

Guide to SSX Analysis

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Startup:

When we take a shot, the labview program running on Ion (the computer in the screen room) captures all the data from the magnetics, ids and all the other systems and scopes and saves it in a specific way on Ion. There is a specific way to set up all the equipment. Before running:

1. [Align the HENE](#), then connect to the screen room cords. You can go look at the signal there if you want.

2. Setting up Labview and systems:

From a complete bootup:

- Turn on Ion (under desk), let it sit for a long while.
- You will be prompted for a username, so type:
 - >>plasma
 - (the >> is to indicate what you should type, don't actually type it in)
- Password:
- >>pl@sm@
- Then open a terminal switch to the root user (admin permissions)
 - >>su
- You will be prompted for the password. (You won't see the characters pop up on the screen, but it is typing):
 - >>bootzig79"nnnewing
- Then type:
- >>httpd
- And to get back to ion:
- >>exit

Otherwise you will have Ion already up and running. In that case, start up all the hardware. Again, assuming that HENE has already been aligned.

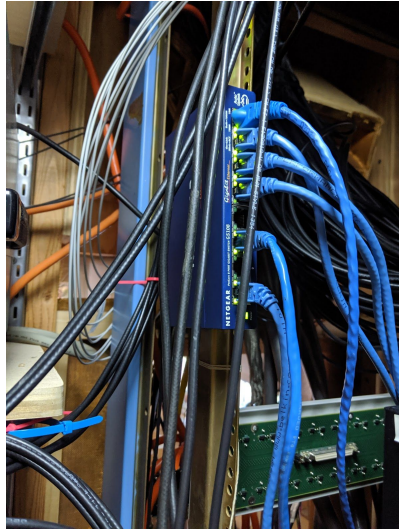
Hardware Startup:

1. **Reset router**

- a. Pull out the power cord of the router (roundish black cord in the back), wait about 5 seconds, and then plug it back in

2. **Switch on the magnetics**

- a. Turn on the magnetics right after you reset the router, when there's three light blinking on the router. Then wait until you see the rest of the router lights come on (should be about 9 light blinking), that means the magnetics are on



b.

3. **IDS**

- a. Switch is above the plug

4. **Oscilloscopes**

- a. Don't think the order matters of turning on the oscilloscopes on matter. Oscilloscopes 1 and 2 have power switches are behind the units, and the third has the switch on the front.

5. **SRS Delay generators** - upper left of screen room.

- a. **Turn left one on first**, then the right one
- b. Traditional settings are
 - i. $A = T + 0.1$
 1. Triggers the banks to fire
 - ii. $B = A - 0.027081$
 1. Triggers the stuffing flux
 - iii. $C = A - 0.006$

1. Timing of gas valves

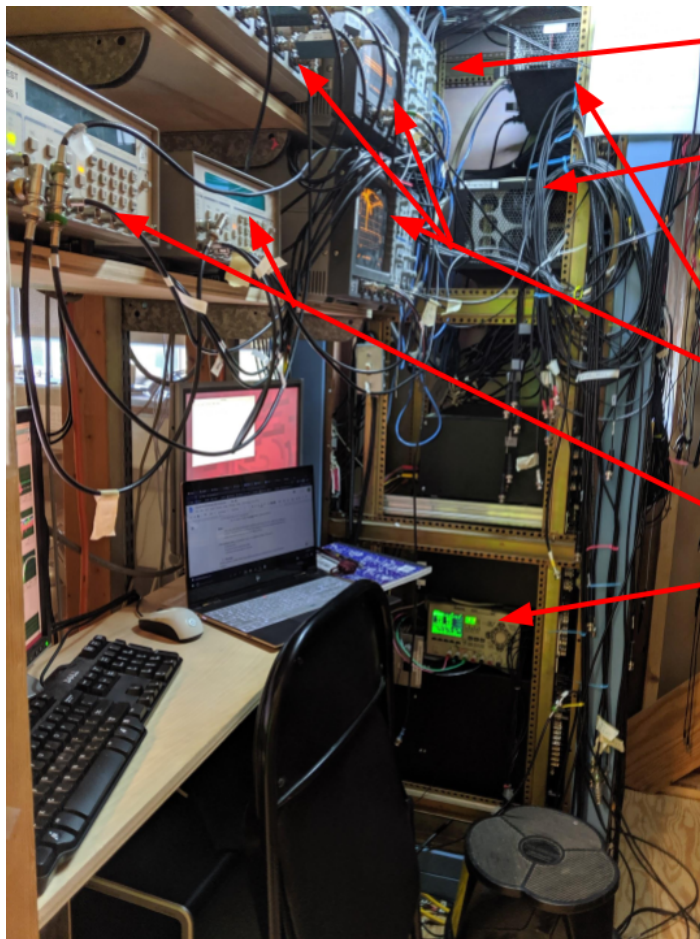
iv. $D = A - 0.0002$

6. Trans-impedance power supply

- a. From the chair, it's down by your right hand. Hit the main power button, then **also turn on 1 and 2**. They should be set to 10 v

7. PMT

- a. ALSO should check that the actual PMT is on. It is located by the SSX machine, on the counter by the IDS



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Software (Labview) Startup:

Once the hardware is all up and running, you need to set up Labview. Go back to Ion:

1. First you need to **create a folder for all the data** to sit in (**as a super-user**). There's a specific naming convention that labview uses to store the data based on the format of the date. To make a folder open up a terminal and type:
 - a. `>> cd ../..`
 - b. Switch to a super user
 - c. `>> su`
 - d. `>> bootzig79"nnnewing`
 - e. Then go to the proper folder, and make a new one
 - f. `>> cd ssx/data/2019/`
 - g. `>> mkdir <month month><day day><year year>`
 - i. (Ie may 1st, 2019 is 050119)
 - h. Give folder permission
 - i. `>> ls -ltr`
 - ii. You should see your folder there, and it will be the only one not in green
 - iii. `>> chmod 777 <dirname>`
 - iv. `>> ls -ltr`
 - v. Now all the folders should be green
2. **Launch labview icon on desktop**
 - a. If you are rebooting ion after it crashed midway though taking some shots, be sure to offset the shot so it doesn't start overwriting data
3. **Click "Run Continuously" button**, up at the top
4. Once dtac errors stops, it's connected
 - a. If you don't see dtac errors, that's the actual problem
5. **Make sure it reads 'press the button' BEFORE you press the button!**
6. And also as a safety measure yell 'fire" before firing.
7. As a general rule, you should **keep a (public) logbook** with information about which shots correspond to which settings

- a. Also **close the screen door** before taking any shots, but also if the door is closed you won't have wifi or cell service so just keep that in mind (**your logbook will need to be offline**).
- b. The link to the old logbooks is here:
- c. <https://drive.google.com/drive/folders/1cnWI2jbiizZqcMoel1FkfV-FYBL4niLYI?usp=sharing>

Envelope Shots:

1. For a full run, the first few shots are 'envelope' shots for the HENE calibration. For the envelope shots, the timescale is set long enough to compute a full circle - say **20 ms** (You should note which ones these are in the logbook). **After these** shots, **switch to a smaller time scale**, that matches the other two oscilloscopes (**20 us** by changing the time per division). For both envelope shots and data, trigger needs to be set to external and it must display single
2. Good to go!
3. To Check Labview is running with
 >>ps -A | grep iv (pipe all running tasks to grep and find iv, the labview program)

Taking Data:

Now you are ready to take your data! Record stuff in the logbook and keep an eye out to make sure nothing has crashed. Sometimes with a lot of shots the magnetics will crash. Sometimes labview will crash. Just restart things and hopefully that will fix it. See the troubleshooting section for more

NOTE: STOP IS LIKE TRIGGER

This is super important: **DO NOT PRESS STOP IN AN EMERGENCY, it will fire the banks.** Just exit using the regular x-out button, and then kill labview from the terminal.

Analyzing Data

Getting Data:

You will either need a flash drive or the ability to SSH into ion. If you don't have ssh set up, it's fairly straightforward and well worth your time to do!

On windows computer, WinSCP is the default. Download and run the package then fill out the following:

Hostname:

>>ion.physics.swarthmore.edu

Username:

>>plasma

Password:

>>pl@sm@

And make sure the port is set to 22.

Then **navigate to root /ssx/data/2019/**

Then drag and drop the files you want onto your computer, inside a folder where the code is, with the same naming convention that is used to store data on Ion.

- Ie if you are running code in a folder called "python_code" then there should be a folder in python_code called data, and inside data is a folder with the year (<year><year><year><year>), and inside that is a folder with the <month><month><day><day><year><year> and inside that folder dump all the data. It's a bit of a pain, but the code looks there for data, and it's good organization

Getting the Code:

All the analysis is **python based** and can be found here:

<https://github.com/kgelber1/SSX-Python>

(Python 3 version)

This git repo contains all the SSX python code I've found, along with some of [David Schaffner's](#)

[BMX code](#) and includes [Manjit Kaur's code](#) as well

The git repo has a project boards with the status of various projects, and Wikis that walk through the hierarchy and high level overview of what things do.

Additional Downloads:

The first time, you will probably need to **download a few other packages**. If you don't have python, you will need to [download it](#). (Either with an interactive system like ipython, anaconda, spyder, or through scripts and an editor. I prefer working with scripts and editing via [atom](#) (<https://atom.io/>) which you can link to github. However, scripts typically requires some familiarity with command lines.

You will need:

1. Python
2. A way to run python (command line or interactive shell)
3. A few other packages:
 - a. Numpy
 - b. Scipy
 - c. Matplotlib
 - d. Itertools
 - e. Pandas
 - f. Pylab
 - g. Ffmpeg:
 - i. <https://ffmpeg.zeranoe.com/builds/>

Running the Code

All this information (should be) on the GitHub wiki, but

FIRST UP: make an 'Analyzed' folder where all the data is. You will get weird errors if you don't!

Running ids data:

- First update the shot range and data of **Density_envelope.py** to have a look at all the envelope shots, then run `Density_envelope.py`
- Pick which envelope shot looks the best from the plots
- Update **density_Calshot.py** with an envelope shot for that day
- Edit **nBT.py** to make sure the scope is set correctly, and also the date (check the logbook!) and shot range. Also edit:
 - If you have bad shots, (ie ids was missing) add them to the `bad_shots` array

In the main of the function:

- **run_nBT()** will produce all the graphs of the temperature, density and magnetic field strength.
- **Run_stats()** will get the average density and temperature
- Run `nBT.py`

Running Magnetics data:

- The magnetics data is read in and calibrated by `basic_hiresmag.py` (often imported as `hdr`).
- I wrote `Vector_plotter` to plot a bunch of different views of the data, and also `generate_bfield_animations.py` to generate animations of the vectors.
- **anim_bfield_merging_nBT.py**
- Or to run all
- **run_all_banim.py**

Troubleshooting:

With labview, the best troubleshooting advice I can offer is restarting things. To fully kill it, run

- >>ps -A | grep iv
- Then find the process ids (PID) and run kill pID
- Ie
- >>Kill 0712

You can also run >>htop

NOTE: I usually see four processes, only one of which (the last one) I can actually kill.

With the code, I've found the most common error comes from incorrect path names. This should have been fixed lately, but just double check where the code thinks the file is. That, and path variables, which will need to be fixed on a person by person basis

One good resource might be the completed issues on the issues page ([py2](#) and [py3](#)) where I tried to note how I solved each issue.

Error:

"No route to host"

Scp :/homedt100//setup/sh: Text file busy

Solution:

→ check the permissions. Go to the directory and check that you see:

```

[root@ion 2019]# ls -ltr
total 216
drwxrwxrwx 2 root root 4096 Apr 24 17:22 842419
drwxrwxrwx 2 root root 49152 Apr 25 17:20 842519
drwxrwxrwx 2 root root 12288 Apr 29 17:04 842919
drwxrwxrwx 2 root root 12288 May 1 13:44 850119
drwxrwxrwx 2 root root 4096 May 2 17:06 850219
drwxrwxrwx 2 root root 12288 Jun 12 16:41 861219
drwxrwxrwx 2 root root 4096 Jun 19 17:30 861919
drwxrwxrwx 2 root root 4096 Jun 20 16:22 862019
drwxrwxrwx 2 root root 20480 Jun 26 15:02 862019
drwxrwxrwx 2 root root 16384 Jul 10 14:36 871019
drwxrwxrwx 2 root root 20480 Jul 18 15:04 871019
drwxrwxrwx 2 root root 4096 Jul 24 10:32 872319
drwxrwxrwx 2 root root 4096 Jul 24 10:33 872419
[root@ion 2019]#

```

instead of:

```

total 224
drwxrwxrwx 2 root root 4096 Apr 24 17:22 842419
drwxrwxrwx 2 root root 49152 Apr 25 17:20 842519
drwxrwxrwx 2 root root 4096 Apr 29 16:47 849019
drwxrwxrwx 2 root root 12288 Apr 29 17:04 842919
drwxrwxrwx 2 root root 12288 May 1 13:44 850119
drwxrwxrwx 2 root root 4096 May 2 17:06 850219
drwxrwxrwx 2 root root 12288 Jun 12 16:41 861219
drwxrwxrwx 2 root root 4096 Jun 19 17:30 861919
drwxrwxrwx 2 root root 4096 Jun 20 16:22 862019
drwxrwxrwx 2 root root 20480 Jun 26 15:02 862019
drwxrwxrwx 2 root root 16384 Jul 10 14:36 871019
drwxrwxrwx 2 root root 20480 Jul 18 15:04 871019
drwxrwxr-x 2 plasma plasma 4096 Jul 23 14:25 072319
drwxrwxrwx 2 root root 4096 Jul 24 10:29 872319
drwxrwxrwx 2 root root 4096 Jul 24 10:33 872419

```

→ if you see the plasma plasma instead of a root root, you need to remake the folder as a super user. (Run the >>su command)

ERROR:

Labview reads:

Read from socket failed connection reset by peer
Lost connection
Connection closed by 192.168.5.203
Connection closed by 192.168.5.202

SOLUTION:

→ N/A. I see these a lot, I don't think anything needs to be done in particular to fix it

ERROR:

I can't kill all the processes I see with ps -A | grep iv

SOLUTION:

→ N/A. I usually can kill one of the four processes, and the other three stay running

ERROR:

IDS and magnetics are down

SOLUTION:

→ Try a restart, then also look into folder permissions, network errors or just completely re-starting ion

ERROR:

Magnetics (mag1, mag2, mag3) are down

SOLUTION:

→ Try a restart. It is probably a hardware issue, if IDS is fine. Also check that trans- impedance amplifiers have both 1 and 2 on.

ERROR:

Just one of the magnetics (ie mag3) is down

SOLUTION:

→ Try a restart. Check that there are no loose connections between the router and the magnetics.

ERROR:

IDS is down

SOLUTION:

→ This is one of the more common errors. Often it will come back with the next shot. If it stays down for several shots, I would recommend a restart. It is probably a hardware issue, if magnetics are fine. Also check that trans- impedance amplifiers have both 1 and 2 on.

Q & A:

- Where are the old logbooks?
 - <https://drive.google.com/drive/folders/1cnWI2jbiizZqcMoel1FkfVFYBL4niLYI?usp=sharing>
- I have python 2, what now?
 - Update to python 3
- I have a code question for whoever wrote this before me
 - Post an issue on GitHub or send me an email

