SLAC LZ System Test
Run 2 Update: Road to HV review

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December 7, 2015

Outline

- Run 2 Successes
- Plan for Remainder of Run 2

Run 2 Setup

- Run has only Reverse field region (cathode down to bottom grid), HV feedthrough, 1 PMT, 1 loop antenna, 7 camera fibers, temp sensors, limited level sensors
  - PMT is 2” Hamamatsu R9288 (same base design as R6041) with positive bias (LUX & LZ uses negative)
- Vessel cool down began Nov 29
- ~75 kg total in vessels Dec 1-3
- HV tests began Dec 4
- Efforts of many people made it possible; 13 of us stayed after 10 pm on Friday to see the tests!

Run 2 Prelim Tests

- Sorry, no plots: our database computer is down and the person who maintains it is traveling! (same computers have our e-logs too so this is based on memory/slack comments
- Test plan was to look at PMT rate, power supply current draw, and loop antenna while slowly ramping up the cathode HV: goal of 25-50 kV is ~50-100kV on LZ
  - Bottom grid set to -1.5 kV as is plan in LZ
- When initially ramping up, at 2 kV, saw lots of signal in PMT, we turned off all high voltage and it continued, reseting the Preamp power supply stopped this: we are worried about the PMT
  - We increased bias voltage to 950 V to get single PE above the noise at testing time too

First ramp up

- Discriminator with 30 mV threshold on PMT rate (DAQ with 8 mV threshold for pulses)
  - initial rate ~320 Hz
- Rose in 600-1000V/min increments, stopped every 2-5 kV to make stable measurements for up to 5 minutes
- Saw ~6 brief rate excursions to 1 kHz PMT rate, not while ramping, all recovered in ~45 seconds
- While ramping from 41-42 kV saw large excursion at 41.3 kV and stopped the ramp at 41.8 kV (see Mp4s)
  - PMT rate up to ~5 kHz and showed large pulses
  - When PMT rate 1-2 kV single PEs at high rate seen

End of Ramp 1

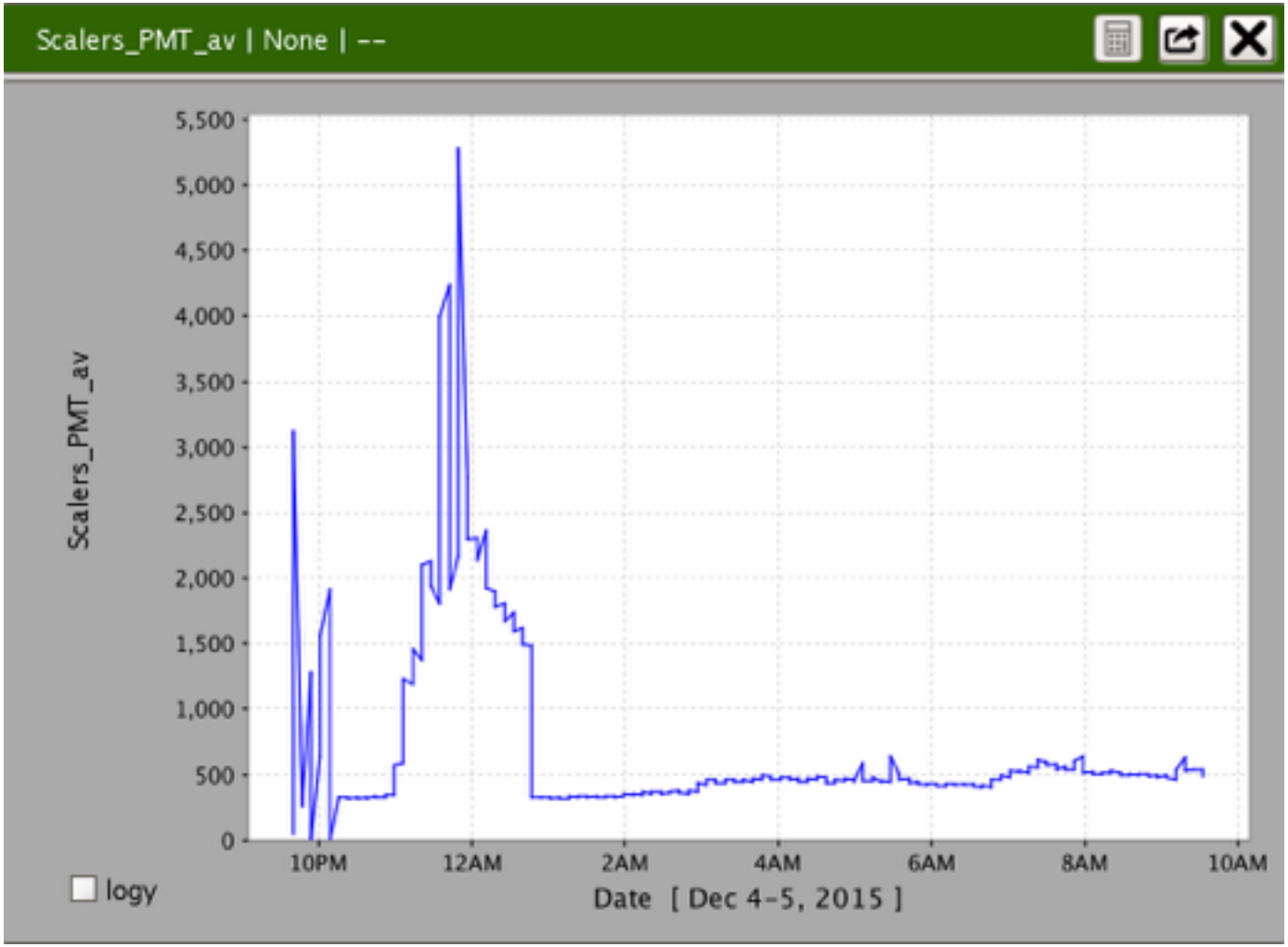
- Ramped down to 40 V, then 35, and PMT rate did not decrease to baseline. Came down to 0 V, and set bottom grid to 0 V, and still PMT rate stayed at ~1 kHz
- Power cycling preamp did not help
- Power cycling PMT did help
- Decided to ramp up again, and try PMT power cycles during event excursions

Second ramp up

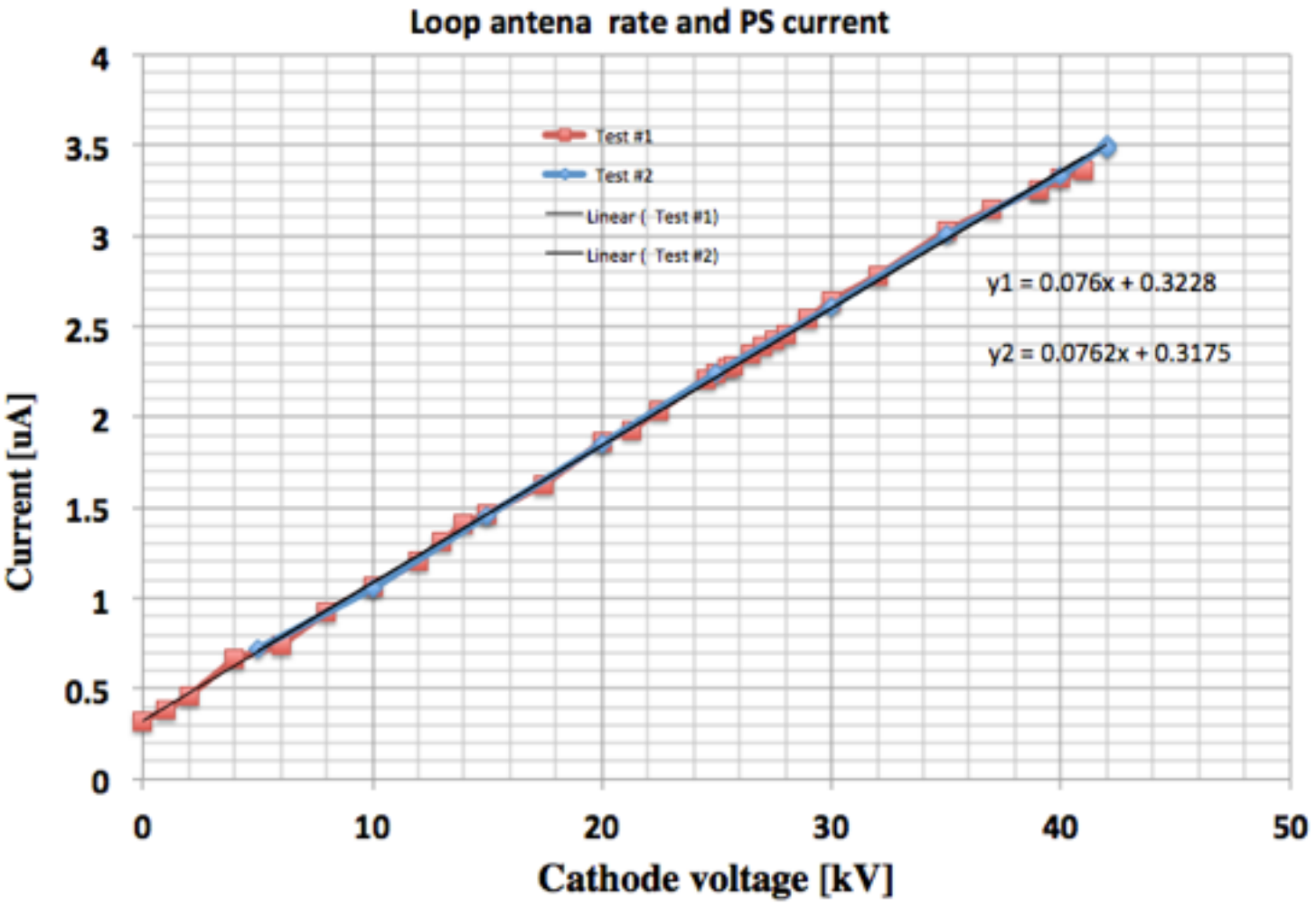
- Went much faster 1-1.2 kV/min
- Few/no rate excursions on the way
- Made it 22 kV, reset the PMT, made it 44 kV
- Then rate still went crazy, and didn't recover

Left PMT on overnight

- Large rate spike seen with no grid HV on! We left at 10:30



Ohm's law

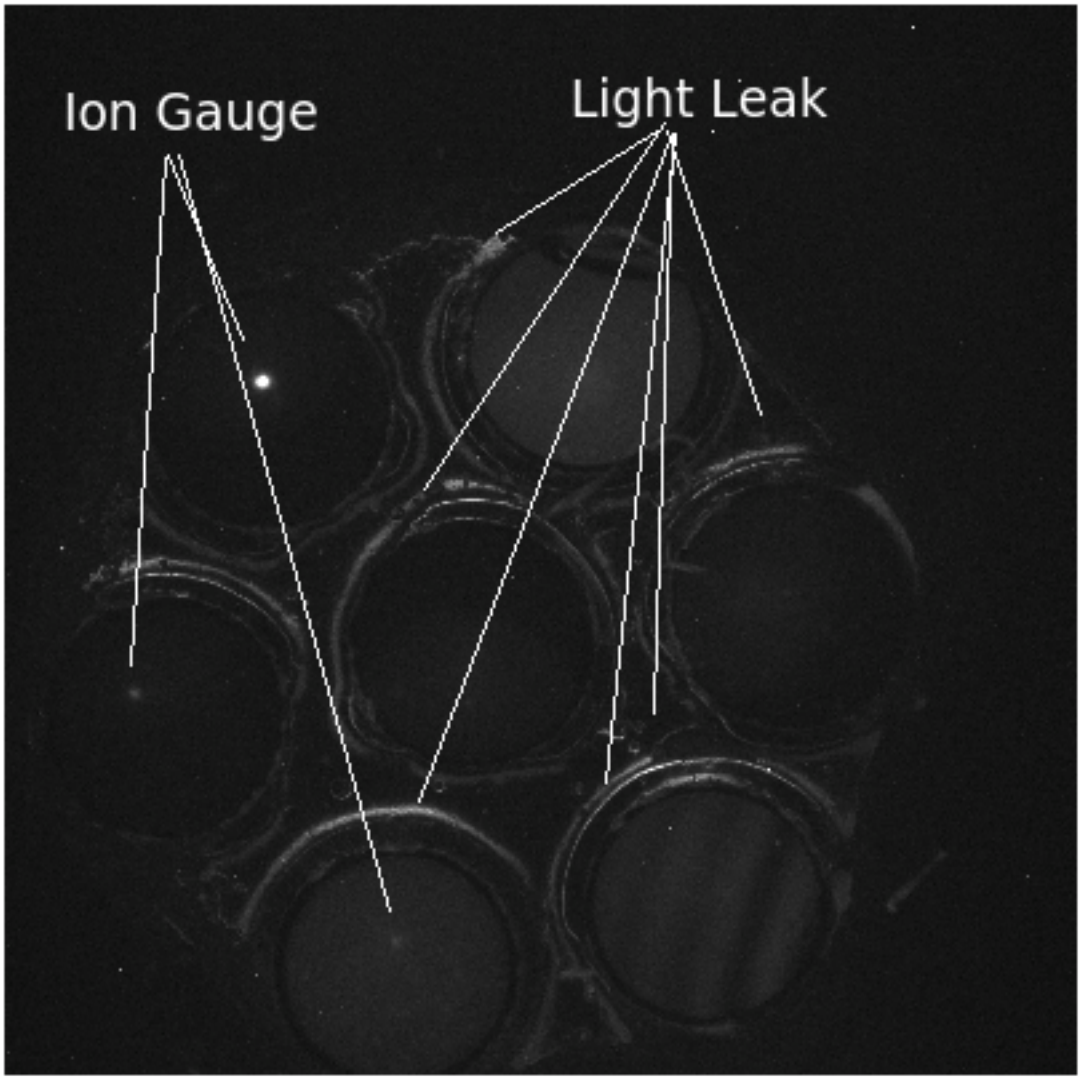


- What Jerry Va'vra looked at during CRID HV tests
- No sign of increased current draw
- Readout from supply causes differences from pure Ohm's law

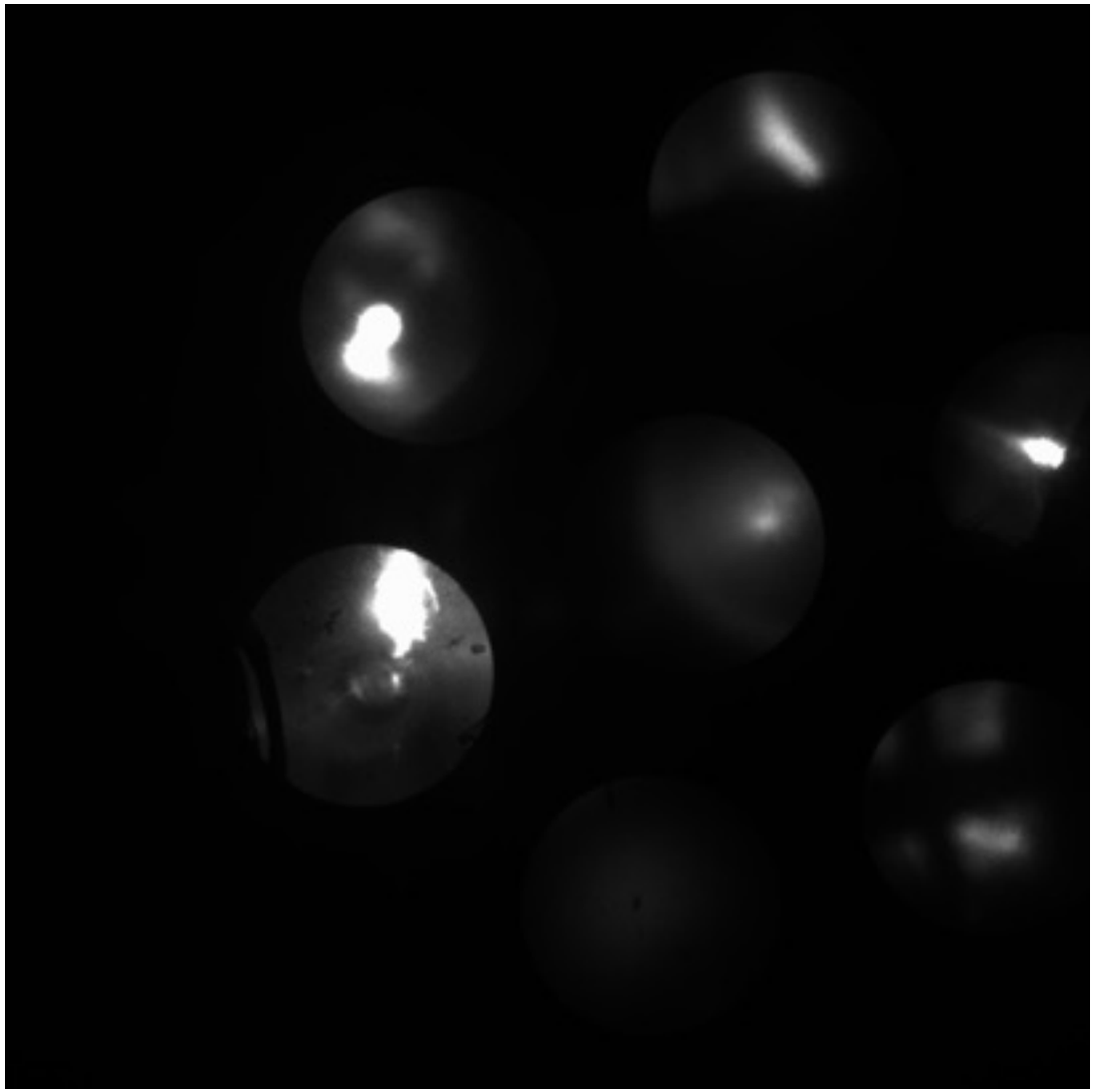
Run 3: Saturday Dec 5

- Reset PMT bias voltage to 900 V
- Saw new electronic noise and had to increase the threshold for the DAQ, but left discriminator at 30 mV (still understanding what that now means in PE)
- Starting rate at 220 Hz
- Ramped similar to Run 1
- No excursions in rate until 52 kV
  - Same large bursts as before

Vacuum, dark camera image



Liquid, only gas lens in focus



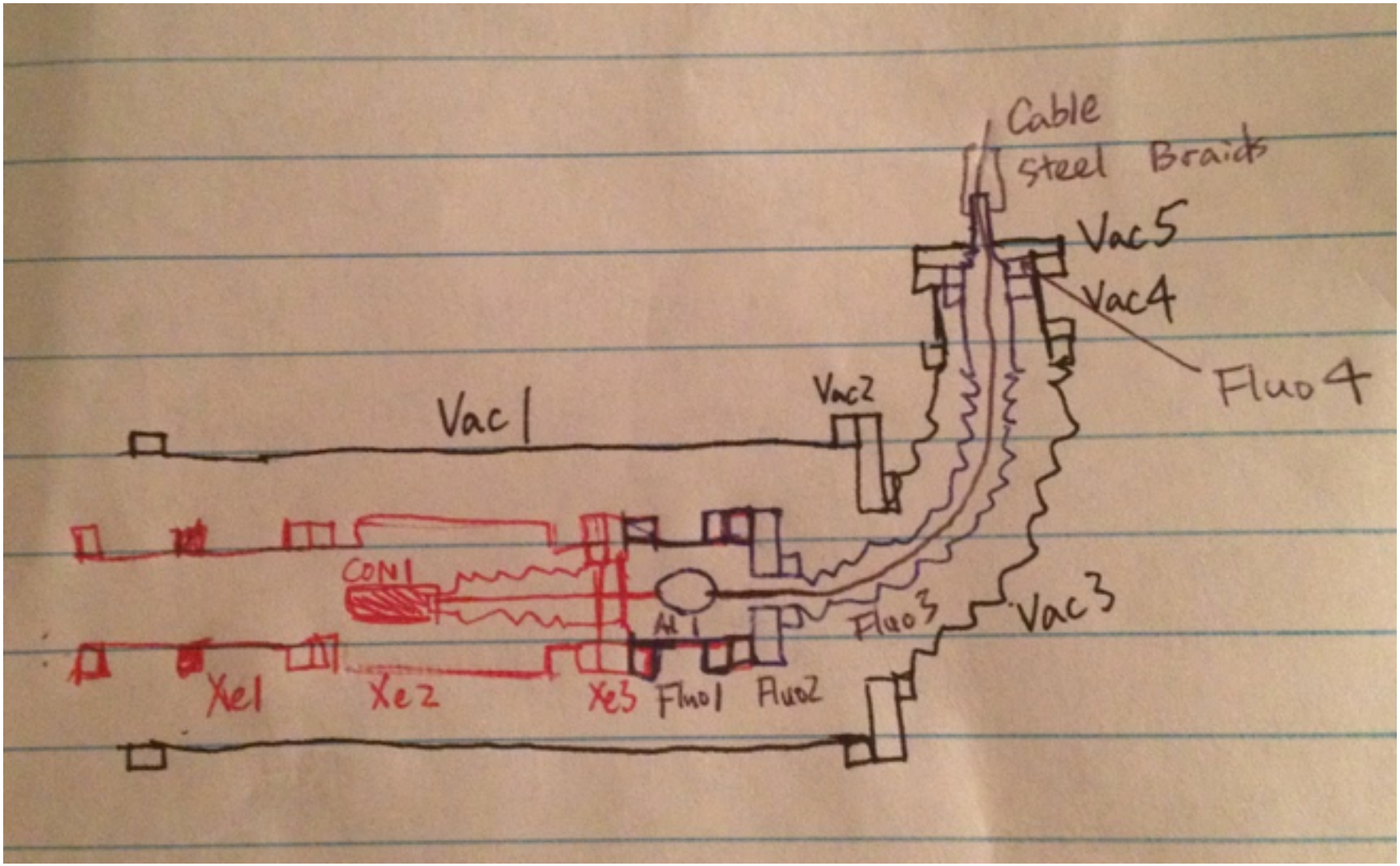
Finishing Run 2

- Big question: are we going to HV breakdown in final test?
- Plan to empty the detector Dec 14th - set by other schedule constraints
- Test plan online at https://docs.google.com/document/d/1_weVF3cpiqqbyFainjOsNpz4_LjTBMLHeP1_sv0TgtY
- Still understanding what creates the light……

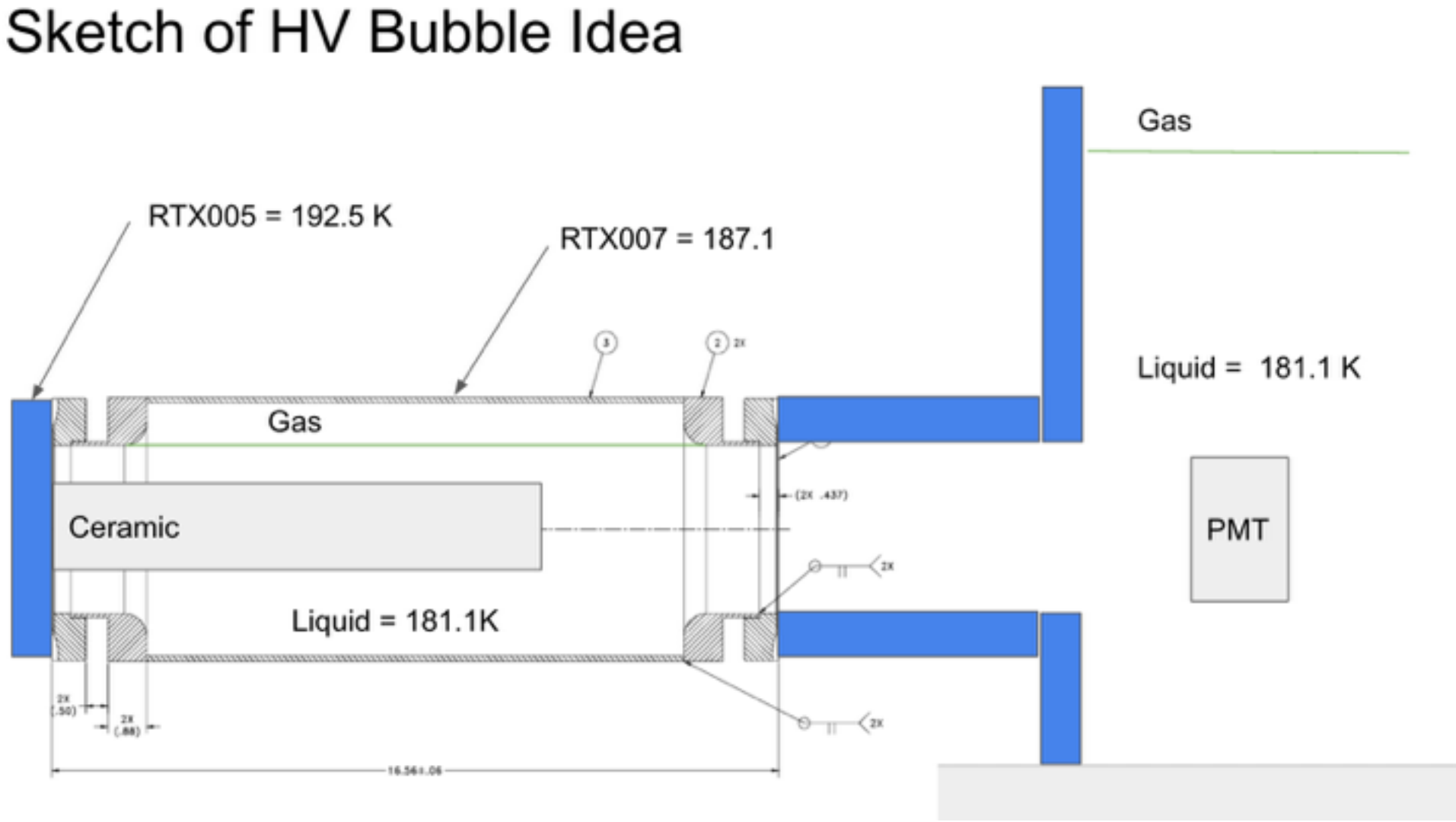
Backup slides

All old. From November Run 1

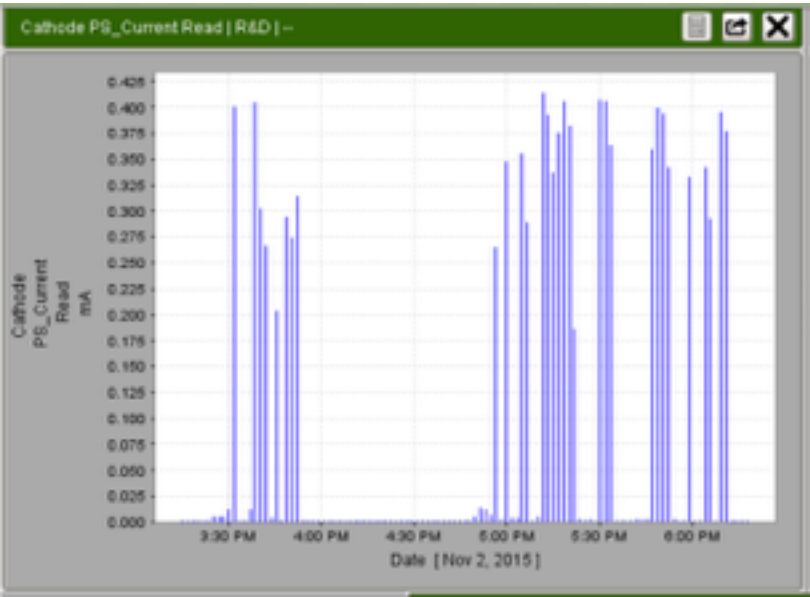
HV feedthrough

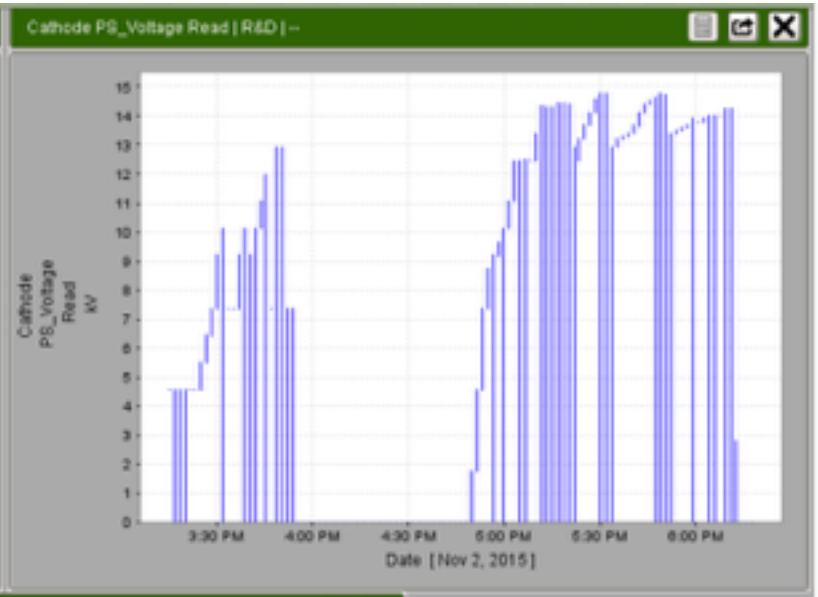


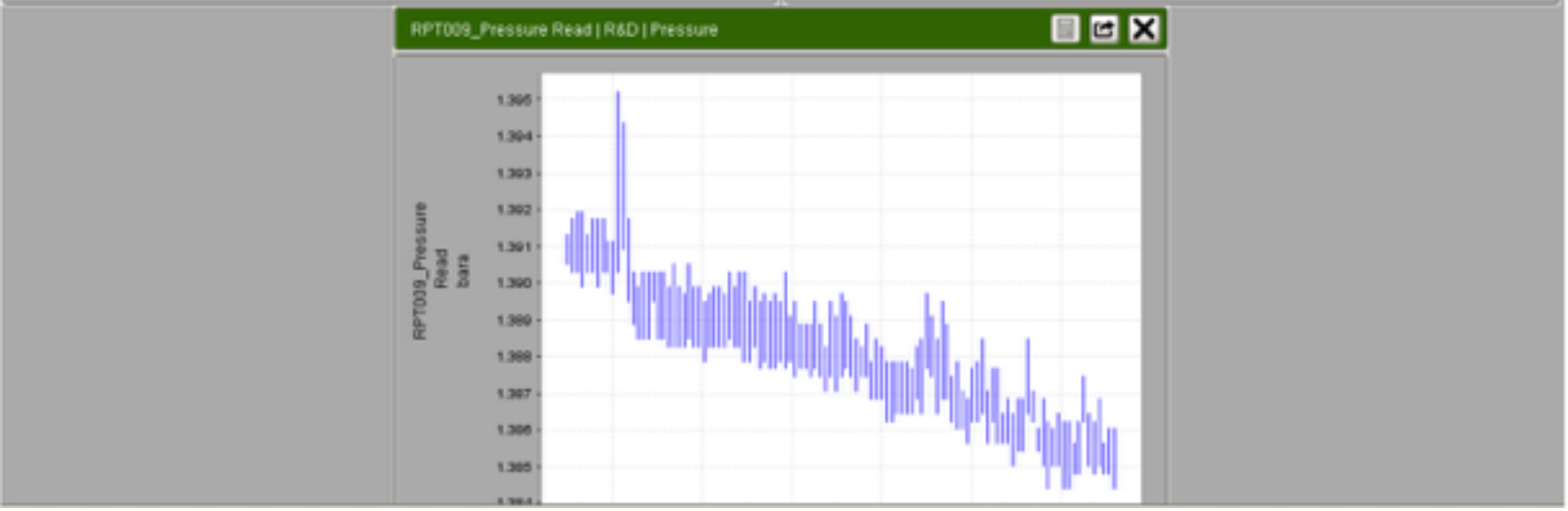
Bubble in feedthrough…



Test 1 LXe







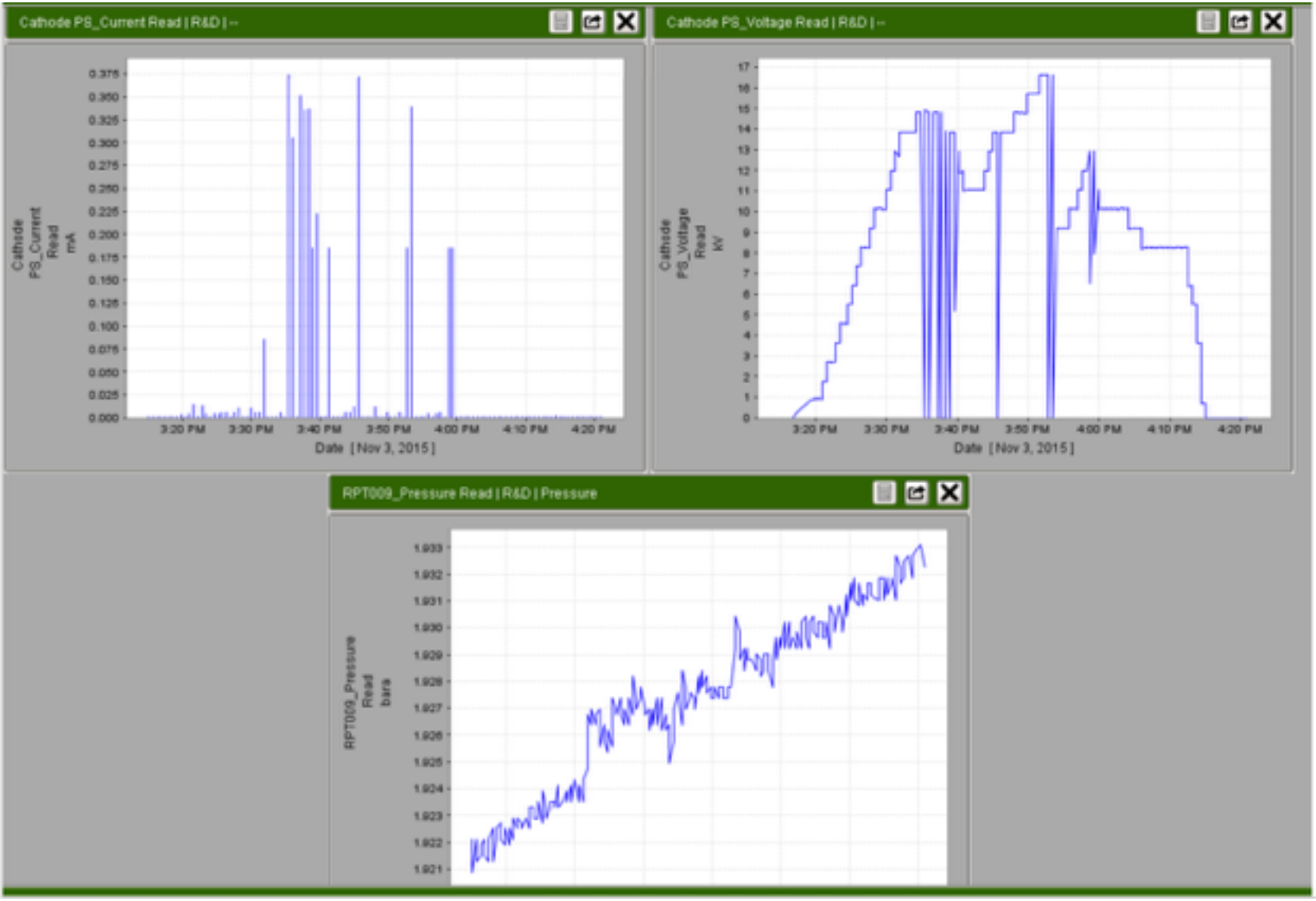
Test 1

Pressure 1.38 bar

Highest voltage

15.8 kV

Test 2 LXe



Test 2

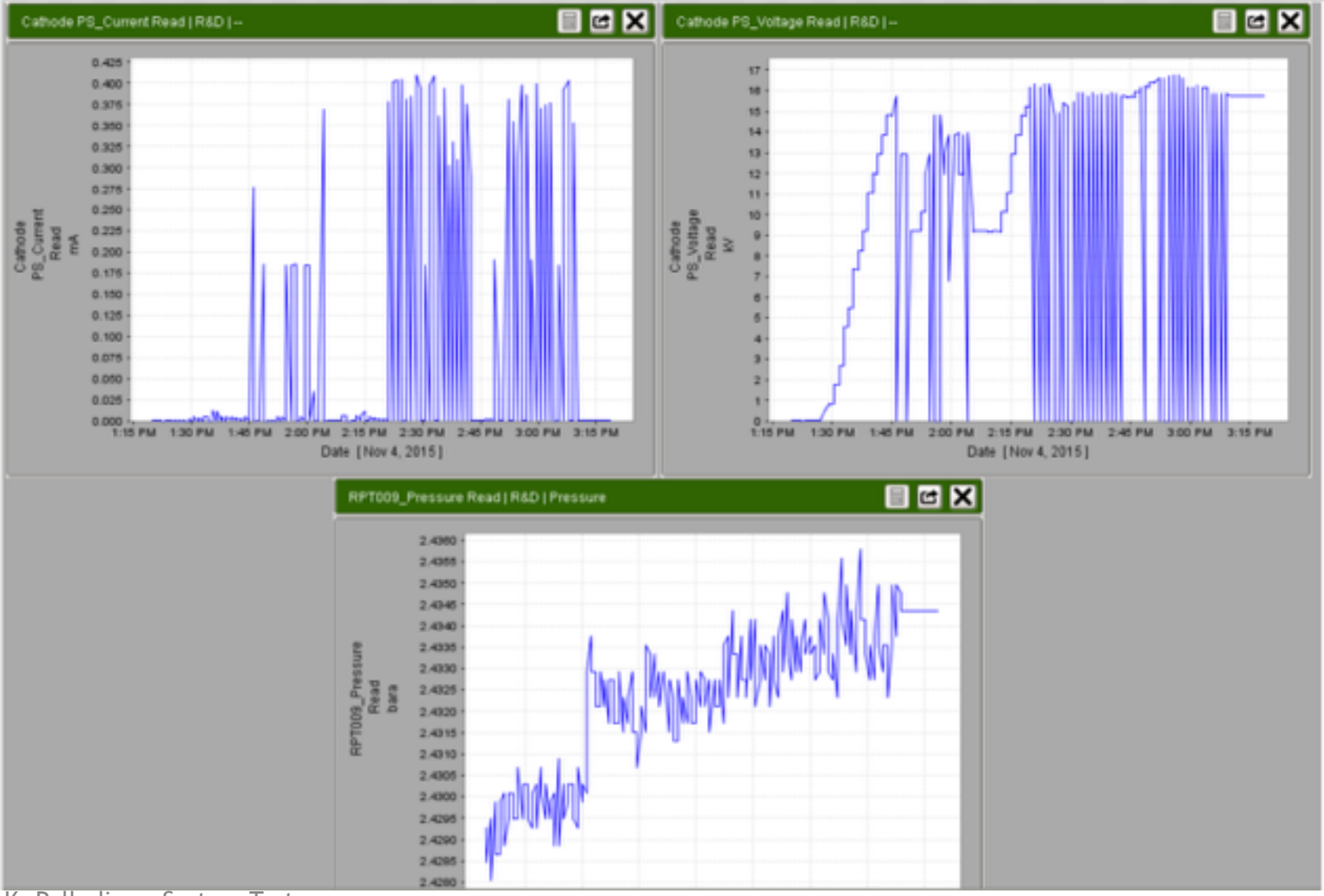
Pressure

1.925 bar

Highest Voltage:

17 kV

Test 3 LXe



Test 3

Pressure

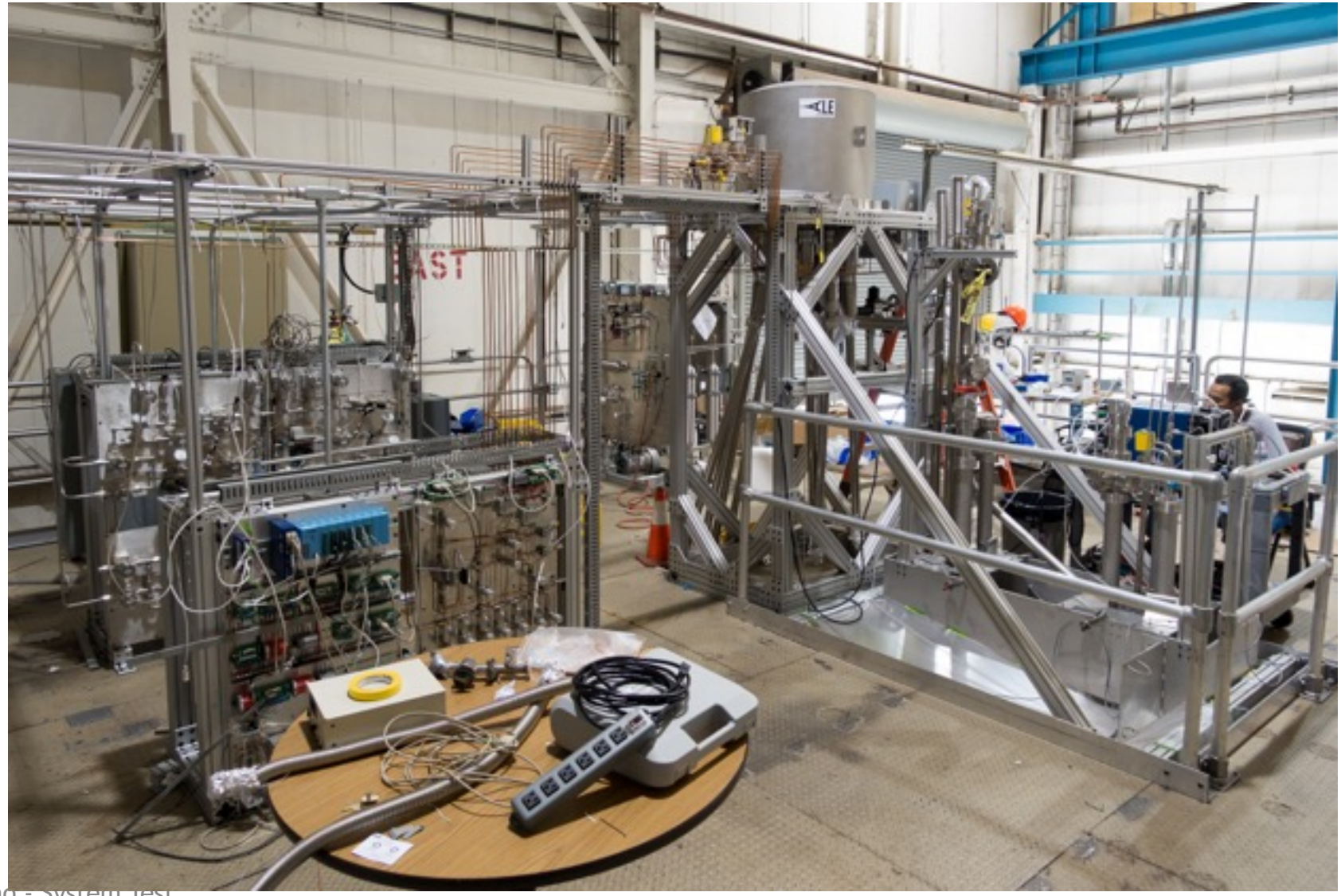
2.43 bar

Highest Voltage:

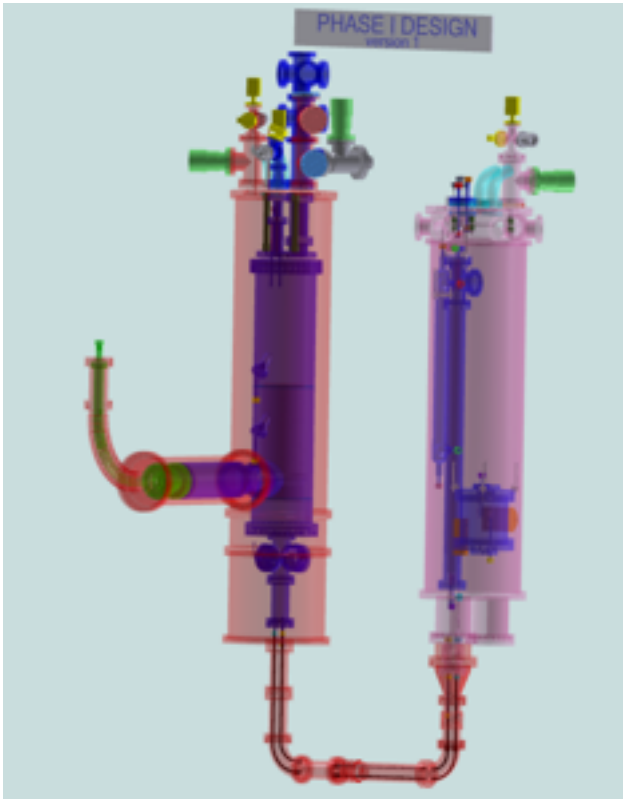
17.5 kV

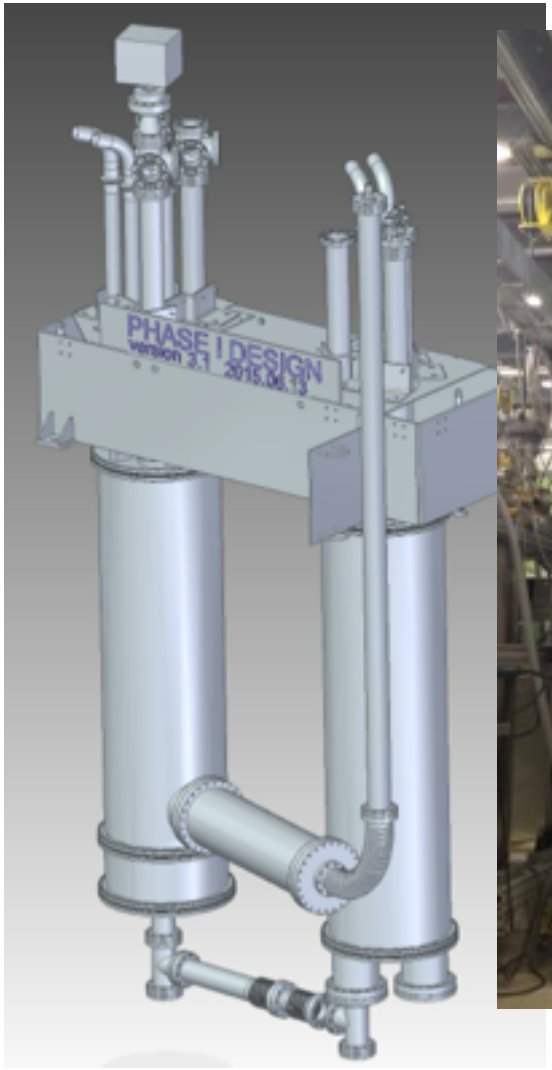
Platform design

Top of the Hut



System Test Vessels





Circulation Compressor

Kr Removal R&D