

Download

To download the program, make sure Git version control system is installed on your machine. Install program by typing following commands:

```
cd Desktop  
git clone https://github.com/DaniilKorshkov/Urania
```

Make sure Python3, pip and following Python libraries (streamlit, matplotlib, pandas, pyserial, pyusb, pyvisa, python-netdiscover) are installed on your system under sudo privileges. Make sure netdiscover is installed on your system:

```
sudo apt install python3  
sudo apt install python3-pip  
sudo apt install netdiscover  
sudo pip install streamlit  
sudo pip install matplotlib  
sudo pip install streamlit  
sudo pip install pandas  
sudo pip install pyserial  
sudo pip install pyusb  
sudo pip install pyvisa  
sudo pip install python-netdiscover
```

This chapter should already be performed before shipping, however, it is included just in case.

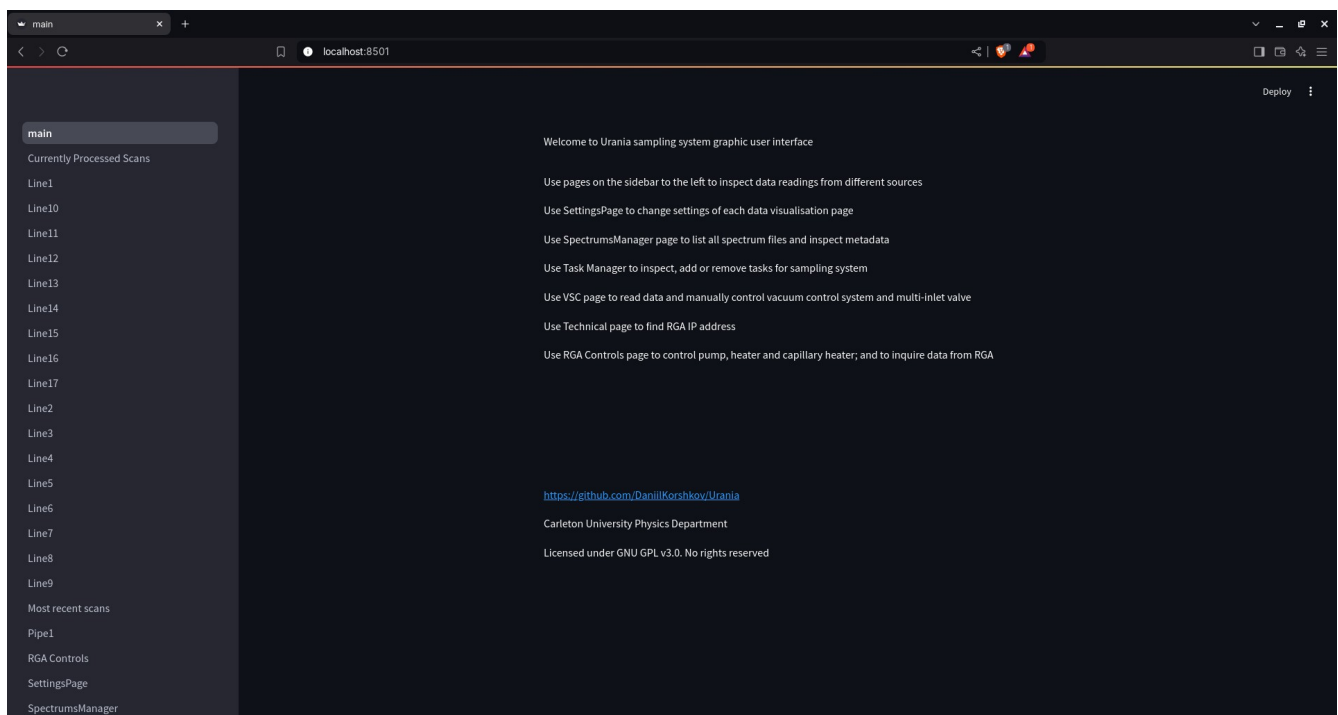
Start the web application

1) User interface of the program works through web application

1.1) To start the web app, navigate to Urania directory and start the webapp by typing following command. Enter admin password as prompted

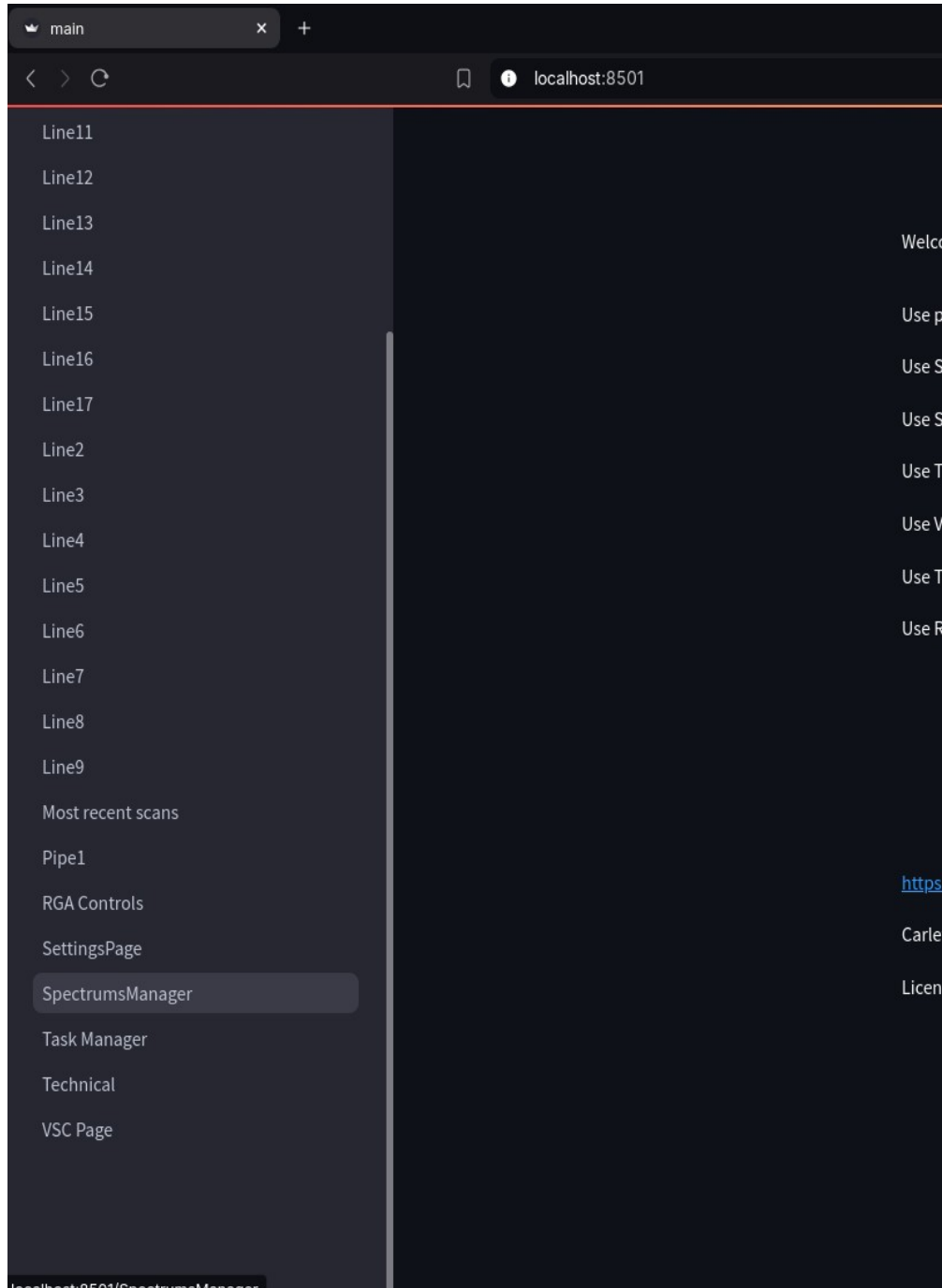
```
cd Desktop/Urania  
sudo streamlit run main.py
```

1.2) Open any web browser (firefox and brave were tested) and navigate to localhost:8501 address. If done correctly, program welcomes you with the following menu:



Data collection

1) Navigate to SpectrumsManager tab with the menu on the left, and create empty spectrum file



1.1) Scroll down to the bottom of the page, specify filename, multi inlet valve position from 1 and 16, initial M, step, amount of steps and purging parameters:

The screenshot shows the 'SpectrumsManager' web application running on localhost:8501. The form is titled 'Create new spectrum file:' and contains the following fields and values:

- Type new spectrum name: MySpectrum
- Type multi inlet valve position: 1
- Type initial molar mass: 1
- Type final molar mass: 50
- How much minutes data is recorded? (for 16 files at a time creation only, otherwise it is specified in TaskManager): 10
- Type purging time in seconds: 600
- Type calmdown time in seconds: 10
- Type MFC behaviour for purging (open,close or number from 20 to 1000): open
- Type MFC behaviour (open,close or number from 20 to 1000): A dropdown menu is open showing options: 10, close, 100, and 1.
- Type step: 1

At the bottom right of the form, there is a red-outlined button area with the text 'Press Enter to apply'.

1.2) Press “Create Spectrum” button to create 1 spectrum; or press “create 16 equivalent spectrums and corresponding tasks” to create 16 spectrums (with multi inlet valve position from 1 to 16) and 16 corresponding tasks. If done so, you can skip step 2

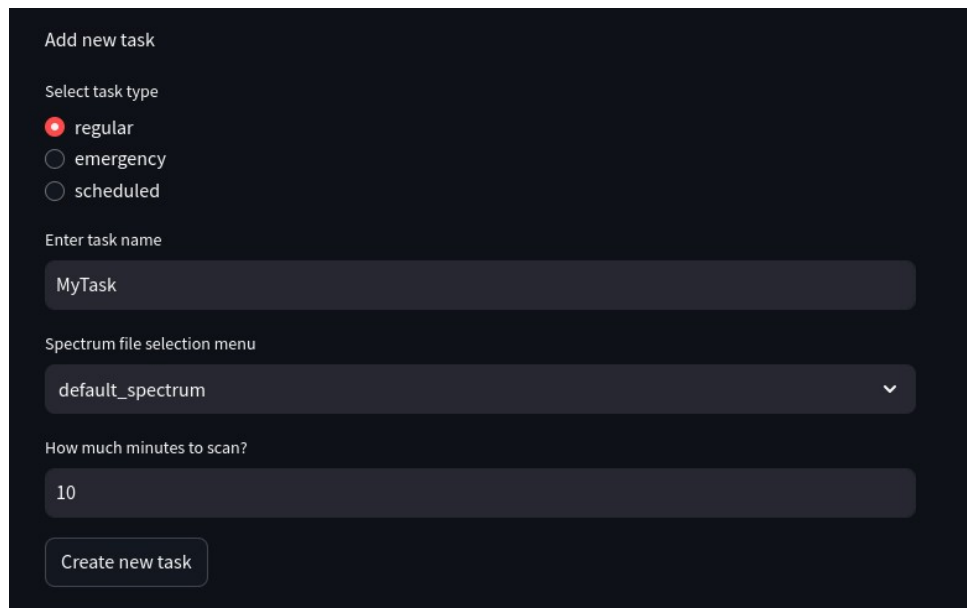
This close-up shows the bottom of the form. The 'Type step' field contains the value '1'. Below it are two buttons: 'Create spectrum' and 'Create 16 equivalent spectrums and corresponding tasks'.

2) Create a task in Task Manager page of web app

2.1) In the bottom of the page, select type of the task (emergency, scheduled or regular)

2.2) Specify unique task name, multi inlet valve position from 1 to 16, filename of spectrum and amount of scans

2.3) If task type is emergency, specify the amount of executions – either integer or “inf”. If task is scheduled, specify the frequency of executions (for example, if freq=3600, task would be executed once every 3600 seconds)



The screenshot shows a dark-themed web form titled "Add new task". It contains the following elements:

- Select task type:** Three radio buttons are present. The "regular" option is selected, indicated by a red dot. The other two options, "emergency" and "scheduled", are unselected.
- Enter task name:** A text input field containing the text "MyTask".
- Spectrum file selection menu:** A dropdown menu with "default_spectrum" selected and a downward arrow icon on the right.
- How much minutes to scan?:** A text input field containing the number "10".
- Create new task:** A button located at the bottom of the form.

Priority of task execution is determined the following way:

- 1) If there is an emergency tasks the in list, first emergency task encountered is executed
- 2) Else, if there are scheduled tasks in the list, first scheduled task that wasn't executed on time, would be executed (for example, task with freq=3600 that was executed 3800 seconds ago)
- 3) Else, regular tasks are executed in alternating manner (for example, task1, then task2, then task3, than task1 if there are 3 tasks in the list)

2.4) You can use menu to move tasks up, down or delete. If web page is not responsive, reload page after pressing button

```
MyTask parameters: valve position:10, spectrum filename: 10_123-04_10_2024, data entries per task: 120
```

```
10_123-04_10_2024 parameters: Valve:10; Initial M:1.0, amount of scans:11, step:1.0, purg.time:11,  
purg.mfc: 111, calmdown time:11, calmdown mfc:111
```

delete MyTask

move MyTask up

move MyTask down

In SpectrumsManager tab, you can view spectrum file parameters:

```
MySpectrum-12_11_2024 parameters: Valve:1; Initial M:1.0, amount of scans:50, step:1.0, purg.time:600,  
purg.mfc: open, calmdown time:60, calmdown mfc:close
```

3) To start data collection, execute StartSampling.py script with sudo privileges. Type admin password as prompted

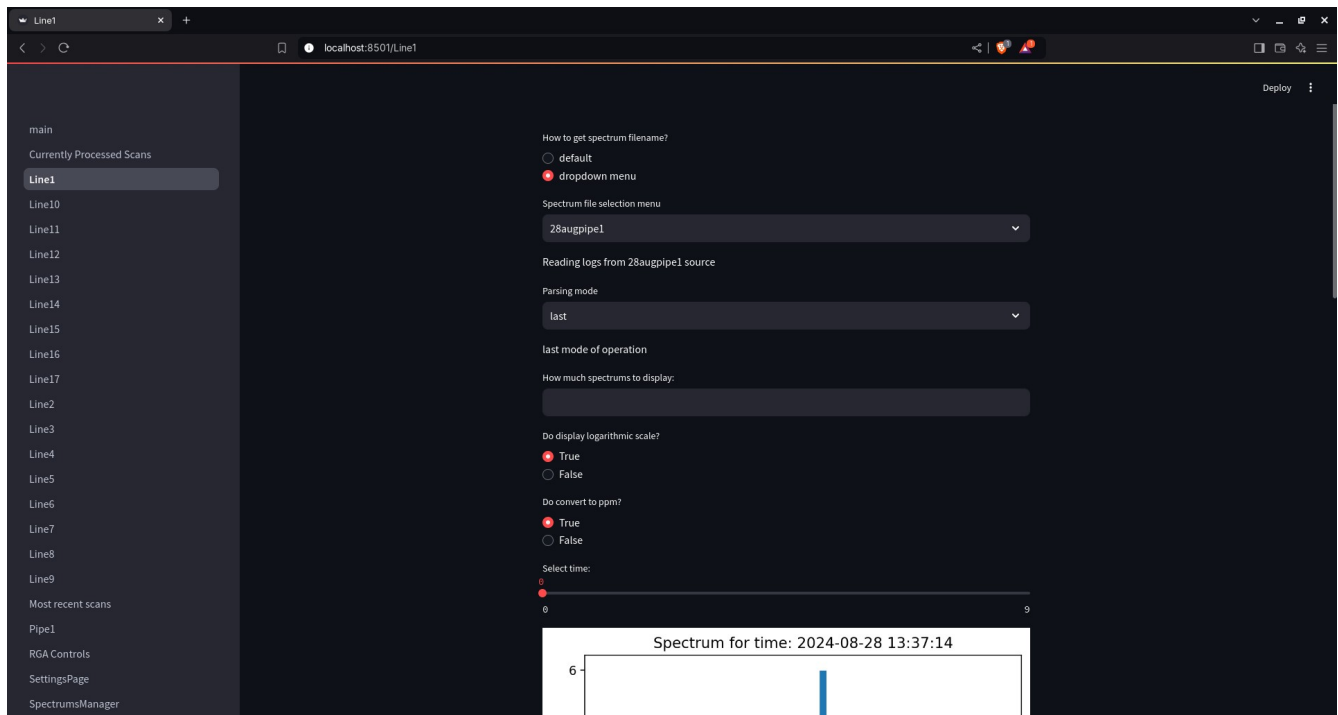
```
cd Desktop/Urania-Main  
sudo python3 StartSampling.py
```

Data visualisation

1) To open data visualisation page, select the name of desired page on left sidebar. Otherwise, you can navigate to “Currently processed scans” page:

The screenshot shows a web application interface for 'Currently Processed Scans'. The browser address bar indicates the URL is `localhost:8501/Currently_Processed_Scans`. On the left, a sidebar lists navigation options: 'main', 'Currently Processed Scans' (highlighted), 'Line1', 'Line10', 'Line11', 'Line12', 'Line13', 'Line14', 'Line15', 'Line16', 'Line17', 'Line2', 'Line3', 'Line4', 'Line5', 'Line6', 'Line7', 'Line8', 'Line9', 'Most recent scans', 'Pipe1', 'RGA Controls', 'SettingsPage', and 'SpectrumsManager'. The main content area displays a list of files being read, including `'8oct_test_file-08_10_2024'`, `'1_8oct_16_test-08_10_2024'`, `'2_8oct_16_test-08_10_2024'`, `'3_8oct_16_test-08_10_2024'`, `'4_8oct_16_test-08_10_2024'`, `'5_8oct_16_test-08_10_2024'`, `'6_8oct_16_test-08_10_2024'`, `'7_8oct_16_test-08_10_2024'`, `'8_8oct_16_test-08_10_2024'`, `'9_8oct_16_test-08_10_2024'`, `'10_8oct_16_test-08_10_2024'`, `'11_8oct_16_test-08_10_2024'`, `'12_8oct_16_test-08_10_2024'`, `'13_8oct_16_test-08_10_2024'`, `'14_8oct_16_test-08_10_2024'`, and `'15_8oct_16_test-08_10_2024'`. Below the file list, there are input fields for 'Enter desired molar masses separated by comma: (default: 28,40,44,ox)' and 'Enter desired molar masses (or 'ox') separated by comma:'. There are also checkboxes for 'Do display logarithmic scale?' (True) and 'Do convert to ppm?' (True). A 'Parsing mode' dropdown is set to 'last'. A 'last mode of operation' section shows 'Reading logs from 8oct_test_file-08_10_2024 source'. At the bottom, a line graph titled 'log10 PPM vs time for given M' is partially visible, showing data for M: 28.0 (blue), M: 40.0 (orange), and M: 44.0 (green).

If you go to Line1 page, interface will look like this:

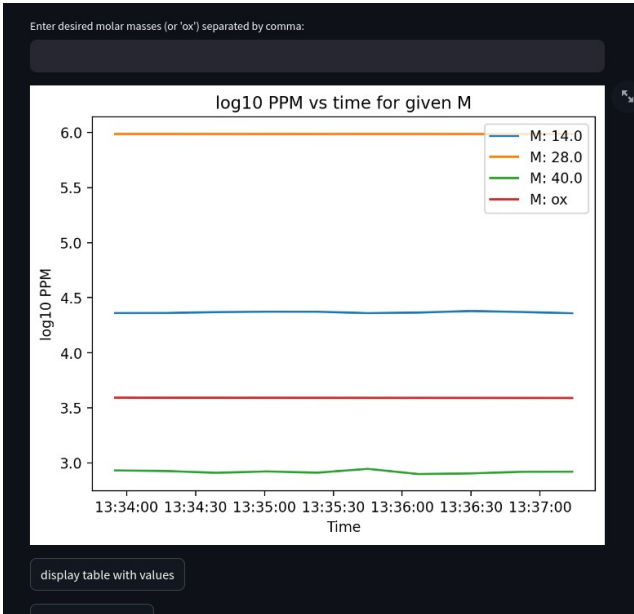
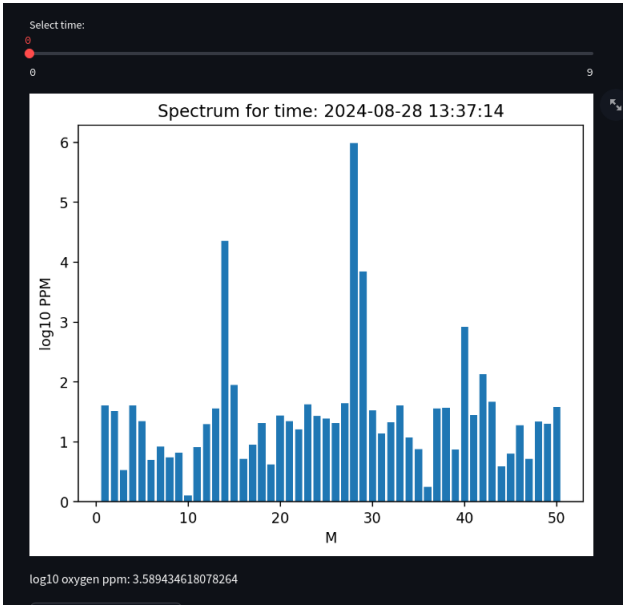


2.0) Select whether you want to process default file or select a “dropdown menu” option and select file from popped up menu.

2.1) Data visualisation works either in “last” or “search” mode of operation. It can be changed in Settings menu. If the mode of operation is “last”, program will automatically display the most recent scans. If the mode of operation is “search”, you should select the date and time through prompted widget. Program will display data for this moment of time

2.2) Select how much spectrums you want to display on screen by typing an integer into the field

2.3) There are two types of graphs displayed below: spectrum for given moment of time and concentration vs time graphs for given molar masses



2.4) Each type of graph can be displayed with values in pascals (raw output of RGA) or in PPM (automatically converted). Each type of graph can be displayed either on linear or logarithmic scale.

2.5) For concentration vs time graph, you can input molar masses (or “ox” or oxygen) splitted by comma into the field

2.6) To display table with values (shown from left to right for two different types of spectrums), press “display table with values” button. It can be copied and pasted to office programm such as LibreOffice or Excel

Display table with values

	Molar mass	PPM
0	1	1.611
1	2	1.5202
2	3	0.5302
3	4	1.611
4	5	1.3472
5	6	0.6975
6	7	0.9261
7	8	0.7415
8	9	0.818
9	10	0.1023

13:34:00 13:34:30 13:35:00 13:35:30 13:36:00 1

Time

display table with values

	Time:	M = 14.0	M = 28.0	M = 40.0	M = ox
0	2024-08-28 13:37:14	22,832.5634	969,079.6912	830.8399	3,884.39
1	2024-08-28 13:36:52	23,438.7687	968,607.9996	829.2175	3,888.28
2	2024-08-28 13:36:30	23,922.6102	968,378.2299	801.8889	3,890.75
3	2024-08-28 13:36:07	23,154.0233	968,988.1843	790.8791	3,893.13
4	2024-08-28 13:35:45	22,879.4266	969,091.1513	881.7922	3,895.22
5	2024-08-28 13:35:23	23,570.3028	968,572.4831	813.9705	3,898.34
6	2024-08-28 13:35:01	23,585.3727	968,581.8246	835.5669	3,900.79
7	2024-08-28 13:34:39	23,377.4011	968,785.9668	811.7616	3,903.73
8	2024-08-28 13:34:17	22,942.3757	969,094.7398	843.101	3,907.15
9	2024-08-28 13:33:55	22,914.8859	969,047.9501	853.5371	3,912.47

Find abnormalities

2.7) To compare results with tolerance values (file with tolerances can be selected in Settings), press “Find Abnormalities” button. Not tested yet and not sure if this feature is needed

Remote Access

1) System can be accessed remotely through RustDesk program

1.1) Install RustDesk on your system. On Debian systems it can be done by typing “sudo apt install rustdesk”

1.2) Enter 9-digit ID and password of system (not provided in this manual for security reasons)

1.3) Set up 2FA through any 2FA application (I recommend Aegis, as it is free and open source and 100% offline). Credentials are not provided in this manual

1.4) Click “Remote connect” to control the system or “file transfer” to use system as network attached storage.

Manual control of hardware

1) VSC and multi inlet valve can be controlled using VSC Page page in web app. Web app displays parameters and readings of each sensor and allows user to change them

2) RGA can be manually controlled through RGA Controls page. There are options to control capillary heater; heater and pump in this page

Hardware address discovery

1) To discover IP address of RGA, navigate to Technical page and press “Netdiscover RGA IP button”. Computer pings all devices in local network and discovers IP address of RGA

2) To discover location of multi inlet valve; vacuum system controller and multi inlet valve, unplug them from USB ports and press “Locate devices on USB bus button”. Follow the instructions appearing on the screen