# PRAD COLLABORATION MEETING - HYCAL HARDWARE WORK UPDATE

BY: ERIK WRIGHTSON


# OUTLINE

- Final HyCal Signal Cable Tests and Repairs
- LMS Functionality
- HyCal Pb-Glass LMS Signal
- HyCal Pb-Glass Cosmic Signal Second Pass
- HyCal Single Channel DAQ Test
- Remaining Work/Other Talks
- The PRad Logbook and the PRad Wiki
- Acknowledgements

# SIGNAL CABLE TESTS AND REPAIRS

E. WRIGHTSON




# HYCAL SIGNAL CABLE TESTS AND REPAIRS

- All 60 bundles have been converted to LEMO connectors use with the FADCs
- Since the previous PRad Collaboration meeting, the final 8 bundles were converted, tested, and re-bundled into their sub-groups (X.X.1 for cables 1-16 and X.X.2 for cables 17 – 25, 27,or 32)
- 4 of the bundles also needed their 32-pin connectors to HyCal replaced due to having bent pins or cracking.
- After testing we did a second pass of any marked cables and if they still presented issues, we marked them for repairs.
- Bundle 5.4.2 cable 17 and bundle 6.6.1 cable 8 each needed repairs and were confirmed to work afterwards.
- The final boards being converted to LEMO ends and the repairs were done by Armen Stepanyan of the Fast Electronics Group.
- This work has been fully completed.

**32-Cable Bundles:**

| 1 | 3 | 5 | 7 | 9 | 11 | 13 | 15 | 17 | 19 | 21 | 23 | 25 | 27 | 29 | 31 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 | 26 | 28 | 30 | 32 |

**27-Cable Bundles:**

| 1 | 3 | 5 | 7 | 9 | 11 | 13 | 15 | 17 | 19 | 21 | 23 | 25 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 27 | 2 | 4 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 | 26 | 6 | | |

**25-Cable Bundles:**

| 1 | 3 | 5 | 7 | 9 | 11 | 13 | 15 | 17 | 19 | 21 | 23 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 25 | 2 | 4 | 6 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 | 8 | | | |


# LIGHT MONITORING SYSTEM (LMS)

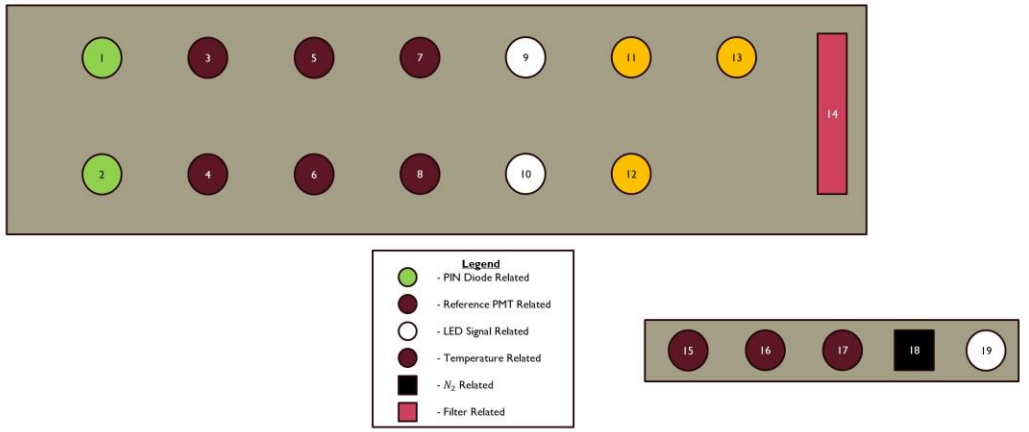
- The LMS was successfully re-started on December 12, 2024

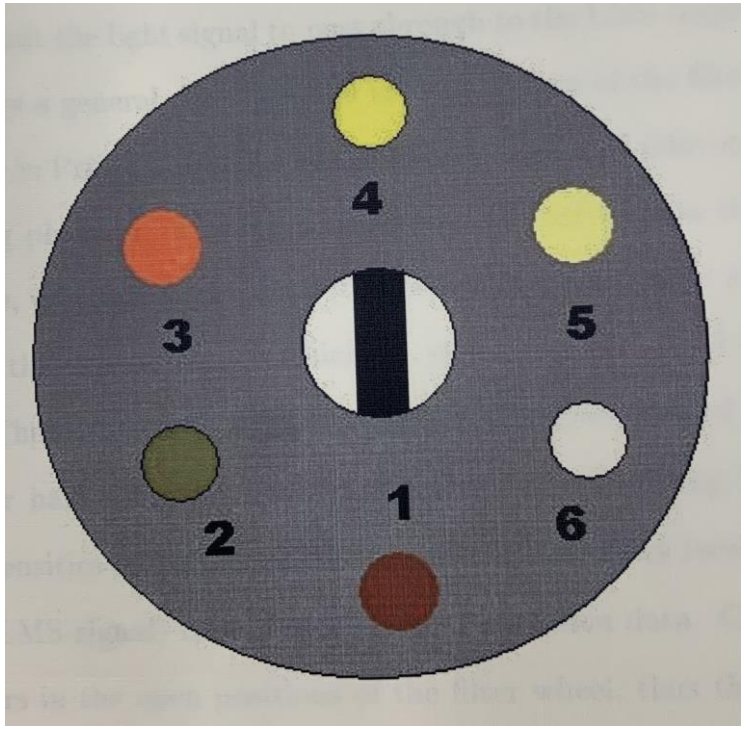
# LMS PRIMARY COMPONENTS

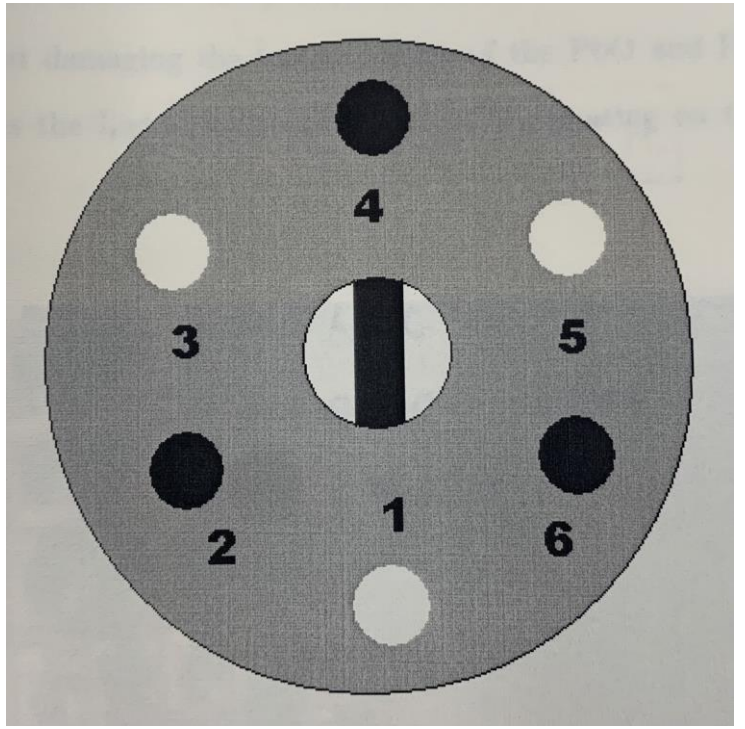
- 31 Nichia Super-Bright Blue LEDs - arranged in Series with one another and "avalanche" transistors that allow for pulsing HV signal to light them
- Integrating Sphere – removes angular dependence of LED Signal via mixing
- PIN Photodiodes – allows for direct LED measurement on Integrating Sphere
- Light Filter – 3 settings to block the LED signal from reaching the Optic Bundle, 3 open settings for different light intensities
- Optic Bundle – carries the LED pulse to all HyCal Modules and Reference PMTs
- 3 Reference PMTs – allows for gain monitoring and signal stability monitoring using radioactive sources and LED fibers

# LMS SIDE PANEL AND VOLTAGES PROVIDED DURING TESTING

- 1, 2 – Connected to Photodiodes (Electronically Connected; Port 2 is unused)
- 3, 5, 7 – Reference PMT Dynodes (#1, #2, and #3 respectively)
- 4, 6, 8 – Reference PMT Anodes (#1, #2, and #3 respectively)
- 9 – LED Pulse Input (5V, 20Hz, 100nS width)
- 10 – LED ~1V Input (No Longer Needed)
- 11, 12, 13 – Temperature Sensors for Reference PMTs
- 14 – Ribbon Cable for Filter
- 15, 16, 17 – HV Input for Reference PMTs (1000-1300V)
- 18 - $N_2$ Supply Input
- 19 – HV Input for LED Array (125V)





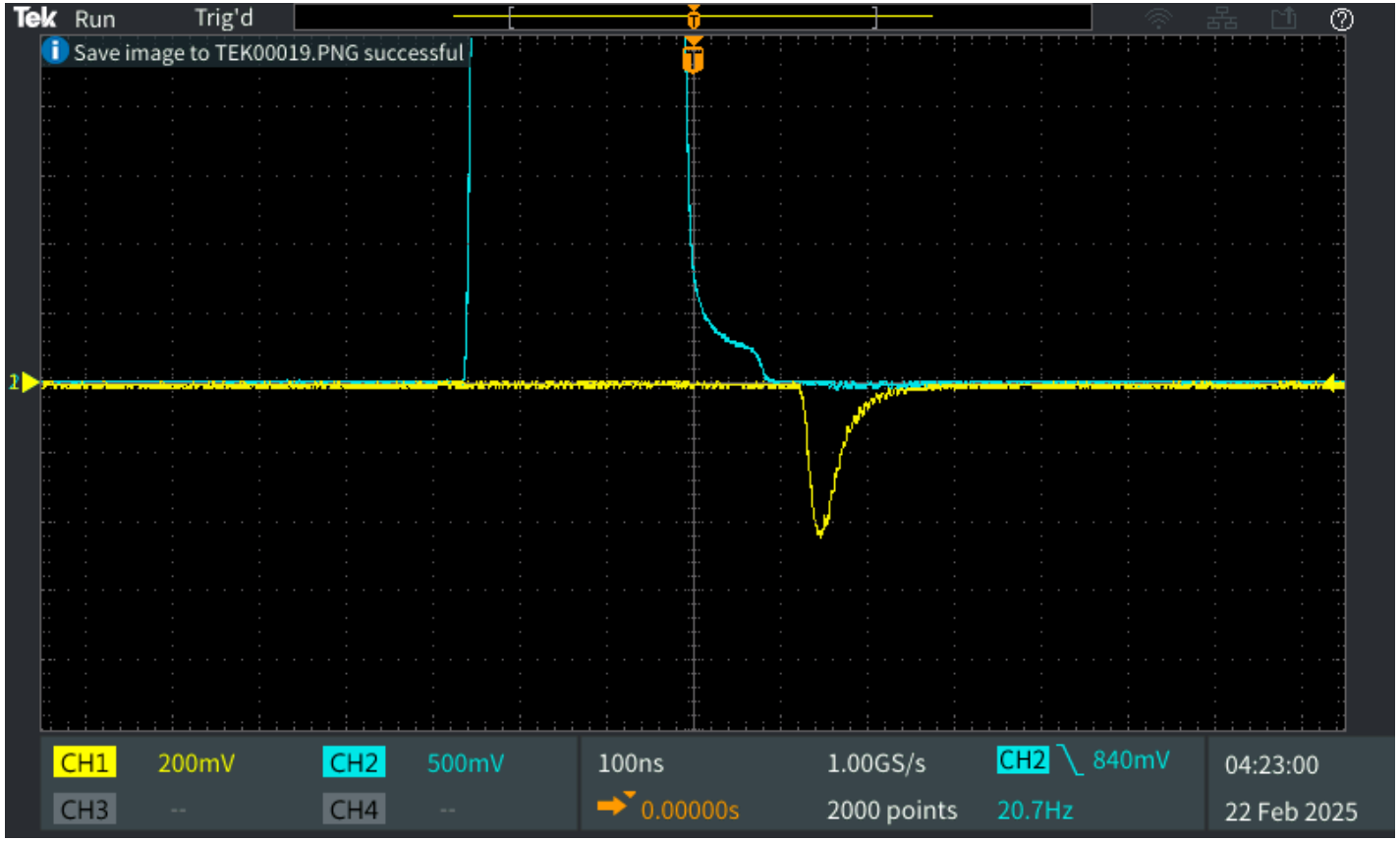




# LMS FILTER WHEEL

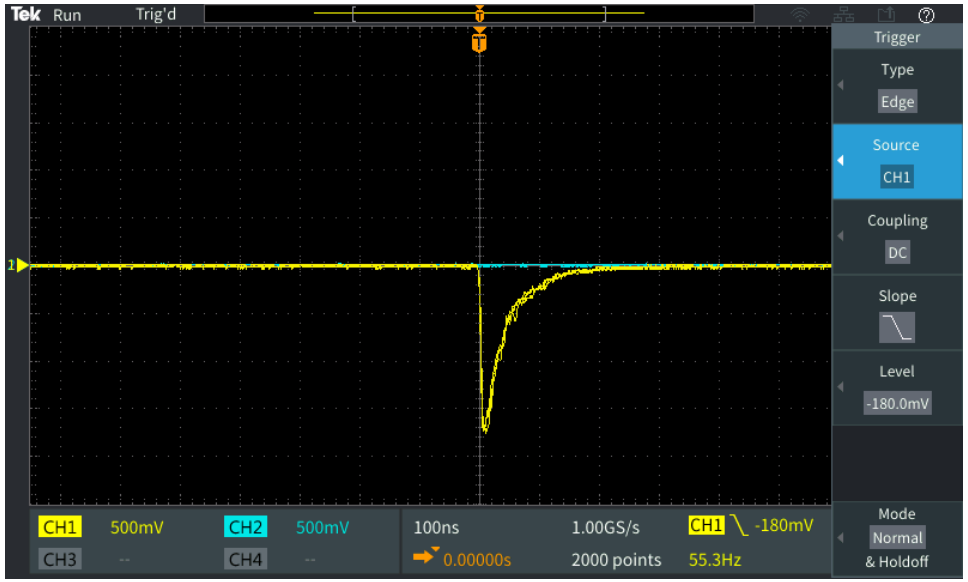
- Originally, the filter wheel allowed for 6 intensities of light to pass through (Left image).
- After modification, 3 settings were covered so that whether the HyCal modules received LMS light or not could be remotely controlled by just rotating the filter and it still allowed for 3 light intensities to be used.
- Images from the Master's thesis of  Larray J. Benton from NC A&T

# PIN PHOTODIODE RESPONSE

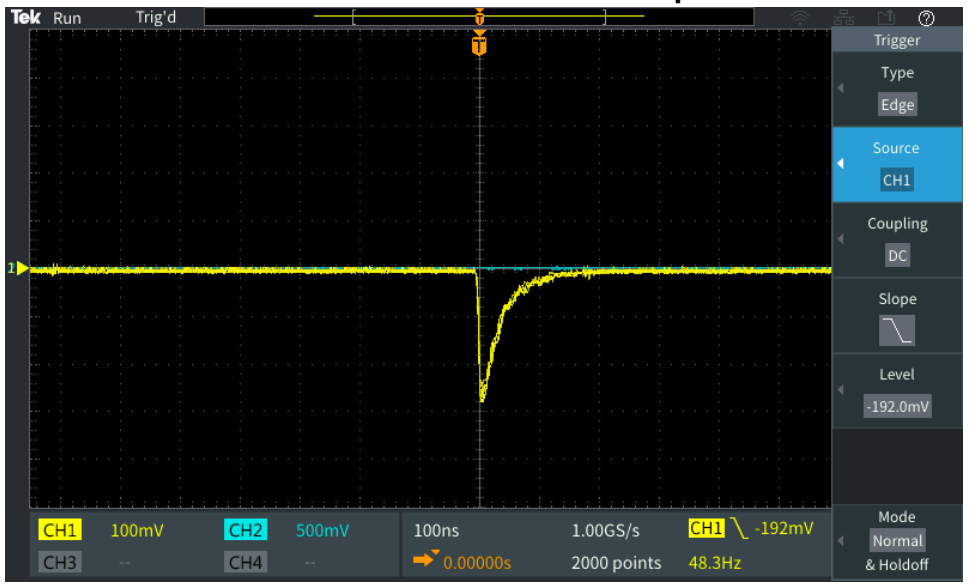
- There are two electrically connected photodiodes attached directly to the integrating sphere.
- There is a center and lower diode on the sphere.
- The blue is just the pulse trigger to ensure the signal is from the LED pulse.



Reference PMT #3 – YAP Response




Reference PMT #2 – YAP Response

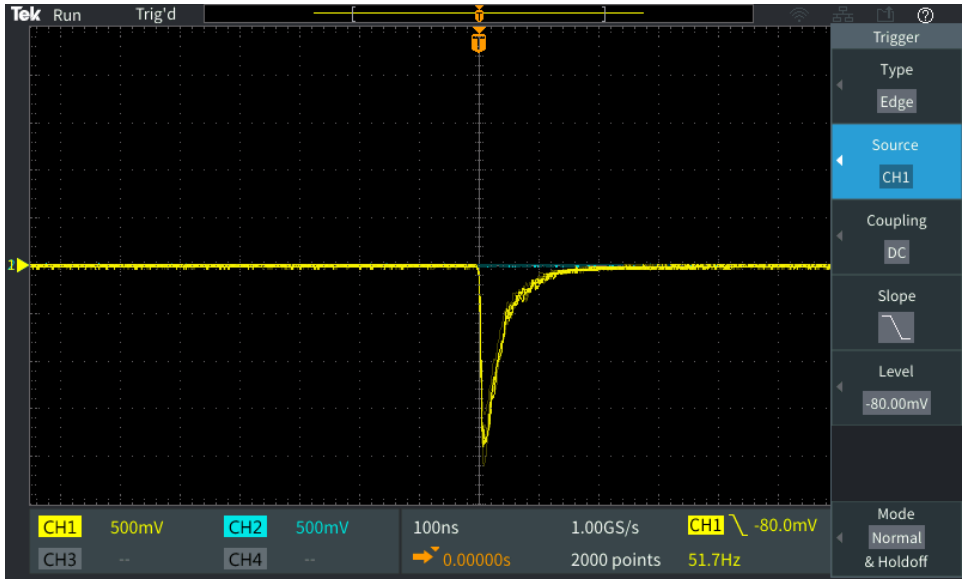



03/03/2025

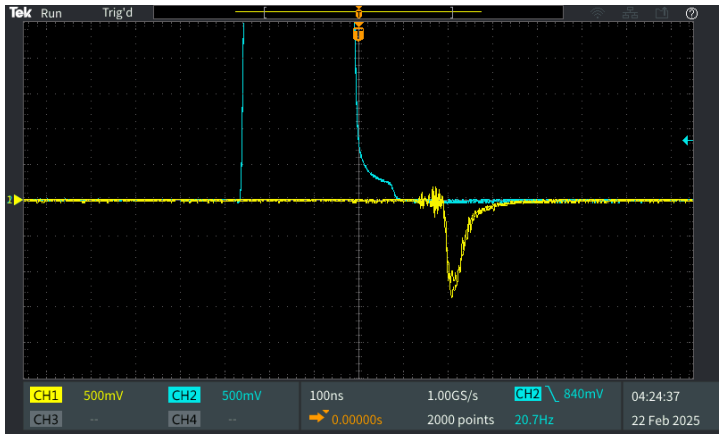
# REFERENCE PMTS – YAP ($Am^{241}$) CRYSTAL $\alpha$-SOURCE

- Allows for a randomly timed known signal for checking stability and calibration.
- Allows for a known signal to normalize to.

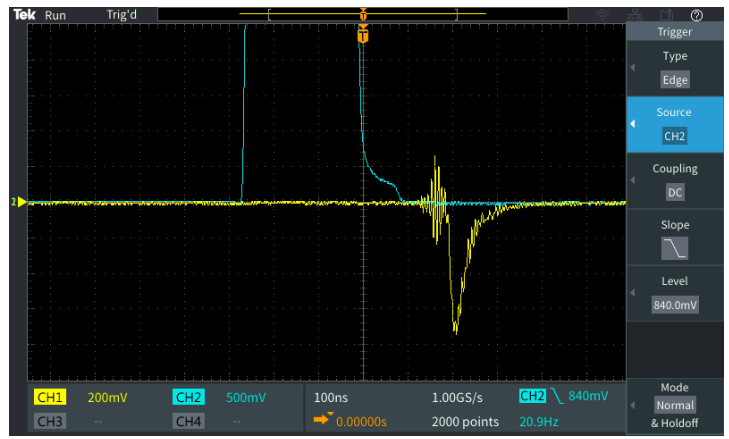
Reference PMT #1 – YAP Response



# REFERENCE PMTS – LMS LED-SOURCE



Reference PMT #1 – LED Response



Reference PMT #3 – LED Response

- Good linearity with HV supplied for the reference PMTs.

$$Stability = \frac{LED\ Response\ \#1\ *\ YAP\ Response\ \#3}{YAP\ Response\ \#1\ *\ LED\ Response\ \#3}$$

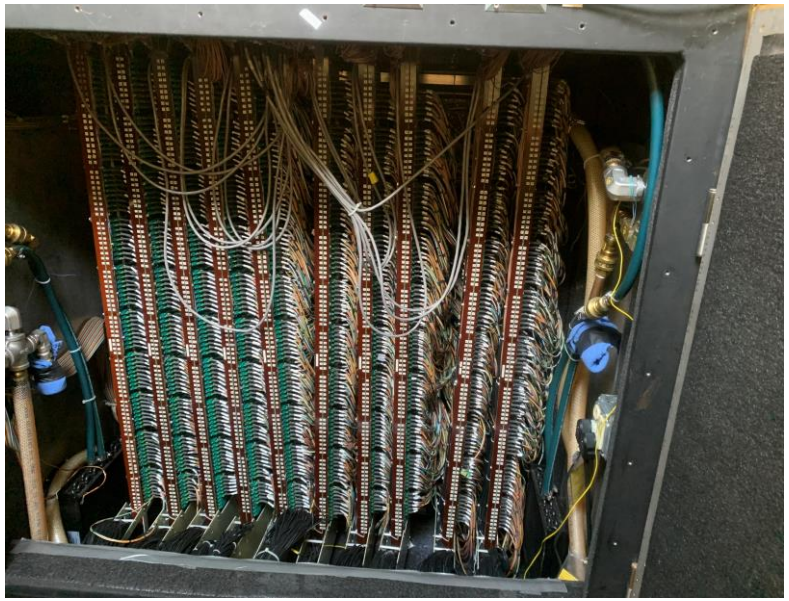
$$E = E_{e^-} \sum_{i=1}^{n} \frac{Q_i}{\alpha_i} \frac{g_i(t_0)}{g_i(t)} = E_{e^-} \sum_{i=1}^{n} \frac{Q_i}{\alpha_i} g_i^{LMS}$$

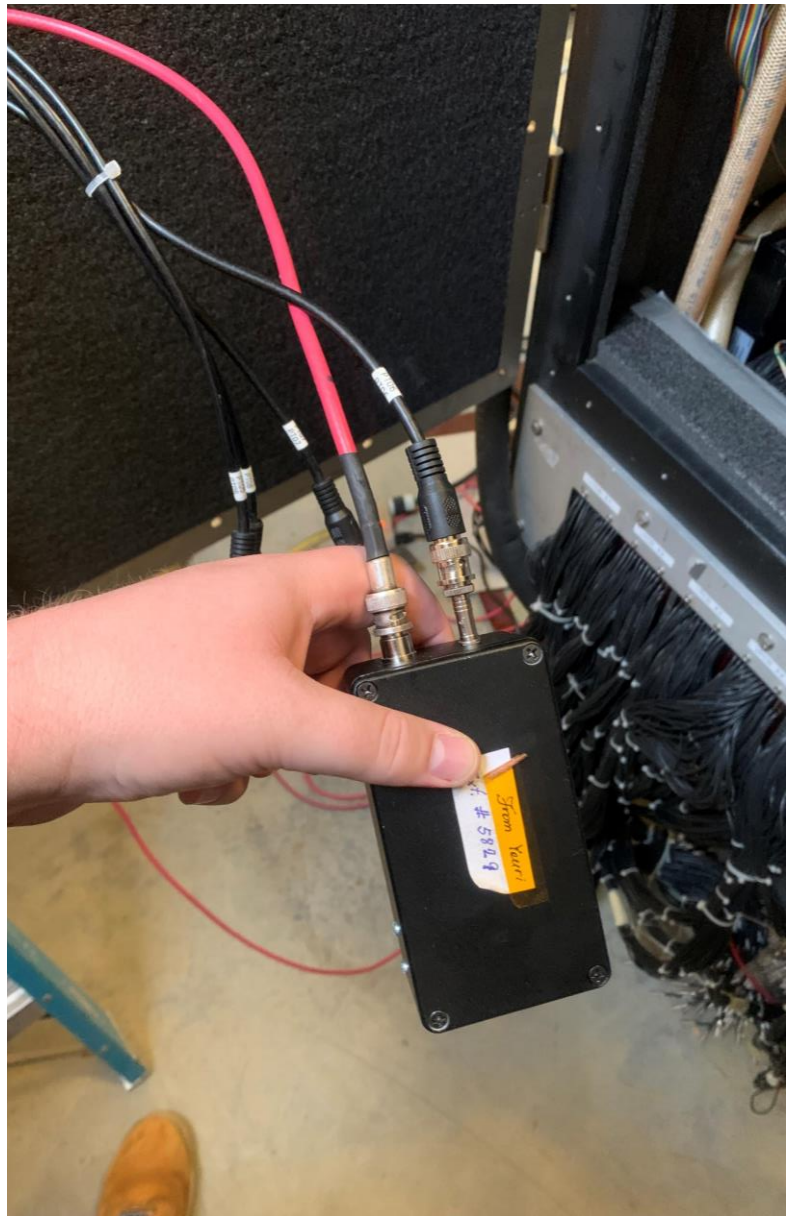
- If the response in the LMS is stable and the calibration constants ($\alpha_i$) are well known for each HyCal module via periodic calibration, then we can get the energy deposited with very good resolution.
- Equations are originally from the master's theses of Jarreas C. Underwood, and Larray J. Benton from NC A&T
- For more detailed information please see the LMS Overview document that I will send out soon prior to putting it up on the Wiki.

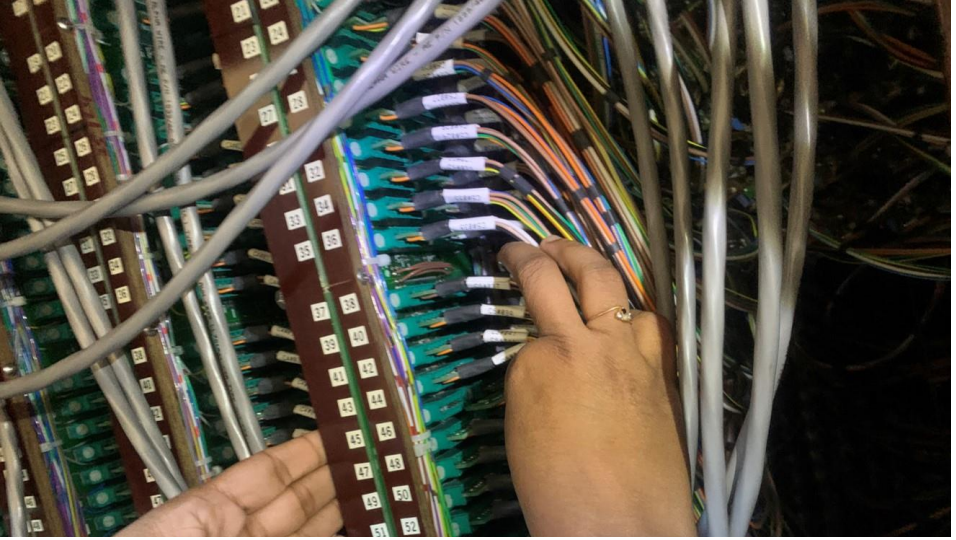
# TESTING HYCAL

# HYCAL HIGH VOLTAGE PMT TESTS

- Each module must be individually tested using both cosmic information and our Light Monitoring System (LMS) using the black box (see right image)
- I will primarily discuss the Pb-Glass testing. For the crystal tests, please see Aruni's talk.
- Hall B techs (and Ashot) removed the HyCal fan system, so we had room to work.
- HyCal Consists of:
  - 1152 $PbWO_4$ crystals in the center region (2.05x2.05 $cm^2$ face, 18 cm long)
  - 576 Pb-glass blocks (3.82x3.82 $cm^2$ face, 45 cm long)







03/03/2025

# TESTING HYCAL PB-GLASS WITH THE LMS

- No LMS responses in the Pb-Glass modules so far.
- We have cycled through the various filter settings with no luck.
- Modules have been tested using cosmic signal information.
- We intend to fix this soon.



HyCal Layout (Module ID Notation) [Front View - Pb Glass ONLY]

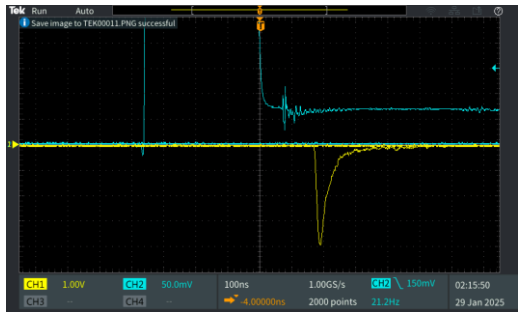
| | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
| 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 |
| 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 |
| 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 | 101 | 102 | 103 | 104 | 105 | 106 | 107 | 108 | 109 | 110 | 111 | 112 | 113 | 114 | 115 | 116 | 117 | 118 | 119 | 120 |
| 121 | 122 | 123 | 124 | 125 | 126 | 127 | 128 | 129 | 130 | 131 | 132 | 133 | 134 | 135 | 136 | 137 | 138 | 139 | 140 | 141 | 142 | 143 | 144 | 145 | 146 | 147 | 148 | 149 | 150 |
| 151 | 152 | 153 | 154 | 155 | 156 | 157 | 158 | 159 | 160 | 161 | 162 | 163 | 164 | 165 | 166 | 167 | 168 | 169 | 170 | 171 | 172 | 173 | 174 | 175 | 176 | 177 | 178 | 179 | 180 |
| 181 | 182 | 183 | 184 | 185 | 186 | | | | | | | | | | | | | | | | | | | 205 | 206 | 207 | 208 | 209 | 210 |
| 211 | 212 | 213 | 214 | 215 | 216 | | | | | | | | | | | | | | | | | | | 235 | 236 | 237 | 238 | 239 | 240 |
| 241 | 242 | 243 | 244 | 245 | 246 | | | | | | | | | | | | | | | | | | | 265 | 266 | 267 | 268 | 269 | 270 |
| 271 | 272 | 273 | 274 | 275 | 276 | | | | | | | | | | | | | | | | | | | 295 | 296 | 297 | 298 | 299 | 300 |
| 301 | 302 | 303 | 304 | 305 | 306 | | | | | | | | | | | | | | | | | | | 325 | 326 | 327 | 328 | 329 | 330 |
| 331 | 332 | 333 | 334 | 335 | 336 | | | | | | | | | | | | | | | | | | | 355 | 356 | 357 | 358 | 359 | 360 |
| 361 | 362 | 363 | 364 | 365 | 366 | | | | | | | | | | | | | | | | | | | 385 | 386 | 387 | 388 | 389 | 390 |
| 391 | 392 | 393 | 394 | 395 | 396 | | | | | | | | | | | | | | | | | | | 415 | 416 | 417 | 418 | 419 | 420 |
| 421 | 422 | 423 | 424 | 425 | 426 | | | | | | | | | | | | | | | | | | | 445 | 446 | 447 | 448 | 449 | 450 |
| 451 | 452 | 453 | 454 | 455 | 456 | | | | | | | | | | | | | | | | | | | 475 | 476 | 477 | 478 | 479 | 480 |
| 481 | 482 | 483 | 484 | 485 | 486 | | | | | | | | | | | | | | | | | | | 505 | 506 | 507 | 508 | 509 | 510 |
| 511 | 512 | 513 | 514 | 515 | 516 | | | | | | | | | | | | | | | | | | | 535 | 536 | 537 | 538 | 539 | 540 |
| 541 | 542 | 543 | 544 | 545 | 546 | | | | | | | | | | | | | | | | | | | 565 | 566 | 567 | 568 | 569 | 570 |
| 571 | 572 | 573 | 574 | 575 | 576 | | | | | | | | | | | | | | | | | | | 595 | 596 | 597 | 598 | 599 | 600 |
| 601 | 602 | 603 | 604 | 605 | 606 | | | | | | | | | | | | | | | | | | | 625 | 626 | 627 | 628 | 629 | 630 |
| 631 | 632 | 633 | 634 | 635 | 636 | | | | | | | | | | | | | | | | | | | 655 | 656 | 657 | 658 | 659 | 660 |
| 661 | 662 | 663 | 664 | 665 | 666 | | | | | | | | | | | | | | | | | | | 685 | 686 | 687 | 688 | 689 | 690 |
| 691 | 692 | 693 | 694 | 695 | 696 | | | | | | | | | | | | | | | | | | | 715 | 716 | 717 | 718 | 719 | 720 |
| 721 | 722 | 723 | 724 | 725 | 726 | 727 | 728 | 729 | 730 | 731 | 732 | 733 | 734 | 735 | 736 | 737 | 738 | 739 | 740 | 741 | 742 | 743 | 744 | 745 | 746 | 747 | 748 | 749 | 750 |
| 751 | 752 | 753 | 754 | 755 | 756 | 757 | 758 | 759 | 760 | 761 | 762 | 763 | 764 | 765 | 766 | 767 | 768 | 769 | 770 | 771 | 772 | 773 | 774 | 775 | 776 | 777 | 778 | 779 | 780 |
| 781 | 782 | 783 | 784 | 785 | 786 | 787 | 788 | 789 | 790 | 791 | 792 | 793 | 794 | 795 | 796 | 797 | 798 | 799 | 800 | 801 | 802 | 803 | 804 | 805 | 806 | 807 | 808 | 809 | 810 |
| 811 | 812 | 813 | 814 | 815 | 816 | 817 | 818 | 819 | 820 | 821 | 822 | 823 | 824 | 825 | 826 | 827 | 828 | 829 | 830 | 831 | 832 | 833 | 834 | 835 | 836 | 837 | 838 | 839 | 840 |
| 841 | 842 | 843 | 844 | 845 | 846 | 847 | 848 | 849 | 850 | 851 | 852 | 853 | 854 | 855 | 856 | 857 | 858 | 859 | 860 | 861 | 862 | 863 | 864 | 865 | 866 | 867 | 868 | 869 | 870 |
| 871 | 872 | 873 | 874 | 875 | 876 | 877 | 878 | 879 | 880 | 881 | 882 | 883 | 884 | 885 | 886 | 887 | 888 | 889 | 890 | 891 | 892 | 893 | 894 | 895 | 896 | 897 | 898 | 899 | 900 |

| Legend |
|---|
| Bad |
| Issue |
| Good |

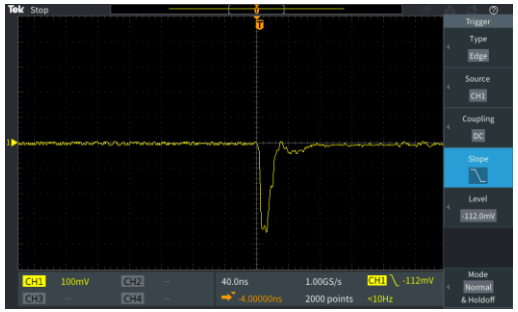
# TESTING HYCAL PB-GLASS WITH COSMIC DATA

- With Bo's help we were able to do a second pass of the marked modules from the last collaboration meeting.
- 7 previously marked modules ended up being moved to "Good"
- 17 modules marked "Bad" for lack of response
- 3 modules marked "Issue" for oddly low response

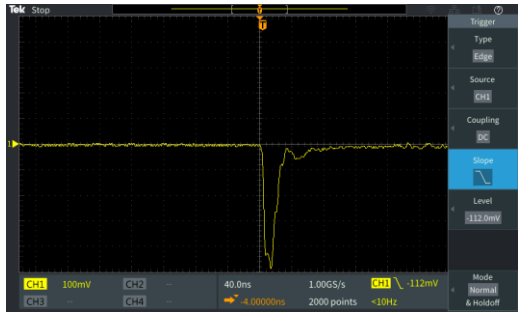
# DAQ SINGLE CHANNEL TEST



Channel W445 LMS Response



Channel W445 Cosmic Response Sample #1



Channel W445 Cosmic Response Sample #2

- With the guidance of Chao Peng, we took a 20-minute LMS run, and a day long cosmic run on 01/28-01/29.
- Used module W445 which is on VPC board 09 and in channel 81.
- The signals were also captured on the oscilloscope to ensure check the signals prior to the run.
- Chao was able to confirm the results and well-characterizable behavior.

# REMAINING WORK/OTHER TALKS

- Finish work on Veto Scintillator (see Buddhiman's talk)
- Finish work on $PbWO_4$ Crystal Section Repairs (14 total modules) (see Aruni's Talk)
- Get Pb-Glass responses to LMS signals.
- Do chiller tests with old chiller
  - Electronics have been set up in ESB for this test to occur when ready
- Test 16 channels at once to be able to more thoroughly test DAQ
- Overall, we have been making steady progress with some hiccups throughout, but we will continue prepping everything as we are able

AS ALWAYS, FIND DAILY UPDATES ON THE PRAD LOGBOOK .

I UPDATE THE PRAD MODULE TEST MAPS EACH DAY ON THE PRAD WIKI.

# ACKNOWLEDGEMENTS


- US Dept. Of Energy under contract #DE-FG02-07ER41528
- My Advisor: Dr. Dipangkar Dutta, Mississippi State
- Dr.  Aruni Naadeshani, Mississippi State [conducted all testing]
- Buddhiman Tamang, Mississippi State [conducted all testing]
- Dr.  Ashot Gasparian - North Carolina A&T State University [helped with LMS and general testing]
- Dr. Eugene Pasyuk, JLab [Oversaw our work]
- Dr. Chao Peng,  ANL [Provided documentation, and processed the data for the DAQ single channel test]
- Dr. Youri Sharabian, JLab [Designed the testing box]
- Dr. Jingyi Zhou, Duke University
- Bo Yu, Duke University
- Current and Future PRad Collaborators
- Armen Stepanyan, Mark Taylor, and all the Fast Electronics Group, JLab

# QUESTIONS?

# HYCAL TESTS AND STATES

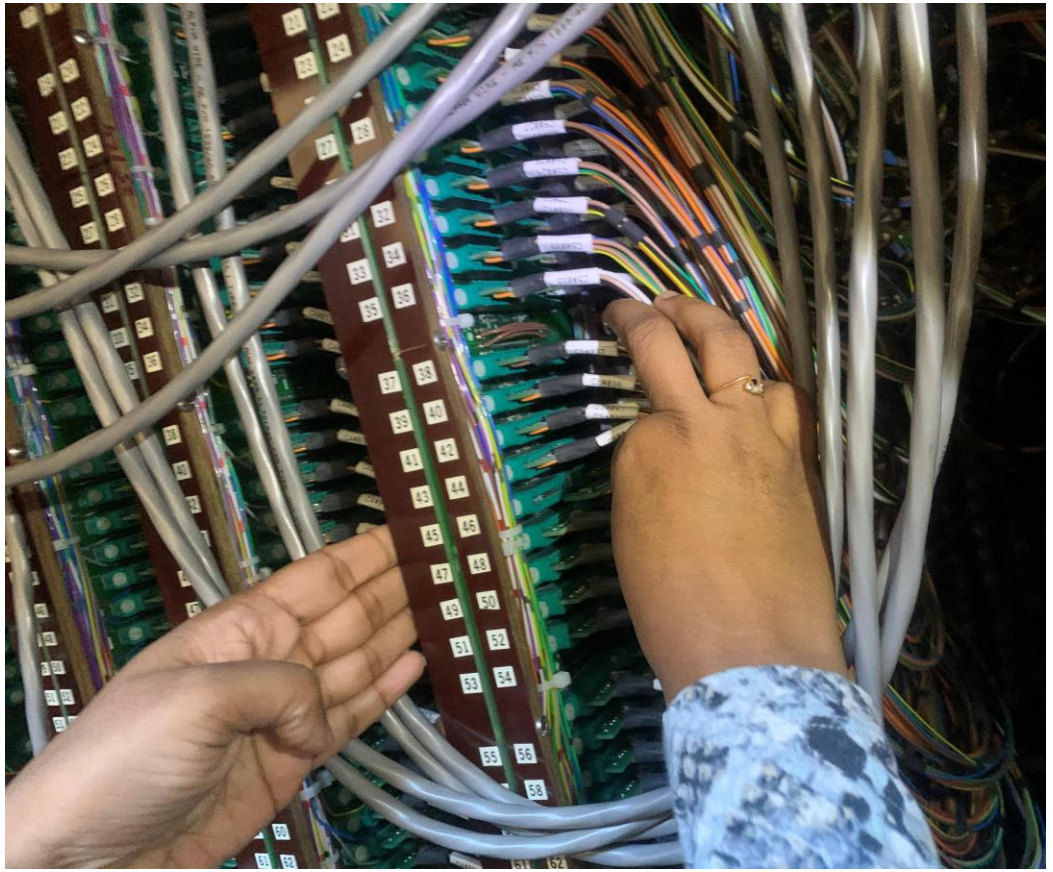
BY: ARUNI NADEESHANI

MISSISSIPPI STATE UNIVERSITY™

DEPARTMENT OF PHYSICS AND ASTRONOMY

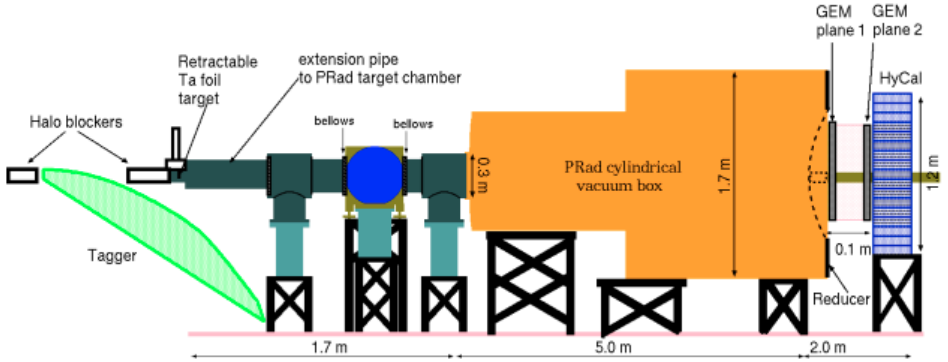
# OUTLINE

- Introduction to HyCal Calorimeter
  - Experimental setup
  - Design of HyCal
- HyCal tests
  - HyCal cabling.-Erik
  - Hycal optical fiber and connection repair (summary)
  - HyCal HV test with cosmics and LMS
- Summary  and future work



# INTRODUCTION : EXPERIMENTAL SETUP

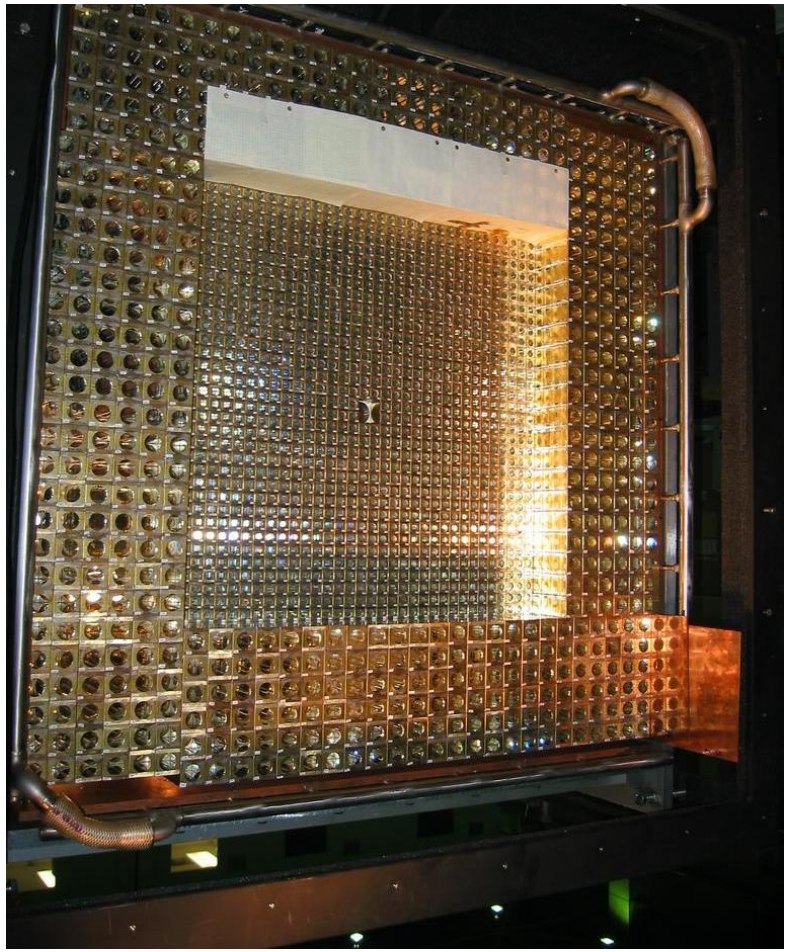
- GEMs- A pair of GEM detector planes, separated by about 40 cm.( From UVA group)
- Target: Windowless hydrogen gas flow target (reduced backgrounds)
- High resolution HyBrid $PbWO_4$ crystal and Pb-Glass calorimeter (the $PbWO_4$ crystals) with fADC based readout. (HyCal repairs: MSU , NC A&T State University and JLab)
- Vaccum chamber, one thin window, large area GEM chambers (better resolution)



# PRIMEX HYCAL CALORIMETER

03/03/2025

- Combination of $PbWO_4$ and Pb-glass detectors (118 *118 $cm^2$)
- 34 *34 matrix of 2.05 x 2.05 x 18 $cm^3$ $PbWO_4$
- 576 Pb-glass detectors 3.82 x 3.82 $cm^2$ x 45 cm.
- Allows coverage of extreme forward angle (0.7° -7.5°) in a single setting and complete azimuthal angle coverage.
- HyCal reused for PRAD experiment.
- The first experiment to use a magnetic spectrometer free method to measure



# HYCAL TESTS

- HyCal optical fiber and connection repairs
- HyCal cabling- Erik W.
- HyCal HV  test with cosmics
- HyCal HV test with LMS



# HYCAL OPTICAL FIBER AND CONNECTION REPAIR

- The optical fibers, plexiglass connectors, and light blocking coverings necessary for the Light Monitoring System (LMS) to send control signals to the HyCal modules required repairs to have all ~2000 modules in proper working order.
- These fibers can be used to test the various modules as well as be used as a control signal during experiment and calibration.
- HyCal is in the ESB at JLab where an ePAS approval needed to be filed for the work as it involved clear UV-activated glue for securing the optical components to each module.

HyCal Layout (Row,Column) [Front View - PbWO4 ONLY]

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.02 | 1.03 | 1.04 | 1.05 | 1.06 | 1.07 | 1.08 | 1.09 | 1.10 | 1.11 | 1.12 | 1.13 | 1.14 | 1.15 | 1.16 | 1.17 | 1.18 | 1.19 | 1.20 | 1.21 | 1.22 | 1.23 | 1.24 | 1.25 | 1.26 | 1.27 | 1.28 | 1.29 | 1.30 | 1.31 | 1.32 | 1.33 | 1.34 |
| 2.02 | 2.03 | 2.04 | 2.05 | 2.06 | 2.07 | 2.08 | 2.09 | 2.10 | 2.11 | 2.12 | 2.13 | 2.14 | 2.15 | 2.16 | 2.17 | 2.18 | 2.19 | 2.20 | 2.21 | 2.22 | 2.23 | 2.24 | 2.25 | 2.26 | 2.27 | 2.28 | 2.29 | 2.30 | 2.31 | 2.32 | 2.33 | 2.34 |
| 3.02 | 3.03 | 3.04 | 3.05 | 3.06 | 3.07 | 3.08 | 3.09 | 3.10 | 3.11 | 3.12 | 3.13 | 3.14 | 3.15 | 3.16 | 3.17 | 3.18 | 3.19 | 3.20 | 3.21 | 3.22 | 3.23 | 3.24 | 3.25 | 3.26 | 3.27 | 3.28 | 3.29 | 3.30 | 3.31 | 3.32 | 3.33 | 3.34 |
| 4.02 | 4.03 | 4.04 | 4.05 | 4.06 | 4.07 | 4.08 | 4.09 | 4.10 | 4.11 | 4.12 | 4.13 | 4.14 | 4.15 | 4.16 | 4.17 | 4.18 | 4.19 | 4.20 | 4.21 | 4.22 | 4.23 | 4.24 | 4.25 | 4.26 | 4.27 | 4.28 | 4.29 | 4.30 | 4.31 | 4.32 | 4.33 | 4.34 |
| 5.02 | 5.03 | 5.04 | 5.05 | 5.06 | 5.07 | 5.08 | 5.09 | 5.10 | 5.11 | 5.12 | 5.13 | 5.14 | 5.15 | 5.16 | 5.17 | 5.18 | 5.19 | 5.20 | 5.21 | 5.22 | 5.23 | 5.24 | 5.25 | 5.26 | 5.27 | 5.28 | 5.29 | 5.30 | 5.31 | 5.32 | 5.33 | 5.34 |
| 6.02 | 6.03 | 6.04 | 6.05 | 6.06 | 6.07 | 6.08 | 6.09 | 6.10 | 6.11 | 6.12 | 6.13 | 6.14 | 6.15 | 6.16 | 6.17 | 6.18 | 6.19 | 6.20 | 6.21 | 6.22 | 6.23 | 6.24 | 6.25 | 6.26 | 6.27 | 6.28 | 6.29 | 6.30 | 6.31 | 6.32 | 6.33 | 6.34 |
| 7.02 | 7.03 | 7.04 | 7.05 | 7.06 | 7.07 | 7.08 | 7.09 | 7.10 | 7.11 | 7.12 | 7.13 | 7.14 | 7.15 | 7.16 | 7.17 | 7.18 | 7.19 | 7.20 | 7.21 | 7.22 | 7.23 | 7.24 | 7.25 | 7.26 | 7.27 | 7.28 | 7.29 | 7.30 | 7.31 | 7.32 | 7.33 | 7.34 |
| 8.02 | 8.03 | 8.04 | 8.05 | 8.06 | 8.07 | 8.08 | 8.09 | 8.10 | 8.11 | 8.12 | 8.13 | 8.14 | 8.15 | 8.16 | 8.17 | 8.18 | 8.19 | 8.20 | 8.21 | 8.22 | 8.23 | 8.24 | 8.25 | 8.26 | 8.27 | 8.28 | 8.29 | 8.30 | 8.31 | 8.32 | 8.33 | 8.34 |
| 9.02 | 9.03 | 9.04 | 9.05 | 9.06 | 9.07 | 9.08 | 9.09 | 9.10 | 9.11 | 9.12 | 9.13 | 9.14 | 9.15 | 9.16 | 9.17 | 9.18 | 9.19 | 9.20 | 9.21 | 9.22 | 9.23 | 9.24 | 9.25 | 9.26 | 9.27 | 9.28 | 9.29 | 9.30 | 9.31 | 9.32 | 9.33 | 9.34 |
| 10.02 | 10.03 | 10.04 | 10.05 | 10.06 | 10.07 | 10.08 | 10.09 | 10.10 | 10.11 | 10.12 | 10.13 | 10.14 | 10.15 | 10.16 | 10.17 | 10.18 | 10.19 | 10.20 | 10.21 | 10.22 | 10.23 | 10.24 | 10.25 | 10.26 | 10.27 | 10.28 | 10.29 | 10.30 | 10.31 | 10.32 | 10.33 | 10.34 |
| 11.02 | 11.03 | 11.04 | 11.05 | 11.06 | 11.07 | 11.08 | 11.09 | 11.10 | 11.11 | 11.12 | 11.13 | 11.14 | 11.15 | 11.16 | 11.17 | 11.18 | 11.19 | 11.20 | 11.21 | 11.22 | 11.23 | 11.24 | 11.25 | 11.26 | 11.27 | 11.28 | 11.29 | 11.30 | 11.31 | 11.32 | 11.33 | 11.34 |
| 12.02 | 12.03 | 12.04 | 12.05 | 12.06 | 12.07 | 12.08 | 12.09 | 12.10 | 12.11 | 12.12 | 12.13 | 12.14 | 12.15 | 12.16 | 12.17 | 12.18 | 12.19 | 12.20 | 12.21 | 12.22 | 12.23 | 12.24 | 12.25 | 12.26 | 12.27 | 12.28 | 12.29 | 12.30 | 12.31 | 12.32 | 12.33 | 12.34 |
| 13.02 | 13.03 | 13.04 | 13.05 | 13.06 | 13.07 | 13.08 | 13.09 | 13.10 | 13.11 | 13.12 | 13.13 | 13.14 | 13.15 | 13.16 | 13.17 | 13.18 | 13.19 | 13.20 | 13.21 | 13.22 | 13.23 | 13.24 | 13.25 | 13.26 | 13.27 | 13.28 | 13.29 | 13.30 | 13.31 | 13.32 | 13.33 | 13.34 |
| 14.02 | 14.03 | 14.04 | 14.05 | 14.06 | 14.07 | 14.08 | 14.09 | 14.10 | 14.11 | 14.12 | 14.13 | 14.14 | 14.15 | 14.16 | 14.17 | 14.18 | 14.19 | 14.20 | 14.21 | 14.22 | 14.23 | 14.24 | 14.25 | 14.26 | 14.27 | 14.28 | 14.29 | 14.30 | 14.31 | 14.32 | 14.33 | 14.34 |
| 15.02 | 15.03 | 15.04 | 15.05 | 15.06 | 15.07 | 15.08 | 15.09 | 15.10 | 15.11 | 15.12 | 15.13 | 15.14 | 15.15 | 15.16 | 15.17 | 15.18 | 15.19 | 15.20 | 15.21 | 15.22 | 15.23 | 15.24 | 15.25 | 15.26 | 15.27 | 15.28 | 15.29 | 15.30 | 15.31 | 15.32 | 15.33 | 15.34 |
| 16.02 | 16.03 | 16.04 | 16.05 | 16.06 | 16.07 | 16.08 | 16.09 | 16.10 | 16.11 | 16.12 | 16.13 | 16.14 | 16.15 | 16.16 | 16.17 | 16.18 | 16.19 | 16.20 | 16.21 | 16.22 | 16.23 | 16.24 | 16.25 | 16.26 | 16.27 | 16.28 | 16.29 | 16.30 | 16.31 | 16.32 | 16.33 | 16.34 |
| 17.02 | 17.03 | 17.04 | 17.05 | 17.06 | 17.07 | 17.08 | 17.09 | 17.10 | 17.11 | 17.12 | 17.13 | 17.14 | 17.15 | 17.16 | | | 17.19 | 17.20 | 17.21 | 17.22 | 17.23 | 17.24 | 17.25 | 17.26 | 17.27 | 17.28 | 17.29 | 17.30 | 17.31 | 17.32 | 17.33 | 17.34 |
| 18.02 | 18.03 | 18.04 | 18.05 | 18.06 | 18.07 | 18.08 | 18.09 | 18.10 | 18.11 | 18.12 | 18.13 | 18.14 | 18.15 | 18.16 | | | 18.19 | 18.20 | 18.21 | 18.22 | 18.23 | 18.24 | 18.25 | 18.26 | 18.27 | 18.28 | 18.29 | 18.30 | 18.31 | 18.32 | 18.33 | 18.34 |
| 19.02 | 19.03 | 19.04 | 19.05 | 19.06 | 19.07 | 19.08 | 19.09 | 19.10 | 19.11 | 19.12 | 19.13 | 19.14 | 19.15 | 19.16 | 19.17 | 19.18 | 19.19 | 19.20 | 19.21 | 19.22 | 19.23 | 19.24 | 19.25 | 19.26 | 19.27 | 19.28 | 19.29 | 19.30 | 19.31 | 19.32 | 19.33 | 19.34 |
| 20.02 | 20.03 | 20.04 | 20.05 | 20.06 | 20.07 | 20.08 | 20.09 | 20.10 | 20.11 | 20.12 | 20.13 | 20.14 | 20.15 | 20.16 | 20.17 | 20.18 | 20.19 | 20.20 | 20.21 | 20.22 | 20.23 | 20.24 | 20.25 | 20.26 | 20.27 | 20.28 | 20.29 | 20.30 | 20.31 | 20.32 | 20.33 | 20.34 |
| 21.02 | 21.03 | 21.04 | 21.05 | 21.06 | 21.07 | 21.08 | 21.09 | 21.10 | 21.11 | 21.12 | 21.13 | 21.14 | 21.15 | 21.16 | 21.17 | 21.18 | 21.19 | 21.20 | 21.21 | 21.22 | 21.23 | 21.24 | 21.25 | 21.26 | 21.27 | 21.28 | 21.29 | 21.30 | 21.31 | 21.32 | 21.33 | 21.34 |
| 22.02 | 22.03 | 22.04 | 22.05 | 22.06 | 22.07 | 22.08 | 22.09 | 22.10 | 22.11 | 22.12 | 22.13 | 22.14 | 22.15 | 22.16 | 22.17 | 22.18 | 22.19 | 22.20 | 22.21 | 22.22 | 22.23 | 22.24 | 22.25 | 22.26 | 22.27 | 22.28 | 22.29 | 22.30 | 22.31 | 22.32 | 22.33 | 22.34 |
| 23.02 | 23.03 | 23.04 | 23.05 | 23.06 | 23.07 | 23.08 | 23.09 | 23.10 | 23.11 | 23.12 | 23.13 | 23.14 | 23.15 | 23.16 | 23.17 | 23.18 | 23.19 | 23.20 | 23.21 | 23.22 | 23.23 | 23.24 | 23.25 | 23.26 | 23.27 | 23.28 | 23.29 | 23.30 | 23.31 | 23.32 | 23.33 | 23.34 |
| 24.02 | 24.03 | 24.04 | 24.05 | 24.06 | 24.07 | 24.08 | 24.09 | 24.10 | 24.11 | 24.12 | 24.13 | 24.14 | 24.15 | 24.16 | 24.17 | 24.18 | 24.19 | 24.20 | 24.21 | 24.22 | 24.23 | 24.24 | 24.25 | 24.26 | 24.27 | 24.28 | 24.29 | 24.30 | 24.31 | 24.32 | 24.33 | 24.34 |
| 25.02 | 25.03 | 25.04 | 25.05 | 25.06 | 25.07 | 25.08 | 25.09 | 25.10 | 25.11 | 25.12 | 25.13 | 25.14 | 25.15 | 25.16 | 25.17 | 25.18 | 25.19 | 25.20 | 25.21 | 25.22 | 25.23 | 25.24 | 25.25 | 25.26 | 25.27 | 25.28 | 25.29 | 25.30 | 25.31 | 25.32 | 25.33 | 25.34 |
| 26.02 | 26.03 | 26.04 | 26.05 | 26.06 | 26.07 | 26.08 | 26.09 | 26.10 | 26.11 | 26.12 | 26.13 | 26.14 | 26.15 | 26.16 | 26.17 | 26.18 | 26.19 | 26.20 | 26.21 | 26.22 | 26.23 | 26.24 | 26.25 | 26.26 | 26.27 | 26.28 | 26.29 | 26.30 | 26.31 | 26.32 | 26.33 | 26.34 |
| 27.02 | 27.03 | 27.04 | 27.05 | 27.06 | 27.07 | 27.08 | 27.09 | 27.10 | 27.11 | 27.12 | 27.13 | 27.14 | 27.15 | 27.16 | 27.17 | 27.18 | 27.19 | 27.20 | 27.21 | 27.22 | 27.23 | 27.24 | 27.25 | 27.26 | 27.27 | 27.28 | 27.29 | 27.30 | 27.31 | 27.32 | 27.33 | 27.34 |
| 28.02 | 28.03 | 28.04 | 28.05 | 28.06 | 28.07 | 28.08 | 28.09 | 28.10 | 28.11 | 28.12 | 28.13 | 28.14 | 28.15 | 28.16 | 28.17 | 28.18 | 28.19 | 28.20 | 28.21 | 28.22 | 28.23 | 28.24 | 28.25 | 28.26 | 28.27 | 28.28 | 28.29 | 28.30 | 28.31 | 28.32 | 28.33 | 28.34 |
| 29.02 | 29.03 | 29.04 | 29.05 | 29.06 | 29.07 | 29.08 | 29.09 | 29.10 | 29.11 | 29.12 | 29.13 | 29.14 | 29.15 | 29.16 | 29.17 | 29.18 | 29.19 | 29.20 | 29.21 | 29.22 | 29.23 | 29.24 | 29.25 | 29.26 | 29.27 | 29.28 | 29.29 | 29.30 | 29.31 | 29.32 | 29.33 | 29.34 |
| 30.02 | 30.03 | 30.04 | 30.05 | 30.06 | 30.07 | 30.08 | 30.09 | 30.10 | 30.11 | 30.12 | 30.13 | 30.14 | 30.15 | 30.16 | 30.17 | 30.18 | 30.19 | 30.20 | 30.21 | 30.22 | 30.23 | 30.24 | 30.25 | 30.26 | 30.27 | 30.28 | 30.29 | 30.30 | 30.31 | 30.32 | 30.33 | 30.34 |
| 31.02 | 31.03 | 31.04 | 31.05 | 31.06 | 31.07 | 31.08 | 31.09 | 31.10 | 31.11 | 31.12 | 31.13 | 31.14 | 31.15 | 31.16 | 31.17 | 31.18 | 31.19 | 31.20 | 31.21 | 31.22 | 31.23 | 31.24 | 31.25 | 31.26 | 31.27 | 31.28 | 31.29 | 31.30 | 31.31 | 31.32 | 31.33 | 31.34 |
| 32.02 | 32.03 | 32.04 | 32.05 | 32.06 | 32.07 | 32.08 | 32.09 | 32.10 | 32.11 | 32.12 | 32.13 | 32.14 | 32.15 | 32.16 | 32.17 | 32.18 | 32.19 | 32.20 | 32.21 | 32.22 | 32.23 | 32.24 | 32.25 | 32.26 | 32.27 | 32.28 | 32.29 | 32.30 | 32.31 | 32.32 | 32.33 | 32.34 |
| 33.02 | 33.03 | 33.04 | 33.05 | 33.06 | 33.07 | 33.08 | 33.09 | 33.10 | 33.11 | 33.12 | 33.13 | 33.14 | 33.15 | 33.16 | 33.17 | 33.18 | 33.19 | 33.20 | 33.21 | 33.22 | 33.23 | 33.24 | 33.25 | 33.26 | 33.27 | 33.28 | 33.29 | 33.30 | 33.31 | 33.32 | 33.33 | 33.34 |
| 34.02 | 34.03 | 34.04 | 34.05 | 34.06 | 34.07 | 34.08 | 34.09 | 34.10 | 34.11 | 34.12 | 34.13 | 34.14 | 34.15 | 34.16 | 34.17 | 34.18 | 34.19 | 34.20 | 34.21 | 34.22 | 34.23 | 34.24 | 34.25 | 34.26 | 34.27 | 34.28 | 34.29 | 34.30 | 34.31 | 34.32 | 34.33 | 34.34 |

| PbWO4 - NOTES |
|---|
| 6.11 - Fiber is disconnected |
| 32.04 - Fiber is disconnected |
| 21.10 - Fixed Black Tape |
| 17.10 - Fiber is disconnected |
| 13.18 - - Fiber is disconnected |
| 14.18 - Fiber is disconnected |
| 14.19 - Fiber is disconnected |
| 16.20 - Fiber is disconnected |
| 17.20 - Fiber is disconnected |
| 18.20 - Fiber is disconnected |
| 19.20 - Fiber is disconnected |
| 16.26 - Fiber is loose |
| 6.27 - Fiber is disconnected |
| 9.29 - Fiber is disconnected |
| 5.30 - Fiber is loose |
| 6.31 - Fiber is loose |
| 28.33 - Fiber is loose |
| 23.31 - Black tape needs to be fixed |

| Temperature Sensors | Simulator Notation | Module ID |
|---|---|---|
| 11.01 | W341 | 1341 |
| 24.09 | W791 | 1791 |
| 11.10 | W350 | 1350 |
| 18.13 | W591 | 1591 |
| 17.20 | W566 | 1566 |
| 25.24 | W840 | 1840 |
| 24.34 | W816 | 1816 |
| 11.25 | W365 | 1365 |

| Key |
|---|
| Temperature Sensor |
| Issue |
| Empty |
| Under Tungsten Absorber |
| Issue/Temperature Sensor |
| Repaired/Found to be good |
| Repaired/Under Tungsten Absorber |

# HyCal optical fiber repair mapping spreadsheet for $PbWO_4$

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.01 | 1.02 | 1.03 | 1.04 | 1.05 | 1.06 | 1.07 | 1.08 | 1.09 | 1.10 | 1.11 | 1.12 | 1.13 | 1.14 | 1.15 | 1.16 | 1.17 | 1.18 | 1.19 | 1.20 | 1.21 | 1.22 | 1.23 | 1.24 | 1.25 | 1.26 | 1.27 | 1.28 | 1.29 | 1.30 |
| 2.01 | 2.02 | 2.03 | 2.04 | 2.05 | 2.06 | 2.07 | 2.08 | 2.09 | 2.10 | 2.11 | 2.12 | 2.13 | 2.14 | 2.15 | 2.16 | 2.17 | 2.18 | 2.19 | 2.20 | 2.21 | 2.22 | 2.23 | 2.24 | 2.25 | 2.26 | 2.27 | 2.28 | 2.29 | 2.30 |
| 3.01 | 3.02 | 3.03 | 3.04 | 3.05 | 3.06 | 3.07 | 3.08 | 3.09 | 3.10 | 3.11 | 3.12 | 3.13 | 3.14 | 3.15 | 3.16 | 3.17 | 3.18 | 3.19 | 3.20 | 3.21 | 3.22 | 3.23 | 3.24 | 3.25 | 3.26 | 3.27 | 3.28 | 3.29 | 3.30 |
| 4.01 | 4.02 | 4.03 | 4.04 | 4.05 | 4.06 | 4.07 | 4.08 | 4.09 | 4.10 | 4.11 | 4.12 | 4.13 | 4.14 | 4.15 | 4.16 | 4.17 | 4.18 | 4.19 | 4.20 | 4.21 | 4.22 | 4.23 | 4.24 | 4.25 | 4.26 | 4.27 | 4.28 | 4.29 | 4.30 |
| 5.01 | 5.02 | 5.03 | 5.04 | 5.05 | 5.06 | 5.07 | 5.08 | 5.09 | 5.10 | 5.11 | 5.12 | 5.13 | 5.14 | 5.15 | 5.16 | 5.17 | 5.18 | 5.19 | 5.20 | 5.21 | 5.22 | 5.23 | 5.24 | 5.25 | 5.26 | 5.27 | 5.28 | 5.29 | 5.30 |
| 6.01 | 6.02 | 6.03 | 6.04 | 6.05 | 6.06 | 6.07 | 6.08 | 6.09 | 6.10 | 6.11 | 6.12 | 6.13 | 6.14 | 6.15 | 6.16 | 6.17 | 6.18 | 6.19 | 6.20 | 6.21 | 6.22 | 6.23 | 6.24 | 6.25 | 6.26 | 6.27 | 6.28 | 6.29 | 6.30 |
| 7.01 | 7.02 | 7.03 | 7.04 | 7.05 | 7.06 | | | | | | | | | | | | | | | | | | | 7.25 | 7.26 | 7.27 | 7.28 | 7.29 | 7.30 |
| 8.01 | 8.02 | 8.03 | 8.04 | 8.05 | 8.06 | | | | | | | | | | | | | | | | | | | 8.25 | 8.26 | 8.27 | 8.28 | 8.29 | 8.30 |
| 9.01 | 9.02 | 9.03 | 9.04 | 9.05 | 9.06 | | | | | | | | | | | | | | | | | | | 9.25 | 9.26 | 9.27 | 9.28 | 9.29 | 9.30 |
| 10.01 | 10.02 | 10.03 | 10.04 | 10.05 | 10.06 | | | | | | | | | | | | | | | | | | | 10.25 | 10.26 | 10.27 | 10.28 | 10.29 | 10.30 |
| 11.01 | 11.02 | 11.03 | 11.04 | 11.05 | 11.06 | | | | | | | | | | | | | | | | | | | 11.25 | 11.26 | 11.27 | 11.28 | 11.29 | 11.30 |
| 12.01 | 12.02 | 12.03 | 12.04 | 12.05 | 12.06 | | | | | | | | | | | | | | | | | | | 12.25 | 12.26 | 12.27 | 12.28 | 12.29 | 12.30 |
| 13.01 | 13.02 | 13.03 | 13.04 | 13.05 | 13.06 | | | | | | | | | | | | | | | | | | | 13.25 | 13.26 | 13.27 | 13.28 | 13.29 | 13.30 |
| 14.01 | 14.02 | 14.03 | 14.04 | 14.05 | 14.06 | | | | | | | | | | | | | | | | | | | 14.25 | 14.26 | 14.27 | 14.28 | 14.29 | 14.30 |
| 15.01 | 15.02 | 15.03 | 15.04 | 15.05 | 15.06 | | | | | | | | | | | | | | | | | | | 15.25 | 15.26 | 15.27 | 15.28 | 15.29 | 15.30 |
| 16.01 | 16.02 | 16.03 | 16.04 | 16.05 | 16.06 | | | | | | | | | | | | | | | | | | | 16.25 | 16.26 | 16.27 | 16.28 | 16.29 | 16.30 |
| 17.01 | 17.02 | 17.03 | 17.04 | 17.05 | 17.06 | | | | | | | | | | | | | | | | | | | 17.25 | 17.26 | 17.27 | 17.28 | 17.29 | 17.30 |
| 18.01 | 18.02 | 18.03 | 18.04 | 18.05 | 18.06 | | | | | | | | | | | | | | | | | | | 18.25 | 18.26 | 18.27 | 18.28 | 18.29 | 18.30 |
| 19.01 | 19.02 | 19.03 | 19.04 | 19.05 | 19.06 | | | | | | | | | | | | | | | | | | | 19.25 | 19.26 | 19.27 | 19.28 | 19.29 | 19.30 |
| 20.01 | 20.02 | 20.03 | 20.04 | 20.05 | 20.06 | | | | | | | | | | | | | | | | | | | 20.25 | 20.26 | 20.27 | 20.28 | 20.29 | 20.30 |
| 21.01 | 21.02 | 21.03 | 21.04 | 21.05 | 21.06 | | | | | | | | | | | | | | | | | | | 21.25 | 21.26 | 21.27 | 21.28 | 21.29 | 21.30 |
| 22.01 | 22.02 | 22.03 | 22.04 | 22.05 | 22.06 | | | | | | | | | | | | | | | | | | | 22.25 | 22.26 | 22.27 | 22.28 | 22.29 | 22.30 |
| 23.01 | 23.02 | 23.03 | 23.04 | 23.05 | 23.06 | | | | | | | | | | | | | | | | | | | 23.25 | 23.26 | 23.27 | 23.28 | 23.29 | 23.30 |
| 24.01 | 24.02 | 24.03 | 24.04 | 24.05 | 24.06 | | | | | | | | | | | | | | | | | | | 24.25 | 24.26 | 24.27 | 24.28 | 24.29 | 24.30 |
| 25.01 | 25.02 | 25.03 | 25.04 | 25.05 | 25.06 | 25.07 | 25.08 | 25.09 | 25.10 | 25.11 | 25.12 | 25.13 | 25.14 | 25.15 | 25.16 | 25.17 | 25.18 | 25.19 | 25.20 | 25.21 | 25.22 | 25.23 | 25.24 | 25.25 | 25.26 | 25.27 | 25.28 | 25.29 | 25.30 |
| 26.01 | 26.02 | 26.03 | 26.04 | 26.05 | 26.06 | 26.07 | 26.08 | 26.09 | 26.10 | 26.11 | 26.12 | 26.13 | 26.14 | 26.15 | 26.16 | 26.17 | 26.18 | 26.19 | 26.20 | 26.21 | 26.22 | 26.23 | 26.24 | 26.25 | 26.26 | 26.27 | 26.28 | 26.29 | 26.30 |
| 27.01 | 27.02 | 27.03 | 27.04 | 27.05 | 27.06 | 27.07 | 27.08 | 27.09 | 27.10 | 27.11 | 27.12 | 27.13 | 27.14 | 27.15 | 27.16 | 27.17 | 27.18 | 27.19 | 27.20 | 27.21 | 27.22 | 27.23 | 27.24 | 27.25 | 27.26 | 27.27 | 27.28 | 27.29 | 27.30 |
| 28.01 | 28.02 | 28.03 | 28.04 | 28.05 | 28.06 | 28.07 | 28.08 | 28.09 | 28.10 | 28.11 | 28.12 | 28.13 | 28.14 | 28.15 | 28.16 | 28.17 | 28.18 | 28.19 | 28.20 | 28.21 | 28.22 | 28.23 | 28.24 | 28.25 | 28.26 | 28.27 | 28.28 | 28.29 | 28.30 |
| 29.01 | 29.02 | 29.03 | 29.04 | 29.05 | 29.06 | 29.07 | 29.08 | 29.09 | 29.10 | 29.11 | 29.12 | 29.13 | 29.14 | 29.15 | 29.16 | 29.17 | 29.18 | 29.19 | 29.20 | 29.21 | 29.22 | 29.23 | 29.24 | 29.25 | 29.26 | 29.27 | 29.28 | 29.29 | 29.30 |
| 30.01 | 30.02 | 30.03 | 30.04 | 30.05 | 30.06 | 30.07 | 30.08 | 30.09 | 30.10 | 30.11 | 30.12 | 30.13 | 30.14 | 30.15 | 30.16 | 30.17 | 30.18 | 30.19 | 30.20 | 30.21 | 30.22 | 30.23 | 30.24 | 30.25 | 30.26 | 30.27 | 30.28 | 30.29 | 30.30 |

| PbGlass - NOTES |
|---|
| 2.01 - Fiber is loose |
| 20.03 - Fiber is loose |
| 20.04 - Fiber is loose |
| 30.01 - Fiber is loose |
| 27.04 - Fiber is disconnected |
| 3.25 - loose |
| 6.20 - loose connection |
| 1.09 - Fix tape |
| 2.09 - Fix tape |
| 5.21 - Fiber is loose |
| 25.08 - Fiber is loose |
| 27.08 - Fiber is loose |
| 3.29,20.01 - Fiber disconnected |
| 16.28 - Fiber is loose |
| 20.25 - Fiber is loose |
| 25.27 - Fiber is loose |
| 25.28 - Fiber is loose |
| 26.28 - Fiber is loose |
| 30.30 - Fiber is loose |
| 30.24 - Fiber is loose |
| 25.24 - Fiber is loose |
| 27.22 - Fiber is loose |
| 29.10 - Fiber is loose |
| 18.04 - Fiber disconnected |

| Temperature Sensors | Simulator Notation | Module ID |
|---|---|---|
| 6.13 | G30 | 30 |
| 1.30 | G163 | 163 |
| 18.06 | G259 | 259 |
| 13.25 | G318 | 318 |
| 25.18 | G414 | 414 |

| Key | |
|---|---|
| | Temperature Sensor |
| | Issue |
| | Empty |
| | |
| | Missing Plexiglass Covering (These have been fixed with Black Tape) |
| | Issue/Temperature Sensor |
| | Repaired |

# HyCal optical fiber repair mapping spreadsheet for Pb-glass

# HYCAL HV TEST WITH COSMICS

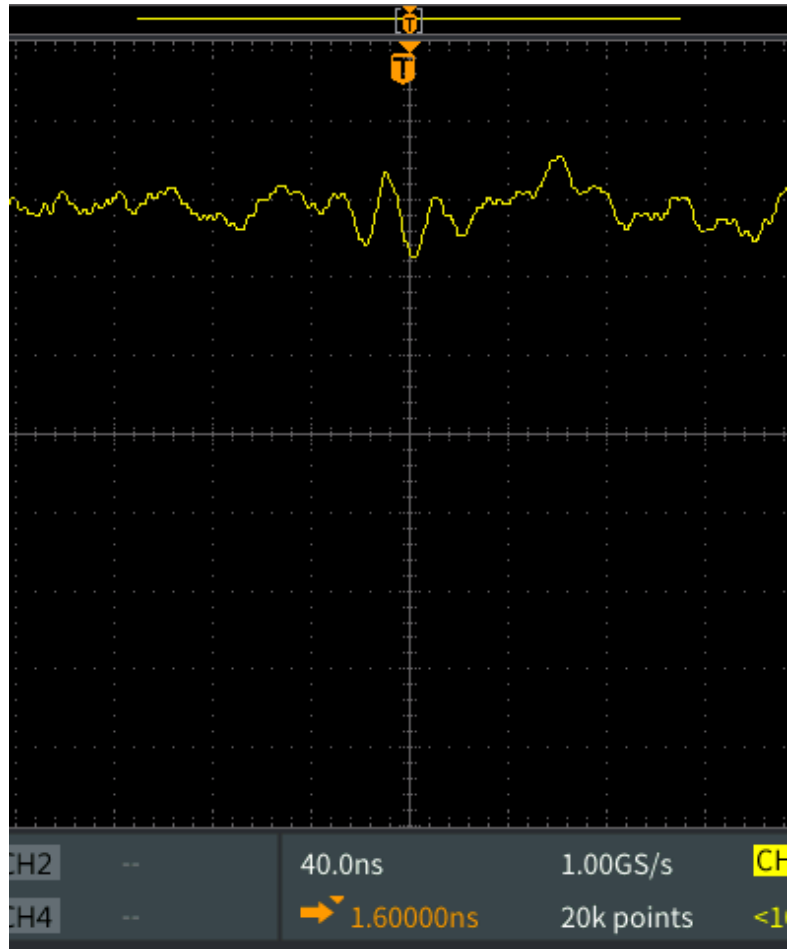
03/03/2025

- Checked all $PbWO_4$ modules and Pb-glass modules.
- Average responses: 5-20 mV, ~40ns width
- Most signals are good.
- This was done in 2 passes.
- Two have been labeled with $PbWO_4$ bad so far.

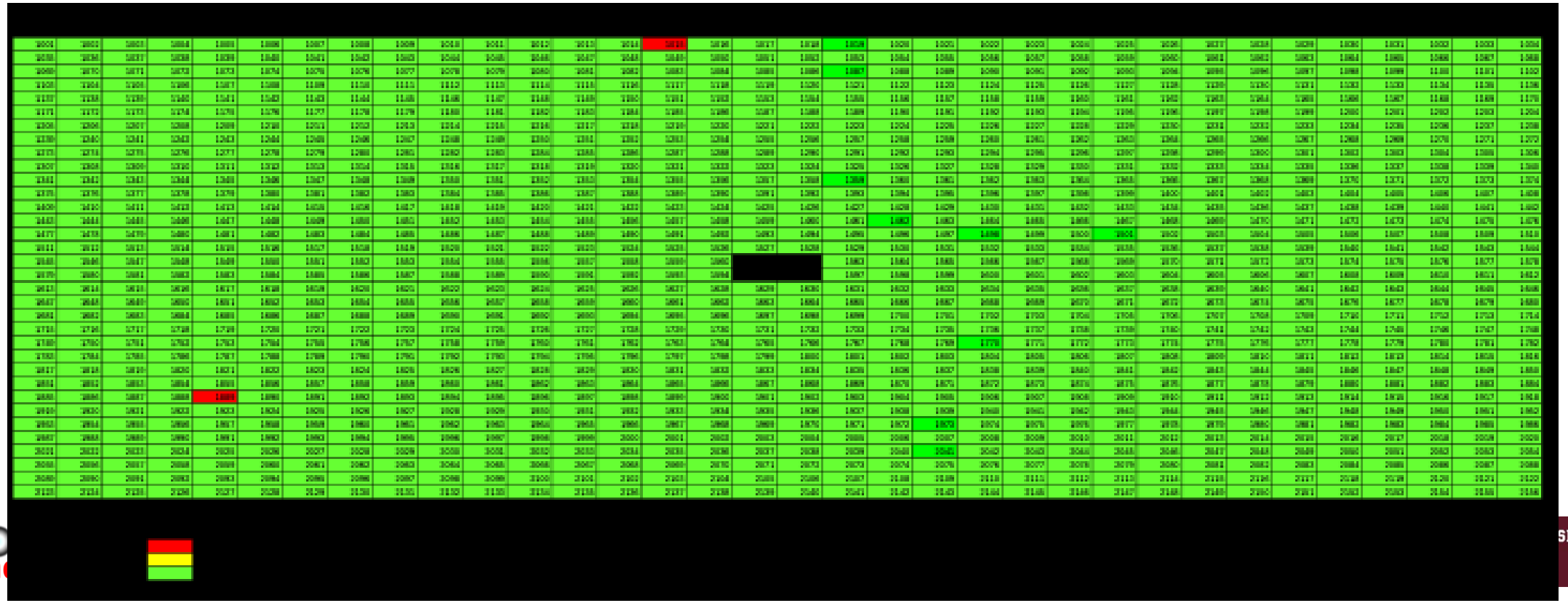
-One module was unresponsive completely.

-One module was continually giving 2 wide signals for every 1 good signal at any voltage.



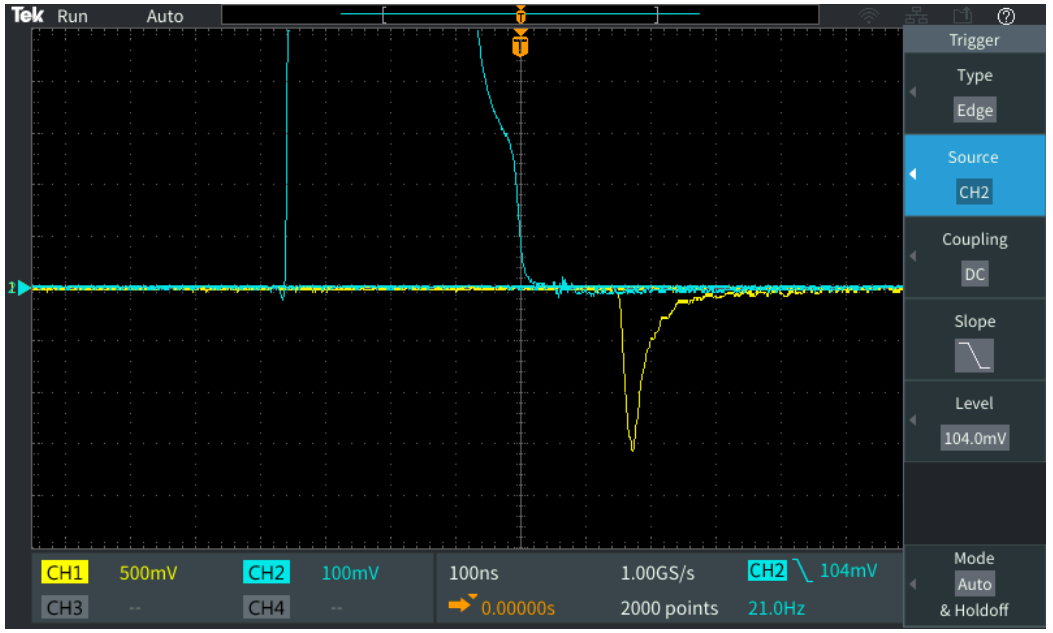


# SUMMARY OF THE $PbWO_4$ MODULE RESPONSE MAPPING FOR COSMIC RUNS

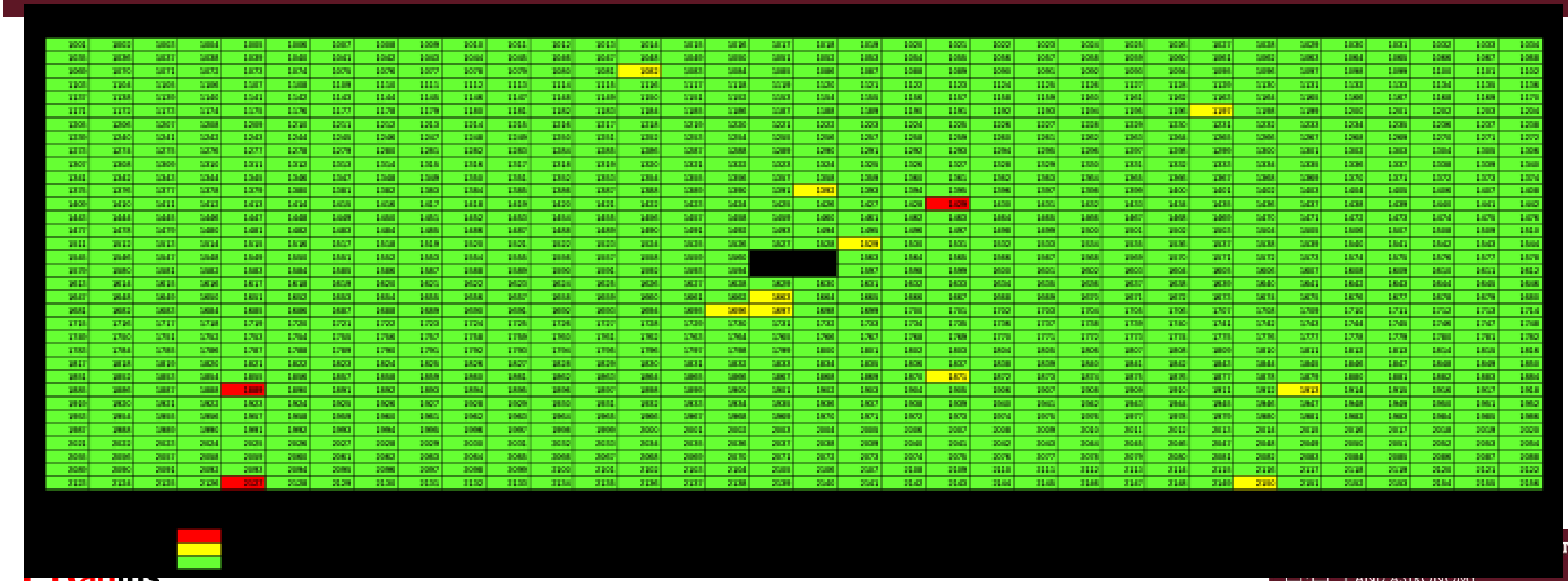


# HYCAL HV TEST WITH LMS

- Checked all $PbWO_4$ modules.
- Average responses : 300 mV-1200 mV,~100ns width
- Most signals are good.
- This was done by two passes.
- The blue signal: from the pulse generator used to capture any signal from the PMT that are in coincidence with the pulse.
- Yellow signal: the PMT's response to the LED pulse.
- 3 modules did not give any signal (mark as bad) and 10 channels identified as still having low voltage signal.



# HYCAL MODULE RESPONSE MAPPING SPREADSHEET FOR $PbWO_4$



# HYCAL REAPARS AFTER LMS AND COSMIC RUNS

- There are few conclusions from the LMS and cosmic runs. They are:

-If cosmic signal present and not LMS signal : fiber disconnections.

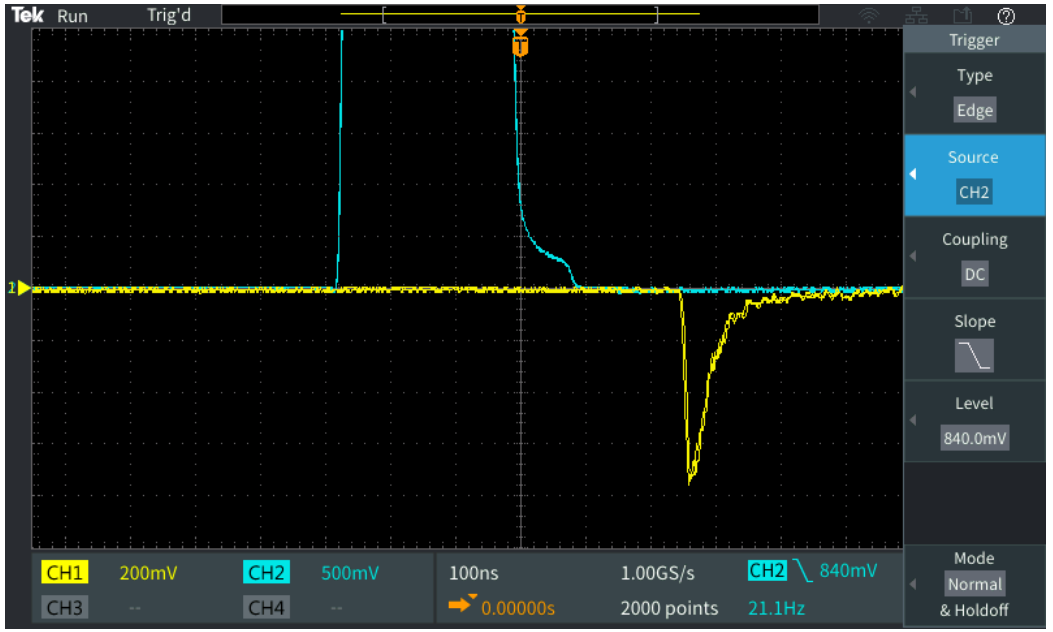
-If cosmic signal and LMS signal both are not working, either there is a PMT base disconnection or the PMT need to be replaced

-If cosmic works great with lower signal for LMS : Need to connect fiber properly to the surface.

- Repairs: W392 (c05#062) which is giving consistently good cosmic responses but would not respond to LMS signal.

-conclude that as fiber disconnection and start repair the fiber entrance.

-After attached the fiber using new optical donuts we were able to get LMS signal. For 1000 V supply output 300 mV,100ns and for 1150 V output is ~800 mV.



# SUMMARY AND FUTURE WORK

- HyCal HV Testing:
  - All $PbWO_4$ modules checked with cosmics and just two module identified as bad modules (later corrected to 1).
  - Pb-Glass module checked with cosmics; identified 17 bad modules and 3 modules with some issues..
  - All $PbWO_4$ modules checked with cosmics; identified 3 bad modules and 10 modules need to repair fiber entrance due to low response .
- HyCal optical fiber and connection repairs:
  - All fibers identified from mechanical test were repaired. After HV test with LMS, we have more fibers which need to be repaired. Now we are working on these repairs.
- Finish Veto scintillator tests within this week .

PRadius

MISSISSIPPI STATE UNIVERSITY
DEPARTMENT OF PHYSICS AND ASTRONOMY

# SPECIAL THANKS TO …

- D. Dutta, Buddhiman Tamang, Erik Wrightson (Mississippi State University group)
- C. Cuevas, Mark Taylor, Armen Stepanian, Jim (Jefferson Lab electronics group)
- Morgan Cook and hall B staff
- Ashot Gasparian, Eugene Pasyuk, Youri Sharabian and Alexander Somov …

03/03/2025

# QUESTIONS?

ARUNI NADEESHANI.
PRAD COLLABORATION MEETING