Modifications to the Nab Detector Electronics System

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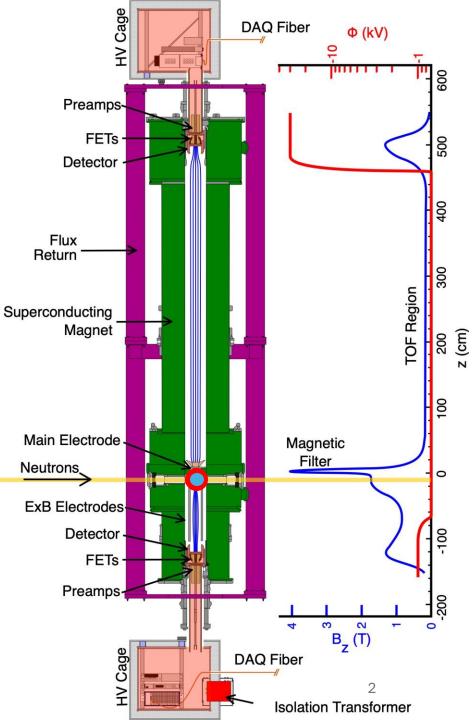
ACNS Conference, June 26, 2024





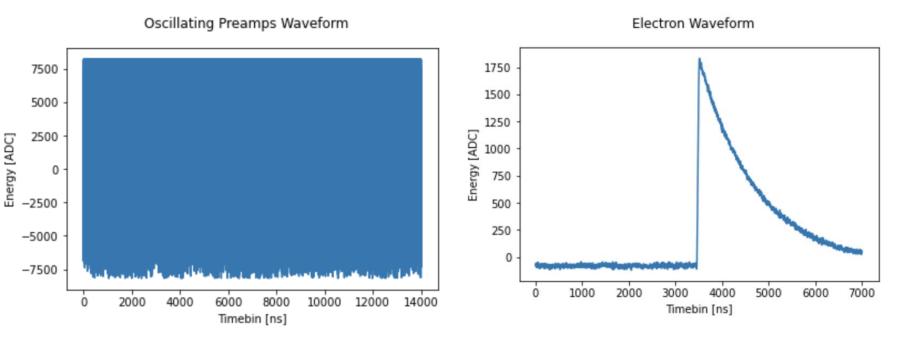


Nab Experiment Detector System

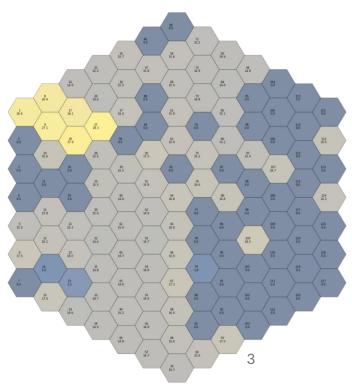


Nab Electronics

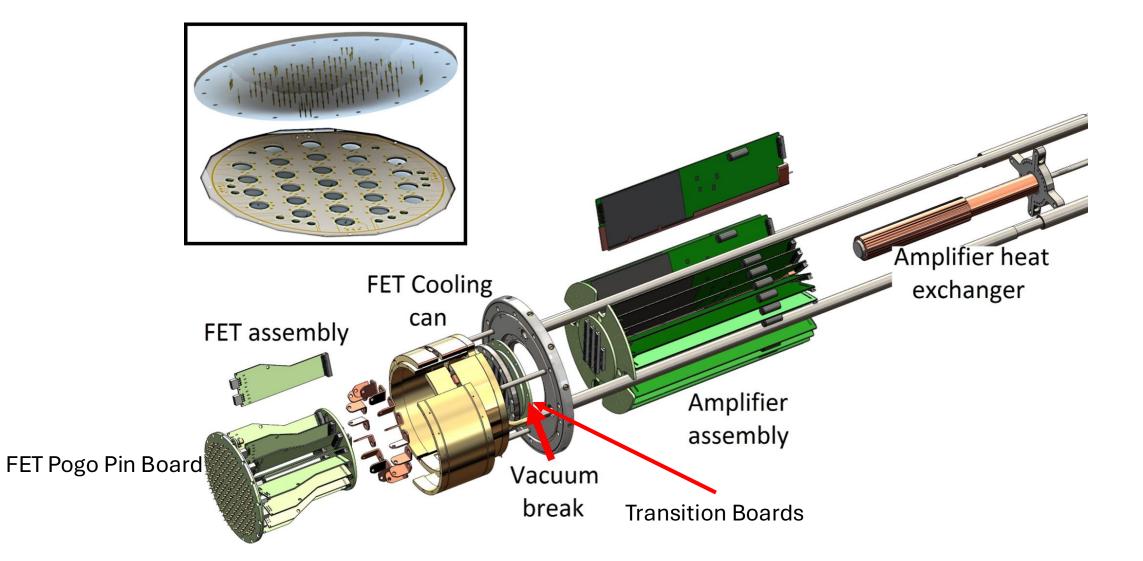
- Stability
 - Too many preamps plugged in leads to system oscillations
 - Preamps too cold leads to oscillations
 - Damage can lead to loss of pixel or instability



Upper Detector Pixel Gain Summer 2023

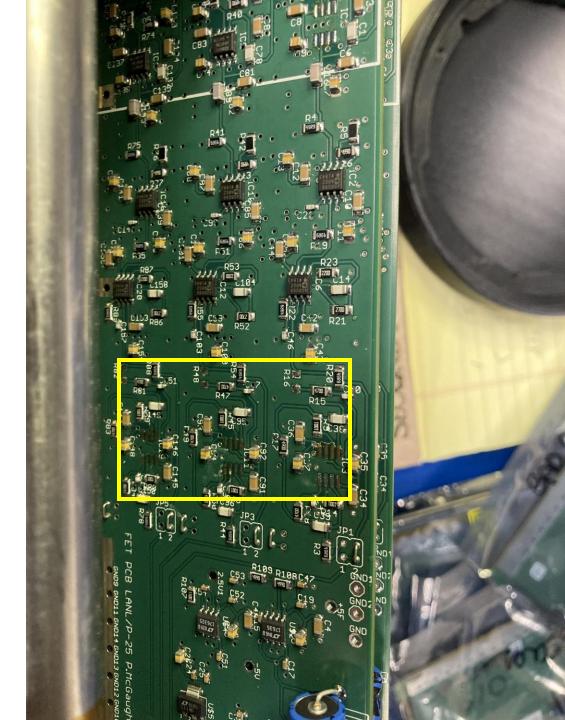


Nab Electronics



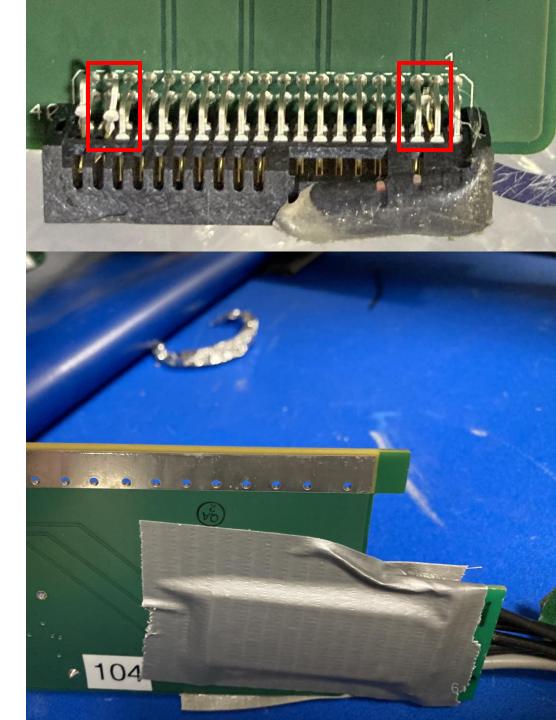
Shaper Circuit Removed

- Shaper Circuit Removed
 - $\circ~$ Not in currently used
 - Preamplifier board power draw reduced by 1/3
 - Before
 - +7V : 295 mA
 - -7V:271 mA
 - After
 - +7V : 211 mA
 - -7V : 186 mA
 - Stability Test
 - All preamps powered, system did not oscillate on bench for 2 hours



Connector Issues

- Connector Damage
 - \circ Movement of Pins
 - Touching other Pins, not Pushed in
 - \odot Connectors disengage easily
 - Tabs taped to connectors, holding them together
 - \circ Repair Difficulty
 - No thermals on ground pins makes replacement effectively impossible



Originial Preamp Map

14 13 G4 J1 J2 G5 J5 H2 J3 G6 КЗ K5 H6 G1 F2 L6 12 H5 F1 J6 E6 K4 L3 Η1 G3 E4 L4 E2 E3 15 F6 F3 L5 L1 M6 L2 16 H4 G2 F5 D6 N4 J4 K1 F4 D3 C2 Μ1 N1 E5 D5 C3 M4 11 М3 Ρ1 K2 D1 C1 E1 M5 M2 01 Η3 D4 **B**3 D2 B2 02 05 04 V1 B5 N2 Ρ5 S3 Β1 C4 N5 B6 06 03 V2 C5 Q4 T6 Q5 Ν3 Q6 Τ1 A1 A2 B4 Ρ3 R2 V4 P4 T2 A6 Q3 P2 R3 S4 U4 A3 A5 P6 R1 S1 U2 U6 A4 Q1 U5 R6 T5 U1 Q2 U3 S5 V5 S2 S6 Τ4 Т3 R4 R5

Pixel Prioritized Preamp Map

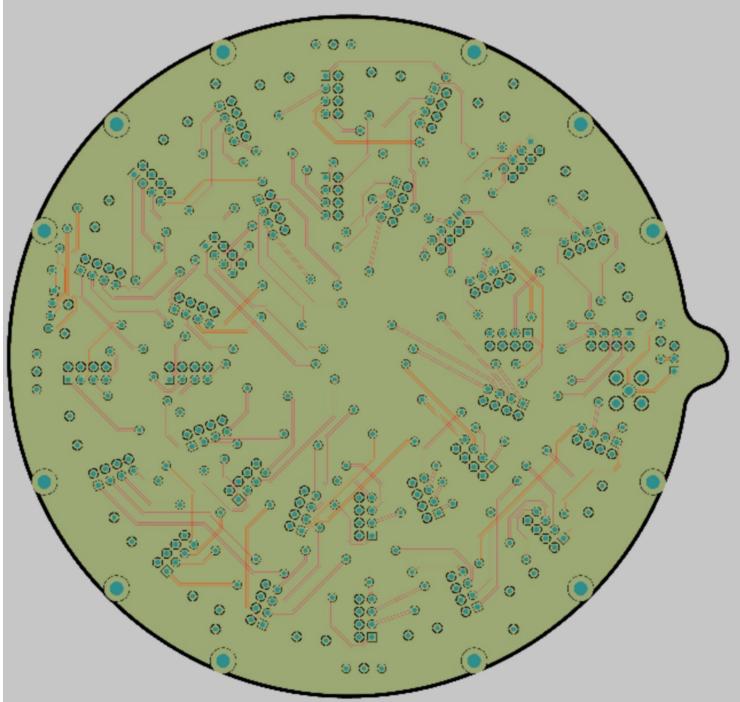
H5 D1 Η1 F5 D4 H2 F2 F1 C6 F6 F4 С3 H4 D5 G3 F3 H6 G1 C1 D3 Н3 G2 Β3 G4 C4 13 D6 15 G6 G5 Β5 B2 D2 K2 E5 Β1 16 J6 B6 W3 12 J3 E3 Β4 E4 C5 E2 КЗ V5 11 A5 J2 W5 A3 J5 E1 V1 C2 14 E6 L5 Μ1 V4 A2 J4 W6 L2 M2 V6 J1 A6 U4 M5 Μ6 L3 V2 K6 U1 W2 V3 L6 S3 P6 U2 M4 K5 03 P2 М3 S2 U5 T1 N2 Ρ3 Ρ1 S5 S6 T4 06 Ρ5 Ρ4 S4 U6 N5 Т3 S1 U3 N1 02 R2 T6 R6 01 R3 N4 T2 R5 N6 04 T5 05 Ν3 Q2 Q5 Q3 Q6

Cold Tests of New FET Pogo Pin Board



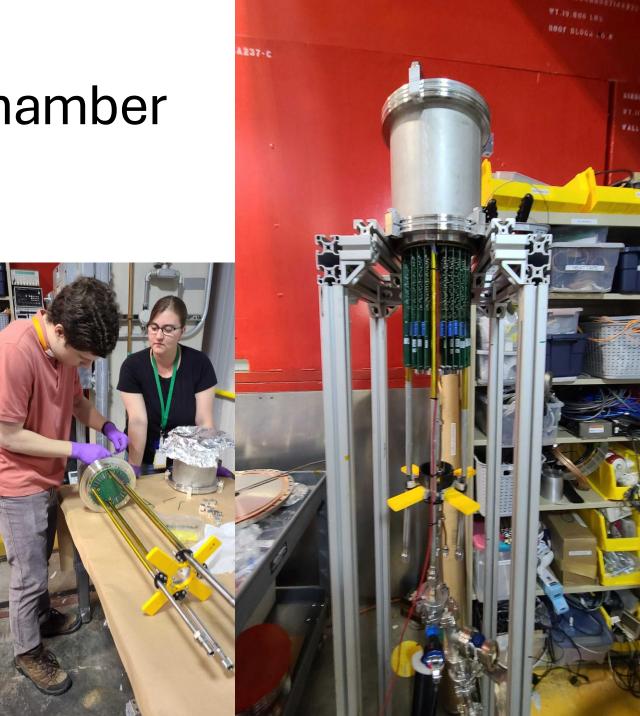
FET Pogo Pin Board Cross Talk Bench Test

- Tested Overlapping Traces looking for crosstalk
 - 1 V output signal saw less than 10 mV crosstalk



Mini Chamber

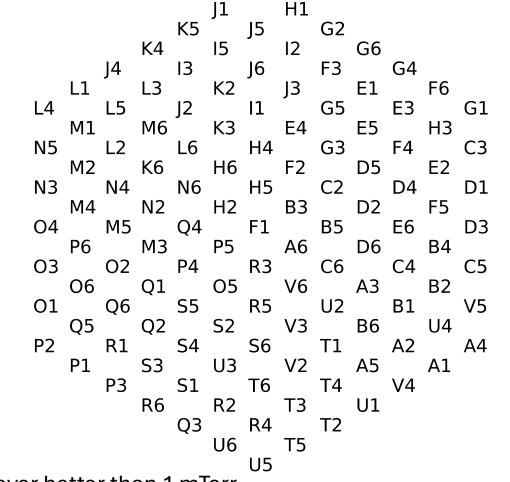
- Tests of Electronics Changes
- Testing for new Lower Detector
- Testing of New Transition Boards



Mini Chamber Test



Pixel Prioritized Pogo Pin Board Mini Chamber Cold Test



- Warm Vacuum never better than 1 mTorr
- Reluctance to put in a low leakage current detector into dirty vacuum led to testing with detectors with high leakage current
- Saw 31 out of 127 pixels on Detector "Smudge"

Test Stand Tests with the "Manitoba" Detector

- Green
 - Working Pixels
- Yellow -
 - FET card inoperative
- Pink
 - Preamp inoperative
- Blue
 - Did not pass detector pogo pin continuity test
- Red
 - Missing after cooldown
- Purple
 - Did not pass detector pogo pin continuity test, reappeared after cooldown

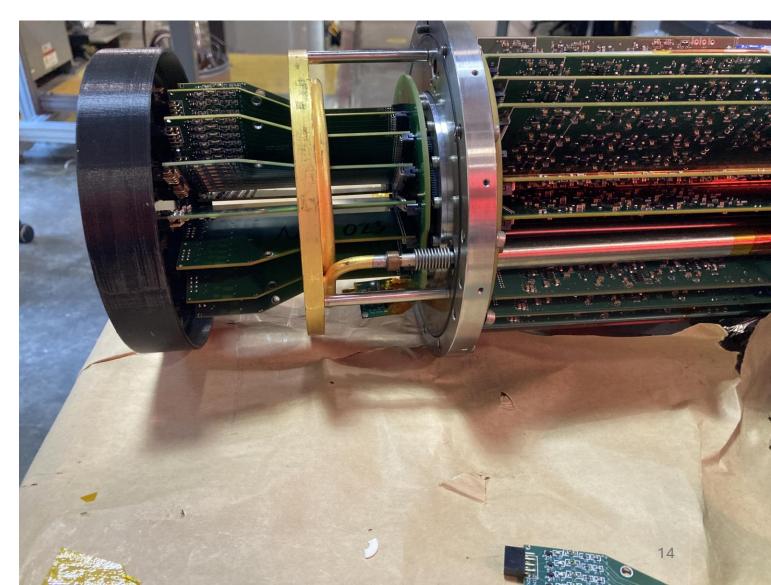
Η1]1 K5 G2 J5 Κ4 15 G6 12 J4 13 J6 F3 G4 L1 L3 K2 J3 F6 E1 J2 G5 L4 L5 11 E3 G1 Μ6 К3 E4 E5 H3 M1 L6 H4 G3 N5 L2 F4 **C**3 K6 H6 F2 D5 E2 M2 N6 H5 Ν3 N4 C2 D4 D1 N2 H2 Β3 D2 F5 M4 M5 F1 Β5 04 Q4 E6 **D**3 P5 P6 A6 D6 B4 М3 02 P4 R3 C6 C4 C5 03 05 V6 A3 B2 06 Q1 S5 R5 U2 01 Q6 Β1 V5 S2 V3 B6 Q5 Q2 U4 P2 S4 S6 Τ1 A2 R1 A4 S3 U3 V2 A5 P1 A1 Р3 **S1** T4 T6 V4 R6 R2 Т3 U1 Q3 T2 R4 U6 T5 U5 12



Electronics Modification Stability Test

FET Card Removal Bench Test

 Removed four FET cards (32 channels) from Electronics system to test stability



Removed Pixels

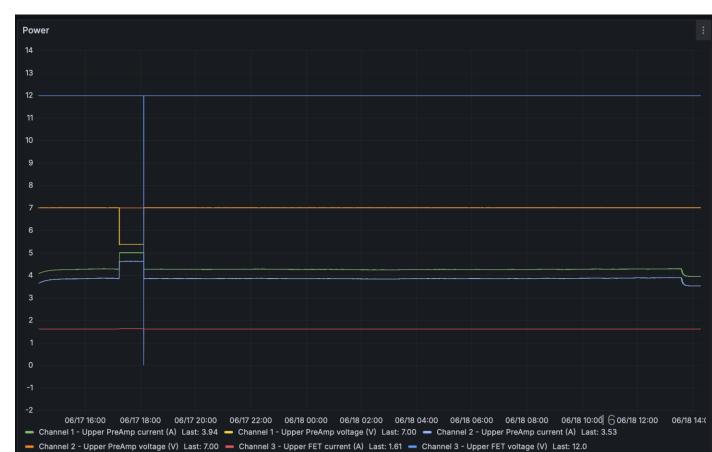
Removed Channels

- Modified Preamps:
 - A,B,D,G,I,J,L,M,P,R,T
 - 25 Channels removed
- Power up Test
 - Current Draws

Preamp	Α	В	D	G	I	J	L	Μ	Ρ	R	Т
+7 (mA)	149	150	147	118	146	200	145	118	145	118	147
-7 (mA)	120	220	120	90	118	120	118	89	125	88	119
+12 (mA)	76	76	71	79	77	76	77	77	76	77	72
Ch. removed	2	2	2	3	2	2	2	3	2	3	2

Test Results

- FET removal test:
 - System oscillated 4 times in 90 minutes
- Op-Amp removal test:
 - System oscillated once in 24 hours
- Bench Test,
 - No Detector
 - FETs not cooled



Future Work

- Tests of new transition boards
 - Continuity test
 - Vacuum Test
- Cold test 2nd new FET pogo pin
- Cold Test of manual outer pixel removal
- Install modifications for use in the upcoming beam cycle













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The Nab Collaboration





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