Person: Fuchey, Eric (efuchey@jlab.org)
Org: PHALLA

Status: PROCESSED
Saved: 8/20/2021 11:39:51 AM
Submitted: 8/20/2021 11:39:51 AM

Jefferson Lab
Thomas Jefferson National Accelerator Facility

Operational Safety Procedure Review and Approval Form # 119476
(See ES&H Manual Chapter 3310 Appendix T1 Operational Safety Procedure (OSP) and Temporary OSP Procedure for Instructions)

Type:	***OSP*** Click for OSP/TOSP Procedure Form Click for LOSP Procedure Form Click for LOTO-COMPLEX Information Click for LOTO-GROUP Information		
Serial Number:	***ENP-21-119476-OSP***		
Issue Date:	***9/1/2021***		
Expiration Date:	***8/1/2024***		
Title:	***BigBite Timing hodoscope for the SBS experiments***		
Location: (where work is being performed) Building Floor Plans	***101 - Experimental Hall A - A103***	Location Detail: (specifics about where in the selected location(s) the work is being performed)	***In BigBite detector stack***
Risk Classification: (See ES&H Manual Chapter 3210 Appendix T3 Risk Code Assignment)	Without mitigation measures (3 or 4): ***3*** With mitigation measures in place (N, 1, or 2): ***1***		
Reason:	This document is written to mitigate hazard issues that are : ***Determined to have an unmitigated Risk code of 3 or 4***		
Owning Organization:	***PHALLA***		
Document Owner(s):	***Tadepalli, Arun (arunts@jlab.org)*** Primary		

Supplemental Technical Validations

50V or Greater: De-energized Work (Phillip Stanley, Tim Fitzgerald)
Mode 1: Class 1, 2, and 3 Electrical Equipment (Phillip Stanley, Tim Fitzgerald)
Portable Hand Tools (Bert Manzlak, Paul Collins)
Ladders (Bert Manzlak, George Perry)
ESH&Q Liasion (Bert Manzlak)

Document History

Revision	Reason for revision or update	Serial number of superseded document
1	***corrected information on electrical trainings in both document 24048 and 3210T1 form. Added risk codes in document 24048.***	

Lessons Learned	Lessons Learned relating to the hazard issues noted above have been reviewed.
Comments for reviewers/approvers:	

Attachments

Procedure: ***Document-24048_TH.pdf***

THA: ***3210T1Form_TH.pdf***

Additional Files: ***BBelect_EpicsUpdateApr32021.pdf***

Review Signatures

Subject Matter Expert : Electricity->50V or Greater: De-energized Work	**Signed** on 8/20/2021 1:29:28 PM by Phillip Stanley (pstanley@jlab.org)
Subject Matter Expert : Electricity->Mode 1: Class 1-> 2-> and 3 Electrical Equipment	**Signed** on 8/20/2021 1:29:23 PM by Phillip Stanley (pstanley@jlab.org)
Subject Matter Expert : Portable Hand Tools	**Signed** on 8/20/2021 1:41:02 PM by Bert Manzlak (manzlak@jlab.org)
Subject Matter Expert : Working at Elevations->Ladders	**Signed** on 8/20/2021 1:41:10 PM by Bert Manzlak (manzlak@jlab.org)

Approval Signatures

Division Safety Officer : PHALLA	**Signed** on 8/20/2021 2:22:38 PM by Ed Folts (folts@jlab.org)
ESH&Q Division Liasion : PHALLA	**Signed** on 8/20/2021 1:41:47 PM by Bert Manzlak (manzlak@jlab.org)
Org Manager : PHALLA	**Signed** on 8/23/2021 4:09:51 PM by Cynthia (Thia) Keppel (keppel@jlab.org)
Safety Warden : Experimental Hall A - A103	**Signed** on 9/1/2021 8:23:43 AM by Jessie Butler (jbutler@jlab.org)

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Jefferson Lab
Thomas Jefferson National Accelerator Facility

Operational Safety Procedure Form

(See ES&H Manual Chapter 3310 Appendix T1 Operational Safety Procedure (OSP) and Temporary OSP Procedure for instructions.)

Click For Word Doc

Title:	BigBite Timing hodoscope for the SBS experiments		
Location:	Hall A on BigBite detector stack	**Type:**	● **OSP** ○ **TOSP**
Risk Classification (per Task Hazard Analysis attached) (See *ES&H Manual Chapter 3210 Appendix T3 Risk Code Assignment*.)		**Highest Risk Code Before Mitigation**	3
		Highest Risk Code after Mitigation (N, 1, or 2):	1
Owning Organization:	Hall A	**Date:**	August 6th 2021
Document Owner(s):	Arun Tadepalli, Rachel Montgomery, Eric Fuchey		

DEFINE THE SCOPE OF WORK

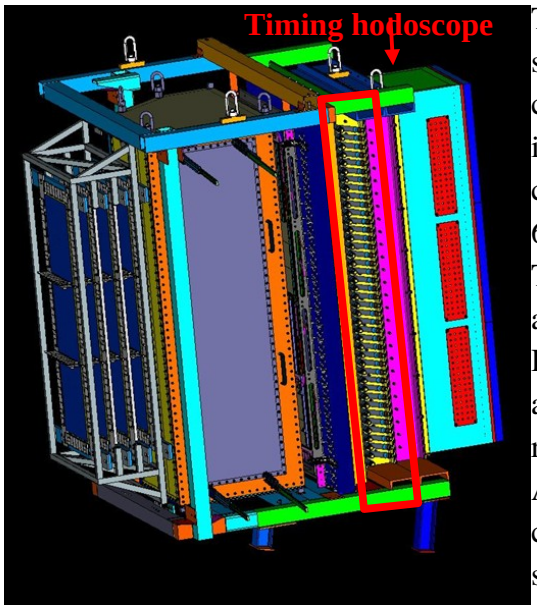
1. Purpose of the Procedure – Describe in detail the reason for the procedure (what is being done and why).

This document describes the timing hodoscope which will be used in the BigBite spectrometer for the SBS experiments. This detector will be sitting in the BigBite detector stack in Hall A, and is produced by University of Glasgow.

2. Scope – include all operations, people, and/or areas that the procedure will affect.

Operation of the BigBite timing hodoscope in the Hall A SBS experiments. The scope of this OSP encompasses electrical issues associated with the timing hodoscope, work conducted under Covid-19 elevated MEDCON levels, and access to the detector by use of the ladder.

3. Description of the Facility – include building, floor plans and layout of the experiment or operation.



The BigBite timing hodoscope will be installed in the Bigbite detector stack, sitting between the BigBite preshower and the BigBite shower calorimeters (see illustration on the left). This detector stack is located in Hall A, on the BigBite platform. The BigBite timing hodoscope is composed of 90 scintillator elements with a 2.5x2.5cm2 section for 60cm long, and readout by 2 photomultiplier tubes (one on each side). The signal from the 180 PMTs are processed by NINO front-end cards, and are conveyed to the hodoscope DAQ located in the DAQ bunker in Hall A through 17-pair flat cables. In order to mitigate the signal attenuation along the 100 ft cables, an LVDS to ECL converter is also required in the hall between the detector package and the DAQ bunker. At the DAQ bunker there is a corresponding ECL to LVDS converter to convert the signals back to the correct format. The high voltage power supplies for the PMTs are also sitting in the DAQ bunker, and also requires cables running from the DAQ bunker to the detector stack. The low voltage for the NINO cards is located in the GEM electronics bunker connected via shielded pair cables to the low voltage distribution panel on the BigBite frame

ANALYZE THE HAZARDS and IMPLEMENT CONTROLS

4. Hazards identified on written Task Hazard Analysis

Electrical shock, potential for ladder work, potential for use of portable power tools and work under Covid-19 elevated MEDCON.

5. Authority and Responsibility:

5.1 Who has authority to implement/terminate

Hall A/C leader, Hall A work coordinator, Rachel Montgomery, David Hamilton, Bogdan Wojtsekhowski, Arun Tadepalli, Bradley Yale

5.2 Who is responsible for key tasks

Rachel Montgomery, Ralph Marinaro, David Hamilton

5.3 **Who analyzes the special or unusual hazards including elevated work, chemicals, gases, fire or sparks** (See ES&H Manual Chapter 3210 Appendix T1 Work Planning, Control, and Authorization Procedure)

Work Coordinator or designee

6. Personal and Environmental Hazard Controls Including:

6.1 Shielding

N/A

6.2 Barriers (magnetic, hearing, elevated or crane work, etc.)

	BigBite timing hodoscope may need to be accessed by ladder. Safety training will be adhered and work in pairs will be advisable to assist
	6.3 Interlocks
	N/A
	6.4 Monitoring systems
	High voltage monitoring, low voltage monitoring
	6.5 Ventilation
	N/A
	6.6 Other (Electrical, ODH, Trip, Ladder) (Attach related Temporary Work Permits or Safety Reviews as appropriate.)
	Use of current limited high voltage supply at 2kV. Use of shielded HV cables and connectors. Use of current limited low voltage supply (6V, 16A) and shielded LV cables and connectors.
7. List of Safety Equipment:	
	7.1 List of Safety Equipment:
	N/A
	7.2 Special Tools:
	N/A
8. Associated Administrative Controls	
	Setup, removal, or changes to the BigBite timing hodoscope setup may be coordinated through Rachel Montgomery
9. Training	
	9.1 **What are the Training Requirements** (See List of Training Skills)
	Hall A walk through, Radiation Worker I, ODH training, Ladder safety training if requiring access by ladder, ES&H manual chapter for portable tools. ESC001, ESC003, ESC004, ESC007, and ESC008 electrical trainings, equipment specific training.

DEVELOP THE PROCEDURE

10. Operating Guidelines

Normal operation of the system high voltage is documented in the HV “how-to” attached. Any other non-routine operation on the system shall not be made unless authorized by an individual in Section 5 and with training as noted above.

11. Notification of Affected Personnel (who, how, and when include building manager, safety warden, and area coordinator)

Contact Hall Work Coordinate prior to start of work

12. List the Steps Required to Execute the Procedure: from start to finish.

1. BigBite timing hodoscope installation prior to start of experiments in the BigBite detector stack.
2. Install hodoscope HV and data acquisition in the SBS DAQ bunker.
3. Connect the electronics, data acquisition, high voltage, and low voltage.
4. Turn on high voltage and low voltage

13. Back Out Procedure(s) i.e. steps necessary to restore the equipment/area to a safe level.

1. Turn off high voltage and low voltage
2. Reassess the job before turning power back on

14. Special environmental control requirements:

14.1 **List materials, chemicals, gasses that could impact the environment** (ensure these are considered when choosing Subject Mater Experts) and explore EMP-04 Project/Activity/Experiment Environmental Review below

N/A

14.2 **Environmental impacts** (See EMP-04 Project/Activity/Experiment Environmental Review)

N/A

14.3 Abatement steps (secondary containment or special packaging requirements)

N/A

15. Unusual/Emergency Procedures (e.g., loss of power, spills, injury, fire, etc.)

In the event of injury, or an immediate emergency exists, call **911** and also notify:

- Guards (**x5822**)
- Occupational Medicine (**x7539**)
- Crew Chief (**x7045**) (if inside the fence)

In case of an injury follow standard JLAB procedures. Initial response cards are located with each phone for appropriate emergency phone numbers. Additional information can be found at https://jlabdoc.jlab.org/docushare/dsweb/Get/Document-24400/*.pdf.

16. Instrument Calibration Requirements (e.g., safety system/device recertification, RF probe calibration)

N/A

17. Inspection Schedules

N/A

18. References/Associated/Relevant Documentation

Documentation for high voltage and low voltage operation

19. List of Records Generated (Include Location / Review and Approved procedure)

Submit Procedure for Review and Approval (See ES&H Manual Chapter 3310 Appendix T1 OSP & TOSP Instructions – Section 4.2 Submit Draft Procedure for Initial Review):

- Convert this document to .pdf
- Open electronic cover sheet: https://jlabdoc.jlab.org/docushare/dsweb/Get/Document-24048/3310T1Form.doc
- Complete the form
- Upload the pdf document and associated Task Hazard Analysis (also in .pdf format)

Distribution: Copies to Affected Area, Authors, Division Safety Officer
Expiration: Forward to ES&H Document Control

Form Revision Summary

Revision 1.7 – 02/25/2021 – Corrected link to Word doc; updated 'ESH&Q' to "ES&H'; other minor edits. No approval required.

Revision 1.6 – 06/23/2020 – Update section 15 to reflect guard number, what to do in an emergency, crew chief numbers, etc. approved by H. Fanning

Revision 1.5 – 04/11/18 – Training section moved from section 5 Authority and Responsibility to section 9 Training

Revision 1.4 – 06/20/16 – Repositioned "Scope of Work" to clarify processes

Qualifying Periodic Review – 02/19/14 – No substantive changes required

Revision 1.3 – 11/27/13 – Added "Owning Organization" to more accurately reflect laboratory operations.

Revision 1.2 – 09/15/12 – Update form to conform to electronic review.

Revision 1.1 – 04/03/12 – Risk Code 0 switched to N to be consistent with 3210 T3 Risk Code Assignment.

Revision 1.0 – 12/01/11 – Added reasoning for OSP to aid in appropriate review determination.

Revision 0.0 – 10/05/09 – Updated to reflect current laboratory operations

ISSUING AUTHORITY	FORM TECHNICAL POINT-OF-CONTACT	APPROVAL DATE	REVIEW DATE	REV.
ES&H Division	Harry Fanning	04/11/18	02/25/24	1.6

This document is controlled as an on line file. It may be printed but the print copy is not a controlled document. It is the user's responsibility to ensure that the document is the same revision as the current on line file. This copy was printed on 8/20/2021.

Jefferson Lab
Thomas Jefferson National Accelerator Facility

Task Hazard Analysis (THA) Worksheet

(See ES&H Manual Chapter 3210 Appendix T1
Work Planning, Control, and Authorization Procedure)

Click For Word

Author:	Eric Fuchey	**Date:**	August 6th 2021	**Task #:** If applicable	

Complete all information. Use as many sheets as necessary

Task Title:	Bigbite timing hodoscope for the SBS experiments			**Task Location:**	Hall A, on the beam left side
Division:	Physics	**Department:**	Hall A	**Frequency of use:**	Daily from September 2021 onwards
Lead Worker:	Ralph Marinaro				
Mitigation already in place: Standard Protecting Measures Work Control Documents	Use of shielded HV cables and connectors, and shielded LV cables and connectors.				

Sequence of Task Steps	Task Steps/Potential Hazards	Consequence Level	Probability Level	Risk Code (before mitigation)	Proposed Mitigation (Required for Risk Code >2)	Safety Procedures/ Practices/Controls/Training	Risk Code (after mitigation
1	Electrical shock from ≤2kV high voltage supplying BigBite timing hodoscope PMTs, or from 6V low voltage power supply for BigBite timing hodoscope front end NINO cards	M	L	2	Use of current limited high voltage supply at 2kV. Use of shielded cables and connectors for HV. Use of shielded cables and connectors for LV	High voltage cables are only connected or disconnected to/from the detectors, power supplies, and patch panels when power supply is not energized. ESH Manual Chapter 6200 Electrical Safety Program: https://www.jlab.org/ehs/ehsmanual/6200.htm / ESC001, ESC003, ESC004, ESC007, and ESC008 Electrical Safety Awareness Class,Modes, etc.	1
2	Covid-19 contamination (if at an elevated MEDCON level)	M	M	3	Face covering required. Maintain Social Distancing of 6' or use appropriate PPE if 6' distancing cannot be maintained.	OSP: ESH-20-102494-OSP. Follow required guidelines	1

Jefferson Lab
Thomas Jefferson National Accelerator Facility

Task Hazard Analysis (THA) Worksheet

(See ES&H Manual Chapter 3210 Appendix T1
Work Planning, Control, and Authorization Procedure)

Sequence of Task Steps	Task Steps/Potential Hazards	Consequence Level	Probability Level	Risk Code (before mitigation)	Proposed Mitigation (Required for Risk Code >2)	Safety Procedures/ Practices/Controls/Training	Risk Code (after mitigation
3	Use of portable hand tools	L	M	2	Tools such as power drills, may be used for minor work. Anyone using portable hand tools must make themselves familiar with ES&H manual chapter 6120 prior to their use.	ES&H manual chapter 6120	1
4	Use of portable ladder for access to BigBite Timing hodoscope detector	M	M	3	Use of ladder training and having an observer/assistant. Vertical extension of the guard rail around the BigBite detector platform.	SAF307 Ladder Safety	1

Highest Risk Code before Mitigation:	3	Highest Risk Code after Mitigation:	1

When completed, if the analysis indicates that the Risk Code before mitigation for any steps is "medium" or higher (RC≥3), then a formal Work Control Document (WCD) is developed for the task. Attach this completed Task Hazard Analysis Worksheet. Have the package reviewed and approved prior to beginning work. (See ES&H Manual Chapter 3310 Operational Safety Procedure Program.)

Task Hazard Analysis (THA) Worksheet

(See ES&H Manual Chapter 3210 Appendix T1
Work Planning, Control, and Authorization Procedure)

Form Revision Summary

Revision 0.2 – 07/26/21 – Periodic Review; updated header and footer
Periodic Review – 08/29/18 – No changes per TPOC
Periodic Review – 08/13/15 – No changes per TPOC
Revision 0.1 – 06/19/12 - Triennial Review. Update to format.
Revision 0.0 – 10/05/09 – Written to document current laboratory operational procedure.

ISSUING AUTHORITY	TECHNICAL POINT-OF-CONTACT	APPROVAL DATE	REVIEW DATE	REV.
ES&H Division	Harry Fanning	08/29/18	07/26/24	0.2

Electronic Setup for the BigBite Timing Hodoscope

Draft

John R.M. Annand
University of Glasgow

3rd May 2021

1 High Voltage

High voltage (HV) for the BigBite Timing Hodoscope (hodoscope) is provided by a CAEN SY1527N mainframe equipped with 8 A1932A HV modules. Each module provides 48 channels of high voltage so that only the first 4 are required to power the hodoscope. The remaining four are available for other systems.

After shipment in July 2019 the mainframe has undergone some initial testing and setting up. Basic communication is provided by an attached VGA monitor and keyboard. Primary power to the mainframe is turned on by the switch at the rear followed by the front key switch turned to `local`. `Main, OK, +5, +12` and `-12` leds should light up on the A1531 module and `+48` should show on any attached A1532 power supplies. The internal PC should then boot up and display some status and initialisation information, followed by a SY 1527 screen when complete. Touch any key to initiate a login window. Two accounts have been setup:

1. `admin` (passwd `admin`) to setup system parameters such as IP, accounts, change passwords etc.
2. `BBhodo` (passwd `bbhodo19`) to setup the HV channels.

There is no mouse or touch screen, so navigation around the window, displayed after login is performed, via the <tab> key and the four <arrow> keys. Operation of the HV system is described in the following.

1.1 Check hardware status

From any account, navigate to `Setup` and then down the menu to `Tech Info` and <enter>. Fan speeds should be around 2700 rpm and Primary and Optional

Power Modules 1,2 should be 'Present'. *Optional module 3 has failed and was removed. The mainframe will not operate at maximum power, but there is more than sufficient power for the 4 hodoscope HV modules. However we will try to source a replacement A1532 power module in Glasgow to provide full-power capability.*

To see the attached HV modules, navigate `Main`, `Crate Map`. This should display A1932 HV modules in slots 0, 2, 4, 6, 8, 10, 12, 14. The A1932 is double width so that odd slots show `Board Not Present`.

Hit <tab> to return to the main window.

1.2 Set IP

From the admin account navigate `Setup` then `Communications` and `TCP/IP Settings` and enter the IP Address, Netmask and Gateway, followed by OK. The IP has now been setup so that one can connect to the mainframe via telnet from an xterm or similar:

```
telnet 129.57.37.95 1527
```

The mainframe LAN card, which has a MAC address 00:0B:AB:11:E5:49, has now been entered in the local DNS data base, so that one can use the mainframe's name instead of IP.

```
telnet bbth-hv 1527
```

Note that the `1527`, which specifies the stream-socket port to use, is absolutely necessary and also that ssh will not work. After connection the terminal will display a login window similar to the attached VGA monitor. The same navigation keys are employed.

1.3 User Accounts and Passwords

As admin navigate `Setup`, '`Security`' and then the desired menu option to `Change Admin Password, Create New User, List Users, Exit`

1.4 Setting the HV Channels

After login as BBhodo, navigate `Main`, `Channels` to display the parameters of the HV channels. Note that the A1932 module jumpers have been set, so that in order to turn on HV:

1. The multiway cable must be connected at both the A1932 and the HV distribution box ends. Connecting the multiway cable makes a loop, which if broken, kills the HV immediately.

2. The `Passive Interlock` lemo connector on the rear panel must be terminated with 50 Ω. It is possible to daisy-chain the `Passive Interlock` ports to a single 50 Ω, which if pulled will kill all HV immediately.

If either of these interlocks is not made the channel display will show `Ext-Dis` `Status` and it is not possible to turn on the HV.

The A1932 has a single primary channel and 48 secondary channels. Secondary voltages are derived from the primary via a programable voltage drop in the range of $\sim$ 10 V minimum to 900 V maximum. Thus the secondary voltages, which are applied at the output are always less than the primary. The maximum primary voltage is 3 kV and maximum primary current 30 mA. The maximum secondary current is 0.5 mA. Do not exceed 1350 V on the primary channel.

The channel display table displays a various columns and those relevant to the hodoscope are described in the following.

`Channel Name` Primary channels of the 4 A1932 modules are named `HV_BBhodo_0 - 3.`

Secondary channels are named `hodo_L0 - 86` and `hodo_R0 - 86`.

Unused channels are named `spare.`

`VOSet` Primary voltages have an initial setting of 1100 V. To change the value, navigate with the <arrow> keys to the desired position in the display table (the current position is highlighted) and type the desired new value, followed by <enter>. Secondary voltages have a preliminary setting of 1000 V and are changed as for the primary. Note that the primary voltage has to be greater than any of the secondaries on a given module.

`IOSet` The maximum current output of the primary channel has been set to 12 mA which is sufficient to power the 48 secondaries at $\sim$ 0.25 mA each. Changing this value is accomplished as for `VOSet`. There is no provision to set the maximum current on the secondaries.

`VMon` This is the sensed voltage when HV is `On` and cannot be changed by the user. It should be within $\sim$ 1 V of the `VOSet` value.

`IMon` This is the sensed current for the primary supply and must be less than `IOSet`, otherwise the module will be current limited, which will then stop `VMon` from reaching the desired value. `IMon` is not available for secondary channels.

`Pw` Power is either `Off` or `On` and pressing the <space> bar while `Pw` is selected and highlighted will toggle between the two states. The secondary channels have been left `On` and turning HV `On/Off` is accomplished using the primary module only. Note that the secondary channels only turn `On/Off` in groups of 8. When a secondary group of 8 is turned on, a corresponding orange led will light on the rear of the A1932 module.

`Status` If `Ext-Dis` displays then one or both interlocks are broken and the module will not turn `On`. The interlock requires the 50Ω terminator on the rear panel of the A1932 module and the multiway HV cable must be connected at both ends. When the interlock is made a green led will light on the rear of the A1932 and `Ext-Dis` will be removed from the `Status` column.

`SVMax` This is the software maximum voltage setting, which is the upper limit for `VOSet` on the primary channel. It is set to 1350 V. Please do not change this limit. If it seems unsuitable consult Rachel Montgomery.

`V1Set, I1Set` For the present setting of the SY1527 these parameters are not used

`RDWn` Voltage ramp down speed, set to 150 V/s

`RUp` Voltage ramp up speed, set to 150 V/s

1.5 Groups of Channels

Channel grouping can be used to display and operate on selected subsets of channels. By default, channel display shows `Group00` which is all channels connected to the mainframe. To change the displayed group, navigate to `Groups` and then to the desired `Group01 - Group15`. Some groups have been setup:

`Group01` The 4 primary power channels of the A1932 modules attached to the hodoscope.

`Group02, Group03, Group04, Group05` Active HV channels attached to hodoscope A1932 boards 0, 2, 4, 6 respectivelyAdditional groups may be setup by selecting a group to view and then running the `Add Channels` or `Rem. Channel` utilities. If `Group Mode` is selected then operations such as `VOSet` or `Pw On/Off` will act simultaneously on all channels of the group.

`Group6` All secondary HV channels attached to the hodoscope

1.6 Status

The SY1527 mainframe has been located in the weldment and is currently running with 2 (out of 3) 48 V power modules, so that its current power capability is 2/3 of the maximum. 4 (out of a maximum 8) A1932 HV modules are connected and the 1st has been tested under load. After a fault in the wiring of the multiway HV distributer boxes as found and corrected, the 44 connected HV

channels, each set to 1 kV, draw 9.84 mA on the primary supply, set to 1.1 kV. Thus each hodoscope PMT base is drawing around 0.22 mA.

At present the A1932 boards seem to trip off randomly. The module HV_BBhodo_0 was replaced with one of the spares, which has reduced the trip frequency, but not eliminated tripping. Before any further debugging the mains power source should be changed to that which supplies the rest of the weldment (this needs a change of power connector). The A1932 cards are operating at about 1/3 of their maximum current, so in principle should run smoothly.

Note that programable HV parameters are stored on the A1932 modulDrafte, so that if a module is changed, the new module will require programing.

1.7 HV EPICS Controls

EPICS controls have been implemented for the SY1527 mainframe (Steve Wood). EPICS controls will provide more flexibility and allow for backup and restoring of HV settings. The EPICS driver for the SYS1527 controls is based on Hall B's driver (from `https://github.com/JeffersonLab/clas12-epics`) and the GUI is based on Hall C's HV screens.

Some of the details below such as location of files and instructions for starting EPICS and GUI controls will change when the detector is moved to the hall.

1.7.1 Starting EPICS

In order to activate EPICS controls for the high voltage, the EPICS server must be running. The EPICS server may either be started manually, or it can be configured to start automatically using cron and the procServMgr package.

To start the server manually, use these commands on the `bbhodo` account:

```
cd ~/EPICS/sbs-epics/apps/iocBoot/ioccaenhv
./st.cmd
```

If the IP address of the SY1527 crate is changed, edit the line

```
Start_CAEN(0, "129.57.37.95")
```

in `st.cmd`.

To configure the EPICS server to start automatically, use this command to configure cron:

```
crontab ~/EPICS/sbs-epics/tools/procServMgr/tedbbdaq.crontab
```

Then after 5 minutes, check that the server is running with

```
ps -aux | grep procServ
```

which should show a line that include `ioccaen`.

To disable automatic starting of the server, remove the crontab entry with

```
crontab -d
```

and stop the server with

```
killall procServ
```

When the EPICS controls are relocated to the counting house computers, the locations of files will likely change.

1.7.2 HV GUI

To run the HV GUI, use these commands:

```
cd ~/EPICS/HV
./starthvgui
```

This will bring up a GUI with bar charts showing the voltage readback and current draw of every primary and distrubted channel. The current draw is meaningless for all but the four primary channels.

To view or change individual channels select one of the five groups from the "Group" menu. These groups are detectors 0-44 for the right and left bars, and detectors 45-89 for the two sides. The fifth group is the primary channels for each of the slots. The primary channels do not necessarily correspond to the detector groups.

Not all properties are available for the distributed channels. Namely current monitoring and current limits for tripping are only availble for the primary channels. A "-1" is shown for these fields on the distributed channels.

1.7.3 Reconfiguring EPICS and GUI

If the mapping of HV supply channels to PMTs changes, both the EPICS software and the GUI screens must be rebuilt. To do this rebuilding, first edit the spreadsheet (e.g. `HodoMapping_Mar2021.csv`) that defines the HV cable mapping and save it to a CSV file. Then run

```
cd ~/EPICS/sbs-epics/apps/caenHvApp/Db/subs
./BBHODOsubs.py -csvfile CSVFILENAME
```

This will create `HVBBHODO.substitutions`. If python3 is not installed, you may need to run the script on a different computer and copy the substitution files back to the subs directory.

After updating substitutions files, rebuild the EPICS system with:

```
cd ~/EPICS/sbs-epics/apps
make
```

Then stop the EPICS server and restart it as described in section **??**. If the server is configured to run automatically, do `killall procServ` and wait 5 minutes for the server to restart. (Or do `telnet localhost 20000` and type `exit`.

When HV channel mappings are changed, the GUI must also rebuilt. When `BBHODOsubs.py` is run it also creates `HV.hvc` and `HV.group`. Copy these files into `~/EPICS/HV/bb_hodo` type `make` in that directory.

2 Low Voltage for NINO Cards

2.1 Main Power Supply

Low voltage is provided by an Agilent N5761A DC supply which can produce 0 - 6 V up to a current of 180 A. It now sits in the weldment directly above the SY1527 HV system. Remote control via a LAN interface is possible, but this has not been setup yet.

A LV panel has been installed to distribute to the 12 NINO cards attached to the hodoscope. Each NINO-card line is fused at 1.5 A. Due to voltage drop along the supply lines the supply has been set to +5.97 V in order to deliver +5.0 V at the NINO card. The total current drawn is 15.8 A. At this current the ripple on the DC voltage was measured as 5.4 mV peak-to-peak. Noise at the analogue output of the NINO card was measured as ~ 0.5 mV.

The NINO cards have also been connected individually and each found to draw the expected 1.3 A.

2.2 Threshold Power Supply

Cabling has been installed to provide remote threshold setting for the NINO discriminators and preliminary tests made of voltage loss through the cable run. A supply voltage of 1.75 V results in 1.6 V at the NINO card. As we have yet to source and install a permanent supply, preferably with a LAN interface to give remote threshold control, the NINO cards have been jumpered to use the onboard threshold voltage. This has been adjusted to +1.5 V using the onboard potentiometers.

3 NINO Cards

12 NINO cards, 6 on each side of the detector stack, have been installed for the hodoscope.

By signing this page, you testify that you have read, understand, and agree to abide by the procedure specified in the above referenced work control document:

Serial Number: ENP-21-119476-OSP

Title: BigBite Timing hodoscope for the SBS experiments

Name	Signature	Date