Liquid Argon Purity

Results of Recent Material Tests with Luke and Effects of Water

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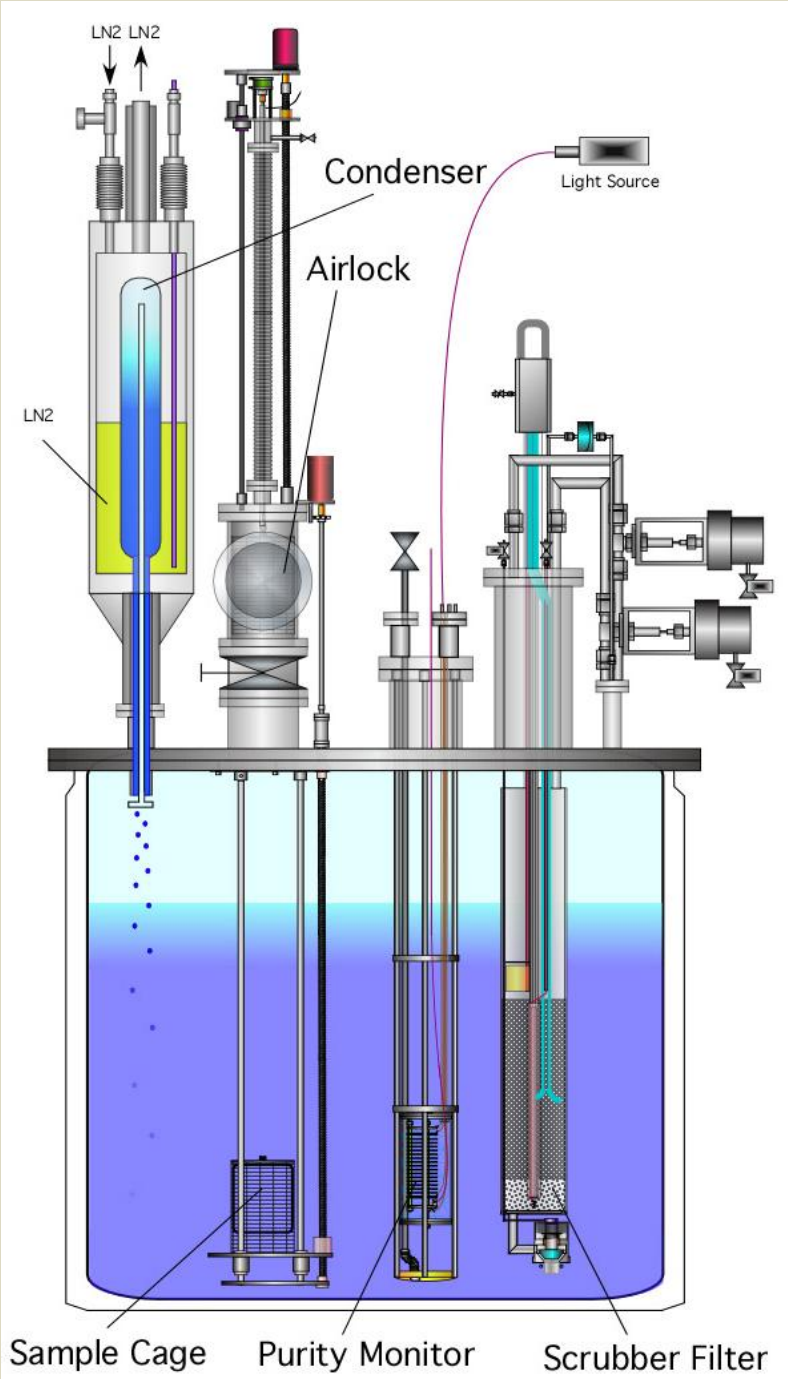
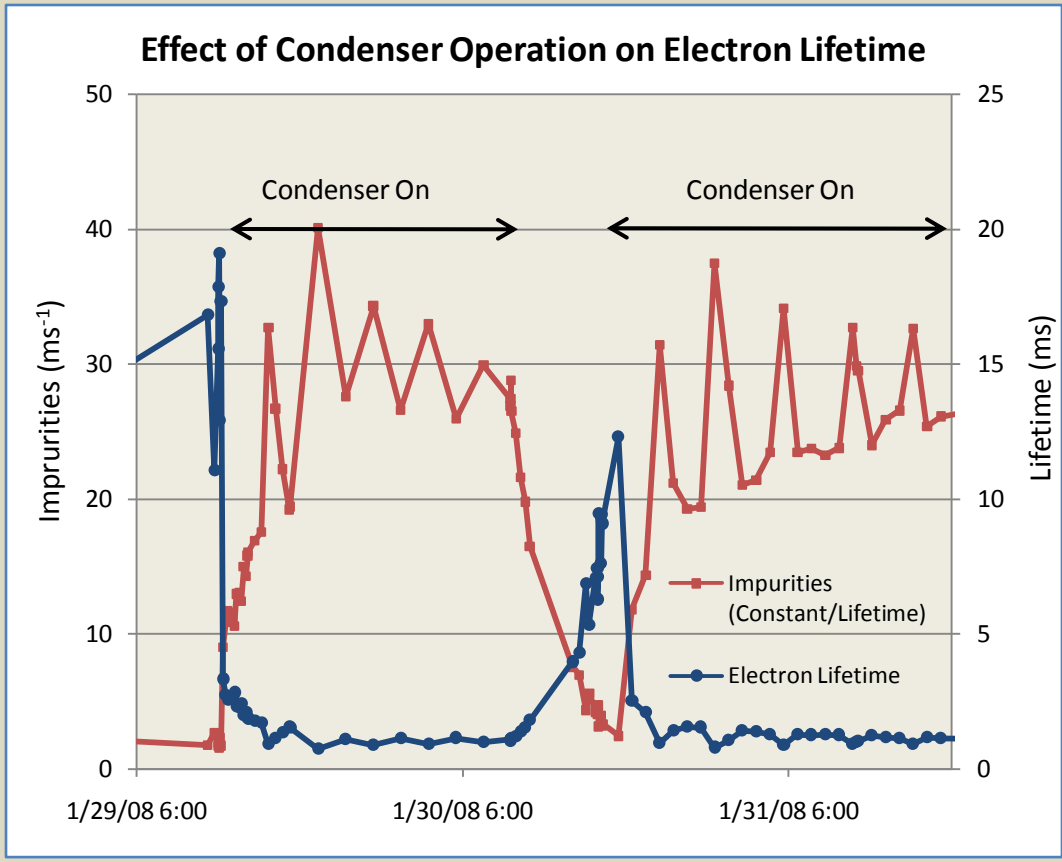
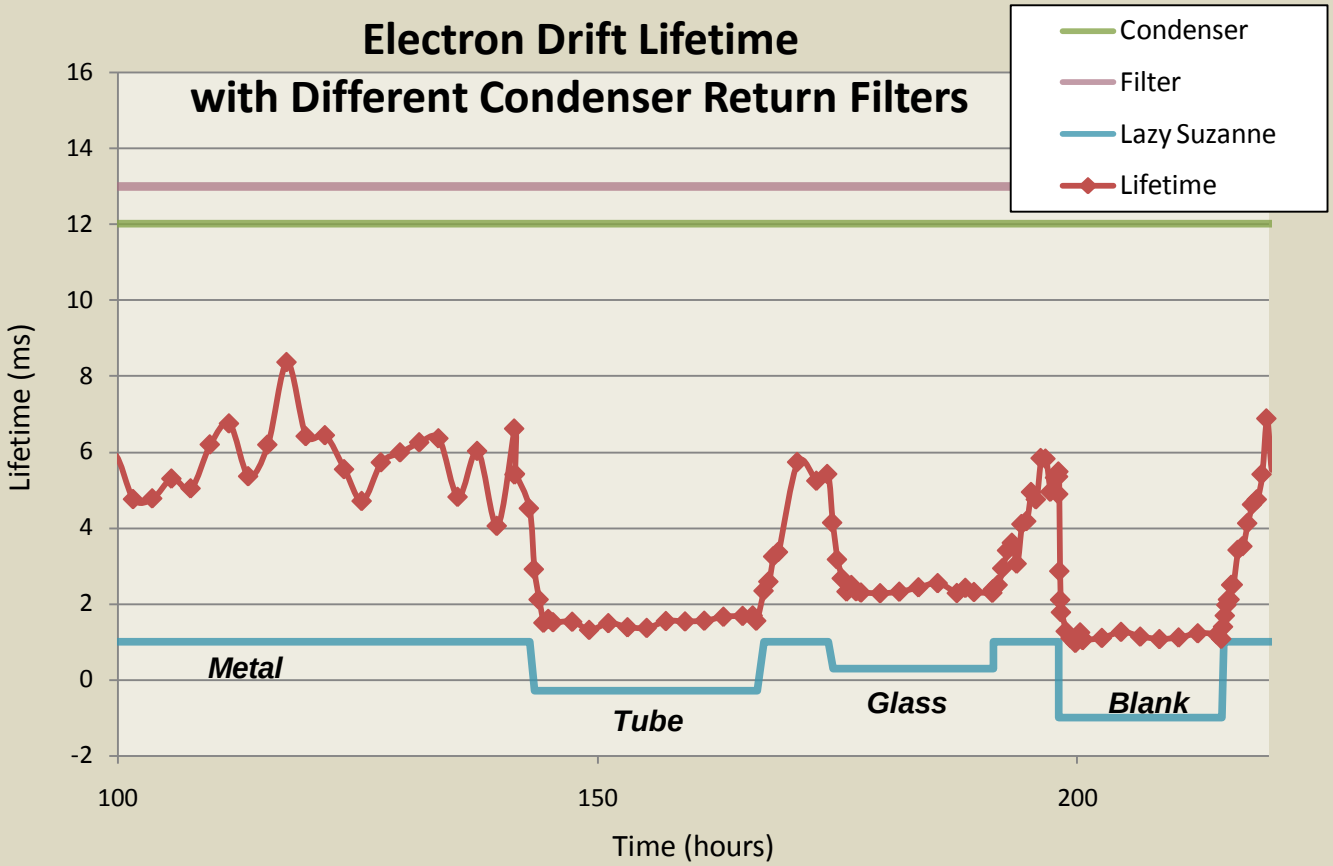
15 May 2009

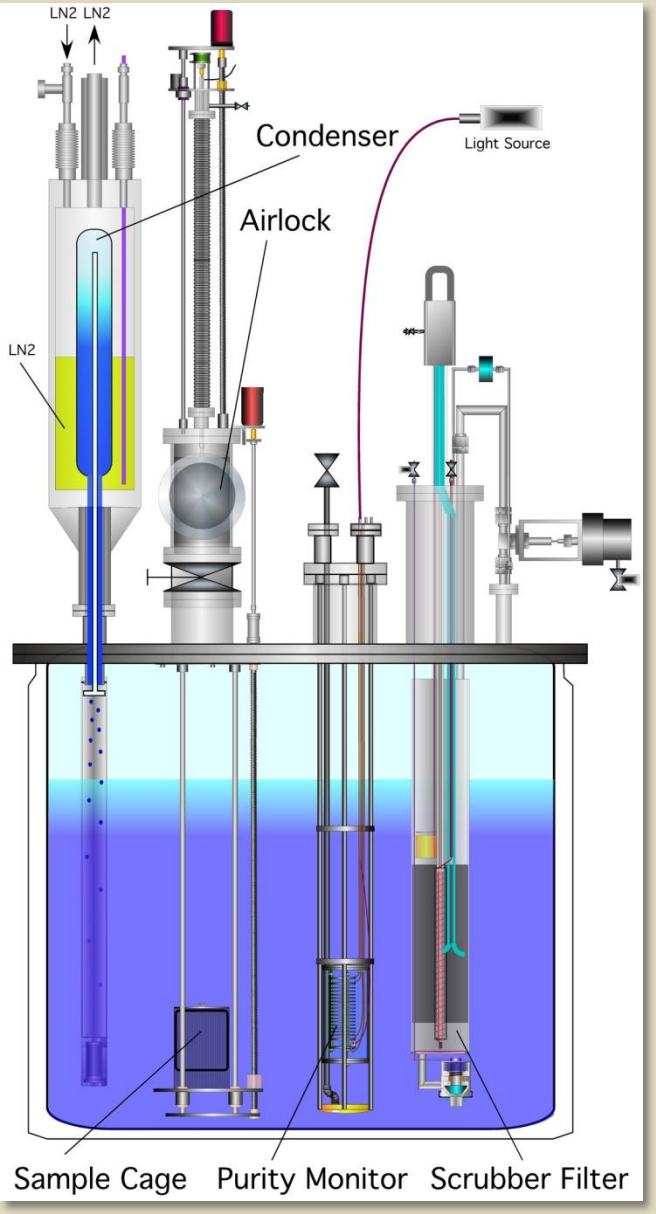

LN2 LN2
Condenser
Light Source
Airlock
LN2
Sample Cage
Purity Monitor
Scrubber Filter


Effect of Condenser Operation on Electron Lifetime
Condenser On
Condenser On
Impurities (ms-1)
Lifetime (ms)
50
40
30
20
10
0
25
20
15
10
5
0
1/29/08 6:00
1/30/08 6:00
1/31/08 6:00
Impurities (Constant/Lifetime)
Electron Lifetime



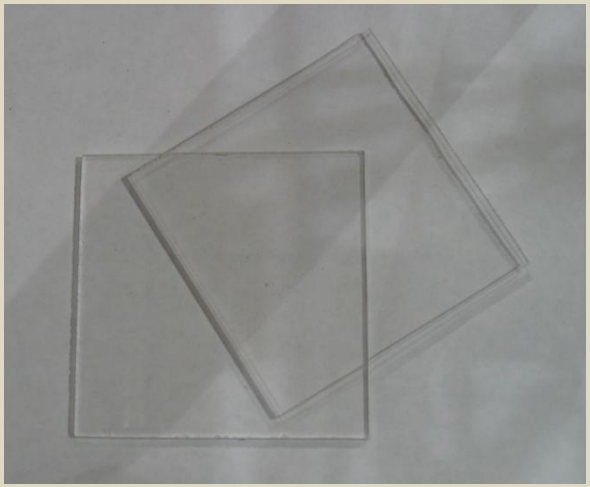
Based on Performance of Return Filters:

- Warm metal surfaces desorb water.
- Condensing introduces water into liquid and affects electron lifetime (Hypothesis).
- Cold metal surfaces (e.g. sintered metal filter) adsorb water.

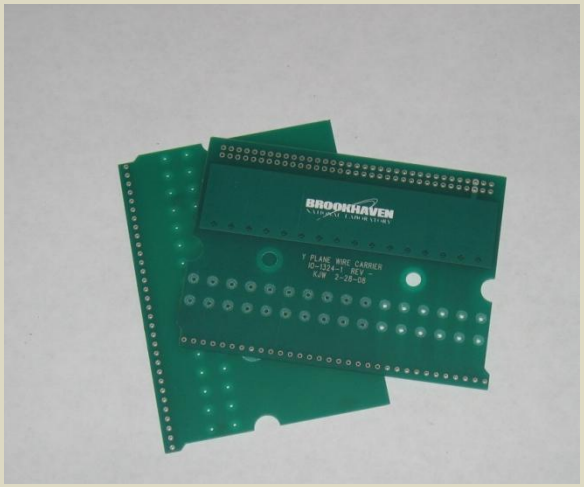


- Monitor H2O in Argon Vapor
  - Sensitive to 2 ppb H2O
- H2O concentration in LAr is roughly 0.002 of that in GAr
  - Sintered metal and scrubber filter reduce amount in LAr
- Test materials with scrubber filter, condenser operating

Tested Materials



Acrylic

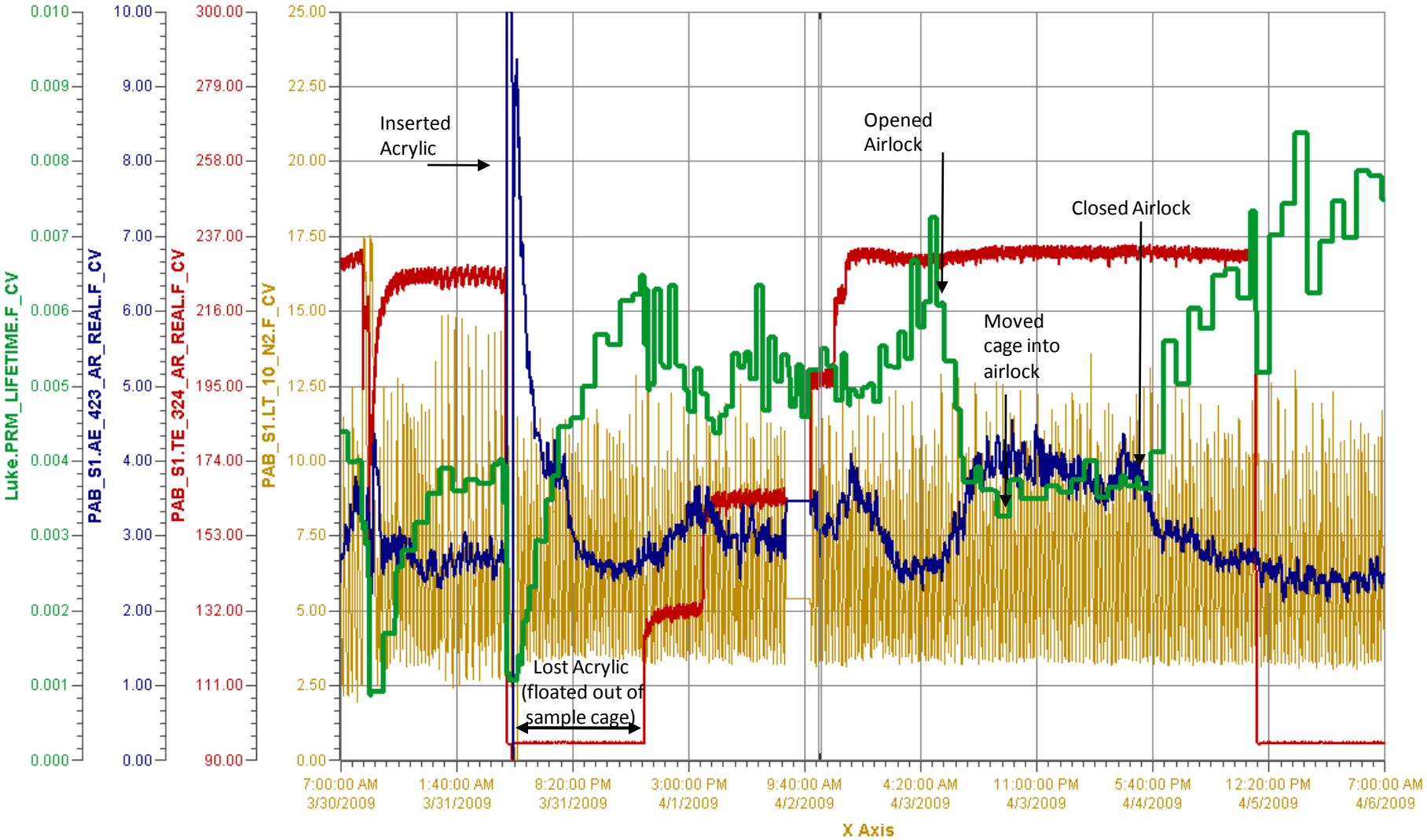


BNL Green PC Board

BNL Yellow PC Board

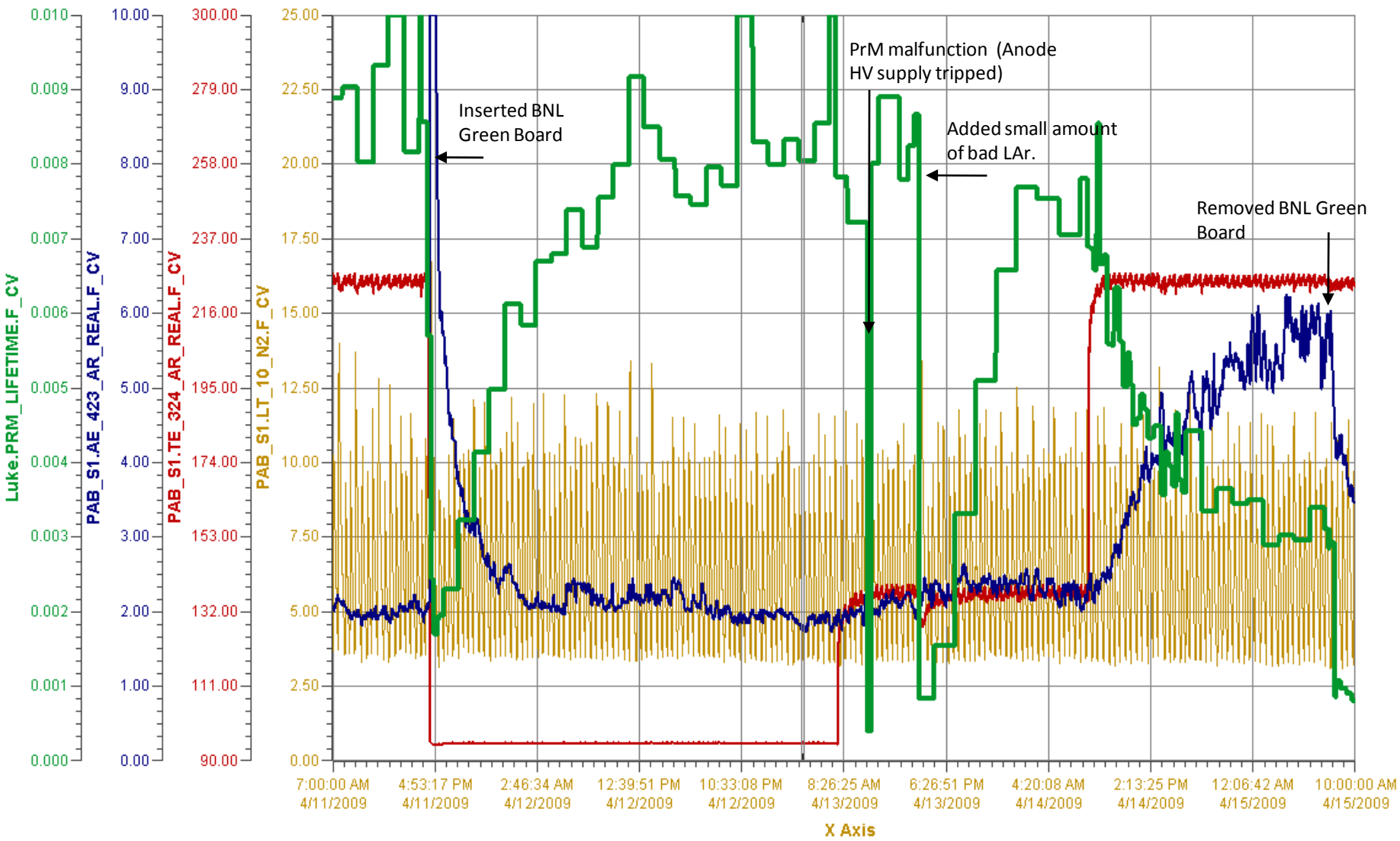
TacPreg

“Acrylic” Material Test



Platform Temp. (K)	Water in Ar vapor (ppb)
Condenser liquid level (inches)	Electron lifetime (ms)

BNL Green PC Board Material Test



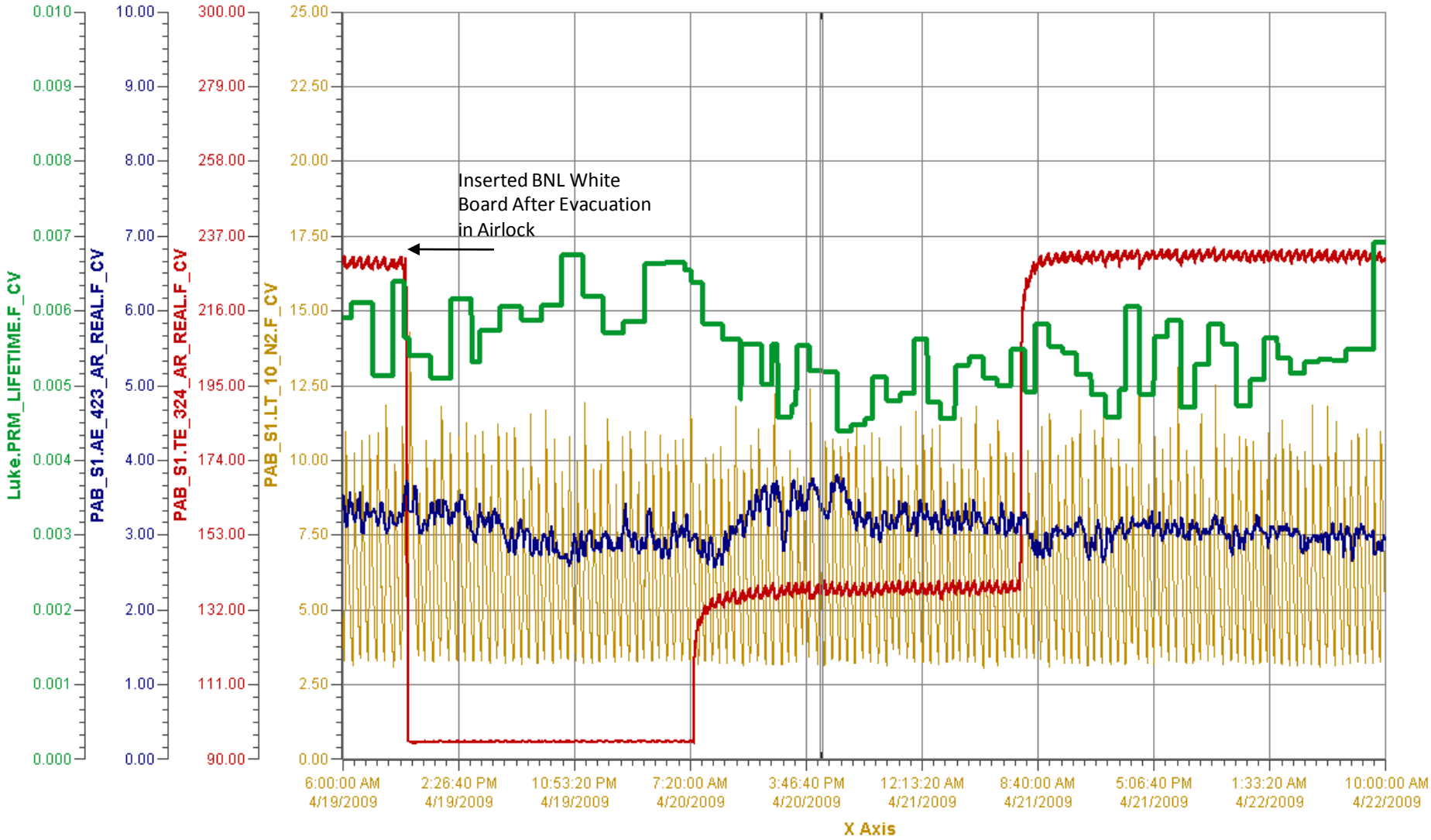
Platform Temp. (K)

Water in Ar vapor (ppb)

Condenser liquid level (inches)

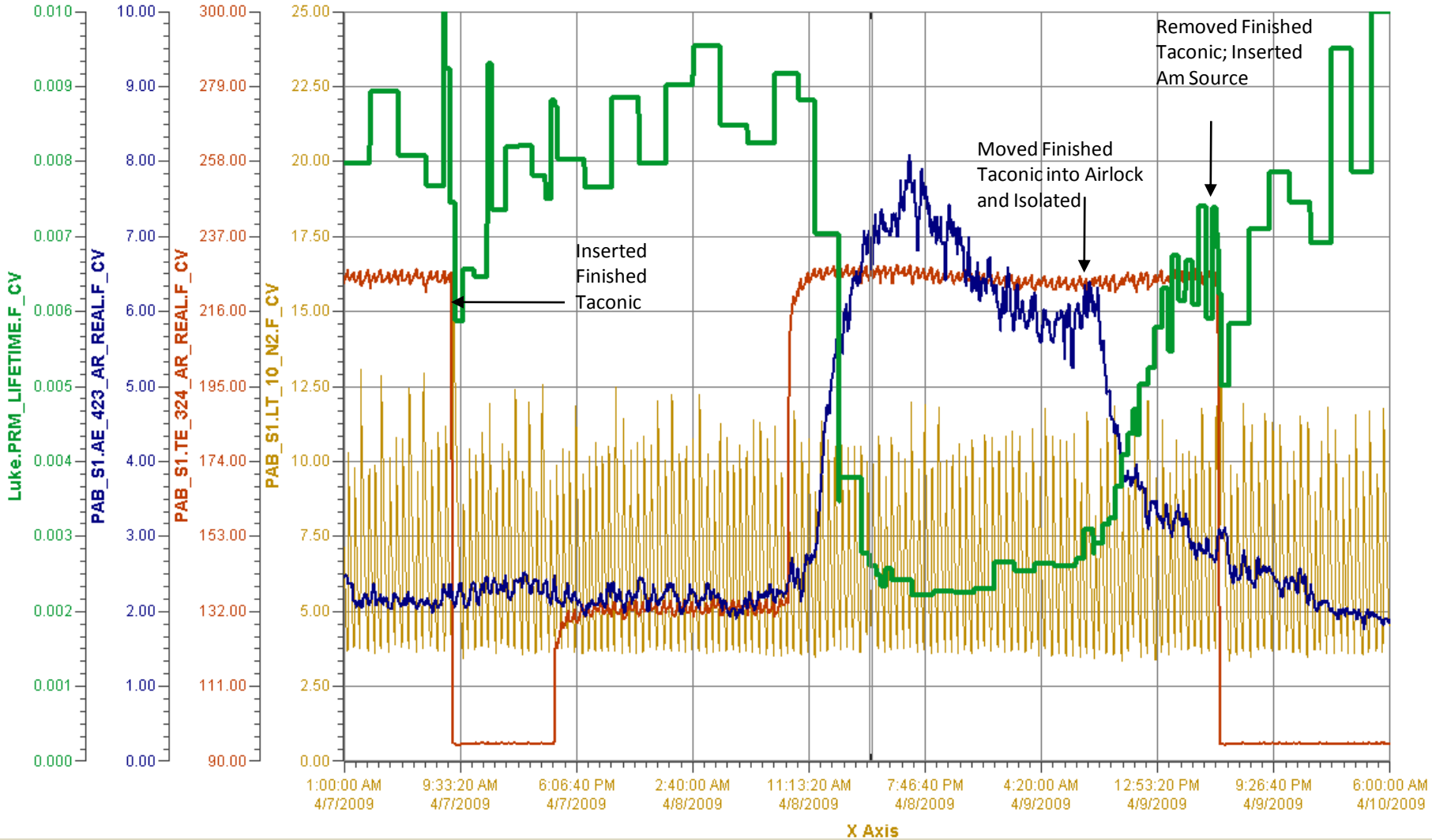
Electron lifetime (ms)

BNL Light Green PC Board Material Test



Platform Temp. (K)	Water in Ar vapor (ppb)
Condenser liquid level (inches)	Electron lifetime (ms)

Finished Taconic Material Test



Platform Temp. (K)

Water in Ar vapor (ppb)

Condenser liquid level (inches)

Electron lifetime (ms)

Summary

- Water is likely the impurity of concern in GAr.
  - (H2O in ppb)*(Lifetime in ms) = Constant
  - Vacuum removes the impurity from PC boards
- Materials at less than 130 K do not outgas.
  - True for PC boards and most other materials
  - Outgassing at higher temperatures may decrease in a reasonable (days) timeframe.
- Condensed argon vapor must be filtered before returning to liquid of cryostat.