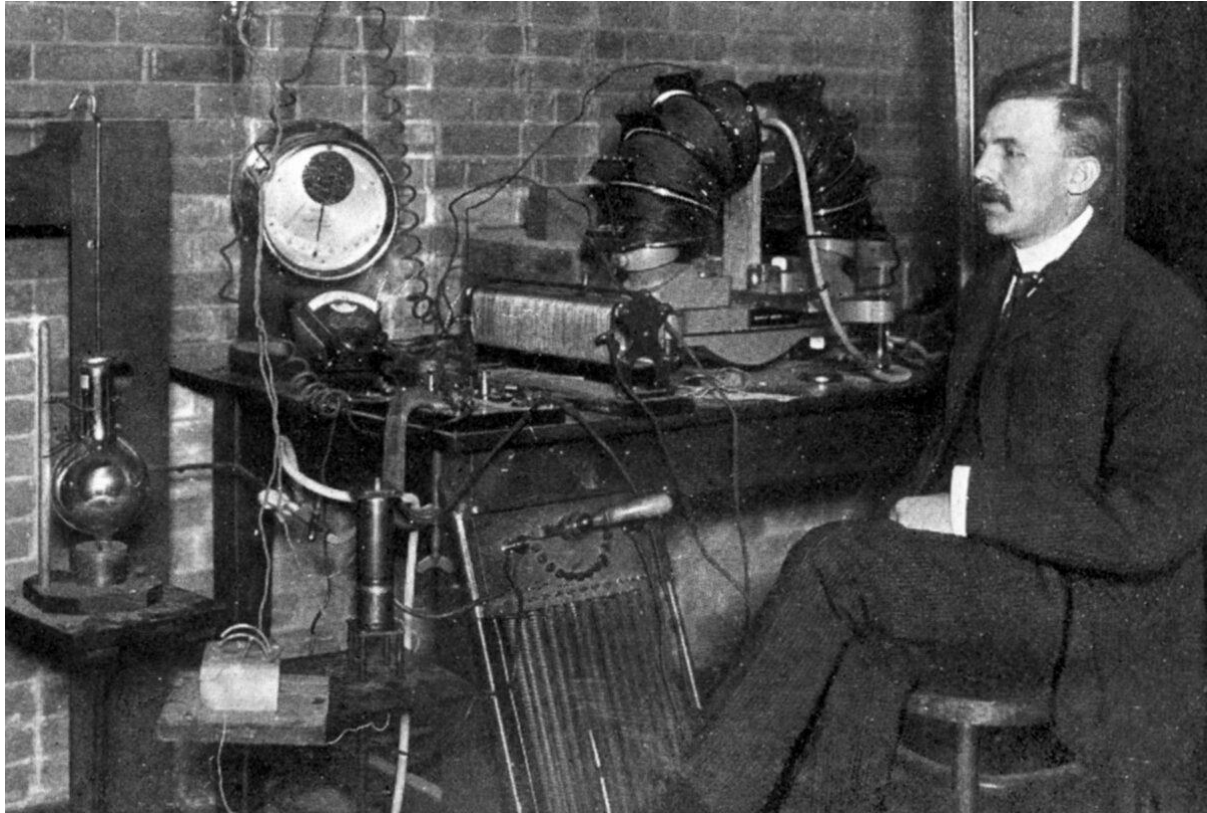




# Rutherford Scattering Outreach Project

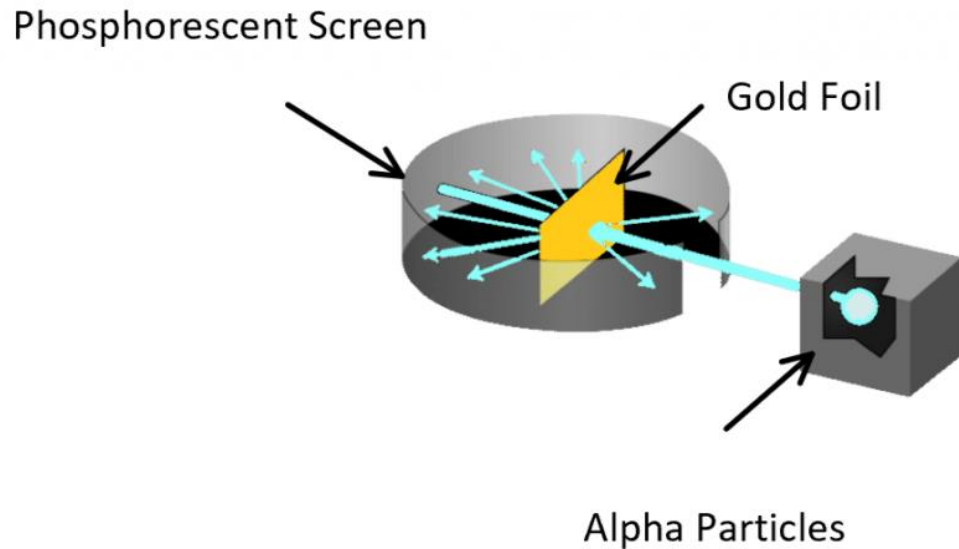
Chloe Rey and Lizzie Bloomfield



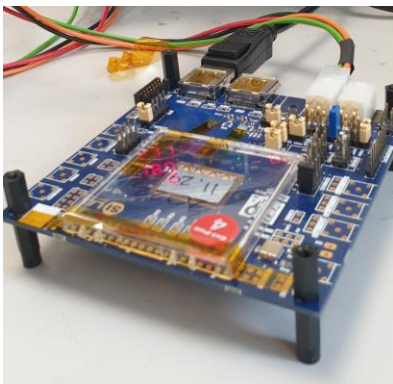
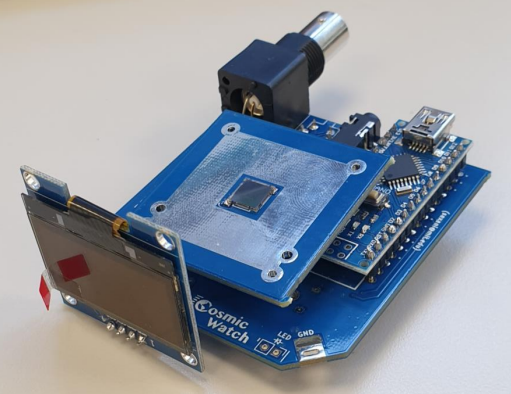
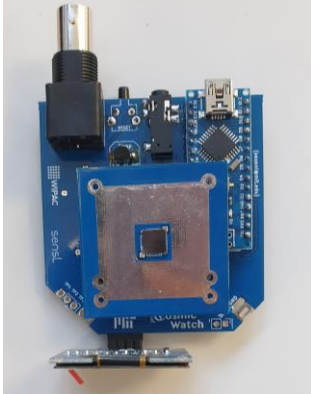
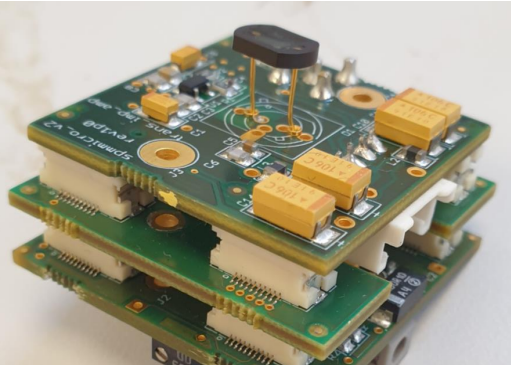
# The Project

- Reconstruction of the Rutherford Experiment from 1909
- Update the setup with modern detector technology
- Final product is a multi-detector array that can display a historical experiment and different iterations of modern particle physics detectors

# The Experiment



- A setup of alpha particles, shot into a sheet of gold foil.
- The scattered alpha particles were then detected by a phosphorescent scene
- The experiment proved Thompson's model of the atom to be incorrect and concluded that the atom was in fact mostly empty space with a dense, positive nucleus.

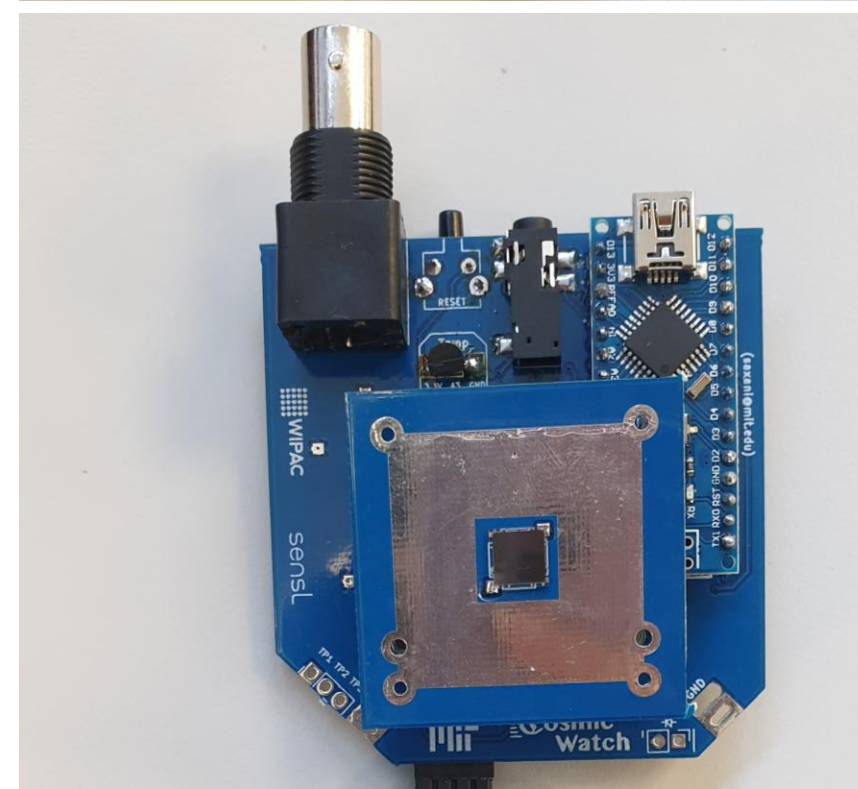
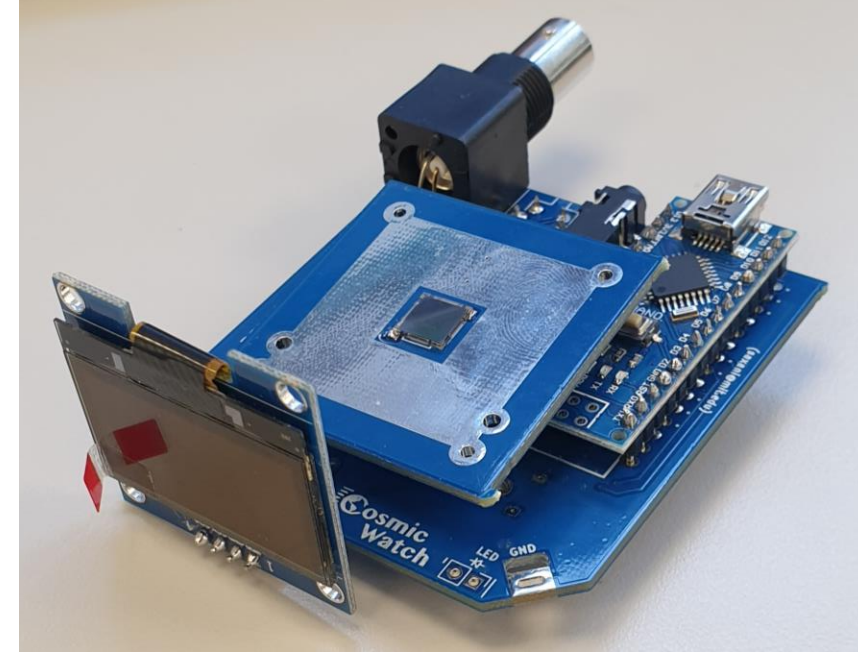


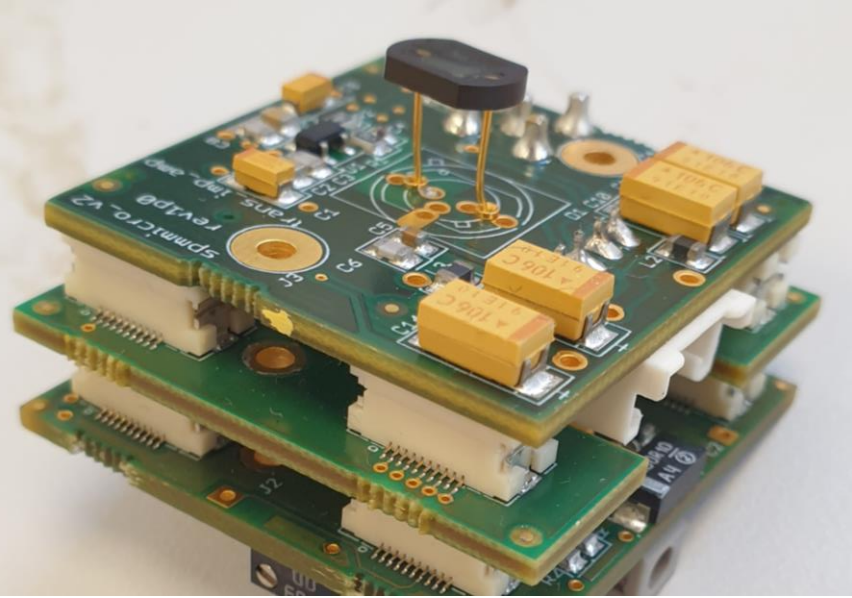
# The Updated Hardware

- Use three types of detectors to replace the zinc sulphide phosphorescent screen.
- All three are silicon based and originally used for other purposes such as muon detection.
- In this experiment, they will be set up in an array and calibrated to produce three coherent data sets.

# Cosmic Watch

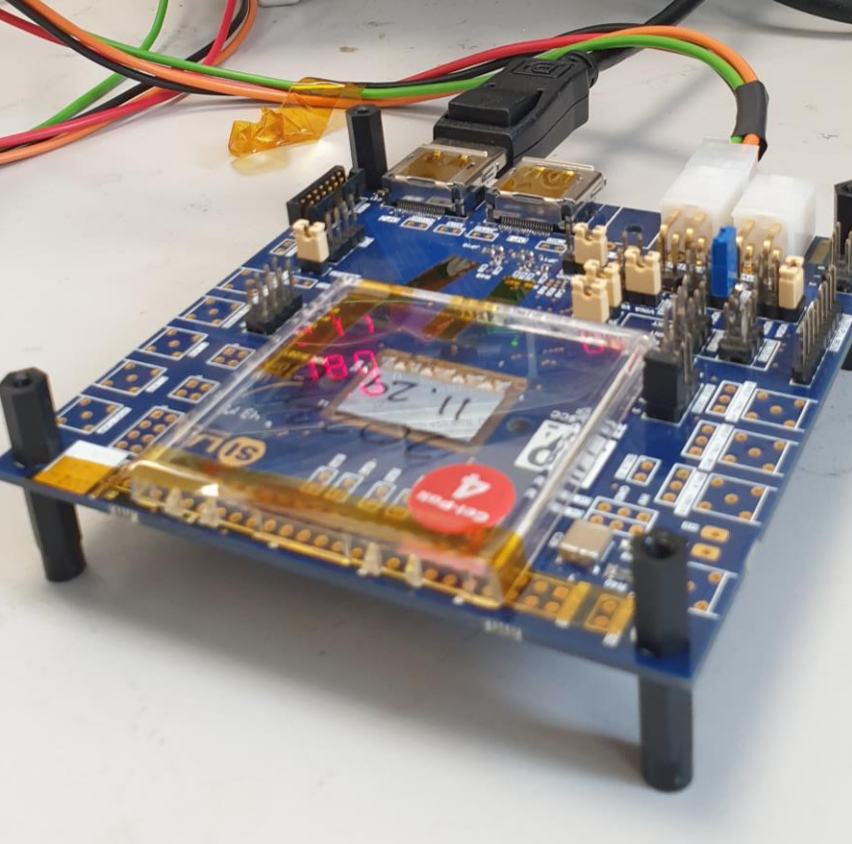
- Originally made to detect cosmic rays and muons
- Its silicon sensor is light dependent and therefore uses a scintillator to detect alpha hits
- The necessary code is uploaded to the Arduino nano attached and a python code on the RPi collects and collates all the data
- The data we're interested in the voltage of the silicon sensor which tells us if there is a hit or no hit





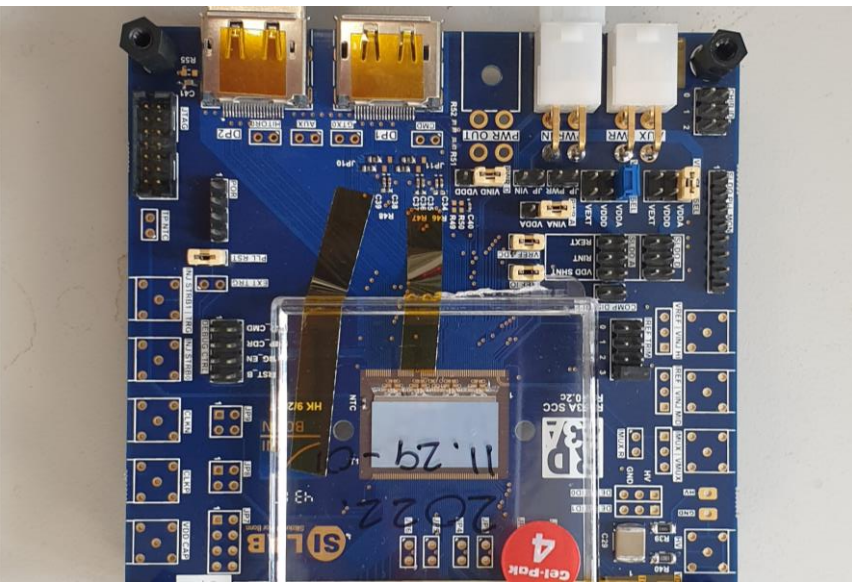
# SPM Micro Sensors 'John'

- With a silicon sensor we can read changes in voltage depending on how much light is incident on the sensor
- This sensor gives an analog output which therefore needs to be translated through an Arduino to digital to be read by the Raspberry Pi
- A python script then reads this and tells us if there is a hit or no hit depending on the change in voltage



# ITk Pixel Sensor and RD53A chip

- The second sensor is an ITk pixel sensor, with an RD53A chip
- Unlike the other two sensors, this one needs to be prompted to supply data as it's originally designed for LHC readout
- To get around this, we have written a bash script to prompt the sensor to run a noise scan, convert the .json file to text file and then push the data to Prometheus.



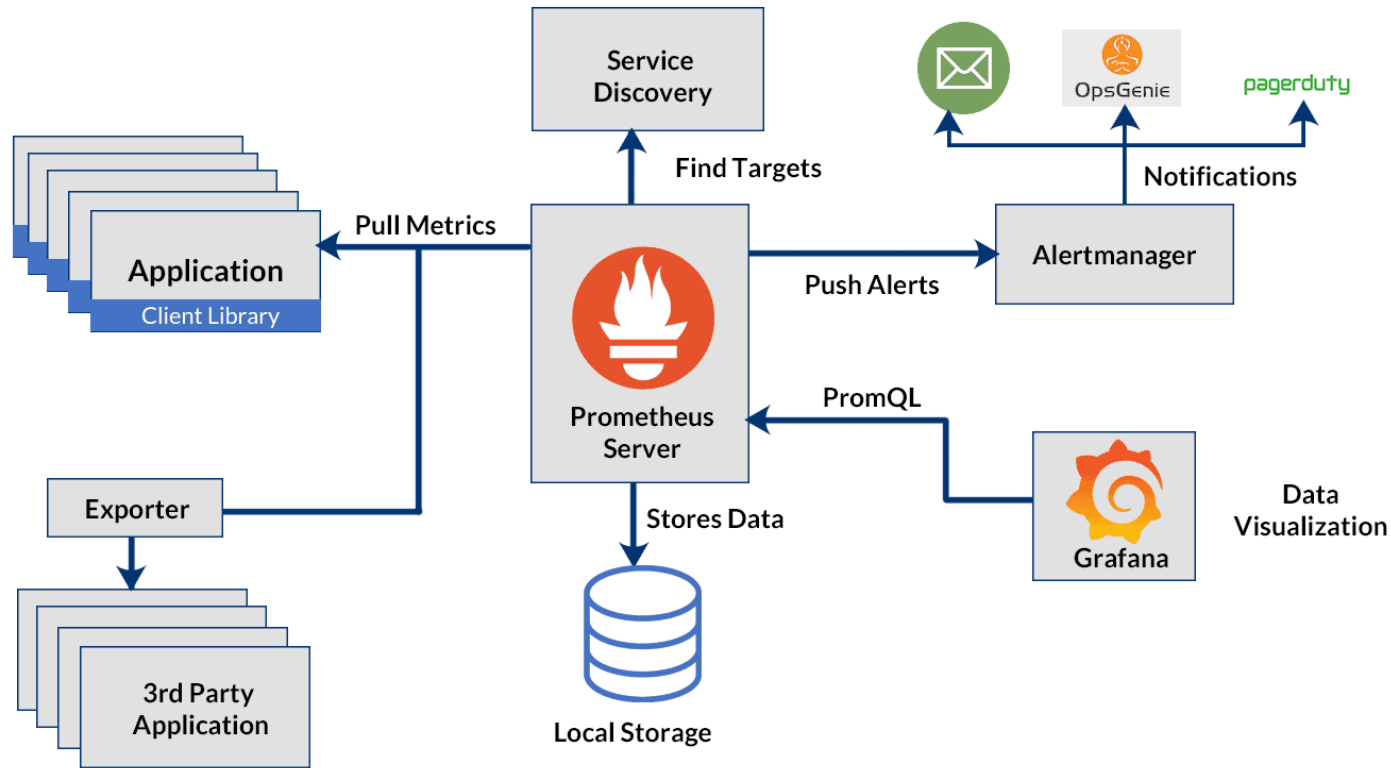
- This setup uses two main pieces of software, Prometheus and Grafana.
- These are used to process and display the data of all of the detectors on an external monitor.
- We will quickly go into what both of these applications do.

## The Software





# Prometheus



- Prometheus is a software application used for event monitoring and in this experimental setup, it monitors the hit/no-hit rate of alpha particles.
- In this experiment, Prometheus collates data from all three sensors and allows us to send them to Grafana to display them.



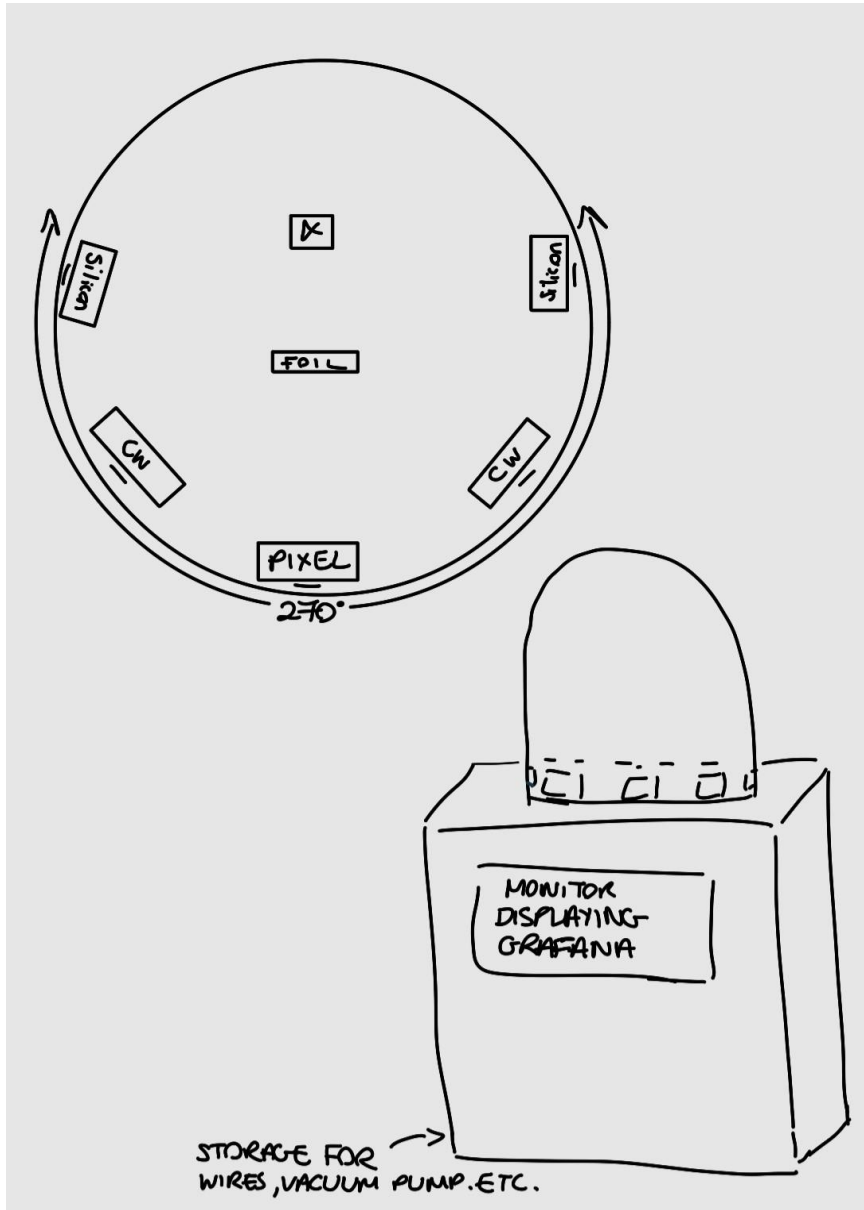
# Grafana

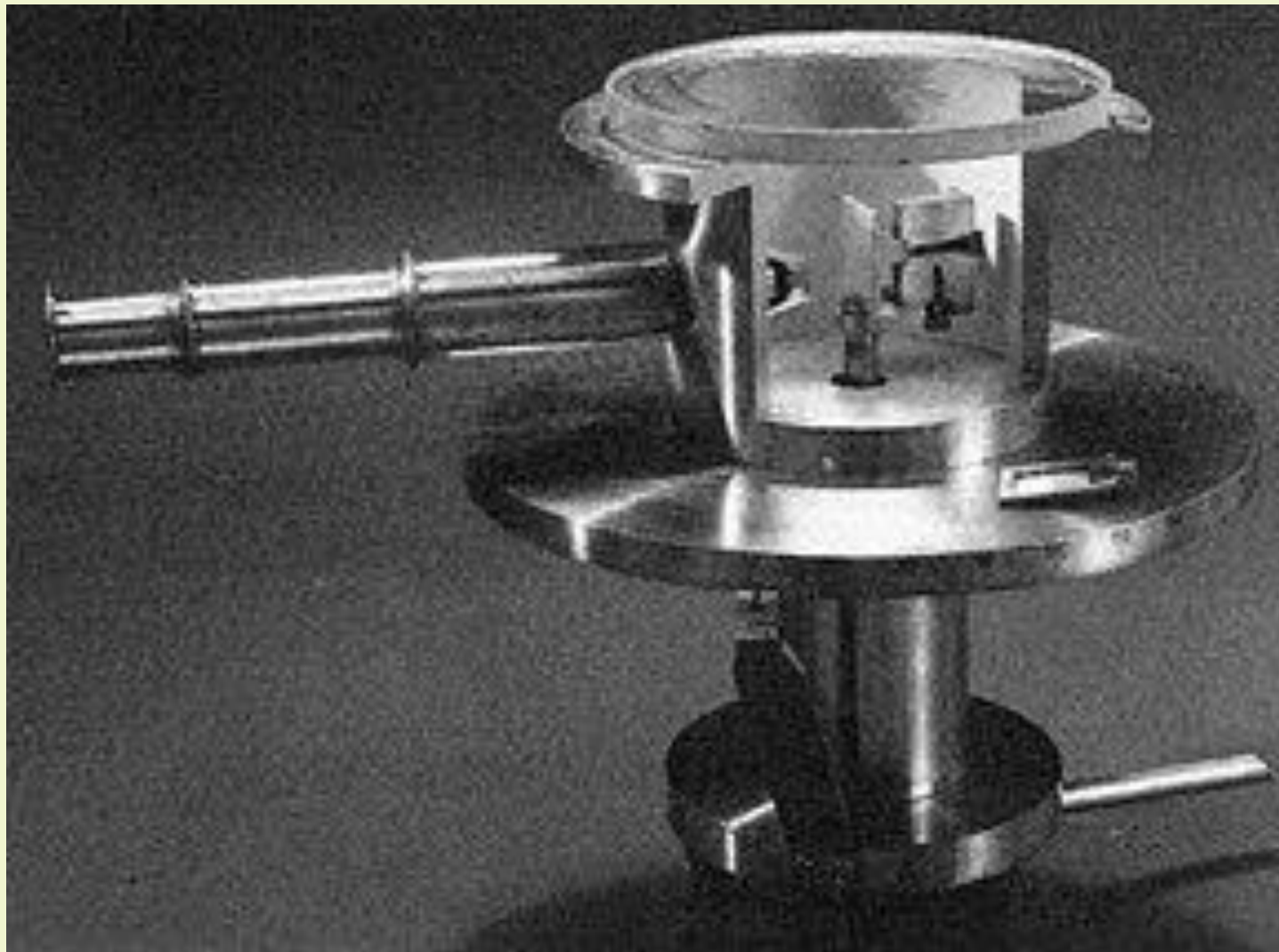
- Grafana works in tandem with Prometheus and is an open-source analytics and interactive visualization web application that allows us to display the real time hits of alpha particles during the experiment.
- We used the gauge metric and a bar gauge to show the hits in real time from each detector.

# Outreach Aims Overall

To Demonstrate:

- How the Rutherford scattering experiment works
- Why it is an important experiment in particle physics
- Different types of silicon-based detectors and how they work





Thank you for listening