ANODES

HARDWARE

The anode controls for the TPC are separated into two parallel systems for the inner and outer sector. Each system consists of a VME crate and processor, a VME ARCNET interface card, a Lecroy 1458 mainframe and 12 (inner) or 13 (outer) model 1471 HV cards. (The outer has one extra card which was for the gain chamber, which is no longer used.) Each 1471 card has 8 independent output channels. The anode wires for each inner and outer sector are separated into 4 sections – so we need 4 * 24 = 96 channels each for the inner and outer sectors. So each 1471 card supports two sectors.

The Lecroy mainframes are mounted in Rack 2A7 – they need single phase 208 volts, so they have a special plug. To have the capability of remotely power cycling the crates they are plugged into a home made box which in turn is plugged into RPS3. The box was made by Ken Asselta. (See the section on RPS). Each Lecroy mainframe has a mini-card cage in the front which has an ARCNET card as well as an interlock/communications card. We use the "MACRO" input on the comm card as the interlock for the crate – the signal comes from the TPC AB interlock system on an RG58 BNC cable. In addition, the "Interlock" input on the comm card has a 50 ohm terminator on it. There is also an RS232 connector which is the input for talking directly to the Lecroy via serial session. The ports for the serial session are 9037 (inner) and 9038 (outer). Each Lecroy also has a three position key – off, on and remote – we run in remote.

The VME crate for the inner anodes is mounted below the Lecroys in Rack 2A7. The outer VME crate is at the bottom of Rack 2A6.

Picture showing the outer anode Lecroy front with card cage.

Inner anode VME crate – processor in left slot, also showing ARCNET card. Inner Lecroy is just above the crate.


Back of Lecroy outer crate showing connections to 1471 cards.

The CANBUS address for the inner anodes is 52, and the serial port is 9006. For the outer CANBUS is 9013 with port 9013. Note that the Lecroy has its own internal memory and controls so you can reboot the VME processor with the anodes at full voltage and the voltage will not go to zero. This is useful for recovering from ARCNET hangups etc.

SLOW CONTROLS

The anode control GUI is available from the TPC top level GUI:
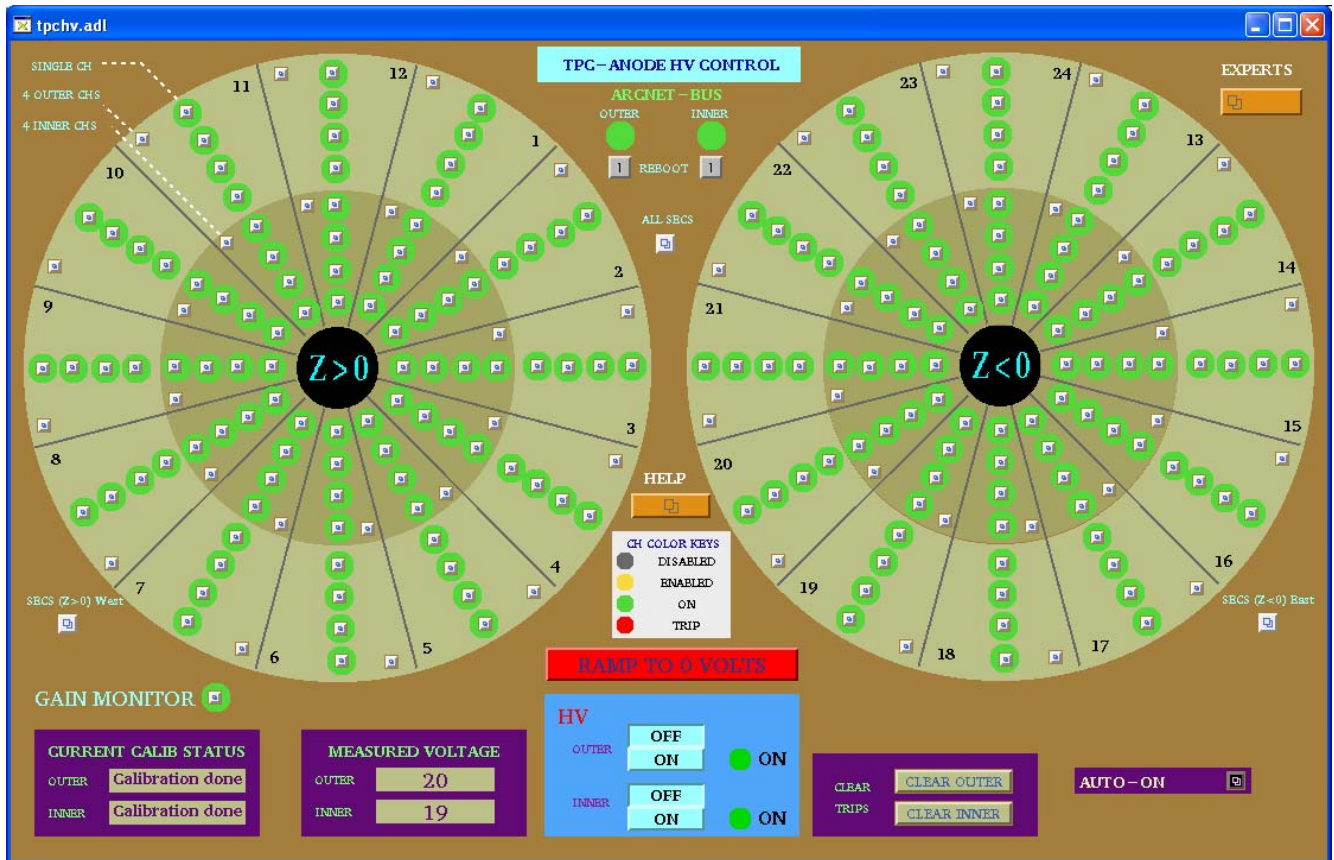
For normal operations the shift crew will use the autoramp program to raise the anodes from off to pedestal voltage (inner = 700, outer = 900) or to physics voltage (inner = 1170, outer = 1390). The autoramp is programmed to raise the voltage in steps, pausing at each level to check for high currents. If it finds a channel with high current it will ramp all channels back to zero and the crew are instructed to call an expert. If the autoramp program is not working, the crew can raise the anode voltage by typing in demand voltages – they follow the same steps as the autoramp. If the VME processor or ARCNET are down we have run for short periods in the past having the crew use the Lecroy serial session – this is less than satisfactory, of course, especially since they do not get an audible alarm for a trip.
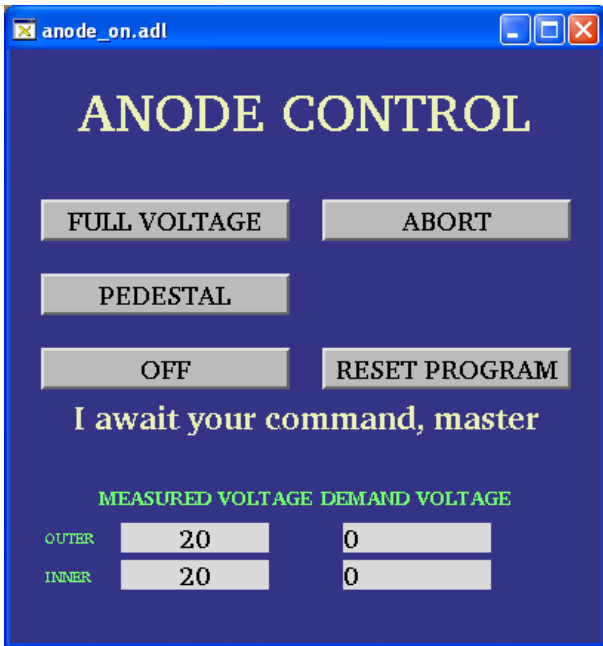
This is the autoramp GUI. This process runs on the stargate processor in the DAQ room. The program has been improved over the years by various slow controls experts. It now sends the demand voltages to the Lecroy multiple times and it has a timer that watches the progress of the ramp and times out if the Lecroy has not responded.
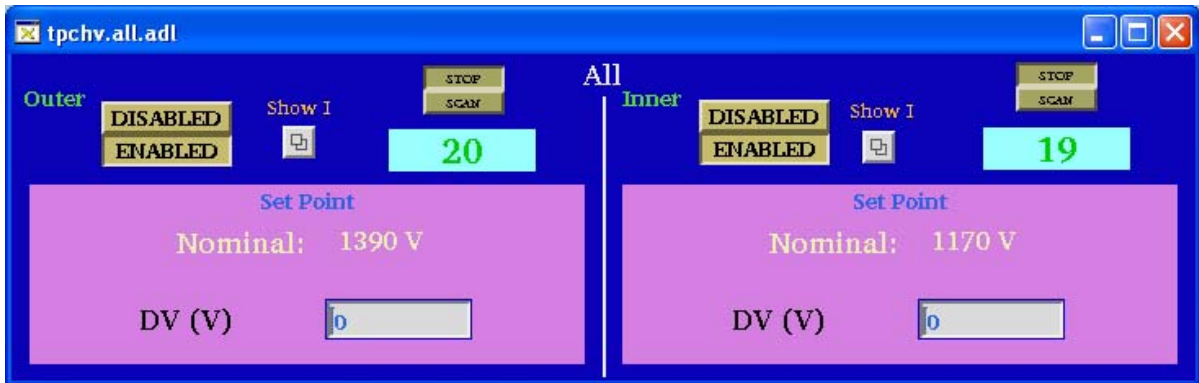
This is the GUI that is used to manually raise the HV if the autoramp doesn't work. It is available from the top anode GUI by clicking on the "All SECS" (all sectors) button. The crew then enters the demand voltage (DV) for the inners and anodes (you have to type in the value and then hit Enter.)

For further descriptions of the anode GUIs and the Lecroy serial session, see below. I've appended the following:

1. The anode section from the original year 2000 operator's manual – it will be somewhat out of date, but it is the longest explanation.

2. The anode section from the current (2007) manual for detector operators.

3. The current document for the detector operators to control the Lecroys by serial session.

SPARES

The Lecroy 1458 mainframes come in three flavors – low, medium, and high power. Originally, TPC owned two low power (installed) and one spare (med power). SVT also used two 1458s (med power) and those are now used for TPC spares. There are also rumored to be some 1458s floating around that were used by BRAHMS – we could probably get these in a pinch. One problem is that Voltronics (who bought Lecroy) will not repair these crates if they are > 10 years old, which ours are approaching.

At the beginning of Run 8 the low power outer crate had an interlock problem – it wouldn't turn off for a dropped interlock. We swapped in the med power crate and ran with it for all of Run 8. Ken Asselta has been working on getting this repaired – you might want to put it back in before Run 9 (test the interlock!) We also had problems with the outer anode Lecroy in 2006 – it was repaired by Voltronics. See pages 5 and 31 in my notebook II.

The spare 1471 cards are in the TPC spares cabinet. They haven't failed very often, so we should have plenty. I believe Voltronics will repair these, and they may also still sell new ones. Note that new cards have to be slightly modified (adding a resistor) to limit the HV out to 5 kV – this is a safety issue for RHIC since the connectors are only rated at 5 kV. Ken Asselta knows how to make this mod.

PAST PROBLEMS

1. One section of the TPC has not held voltage since day one. It is section 20-5 (outer sector 20, pad rows 14-21). I have tried it each year but it always trips after ~ ½ hour. I assume it's an internal problem, maybe on the ABDB board. We run with that cable unplugged at the Lecroy end – that way the GUI looks normal for the operators. The voltage for that channel ramps up as per normal – the sector is just not attached. Since this section coincides with RDO 2 of sector 20 we normally mask out that RDO in DAQ also.

2. I have a notebook where the operators record which channels trip during data runs – this is a good way of finding twitchy channels. Section 4-1 is by far the worst. Sections that trip too often should be investigated – I usually start by swapping the Lecroy output. We have had cards that go bad in one channel only. A typical sign of a bad Lecroy channel is if the baseline current goes up, or the zero point voltage (typically 20 volts) increases. The serial readout from the Lecroy will show the current for a channel down to a few nA. For more accuracy and faster response we have a homemade nano ammeter that can be put in series with the chamber to check for twitchy currents.

3. Usually, after a few days of running, if you login to either VME processor (9006 or 9013) you will see a message like "Node1 mainframe in bad status", in addition to some activity related output (read and write messages). This bad status message is generated by the program which is reading a status word from the crate. I have never figured out precisely what it is complaining about and, in fact, the Lecroy seems to operate ok even with this bad status. So I usually ignore it. It can be cleared only by power cycling the Lecroy.

Controlling the TPC Anodes with the LECROY Serial Session

Blair Stringfellow - valid from 6/4/2007

If the inner or outer VME crates go down you can still raise and lower the TPC anode voltages by sending commands directly to the LECROY mainframe.

NOTE: In this case the autoramp program will NOT work. If the outer anode VME crate is down, you will need to control the inner voltages by entering voltages by hand from the GUI on the anode desktop. (and vice-versa) There will also be no alarms for trips etc.

To control the inner or outer anodes by the direct method:

Log on to sc3.starp.bnl.gov with a putty session. (Shiftleader has the password.) There is normally a putty session open on the "other" desktop on the TPC control computer.

SC3> telnet scserv 9037 (inners) or 9038 (outers) (CR or Enter)
Type two CR
Type 1450
1\EDIT\1450>VT100 (CR or Enter)

Control screen with help screen should start up....
To see the full control screen type w (no CR)
To see the help screen again, type w (toggles between these two screens)

Using the keyboard arrow keys move the white cursor to the column headed "target voltage".

To select all channels, type shift and > together, then up arrow. The entire column should now be white.
Type in the first voltage value and CR. After a delay the voltages for all channels should start to ramp up. Repeat this method until the anodes are at the desired voltage (pedestal or operating voltage) Raise the voltage following the steps that are posted near the control computer.

The screen shows only 2 HV cards (4 sectors). To see the other sectors page down by typing SHIFT and 2 or 4 or 6 or 8 or A. Return to the top page by typing SHIFT and 0

In the column labeled S is a symbol that shows that channels status. Normal status is indicated by a diamond symbol. (♦) A tripped channel is indicated by the symbol ⊥ Detector operators should check the status of all channels every 15 minutes to look for tripped channels.

A tripped channel can be cleared by moving the white cursor to the target voltage column for that channel - first enter 0 (CR) to change the target voltage to zero. Then type [This should change the status back to the diamond. Then ramp that channel up by the normal steps.

To exit the LECROY session, first type q, then at the prompt type quit.
Then type CNTRL and] This will get the telnet prompt. Then type quit. This will get the SC3 prompt.

To exit the LECROY session, first type q, then at the prompt type quit.
Then type CNTRL and] This will get the telnet prompt. Then type quit. This will get the SC3 prompt.

If the control screen becomes garbled with graphics characters etc just type w twice to refresh the screen.
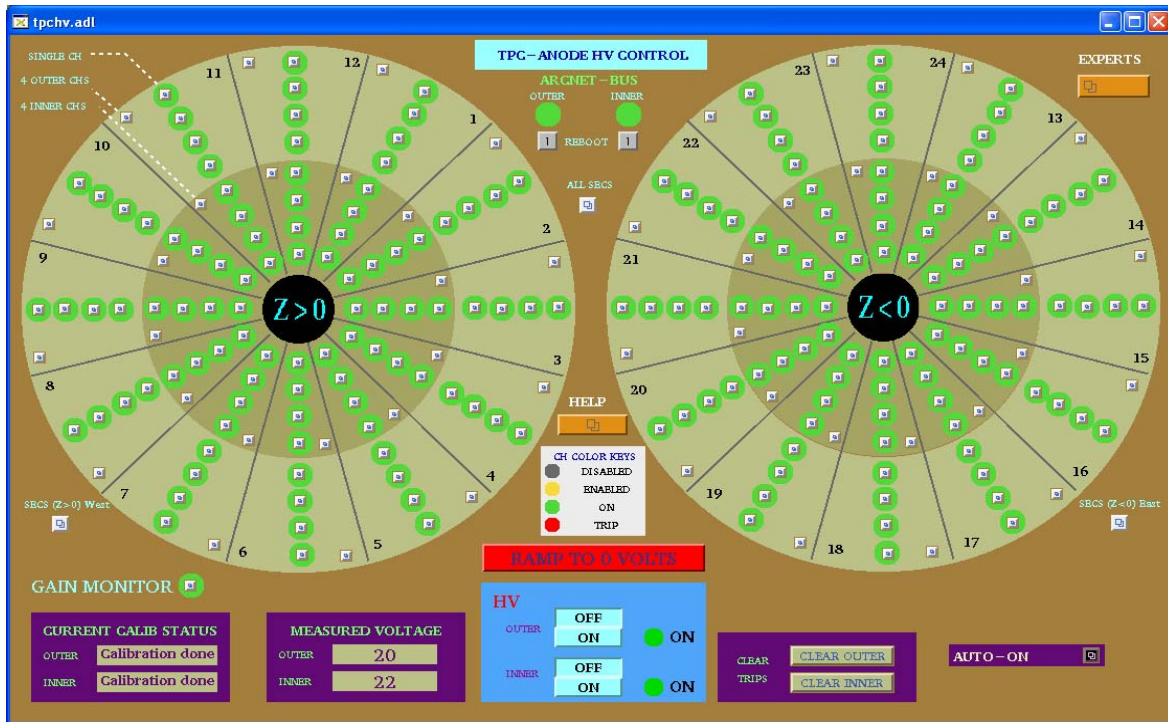
If the HV does not ramp up after entering a demand voltage, check in the top right corner of the window whether HV is on or off. If it off, type { to turn it on. If it still doesn't turn on, call an expert.

2.7 ANODE & TRIPS

AUTORAMP

To turn the anodes on using the autoramp program:

1. Go to desktop # 1 and click on "Anode Voltage" on the top level GUI. This brings up the Anode GUI:

2. Check the ARCNET-BUS status lights for the Inner and Outer sectors – if either or both are red, click the corresponding "reboot" button. This will reboot the processor. (The display will go white while it reboots). WAIT ~ five minutes for the reboot. The state of the anode voltages (on or off) is unaffected by rebooting the processor – the Lecroy system has local memory.

3. When the status lights have turned green, click on the "Auto-On" button. This gives the GUI:

If the autoramp GUI displays the message "ARCNET connection lost", click on the "Reset PGM" button.

4. Make sure RHIC has stored, cogged and stable beam!

5. At this point, you can go to pedestal voltage (Inner = 700, Outer = 900) or to full operating voltage (Inner = 1170, Outer = 1390).

6. To go to pedestal voltage, click "pedestal". The program will:

       Turn on the HV
       Enable all channels
       Ramp HV to 400 volts
       Calibrate the currents (subtract out any DC offset)
       Ramp to pedestal voltage

If the HV is already on, the program will just ramp up (or down) to pedestal values.

At any time the operator can stop the process by clicking "Abort". This will ramp the voltage back to 0.

After the voltages are at pedestal values, the TPC is ready to take a pedestal run (make sure the GG is on!)

7. One can go to full voltage from either the off position or from the pedestal position.

From off, the program will repeat the pedestal procedure, and then:

       Check for tripped channels
       Check for excessive currents
       Ramp to Inner = 1000, Outer = 1200
       Check for trips
       Check for currents
       Ramp to Inner = 1100, Outer = 1300
       Wait for 2 minutes
       Check for trips and currents
       Ramp to final voltage (Inner = 1170, Outer = 1390)
       Check for trips or currents.
       HV ready for data

This procedure takes ~ 10 minutes.

If a trip or high current is detected during this procedure , the voltage for all channels will be ramped back to pedestal values automatically.

To turn the HV off, click on the "Off" button in the auto-on window, or click on the red "Ramp to 0 Volts" button on the main anode GUI.

MANUAL ANODE OPERATION
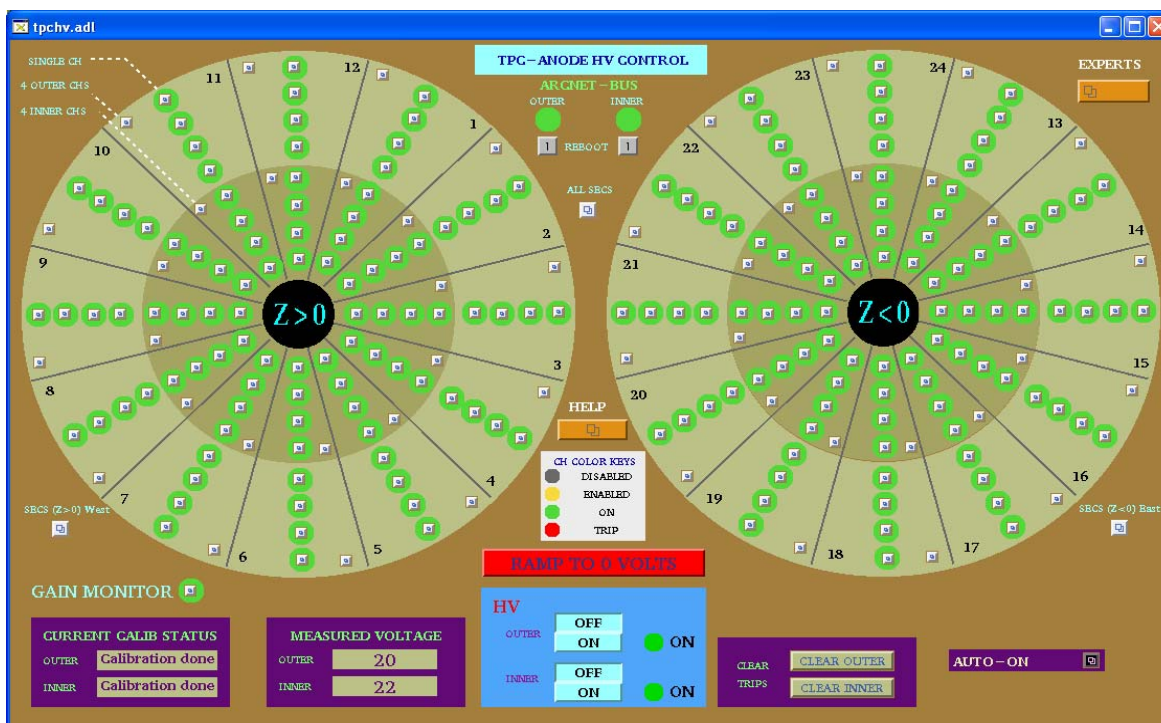
There are 193 separate anode supplies, 1 for the gain chamber and 192 for the TPC. For each sector, the anode wires are grouped in sections, so there are four supplies per sector. The operator can control the voltage for all sectors (including the gain chamber), for the east or west end only, for a sector only (4 sections) or for an individual section (usually necessary to reset a trip.) In the main GUI above, the status of each power supply (section) is indicated by the round color field surrounding the control button. Thus:

Grey = Channel is disabled. Even if the HV is turned on and you set a demand voltage for that channel, nothing will happen.

Yellow: Channel is enabled but the HV is off or <10 volts.

Green: Channel is on at some voltage > 10 volts.

Red: Channel has tripped off due to excessive current draw. (> 2 μA)

NOTE: The Anode program is very slow. You MUST wait for each command to be acknowledged before issuing another command or it will crash!

To turn on all sectors manually:

1. Check the status lights of the Arcnet-Bus. If either is red, click and drag on the reboot button to reboot the processor. Wait ~ 5 minutes. (There is a separate processor for the inner and outer sectors).

NOTE: The ARCNET link is lost frequently – you will get a TPC alarm when this happens. When this link is down the program can't get updated information from the Lecroy HV mainframe, BUT the HV is still on and the chamber is still protected. Rebooting the processor has no effect on the HV.

2. When the ARCNET lights are green, click the HV on button for the inner and outer sectors. Wait for the HV lights to turn green.

3. Open the "ALL SECS" control panel:
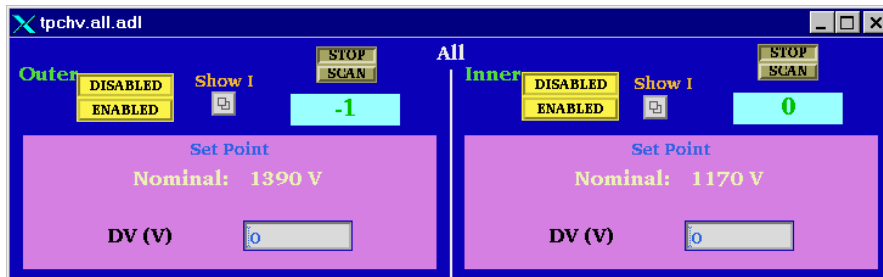
4. Check that the demand voltage DV (V) for inner and outer reads 0. If not, enter 0, CR in each window.

5. Click on "Enabled" for the inner and outer. Wait until the color circles turn green on the main anode GUI.

6. Type in a demand voltage of 400 V for the inner and outer sectors. Wait until the voltage ramps up and is confirmed in the readback window.

7.Check the Current Calibration status window in the main anode GUI. If the status is "calibrated" continue raising the voltage (see below step 10). If the status is uncalibrated, click on the Outer "SHOW I" button in the "ALL SECS" control GUI, drag down to "I (Z > 0) West) and release. This brings up the current display for all the outer sectors on the west end:
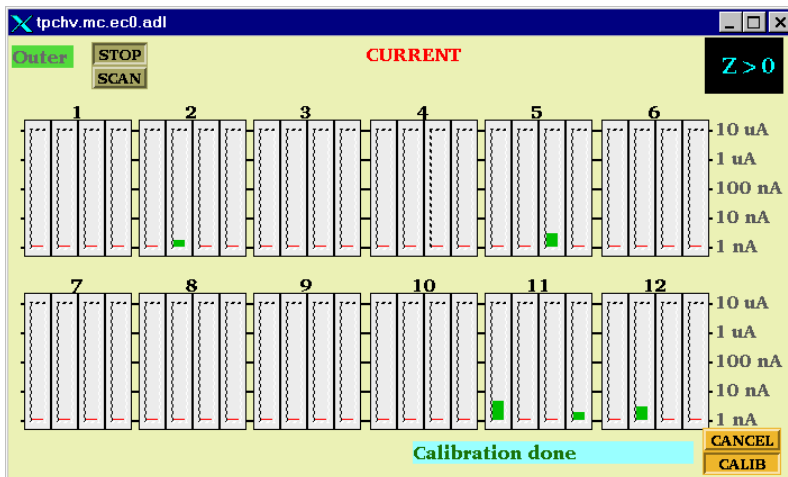
8. Click on the "Calib" button. The status window will say "Current is Ready" and then "Calibration in Progress". The program will subtract the DC current offsets FOR ALL OUTER SECTORS (east and west). The status window will then say "Calibration Done".

9. Repeat this procedure for the Inner sectors, if needed.

10. Set the demand voltage to pedestal values (Inner = 700, Outer = 900). Wait for the voltage to ramp up.

11. Continue to raise the voltage in steps, checking the currents after each step:

       Inner = 1000, Outer = 1200
       Inner = 1100, Outer = 1300
       Wait ~ 2 minutes
       Inner = 1170, Outer = 1390

12. To turn the Anodes off, either type in 0 for the demand voltage or click on the red "Ramp to 0 Volts" button on the main anode GUI.

RESETTING TRIPS

Occasionally, one or more channels will draw excessive current (> 2 µA) and automatically trip off. There will be a TPC alarm. These trips can be random or beam induced. First, STOP the current run. Then, to reset a tripped channel:

1. Click on the individual control button for the tripped channel in the main anode GUI. This brings up the channel status panel:
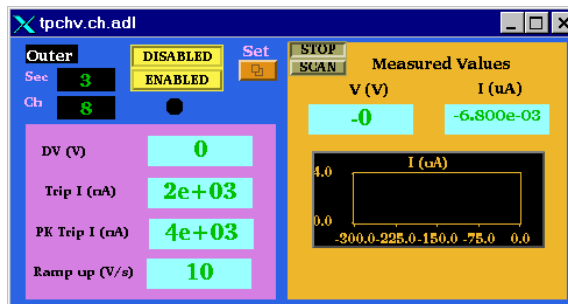
2. Click on the "SET" button. This brings up the control panel:
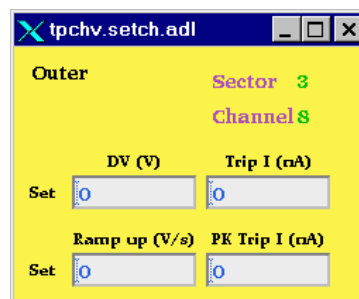
3. In the demand voltage window "DV (V)", type in 0,cr to set the demand voltage back to zero. Do this FOR ALL tripped channels.

4. In the main anode GUI, click on the "Clear Trips" button for inner or outer sectors, depending on which channels tripped. Wait – the tripped channels which were red should turn back to green.

5. If the tripped channel remains grey on the main GUI after 2 minutes, it is neccesary to enable it manually. Click the "Enabled" button for the channel on the channel control GUI shown in step 1 above. If the channel is not green, you cannot raise the voltage.

6. Using the individual channel control windows, slowly raise the voltage in stages back up to the operating point. Monitor the current for each channel. For any indication of excessive current draw, lower that channel back to 0 and call an expert. (Excessive current for constant voltage = 50 nA)

7. Record the tripped channels in the "STAR TPC ANODES" binder.

NOTE: The current limits can only be changed by the subsystem manager. If a channel will not stay on with a limit of 2 μA, LEAVE IT OFF and call an expert.

ALTERNATE METHOD FOR CLEARING MULTPLE TRIPS

Sudden RHIC beam losses can cause multple anode trips. A more efficient method for clearing these trips is:

1. If the RHIC beam is lost: Use the autoramp to run ALL anode HV down to zero. Then click on the "Clear Trips" buttons. The tripped channels should clear and be ready for the next autoramp.

2. If RHIC still has beam and the run will continue then:

   First, STOP the current run. Use the autoramp program to run ALL anode HV down to pedestal voltage. Then click on the "Clear Trips" button for inner and outer, depending on which channels tripped. WAIT for the tripped channels to reset – they should automatically ramp back up to pedestal voltage. You can then autoramp back up to full voltage if the RHIC losses have stopped.

X. ANODES

OK, right up front, the most important thing with the anodes is:

PATIENCE

This won't be the last time I tell you. In addition to the normal care one needs to take with MWPC, the slow controls program for the anodes really IS slow. If you try and do multiple commands or not wait for one step to finish, it will crash and burn for sure. So…. here we go:

The HV MWPC for the TPC (anodes) is supplied by Lecroy 1471 HV cards. Each sector is segmented into four sections, each with its own independently settable HV. The Lecroy crates for the HV supplies are in Rack 2A7 (Outer sectors in the upper crate, inner sectors in the lower crate). Each Lecroy 1471 card has eight independent outputs and supplies two sectors. The Inner sections are numbered from 1 to 4 (1 = innermost radius) and the Outer sections from 5 to 8 (8 = outermost radius). The HV is controlled by a VME processor which talks to the crate via an ARCNET interface. There is a separate CPU for the inner and outer sectors. The inner CPU is in Rack 2A7, the outer in 2A6. In addition, one can communicate with the Lecroy crates independent of VME using a serial connection. (see below for details.)

COLD START

      1. After a complete shutdown, the crates may be completely off. Also, after replacing a HV card it will be necessary to do a cold start. The main AC switch for the Lecroy crate is in the back. Turn this on (Both crates).

      2. On the front of the crate, turn the key to "remote". (Both crates.)

WARM STARTUP

      1. If the Lecroy crates are on and in remote, first check the interlock. Select Desktop # 7 and bring up the Interlock GUI. Check that the "Anode HV Enabled" button is green and not flashing. If not, contact a TPC expert or check the TPC Interlock manual.

      2. Select Desktop # 8 and bring up the VME status GUI. Make sure the two VME crates are on (2A7 ANHV/Interlock for the Inner and 2A6-3 ANHV-2 for the Outer)

      3. Select Desktop #1 and bring up the Anode Voltage GUI. It looks like this:
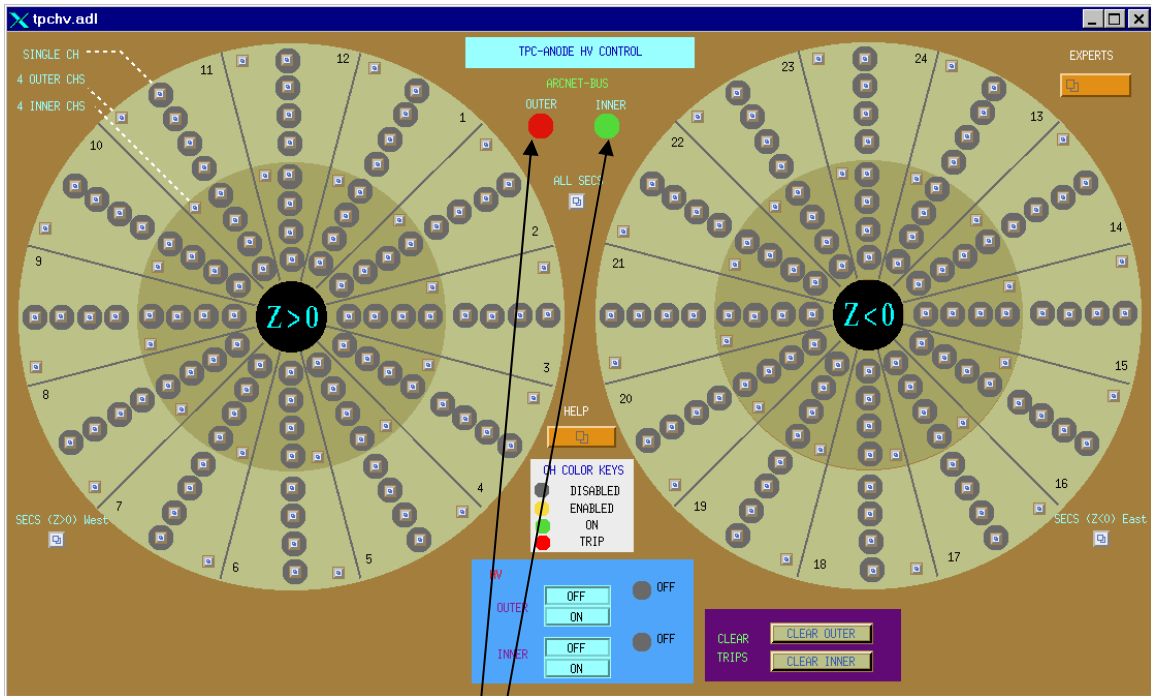
4. Check the ARCNET bus status .   Are they red? (Probably). If so you need to reboot the VME processors.

5. On the desktop, click on the Exceed shortcut "sc.session.xc".

6. At the sc prompt, type telnet scserv 9013 (Outer sectors). This will bring up a terminal session for the VME processor. Type CR to get the prompt, then type reboot. Reboot takes ~ 5 minutes. If the processor is working properly, the ARCNET status light will turn green and debug messages will appear in the session window. (Typical messages are STARCNET: reply LS and RC_MC:RC S2 MC) These are normal. For normal running, leave this session window up – you'll need it to reboot from time to time.

7. For the Inner Sectors, repeat step 6 except telnet scserv 9006. Leave that session window up also.

8. The status for each channel (1 channel = 1 section of one sector) is indicated by the color circle around its access button:
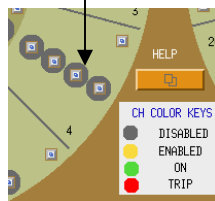
9. The color code for the status is shown on the GUI:

White: The VME processor is dead or the VME crate is off.
Grey: Channel is disabled. Even if the HV is turned on and you set a demand voltage for this channel, nothing will happen.
Yellow: Channel is enabled but HV is off or < 10 Volts. Note that a channel can be enabled even if the HV is OFF.
Green: Channel is on at some voltage greater than 10 volts.
Red: Channel has tripped off due to excess current draw.

10. Check that the status of ALL channels (inner and outer) is disabled (grey.)

11. Turn on the HV for each crate by clicking on the "HV on" buttons in turn.
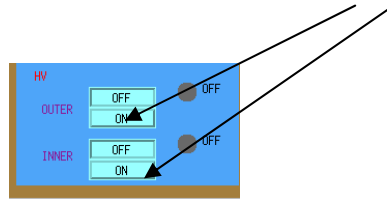
The HV status should turn from off to on and the light will turn green. (Wait for it!).

A TOUR OF THE CONTROL WINDOWS

At this point the system is ready to apply HV to the sectors.
Note that there are multiple GUI entry points for each channel. One can control a single channel, 4 channels (= 1 sector), the whole west or east end or all of the TPC.
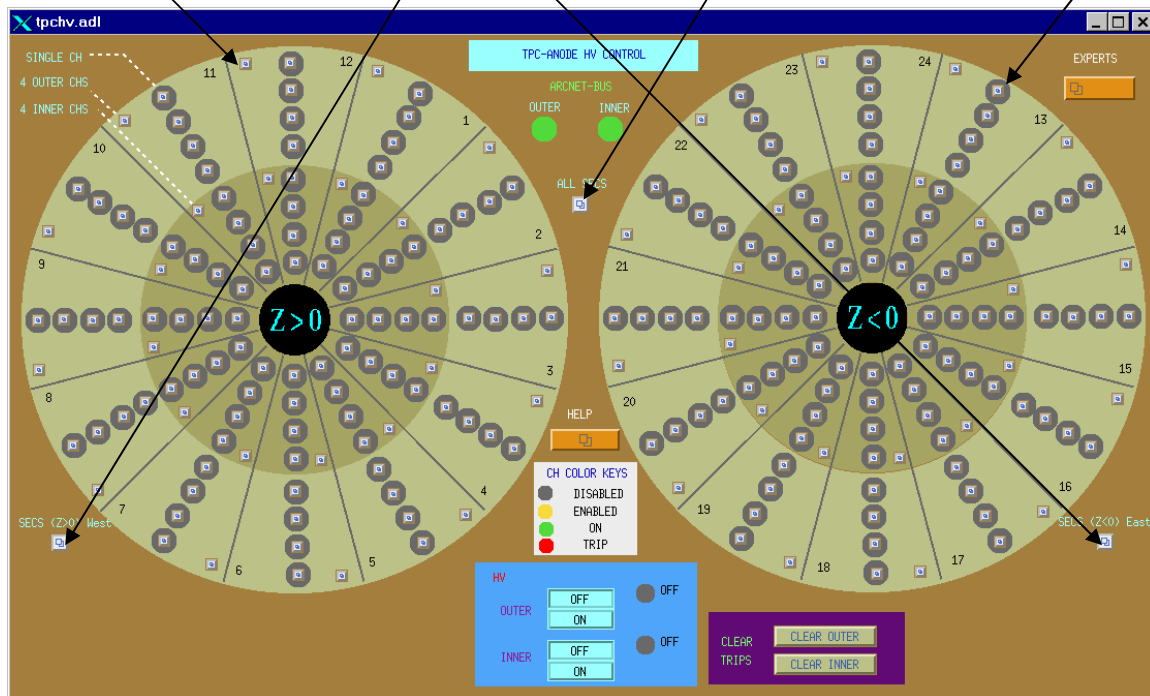
SINGLE CHANNEL

The single channel window would typically be used to reset one tripped channel or to monitor a channel that was drawing current.

1. On the top level GUI, click on a single channel button. This brings up the monitor window for that channel:
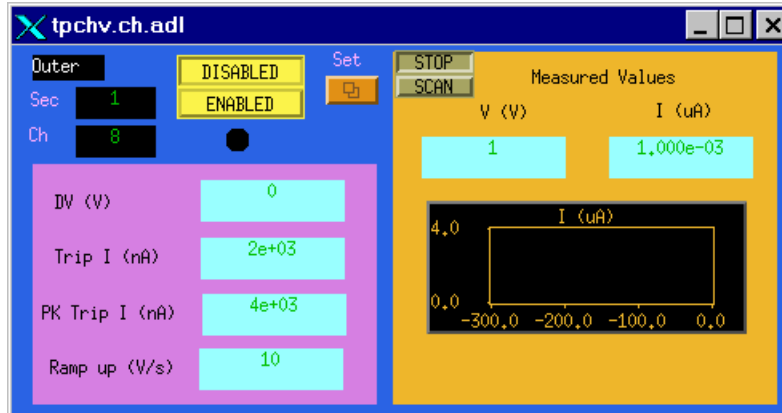
All of the windows on this screen are output values. The demand voltage (DV) is shown in the first window. The next two windows show the database values for the trip current and peak trip current. A channel that draws current above these levels will automatically trip off. The trip current has a time constant of ~ 10 msec, the peak trip current ~ .75 msec. As shown the limits are set to Trip current = 2.0 μa, PK trip = 4.0 μa.

NOTE: These limits are set purposefully low in order to protect the MWPC's. They will be adjusted after we see what the RHIC operating conditions are.

THESE LIMITS CAN ONLY BE CHANGED BY EXPERTS!!! NO EXCEPTIONS.

The Ramp up window shows the current value for the rate at which voltage is applied to the chamber. It should always be 10 V/sec.

The windows on the right show the readback parameters for this channel (Volts and Current) along with a strip chart of the current. The "Scan" button is used to force the program to read this channel more often. It can be used when the window is active, but click stop before closing the window.

To enable this channel ONLY, click on the "Enabled" button. The status light just below the button will turn to yellow (for demand voltage = 0) or green (for demand voltage > 40 V) or red (tripped).

2. To input a demand voltage for this channel, click on the "Set" button. This brings up the single channel control window:

3. To set a demand voltage for this channel, type a value in the DV window and hit
   return. (Note: The mouse pointer has to be on the window to input a value).
   If the channel is enabled and not tripped, the voltage will ramp up to the demand
   value.

AGAIN, EXPERTS ONLY FOR THE OTHER THREE WINDOWS!

4 CHANNELS OR 1 SECTOR

This window would typically be used to reset a sector if more than one section tripped or to lower the voltage for one sector.

1. On the top level GUI, click on one of the sector buttons to get the monitor screen:
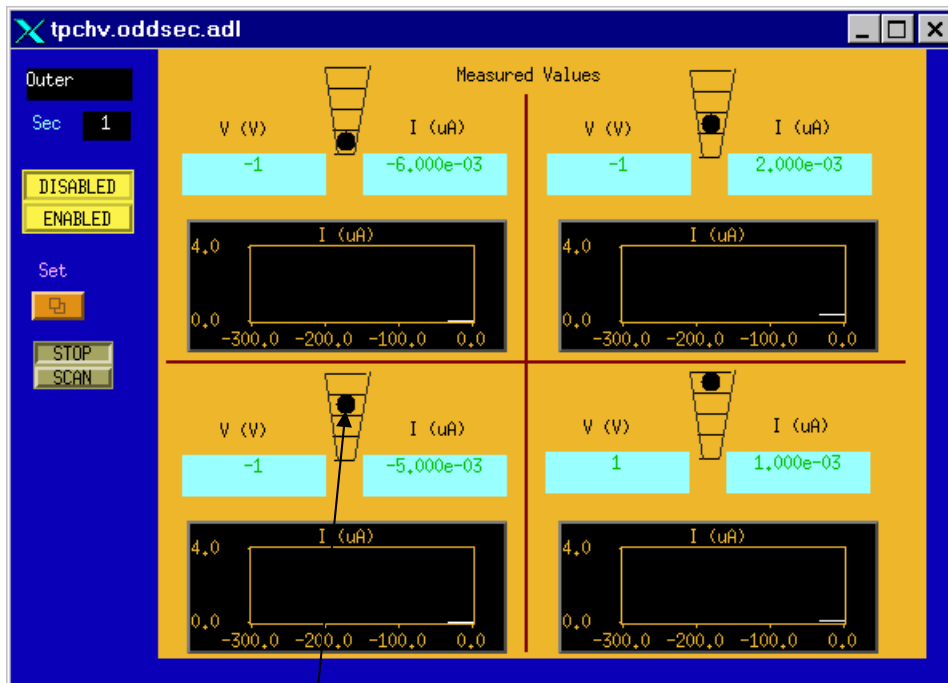
Here each section of the sector has the voltage, current and current stripchart displayed. The status of each section is also indicated. To input a demand voltage FOR THE WHOLE SECTOR, click on the "Set" button. This brings up the control window:
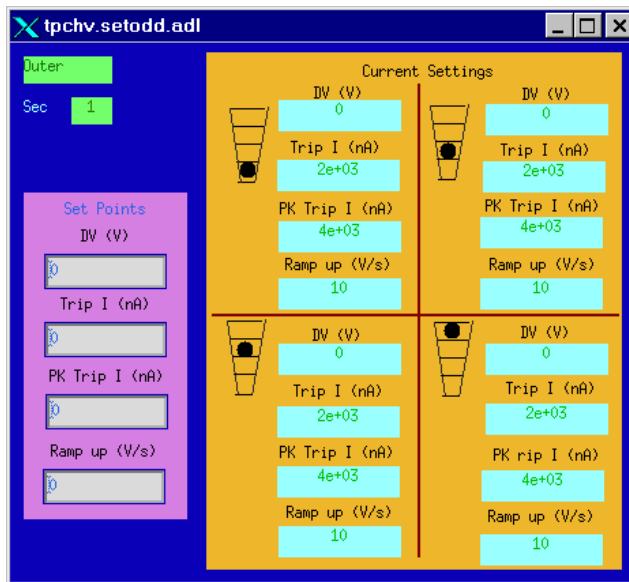
As for the single channel window, set a demand voltage by typing in the DV set point window and hitting CR. Do NOT type anything in the other three windows.

EAST OR WEST END

These windows are used to control one whole end of the TPC (12 Inner & 12 Outer Sectors)

1. On the main Anode window, click on the "SECS (Z>0) West" or SECS (Z<0) East button to bring up the control screen:
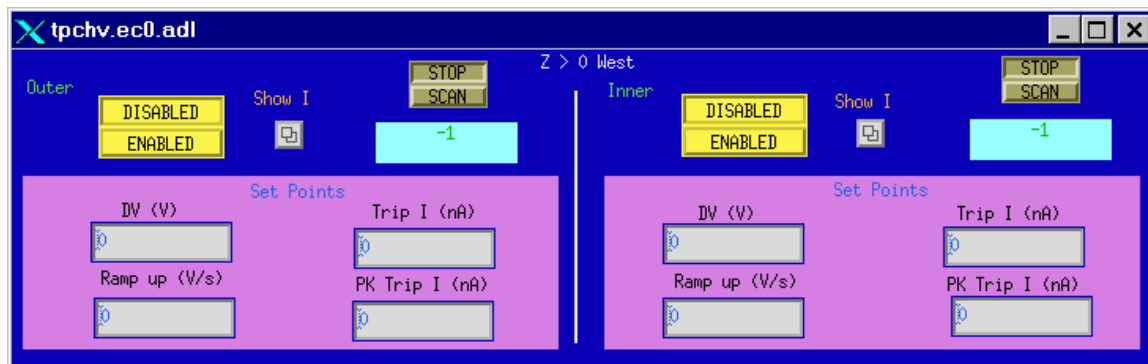
The "Enabled" button will now enable all sectors on that end. To raise the voltage, input the demand value into the Set Point DV window. NOTE: This will raise the voltage on ALL sectors of that end. To see the current for the Inner or Outer sectors, click on the corresponding "Show I" button:
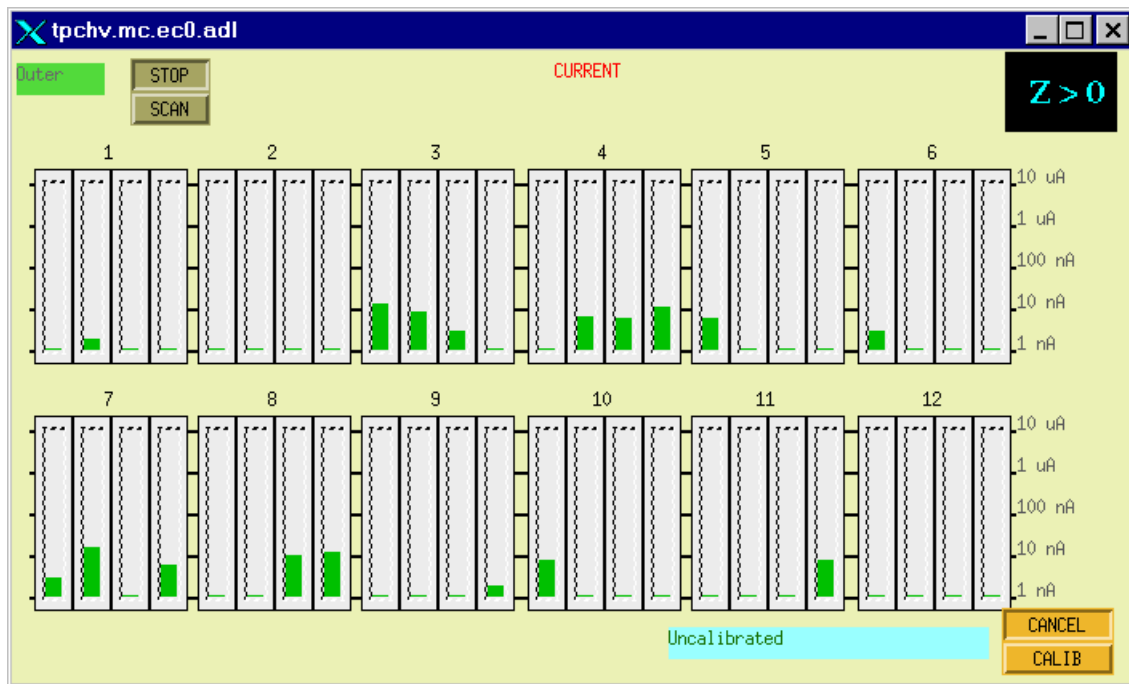
This shows the uncalibrated current for all sections of the 12 outer sectors of one end (log scale). The Lecroy modules have varying levels of DC current offsets – to do a calibration, see below.

RAISING THE VOLTAGE (WHOLE TPC)

This is the window and method that is normally used to bring the TPC MWPC's to operating voltage.

1. On the top level Anode GUI make sure both ARCNET lights are green. If one or both are not, reboot the corresponding processor and do the Warm Startup Procedure (see above).

2. On the top level Anode GUI, click on the "All SECS" button to bring up the control window:
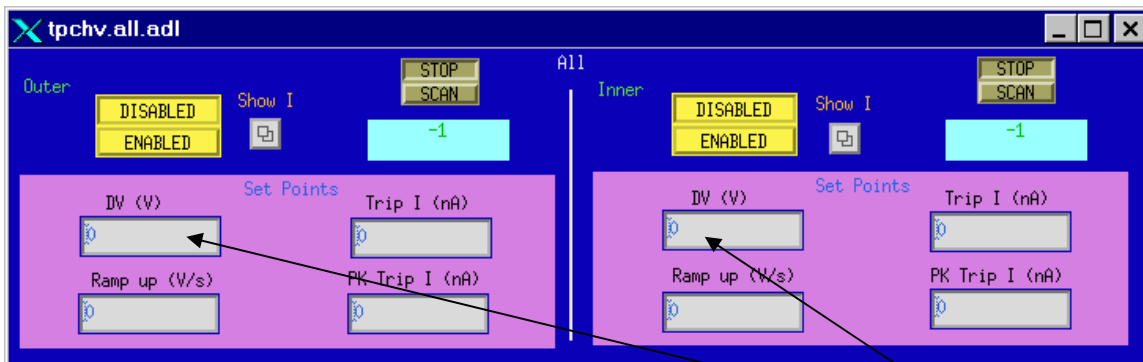
3. Check that the set point Demand Voltage for both Inner and Outer Sectors is 0.

4. Click on the Outer "ENABLED" button. All the outer sectors should turn green. (WAIT!)
Do the same for the Inner sectors. The measured voltage should now read ~ 20 Volts.
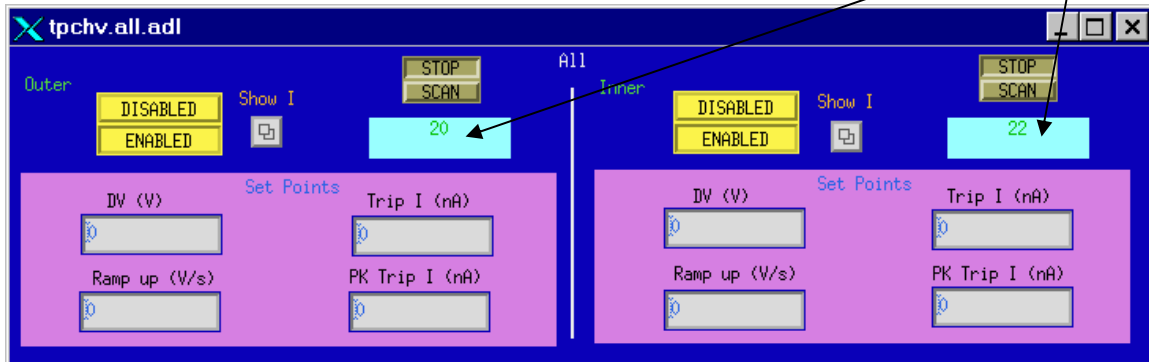
5. Before raising the voltage, you need to subtract the DC current offsets for all channels. For the outer sectors, click on the "Show I" button. There will be a drop down menu – click on "I (Z > 0) West" to view the current for 12 sectors at a time.
The window will look like:
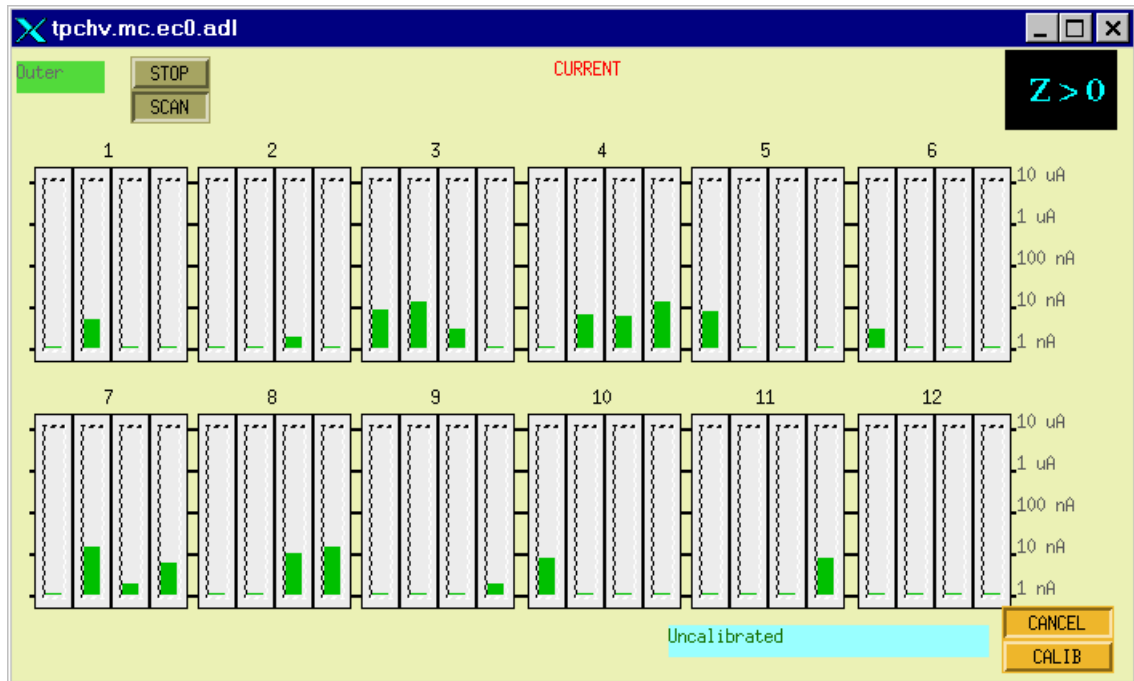
6. To remove the DC offsets (some of which are negative), push the "Calib" button. The status window should read "Current is ready" and then "Calibration is in Progress" and then "Calibration done". The currents should then all read ~ zero. This calibrates ALL 24 of the outer sectors.

7. Do the same for the Inner sectors using the Inner "Show I" button.

IT'S TIME TO RAISE THE VOLTAGE!

The voltage is raised in steps up to the operating point. NEVER input the full HV from zero. It should take ~ 20 to 30 minutes to reach full voltage.

THE CURRENT OPERATING VOLTAGES ARE:

INNER   1170 V
OUTER   1390 V

THESE MAY CHANGE FROM TIME TO TIME – ALWAYS CHECK THE MAIN LOGBOOK BEFORE TURNING ON.

1. In the "ALL SECS" control window, type in 400 in the Outer DV window and hit CR. The voltage should slowly ramp up to 400 V. Remember, the readback program is slow, so you may only get one or two refreshes between 20 and 400.

2. When the Outer Sectors have reached 400, then type 400, CR in the Inner Sector DV window. Wait again.

3. Continue this way up to the operating point. Recommended steps are:

   Outer: 400,800,1000,1200,1300, pause here and check currents, 1390

   Inner: 400,800,1000,1100, pause here and check currents, 1170.

4. One step before maximum, and after reaching the setpoints, open the four "Show I" windows and check for excessive current draw. Any current over 10 nA is cause for concern. Lower the voltage on that section or sector and consult an expert. NEVER let a sector that is drawing current sit at full voltage.

NOTE: There is an additional built in hardware over-voltage protection for each channel. If you attempt to enter a demand voltage above this limit, the Lecroy card will immediately trip that channel (or channels). The hardware trip limit is set by a pot on the front of each HV card (common to 8 channels.) The present limits are Inner = 1210V, Outer = 1510 V.

5. The TPC is now at full operating voltage – see THE SECTION ON MONITORING A RUN.

RESETTING A TRIP

HV trips due to overcurrent can be caused by a sector breaking down, excessive RHIC beam losses or bad Lecroy cards. If a channel or sector trips consistently, don't force the issue – consult an expert.

1. A tripped channel(s) will be indicated by a red status indicator on the top level Anode GUI.
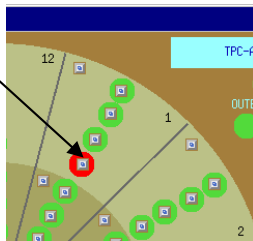
2. To reset the trip, first open the appropriate control window. For a single section (as above) just click on the section button. If two or more sections of a sector have tripped, it's usually easier to use the whole sector control window.

3. In the control window, set the demand voltage for the tripped channels to 0. (Make SURE you are entering in the right place – otherwise you will reduce the voltage on more than the tripped sector!)

4. In the top level Anode window, click on the appropriate "Clear Trips" button for inner or outer sectors:
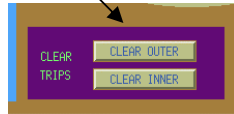
5. In the control window for the tripped sections, raise the voltage in steps back to the operating point. Make sure to monitor the current carefully. Sections that re-trip for no known reason should be turned off and an expert notified.

6. Locate the "STAR TPC ANODES" three ring binder and log the trip. There is a separate page for each sector – log the date, time, section, the current trip limit, peak current trip limit and whether the beam was on. There is also a column for comments.

SERIAL SESSIONS

There is a parallel path into the Lecroy HV system using a serial connection for each crate (Inner and Outer). Commands can be entered from either the GUI or the serial sessions and the results will show up on both. In addition, some information is available through the serial line that is not apparent from the GUI. (Trip codes and hardware voltage limit being the most prominent). The entire system can be controlled in an emergency using the serial lines if the VME processors are down, for instance.

To open a serial session:

1. Select Desktop # 1 and double-click on the sc.session.xs shortcut located on the desktop.

2. At the sc prompt, type telnet creighton2, CR. Creighton2 is a Sun workstation located on the platform (Rack 2A8).

   username: sysuser
   password: dv4hwco8

3. At the creighton2 prompt, type "tip a" for the inner sectors. For a similar session for the outer sectors, repeat steps 1-3 but type "tip b".

4. The response should be "connected". Hit CR.

5. At the prompt 0\ENTER "1450" to begin>, type 1450 CR

6. It will respond "Begin Serial Session" and then prompt 1\EDIT\1450>. Type VT100 CR

7. The display will change to the following:
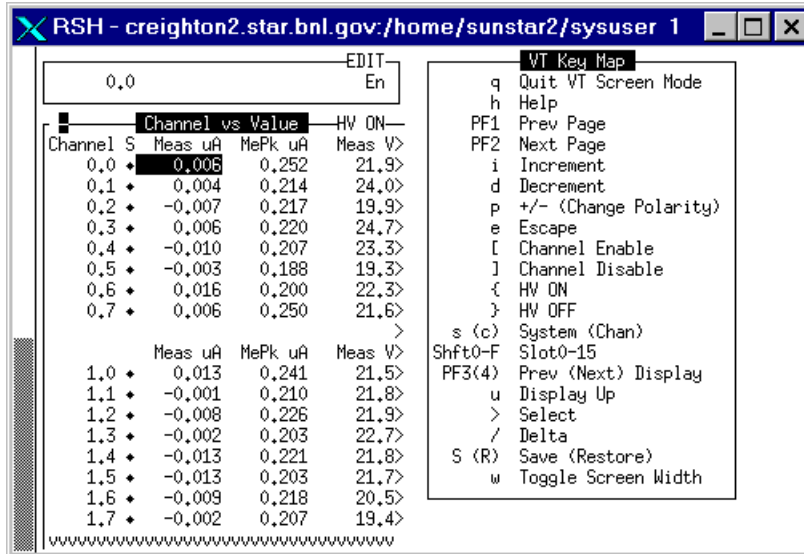
8. This shows a partial display of the first two HV cards plus the help screen. Typing "w" toggles to the full display, shown below:
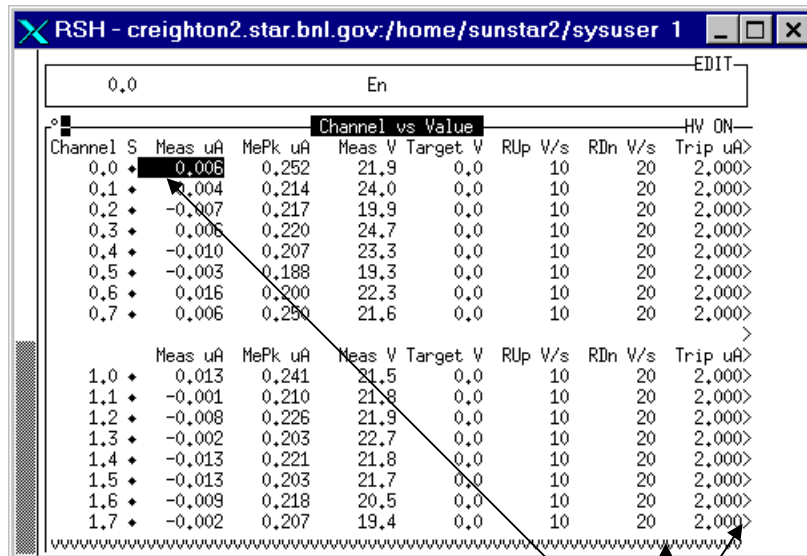
There is more information than can be displayed on one screen. The arrow (>)shows the direction where more data can be found. Use the keyboard arrow keys to move the cursor to different cells – moving all the way to the right or bottom will cause the display to shift over or down.

The rows are labeled by the crate slot number of the HV card and the output channel within the card. Each CARD controls TWO sectors (either inner or outer).

A translation table between the serial window designation (Card slot #.channel #) and the actual Sector & Section is shown below :

INNER			INNER			Outer			Outer		
Lecroy	Sector	Section	Lecroy	Sector	Section	Lecroy	Sector	Section	Lecroy	Sector	Section
0.0	1	1	6.0	13	1	0.0	1	5	6.0	13	5
0.1	1	2	6.1	13	2	0.1	1	6	6.1	13	6
0.2	1	3	6.2	13	3	0.2	1	7	6.2	13	7
0.3	1	4	6.3	13	4	0.3	1	8	6.3	13	8
0.4	2	1	6.4	14	1	0.4	2	5	6.4	14	5
0.5	2	2	6.5	14	2	0.5	2	6	6.5	14	6
0.6	2	3	6.6	14	3	0.6	2	7	6.6	14	7
0.7	2	4	6.7	14	4	0.7	2	8	6.7	14	8
1.0	3	1	7.0	15	1	1.0	3	5	7.0	15	5
1.1	3	2	7.1	15	2	1.1	3	6	7.1	15	6
1.2	3	3	7.2	15	3	1.2	3	7	7.2	15	7
1.3	3	4	7.3	15	4	1.3	3	8	7.3	15	8
1.4	4	1	7.4	16	1	1.4	4	5	7.4	16	5
1.5	4	2	7.5	16	2	1.5	4	6	7.5	16	6
1.6	4	3	7.6	16	3	1.6	4	7	7.6	16	7
1.7	4	4	7.7	16	4	1.7	4	8	7.7	16	8
2.0	5	1	8.0	17	1	2.0	5	5	8.0	17	5
2.1	5	2	8.1	17	2	2.1	5	6	8.1	17	6
2.2	5	3	8.2	17	3	2.2	5	7	8.2	17	7
2.3	5	4	8.3	17	4	2.3	5	8	8.3	17	8
2.4	6	1	8.4	18	1	2.4	6	5	8.4	18	5
2.5	6	2	8.5	18	2	2.5	6	6	8.5	18	6
2.6	6	3	8.6	18	3	2.6	6	7	8.6	18	7
2.7	6	4	8.7	18	4	2.7	6	8	8.7	18	8
3.0	7	1	9.0	19	1	3.0	7	5	9.0	19	5
3.1	7	2	9.1	19	2	3.1	7	6	9.1	19	6
3.2	7	3	9.2	19	3	3.2	7	7	9.2	19	7
3.3	7	4	9.3	19	4	3.3	7	8	9.3	19	8
3.4	8	1	9.4	20	1	3.4	8	5	9.4	20	5
3.5	8	2	9.5	20	2	3.5	8	6	9.5	20	6
3.6	8	3	9.6	20	3	3.6	8	7	9.6	20	7
3.7	8	4	9.7	20	4	3.7	8	8	9.7	20	8
4.0	9	1	10.0	21	1	4.0	9	5	10.0	21	5
4.1	9	2	10.1	21	2	4.1	9	6	10.1	21	6
4.2	9	3	10.2	21	3	4.2	9	7	10.2	21	7
4.3	9	4	10.3	21	4	4.3	9	8	10.3	21	8
4.4	10	1	10.4	22	1	4.4	10	5	10.4	22	5
4.5	10	2	10.5	22	2	4.5	10	6	10.5	22	6
4.6	10	3	10.6	22	3	4.6	10	7	10.6	22	7
4.7	10	4	10.7	22	4	4.7	10	8	10.7	22	8
5.0	11	1	11.0	23	1	5.0	11	5	11.0	23	5
5.1	11	2	11.1	23	2	5.1	11	6	11.1	23	6
5.2	11	3	11.2	23	3	5.2	11	7	11.2	23	7
5.3	11	4	11.3	23	4	5.3	11	8	11.3	23	8
5.4	12	1	11.4	24	1	5.4	12	5	11.4	24	5
5.5	12	2	11.5	24	2	5.5	12	6	11.5	24	6
5.6	12	3	11.6	24	3	5.6	12	7	11.6	24	7
5.7	12	4	11.7	24	4	5.7	12	8	11.7	24	8

The columns in the serial session window are as follows:

Channel	Output	
S (status)	Output	Blank = disabled, ♦ = enabled, ⊥ = tripped
Meas μA	Output	Measured current (not baseline corrected)
MePk μA	Output	Measured peak current (~ .2 -.3 even with 0 volts)
Meas V	Output	Measured voltage
Target V	Input	Demand voltage
Rup V/s	Input	Voltage ramp up rate (should be 10 V/s)
RDn V/s	Input	Voltage ramp down rate (should be 20 V/s)
Trip μA	Input	Current trip limit (should be 2.0 μA)

Shifting the display over reveals more columns:
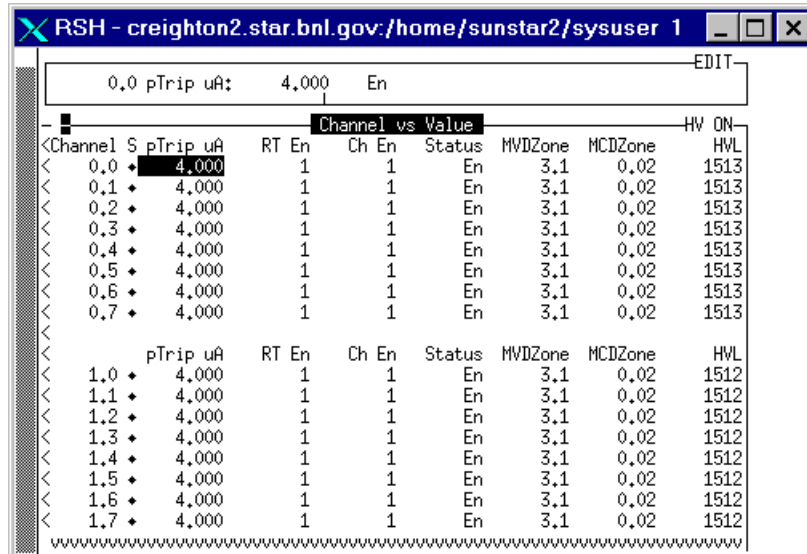
pTrip μA	Input	Peak current trip limit (should be 4.0 μA)
RT en	Input	Ramp trip enable (trips a channel during ramp up is current exceeds 40 μA (should be 1)
Ch En	Input/Output	Enable status (0=disabled, 1=enabled)
Status	Output	Channel status (Shows trip codes)
MVDZone	Input	Voltage Dead Zone – variations in measured voltage smaller than this value will not be updated on the screen (should be 3.1 V)
MCDZone	Input	Current dead zone – variations in measured current smaller than this value will not be updated on the screen (should be 0.02)
HVL		Hardware voltage trip limit – set by front panel pot on the card. Outer = 1510 Inner = 1210

9. To control the HV you only need a few commands:

```
X RSH – creighton2.star.bnl.gov:/home/sunstar2/sysuser 1   _ □ ×
                                                          ─EDIT─
        0.0                    En
 ○■                ─Channel vs Value─              ─HV ON─
Channel S  Meas uA  MePk uA  Meas V Target V  RUp V/s  RDn V/s  Trip uA>
   0.0 ◆     0.006    0.252    21.9    0.0       10       20      2.000>
   0.1 ◆     0.004    0.214    24.0    0.0       10       20      2.000>
   0.2 ◆    -0.007    0.217    19.9    0.0       10       20      2.000>
   0.3 ◆     0.006    0.220    24.7    0.0       10       20      2.000>
   0.4 ◆    -0.010    0.207    23.3    0.0       10       20      2.000>
   0.5 ◆    -0.003    0.188    19.3    0.0       10       20      2.000>
   0.6 ◆     0.016    0.200    22.3    0.0       10       20      2.000>
   0.7 ◆     0.006    0.250    21.6    0.0       10       20      2.000>
                                                                    >
           Meas uA  MePk uA  Meas V Target V  RUp V/s  RDn V/s  Trip uA>
   1.0 ◆     0.013    0.241    21.5    0.0       10       20      2.000>
   1.1 ◆    -0.001    0.210    21.8    0.0       10       20      2.000>
   1.2 ◆    -0.008    0.226    21.9    0.0       10       20      2.000>
   1.3 ◆    -0.002    0.203    22.7    0.0       10       20      2.000>
   1.4 ◆    -0.013    0.221    21.8    0.0       10       20      2.000>
   1.5 ◆    -0.013    0.203    21.7    0.0       10       20      2.000>
   1.6 ◆    -0.009    0.218    20.5    0.0       10       20      2.000>
   1.7 ◆    -0.002    0.207    19.4    0.0       10       20      2.000>
```

```
      ─VT Key Map─
   q   Quit VT Screen Mode
   h   Help
  PF1  Prev Page
  PF2  Next Page
   i   Increment
   d   Decrement
   p   +/- (Change Polarity)
   e   Escape
   [   Channel Enable
   ]   Channel Disable
   {   HV ON
   }   HV OFF
 s (c)  System (Chan)
Shft0-F  Slot0-15
PF3(4)  Prev (Next) Display
   u   Display Up
   >   Select
   /   Delta
 S (R)  Save (Restore)
   w   Toggle Screen Width
```

{	Turns the HV ON for the <u>whole crate.</u>
}	Turns the HV OFF for the <u>whole crate</u>
[	Enables the HV for the channel (row) that has the cursor (ie channel 0.0 above)
]	Disables the HV for the channel.
Shft 0-B	Scrolls up/down to slot (0 – B) There are 12 slots occupied in each crate.

To change the target (demand) voltage for ONE channel, use the arrow keys to move the cursor to the "Target V" column for that channel. Then type in the needed voltage and hit CR.

To change the target voltage for multiple channels, use the select key. First, move the cursor to the "Target V" column of the first channel to change. Then type > and use the down arrow to highlight more channels. When all channels of interest have been highlighted, type in the desired voltage and CR. Thus, to change 0.0 – 0.7, the window looks like this. The new target voltage appears in here:

```
X RSH – creighton2.star.bnl.gov:/home/sunstar2/sysuser 1   _ □ ×
                                                          ─EDIT─
       0.0 - 0.7>          En
                  ─Channel vs Value─              ─HV ON─
Channel S  Meas uA  MePk uA  Meas V Target V  RUp V/s  RDn V/s  Trip uA>
   0.0 ◆    -0.006    0.216    20.7    0.0       10       20      2.000>
   0.1 ◆     0.005    0.216    22.7    0.0       10       20      2.000>
   0.2 ◆    -0.005    0.183    22.5    0.0       10       20      2.000>
   0.3 ◆    -0.007    0.190    20.5    0.0       10       20      2.000>
   0.4 ◆    -0.008    0.194    22.2    0.0       10       20      2.000>
   0.5 ◆    -0.010    0.217    20.1    0.0       10       20      2.000>
   0.6 ◆    -0.003    0.199    22.1    0.0       10       20      2.000>
   0.7 ◆    -0.005    0.219    20.9    0.0       10       20      2.000>
                                                                    >
           Meas uA  MePk uA  Meas V Target V  RUp V/s  RDn V/s  Trip uA>
   1.0 ◆     0.009    0.290    16.6    0.0       10       20      2.000>
   1.1 ◆     0.012    0.227    16.8    0.0       10       20      2.000>
   1.2 ◆     0.001    0.248    15.0    0.0       10       20      2.000>
   1.3 ◆    -0.025    0.250    15.7    0.0       10       20      2.000>
   1.4 ◆    -0.008    0.248    13.3    0.0       10       20      2.000>
   1.5 ◆     0.007    0.217    16.2    0.0       10       20      2.000>
   1.6 ◆     0.004    0.282    15.0    0.0       10       20      2.000>
   1.7 ◆     0.014    0.235    13.5    0.0       10       20      2.000>
```

Since there are only 4 sectors visible in the serial session windows at a time, it is NOT recommended as a method for operating the entire TPC. It is useful for checking that the slow controls GUI is operating properly or for resetting one or two channels.

TURNING OFF

If the TPC is to be off for some time it is best to reduce the voltages to zero and close all the active windows properly. This includes the serial sessions, VME terminal server windows and the GUI. Sessions that aren't closed out can cause problems later.

SERIAL SESSIONS

1. Do the following for each window (inner and outer):

2. Type q. This gets back to the "1\EDIT\1450>" prompt.

3. Type quit CR It will say "bye bye". Type ~. (tilde, period) This will end the tip session
   and return to the creighton2 prompt. Type exit to get to sc then exit again to close out.

SCSERV SESSIONS (VME)

1. Do the following for both 9006 (inner) and 9013 (outer).

2. Type CTRL]. This will get the telnet prompt. Type quit to get back to sc then exit to close.

SLOW CONTROLS GUI

1. Using the "ALL SECS" control window, set the demand voltage for inner and outer
   to 0.

2. Wait for the voltage to ramp down. When the measured voltage reads ~ 20 V,
   push "Disabled" for both inner and outer.

3. When the status turns grey, return to the main GUI and click "HV OFF" for both.
   The HV status lights will turn grey.

4. Close all auxiliary windows and then close the main Anode GUI.

TROUBLESHOOTING

1. All the anode HV are on and one of the VME processors is spewing out error messages and the ARCNET light is red! Can I safely reboot?

   YES – The Lecroy stores the setpoints locally and the HV will stay on while the
   VME reboots. All trip functionality is also working.

2. The TPC is up and running and all of a sudden ALL the HV go off (including gated grid and cathode) and there is a loud beeping noise. What the hell?

   Gas alarm – some critical gas system parameters (methane content, TPC pressure etc)
   are tied into the interlock system. Under certain conditions, ALL TPC HV
   are turned off. To recover after the gas system is operational again,
   first run all demand voltages (for all systems) to zero and start from
   scratch.