PrimEx Shift Takers Documentation

Version: September 16, 2004

Please submit all updates, changes and corrections to Dan Dale

Contents

1 What do I need to do before taking a shift?

Reference copies of the following documents will be available in the Counting House for the duration of the experiment.

- The Conduct of Operations for JLab Experiments (COO).
- Experiment Safety Assessment Document (ESAD) for *PrimEx* (referring to the base equipment as well as any experiment-specific changes)
- Radiation Safety Assessment Document (RSAD)
- Hall B Experimental Equipment Operations Manual (EEOM)
- Personnel Allowed to Operate Hall B Equipment
- JLab Emergency Response Plan

The COO, the ESAD and the RSAD are required reading for shift personnel. All personnel on shift are required to have successfully completed and be current in the following JLab safety training:

- EH&S Orientation (SAF 100)
- Radiation Worker Training (SAF 801)
- Oxygen Deficiency Hazard Training (SAF 103)
- Hall B Safety Awareness Walk-Through
- Conduct of Operations

All experiment personnel are required to have radiation badges in their possession during their shifts.

2 Documenting what happens while on shift

2.1 Logbooks

Throughout the experiment, both electronic and paper logs will be maintained. **It is difficult to understate the importance of clear, thorough documentation of what occurs during the run.** The Collaboration has decided that the paper logbook will be the primary logbook during commissioning. During the data taking phase, the electronic logbook will take precedence, and only things that cannot easily be entered in the electronic log will be recorded in the paper logbook. Acceptable languages for logbook entries are English, Russian, Armenian, Chinese, Japanese, and Bangla.

2.2 How do I do a snapshot of a screen?

Right click on a background → Applications → Snapshot

After you save the image, you can go to File and “Save As”, or Print it directly.

3 *PrimEx* beam quality requirements

- Knowledge of the electron beam energy with 3×10^{-4} accuracy.
- Stability of the electron beam energy $\leq 10^{-4}$.
- Stability of the beam intensity $< 5\%$.
- Beam position stability on the entrance to the Hall B photon tagger dipole (controlled by the x and y positions on 2C22A and 2C24A) $< 100\mu m$.
- Beam divergence at 2C24A $< 100\mu$ radians.
- Beam spot size at the tagger harp: $\sigma_x \leq 100\mu m$ and $\sigma_y \leq 100\mu m$.
- The Hall B tagger dipole magnet will have a fixed current throughout the entire run. **Under NO circumstances should the position of the beam spot on the tagger viewer be adjusted by changing the tagger magnet current!**

4 Tagger

4.1 Bremsstrahlung Radiators

Brems radiators:

radiator label	thickness
A	3×10^{-4}
B	1×10^{-4}
C	1×10^{-5}
D	1×10^{-5}

Figure 1: Screen shot of the tagger radiator gui.

4.2 How to plateau the focal plane counters

4.2.1 T counters

4.2.2 E counters

4.3 How to check tagger is working properly

5 Target

5.1 Overview

We have the following targets intercepting the beamline:

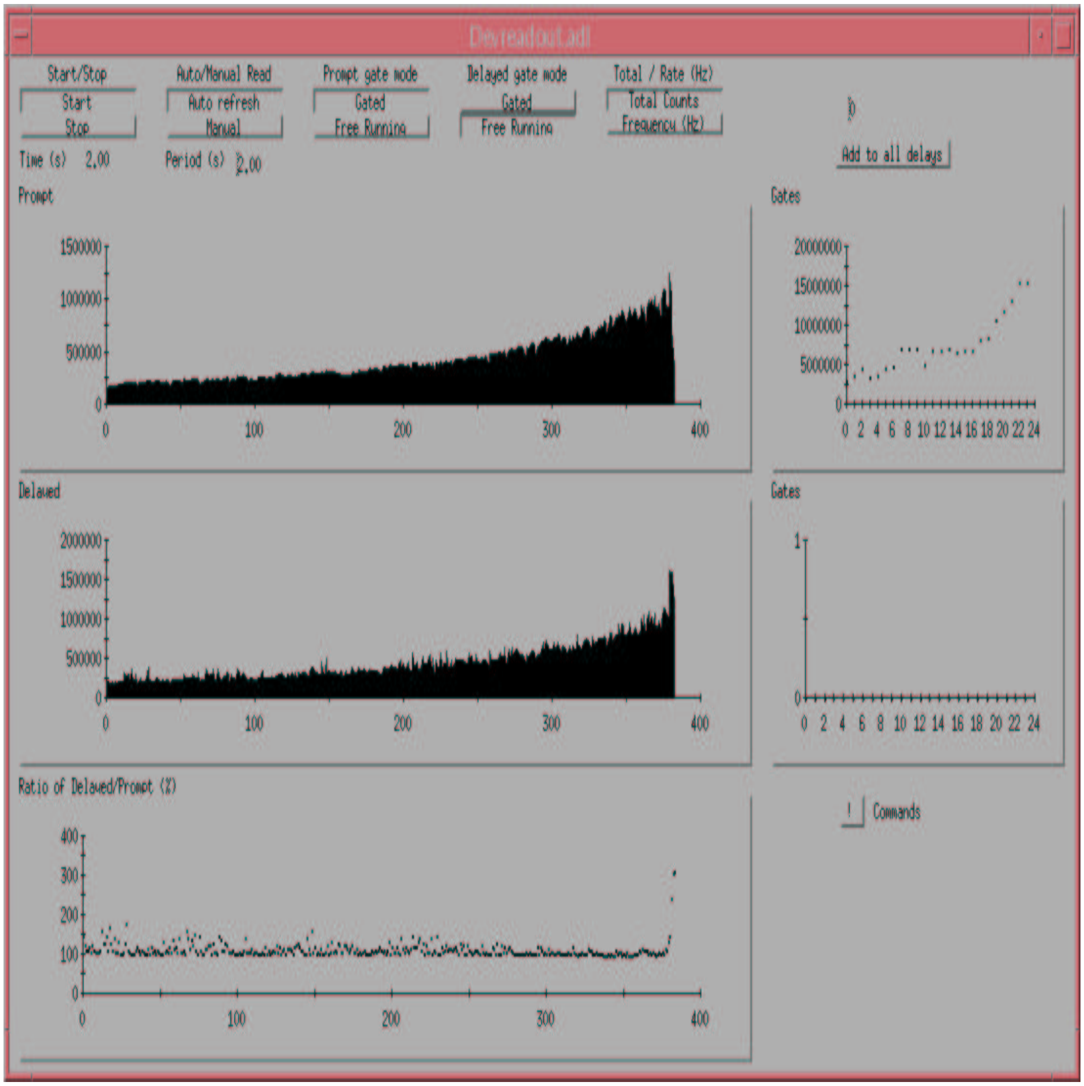

Figure 2: Screen shot of the tagger monitoring histograms.

Brems radiators:

radiator label	thickness
A	3×10^{-4}
B	1×10^{-4}
C	1×10^{-5}
D	1×10^{-5}

Harp (order from top to bottom):

converter label	thickness
carbon	$1\% X_o$
Be	$0.1\% X_o$
Al	$1.1 \times 10^{-4} X_o$
W wire	100μm

PrimEx target ladder:

PrimEx target label	thickness
blank	
C	$5\% X_o$
Pb	$5\% X_o$
Sn	$5\% X_o$
Be	$0.5\% X_o$
wires	

5.2 How to move the target

"Field Guide for the Primex Target Ladder"
Author: Eric Clinton

The GUI should be available on the clon01 tree under *primex_target.adl*.
To bring up *PrimEx* target gui:

medm -x primex_target.adl

It's a point, click, and wait (a long time, usually) operation.
If you want to run the ladder to the limit switches (and redefine the origins of the axes), hit the "home button". If you want to center the ladder on 1.1% Al target, click on that button. Same for any of the other targets/positions. The GUI will highlight which target/position the ladder is current centered on.
The "Big Blank" position is a large hole of roughly 1.3 inches square. Plenty of room for the beam to pass through.
If the ladder is moved for some reason, or if there is doubt as to its true position, the recommended procedure is to click "home" and wait until both X and Y status fields read "done". Then click on the desired position/target. Wait until the status fields read "done". This whole process can take upwards of 1/2 hour due to large gear and speed reduction in the Y direction.

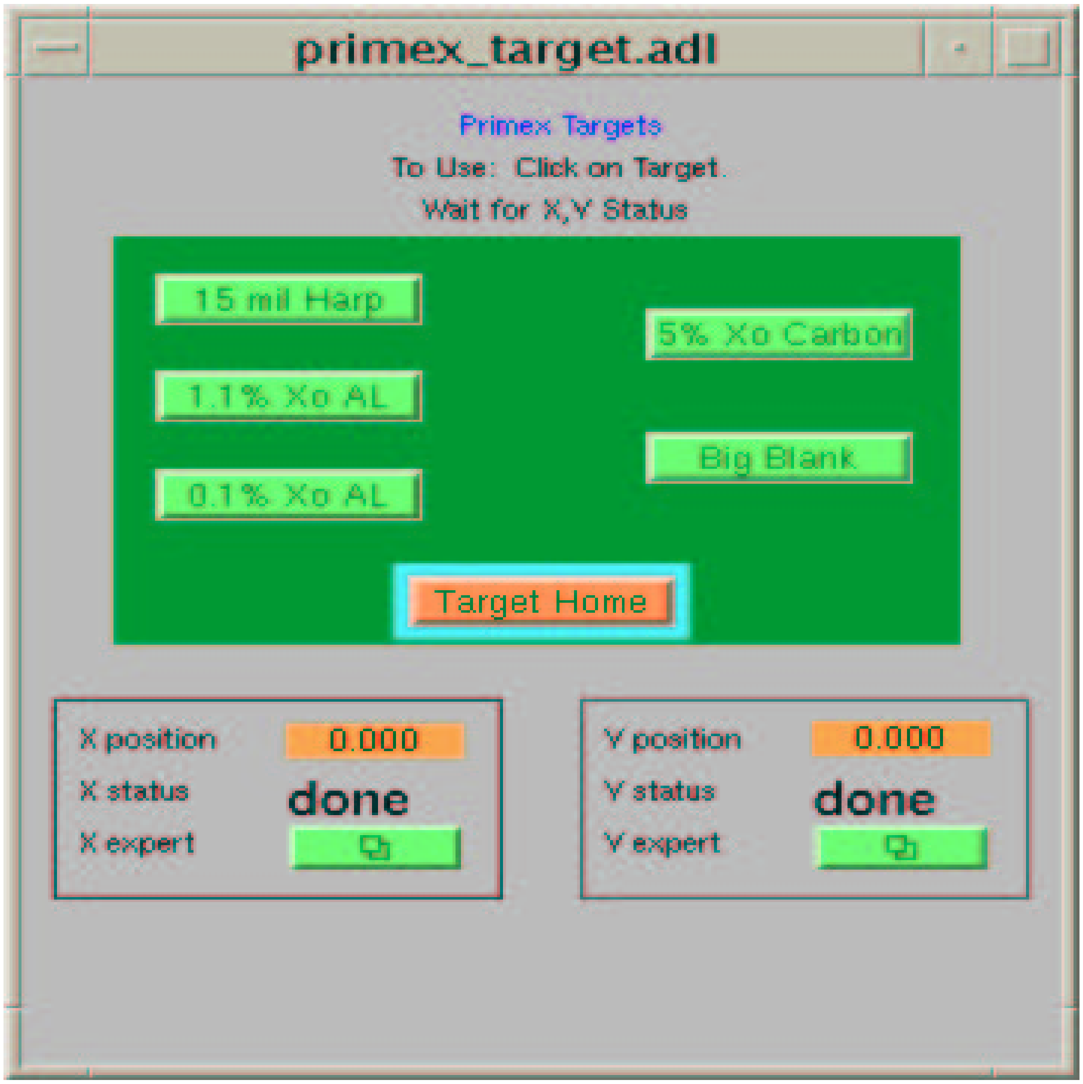

Figure 3: Screen shot of the *PrimEx* target gui.

***Please note well. The following problem is a hardware level issue with the driver card, and it can't be easily fixed right now. Sometimes the card does not fully move to the X/Y value specified in the database–the card hangs up and stops moving an axis. That axis shows a status of "done". The current guess is that there is a processor speed bottleneck. The quick and dirty solution is to double check that the X and Y values shown by the GUI correspond to what are known to be good target/position X/Y values. Fortunately, when the card hangs up, all it does is stop driving the motor and remembers where it stopped. So, all one needs to do re-click the button for the desired target/position if the card hangs. This may require two or more attempts.

Target 1 = 15mil Tungsten wire

X = 14.1034 Y = 11.89355

Target 2 = 1.1X = 44.2659 Y = 11.89355
Target 3 = 0.1X = 74.4284 Y = 11.89355

Target 4 = 5X = 104.5909 Y = 11.89355

Target 5 = "Big Blank"
X = 149.8346 Y = 19.42465

If you have any questions, feel free to contact me.

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6 Pair Spectrometer

6.1 Discriminators

Thresholds are 46 mVolts.
Widths are 30 nsec.

6.2 How to check it is working properly

Bringing up pair spectrometer medm screen:
log on clon01 as clasrun

type:

clas_epics
using *clas_epics* GUI navigate to *Photon Devices* > *pair_spec_central*
from here you have access to all vital Pair Spectrometer controls:
1. *pspec_scalers* channels 0-6 no detetors conected channels 7-31 correspond to detectors from PF-8 through PF-32 (singles)

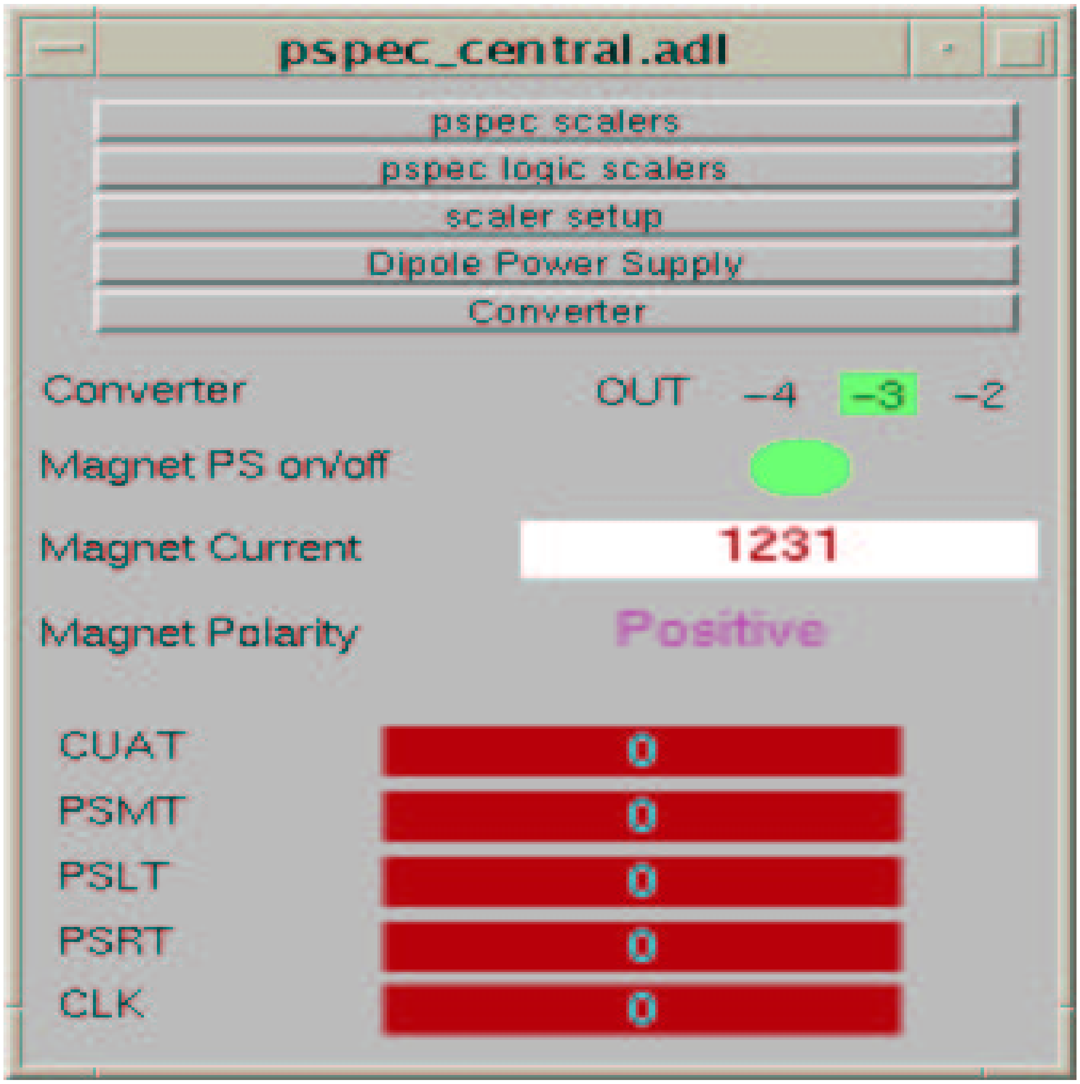


Figure 4: Screen shot of pair_spec_central.

2. pspec_logic_scalers channels 16-31 correspond to detectors from PB-1 through PB-16 (singles) channels 0-6 ————–??????????????????——?????????????—-

3. *scaler_setup* better not play with this

4. *Dipole_Power_Supply* brings up a screen wich allows you to control Pair Spectrometer Magnet Power Supply.

5. Converter brings up a screen which let's you to put in or retract different pair converters

6.3 Setting the High Voltage

login to clon01 as clasrun

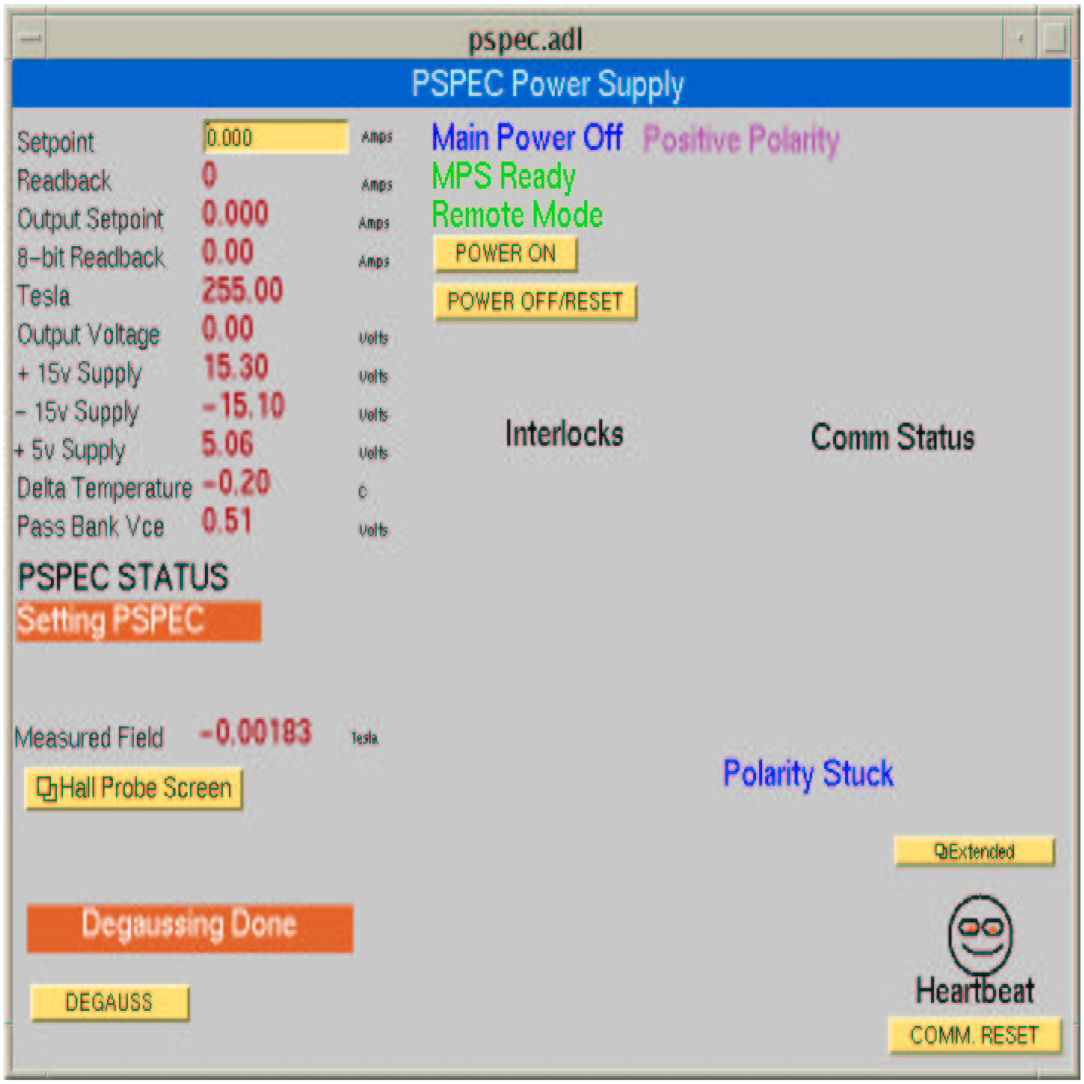


Figure 5: Screen shot of pair spectrometer magnet screen

type *clas_epics*:

using *clas_epics* GUI navigate to *High Voltage* > *Beam_HV* >*pair_spec_new*

Typical pair spectrometer voltages:
front -1100V
back -1050V

To get an HV channel map:
cd $APP
cd hvcal

cd db
more bm.dat
A user shouldn't change anything in bm.dat
Explanation of table is on:
clasweb.jlab.org/slow/doc/hvgui/node3.html

6.4 How to plateau the pair spectrometer detectors

login to clon01 as clasrun

type:

primex/Plateau/ps_plateau.pl

this will show the usage statement, an example command to plateau the PS detectors looks like:

ps_plateau.pl hvmax=-1650 hvmin=-600 nsteps=25

This will produce plateau curves for all ps-counters at 25 HV points evenly spaced between -1650V and -600V, inclusive.

6.5 How to set the Pair Spectrometer magnet

The excitation curve for the dipole is shown is figure 6, and a few centerline maps are shown in figure 9. The fields are in Gauss and the current is in Amps. Negative current values correspond to negative polarity, which gives a magnetic field pointing down.
A fit to the data gives:

$$I(Amps) = -0.6657 - 0.1537 \times B(Gauss)$$

To obtain reproducable fields the procedure to follow is:

1 If the magnet is cold (not used recently), it has to be warmed up at 2975 AMps for about an hour. One has to be careful here because the current trip is set to 3010 A.

2 Ramp down the current to zero, and wait for 3 minutes.

3 Ramp up the current to 2975 Amps and stay there for 3 minutes.

4 Set the current to the desired value.

This procedure gives field reproducibility to better than 10^{-4}.

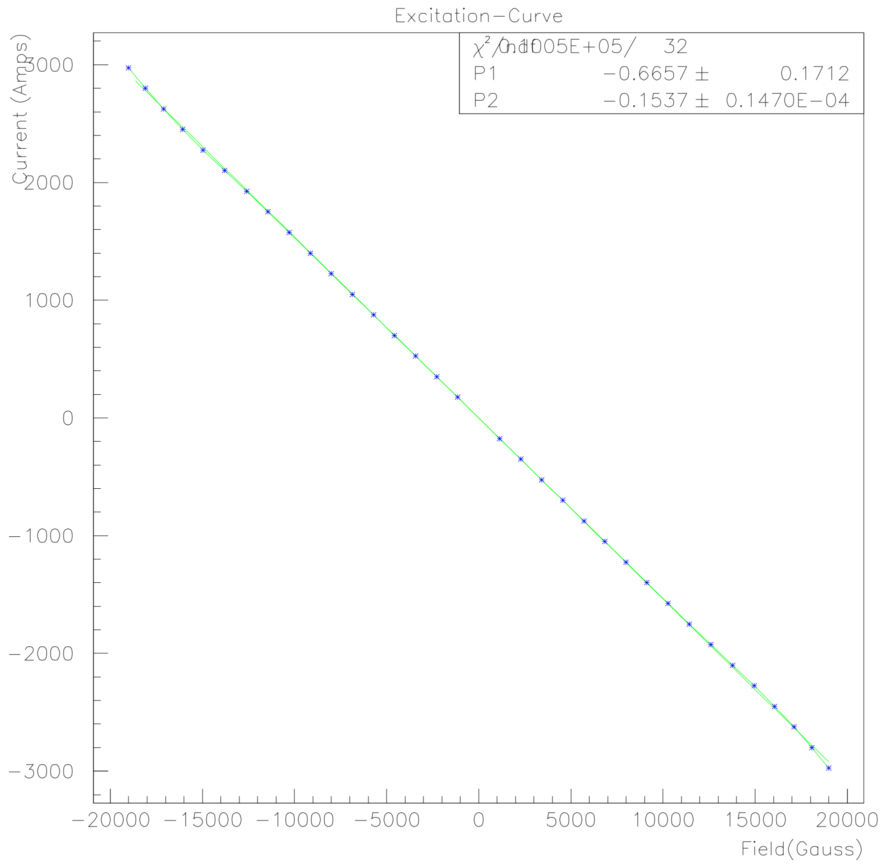


Figure 6: Pair spectrometer dipole excitation curve.

6.5.1 How to verify magnetic field setting is correct

7 Beamline

7.1 Overview

7.2 How to do an electron harp scan

(The following is based on: $http://claspc1.jlab.org/PROCEDURES/electron\_beam\_profile\_scan/$)

There are now THREE harps on the HallB beamline.

harp_2C21
located just upstream of the Goniometer, just downstream of the 2C21 girder. This harp is 40.8m upstream of the CLAS target. This harp has 20μm Tungsten wires.
harp_tagger
located just upstream of the tagger magnet, 22.1m upstream of the CLAS target. This is the "default" harp, as it is the oldest harp device in Hall B. The harp stick has the nominal 50μm tungsten wire as well as 4 target positions for radiators to produce the photon beam.
harp_2H00
located downstream of the tagger magnet and collimator box, 15.5m upstream of the CLAS target. This harp has two sets of wires, 100μm Fe, 1mm Fe and has a 10mmx1mm plate. This harp is intended to measure the electron beam halo and photon beam profile. The halo portion of the harp stick has not been commissioned yet.
The purpose of a harp scan is to determine the electron or photon beam profile. During the wire scan the beam scintillation counters are read out and their rates are correlated with the position of the wire to not only obtain beam profile but the position of the beam relative to the harp can also be determined. Two devices, the harp stepper motor and the PMT scaler, are synchronized via an epics application. This procedure from initiating the motor motion to analyzing the data is commonly referred to as "taking a harp scan."

To take a harp scan:
A harp scan is performed whenever the electron beam has been restored to the Hall B beamline or if the beam conditions have changed during a run. The whole procedure can be performed from the harps (see Figure x) GUI which is launchable from the *clas_epics*. First decide which harp to use, *tagger_harp* is usually the correct choice, click on the *tagger_harp_scan* button on the harps.adl GUI, this will open the harp scan GUI. The time it takes to perform a harp scan should be less then 15 minutes. Before taking a harp scan you should verify the following:

* Drift Chamber High Voltage is off or lowered sufficiently. This will presumably be the case for the entire *PrimEx* run.
* Beam halo counters are operational
* MCC is not moving the beam or changing beam conditions.

To initiate a harp scan click on the SCAN button on the harp GUI (see Figure). You should see evidence that the motor is moving on the GUI, if motor/application appears stuck follow the steps outlined in the stepper motor TSG (*http://claspc1.jlab.org/TSG/stepper_motors*). The harp will return to the "Retract" position when the scan is complete and the position reading will be 0.0mm. During the scan, the beam scalers are read out and the data resides in an ASCII file in */home/clasrun/SCANS/SCAN_harp_n.txt*.

Looking at the Data

When a scan is finished it will write a file in to */home/clasrun/E_SCANS* directory on clon01, the name indicated in the log file box. Files from the harp will be named *harp_name_date_time.txt*. The harp analyzer GUI is launched by using the Analyze Scan Data button (see Figure). This will bring up a Tcl/TK GUI that allows the user to configure the data fitting/selection and a gnuplot window displaying the data and fits (see Figures and). The scan data is fit to a simple Gaussian plus constant background. The results of the fit appear in the top part of the gnuplot window as well as the Tcl/Tk GUI. The width and signal/background values on the Tcl/Tk GUI will appear on a yellow/red background if the values are out of specification.

Printing a SCAN

To get a hard copy of a scan, simply choose the "print" option underneath the File menu. If you wish to ship a copy to MCC, use the "print setup" option underneath the File menu to set the print command to "lpr -dmcc104a". If you want the printout in color click the "color" button on the "print setup" screen.

7.3 How to do a photon harp scan

7.4 Photon beam collimator

We will have two photon beam collimators (8.6 and 12.7 mm) as well as a convertor mounted in the collimator box.

7.5 How to use the sci-fi beam position monitor

To run sci-fi monitor scaler program:

cd /home/hovanes/EPICS/app/primex_profiler/medm

$> medm - xpg\_profile.adl$

Typical sci-fi monitor voltages:

PMT 1: 815V
PMT 2: 840V
PMT 3: 860V
PMT 4 805V

7.6 Electron beam position monitors

8 Flux normalization with the TAC

8.1 How to set the TAC voltage

8.2 How to do a TAC run

- Call MCC (x7048). Tell them to turn orbit locks off.
- Request current of 70 picoAmps.
- Change trigger to MOR.
- Put in radiator D. Note: Never put more than 1 nAmp on radiator D. MOR rate should be about 10 kHz.
- Remove *PrimEx* target, if that is the type of run you are doing.
- Put the TAC in. (Go Beam on the gui.)
- Begin run.
- End run.
- Take TAC out.
- Put in radiator B.
- Put in *PrimEx* target, if appropriate.
- Change trigger to production run.
- Call MCC. Ask them to put orbit locks back on and increase beam current.

8.2.1 How to ensure TAC is working properly

9 Data acquisition

9.1 How to begin and end runs

9.2 How to check it is alive and running properly

9.3 How to change the trigger configuration

9.4 How to do a cosmic run

10 HYCAL

10.1 The HYCAL interlock/alarm system

effect	**action**
door open	HV + booster power supplies off
hardwire trip temperature sensor (Omega) $> 26°C$ (adjustable)	HV + booster + fan off + alarm + page
chiller trip	alarm + page
water leak (wire sensor)	chiller off + alarm + page
hygrometer ΔH	chiller off + alarm + page
$\lvert\Delta T_{innerPbWO_4}\rvert \geq 2°C$ $\frac{dT}{dt} > 0.1°C/hour$ (adjustable)	alarm
$\lvert T_{supplycoolingwater} - T_{crystalA}\rvert > 3°C$ $\lvert T_{supplycoolingwater} - T_{crystalB}\rvert > 3°C$	alarm

10.2 The HYCAL high voltage system

by Eric Clinton

NEVER change the HYCAL voltage unless you are absolutely sure of what you are doing.

The executable "primexHV" which is used to control the HYCAL high voltage is under password protection. There are separate passwords to log in as an Adminstrater with full read/write access, User with limited read/write, and as a guest with only read priveleges. We will use the Admin configuration during commissioning to calibrate the gains on each of the 2000 + HV channels. We will then switch to a specially configured "user" mode for the physics run.

As it is extremely important that the voltages not be inadvertently changed, the Admin password will be restricted to only a few people qualified to change HyCal HV settings. These people are the expert shift takers.

There is a built in crate definable High Voltage limit that can be set across a whole board. In principle, this can prevent too high of a voltage being placed on a PMT and thus damaging it. However, we are unable to use this feature due to the mixing of Lead Glass and Lead Tungstate detectors on the same board. The maximum voltage for a Lead Tungstate is simply too low for the Lead Glass PMTs to function. Therefore, a software limit has been implemented. This safeguard is based on our naming convention for our detectors. All channels with a "W" as the first letter of their name have a maximum writable voltage of 1300V. Lead glass is similarly protected. The veto counter, light monitoring system, and total absorption counter (TAC) voltages will also be protected in this manner. As long as this naming convention is respected and any changes registered with the maintainers of the code, this protection should be adequate.

The CAEN SY1527 are interlocked to the door, moisture, and chiller interlocks. If an interlocked door is opened, moisture detected, or if the chiller is disabled, the HV is shut down. This prevents damage to the PMTs (wrt the first two interlocks) and prevents rapid heating of the interior of HyCal (wrt the last interlock), which are vital to the health of the Lead Tungstate.

HV_status_mon: A (separate from "primexHV") status monitoring program will query all channels every 30 seconds regarding trip, over/under voltage conditions, disconnections, disabled, overcurrent and power on/off status. Errors will be written to a file local to the Linux machine running "primexHV" and to either or both the CVS repository or to the PrimEx website for archival and online purposes.

A hardware TTL signal from the SY1527 to the Counting House will also be implemented. This signal will be an OR of all possible status errors that will affect crate and board operation. All of these status errors will generate a message in "HV_status_mon".

10.2.1 HVinit and HV_status_mon

HVinit is located on primexhv in the Hall B Couniting Room. It lives under
/home/primex/src/programs/HighVoltage/HVinit/bin/Linux.
The command line options tell most of it's story.
primexdaq2:Linux>HVinit
Usage:
HVinit[options]
options:

- -h Print this usage statement
- -I Initialize HV crates. No snapshot.
- -S Do not initialize, only take snapshot of system, cd into 'latest'
- -O Do not initialize, take Snapshot and make it new CPD Current Parameter Directory (CPD).
- -Uname Initialize with User specified Parameter Directory User specified directory becomes CPD.
- -P Print CPD
- -M Enter 'Safe Mode'-all channels set to V=500volts
- -N[#] Program Channel names from MySQL DB. If # is specified then only update that crate.

primexdaq2:Linux>
HVinit does not power on or off any channels. Thus if potentailly damaging initialization errors occur, no damage can be done unless someone uses either primexHV or is physically at the crate and turns on channels without checking to make sure voltage setpoints are reasonable.
'HVinit -I' loads High voltage settings into all the crates from sequentially named files in the symbolically linked "current" directory. This symbolic link must exist for 'Hvinit -I' to work.
'HVinit -S' takes a snaphot of the entire system. It writes all files into a time stamped

directory, preserving the sequential naming structure of the files. It does not overwrite the "current" symbolic link but does overwrite the "latest" symbolic link. The idea behind this option is for testing and diagnostic purposes without altering good high voltage settings.
'HVinit -O' takes a snapshot just like 'HVinit -S' but it also changes the "current" symbolic link to the new time-stamped just created by this option or the "-S" option. It also updates the "latest" symbolic link.
Options -S and -O also archive the sequential channel map files into a time stamped directory located on the primex group account at /group/primex/HV_archives/snapshot/.
'HVinit -Uname' simply changes the "current" symbolic link to a user specified directory.
'HVinit -P' prints the path of the "current symbolic link.
'HVinit -M' sets all channels to 500V. This is a "safe mode" that keeps HyCal energized and temperature stable by mantaining a heat load.
'Hvinit -N[#]' is self explanatory.

HV_status_mon is our definitive method of finding and diagnosing errors in the HyCal High Voltage system in real time, complementing the hardware alarm. It lives on primexhv at /home/primex/src/programs/HighVoltage/HV_status_mon/bin/Linux. It is a command line program, run on a terminal window as 'HV_status_mon -g'. 'HV_status_mon' or "HV_status_mon -h' should give all command line options, in case more are added later.
The shifttaker should make sure that HV_status_mon is running on a terminal, and if any doubts arise as to weather the process is still working, the shift taker should "Control C" the program to stop and re-start HV_status_mon.
HV_status_mon performs three major monitoring tasks. It monitors the TCP/IP connection to each crate and crate firmware, monitors board level errors such as current trips, over/under voltage conditions, connector disconnects, firmware failure, calibration status, and current power status of the primary channels of the A1932 distribution board.
It also specifically monitors all channels to assure that the nominal monitored voltage does not fluctuate by more than 2V, in accordance with CAEN specs and PrimEx requirments.
If a primary channel is off, the terminal will beep once for each primary off. A text message will print out on the terminal. No files will be generated.
If any other status fault is found (such as the one listed above), time stamped files containing a description of the errors wil be placed in time stamped directories and the most current errors will have a symbolic link of either "current_errors_status" or "current_errors_voltage" pointing to them. Obviously, the name of the link implies the type of error. The terminal will also beep when files are generated. A test message will also output on the terminal giving limited information on the number and species of errors. Furthur information lies in the text files.

HV_status_mon queries the crates for information about once every minute. A shifttaker should either "Control C" out of HV_status_mon or be prepared for a series of terminal beeps if one shuts down parts or all of HyCal.
If a massive amount of erros is suddenly generated, the shift taker should feel free to "Control C" HV_status_mon and restart it when all errors have been resolved. Otherwise, the terminal beeps may get a little irritating.
Depending on the reliability of the entire system, it may be advisable to re-start HV_status_mon every day to every shift. This will need ot be determined during commisioning time.
Both programs can be checkout out from CVS and made to run on any Linux sytem on site, since it uses proprietary CAEN Linux libraries and IP protocal.
/src/programs/HighVoltage/HVinit/
and /src/programs/HighVoltage/HV_status_mon
are where the programs reside in the CVs repository.

10.3 How ensure HYCAL is working properly

10.4 How to operate the light monitoring system

10.5 How to monitor HYCAL temperature control

10.6 HYCAL motion control

HyCal Transporter Instrumentation

Krister Bruhwel

July 2004

10.6.1 Overview

The purpose of this paper is to describe the theory and operation of the Hall B HyCal transporter control system. Although the system will be controlled via EPICS software, this document will only cover the electronic hardware used to control and interlock the system. There is a distinction made between Software (EPICS) and hardware (electronic) control of the transporter. All hardware interlocks will supersede any software limits that may be implemented. A basic overview of all components involved, theory of operation, and a detailed breakdown of each item that a technician may use to repair or modify the system is provided in this document.

10.6.2 Theory of Operation

The system is composed of two stepper motors that move a large transporter in the X and Y axis (See fig. 12). Each axis has hardware switches that limit its path of motion. In addition to end limit switches at the edges of axis travel, there are home switches in mid travel that will facilitate easy positioning during an experiment. To determine the exact location of the transporter, digital and analog encoders are used to transmit its position. The transporter is controlled by our standard EPICS software interface, and there are hardware interlocks installed to prevent unwanted movement of the transporter.
The transporter operates in two modes: normal mode and storage mode. The normal mode is used during an experiment when the transporter is positioned within its normal operation limits. The storage mode is used when the transporter must traverse higher in the Y axis than normal. This is used to clear the area for other experiments or work that may need to be done in the hall.

10.6.3 System Requirements

During normal operation, the system must stay within set boundaries in the beam-line area. This area will be kept clear during an experiment, minimizing the damage risk to personnel

and equipment.
During transporter storage, operator alertness is essential. The transporter will traverse the height of the space-frame and an operator must ensure that the path is clear at all times. Under any operational condition the transporter must be checked for mechanical problems that may arise. Drive train problems, movement of the transporter outside of preset limits, and unbalanced loading are all examples of events that may cause damage to personnel and equipment. Interlocks have been designed into the system to stop all transporter movement in the event of a problem. With these precautions and operator alertness, the transport will operator efficiently and safely.

10.6.4 Hardware Interlocks

There are two modes of operation, Normal Mode and Storage Mode. The main difference between the two modes is the height of the transporter in the Y axis. Above a certain height, an operator must be more alert to the movement of the transporter. A different set of hardware interlocks is used in each of the two modes.
The following hardware interlocks are used during normal mode:

1. Pitch and roll tilt sensors
2. Emergency stop buttons
3. Analog Y-axis encoder

The following hardware interlocks are used during storage mode:

1. Pitch and roll tilt sensors
2. Emergency stop buttons
3. Dead-man switch
4. X center limit switch

During normal operation, all transporter movement will stop in the event of a tilt sensor alarm, an emergency stop button is depressed, or the analog encoder goes above a predetermined Y-axis range.
During storage operation, all transporter movement will stop in the event of a tilt sensor alarm or emergency stop button is depressed. The transporter must have the dead-man switch depressed and the X-axis centered for any movement in the Y-axis.
See fig. 14 for a logic diagram.

10.6.5 Hardware Layout

The main transporter system is located on the space-frame. Its normal operating range during an experiment is limited to travel around the beam-line area, and when stowed it is positioned much higher in Y and limited to a centered position on the X axis.
The control system is located on level two, North-East side of the space-frame. A rack contains the VME crate and the Motor Driver chassis. All hardware interlocks are housed in the Motor Driver chassis. When an interlock has been generated, power to the axis X and/or Y motor is removed via an All Windings Off (AWO) selection at the driver. This prevents motor movement at the end of the control chain. Hardware interlocks supersede any other control logic used. Please see fig. 12 for the hardware layout.
Listed below are the major hardware components of the system:

- Stepper for motors X and Y motion.
- Dual upper and lower limit switches per axis.
- Home limit switches, X and Y axis.
- Emergency stop buttons.
- Dead-man switch.
- X center limit switch.
- tilt sensor box.
- Analog encoder for position monitoring and interlocking of the Y axis.
- Two digital encoder for positioning on Y axis and one on the X axis.
- Motor Driver Chassis.
- VME crate with IOC.
- VME Motor Driver control board.
- VME Motor Driver ADC board.

10.6.6 System Components

A schematic diagram of the connections among the following system components is shown in fig 13.
<u>VME Crate</u>

The VME crate is located on level 2 of the space frame NE side. It contains the Input Output Controller, Motor Driver Board, and the Analog Input Module.

MVME 2306 IOC Board

The IOC controls the entire crate and serves variable to EPICS so that a software interface may be used to control the transporter. Refer to reference [1] for more information.

OMS VS-040 Motor Driver Board

This board receives command from the IOC and transmits motor movements to the Motor Driver Chassis. As well, it receives inputs from the digital encoders via the Motor Driver Chassis for use by EPICS. Refer to reference [2] for more information.

XVME-560 Analog Input Module

The XVME-560 board is used to convert signals from the analog encoder and the tilt switches into a format usable to EPICS. This is for EPICS use only. In addition, both the analog encoder and the tilt switches are hardwired to the interlock system. Refer to reference [3] for more information.

Motor Driver Chassis

The Motor Driver Chassis houses two motor driver modules for the X and Y axises, a VME break-out board, and a hardware interlock board. All system hardware interlocking is implemented through this chassis. All hardware interlocks override any software interlocks that may be in place. A triggered interlock will remove power from its associated motor by using the All Windings OFF (AWO) selection at the driver module. Please see: fig 13, fig 14, fig 15, and fig. 16.

Interlock Board

The Interlock Board in the Motor Driver chassis is the heart of the interlock system. This board controls two relays that supply power to the X and Y axis motor driver modules. If the interlocks are not made, no power will be available to drive a motor in a any direction. The board has bypass switches and indicating lights so that it may be easily modified by a technician to meet non-standard system interlock requirements. Please see: fig. 16.

Stop Buttons

Four stop buttons are provided that will prevent movement of the transporter in the X and Y axis. The switches must be pulled back out to reset the interlock. There is one switch per level of the space frame and one in the Hall B Counting House. The stop switches enable a constant high voltage level to the Interlock Board. If it is removed, power to the X and Y drives will be disabled. If the cabling for the stop switches is unplugged, the interlock will automatically disable the drives.

Dead-Man Switch

The dead-man switch is used to insure an operators physical presence when moving the transporter in the Storage Mode. It is a momentary on push button that must be depressed to meet the interlock requirements of the Motor Driver Chassis.

Tilt Switches

The Tilt Switches sense pitch and role of the transporter. There is a sensor box on the transporter and a control module in the control rack on the second level of the space frame. The control module provides input to EPICS and interlock inputs to the Motor Driver chassis that must be made to meet interlock requirements for system operation. It is wired in a similar fashion as the Stop Switches in that an unplugged cable will prevent motor driver operation. Refer to reference [4] for more information on it hardware.

10.6.7 Summary

While the operators of the transporter must be trained in its use, there are important measures designed into the system to prevent damage to personnel and the system. The hardware interlocks supersede any software interlocks that may be put into place, and will ensure the system is in a safe state in the event of an error or malfunction.

10.7 HYCAL Trigger Logic

TRIGGERS: Pi-0, Single-cluster and Cosmic
= In case of trigger problems, power hits or if reloading is needed,
CONTACT: Paul Kingsberry, TC16, Room 95, 269-5023

- For trigger logic, see
www.jlab.org/primex/subsystems/electronics/,
Itaru Nakagawa's Diagrams of the HYCAL trigger and associated logic:
MLU Bit Assignments
(note: MLU3A bit 2 out is our preferred trigger - any 2 hits anywhere, i.e. any MLU3A input)
Horizontal/Vertical Trigger Strip Groups;
HYCAL Trigger Groups.
- Logic Summary:
HYCAL dynode signals *rightarrow* summers (UVA120A) *rightarrow* "groups"
rightarrow summer/discriminators (UVA125A) *rightarrow* "strips"
or discriminator (Phillips 7106) for single glass groups
rightarrow 3 Memory Look-up Units (CAMAC Caen C542), 2 sections each -
outputs controlled by 1 set of 6 programs loaded via LabView.
rightarrow 5 triggers selectable without reprogramming/reloading
(5 different Master MLU3 bits *rightarrow* Trigger Supervisor):
Single-cluster;
Cosmics;
3 PI-0 TRIGGERS (2 clusters) -
1) ANY 2 strips/glass-groups firing in any MLU section, adjacent or non-adjacent (minimum bias)
2) ANY 2 GLASS strips/groups firing in either MLU (horiz/vert), NON-ADJACENT TUNGSTATE strips firing, either MLU, or adjacent pairs both horizontally and vertically
3) NON-ADJACENT strips/glass-groups firing, glass and W, or adjacent pairs both horizontally and vertically (W)

11 Veto detectors

11.1 Setting veto high voltages

11.2 How to ensure veto detectors are working properly

12 Helium bag

12.1 Monitoring helium bag pressure

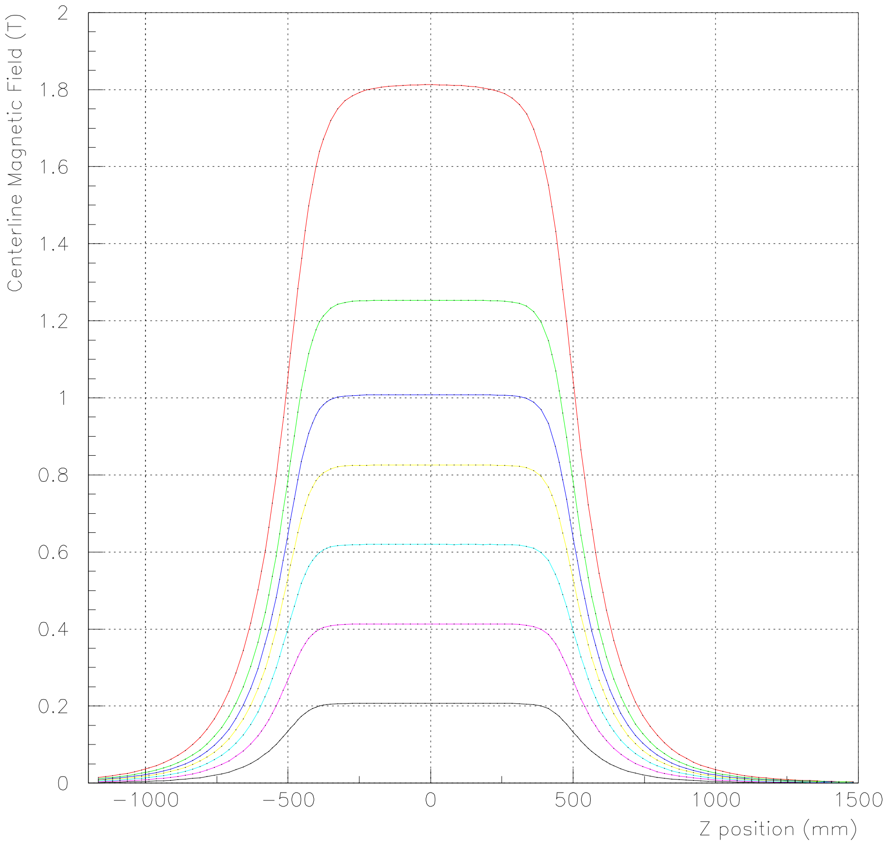


Figure 7: Field maps of pair spectrometer dipole along the center line.

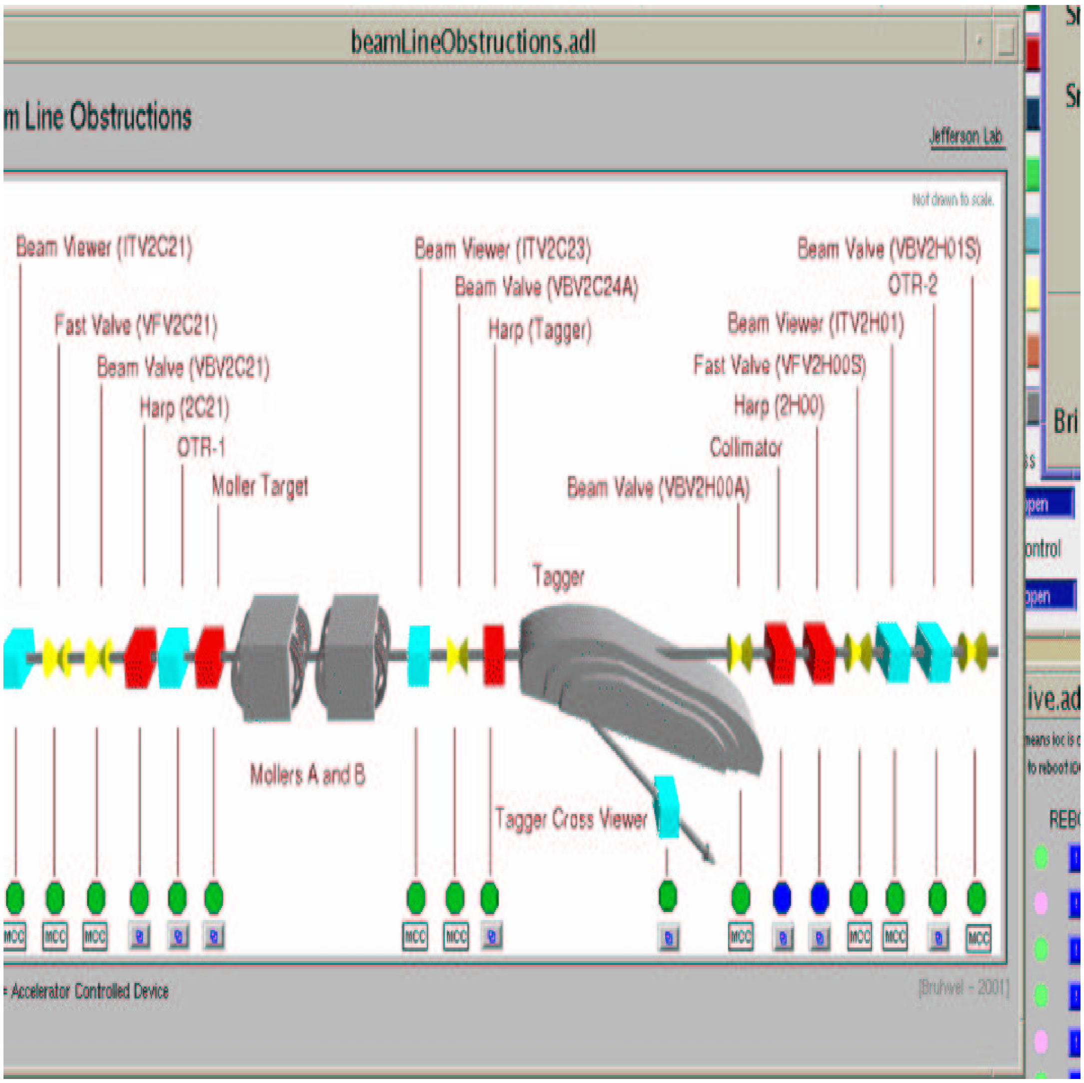
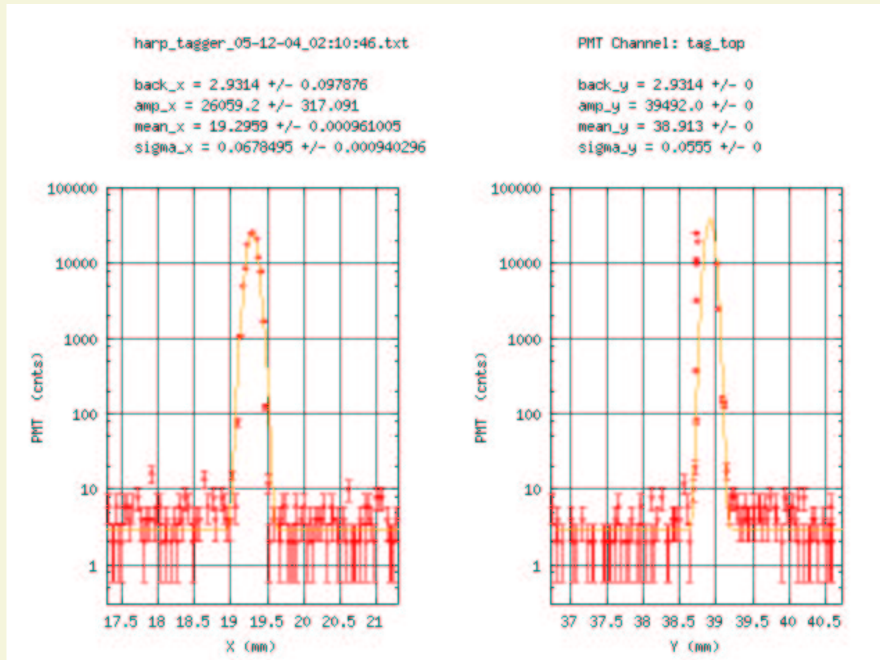


Figure 8: Snap shot of the beamline screen.

33

Figure 9:



2C21 Current (nA)	IPM2C21A.VAL	5.211273
2C24 Current (nA)	IPM2C24A.VAL	4.966531

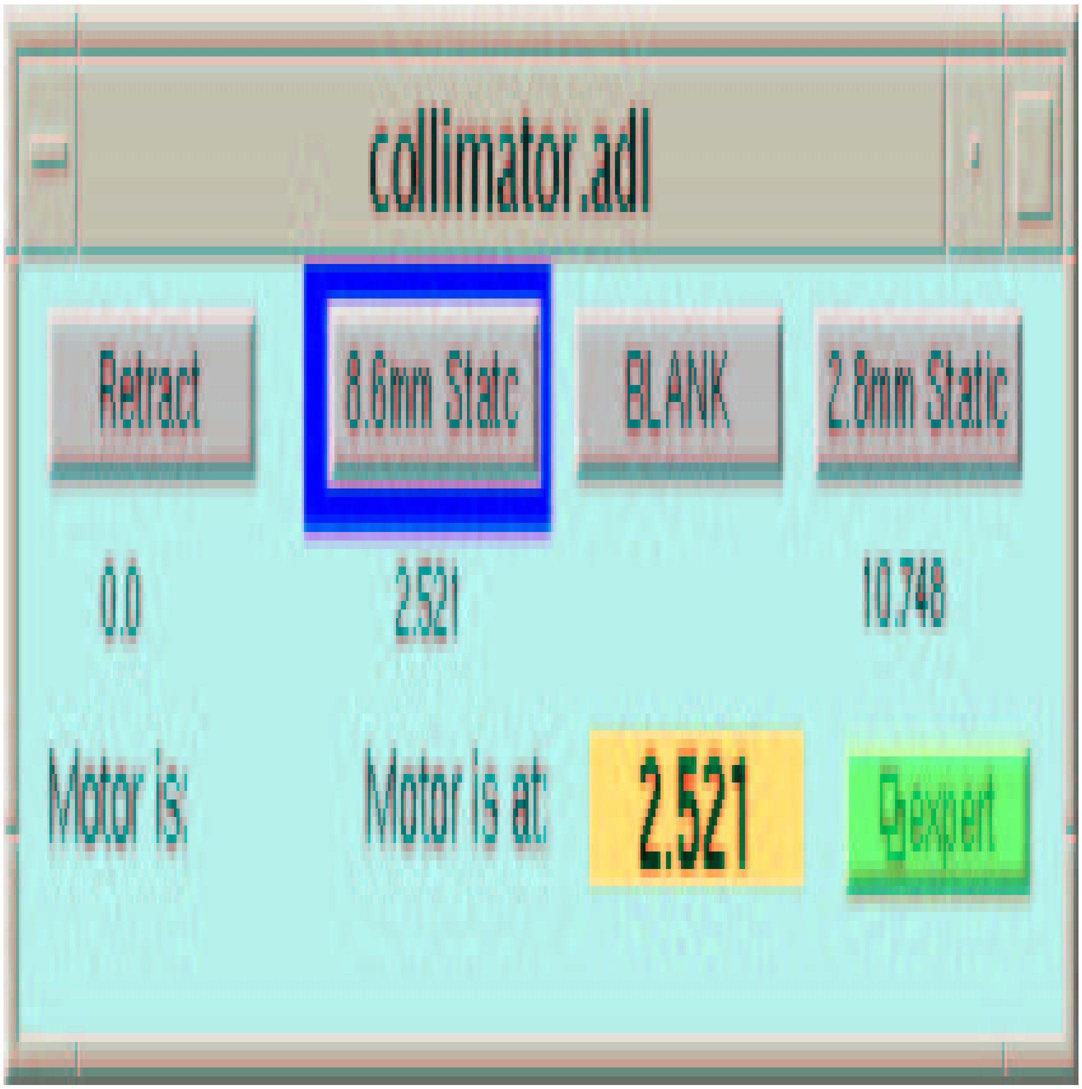


Figure 10: Screen shot of the photon beam collimator gui.THIS NEEDS TO BE UPDATED.

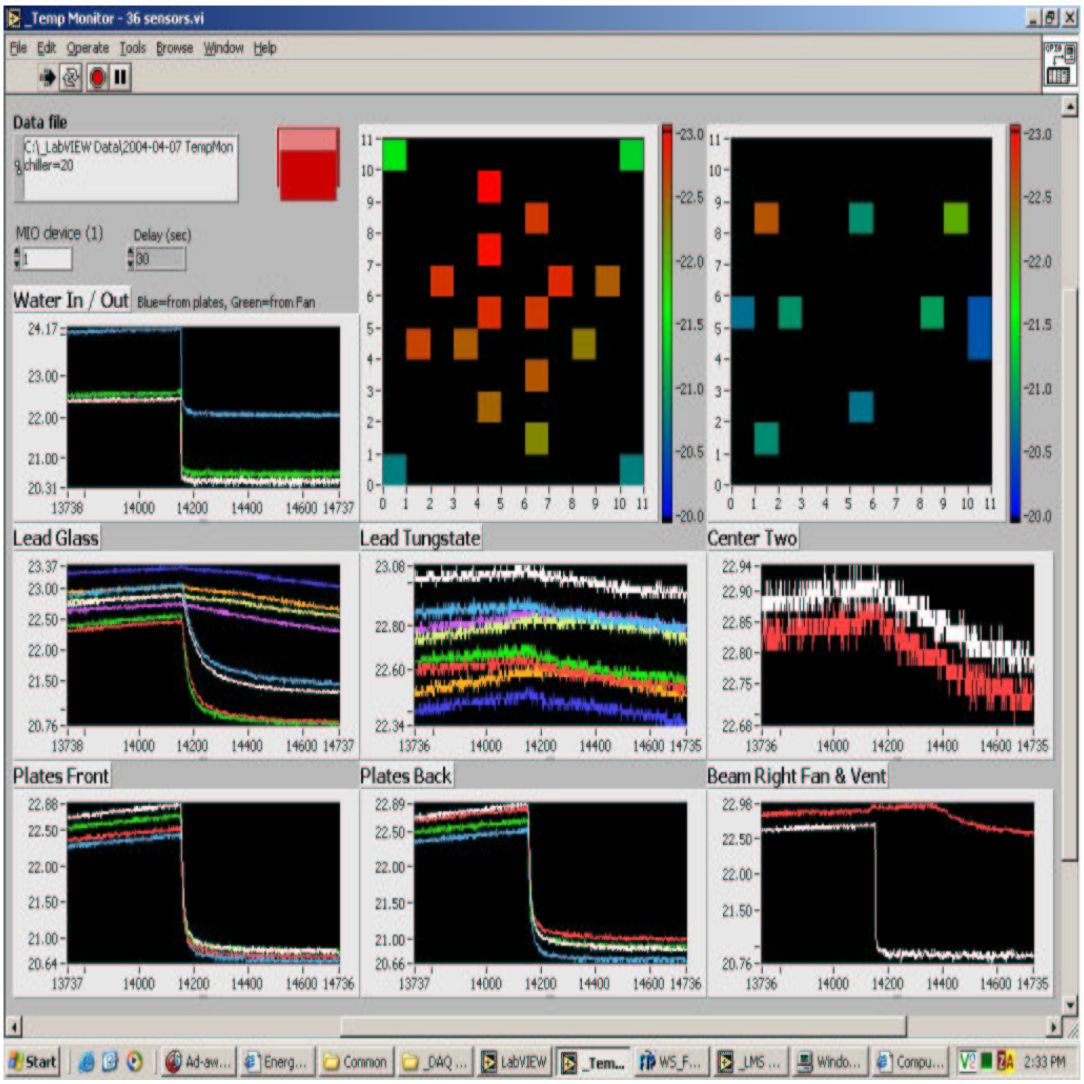


Figure 11: Screen shot of the HYCAL temperature monitoring system.

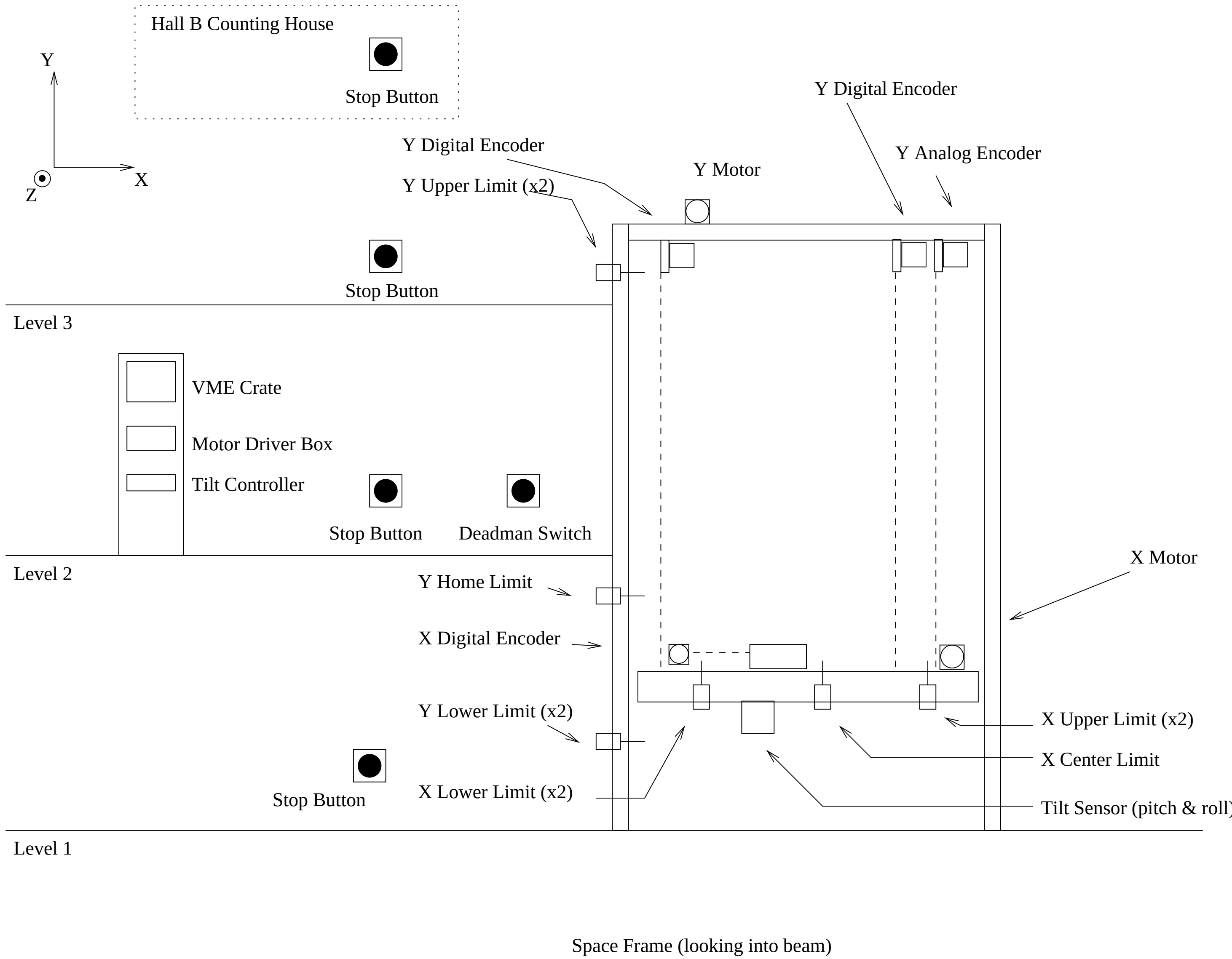


Figure 12: Hardware Overview

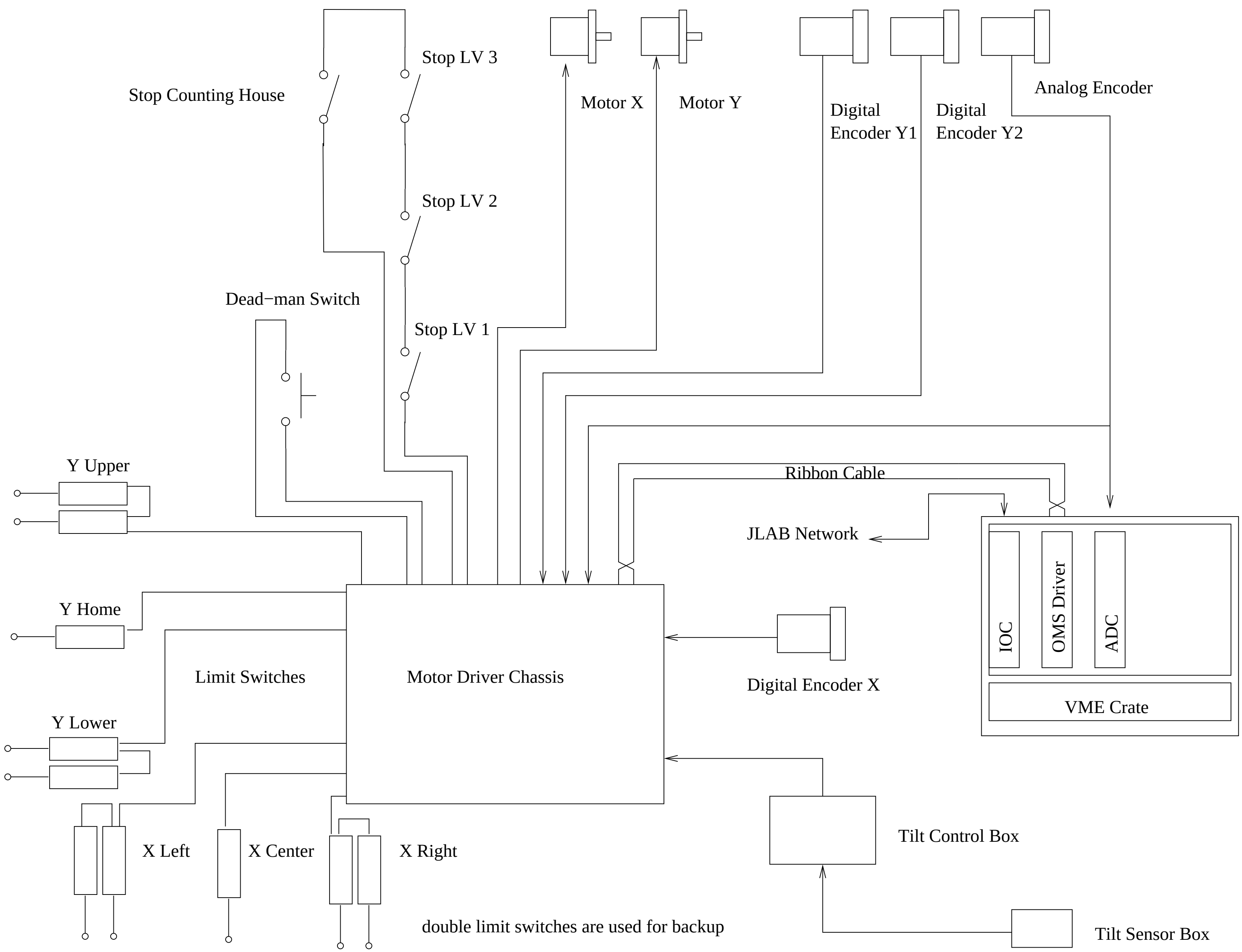
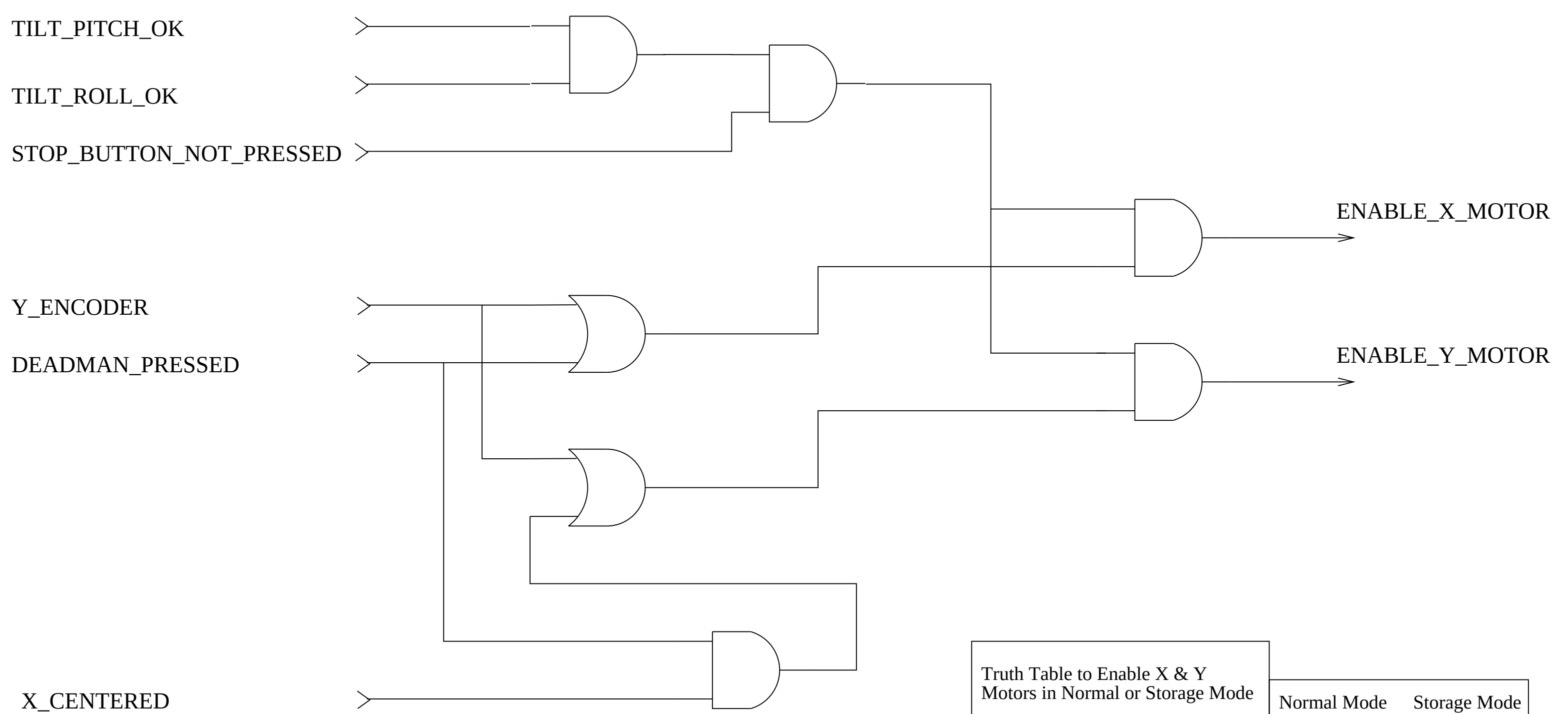


Figure 13: Motor Driver Chassis Connections



Truth Table to Enable X & Y Motors in Normal or Storage Mode	Normal Mode	Storage Mode
TILT_PITCH_OK	TRUE	TRUE
TILT_ROLL_OK	TRUE	TRUE
STOP_BUTTON_NOT_PRESSED	TRUE	TRUE
Y_ENCODER	TRUE	FALSE
DEADMAN_PRESSED	FALSE	TRUE
X_CENTERED	FALSE	TRUE

Figure 14: Interlock Logic

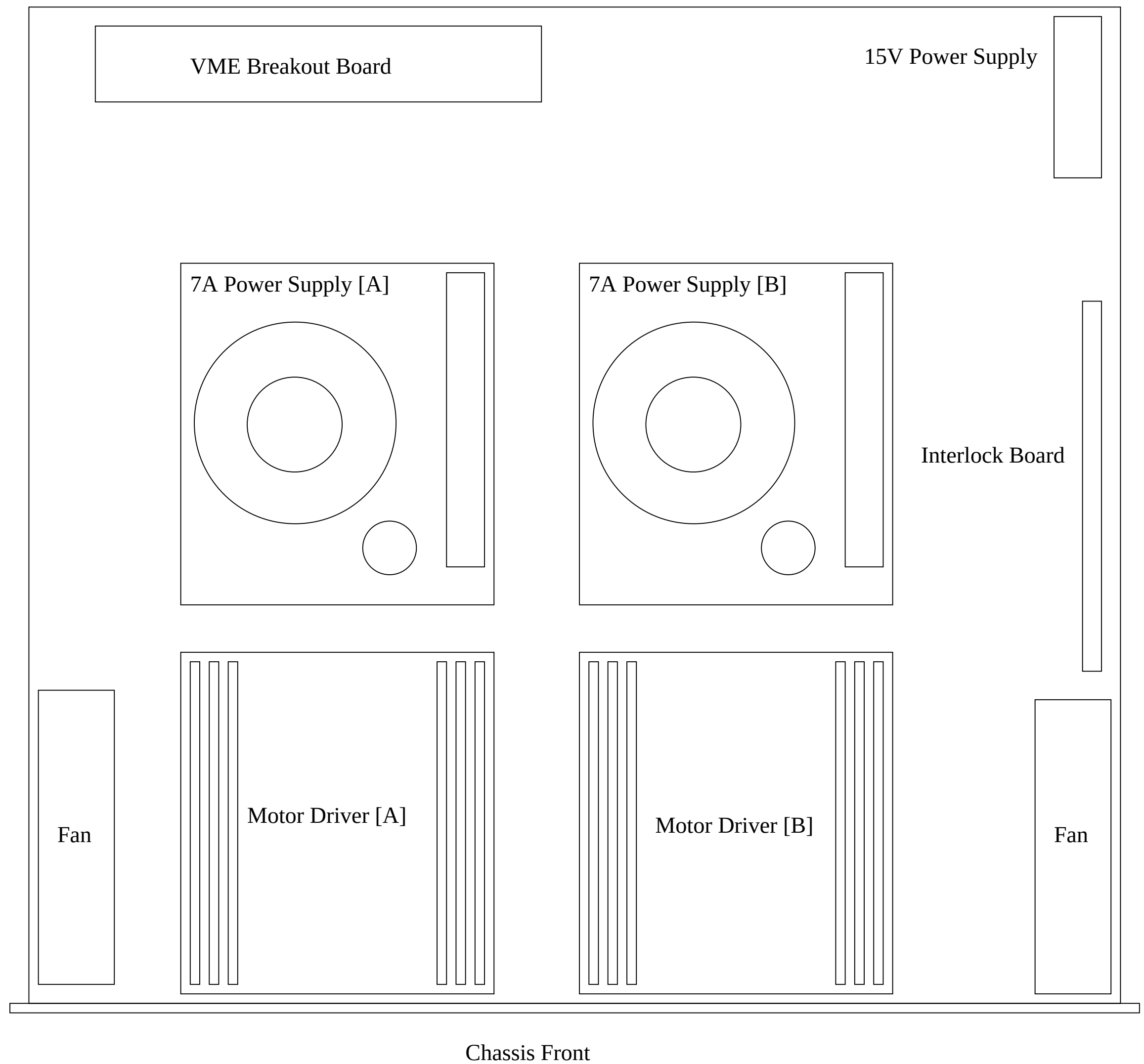


Figure 15: Motor Driver Chassis

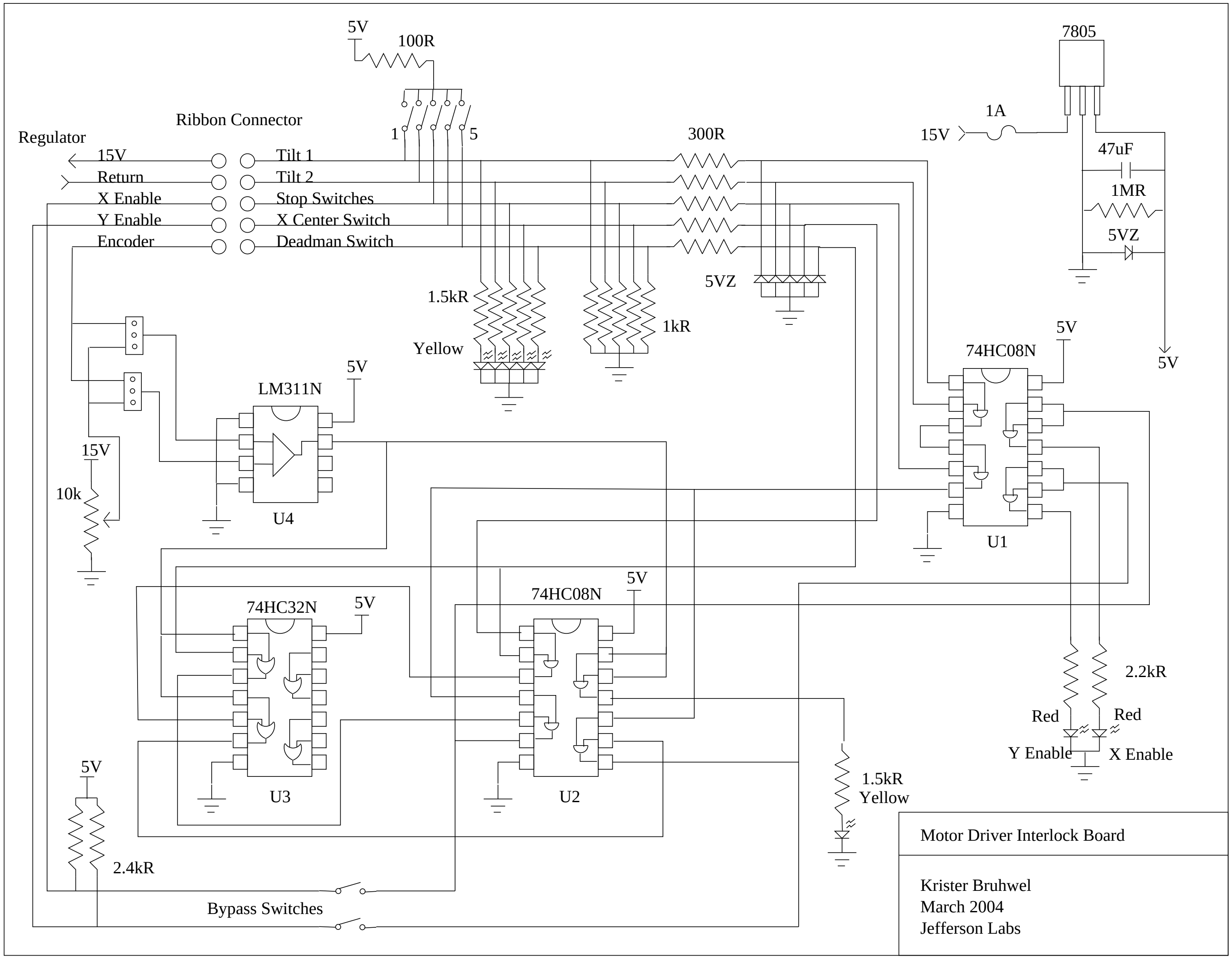


Figure 16: Motor Driver Interlock Board

References

[1] Motorola Inc, *MVME162 Embedded Controller User's Manual*

[2] Oregon Micro Systems Inc, *OMS Intelligent Motor Controllers User's Manual*

[3] XYCOM Inc, *XVME-560 Analog Input Module*

[4] Rieker Electronics Inc, *RDDR16-4-a Manual*, *http://www.riekerinc.com/DigitalInclinometers.htm*