Pychron Documentation

Release 2.1.1

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Contents

CHAPTER 1

Lab Procedures Guide

Various Lab procedures are explained below.

1.1 Loading CO_2 Samples

Please read this guide carefully and follow the provided checklist

1.1.1 CO2 Laser Loading Instructions for the Argus VI

This section describes the procedure for loading a CO_2 laser tray on the new NMGRL extraction line.

You will need: torque-wrench, flat-head screw driver, vice grip pliers, 4mm hex wrench, tweezers, new KBr cover slip, new 4.5 in. copper gasket

1. Confirm that multiple-runs has finished.
2. Take note of the pressure in the roughing, minibone, and microbone system. Roughing and analytical pressures should be approximately 10^{-7} to 10^{-8} and 10^{-9} to 10^{-10} torr, respectively.
3. Configure values for breaking vacuum. Close and lock pneumatic valves G (CO2 laser to roughing), A (CO2 laser to microbone), and F (CO2 laser to bone). If necessary, close the manual valve between the diode laser chamber and the roughing line (Fig. 1). CO2 chamber is now isolated from UHV and roughing systems.
4. Place protective metal plate on CO_2 laser chamber window.
5. Slightly loosen the two bolts that connect the CO_2 laser base to the CO_2 laser stand. Bolts should remain engaged in their nuts. Slide the CO_2 laser back on the rail until you can freely access CO_2 laser chamber. The base of the laser will hang off of the laser rack. Retighten the bolts (Fig. 2).
6. Loosen the heating tape on the CO_2 laser chamber so that the heating tape dangles beneath the CO_2 laser chamber.
7. Unbolt the CO_2 laser chamber window.. Roughing, minibone, and microbone pressure should not change. Set the CO_2 laser chamber window on a fresh piece of Al-foil on the CO_2 laser cart. Remove the copper gasket using a vice grip wrench. Place a fresh copper gasket on the knife-edge seal of the CO_2 laser chamber. Never leave

the knife edge exposed for long periods. The three, free-floating posts on the inside of the laser chamber are used to stabilize the KBr cover slip. These can be kept in their position or set aside for easy access. Dispose of the KBr cover slip in the radiation waste bin in the radiation room. Remove the "used" laser tray using tweezers and place it back in the radiation room.

8. Using tweezers, carefully place the "new" laser tray in the CO_2 laser chamber so that the notch at the top of the tray is closest to the extraction line (Fig. 3). Using tweezers, place a new KBr cover slip on the copper tray.
9. Place the CO_2 laser chamber window on top of the CO_2 laser chamber base. Tighten the CO_2 laser chamber bolts using the torque wrench and a "wagon wheel" pattern (Fig. 4). Tighten the CO_2 laser chamber in four increments (40, 70, 100, and 120 in/lbs). CO_2 laser chamber is now ready to be evacuated.
10. Turn off roughing ion gauge (lower switch on gauge display) and roughing turbo pump (far right button on "shared roughing" pump controller.)
11. Unlock and open pneumatic valve G (CO_2 laser to roughing). Atmospheric gas is now in the roughing section of the extraction line. Backing pressures of the roughing section (bottom two displays on the roughing gauge) will briefly increase (~3-4 torr) and then decrease to approximately 10-1 torr.
12. Turn on the roughing turbo pump. Initial current will be between 2 and 3 amps. Within a couple of minutes the turbo current should decrease to ~0.2 amps when back to full speed or 1500 hz. Turn on roughing ion gauge. Pressure should be between 10-5 and 10-6 torr and decreasing. Lock pneumatic valve G in the open position. If the turbo pump is pulling too much current and/or the pressure is significantly higher than expected values, this may indicate a leak in the CO_2 laser chamber. Close and lock valve G (CO_2 laser to roughing) and repeat steps 6 through 11.
13. Rewrap the sides of the CO_2 laser chamber with the heating tape (Fig. 2). Fasten thermocouple ring to laser chamber and insert thermocouple. Make sure the thermocouple and heating tapes are plugged in. If necessary, place heating tape over the cold-finger. Wrap the CO_2 laser chamber and cold finger with aluminum-foil.
14. Open Bakedpy on the pyValve/pyCO2 computer. Using the drop-down menu in the control panel, select "CO2-8hour.cfg", then hit execute. Bakeout controllers 2,3, and 4 should begin heating and temperatures will slowly increase on the time vs. temperature plot at the bottom of the Bakedpy window. (NOTE: Sometime heating tapes are switched for various reasons; controllers 2,3, and 4 will not always be used).
15. Put tools away and clean up the workspace!

procedures/images/CO2_Figure1.png

Fig. 1: Picture of diode laser chamber showing location of valves. For baking the CO_2 chamber, close the valve between the laser chamber and roughing system.

procedures/images/CO2_Figure2.png

Fig. 2: Picture showing the configuration of CO_2 system for loading laser trays and baking. Base of the laser will hang off the laser cart. CO_2 laser has heating tapes in correct orientation for baking.

procedures/images/CO2_Figure3.png

Fig. 3: Proper orientation of laser tray in CO2 laser chamber.

procedures/images/CO2_Figure4.png

Fig. 4: Bolting pattern for CO2 laser chamber.

1.2 CO_2 Stage Calibration

1. Move the laser to the center hole.
2. Select the correct stage map e.g `221-hole`
3. Select `pychron-auto` as the calibration style
4. Hit `Calibrate`

Pychron will now automatically find up to five calibration holes. The calibration holes are specified on the third line of the stage map file e.g `221-hole.txt`. The calibration holes should be the N,E,S,W, and center holes.

Using the calibration holes Pychron calculates the center position and rotation of the tray. With an accurate calibration, Pychron will then move to each hole and determine a corrected position. This will take a few minutes.

1.2.1 Autofocus

Pychron has an auto focus feature that can produce a very sharp image. Configuration allows you to use various alogrithms to calculate the *focus measure* of an image. I find the Laplace filter with ~50% zoom produces a nice result. Autofocus is actual a misnomer in this case. What is really happenig is called passive focus. The *focus measure* is calculated by applying a mathematical filter the the image. These filters are used for example to calculate the gradient between adjacent pixels. Theoretically maximizing the gradient yields the most focused image. For more information see Autofocus

Hit `Autofocus` to perform an autofocus routine

1.3 CO_2 Diagnostics

This section describes some questions to ask when debugging the Fusions CO_2 Laser System

Start with a clear definition of the Problem

1. Is Pychron running? Is the CO_2 plugin enabled?
2. Are there any warnings on startup?

3. When starting does the laser home its beam motor? If so, the progress window will display Homing Beam for a few seconds
4. Open the laser manager. Is there a view of the sample chamber? Is the `use_video` preference enabled?
5. Can you enable the laser? Red lights turn on Fusion control boxes are illuminated.
6. Do the red lights stay on for only 7 seconds?
7. Are the emergency **STOP** buttons depressed?
8. Is the manual beam blocked in place? Check the knob on the back of the CO_2 laser.

1.4 UPS Battery Change

1.4.1 Ferrups

See manual.

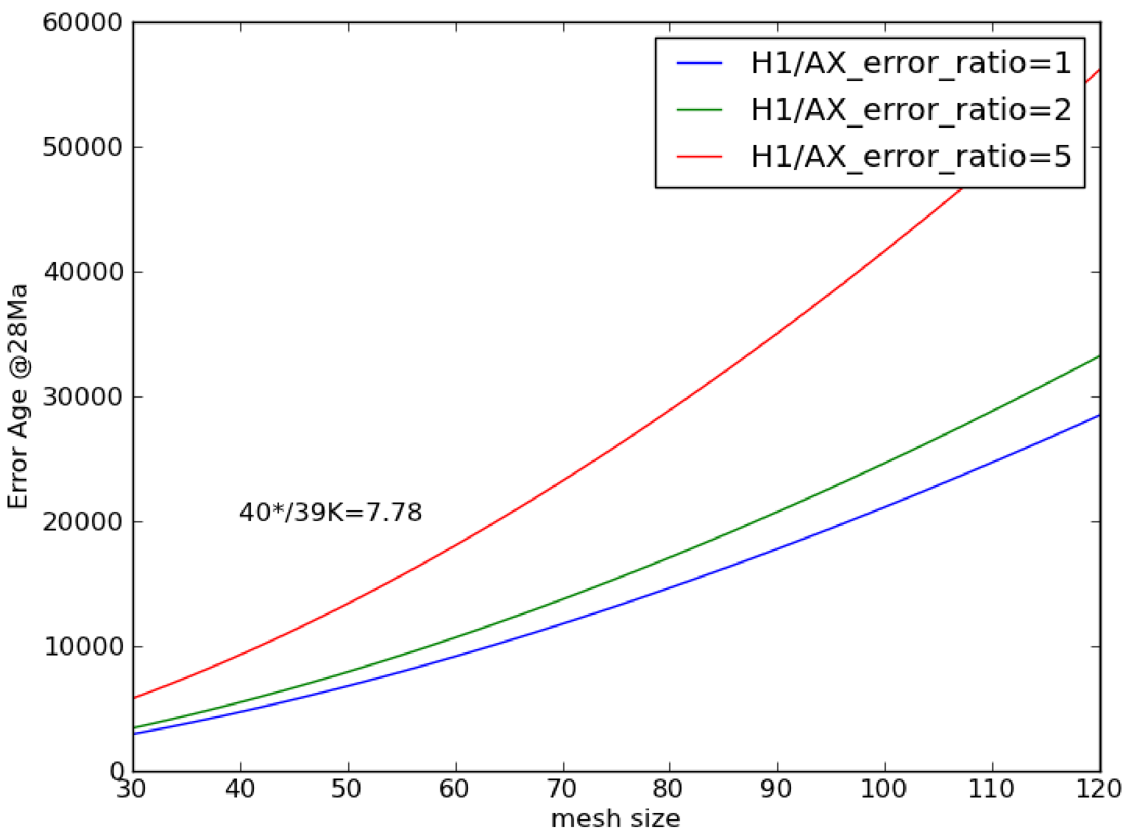
1. Set ups to **Inverter** mode.
2. Open front panel and disable circuit breaker. This cuts of battery power to the ups
3. Remove side panels
4. Disconnect negative battery terminal from the ups
5. Disconnect positive battery terminal from the ups
6. Disconnect batteries from one other
7. Remove strap and plastic dividers, noting orientation for when reinstalling
8. Remove old batteries
9. Install new batteries
10. Install plastic dividers and strap
11. Connect side A batteries together with a short cable
12. Connect side B batteries together with a short cable
13. Connect side A to side B with long cable
14. Connect positive terminal to ups
15. Connect negative terminal to ups
16. Enable circuit breaker
17. Set UPS to **Auto** mode

1.4.2 BestPower

CHAPTER 2

Reference Values

2.1 Mesh vs Age Error



2.2 MSWD Interval

N	Low 95%	High 95%
2	0.001	5.024
3	0.025	3.689
4	0.072	3.116
5	0.121	2.786
6	0.166	2.567
7	0.206	2.408
8	0.241	2.288
9	0.272	2.192
10	0.300	2.114
11	0.325	2.048
12	0.347	1.993
13	0.367	1.945
14	0.385	1.903
15	0.402	1.866
16	0.417	1.833
17	0.432	1.803
18	0.445	1.776
19	0.457	1.751
20	0.469	1.729
21	0.480	1.708
22	0.490	1.689
23	0.499	1.672
24	0.508	1.655
25	0.517	1.640
26	0.525	1.626
27	0.532	1.612
28	0.540	1.600
29	0.547	1.588
30	0.553	1.577
40	0.607	1.490
50	0.644	1.433
60	0.672	1.392
70	0.695	1.360
80	0.713	1.335
90	0.728	1.314
100	0.741	1.297
200	0.813	1.206
300	0.846	1.167
400	0.866	1.143
500	0.880	1.128
600	0.890	1.116
700	0.898	1.108
800	0.904	1.100
900	0.910	1.095
1000	0.914	1.090

2.3 Constants

Name	Value	units
1 A	6.2415e18	e-
1 fA	6241.5	counts
1 fA	0.1	mV @10e11 Ohms
1 fA	1	mV @10e12 Ohms
1 fA	10	mV @10e13 Ohms

2.4 Typical Mineral Values

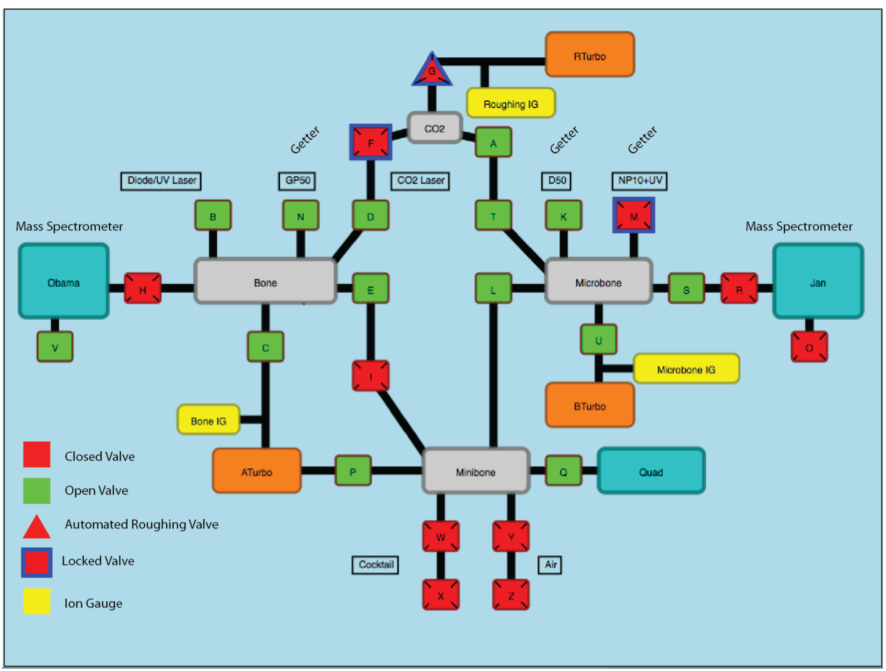
Name	Min	Max
Biotite K/Ca		
Sanidine K/Ca		
Plagioclase K/Ca		
Hornblende K/Ca		
Mol 40Ar/g		

2.5 Typical Hardware Values

Name	Min	Max	units
Analytical IG	1e-10	1e-8	torr
Jan Sensitivity CO2	5e-14		mol/fA
Jan Rise Rate	0.75		fA/min
Jan Rise Rate CO2	1.0		fA/min
Jan Rise Rate UV	1.0		fA/min
Obama Sensitivity CO2	8e-14		mol/fA
Obama Rise Rate			
Obama Rise Rate CO2	1		fA/min
Obama Rise Rate Diode	1		fA/min

CHAPTER 3

Extraction Line



3.1 Bone Valves

Name	Description
B	Bone to Diode Laser
C	Bone to Turbo
D	Bone to CO2 Laser
E	Bone to Minibone
H	Obama Inlet
N	Bone to Getter GP-50

3.2 Minibone Valves

Name	Description
I	Minibone to Bone
Q	Quad Inlet
P	Minibone to Turbo
W	Outer Pipette 1
X	Inner Pipette 1
Y	Outer Pipette 2
Z	Inner Pipette 2

3.3 Microbone Valves

Name	Description
K	Microbone to Getter D-50
L	Microbone to Minibone
M	Microbone to Getter NP-10
R	Jan Inlet
S	Microbone to Inlet Pipette
T	Micorbone to Laser
U	Microbone to Turbo

3.4 CO2 Valves

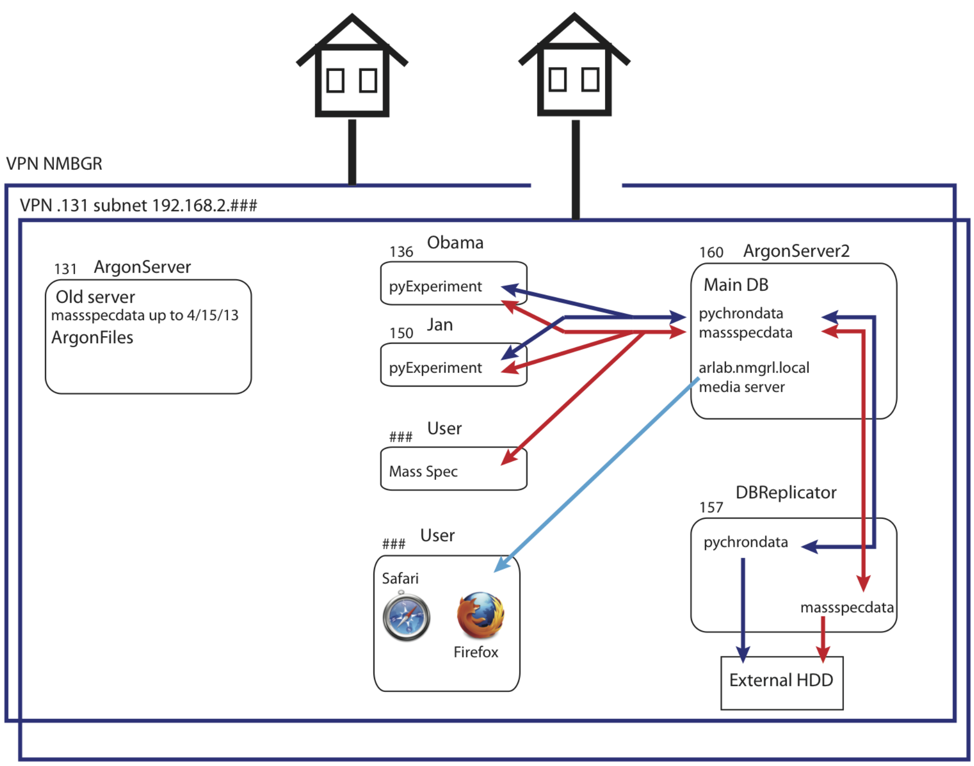
Name	Description
A	CO2 Laser to Jan
F	CO2 Laser to Obama
G	CO2 Laser to Roughing

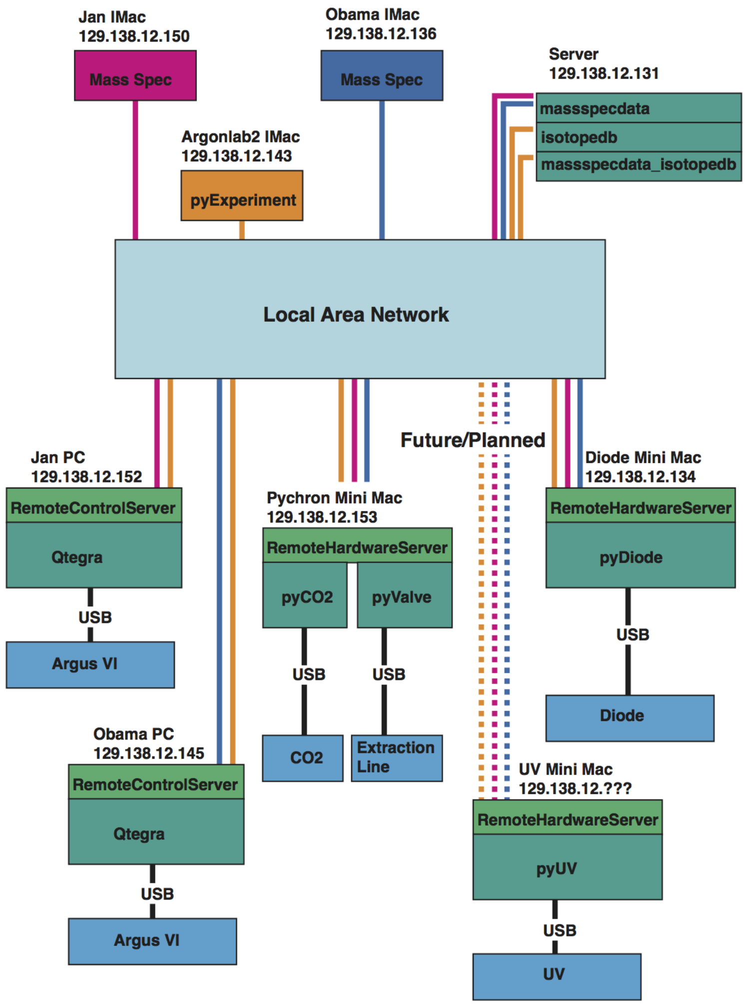
3.5 Spectrometer Ion Pump Valves

Name	Description
V	Obama Ion Pump
O	Jan Ion Pump

CHAPTER 4

Software Layout




Jan IMac
129.138.12.150
Mass Spec
Obama IMac
129.138.12.136
Mass Spec
Server
129.138.12.131
massspecdata
isotopedb
massspecdata_isotopedb
Argonlab2 IMac
129.138.12.143
pyExperiment
Local Area Network
Future/Planned
Jan PC
129.138.12.152
RemoteControlServer
Qtegra
USB
Argus VI
Pychron Mini Mac
129.138.12.153
RemoteHardwareServer
pyCO2
pyValve
USB
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CO2
Extraction Line
Diode Mini Mac
129.138.12.134
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Obama PC
129.138.12.145
RemoteControlServer
Qtegra
USB
Argus VI
UV Mini Mac
129.138.12.???
RemoteHardwareServer
pyUV
USB
UV

CHAPTER 5

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5.1 Fish Canyon and Intercalibration

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2. *Bachmann, O., Dungan, M. A. and Lipman, P. W.* **The Fish Canyon magma body, San Juan volcanic field, Colorado: rejuvenation and eruption of an upper-crustal batholith.** J Petrol 43, 1469–1503 (2002).
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4. *Bachmann, O., Oberli, F., Dungan, M., Meier, M., Mundil, R., and Fischer, H.* **40Ar/39Ar and U–Pb dating of the Fish Canyon magmatic system, San Juan Volcanic field, Colorado: Evidence for an extended crystallization history.** Chemical Geology 236, 134–166 (2007).
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9. *Lipman, P. W. and McIntosh, W. C.* **Eruptive and noneruptive calderas, northeastern San Juan Mountains, Colorado: Where did the ignimbrites come from?** Geological Society of America Bulletin 120, 771–795 (2008).

10. *Min, K., Mundil, R., Renne, P. R. and Ludwig, K. R.* **A test for systematic errors in 40Ar/39Ar geochronology through comparison with U/Pb analysis of a 1.1-Ga rhyolite.** Geochimica et Cosmochimica Acta 64, 73–98 (2000).

11. *Renne, P. R., Mundil, R., Balco, G., Min, K. & Ludwig, K. R.* **Joint determination of 40K decay constants and 40Ar*/40K for the Fish Canyon sanidine standard, and improved accuracy for 40Ar/39Ar geochronology.** Geochimica et Cosmochimica Acta 74, 5349–5367 (2010).

12. *Schmitz, M. D. and Bowring, S. A.* **U-Pb zircon and titanite systematics of the Fish Canyon Tuff: an assessment of high-precision U-Pb geochronology and its application to young volcanic rocks.** Geochimica et Cosmochimica Acta 65, 2571–2587 (2001).

5.2 BibTex Keys

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author = {Bachmann, O and Dungan, M A},
title = {{Temperature-induced Al-zoning in hornblendes of the Fish Canyon magma,␣
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journal = {American Mineralogist},
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7.
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CHAPTER 6

Computer Names

6.1 Mac

To connect from a Mac use the Finder, *Go > Connect To Server...* (*cmd-K*)

Enter the address of the computer you would like to connect to.

To file share prepend the address with `afp://`

```
afp://pychron.local
or
afp://129.138.12.153
```

To screen share use `vnc://`

```
vnc://pychron.local
or
vnc://129.138.12.153
```

If a connection is made you will be prompted for a `username` and `password`.

Enter the username and password of the computer you are trying to connect to.

Computer	Username	Address	short address	Task
Pychron mini	pychron	153	pychron.local	Extraction Line
Obama iMac	obama	137	obama.local	Pychron Master
Jan iMac	jan	150	jan.local	Pychron Master
Diode mini	diode	134	diode.local	Diode
UV mini	uv	132	uv.local	UV
CO2 mini	argonlab3	133	co2.local	CO2
ArgonLab1 iMac	argonlab1	138	argonlab1.local	Lab computer
ArgonLab2 iMac	argonlab2	143	argonlab2.local	Lab computer
Argonlab4 mini	argonlab4	158	argonlab4.local	Database replication, Bakeout
		155		Environmental Monitor
		157		USB server

6.2 Windows

Computer	Username	Address	Task
ObamaArgus	Thermo	145	Qtegra
JanArgus	Thermo	152	Qtegra

To connect to a Windows computer using a remote desktop client such as TightVNC or Chicken of the VNC

CHAPTER 7

Lab Meetings

7.1 LabMeeting 1. 1/27/15

7.1.1 Changelog

- added "Whats New" action. brings user to this doc.
- added Experiment Columns defaults. [root]/setupfiles/experiment_defaults.yaml
- fixed displaying irradiation holder
- added auto saving of experiment queues. Auto saves to a .bak file whenever values change or run added
- added SampleImageTask
- added notes to irradiation levels
- added task switching to Browser pane

7.1.2 Go Over

1. Whats New
2. Experiment Columns
3. Auto save experiments
4. Notes to Irradiation levels. Info/Chronology Panes
5. Conditional edit/view

CHAPTER 8

Indices and tables

- genindex
- modindex
- search