Test Procedures Document

Introduction

This document describes the setup and test procedures for TOFp construction. The Document contains descriptions of various devices and instructions for their use. The Tests Procedures section is a detailed outline of the tests used to examine the Scintillator, the High Voltage System Cells, the Photomultiplier Tubes, and the FEE board. It also includes tests performed on the assembly of Slat, HV Sys Cell, and PMT. This document is followed by a Glossary of terms and Test Data Pages.

The format for the first six sections of this document is a numerical tree of descriptions and instructions for the various devices used. The Tests Procedures section has an alphanumeric format. The letters indicate instructions for set-up of a test. The numbers between 100-600 indicate specific tests corresponding to the Test Data Pages.

Laser and Splitter Box

1. **Laser Description**
    1.1 Front – Attached to the front of the laser, there is a tube that contains an optical lens that focuses the beam to a point. Emerging from the tube is a plastic optical fiber (POF) with an AMP Single Position Plug.
    1.2 Sides – No distinguishing features on the left side of the laser. On the right side, there is a push-pull shutter that allows the laser to fire without emitting light.
    1.3 Rear – There is a key on the upper right side of the laser. This key turns the laser on. Above the key, there is a small red light that indicates the power is ON. There is a control knob in the center towards the top of the laser. This knob sets the rate of firing; the range is about 1Hz to 20Hz. At the lower end of the laser, there are some connectors that are used when firing the laser externally.
2. **Plug Laser in.**
3. **Shutter should be closed.**
4. **Turn key clockwise 90° and wait 20 sec.**

5. **Turn rate knob to 10Hz (or the desired rate).**
   5.1 Small clicking noises should be heard coming from the laser.
   1.2 If they sound out at a regular time interval, the laser is firing correctly.
   1.3 If they sound random, with no apparent pattern, then there is a problem with the plasma cartridge or the power supply. Turn Laser OFF.
6. **Wait approximately one hour for laser to stabilize (intensity of light not rate of firing).**
7. **Open shutter to allow light into the Splitter Box.** Make sure the AMP Single Position Plugs from the laser and from the Splitter Box are connected to the Splice.
8. **Description of Splitter Box (SB)**
   8.1 The splitter box is about 1 _ ' x 2' x 4". There is a rectangular hole in the top on the left to allow for placement of large filters.
   8.2 Brass gas tubing Unions are glued to the front. These are used to connect POFs to the Dark Box and the scintillators inside.
   8.3 On the left, there is a POF with an AMP Single Position Plug used to connect to the laser's AMP plug through a splice. Inside the Splitter Box there is a lens which disperses the light such that each position on the SB has approximately the same amount of light output. Unfortunately, due to the age and frequent use of the SB, some positions have little to no light output.
9. **Connect Reference PMT (Ref) to SB.**
   9.1 Carefully screw connector to SB. (If screwed on too tight, the optical fibers will break at the tip.)
   9.2 Turn Ref High Voltage ON (keep voltage low, around 800V).
   9.3 Find SB position that maximizes light output (or average ADC, refer to Conducting Tests). Remember to turn HV Off when switching SB positions.
10. **Connect Scintillator to SB.**
    10.1 Carefully screw connector to SB.
    10.2 Turn Scintillator HV ON.
    10.3 Find position that gives approximately the same ADC output as cosmics. For instance, Slat1 has an ADC of about 460ch at 1600V. (Refer to Conducting Tests) Remember to turn HV Off when switching SB positions.

High Voltage ON
1. **Ref**
   1.1 Plug in Linear High Voltage Power Supply.
   1.2 Connect red High Voltage cable to High Voltage Power supply and Ref.
   1.3 Switch High Voltage ON.
   1.4 Turn up Power Supply so that ADC average is around 930ch (ADC level used to conduct tests).
2. **Description of HVSys Module**
   2.1 The power switch is located at the top of the module. There is a green LED to indicate that the module has power.

2.2 There is a long thin 20 pin Ribbon cable connector on the left below the power switch. This Ribbon cable is how the module interacts with the cells.

2.3 On the right of the Ribbon cable connector, there is a series of red LEDs and to the left of the LEDs the number of the branch associated with the LED. These LEDs indicate when HV for a given branch is ON.

2.4 On the lower end of the module is a smaller 9 pin ribbon cable connector which connects to a com port on the computer.

3. **Scintillator (HV Terminal Program)**

3.1 Plug in HVSys SM-255 with Reverse Converter (120VAC,60Hz,44W Input to 240VAC, 60HZ, 40W Output by Radio Shack).

3.2 Connect ribbon cables to HVSys SM-255.

3.3 Connect Bases to 20 pin Ribbon cable (order of Bases on cable is not important).

3.4 Connect smaller 9 pin ribbon cable to computer (make sure to use the com port that is initialized in START.bat).

3.5 Switch HVSys ON.

3.6 Run HV terminal program.

 3.6.1 In the Start menu of the computer, go to Programs.

 3.6.2 Then go to Accessories.

 3.6.3 In the Hyperterminal folder, click on hv.ht.

3.7 Set default base cell. Ex. d<branch>,<cell> = d0,1 if setting branch0, cell1 as default.

3.8 Readout default cell to determine if connection is correct.

 3.8.1 If m gives a number between 85 and 95, connection is good.

 3.8.2 If m gives 1023, then connection is not correct.

  3.8.2.1 Check fuses on HVSys circuit board.

  3.8.2.2 Replace fuse if necessary.

  3.8.2.3 Go back to 2.5 and begin again. If already replaced once, then the ribbon cable should be checked to insure proper signals to cells.

3.9 Readout other cells to check their connections as well.
  Ex. c<branch>,<cell> = c0,2 if checking branch0, cell2.

3.10 Switch on high voltage for each branch. Ex. e<branch> = e0 for branch0. The red LED on the left of branch0 on the HVSys module will light up to indicate that HV is ON.

3.11 Readout a cell to make sure high voltage is on. Number should be between 500 and 540.

3.12 Set voltage for each cell.

 3.12.1 The value entered for setting the voltage is the count, which ranges from 0 to 255. The formula for converting count to approximate voltage is 4.49*count – 125V.

 3.12.2 For default cell, v<value> = v128 if setting default cell to 1600V.

 3.12.3 For any other cell, s<branch>,<cell>,<value> = s0,3,39 to set branch0, cell3 to 1200V.

3.12.4 To set all voltages of a given branch to the same value, f<branch>,<value>.

   3.13 Readout cells to ascertain actual voltage. The formula for converting readout to voltage is (readout – 125V)*2.585.

   3.14 Make changes in voltage for each cell if necessary. (Go back to Step 2.11.)

4. Scintillator (HV GUI)

   4.1 Plug in HVSys SM-255 with Reverse Converter.

   4.2 Connect ribbon cables to HVSys SM-255.

   4.3 Connect Bases to 20 pin Ribbon cable (order of Bases on cable is not important).

   4.4 Connect smaller 9 pin ribbon cable to computer (make sure to use the com port that is initialized in START.bat).

   4.5 Switch HVSys ON.

   4.6 Double Click on HVSys GUI on Desktop.

   4.7 Program begins by running a Cell Scan. (It is not necessary to click on Cell Scan button.)

4.7.1 Program will create pop up windows to indicate when a branch is NOT detected. Click OK to proceed from the pop up windows.

4.7.2 Pop up windows also indicate when Cells from an active branch are NOT detected. Click OK to proceed from the pop up windows.

   4.8 On the bottom right of the screen, there is a slide switch to designate branch.

   4.9 Click on the blue button to the left of the slide switch to turn the HV ON for a given branch. The red LED on the left of branch0 on the HVSys module will light up to indicate that HV is ON.

   4.10 At the top of the screen, each cell for the designated branch is shown.

4.10.1 Clicking on the number of a cell allows a voltage to be set.

4.10.2 Click inside the box to the right of the V to type-in the desired voltage in Volts.

4.10.3 The box to the right of the R gives the readout of the cell.

4.10.4 Clicking on the blue box below the number of a cell makes that cell the default cell.

FEE Board ON

1. FEE Board Description

   1.1 There are two black connectors on the board for the Power Supply and the Threshold System (TS). There is writing on the board to indicate which connector goes to the Power Supply and which goes to the TS.

   1.2 There are 5 channels on each board.

   1.3 The channels are numbered 1-5 starting with the channel closest to the Power Supply and Threshold connections.

   1.4 Each channel has one lemo input and two lemo outputs.

1.4.1 One output goes to the TDC.

1.4.2 The other output goes to the ADC.

2. Turn BK Precision (1780) Power Supply ON.

3. **Set Voltages for Power Supply.**
    3.1 Set 6.2 on ch1.
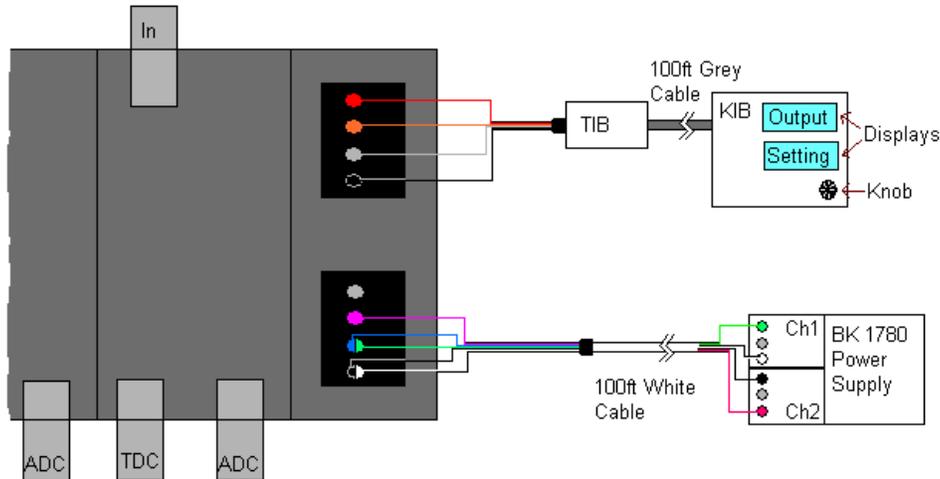   3.2 Set 5.2 on ch2.
4. **Turn Power Supply OFF.**

Fig 1. FEE board shown with proper connections to the Threshold System and Power Supply.
(Drawing is not to scale.)

5. **Connect FEE Board to Power Supply. (See Fig 1.)**
    5.1 First connect 100ft White Cable to Power Supply.
        5.1.1   The Green wire connects to the negative output of Ch1.
        5.1.2   The White wire connects to the positive output of Ch1.
        5.1.3   The Black wire connects to the negative output of Ch2.
        5.1.4   The Red wire connects to the positive output of Ch2.
    5.2 The White/Black wires are connected to the bottom most hole in the connector.
    5.3 The Blue/Green wires are connected to the next hole.
    5.4 The Pink wire is connected to the next hole.
    5.5 Nothing is connected to the last hole.
6. **Connect Knob Interface Board (KIB) to Threshold Interface Board (TIB) using the 100ft Grey Cable.**
7. **Connect FEE Board to TIB.**
    7.1 The Black wire is connected to the bottom most hole of the other black connector.
    7.2 The Dark Grey wire is connected to the next hole.
    7.3 The Oranges wire is connected to the next hole.
    7.4 The Red wire is connected to the last hole.
8. **Turn Power Supply ON.**
    8.1 Make sure that the current is correct.
    8.2 For ch1, it should be 1.0mA.
    8.3 For ch2, it should be 0.2mA.
9. **Plug In the Threshold System.**

10. **Set desired threshold using the small black knob. Make sure that the Output display is closely following the Setting display.**

Conducting Tests (for specific tests see Tests Procedures)
1. **Determine which NIM and CAMAC modules are necessary for tests.**
2. **Insert modules into the crates.**
   2.1 GPIB Interface should be placed in slots 24 and 25 of CAMAC crate.
   2.2 ADC module should be placed in slot 19 of CAMAC crate.
   2.3 TDC module should be placed in slot 11 of CAMAC crate.
3. **Switch NIM and CAMAC crates ON.**
4. **Switch Computer ON.**
5. **Start VLPC program.** (There is a shortcut on the desktop.)
6. **Set Control to DAQ.** (Program begins with Control set to MC.)
7. **Lights should appear on the GPIB interface.**
8. **To begin taking data, click Go in the Run menu.** (Lights on the GPIB interface should begin to flash.)
   8.1 If data did not start appearing on the screen, the program might have frozen.
   8.2 Click Stop in the Run menu.
   8.3 Click New in the File menu. It is not necessary to save.
   8.4 Try running again. Click Go in the Run menu.
   8.5 If data is still not appearing on the screen, then Stop the run and close the program. Sometimes it is necessary to recycle power to the CAMAC crate (switch CAMAC crate off and on).
   8.6 Restart VLPC program. (Go to Step 5.)
9. **When data taking is complete, save Hbook file.**
10. **Start PAW++.** (There is a shortcut on the desktop.)
11. **In Paw, plot histograms and record data. Repeat Steps 8,9,and 11 as needed to complete tests.**
   11.1 To record ADC data, the mean value of ADC was read from the statistics box in the upper right hand corner of the histogram plot.
   11.2 To record TDC data, the command **h/fit [histogram ID] g** was used. This fits a Gaussian to the histogram. The mean TDC can now be read from the chi square statistics box in the upper right hand corner. The sigma is also recorded.
   11.3 The risetime kumac will fit a line to the edge of a pulse waveform that was saved from the HP Infinium. The data file must first be opened in a text program, where one can delete the lines of information that do not include rise time data.
12 **Close VLPC and Paw.**

FEE OFF
1. **Unplug Threshold System.**
2. **Switch Power Supply OFF.**

HV OFF
1. **For Ref, switch High Voltage power supply OFF.**

2. Scintillator (HV Terminal)

2.1 Set voltages for all cells to 0 counts.
2.2 Switch voltage off for all cells. Ex. g<branch> = g0 for branch0.
2.3 Wait approximately 30 sec.
2.4 Readout cells to make sure the voltage has gone down to about 90.
2.5 Switch HVSys OFF.
2.6 Click the Disconnect button on the top of the screen. (It looks like a small telephone with the receiver off the hook.)
2.7 Close terminal program.

3. Scintillator (HV DOS GUI)

3.1 Set voltages to 0.
3.2 Switch branch off by clicking on the blue button to the left of the branch.
3.3 Check readout to make sure the voltage has gone down to 0.
3.4 Switch HVSys OFF.
3.5 Exit GUI.

Tests Procedures

I. SLAT - Visual Inspection

101. Inspect the Wrapped scintillator.

Unwrapped

102. Inspect the scintillator for internal areas of Cloudiness.
103. Inspect the scintillator for internal Bubbles and/or Cracks.
104. Inspect the scintillator for other internal Impurities, such as specks of dust.

Surface Cracks

Fig 2. Slat shown with Edges, Ends, and Faces highlighted.

105. Ends – Inspect the smallest face of the scintillator for surface cracks.
106. Edges – Inspect the medium face of the scintillator for surface cracks.
107. Faces – Inspect the largest face of the scintillator for surface cracks.
108. Corner Quality – Inspect the quality of the corners. Note any damage.

<u>Dimensions</u>
109. Measure the Width at 3 positions along length (2cm from each end and in the middle).
110. Measure the Height at 3 positions along length (2cm from each end and in the middle).
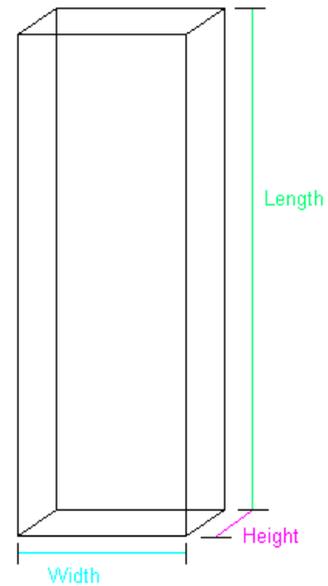111. Measure the Length.

Fig 3. Shows Height, Length, and Width of Slat highlighted.

II. PMTs - Record Hamamatsu Part number.
Visual Inspection
201. Inspect the Pins. Note if they are Straight.
202. Inspect the Photo Cathode. Note any damage.
203. Inspect the Wrapping/Grounding. Note any damage.
HV Tests
204. Connect PMT to a linear base. Connect base to HV and set to 1800V. Record the Pulse Height (PH) of the output signal.
205. Record dark current reading after Burn In at room temperature.
206. Record dark current reading after Burn In at room temperature plus 20 degrees Celsius.
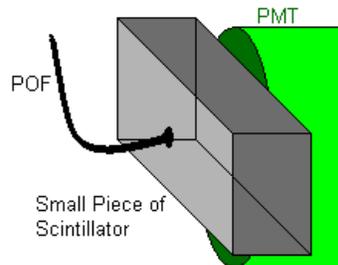

Fig 4. Test Fiber shown with proper placement against PMT.

207. Connect PMT to a linear base. Connect base to HV. Place test fiber and small scintillator up to the face of the PMT. Place in Dark Box. Set HV to 1200V. Run VLPC program. Record ADC value.
208. Same as 207 except set HV to 1600V.
209. Connect PMT to a linear base. Connect base to HV. Place test fiber and small scintillator up to the face of the PMT. Place in Dark Box. Set HV to 1200V. Connect output signal to oscilloscope. Make signal as large as possible on screen. Save Waveform to a floppy diskette. Using Rise time kumac, get and record PMT rise time (10-90%).

210. Same as 209 except set HV to 1600V.

III. CELL - Visual Inspection

301. Measure Socket Outer Diameter. (a)
302. Measure Length. (b)
303. Measure Width at end. (c)
304. Note if the Casing is Secure and Complete.
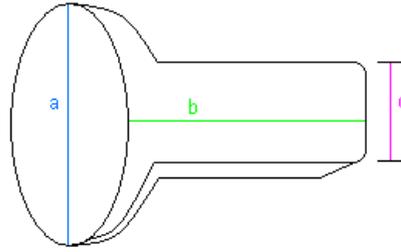305. Inspect the Potting.
306. Inspect the Connectors.

Fig 5. HV Sys Cell shown with Diameter, Length, and Width highlighted.

IV. FEEs

Cross Talk

A. Using Stanford DG535 Pulse Generator, connect one channel of a Linear Fan to AB positive going signal.
B. Connect another channel of Linear Fan to CD positive going signal.
C. Make sure that both channels of Fan are set to INV (invert pulses).
D. Using HP Oscilloscope, set scope to 8.0 GS/s.
E. Connect scope channel 1 to AB output of Fan.
F. Connect scope channel 3 to CD output of Fan.
G. Set pulse generator delays for both channels.
  G.1 Hit Delay button until delay for channel A is shown. Increase delay to 5ns. The easiest way to increase the delay is to set the center selector to the two green arrows which are pointing right and left. Then one can use the green arrow keys on the number pad to move along the number (right and left pointing arrows) and then to increase or decrease (up and down pointing arrows) the selected digit.
  G.2 Hit Delay button until delay for channel B is shown. Increase delay to 20ns. This sets the width of pulse AB to 20ns.
  G.3 Hit Delay button until delay for channel C is shown. Increase delay to 5ns.
  G.4 Hit Delay button until delay for channel D is shown. Increase delay to 25ns. This sets the width of pulse CD to 20ns.
H. Determine if there is a relative delay between the two channels.
  H.1 Scope measure delta T.
  H.2 Positive delta T means increase A
  H.3 Negative delta T means increase C and D by the same amount to keep CD width at 20ns.
I. Set desired delay to measure Cross Talk.
  I.1 Hit Delay button until delay for channel C is shown.
  I.2 Set desired delay. For example, a delay of –200ps would mean decreasing the delay on channel C by 200ps.
  I.3 Hit Delay button until delay for channel D is shown.

I.4 Set delay so that the width of CD is still 20ns. For example, channel C was reduced by 200ps in I.2 so that channel D would also be reduced by 200ps.

401. Measure Cross Talk between Ch1 and Neighboring Ch2 at –600ps.
402. Same as 401 except remove Neighboring Ch2.
403. Same as 401 except measure at +400ps.
404. Same as 403 except remove Neighboring Ch2.
405. Measure Cross Talk between Ch3 and Neighboring Ch4 at –600ps.
406. Same as 405 except remove Neighboring Ch4.
407. Same as 405 except measure at +400ps.
408. Same as 405 except remove Neighboring Ch4.
409. Measure Cross Talk between Ch4 and Neighboring Ch3 at –600ps.
410. Same as 409 except remove Neighboring Ch3.
411. Same as 409 except measure at +400ps.
412. Same as 409 except remove Neighboring Ch3.

Pulse Height

413. Using an HP 8110A pulse generator, create a fake PMT signal (see Fig 6a). Pulser settings were determined from comparing cosmics at various voltages (see Fig 6b). Set the pulser as follows:Width 6.04ns, LeadEdg 3.50ns, TrailEd 8.75ns. The Vhigh and Vlow are determined by what pulse height is desired. Split the signal with a linear fan. With the HP Infinium oscilloscope, measure the PH going into the board. Measure the PH of the output signal of the board for Ch1.
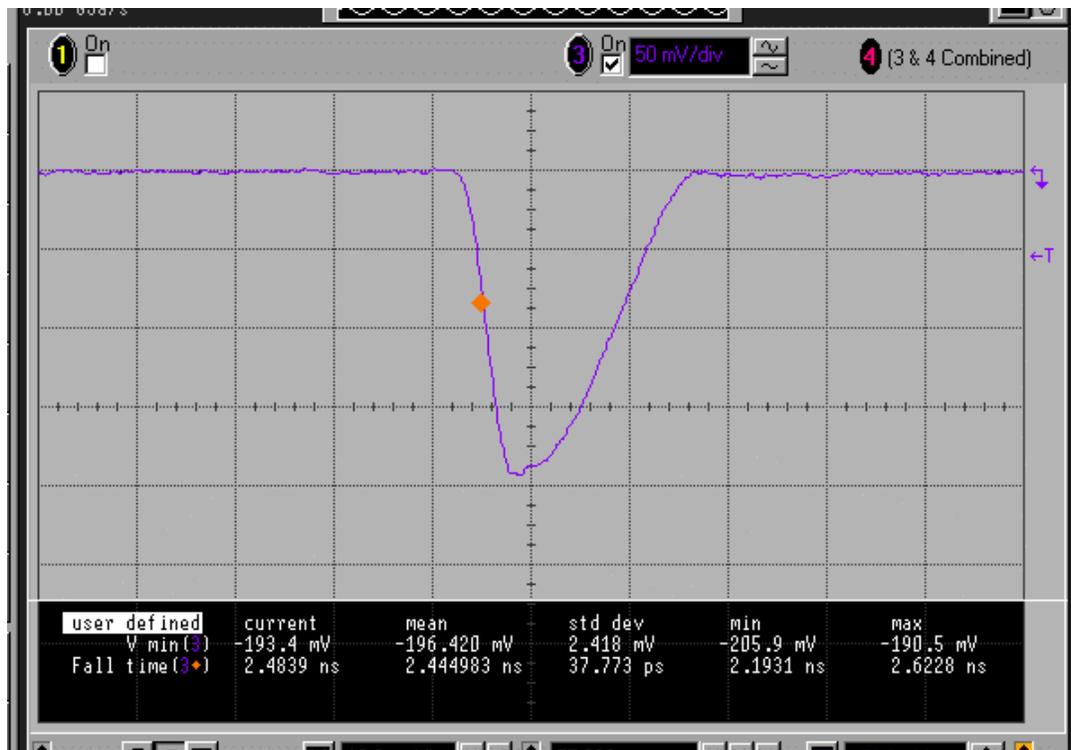

user defined	current	mean	std dev	min	max
V min(3)	-193.4 mV	-196.420 mV	2.418 mV	-205.9 mV	-190.5 mV
Fall time(3◆)	2.4839 ns	2.444983 ns	37.773 ps	2.1931 ns	2.6228 ns

Fig 6a. Scope trace of a "Fake" PMT signal.

Graph with axes "Voltage (mV)" and "Time (ns)".

Pulser Settings for 400mV Pulse
Vhigh -2.0mV Vlow -398mV
Width 6.04ns LeadEdg 3.50ns
TrailEd 8.75ns

Pulser Settings for 500mV Pulse
Vhigh -7.0mV Vlow -488mV
Width 6.04ns LeadEdg 3.20ns
TrailEd 8.75ns

Pulser Settings for 630mV Pulse
Vhigh -4.9mV Vlow -625mV
Width 6.04ns LeadEdg 3.50ns
TrailEd 8.75ns

Scope Averages for Cosmics
RT slope = -0.00591ns/mV
FT slope = 0.0157220ns/mV
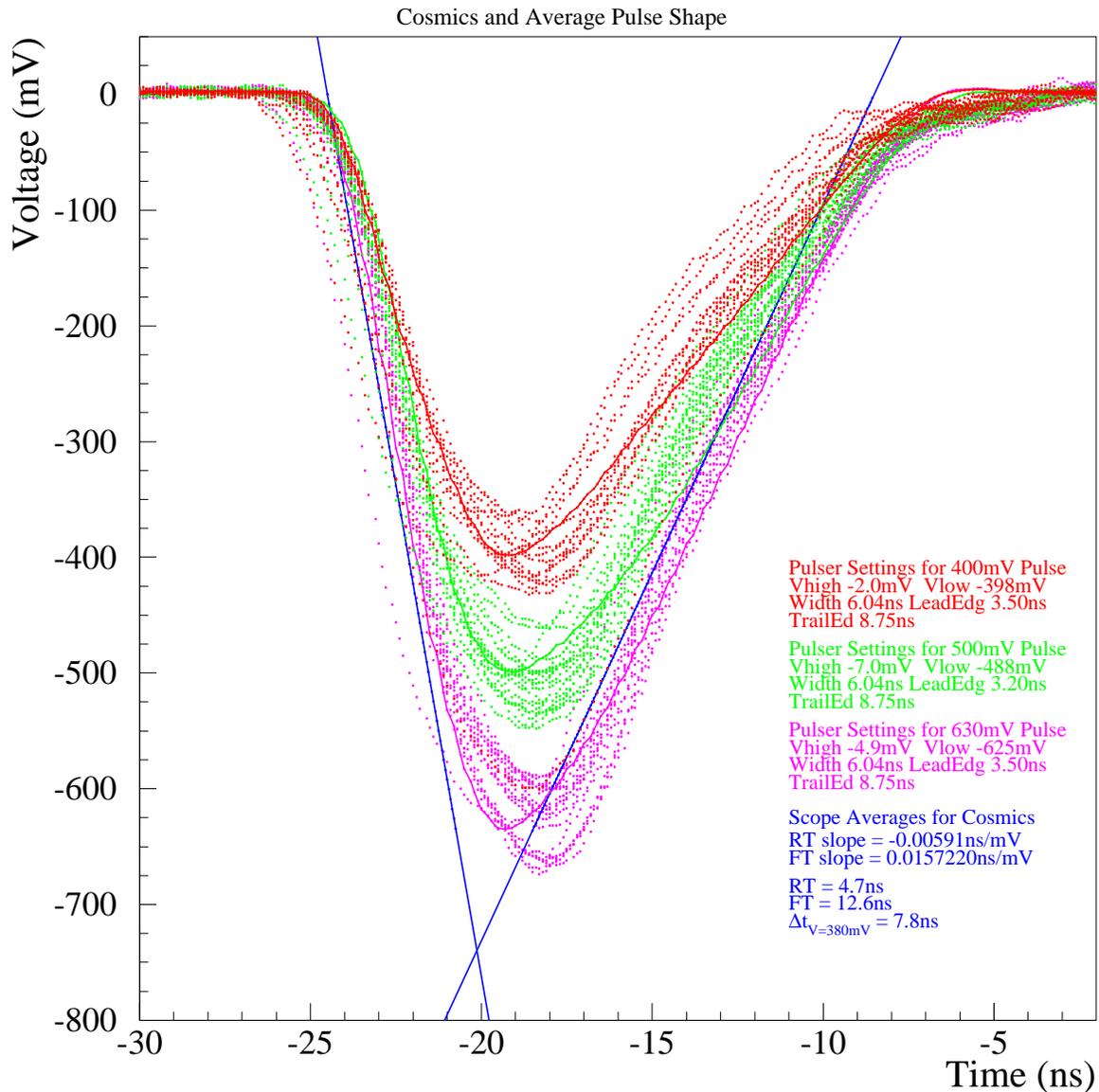
RT = 4.7ns
FT = 12.6ns
$\Delta t_{V=380mV}$ = 7.8ns

Fig 6b. Graph of various sized Cosmics – used to determine pulser settings.

414. Same as 413 except measure for Ch2.
415. Same as 413 except measure for Ch3.
416. Same as 413 except measure for Ch4.
417. Same as 413 except measure for Ch5.

T-Resolution

418. Using a pulse generator, create a fake PMT signal. Split the signal with a linear fan. Delay one of the signals. Using the HP Infinium oscilloscope, measure the ΔT and $\sigma_{\Delta T}$ for Ch1.
419. Same as 418 except measure for Ch2.
420. Same as 418 except measure for Ch3.
421. Same as 418 except measure for Ch4.
422. Same as 418 except measure for Ch5.

Threshold Sensitivity

423. Using a pulse generator, create a fake PMT signal. Split the signal with a linear fan. One of the signal outputs goes directly to the HP Infinium and the PH is measured. The other output goes to the FEE. The FEE output signal is then discriminated with a Ph704. The output gets fed into an ORTEC 772 Counter. Let the counter run for 30s. Find the Threshold that produces around 15000 counts for a –50mV input pulse. Record that Threshold for Ch1.
424. Same as 423 except measure for Ch2.
425. Same as 423 except measure for Ch3.
426. Same as 423 except measure for Ch4.
427. Same as 423 except measure for Ch5.
428. Same as 423 except measure Ch1 near –100mV.
429. Same as 428 except measure for Ch2.
430. Same as 428 except measure for Ch3.
431. Same as 428 except measure for Ch4.
432. Same as 428 except measure for Ch5.
433. Same as 423 except measure Ch1 near –150mV.
434. Same as 433 except measure for Ch2.
435. Same as 433 except measure for Ch3.
436. Same as 433 except measure for Ch4.
437. Same as 433 except measure for Ch5.
438. Using a pulse generator, create a fake PMT signal. Split the signal with a linear fan. One of the signal outputs goes directly to the HP Infinium and the PH is measured. The other output goes to the FEE. The FEE output signal is then discriminated with a Ph704. The output gets fed into an ORTEC 772 Counter. Let the counter run for 30s. Find the Pulse Height that produces around 15000 counts for a –50mV Threshold. Record that PH for Ch1.
439. Same as 438 except measure for Ch2.
440. Same as 438 except measure for Ch3.
441. Same as 438 except measure for Ch4.
442. Same as 438 except measure for Ch5.
443. Same as 438 except measure Ch1 near –100mV.
444. Same as 443 except measure for Ch2.
445. Same as 443 except measure for Ch3.
446. Same as 443 except measure for Ch4.
447. Same as 443 except measure for Ch5.
448. Same as 438 except measure Ch1 near –150mV.
449. Same as 448 except measure for Ch2.
450. Same as 448 except measure for Ch3.
451. Same as 448 except measure for Ch4.
452. Same as 448 except measure for Ch5.

V. Assembly
Cosmics
A. Arrange Slats (there should be a minimum of 3) in the dark box so that each slat is perpendicular to the one above and below and the intersection is equidistant from the face of the PMT.
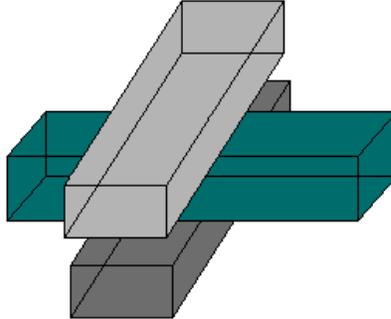
Fig 7. Arrangement of Slats shown for performing a Cosmics Test.

B. Run output signal cables through a linear fan. Use short 50Ω cables.
C. One set of output gets delayed and connected to ADC.
D. Using a Ph704, the other set of outputs gets discriminated at –100mV.
    D.1 From one output, the signal gets delayed and connected to TDC.
    D.2 From the other output of the discriminator, the signal gets directed to a 4-fold Logic Unit (LeCroy 365ALP).
    D.3 The output of the Logic Unit becomes the Gate for the ADC and the Start fot the TDC.
E. Make sure the Dark Box is closed and that all POFs are terminated with black tape or cloth.
F. Turn HV ON.
G. Start VLPC.
H. In Control menu, click on MC.
I. Set "number of events to generate" to 3000.
J. In Run menu, click Go.
K. Once run has finished, in Run menu click Stop if events are less then 3000.
L. Save Hbook file.
M. Examine data using Paw.
501. Run Cosmics overnight to get approximately 1000 events. Record the mean ADC, σ_{ADC}, and the voltage that was applied.

Position Scan

A. Wrap the slat in the standard sleeve, which is a double wrapping of Tyvek with holes at 1cm,2.5cm,4cm,5.5cm,…,16cm,17.5cm, and 19cm. Distances are measured from the face of the PMT.
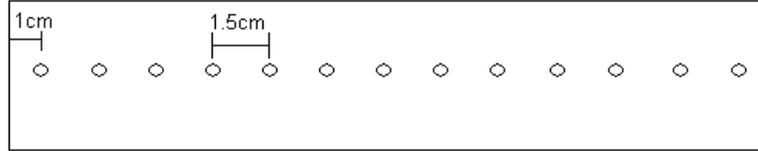

Fig 8. Standard sleeve shown with spacing labeled.

B. Place the slat in the dark box.
C. Place Plastic position device on top of the slat.
D. Plug AMP POF into position device at desired distance from PMT.
E. Close dark box.
F. Set up Electronics.
    F.1 Send Ref PMT signal to a linear fan.
        F.1a One output should be sent to Ph704 with threshold set to −150mV. From here one output is delayed to a TDC channel, another is the Start for the TDC, and the other is the Gate for the ADC.
        F.1b The other should be delayed and sent to an ADC channel.
    F.2 The slat signals should be directed to the FEE board.
    F.3 The TDC outputs should be sent to TDC channels.
    F.4 The ADC outputs should be sent to ADC channels.
    F.5 If using long cables, a second discrimination using a Ph704 is added to setup.
        F.5a After initial discrimination of Ref and Slat, add approximately 300ft of 50Ω cable.
        F.5b Discriminate the TDC bound signals and the ADC Gate using a Ph704 with threshold set to −100mV.
        F.5c Use short 50W cables to delay the ADC channel bound signals so that they remain within the ADC Gate.
        F.5d Using short 50Ω cables, send signals to TDC and ADC Gate. Make sure that these signals are delayed enough to come after the TDC Start.
G. Turn HV ON.
    G.1 Make sure that the voltage applied to the slat is approximately the same as that required for one m.i.p based on the Cosmics Test. Note: For long 300ft cable tests, increase voltage so that ADC appears on VLPC even for the furthest distance from the PMT.
    G.2 The voltage applied to the Ref PMT should be set so that the ADC output is approximately 800ch.
H. Run VLPC.
I. To move to another position or if test is complete, turn HV OFF.
J. Open dark box.

K. Move POF to new position.

L. Close dark box.

M. Begin Position Test instructions from G.

502. With short 50Ω cables, measure the mean ADC, the mean TDC, and the σ_{TDC} at 4cm.

503. Same as 501 except measure at 10cm.

504. Same as 501 except measure at 16cm.

505. With long 300ft 50Ω cables, measure the mean ADC, the mean TDC, and the σ_{TDC} at 4cm. Record HV if different from short cable tests.

506. Same as 505 except measure at 10cm.

507. Same as 505 except measure at 16cm.

Gain Curve Scan

A. Refer to Steps A-F from the Position Scan Tests.

B. Turn HV ON.

    B.1 Slat voltage is choosen. Make sure that ADC is on scale for the VLPC program.

    B.2 The voltage applied to the Ref PMT should be set so that the ADC output is approximately 800ch.

C. Run VLPC.

D. Increase or decrease voltage as desired.

E. Run VLPC.

F. Repeat steps D,E until test complete.

G. Turn HV OFF.

508. With the POF at 10cm, choose an applied voltage and measure the mean ADC, the mean TDC, and the σ_{TDC}. Record Ref ADC.

509. Same as 505 except choose another applied voltage.

510. Repeat 506 with another applied voltage.

511. Using 300ft 50W cables, repeat 508.

512. Choose another applied voltage and repeat 511.

513. Repeat 512.

V. Cable A – 20ft Cable

601. Record the length of cable from cable cutter.

602. Inspect the LEMO connectors.

603. Inspect the BNC connectors.

604. Test the continuity of the cable. Circle Y if cable has continuity, N if no continuity.

605. Test the continuity between the signal and ground. Circle y if there is continuity, N if no continuity.

606. With a pulse generator, create a "fake" PMT signal. . Using a short 50Ω cable, measure the pulse height with the HP Infinium. Record the pulse height of the signal.

607. Send the "fake" PMT signal through the cable. Measure the output pulse height and record.

608. Calculate the ratio of V_{in}/V_{out}.

VI. Cable B – 100ft Cable
701. Record the length of cable from cable cutter.
702. Inspect the LEMO connectors.
703. Inspect the BNC connectors.
704. Test the continuity of the cable. Circle Y if cable has continuity, N if no continuity.
705. Test the continuity between the signal and ground. Circle y if there is continuity, N if no continuity.
706. With a pulse generator, create a "fake" PMT signal. . Using a short 50Ω cable, measure the pulse height with the HP Infinium. Record the pulse height of the signal.
707. Send the "fake" PMT signal through the cable. Measure the output pulse height and record.
708. Calculate the ratio of V_{in}/V_{out}.

VII. Cable C – undetermined length
801. Record the length of cable from cable cutter.
802. Inspect the LEMO connectors.
803. Inspect the BNC connectors.
804. Test the continuity of the cable. Circle Y if cable has continuity, N if no continuity.
805. Test the continuity between the signal and ground. Circle y if there is continuity, N if no continuity.
806. With a pulse generator, create a "fake" PMT signal. Using a short 50Ω cable, measure the pulse height with the HP Infinium. Record the pulse height of the signal.
807. Send the "fake" PMT signal through the cable. Measure the output pulse height and record.
808. Calculate the ratio of V_{in}/V_{out}.

Glossary
Cells (or Bases) – High Voltage carriers to Photomultiplier Tubes
FEE – Front End Electronics, Leading edge discriminator
GUI – Graphic User Interface, in this case the HVSys Dos interface
HP Infinium – Hewlett Packard Infinium oscilloscope
HV – High Voltage
HVSys – High Voltage System used to power Russian Cells
KIB – Knob Interface Board
PMT – Photomultiplier Tube
Ref – Reference PMT
SB – Splitter Box
Slat (or scintillator) – scintillating plastic used to detect particles
TIB – Threshold Interface Board
TS – Threshold System used to control the threshold on the FEE
VPLC – Program for collecting data from CAMAC