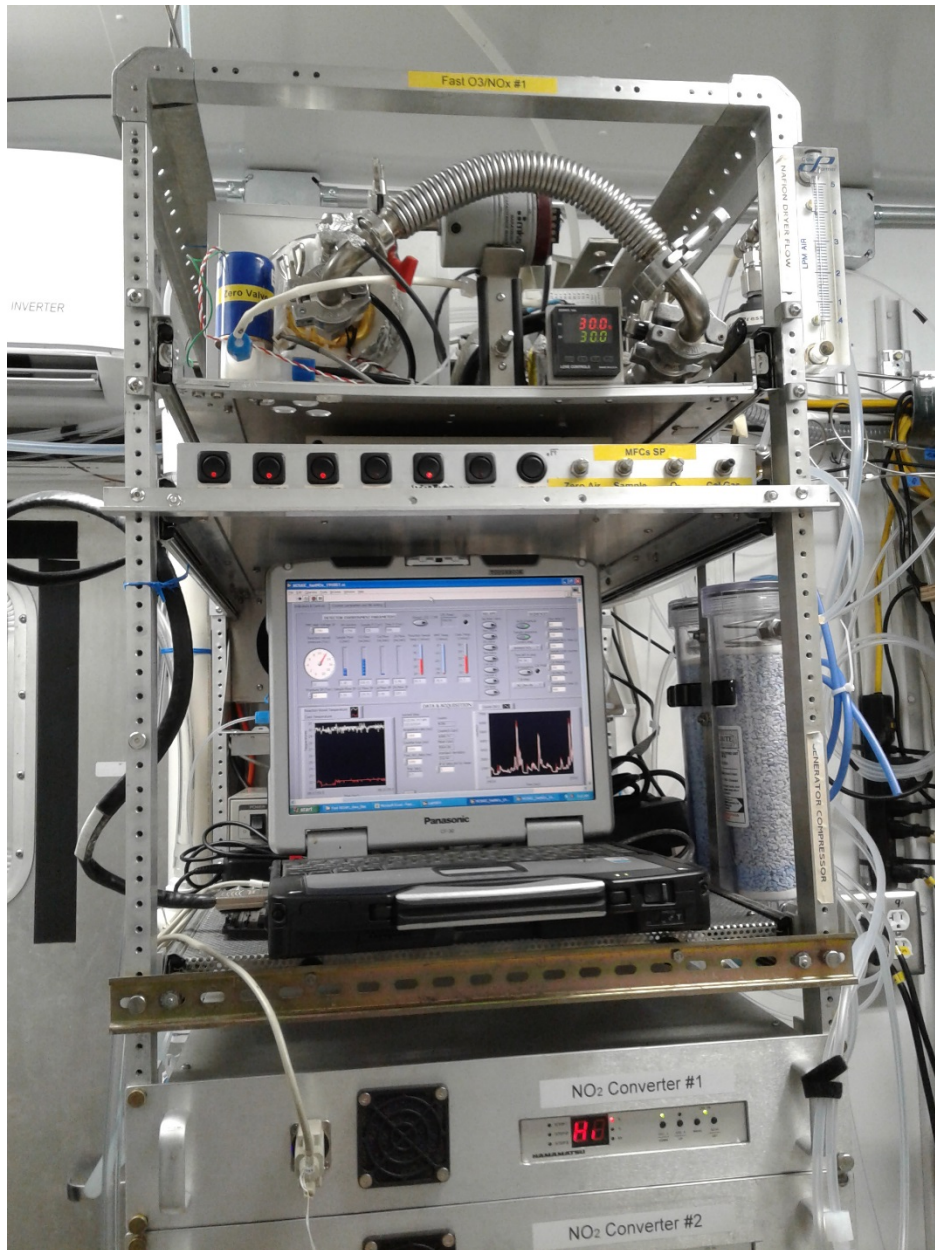
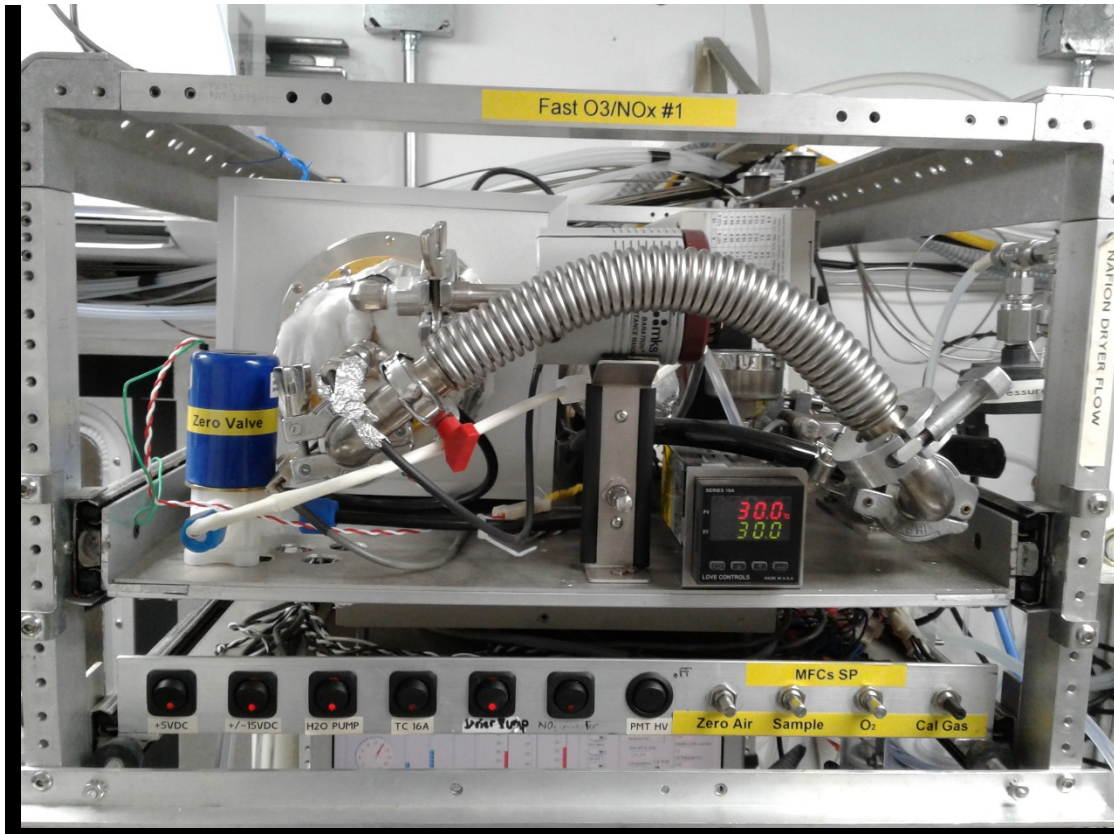


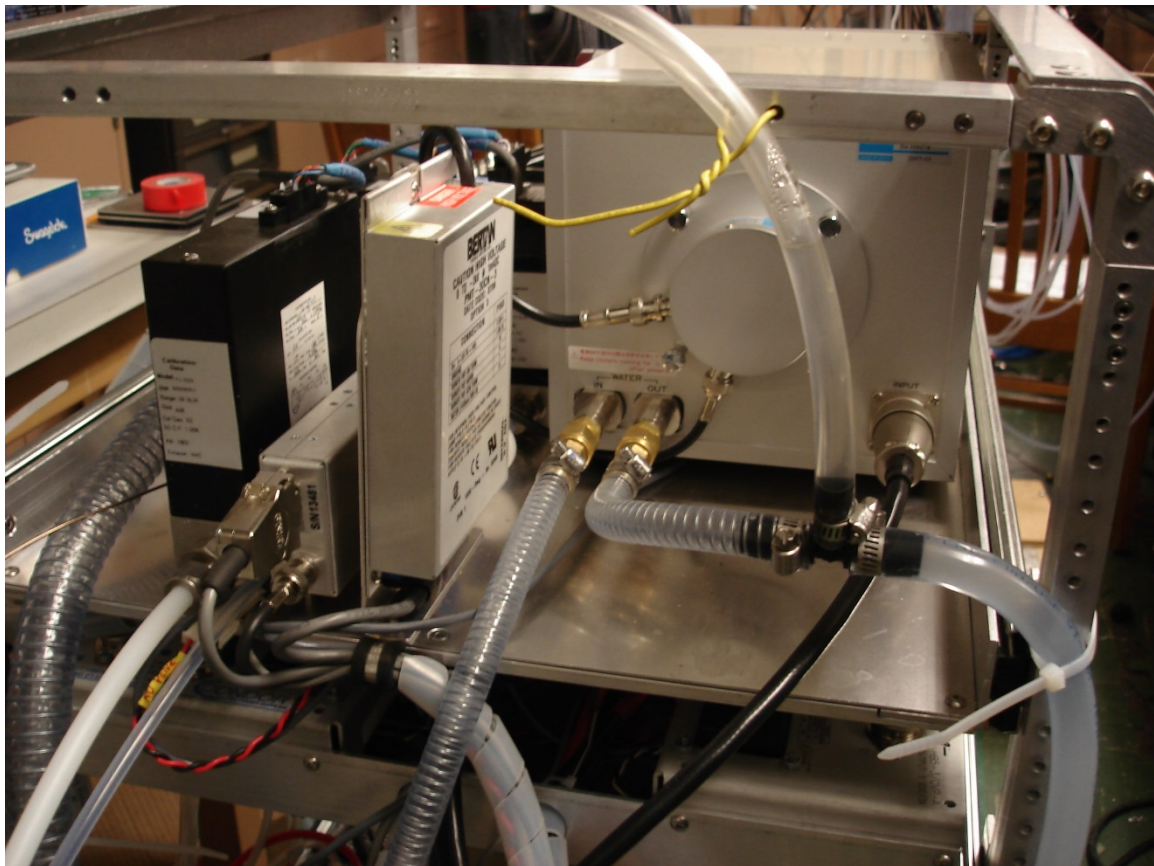
Fast NO_x instrument #1 operation guide (MOSAIC version 1.0, 10/13/2019)



Pic 1: general view of the instrument



Pic 2: Front of the top drawer : Temp controller, Pressure transducer, Reaction vessel.



Pic 3: Back of the top drawer: PMT enclosure, PMT power supply, A/D, MFC

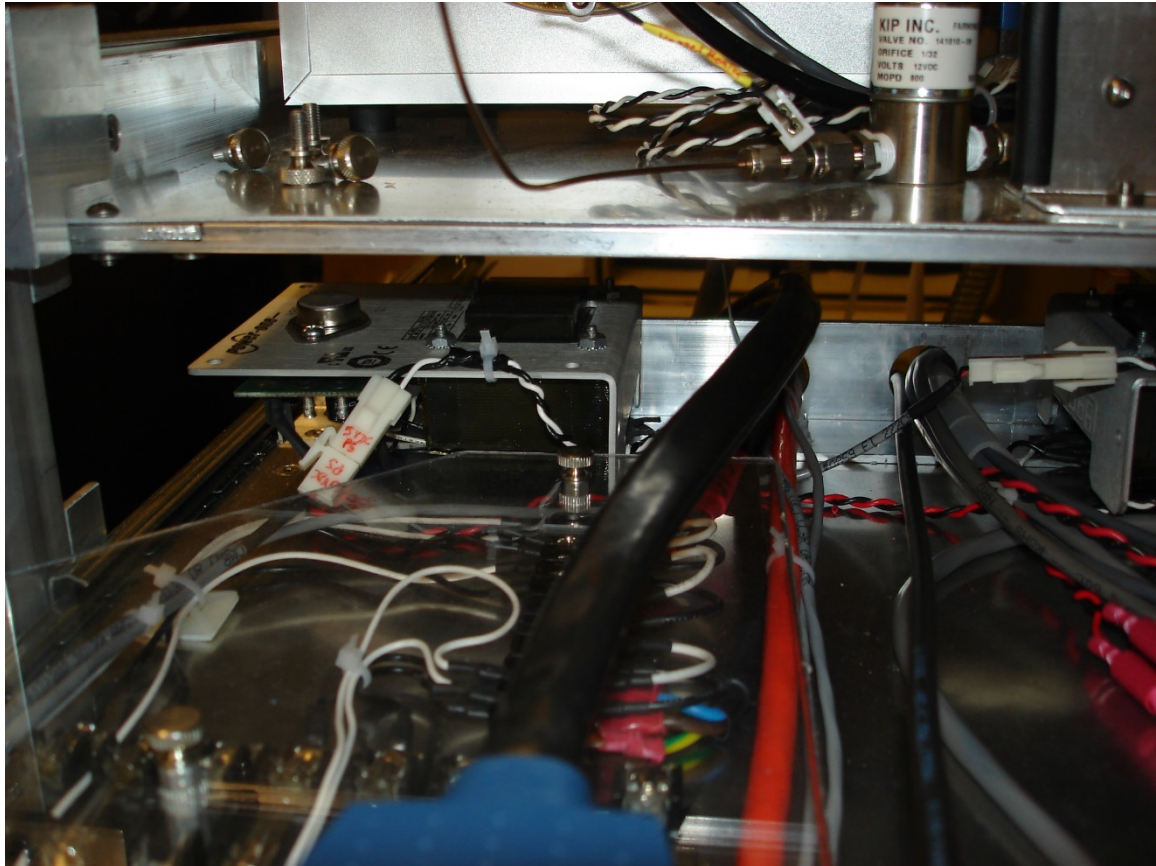


Pic 4: Top drawer: Ozone generator

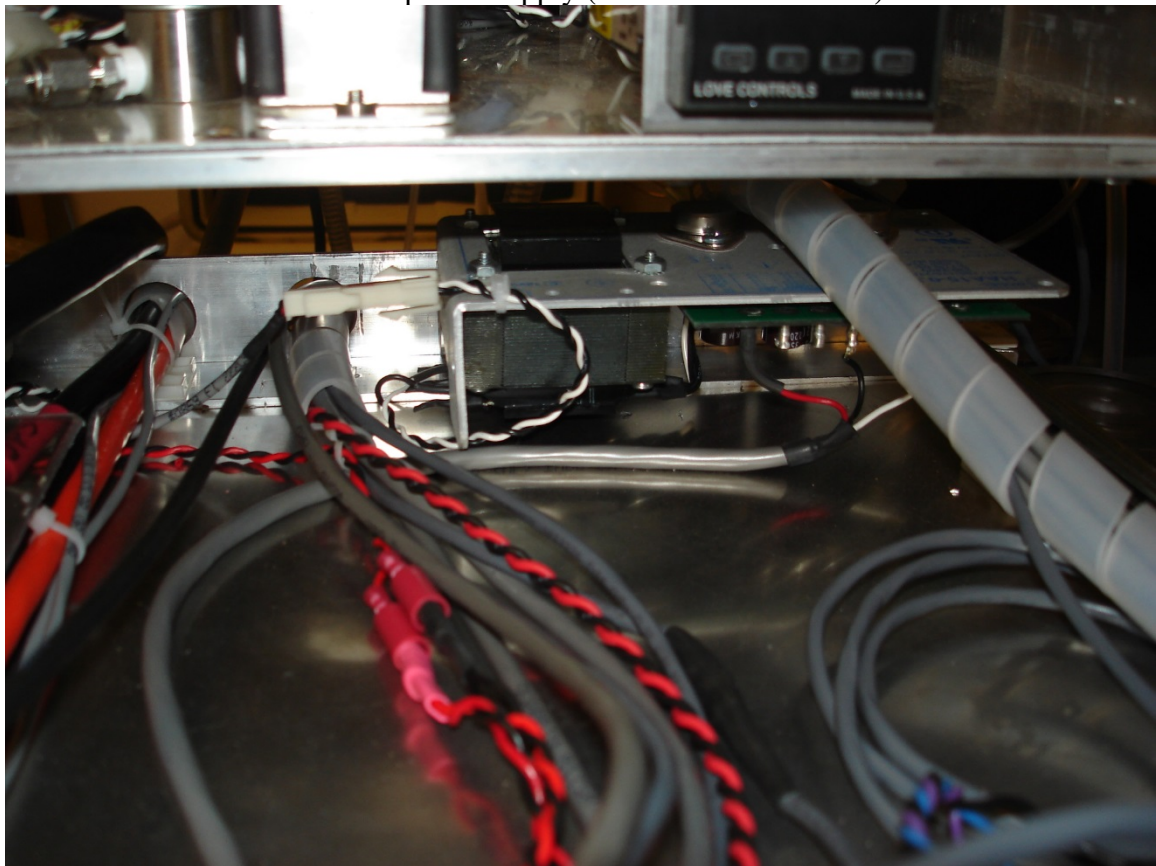


Pic 5: Second drawer: vacuum isolation valve.

Pic 6: Second drawer: +/-15VDC distribution and fuses for the PMT power supply



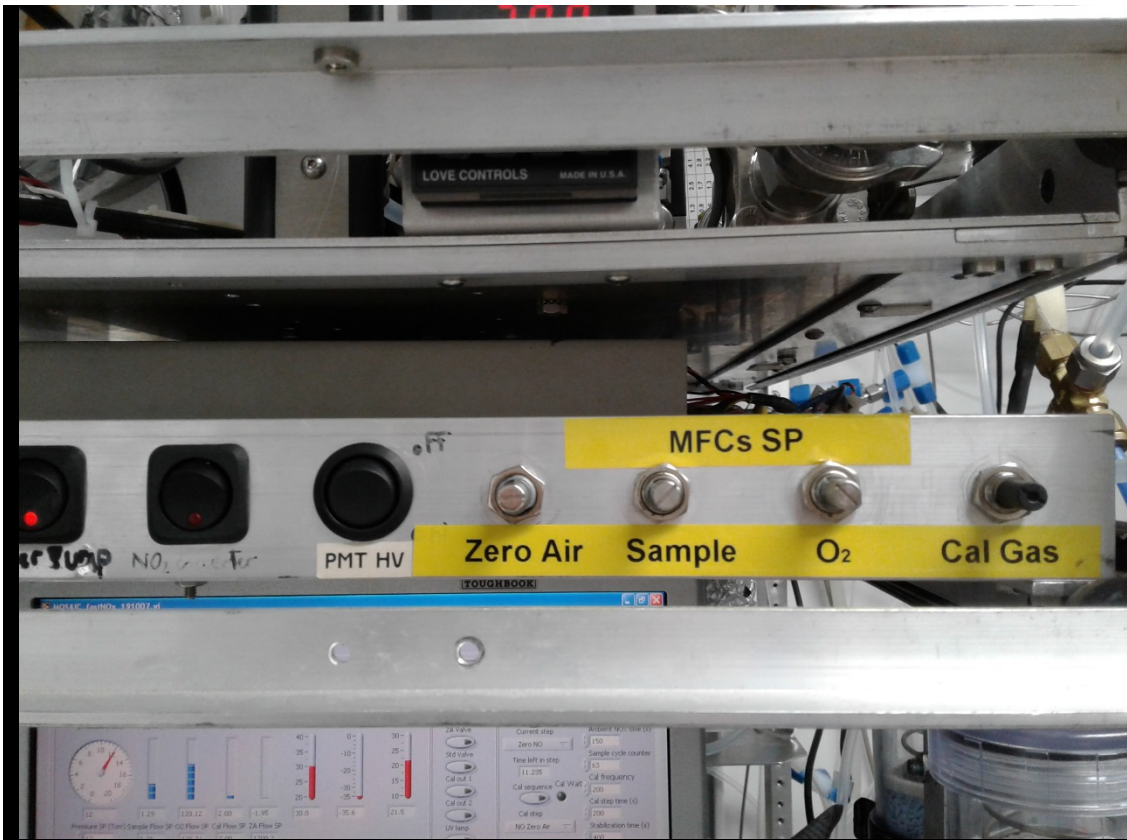
Pic 7: Second drawer: +5VDC power supply (on the back to the left)



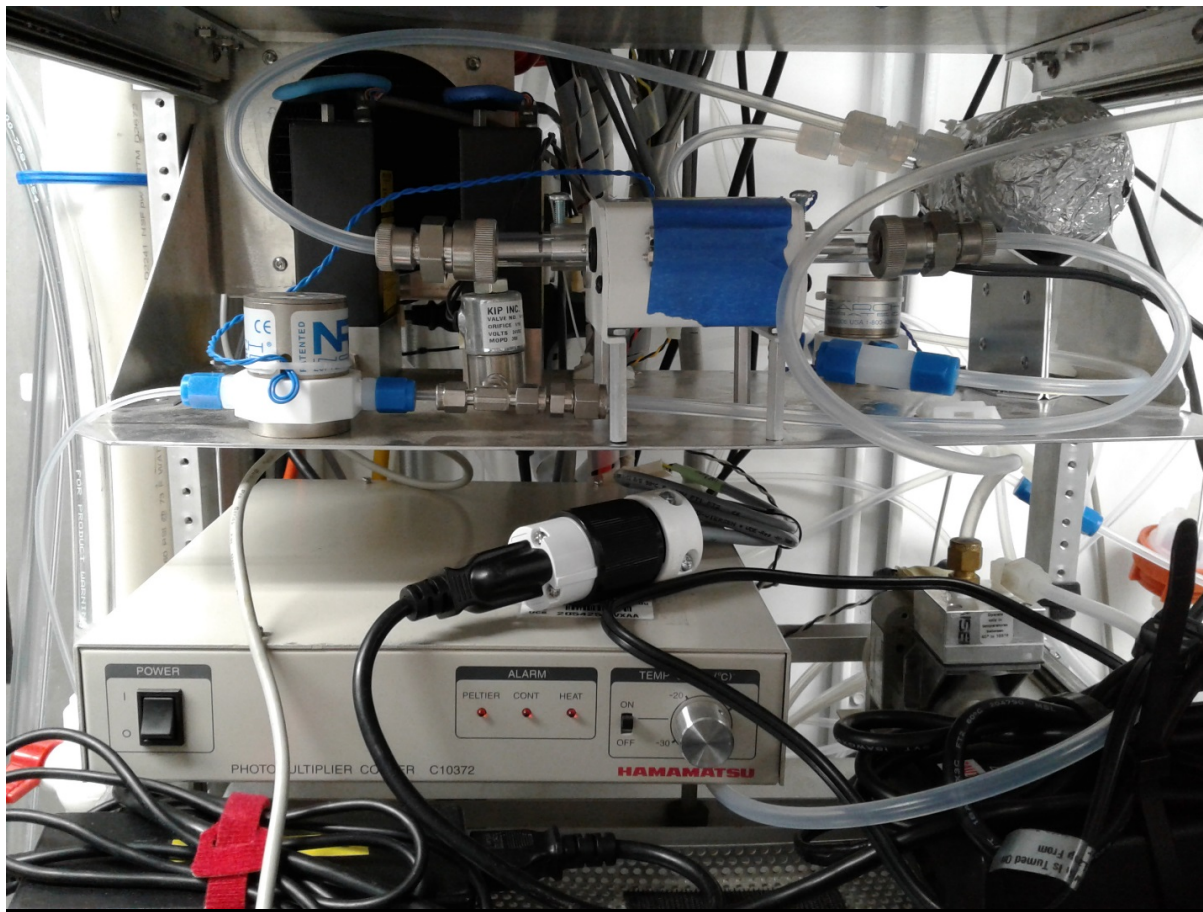
Pic 8: Second drawer: +/-15VDC power supply (on the back right)



Pic 9: Second drawer: Main switches.



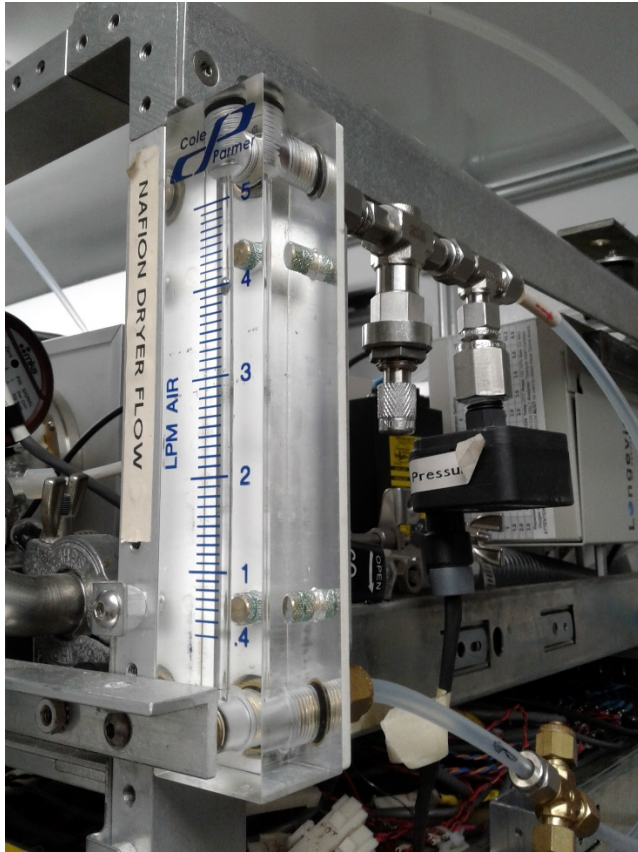
Pic 10: Second drawer: Main switches and potentiometers for MFC flows setpoint.



Pic 11: Third drawer: PMT Cooler controller, drier pump, computer and calibration system



Pic 12: O2 regulator with shut off valve



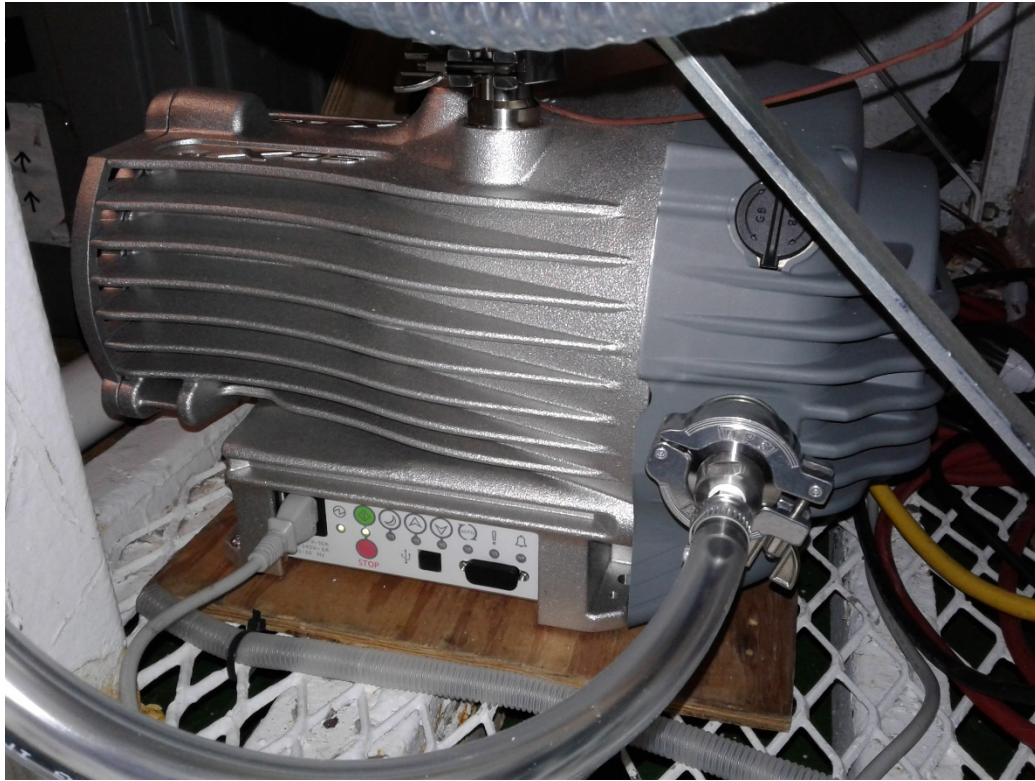
Pic 13: Drier Cycle is attached to the right side of the frame: Flow meter with needle valve, pressure sensor. Drierite columns underneath.



Pic 14: Water pump



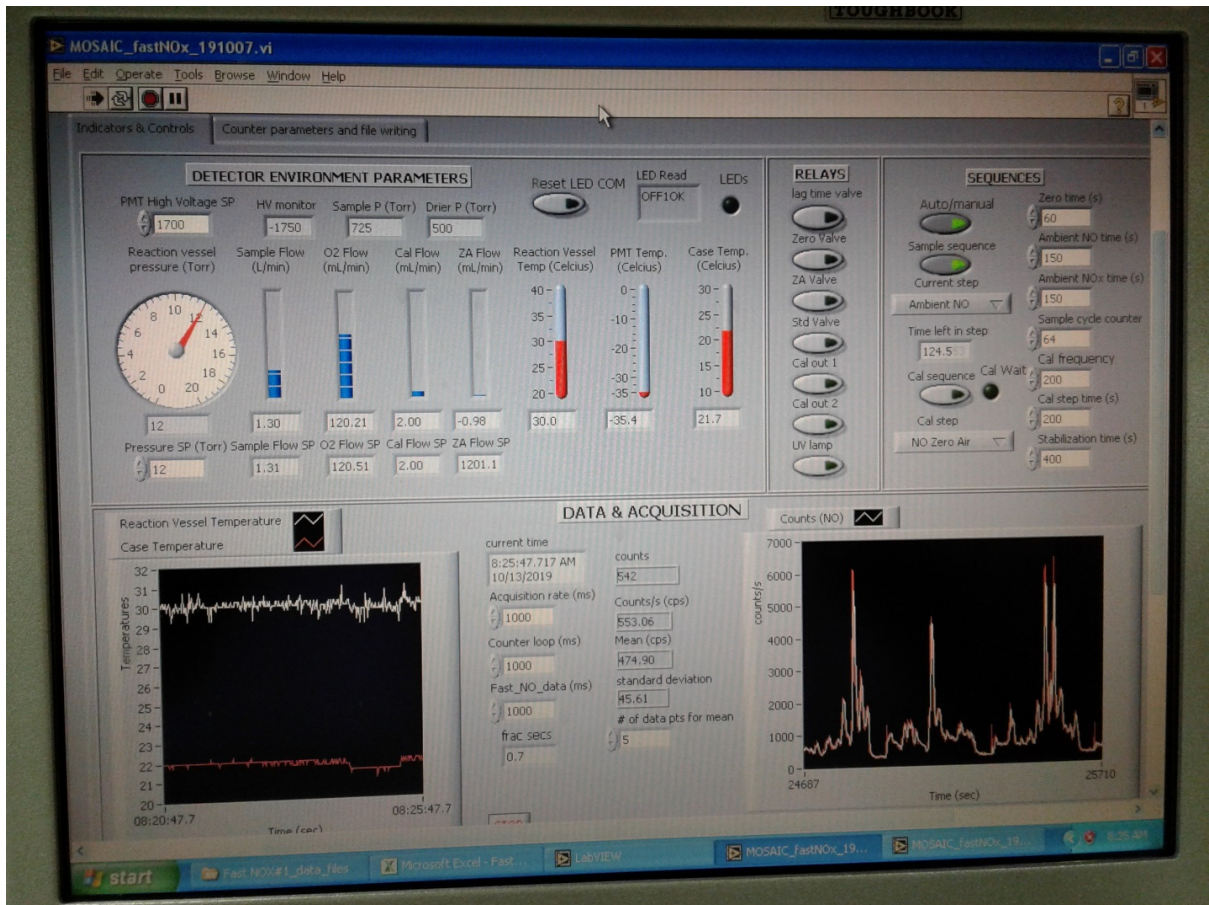
Pic 15: Water reservoir and water reservoir fill port



Pic 16: Scroll pump (outside the container, in the front)



Pic 17: Exhaust filter (filled with charcoal), shared with FastO3 pump exhaust.



Pic18: Labview VI front panel.



Pic19: 1.5ppm NO standard cylinder

Turning off the instrument:

1. **Shut OFF the 1.5ppm NO standard** delivery valve and cylinder valve.
2. In the Labview VI, **turn OFF the Auto/Manual** button and wait that the current sample sequence is done (can take up to 6min).
3. **Turn OFF the O3 generator** on the top drawer. Switch is on the side.
4. **Switch OFF the O2 cylinder valve and the valve at the outlet of the O2 regulator** (located outside, in the back of the container). After a couple minutes, the O2 flow reading should drop slowly to 0.
5. Slowly turn down the **PMT High Voltage SP** in the VI (steps of 100V), all the way to 0.
6. Switch OFF the **PMT cooler** (switch on the left side, pic. 11)
7. On the switch panel, turn the **HV PS** switch OFF (pic. 10)
8. On the switch panel, turn OFF **Drier Pump** switch and **TC 16A** switch (pic. 9)
9. Close the **vacuum isolation valve** and watch the **Reaction Vessel pressure** in the VI go to 20.
10. If the system will stay off for an extended period of time (days), turn off the scroll pump. Since the exhaust of the scroll pump is shared with the FastO3 instrument, turn OFF the NO shut off valve on the FastO3 system, wait for a few minutes and then disconnect the output of the FastNOx scroll pump and cap the tubing. This will prevent back flow of FastO3 exhaust through the FastNOx pump. Then, turn the NO shut off valve back ON on the FastO3 system.
11. On the switch panel, turn OFF the **NO2 converter**, **+/-15V** and **5VDC** switches (pic. 9)
12. If the system will stay off for several days, shut OFF the **H2O pump** switch on the switch panel (pic. 9).
13. Stop the Labview VI on the laptop (stop button on the top left)

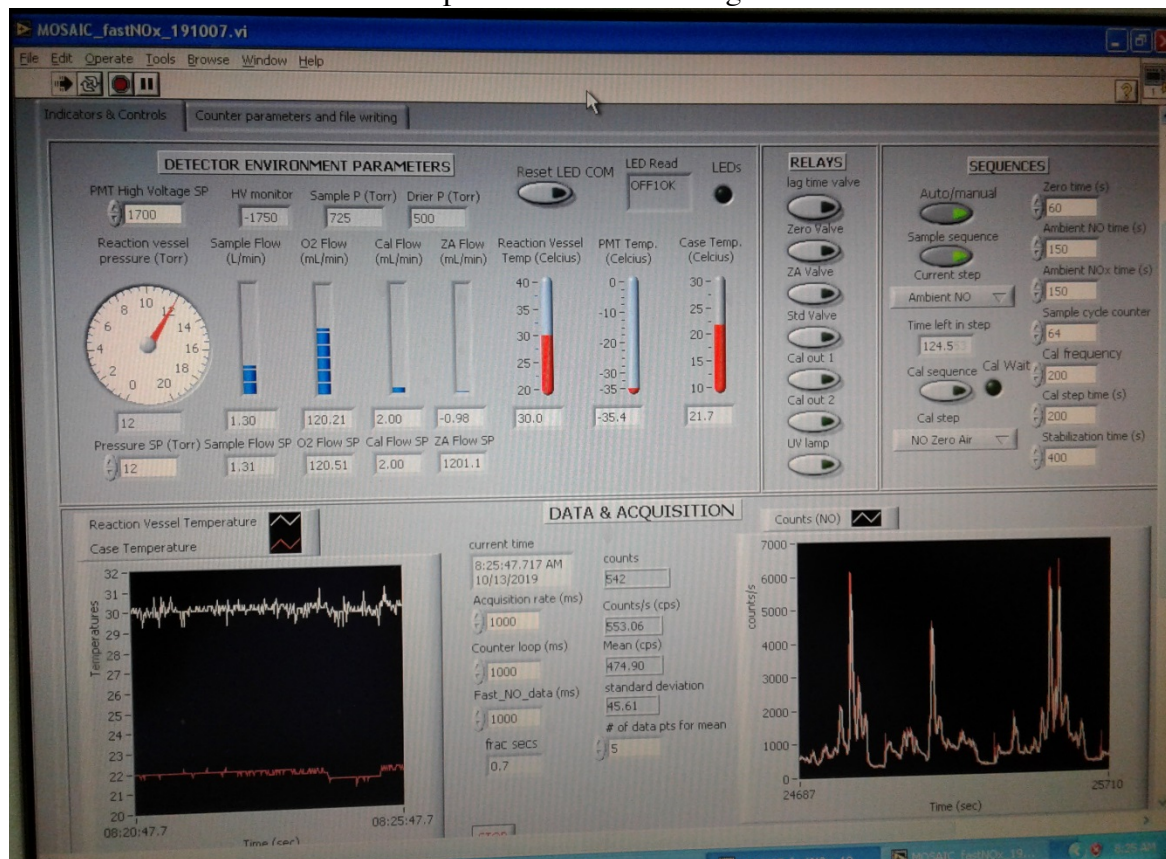
Turning on the instrument:

1. Turn ON the H₂O Pump switch on the switch panel (pic.9)
2. Turn ON the computer and launch the Labview VI (shortcut on the desktop: **MOSAIC_fastNOx#1_191007.vi**)
3. In the VI, change the **PMT High Voltage SP** to 0.
4. Turn ON the **5VDC and +/-15V** switches on the switch panel (pic 9)
5. Turn ON the temperature controller: **TC 16A** switch on switch panel (pic. 9). On the VI, the Reaction vessel temperature should start rising and will settle at 30C.
6. Turn ON the **NO₂ converter** on the switch panel
7. Switch ON the **PMT cooler** (toggle switch on the left side, pic. 11). Also make sure that the temperature knob is set to -35C (all the way count-clockwise) and that the grey button next to it is on the ON position.
8. Turn ON the **scroll pump** (green button on the side of the pump)
9. Open the **vacuum isolation valve**. On the VI, you should see the sample flow reading go to 1.3L/min and the Reaction Vessel pressure settle at 12 Torr. If you have disconnected the pump output when you turned off the system, reconnect the exhaust tube to the output of the pump. Make sure to turn OFF the NO shut off valve on the FastO₃ system before uncapping the exhaust tube.
10. On the switch panel, turn ON the **Drier Pump**. Check that the ball on the flowmeter is around 4 L/min. If necessary, adjust it with the needle valve on the back of the flowmeter.
11. **Open the O₂ cylinder valve and the shut off valve at the outlet of the regulator** and watch the **O₂ flow** reading on the VI. It should go to 120mL/min
12. **Open the 1.5ppm NO standard valve and the regulator delivery valve.**
13. **Turn ON the O₃ generator** located on the top drawer. The switch is on the right side.
14. When the PMT temperature is below 0C, turn the **HV PS** switch ON (pic. 10). Then, in the VI slowly increment the **PMT High Voltage SP** to 1700. You should start seeing counts on the VI now.
15. **Stop the VI for a few seconds, then start it again.** Check the LED Read display on the VI: it should display CNT1 OK.
16. **Turn ON the Auto/Manual switch**
17. Let the instrument equilibrate for a while and check that control files and data files are being recorded. Also check that data is being recorded in the DAS.

REGULAR CHECKS/MAINTENANCE:

Daily:

- **Check the Drierite** status. If first column is all purple/pink, replace with a spare one (replace before the second one starts turning purple/pink). Turn off the drier pump during the replacement and turn it back on right after.
- **Check the O2 cylinder pressure and the 1.5ppm NO standard pressure** and log it in the gas logbook on the GCMS inlet computer.
- **Check the water level** in the water reservoir. Should be 1-2" (3-5cm) below the tee where the water cycles back in.
- **Check the VI** to see if all parameters and readings are ok:



PMT High Voltage SP: 1700

PMT reading: -1750V (+/-20V)

Reaction Vessel Pressure SP: 12 Torr

Reaction Vessel Pressure reading: 12 Torr (+/-0.02)

Sample Flow SP: 1.30 L/min

Sample Flow reading: 1.30 L/min (+/-0.02)

O2 Flow SP: 120 mL/min

O2 Flow reading: 120 mL/min (+/-0.5)

Cal Flow SP: 2.00 mL/min

Cal Flow reading: 2.00 mL/min (+/-0.01)

ZA Flow SP: 1200 mL/min

ZA Flow reading: most of the time 0, only at 1200 during a calibration

Reaction Vessel Temperature: 30.0C (+/-0.5C)

PMT Temperature: below -34C

Case Temperature: 20-25C

Sample Pressure: 720 Torr (+/-30)

Drier Pressure: 500 Torr (+/-50)

Acquisition Rate: 1000ms

- **Check that the control file and the data file** are getting written:

Control File: My Documents/LabVIEW Data/MOSAIC/FastNOx#1_control_files/control_DATE_TIME.lvm

Data File: My Documents/LabVIEW Data/MOSAIC/FastNOx#1_data_files/fastNOx#1_DATE_TIME.lvm

- **Transfer data** to a USB stick or drive and transfer to the ship's data archive

Weekly, or when necessary:

- **Refill the water reservoir** to about 1-2" (3-5cm) below the tee where water comes in. Use the small bottle with the green cap and a funnel if necessary. **Be careful to pour very slowly! It fills up fast!**
- **Regenerate the used Drierite** in the oven in Wet Lab1 (Nasslab 1). Lay the Drierite in a **thin layer** on an aluminum boat. Set the oven at **190C** and bake the Drierite for **1h**. Make sure to take the Drierite out of the oven while it's **still hot**. Pour into a glass jar to let it cool and then transfer back into the Drierite column.
NOTE: As drierite is reused, it tends to get dustier and stick to the walls of the plastic column, so before refilling a column always wipe the inside with a damp paper towel or completely remove the felt bottom and rinse with water and dry.
- **Replace the O2 cylinder.** Before replacing the cylinder, turn off the O3 generator. Turn it back on once the flow of O2 has been established again.