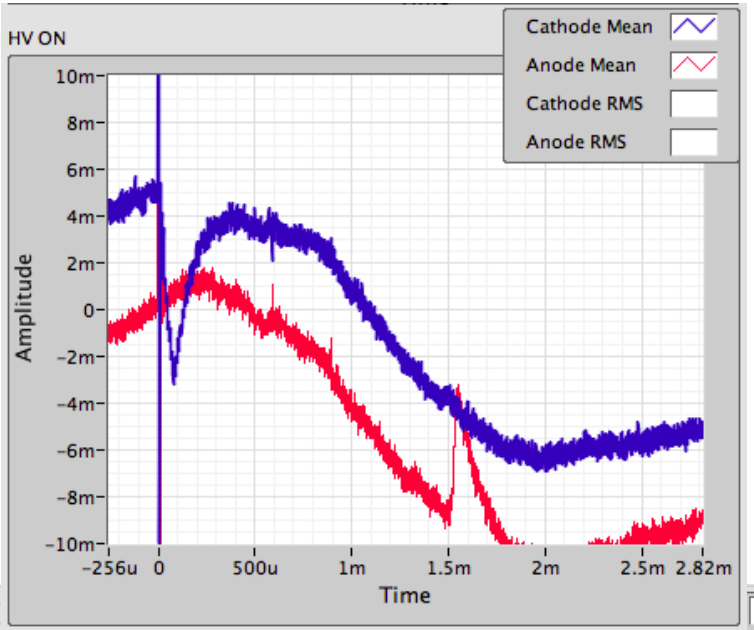


Reappearance of PrM1&3 Anode Signals during the warmup of 35T Cryostat

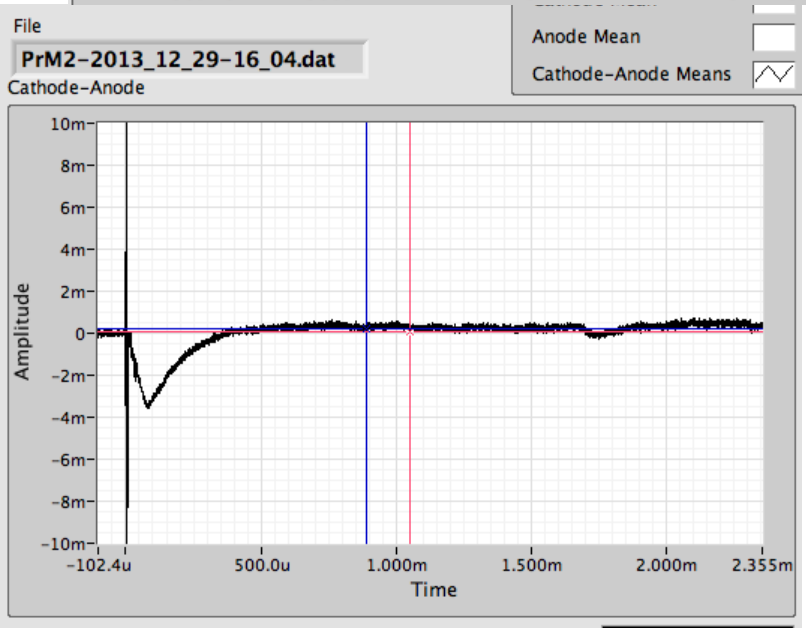


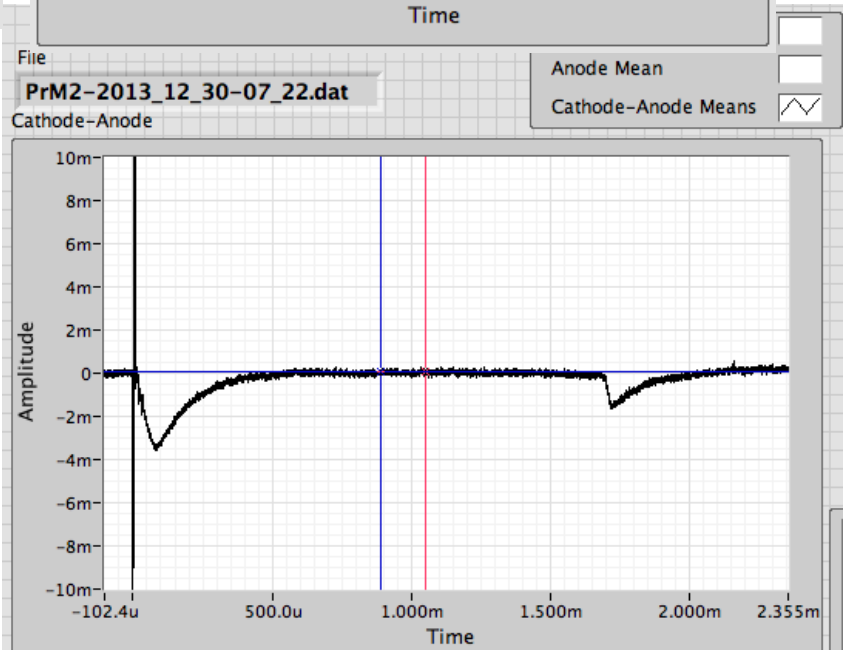
PrM2 Anode PH Bi-State (cathodes relatively constant)





Same run





Diff. runs

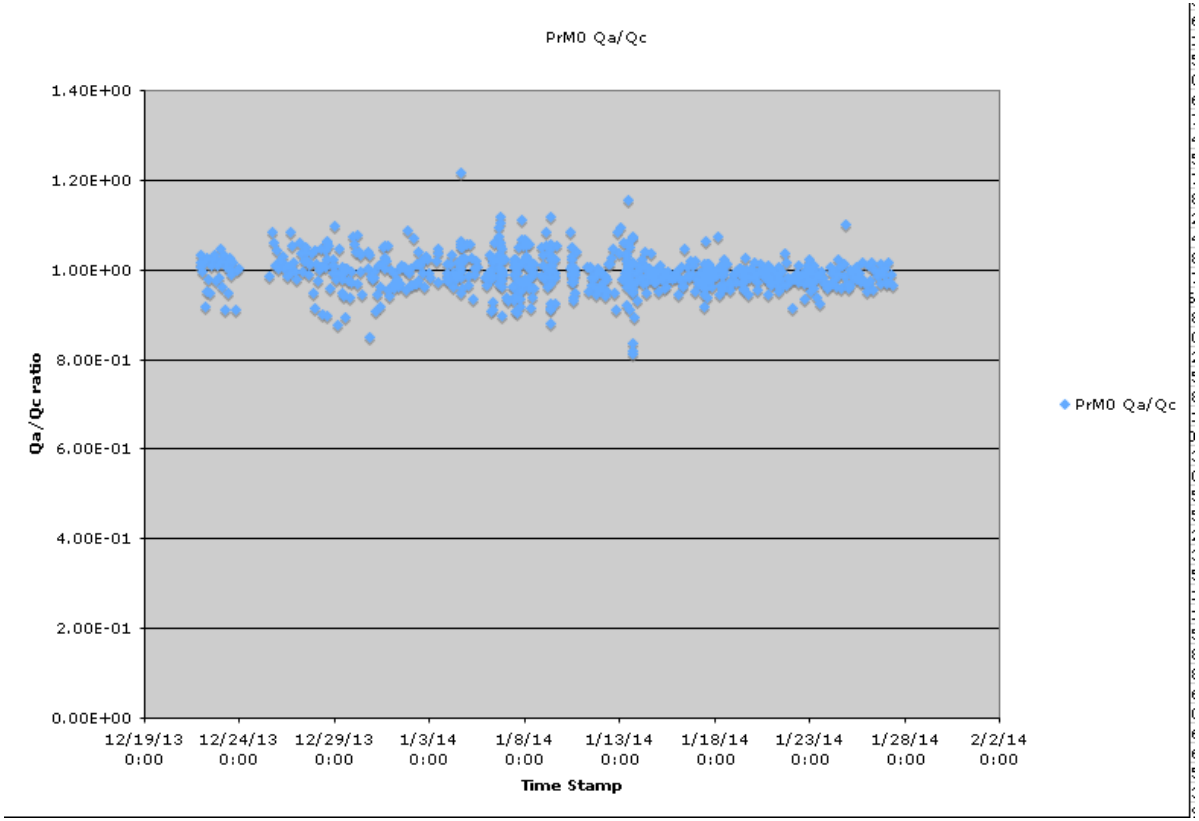
Summary of Issues

- PrMs mechanically seem very susceptible to vibrations, perhaps even losing electrical contacts on field systems
  - PrM1&3 suffered “catastrophic” issues
  - PrM2 was bi-stable
    - Even low state seem to follow the purity though
  - PrM4 worked best, but even then had periods where it was very susceptible to microphonic noise.
- On a different scale, need to improve the actual intensity of the cathode signal
  - Low cathode signals (<10mV) makes system even more sensitive to noise issues
  - Improve Flashlamp/Fiber Optic efficiency.
    - Reduce length of FO
    - Understand if how much connectors reduce yield
    - Are we breaking fibers during insertion? (see Mark R. pictures of autopsies in PAB log.
- Had some problems with apparent HV breakdowns—pulses with very fast risetimes.
  - Some may have been HV breakdowns, but maybe poor contacts in field cages ??

Success Stories

- Walter's Faraday cage really worked well.
- PrM0 had many fewer problems than the others.

Mean =0.99



Future

- Look into “ruggedizing” the PrM
  - Not sure I completely understand what is actually happening, but it appears the PrM loosens up as it cools down (see slides 9&10)
    - Makes it sensitive to microphonics (particularly the anode)
      - Not clear what was source of pump acoustical noise—vibration or flow (see next slide)
    - Even possible to lose signals---only anode in this run.
- Get frontend electronics closer to PrM flange (~20+ feet this time).
- Improve the Fiberoptic “bundling” at the flashlamp.
  - Everytime I touched the flashlamp assembly, I seem to make changes in light pickup
  - Need to hold fiber bundle together better.
  - Reduce the length of fiber—get Faraday cage closer to flanges.
- I note that changing the flashlamps/bulbs improved the cathode peakheight by ~3-4 x over previous value.
  - Also note putting in new bulb made things worse at one point.

Cryostat setup (T.Tope)