Development of a Lab Environmental Monitor

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CASST

Supervisors: Chris Chambers,
Thomas Brunner
and Soud Al Kharusi

Intro About Myself

- I am from Montreal

- Finished CEGEP last May

- Worked at the Brunner Neutrino Lab during the summer
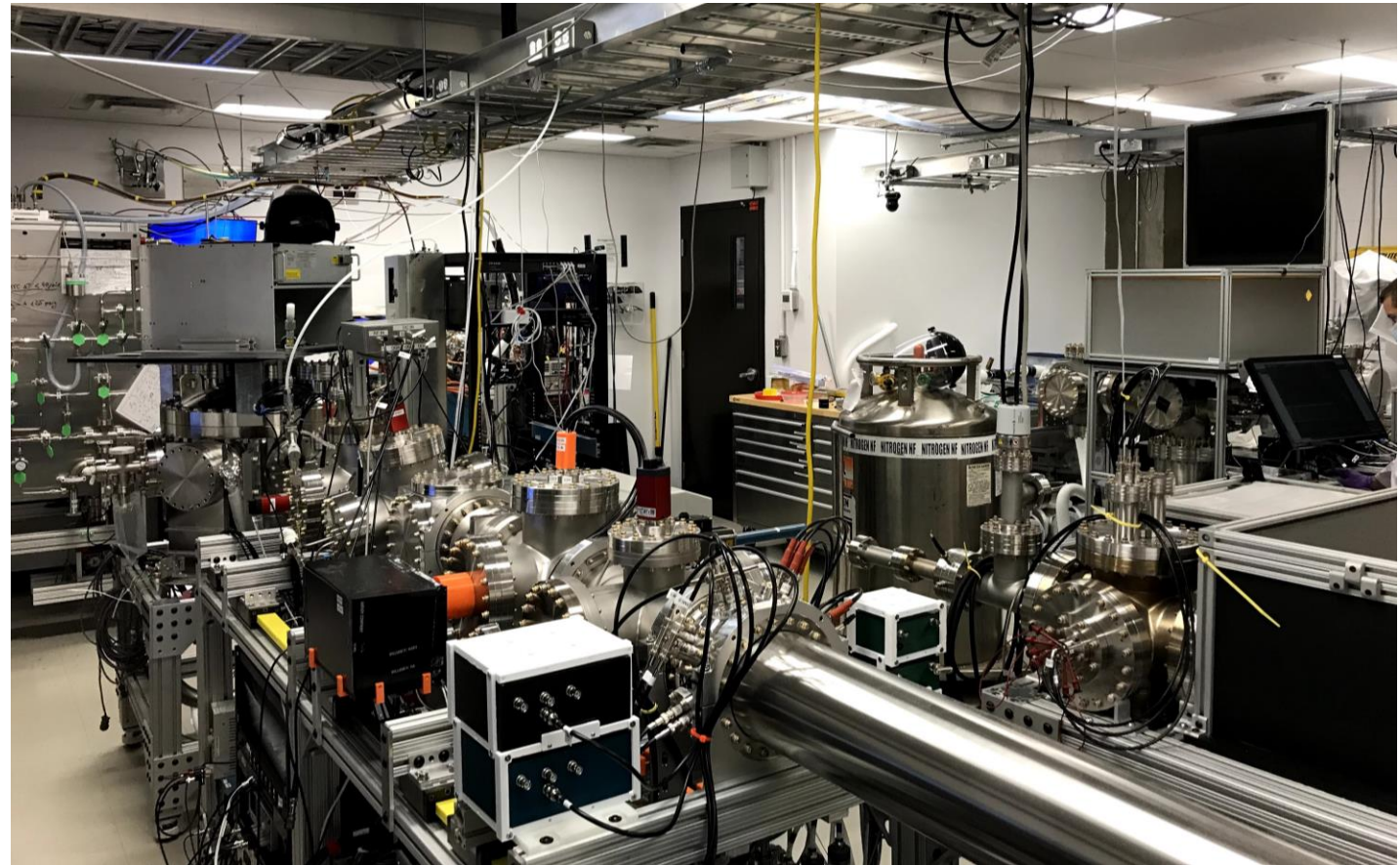
- I will start first year at McGill in physics next week!

Purpose of the Lab Environmental Monitor

Goals:

- Sensitive experiments require clean working space

- Track temperature, pressure, humidity and dust levels

- Verify if lab is positive pressure

- Find out how dust enters the lab

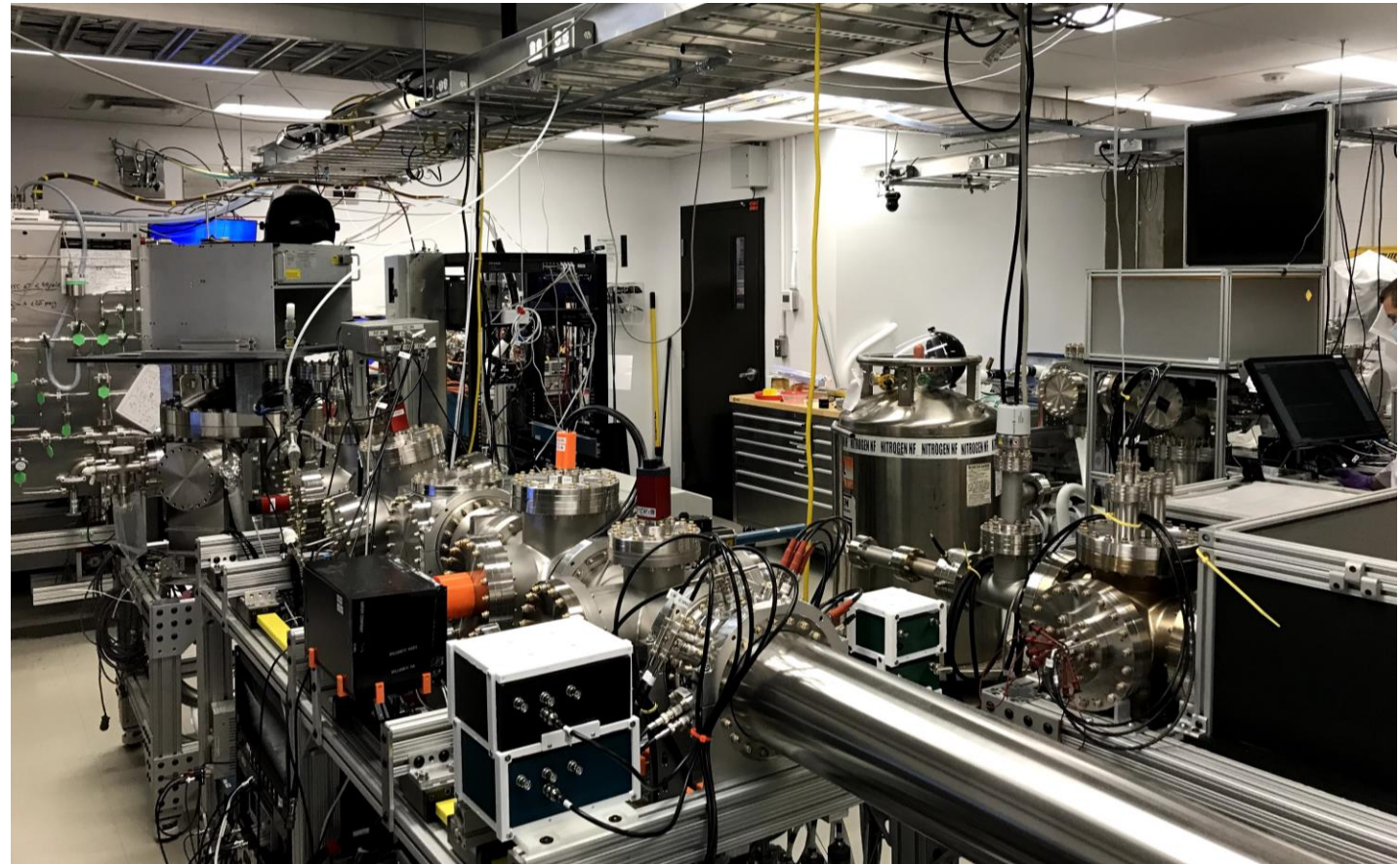The BvL at McGill

Purpose of the Lab Environmental Monitor

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Design Requirements:
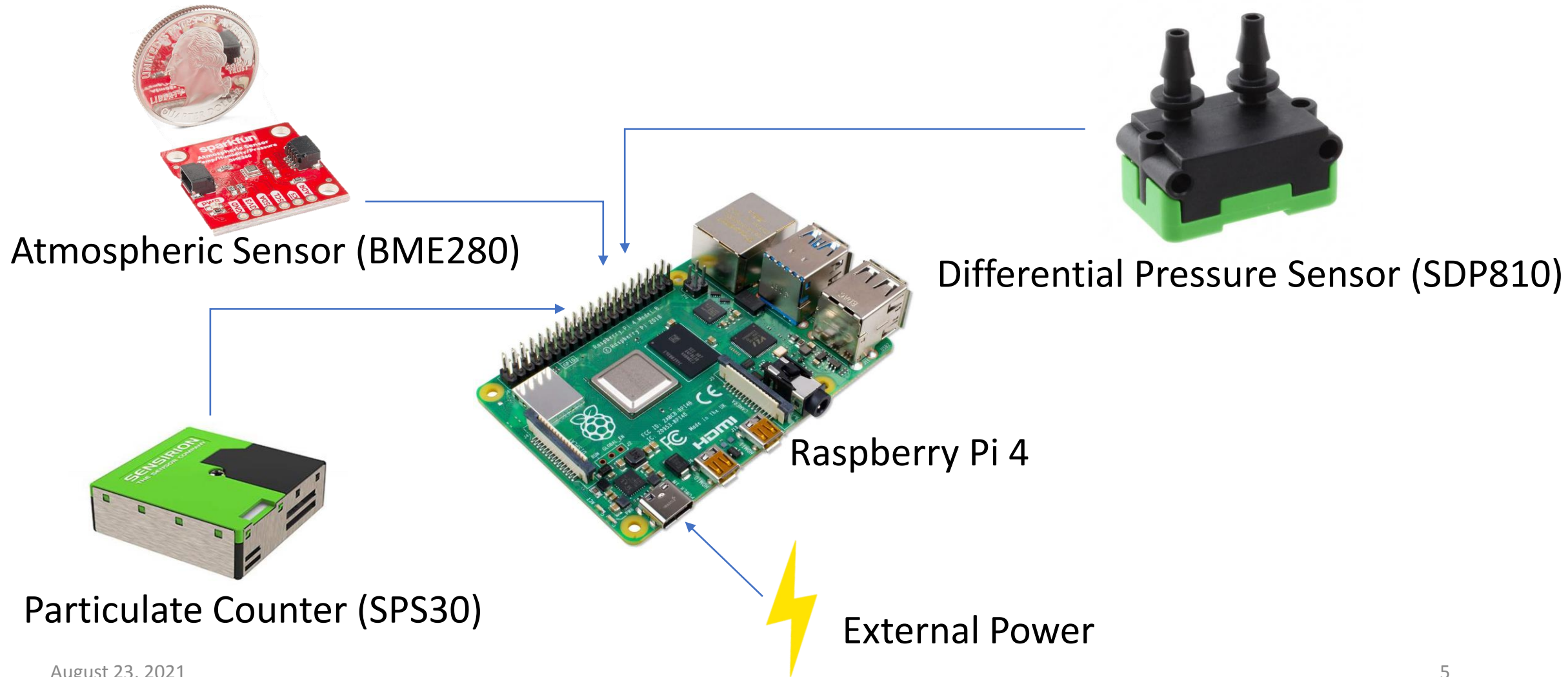
- Low maintenance/ headless

- Cost efficient ≈ 150$

- Modular

- Open source

The BvL at McGill

Key Components and Sensors

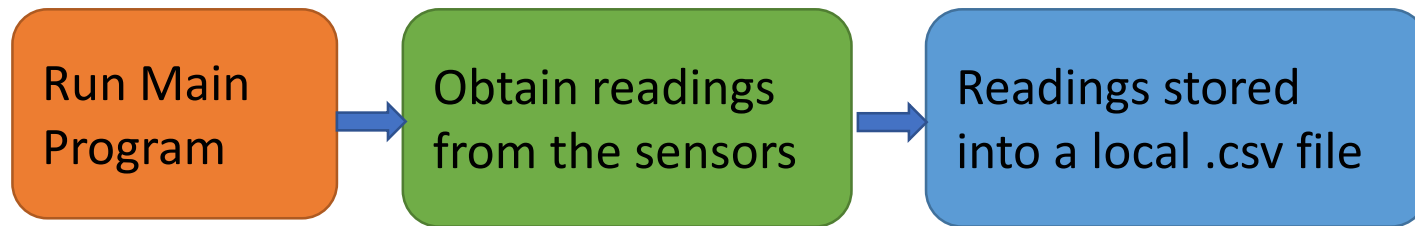Atmospheric Sensor (BME280)
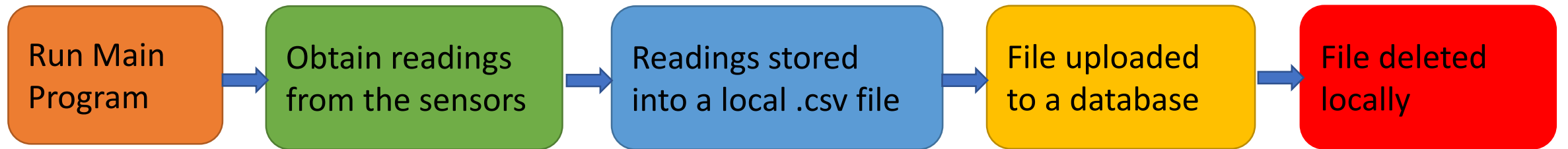
Differential Pressure Sensor (SDP810)

Particulate Counter (SPS30)

Raspberry Pi 4

External Power

Data Flow

Run Main
Program

Data Flow

Run Main Program → Obtain readings from the sensors → Readings stored into a local .csv file

Data Flow

```
Run Main        Obtain readings      Readings stored        File uploaded      File deleted
Program    →    from the sensors  →  into a local .csv  →   to a database  →   locally
                                     file
```

Data Flow

Software Framework

Config file

- Determines the data taking and uploading intervals

- Sensor addresses

Software Framework

Config file

→

Sensor Functions

- Determines the data taking and uploading intervals

- Sensor addresses

- Responsible for obtaining readings from sensors

- Formats the readings and a header for a .csv file

Software Framework

Config file

- Determines the data taking and uploading intervals

- Sensor addresses

Sensor Functions

- Responsible for obtaining readings from sensors

- Formats the readings and a header for a .csv file

MongoDB

- Uploads the file to a database

Main Program
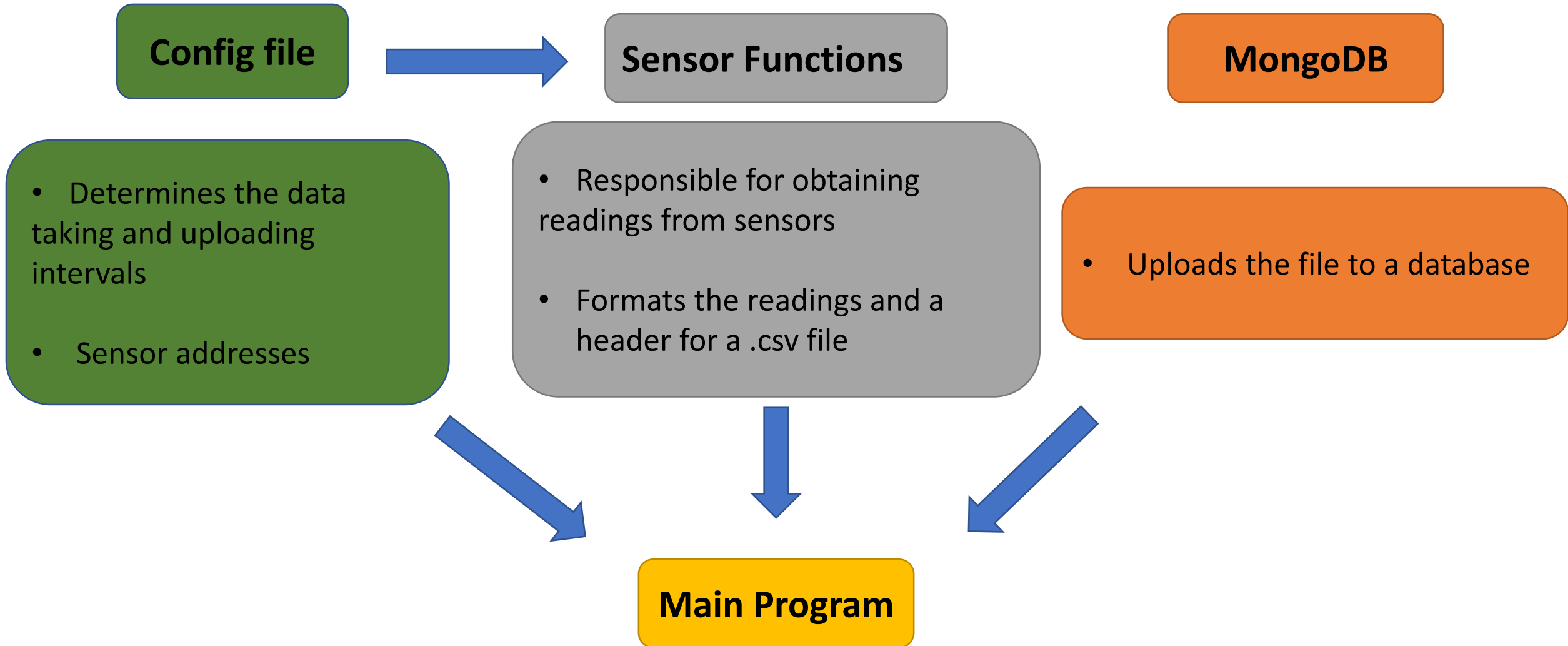
3D-Printed Case Design

BME280
Temperature,
Pressure, Humidity

Cooling
Fan

Cooling
Slits

SDP810
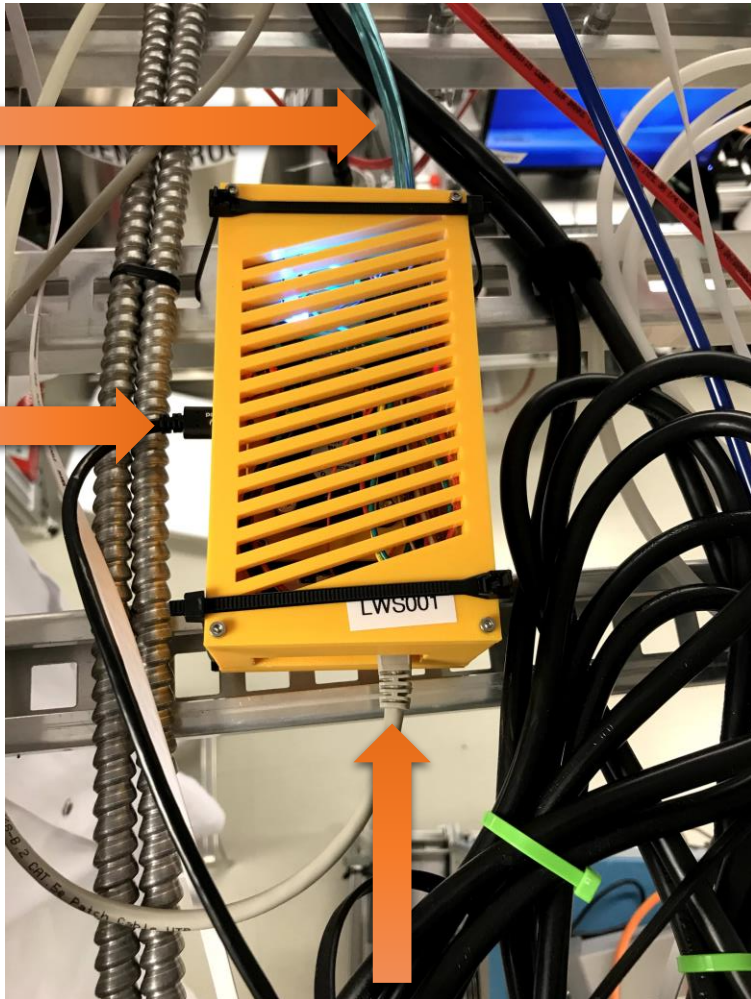Differential Pressure

Port Openings

SPS30 Particulate Sensor
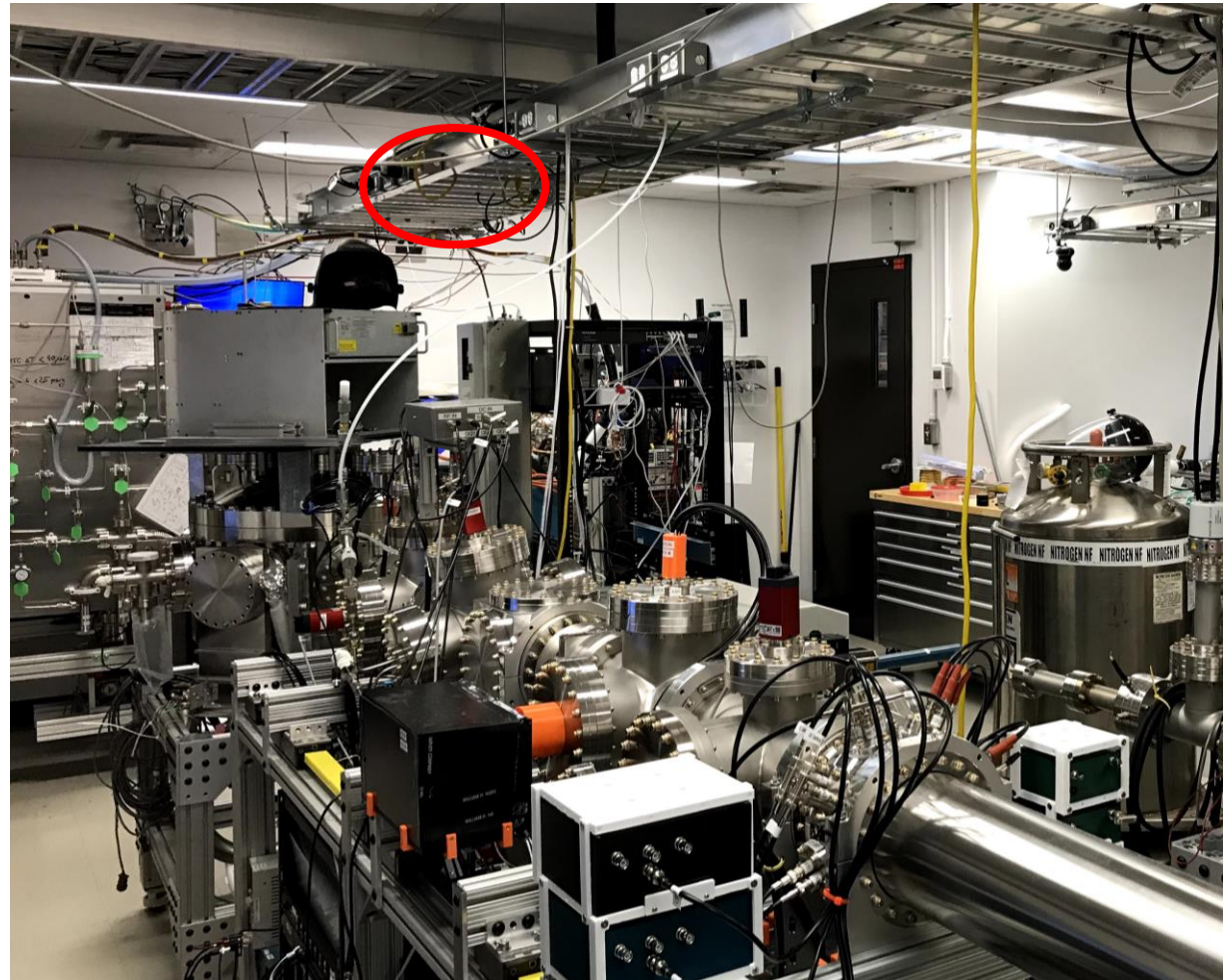
Raspberry Pi
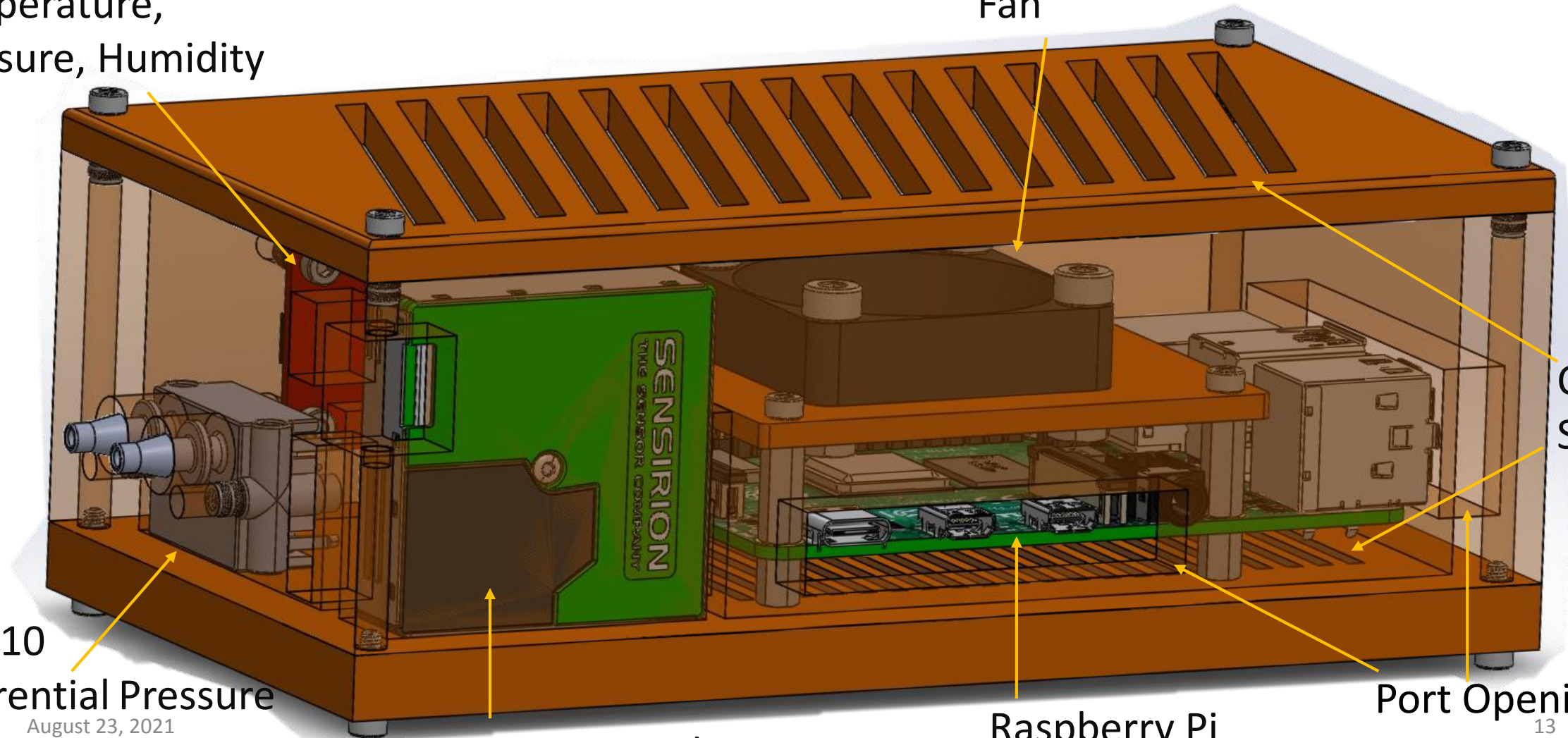
Deployment of the Environmental Monitor

Exterior lab air

Power Source

LWS001

Ethernet

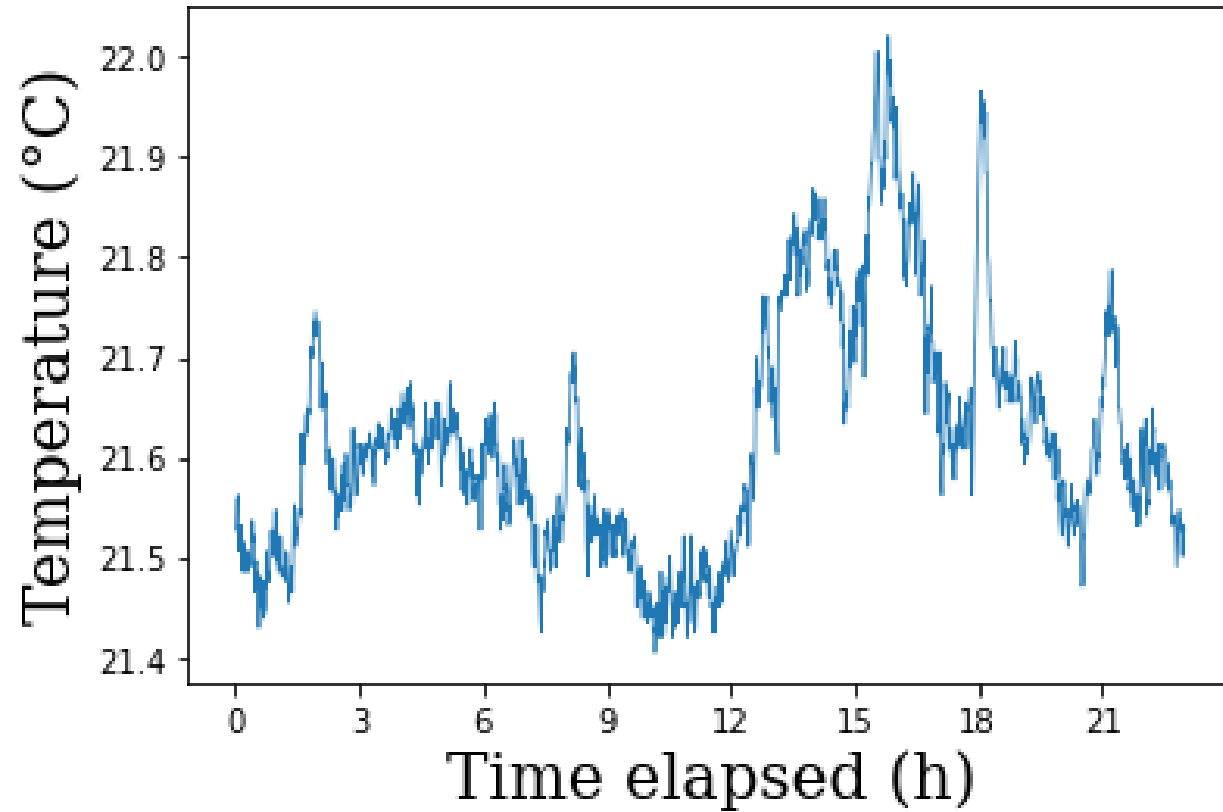Current placement of the device

Results

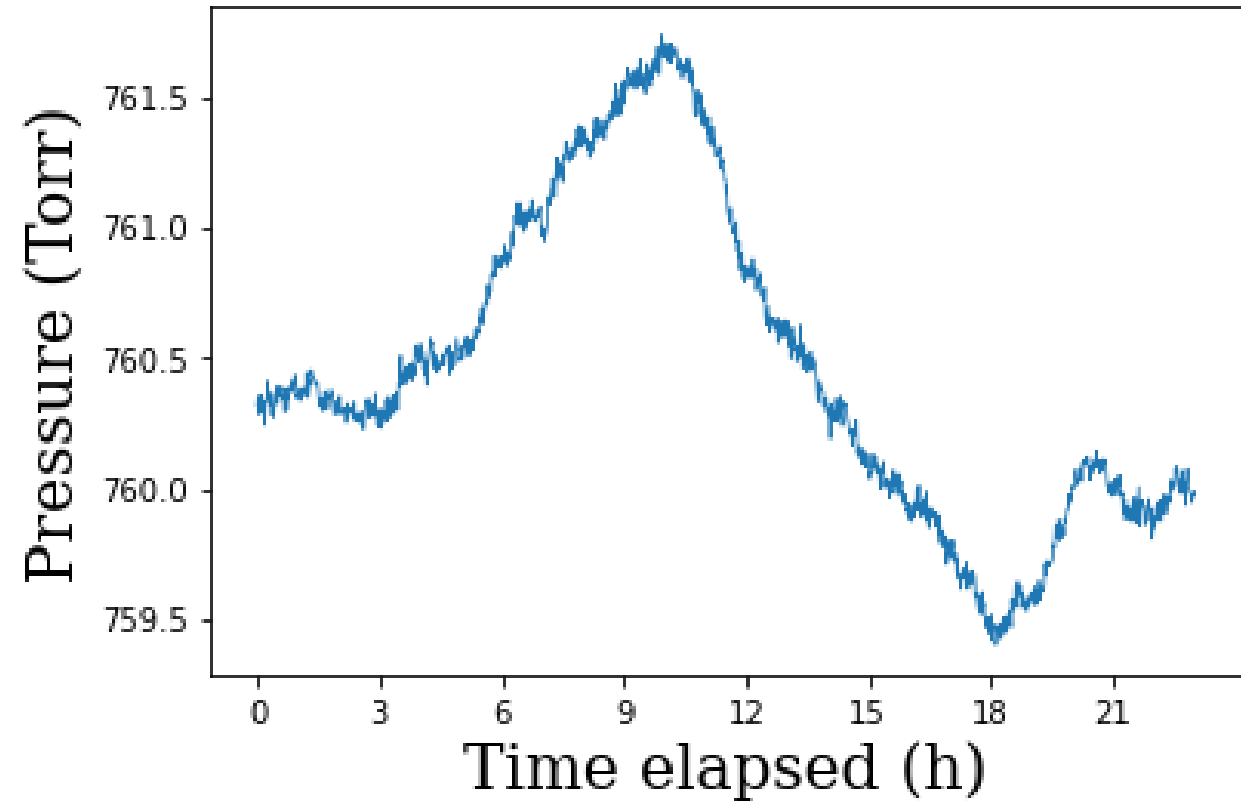Average Temperature = 21.6 °C - STD = 0.12 °C

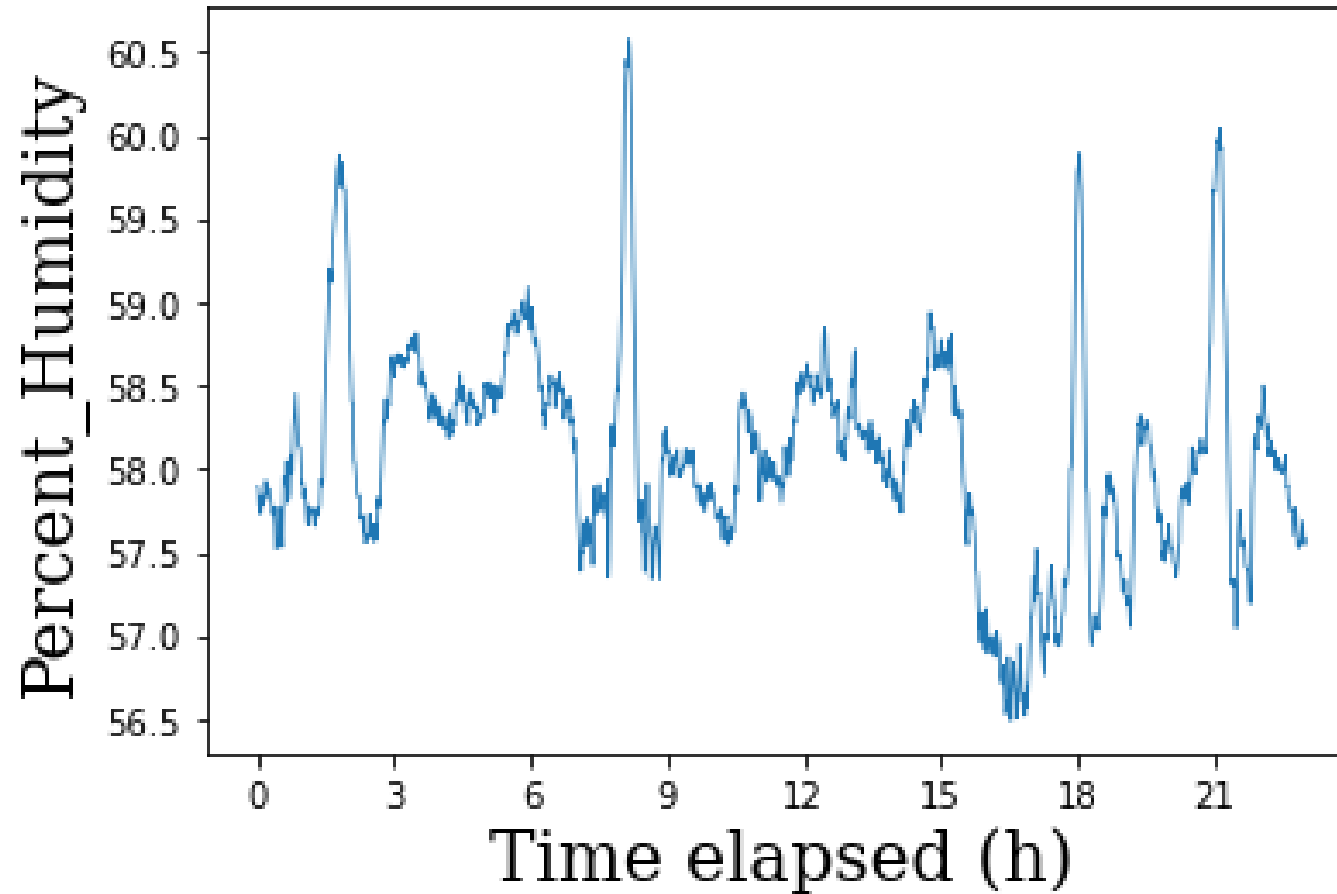Average Pressure = 760.4 Torr - STD = 0.6 Torr

Instrumental resolution = ± 0.01 °C

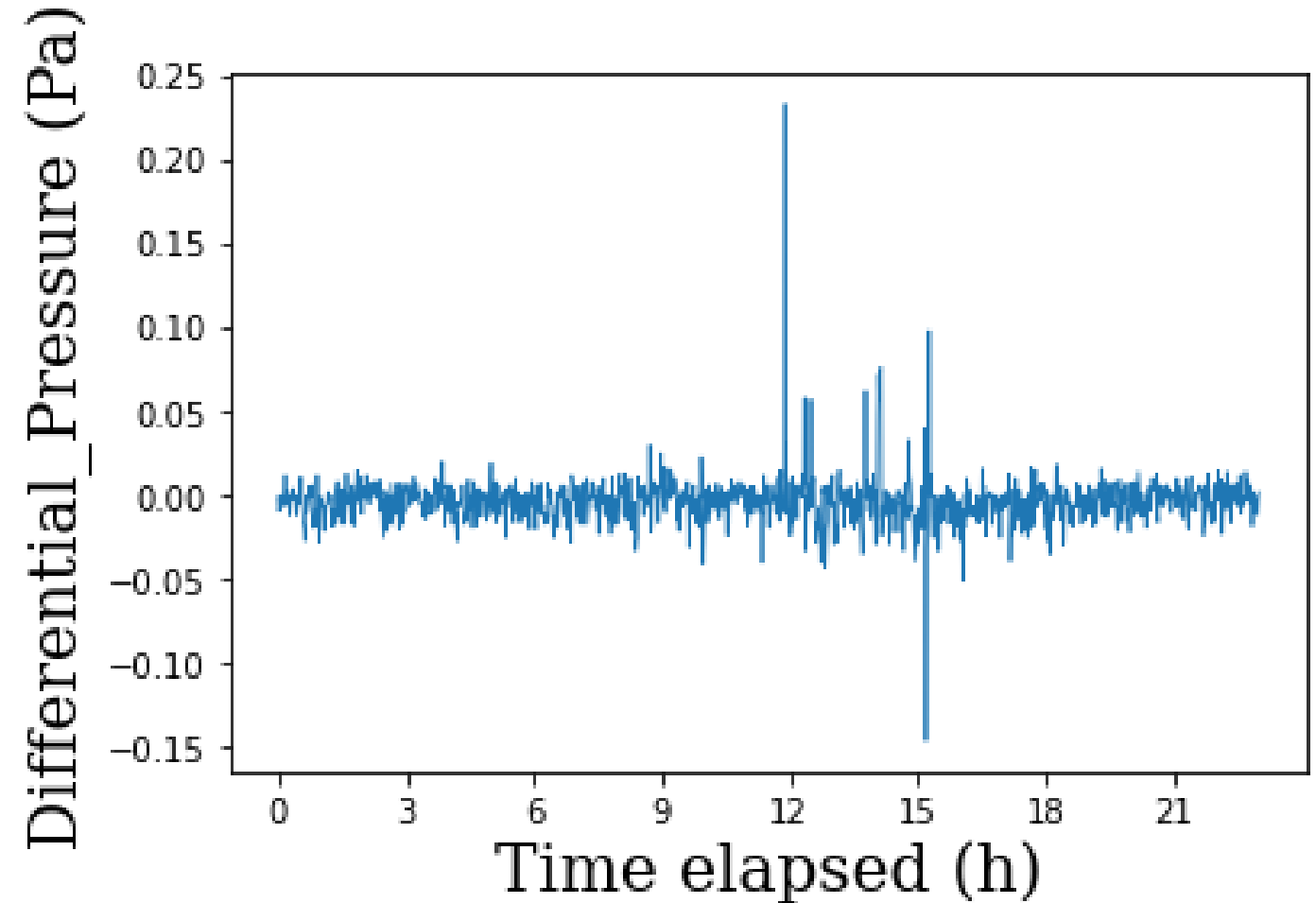Instrumental resolution = ± 0.1 Torr

760 Torr = 1 atmosphere

Average % Humidity= 58.08 %H - STD = 0.63%
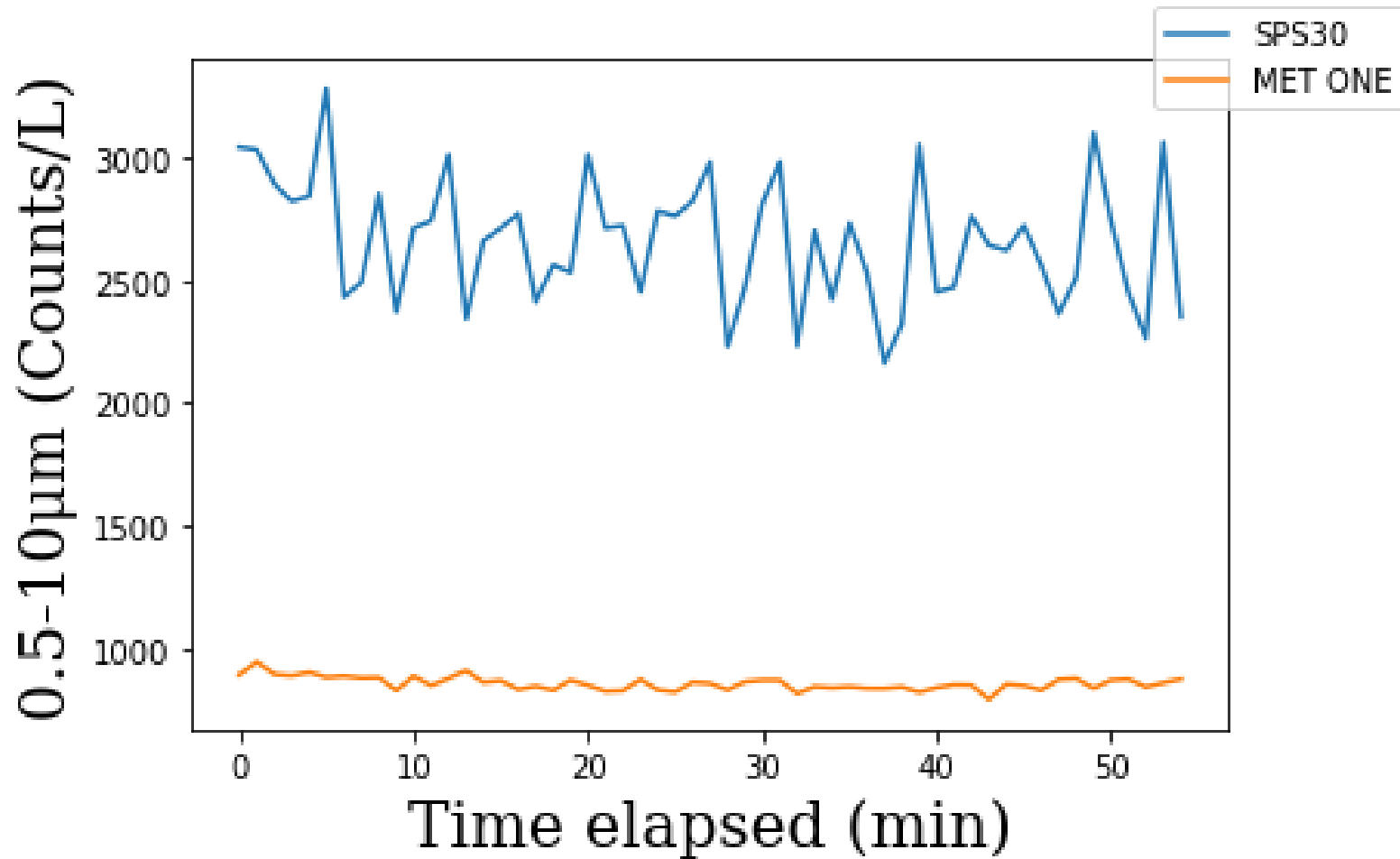
Instrumental resolution = ± 0.008 %H

- Positive Pressure lab?

- Verify measurements of the sensor

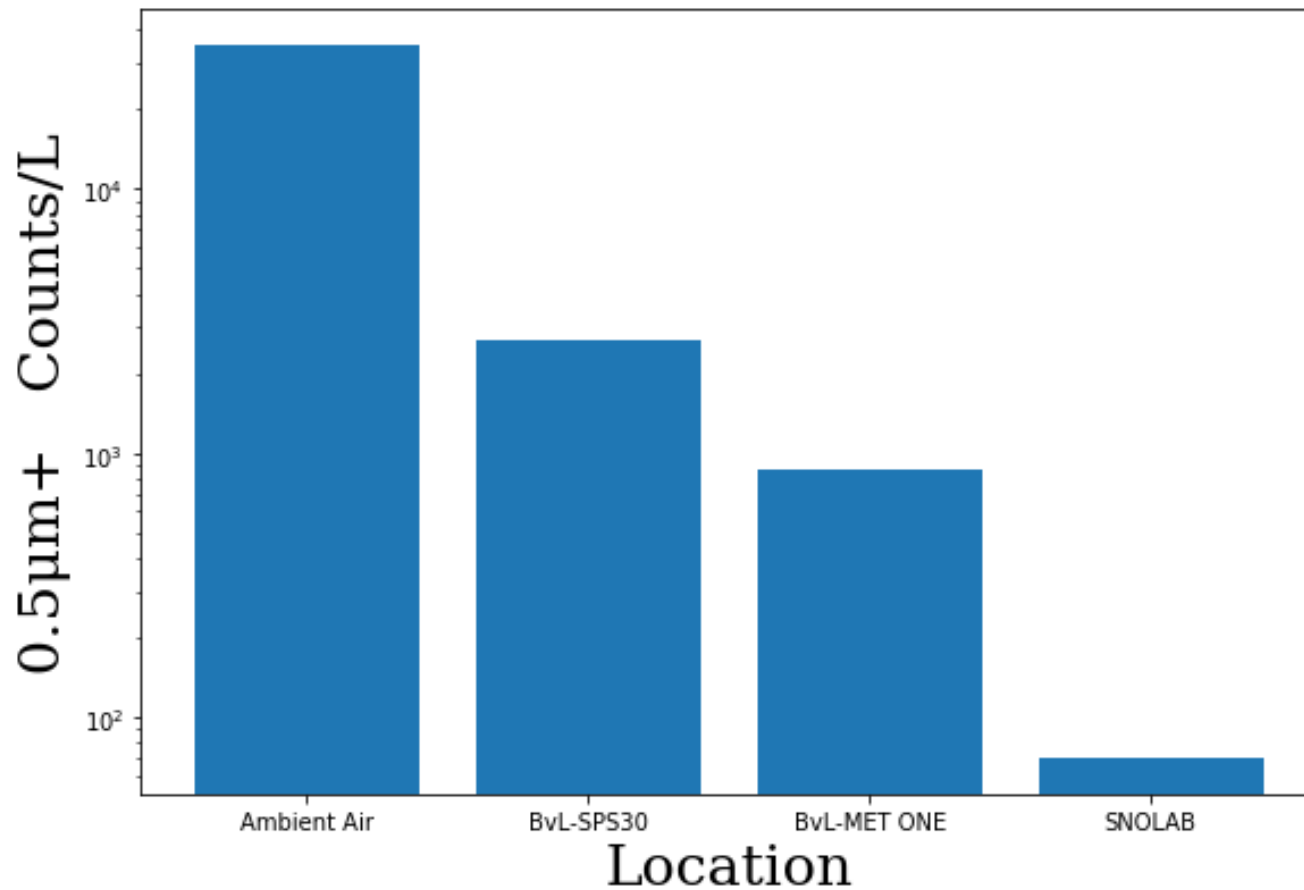Instrumental resolution = ± 0.1 Pa

Particulate Sensor results

SPS30

MET ONE

Particle Counts Comparison
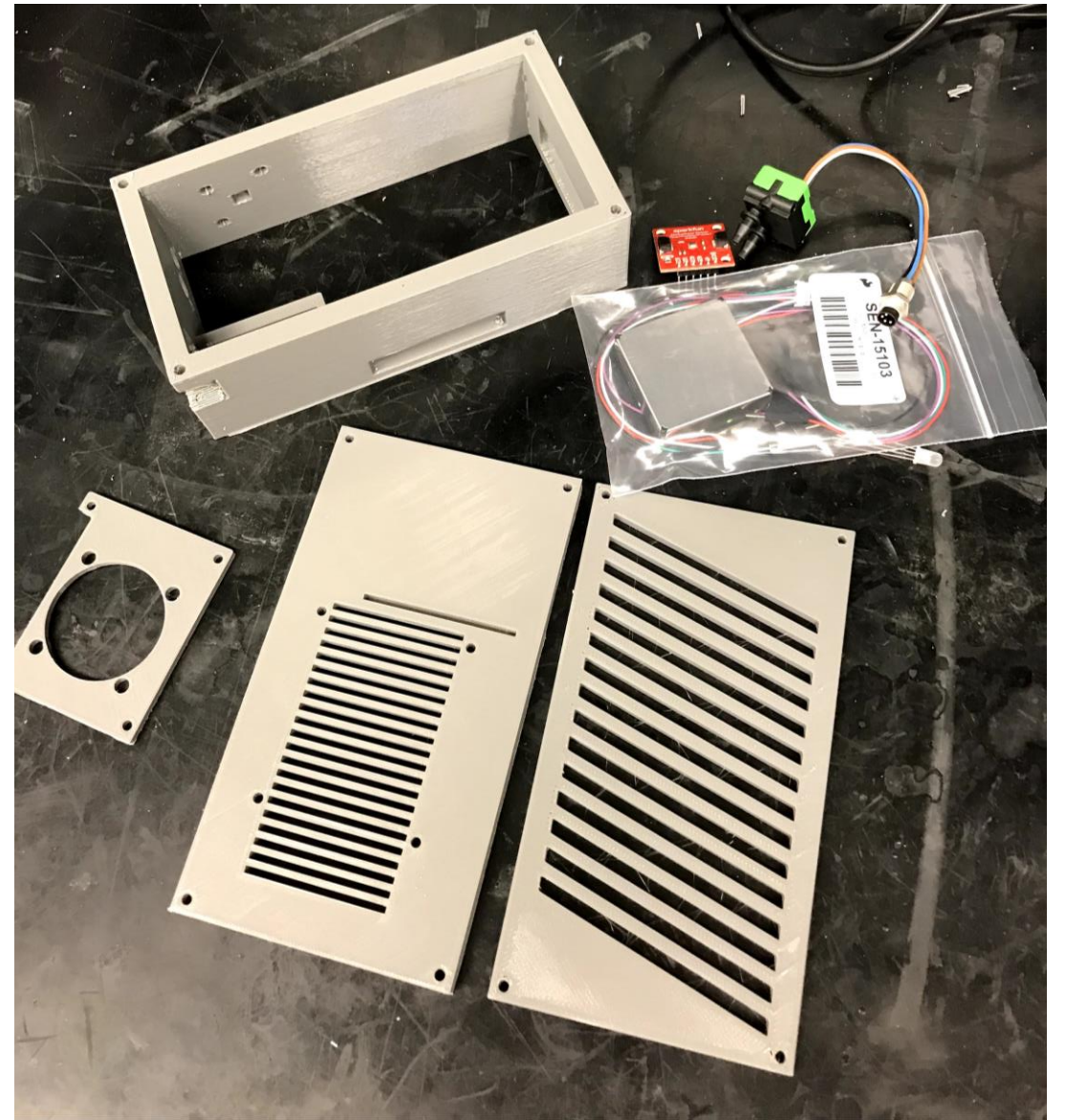

Location	Approximate Counts/L Particle size > 0.5μm
Ambient Air[1]	35000
BvL (SPS30)	2600
BvL (MET ONE)	860
SNO LAB[2]	70

* Log scale

Concluding Remarks

- Fully assembled and taking data

- Will be uploaded later today onto https://github.com/Brunner-neutrino-lab/

- Constructing a second Lab Environmental Monitor

Acknowledgments

Thanks to:

Robert Turner,

Tsvetelin Totev,

Kevin Murray,

Chris Chambers,

Thomas Brunner,

Soud Al Kharusi