Shift Manual for ANNIE (T-1063)

The Accelerator Neutrino Neutron Interaction Experiment

Friday 10th June, 2016



Contents

I Introduction

This is the shift manual for Phase I of the ANNIE experiment, running through until the end of July, summer of 2016. This document is organized to progress from the broad, big picture overviews to detailed procedures and instructions. The body of this document assumes that the shifter already has their computer and accounts set up for shifting, and knows about shift taking at Fermilab in general. The appendices at the end of this manual provide detailed instruction for setting up the shift.

Before even discussing shift responsibilities, it is good to review the design of the ANNIE Phase I detector. A concept drawing is shown in Fig 1. The main volume consists of an upright cylindrical tank (10 ft diameter x 13 ft tall), initially filled with 30 tons of ultra-pure water. A smaller Neutron Capture Volume (NCV), consisting of a transparent acrylic vessel loaded with Gd-enhance scintillator oil, will be lowered into the water. The Gd enhances the neutron-capture cross section of the target and produces a detectable (8 MeV) photon signal within a much shorter time frame than that of hydrogen (20 μs vs. 200 μs). Neutrons that thermalize in this sub-volume will be detectable from the high light yields of scintillating oil, collected by an array of 60 upward-facing 8" (Hamamatsu) PMTs at the bottom of the tank. Position dependence of the neutron rates from different overburdents of water can be studied by raising and lowering the NCV and traslating it along the beam axis. Muons entering and exiting the tank will be tagged using muon paddles in a newly installed Forward Veto detector and several recommissioned layers of the existing Muon Range Detector (MRD) from SciBooNE.

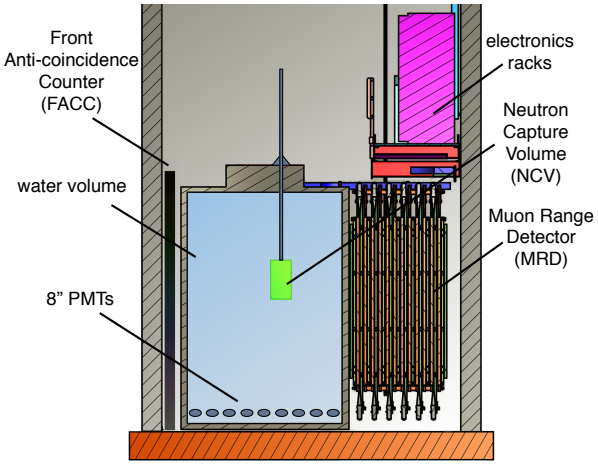

Figure 1: A concept drawing of the ANNIE detector system.

II What are you Monitoring?

As a shifter, there are several basic things you need to be monitoring:

- **High voltages** are the crates on? are the channels on and set? are the currents normal?
- **The DAQ:** is the DAQ running? is it producing diagnostic plots? is it writing output file?
- **Data quality:** do the diagnostic plots look reasonable?
- **Beam:** what is the status of the beam?
- **Other slow monitoring:** (to be added later) webcams, temperatures, etc

III What Pages Need to Be Open?

In order to effectively do your job, you will need to have the following webpages open :

- **The HV webpage:** http://192.168.163.61:8080/CAEN_HV/
  requires ssh proxy connection
- **The DAQ webpage:** http://131.225.194.149/
  requires ssh proxy connection
- **The BNB webpage:** http://dbweb5.fnal.gov:8080/ifbeam/bmon/bnbmon/Display
- **The electronic logbook:** http://dbweb5.fnal.gov:8080/ECL/annie/E/index
- **ANNIE slack:** https://annnie.slack.com/

IV How to Connect to the Shift Webpages

The ANNIE web-based shift controls are only available on the Fermilabl intra-net, and require an ssh tunnel and browser plug-in to aceess remotely. This requires a working Fermilab kerberos account. Communications and book-keeping will require a Fermilab ServiceNow account (for the elog) and a slack account (for more detailed communications).

Instructions for how to set up the necessary accounts, pluggins, and software can be found in:
Appendix II: Accounts, Plugins, and Software Needed For Shift

Instructions for connecting to the HV and DAQ webpages through an ssh proxy can be found in:
Appendix III: Connecting To The Webpages Through A Proxy Connection

V Monitoring 101

V.1 HV Monitoring, In a Nutshell

Figure 2 schematically shows the arrangement of the Phase I electronics systems for the two unit cells of the ANNIE detector systems:

- The water volume, with 60 PMTs powered by **positive** HV.
- The Forward Veto and Muon Range Detector (MRD), with 82 PMTs powered by **negative** HV

The ANNIE High Voltage is provided by a single CAEN SY527 sytem. The two different polarities are provided by two different high voltage modules:

- The 60 positive HV channels are provided by CAEN A734P modules, which allow independent control and readout of each channel. **Current draw on a single channel should not exceed 70 microamps, with the exception of channel 7-04 (which can go slightly above)**.
- The 82 negative HV channels are provided A938AN cards. These cards are 24 channels, powered by a single master channel. The 24 channels on each negative HV card are not independent. **It is not possible to read the current on a per-channel basis, only on a per-card basis. Current draw per card should not exceed 24 milliamps**.

For checking voltages and currents the HV webpage provides (among other things), two useful tables: (1) The "Summary Page" which shows the per-card currents, and (2) the "Channel Table" which shows the currents and voltages on per-channel basis (where possible).

Figure 3 shows what to look for on the Summary Page.

The Channel Table is a long, scrollable table featuring all of the channels in both the positive and negative HV. As you scroll through it, you will first encounter the negative HV channels. Channels are numbered from 0 to 23. As discussed above, there are 24 channels per card and the currents are only monitored on a per-card basis, so "Imon" will be 0. The 25th channel on each card (number 24) is the "master channel", from which the other channels are divided. This channel will report the current for the whole card, which should be below 24 mA. So, in checking the negative HV, you will scroll through the channels checking every 25th entry. Figure 4 illustrates this for card 0. Eventually you will scroll to the 60 positive HV channels, which report individual currents per channel, as pictures in Fig 5. The positive channel should all have currents below 70 μA, with the exception of 7-04, which can sometimes go slightly above.

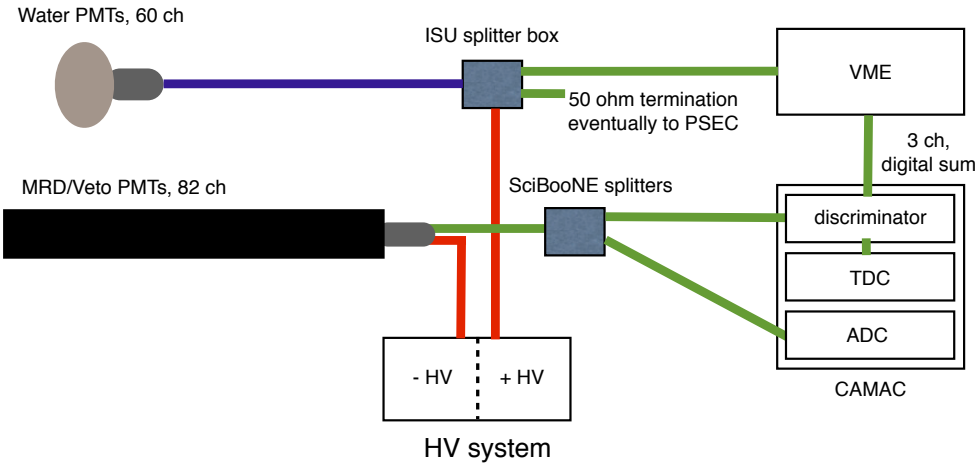

Figure 2: A schematic of the signal and high voltage arrangements for water-volume PMTs and veto/MRD muon-paddle PMTs.

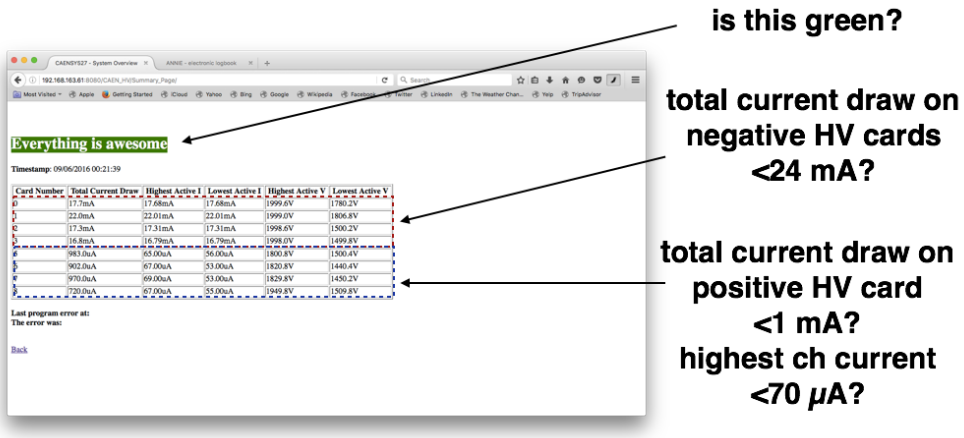

Figure 3: What to look for on the HV summary page.

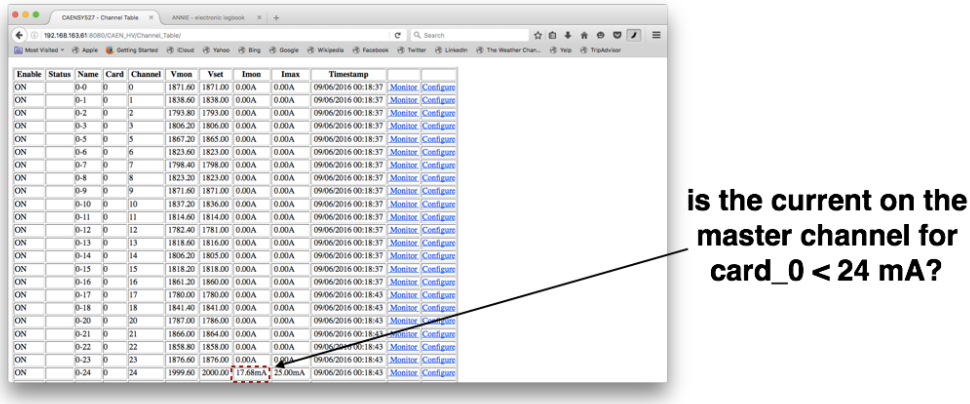

Figure 4: What to look for, regarding negative high voltages on the Channel Table.

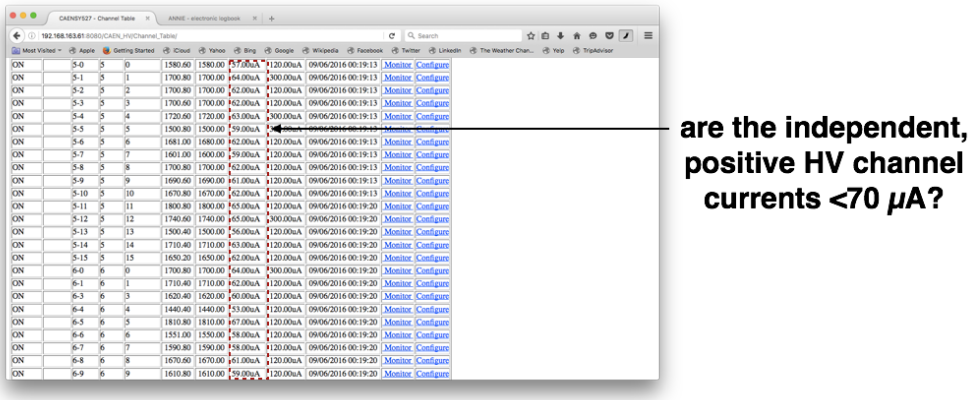

Figure 5: What to look for, regarding positive high voltages on the Channel Table.

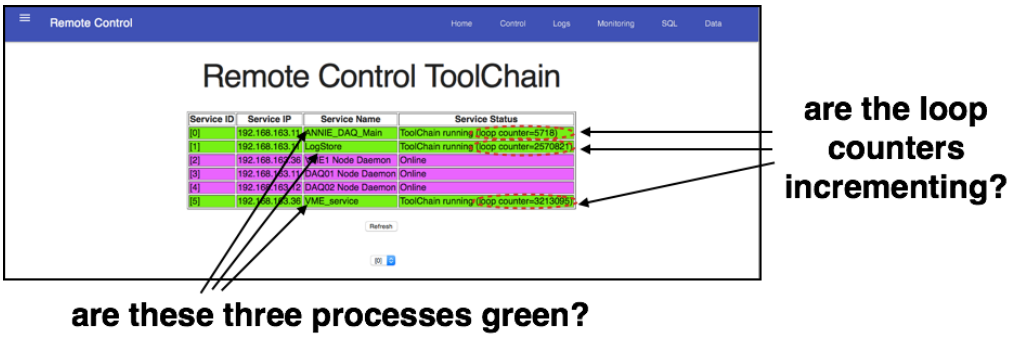

Figure 6: What to look for on the DAQ control page.

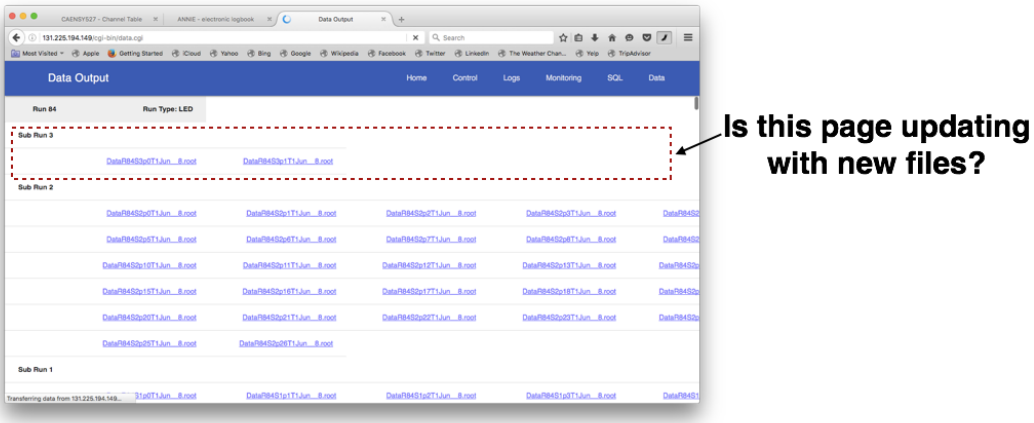

Figure 7: What to look for on the DAQ data page.

V.2 DAQ Monitoring, In a Nutshell

Monitoring the DAQ consists of (1) checking that the DAQ process is on and (2) running and making sure that data is being written to disk. Figures 6, 7, and 8 illustrate what the shifter should be looking for. **Note: The DAQ SQL page will not provide an event count for the current subrun.** As long as the data page shows new files being created and the counters on the DAQ control page are incrementing, everything is fine.

The only other related DAQ responsibility is to periodically stop and the start new subruns. How to do this, along with more detailed instruction on how to control the DAQ, can be found in Sec **??**.

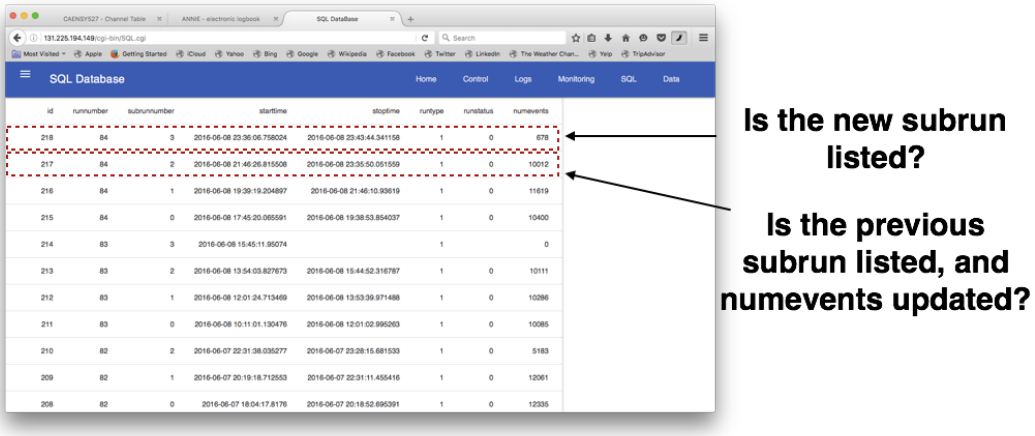

Figure 8: What to look for on the DAQ SQL page.

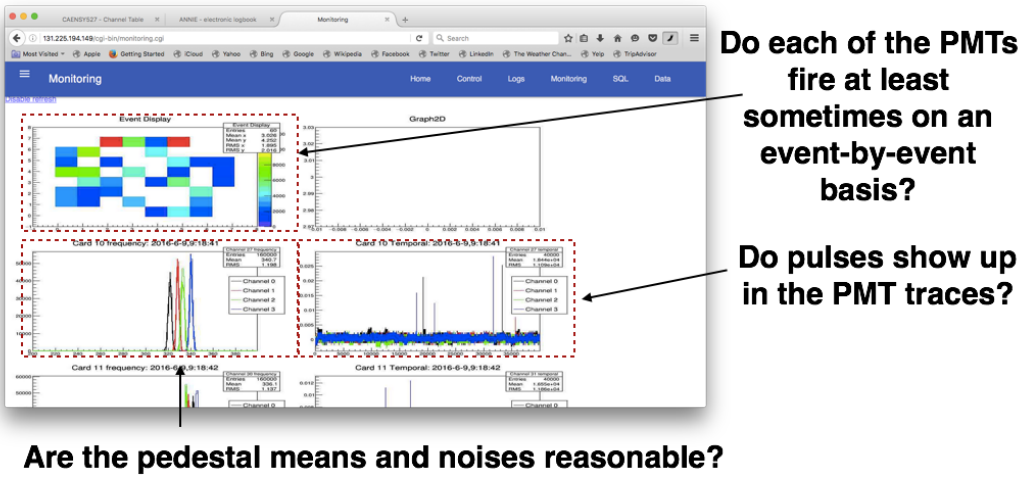

Figure 9: What to look for on the DAQ Monitoring page.

V.3 Data Quality Monitoring, In a Nutshell

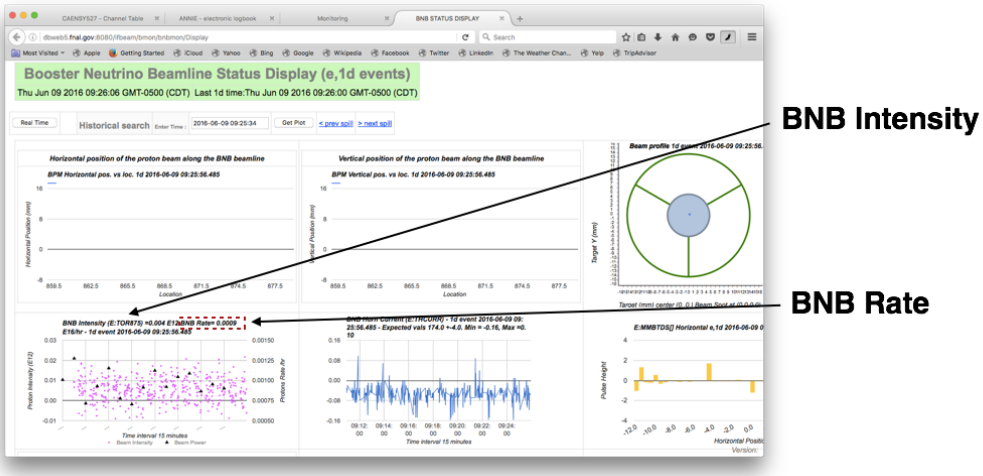

Figure 10: What to look for on the DAQ Monitoring page.

V.4 Beam Monitoring, In a Nutshell

VI Shift Forms and Checklists

Regular shift forms

Start Shift: At beginning of shift, fill out "Start of Shift" form in the ECL (login to ECL with your account, click on the "New Entry" item in the left column menu, select the Start of Shift form from the Forms drop down menu).

Two Hour Checklist: To be filled out once every two hours.

End Shift: At the end of your shift, fill out the "End of Shift" form.

Start of Run: To be filled out at the start of each run series (not necessary for each subrun).

End of Run: To be filled out at the end of each run series (not necessary for each subrun).

If there is trouble

HV Status: To be filled out if any or all of the PMTs are powered on or off, or if their voltage is changed.

HV Warning/Error: Any warning/error thrown by the HV Control and Monitoring webpage.

HV High Current: For those PMTs with high current (I) values or if a PMT trips off.

Beam Conditions: Note any BNB (Booster Neutrino Beam) changes or conditions.

VII Detailed DAQ Instructions

VII.1 Quick start

*NOTE : In order to open the DAQ website in a browser window, follow the instructions found in the HV System/Logging On subsection (**??**).*

In order to get started with controlling the DAQ you must first understand the topology.

Each computer or "Node" in the DAQ system has a process called a "Node Daemon" that runs automatically on startup and can be used to control the computer.

The Node Daemon can be used to create and destroy programs/processes on each computer needed for the DAQ, as well as other tasks like uploading or changing files, compiling new code, and rebooting the node (for a full list send the command "?" to query the available commands).

In order to run the DAQ system three programs/processes need to be created. One of these programs (called VME_service) is on the VME computer and is responsible for sending trigger infromation, reading out the ADC cards, and transmitting that data to the DAQ computer. The other two (ANNIE_DAQ_Main and Logger) exist on the DAQ computer. ANNIE_DAQ_Main is responsible for Receiving the VME trigger signals, ADC data, and writing it to disk. Whilst Logger receives output logs and error messages from the VME_service and saves them to the webpage.

Therefore in order to run the DAQ, each of these processes need to be created on their respected computer and then started.

To do this first we must create the three processes, you need to send the command "Create XXX" to the node daemons on each node, see below.

To the DAQ computer's node Daemon:

1. Send "Create XXX" to create the ANNIE_DAQ_Main process (where XXX is replaced with "Testing", "LED", "PED", or "Beam")
2. Send "Create Logger" to create the Logger Process

To the VME computer's node Daemon:

1. Send "Create VME" to create the VME_service process

Now the processes are created on each computer you should be able to see them in the service list like the node daemon processes. These processes can be sent commands too just like the node daemons. These commands can start and stop each program as well as check its status and quit it (send the command "?" to each service to query the available commands).

Next we need to start the Logger and VME services. Generally these can be left running all the time and don't need to be stopped or restarted for each run and subrun as they are passive. To do that we send the following commands.

To the Logger service:

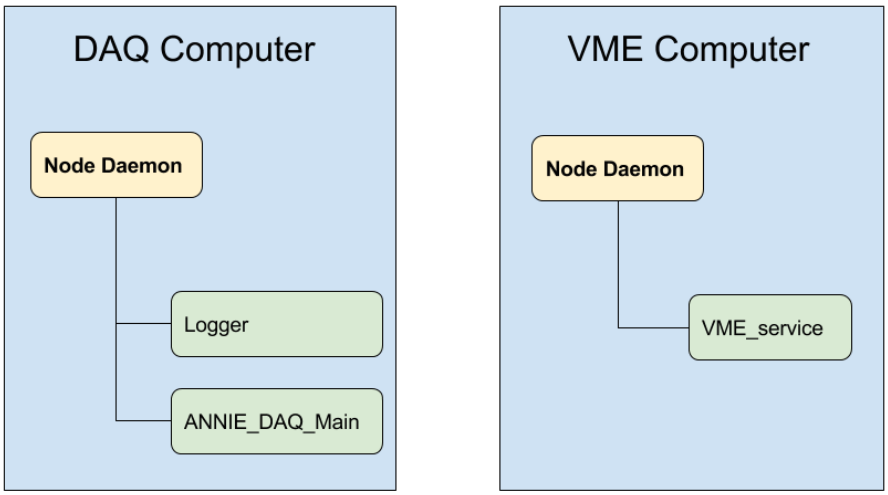

Figure 11: Basic diagram of the DAQ topology.

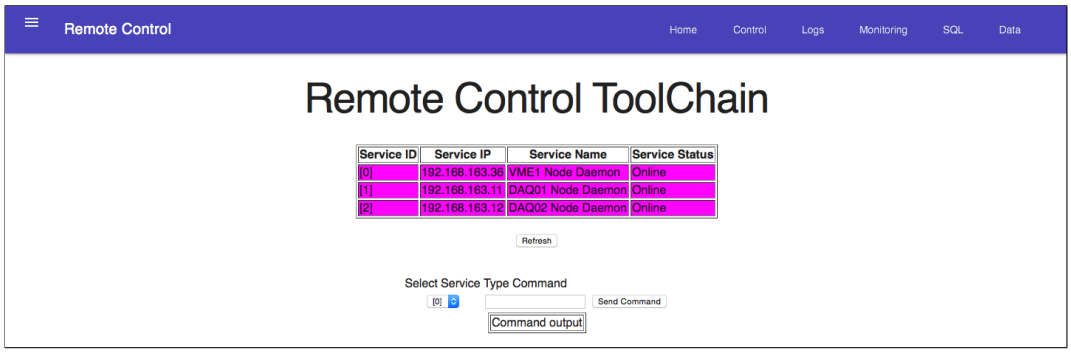

Figure 12: The start screen for the DAQ. The three node daemons are colored fusia.

1. Send "Start" to start logging

To the VME_service:

1. Send "Start" to start the VME_service

Data taking can now be stopped, started, paused, or unpaused by sending the commands "Start", "Stop", "Pause", "Unpause" respectively to the ANNIE_DAQ_Main service. (Note: In the future different run types will be started by using commands like "Start Data" or "Start Calibration" etc.)
Note: Each stop and start of the ANNIE_DAQ_Main service will result in a new subrun being started. To start a new run the ANNIE_DAQ_Main process must be stopped, then quit (by sending "Quit") and then restarted from the DAQ node daemon as before.

Fully shutting down the DAQ system can be done by stopping and quitting all three processes using the "Stop" and "Quit" commands.

Note: you cannot Quit the Node Daemon processes as they are needed to restart the DAQ processes. They can however be killed in exceptional circumstances.

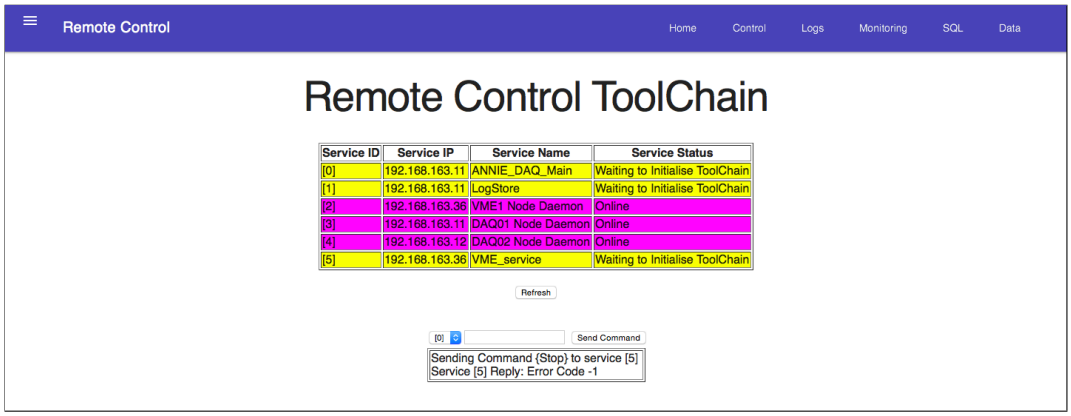

Figure 13: All three services (VME, DAQ, and Logger) are opened but not yet initialized (as indicated by the yellow).

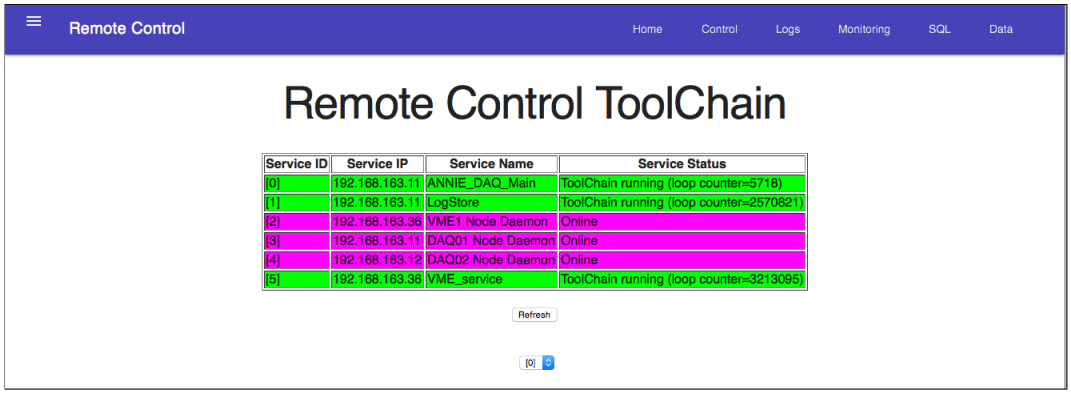

Figure 14: All three services (VME, DAQ, and Logger) are running (as indicated by the green). The DAQ is acquiring data.

VIII Detailed High Voltage System

VIII.1 Remote Operation Via Web Browser

Once the ssh tunnel has been opened the ANNIE HV website can be accessed at http://192.168.163.61:8001/CAEN_HV/ (or port 8080)

The website has some pages that are of use to the shifter:

- View Summary Page
- View Crate Maps
- View Channel Array
- View Channel Monitor
- View Channel Config
- View Terminal Emulation
- View Config Page

VIII.2 Using the terminal control

Crate Map

Num Crates: 1

Total Num Positive Cards: 3

Total Num Positive Channels: 48

Total Num Negative Cards: 0

Total Num Negative Channels: 0

CAENet Address	Model	Firmware	Num Cards	Slot	Model	Num Channels	Polarity	Vmax	Imax	Revision
1	SY527	V4.05	10							
				0	Not Present	0		0.00	0.00	
				1	Not Present	0		0.00	0.00	
				2	Mod. A734	16	POSITIVE	3000.00	3000.00	20, Rel. 1.01
				3	Mod. A733	16	POSITIVE	2500.00	2500.00	98, Rel. 1.04
				4	Not Present	0		0.00	0.00	
				5	Mod. A734	16	POSITIVE	3000.00	3000.00	6, Rel. 1.01
				6	Not Present	0		0.00	0.00	
				7	Not Present	0		0.00	0.00	
				8	Not Present	0		0.00	0.00	
				9	Not Present	0		0.00	0.00	

Back

Figure 15: .

Channel Array

Total HV Channels: 48

Enable	Status	Name	Crate	Card Type	Slot Num	Channel	Vmon	Vset	Vswmax	Imon	Imax	Timestamp		
0		KLs_blah	1	A734	2	0	1.60	1600.00	2200.00	0.00	20.00	19/02/2016 02:31:13	Monitor	Configure
0		KLn_18	1	A734	2	1	1.60	1700.00	2200.00	0.00	3000.00	19/02/2016 02:31:13	Monitor	Configure
0		KLn_19	1	A734	2	2	2.00	1700.00	2200.00	0.00	3000.00	19/02/2016 02:31:13	Monitor	Configure
0		KLn_20	1	A734	2	3	1.60	1700.00	2200.00	0.00	3000.00	19/02/2016 02:31:13	Monitor	Configure
0		KLn_21	1	A734	2	4	1.40	1700.00	2200.00	0.00	3000.00	19/02/2016 02:31:13	Monitor	Configure
0		KLs_1	1	A734	2	5	1.60	1700.00	2200.00	0.00	3000.00	19/02/2016 02:31:13	Monitor	Configure
0		KLs_2	1	A734	2	6	2.20	1700.00	2200.00	0.00	3000.00	19/02/2016 02:31:13	Monitor	Configure
0		KLs_3	1	A734	2	7	1.20	1700.00	2200.00	0.00	3000.00	19/02/2016 02:31:13	Monitor	Configure
0		KLs_4	1	A734	2	8	1.60	1700.00	2200.00	0.00	3000.00	19/02/2016 02:31:13	Monitor	Configure
0		KLs_5	1	A734	2	9	1.60	1700.00	2200.00	0.00	3000.00	19/02/2016 02:31:13	Monitor	Configure
0		KLs_6	1	A734	2	10	3.20	1700.00	2200.00	0.00	3000.00	19/02/2016 02:31:13	Monitor	Configure
0		KLs_7	1	A734	2	11	1.40	1700.00	2200.00	0.00	3000.00	19/02/2016 02:31:13	Monitor	Configure
0		KLs_8	1	A734	2	12	1.40	1700.00	2200.00	0.00	3000.00	19/02/2016 02:31:13	Monitor	Configure
0		KLs_9	1	A734	2	13	1.40	1700.00	2200.00	0.00	3000.00	19/02/2016 02:31:13	Monitor	Configure
0		KLs_10	1	A734	2	14	1.80	1700.00	2200.00	0.00	3000.00	19/02/2016 02:31:13	Monitor	Configure
0		KLs_11	1	A734	2	15	1.80	1700.00	2200.00	0.00	3000.00	19/02/2016 02:31:13	Monitor	Configure
0		TOF1_46	1	A733	3	0	2.60	1700.00	2200.00	0.00	360.00	19/02/2016 02:31:16	Monitor	Configure
0		TOF1_47	1	A733	3	1	0.40	1700.00	2200.00	0.00	360.00	19/02/2016 02:31:16	Monitor	Configure
0		TOF1_48	1	A733	3	2	0.40	1700.00	2200.00	0.00	360.00	19/02/2016 02:31:16	Monitor	Configure

Figure 16: .

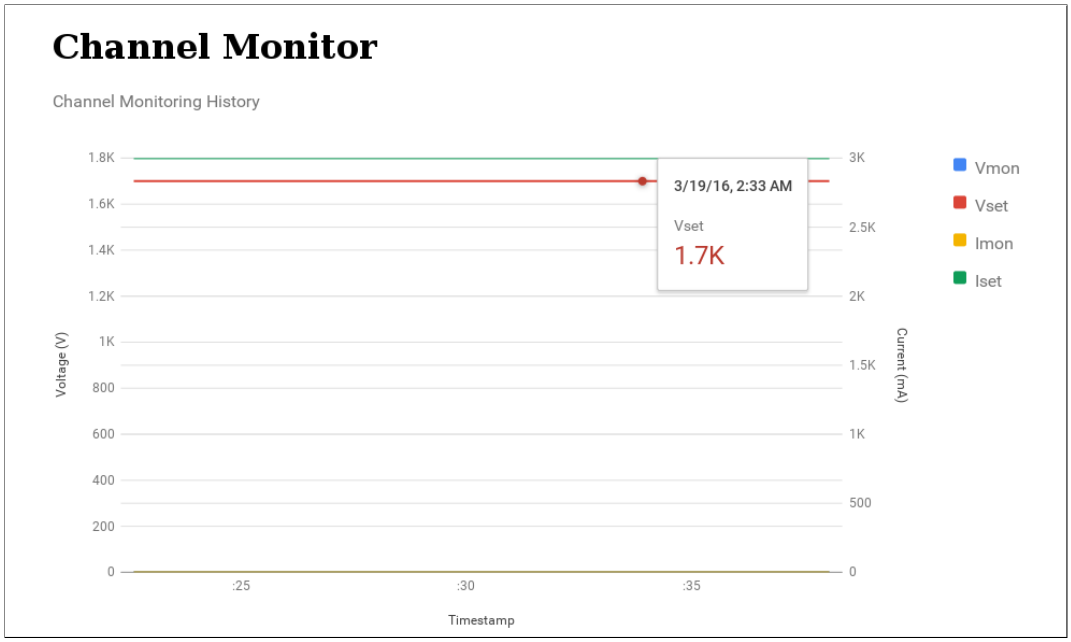
Channel Monitor
Channel Monitoring History
1.8K
1.6K
1.4K
1.2K
1K
800
600
400
200
0
Voltage (V)
3K
2.5K
2K
1.5K
1K
500
0
Current (mA)
:25
:30
:35
Timestamp
3/19/16, 2:33 AM
Vset
1.7K
Vmon
Vset
Imon
Iset

Figure 17: .

Appendix I: Important Phone Numbers, Emails, and General Shift Instructions

For all shifts:

For those on−site at Fermilab, shifts are taken in the ROCWest Control Room (CR), located on the first floor on the West side of the Wilson Hall Atrium.

Please plan to arrive (either in the CR or via Slack) at least 5-10 minutes before the start shift time. This will allow you to interact with the current shifter, so you know what the running conditions are and if there are any special duties for your shift. (Night shifts start at midnight of Sun/Mon and Thu/Fri, respectively!)

Shift blocks go as (Central US Time)

- Monday – Thursday
  - Owl : 12 am – 8 am (starts midnight on Sunday)
  - Day : 8 am – 4 pm
  - Evening : 4 pm – 12 am
- Friday – Sunday
  - Owl : 12 am – 8 am (starts midnight on Thursday)
  - Day : 8 am – 4 pm
  - Evening : 4 pm – 12 am

ANNIE Fermilab Control Room Phone Numbers

- ROC West CR – x2482 [or (630) 840−2482 off−site]

Other Useful Phone Numbers

- Carrie McGivern – (785) 312−0252
- Vincent Fischer – (331) 250−2266
- Main Control Room – x3721 [or (630) 840−3721 off−site]

→ When calling, dial 9−1 first to get a outside line

Useful Email Address Lists

- ANNIE Collaboration – annie_collab@fnal.gov
- ANNIE Operations – annie_ops@fnal.gov
- Carrie McGivern – mcgivern.olney@gmail.com
- Vincent Fischer – vincent.fj.fischer@gmail.com

Important and Useful Web Pages

- ANNIE
  - Electronic logbook (ECL) – http://dbweb6.fnal.gov:8080/ECL/annie/E/index
  - ANNE DAQ – http://131.225.194.149 (only works if your network is setup correctly)
  - HV Control and Monitoring Webpage – http://192.168.163.61:8080/CAEN_HV (only works if your network is setup correctly)
- For Beam
  - BNB Monitor Display – http://dbweb5.fnal.gov:8080/ifbeam/bmon/bnbmon/Display
  - Channel 13 – http://www-bd.fnal.gov/notifyservlet/www?project=&refresh=on
  - Main CR ECL – https://www-bd.fnal.gov/Elog/

Procedures for Outside Requests

Calls from Main Control Room (MCR): When the MCR calls with information or a request, it is meant for everyone in the control room (no matter which phone number rings). Since NOvA is the lead experiment, it is their responsibility to notify the other experiments (Minerva, MicroBoone, etc.) of the MCR call. *Make sure to remind the other Experiments/Shifters that you are back in the corner, hiding.*

ROC West Control Room Configuration

There are two groups of two monitors in the CR:

- ANNIE-CR-01 (two most left monitors)
  - Displays ANNIE DAQ page, ECL, HV webpage, and BNB Status
- ANNIE-CR-02 (two most right monitors)
  - For Expert use

On ANNIE-CR-01, web applications can be obtained by starting FireFox from the toolbar. Bookmarks include: ANNIE ECL (Electronic Collaboration Logbook), ANNIE DAQ, Caen HV Control & Monitor. Each machine has a virtual network connections (VNCs) running on it. This is needed to access the HV laptop directly.

Appendix II: Accounts, Plugins, and Software Needed For Shift

There are two different computing accounts you will need at Fermilab:

- **Kerberos account**: This allows access the annie linux machines via ssh. You need this account to create the ssh tunnel for the HV and DAQ control webpages.
- **Fermilab ServiceNow account:** This allows access to online fermilab material, such as the annie elog, the wiki, and vpn.

If you do not already have these accounts, follow the instructions on:
https://cdcvs.fnal.gov/redmine/projects/anniesoft/wiki/How_to_obtain_Fermilab_Computing_Access
Also necessary for shift communications, all collaborators should sign up for accounts on Slack:
go to https://annnie.slack.com/ and follow the instructions.

Note: the extra n in annnie is not a typo.

You will also need the following software/plugins:

- **a "kerberized" ssh terminal for logging on to the annie linux machines:** Fermilab linux machines use a ticketing system called kerberos to validate users. Instructions on how to kerberize your computer can be found here: http://computing.fnal.gov/authentication/krb5conf/
- **a browser (preferably firefox) configured for web access through a proxy:** In order to route webpage requests through ssh, you will need to configure your browser. For Firefox, there is a nice add-on call Socks. You can download and install that add-on here: https://addons.mozilla.org/en-us/firefox/addon/socks-proxy/. Instructions on how to set up Socks or manually configure a proxy connection can be found here: https://addons.mozilla.org/en-us/firefox/addon/socks-proxy/

Optional, but also useful to have:

- A vnc viewer.
- Cisco AnyConnect (for vpn connections).

Appendix III: Connecting To The Webpages Through A Proxy Connection

Creating an ssh tunnel

1. Obtain a kerberos ticket. In a terminal prompt, execute $kinit principle@FNAL.GOV (where 'principle' is *your* kerberos user name) and then enter your password.
2. Connect over ssh with port forwarding:
   $ssh -L5900:192.168.163.61:5900 -D8080 annie@annie-gw01.fnal.gov

   - -D sets up dynamic port forwarding on ports 2000 and 8080. When appropriately configured your web browser will make SOCKS requests to local port 2000 or 8080, which ssh will then forward through the tunnel in order to make the request remotely, and return the response.
   - -L performs local port forwarding, forwarding the local port 5900 to the port 5900 on the remote machine (192.168.163.61, the gateway machine). The VNC server listens and responds on port 5900, so this sets up that connection (if you end up using a VNC viewer).

Configuring your browser (manual mode)

- Configure your browser to use a SOCKS connection on port 2000 (or 8080) of localhost.
- In firefox, go to:
  - Preferences $>$ Advanced $>$ Network
  - click 'Settings' under the 'Configure how Firefox connects to the Internet' section
  - Select 'manual proxy configuration':
    * set 'SOCKS host' to localhost, port 2000 (or 8080).
    * Check 'SOCKS v5'
    * Leave other boxes blank

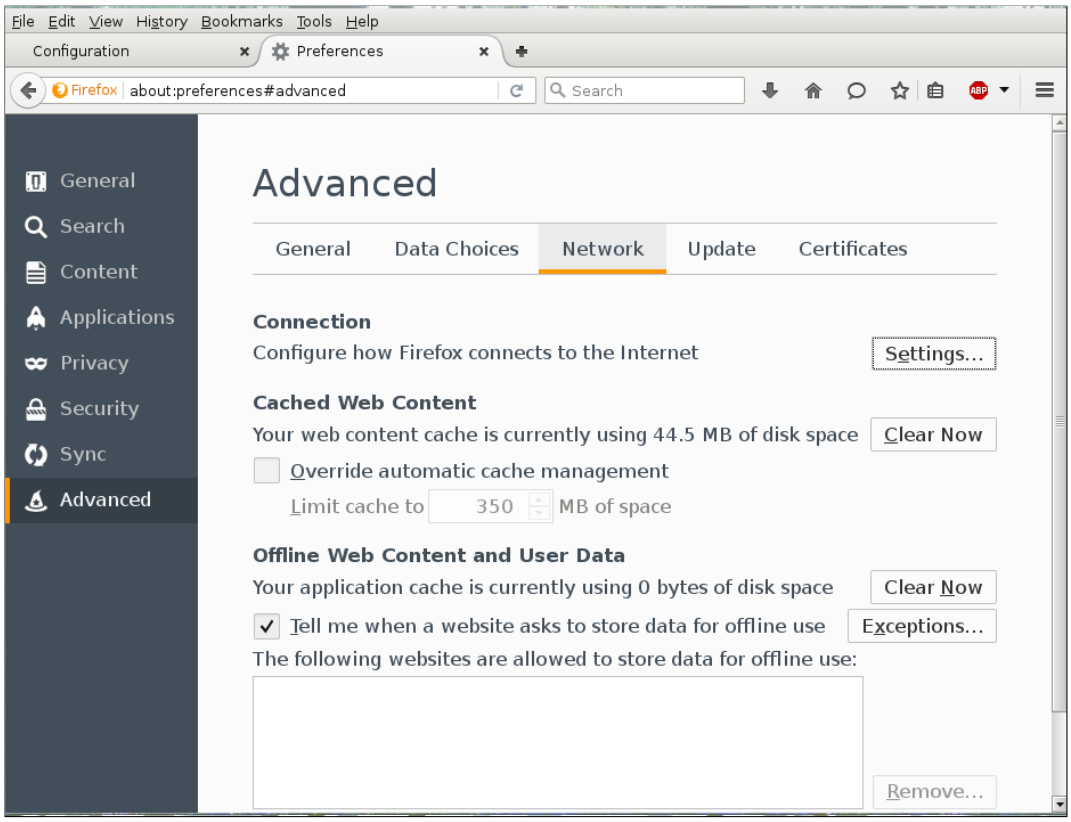

Figure 18: Socks proxy setup.

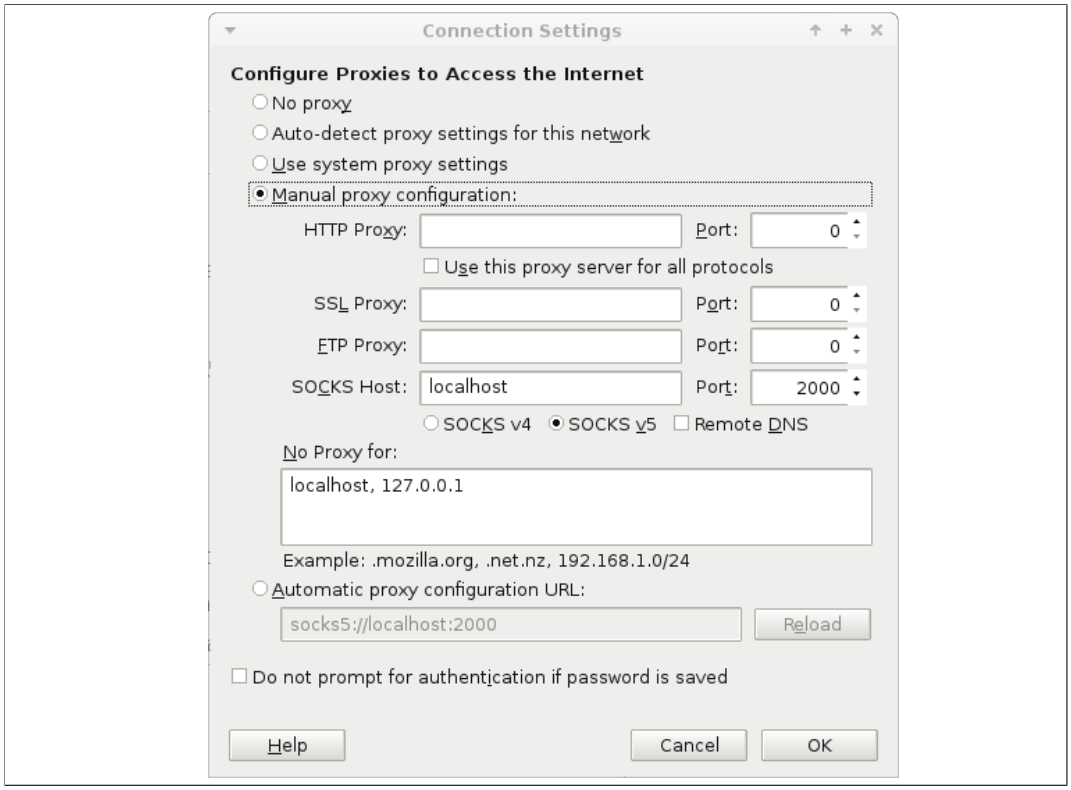

Figure 19: Socks proxy setup.

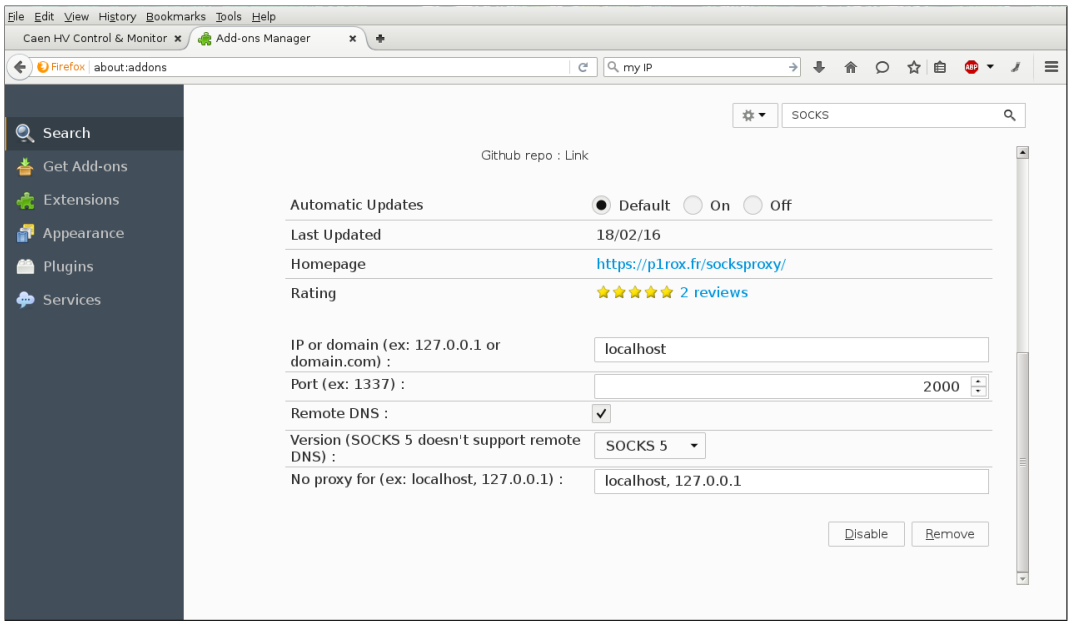

Figure 20: Socks proxy setup.

Appendix IV: Bibliography

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