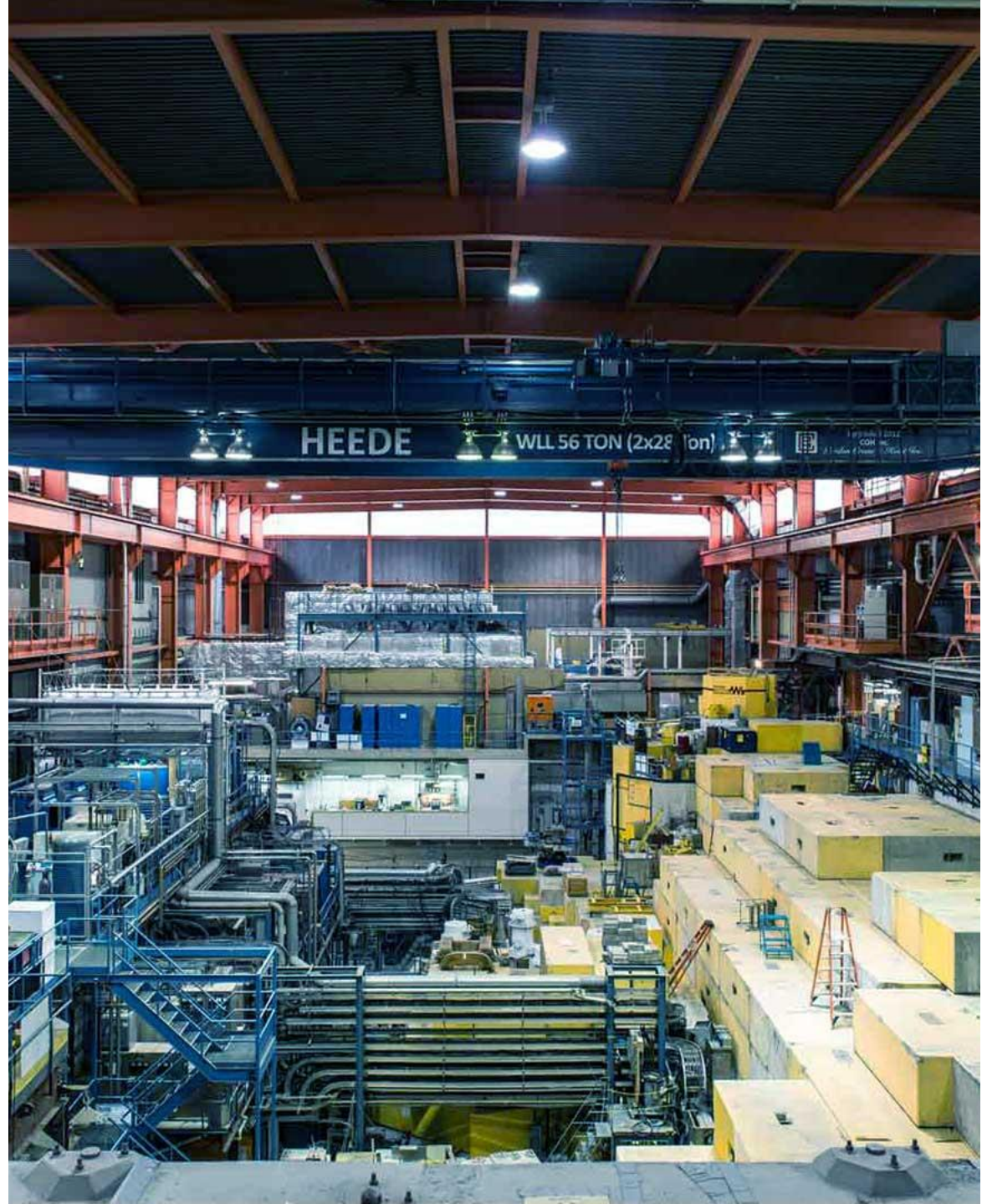


# Single Photon Air Analyzer (SPAA)

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## What is SPAA?

- **Single Photon Air Analyzer (SPAA)**
- A low(ish)-cost, portable, highly sensitive particulate matter detector
- Currently working towards proof-of-concept

## Outline

- Why does SPAA matter?
- How does SPAA work?
- Does SPAA work?

# Why SPAA?

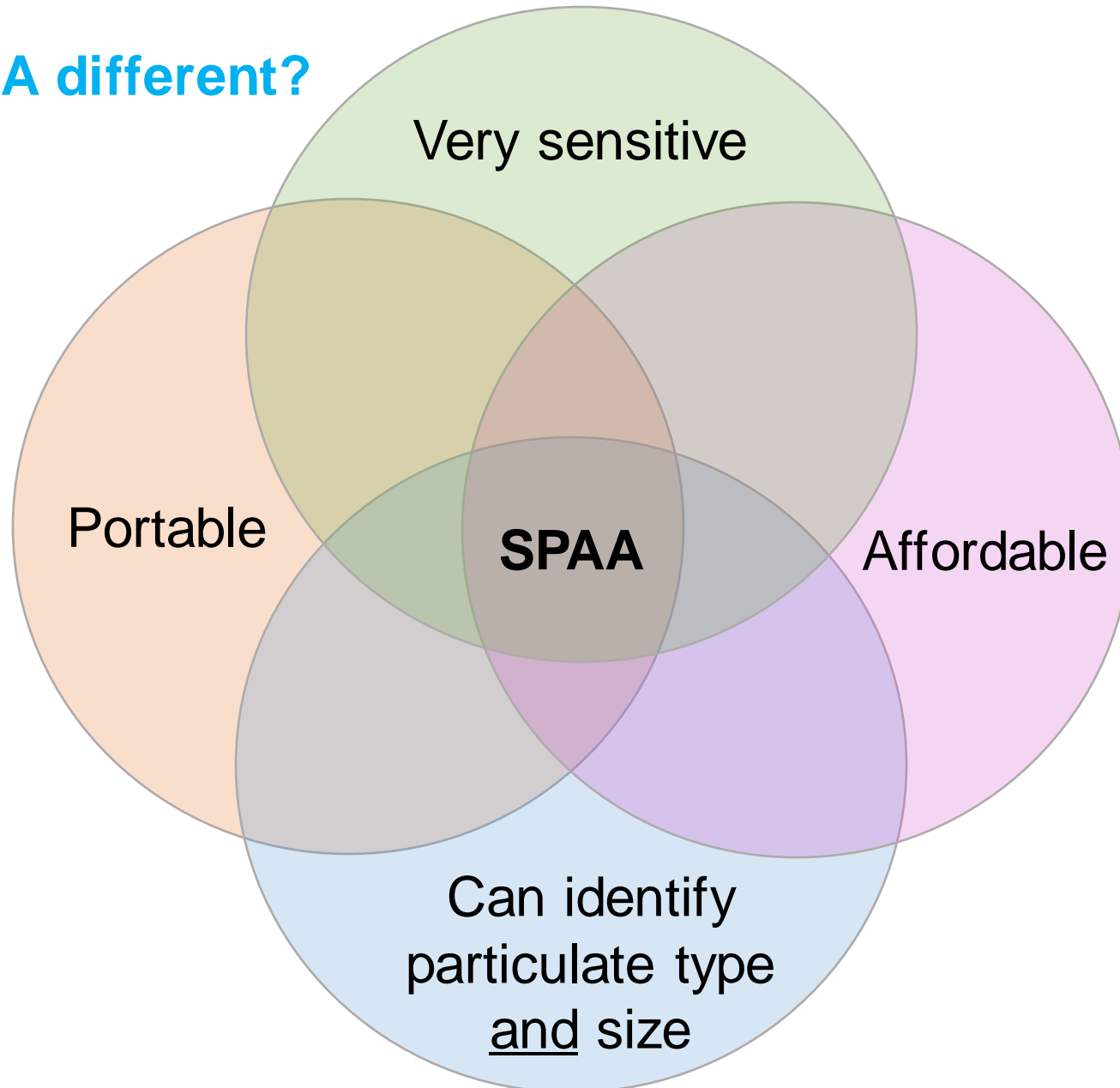
Example use case: early detection and warning of forest fires



## Example use case: early warning for forest fires

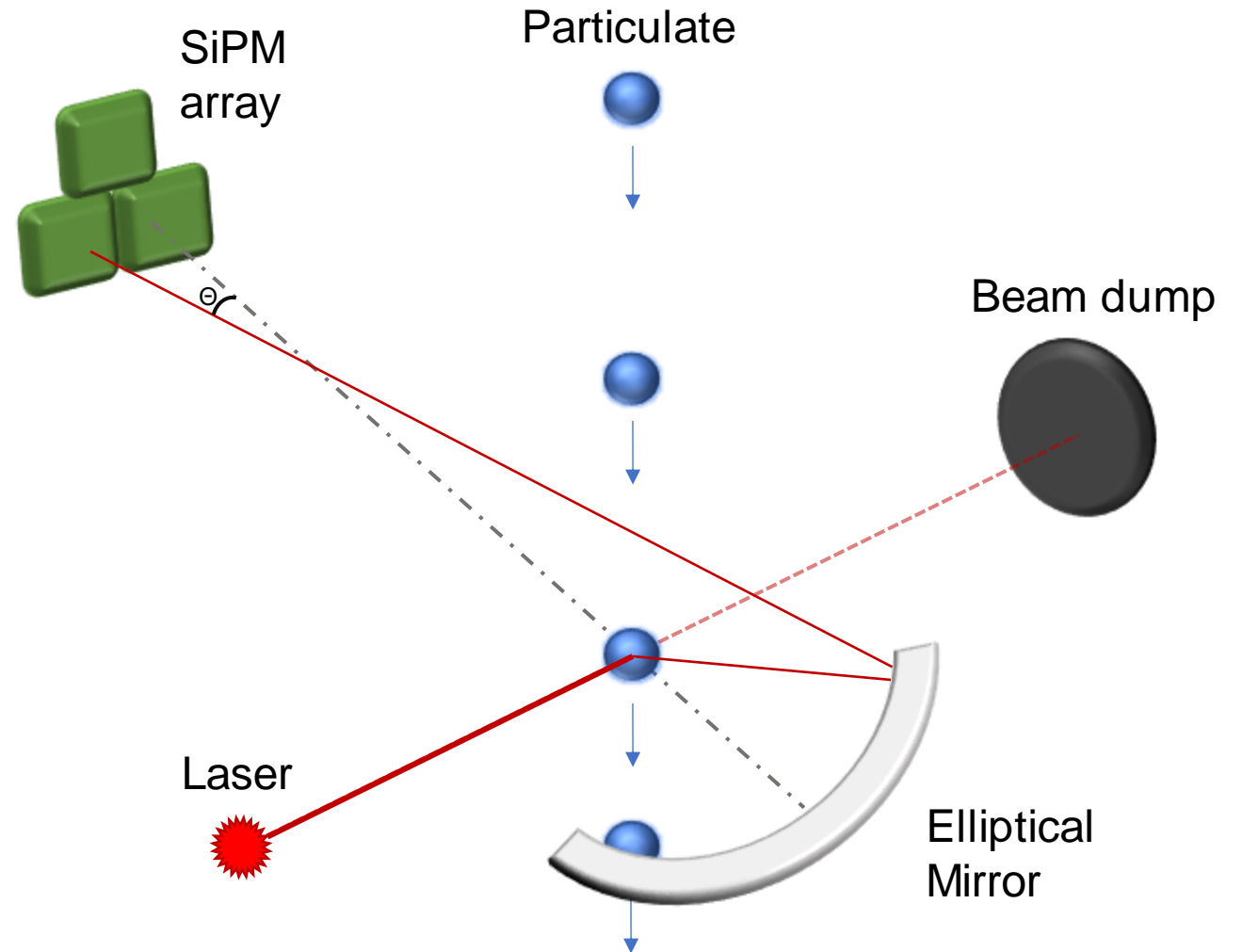
- What if we had a widespread, continuous monitoring system for forest fires?
  - Early warning -> protect people and property
- Would a smoke detector work?
  - Must be highly sensitive and affordable
  - Need to avoid false alarms! For example, cigarette vs. forest fire

## What makes SPAA different?



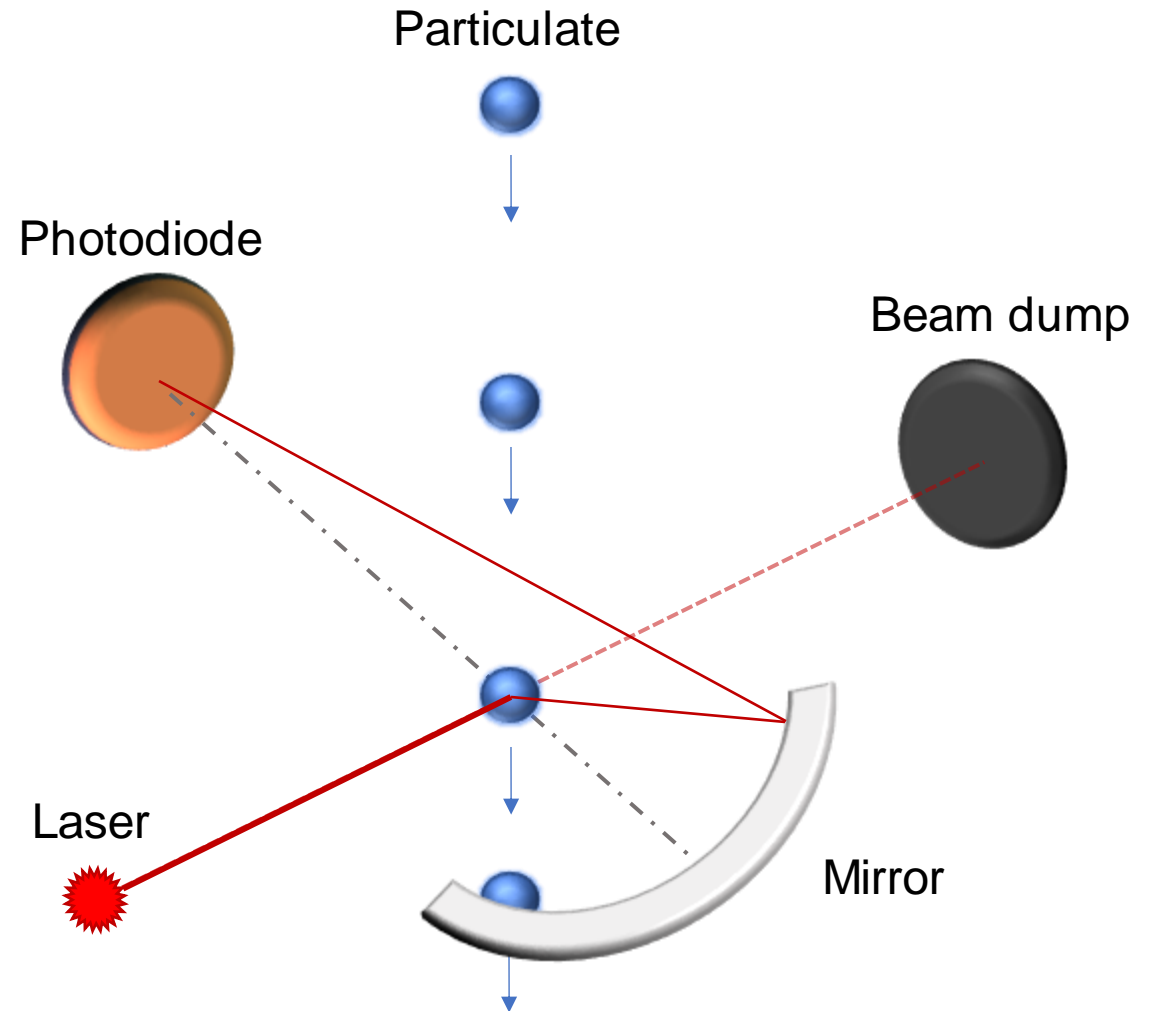
# How does SPAA work?

Optical particulate counters + scattering angle



## Existing low-cost sensors (one of many designs)

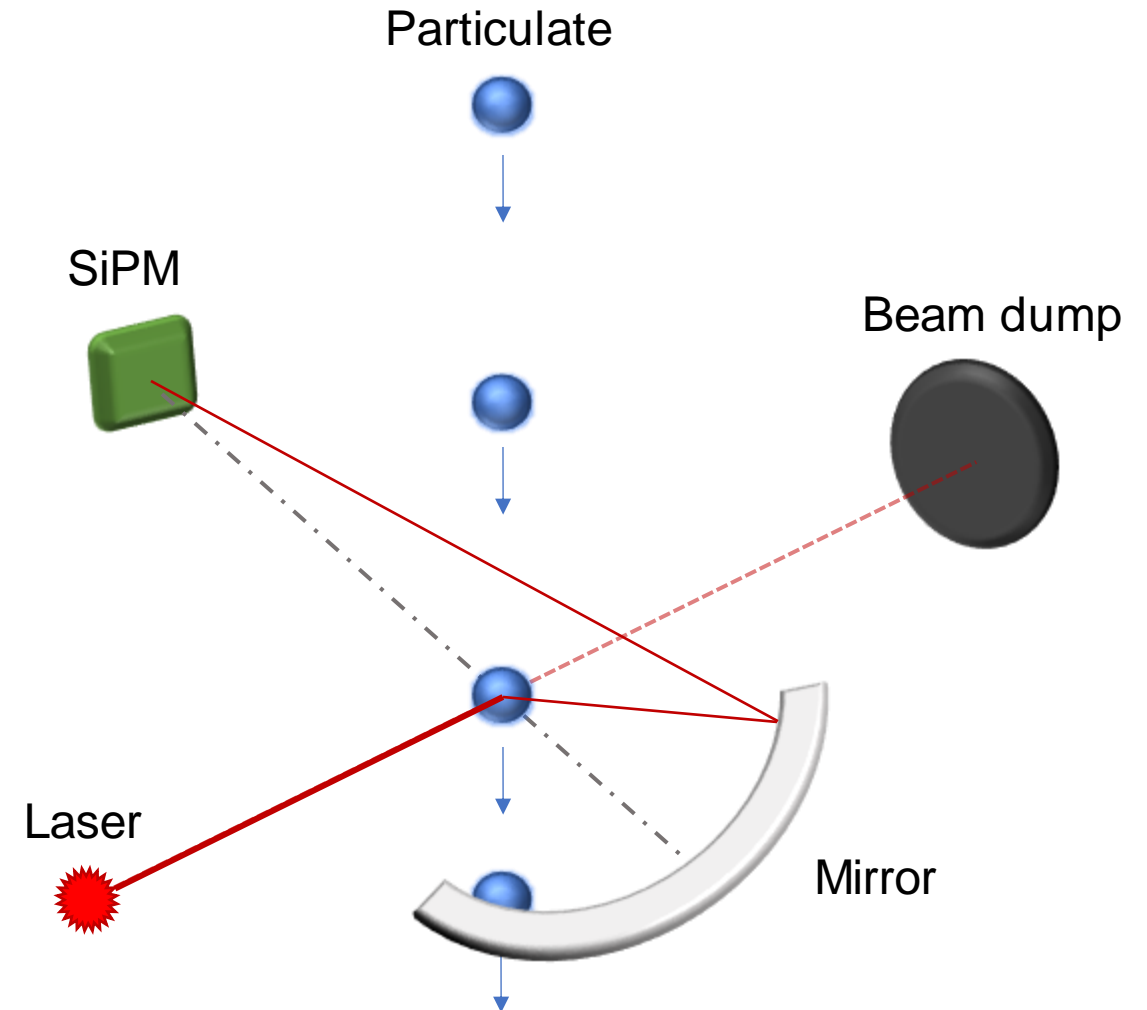
- Light scatters off particulate and is directed towards a sensor
- Calculate particulate size based on how much light is scattered





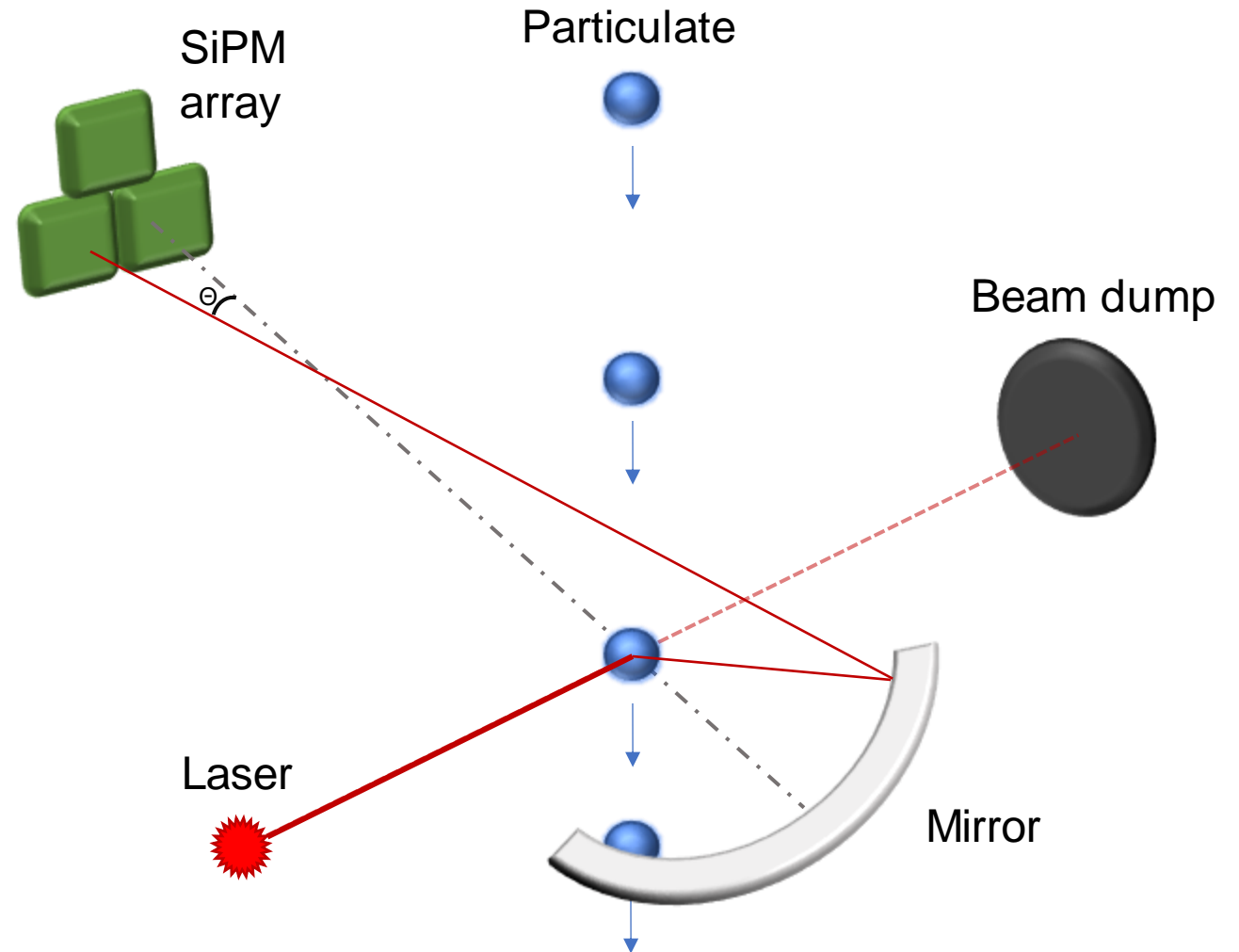
## How is SPAA different?

- Use silicon photomultipliers (SiPMs)
- More sensitive than other photodiodes
- Can count individual photons



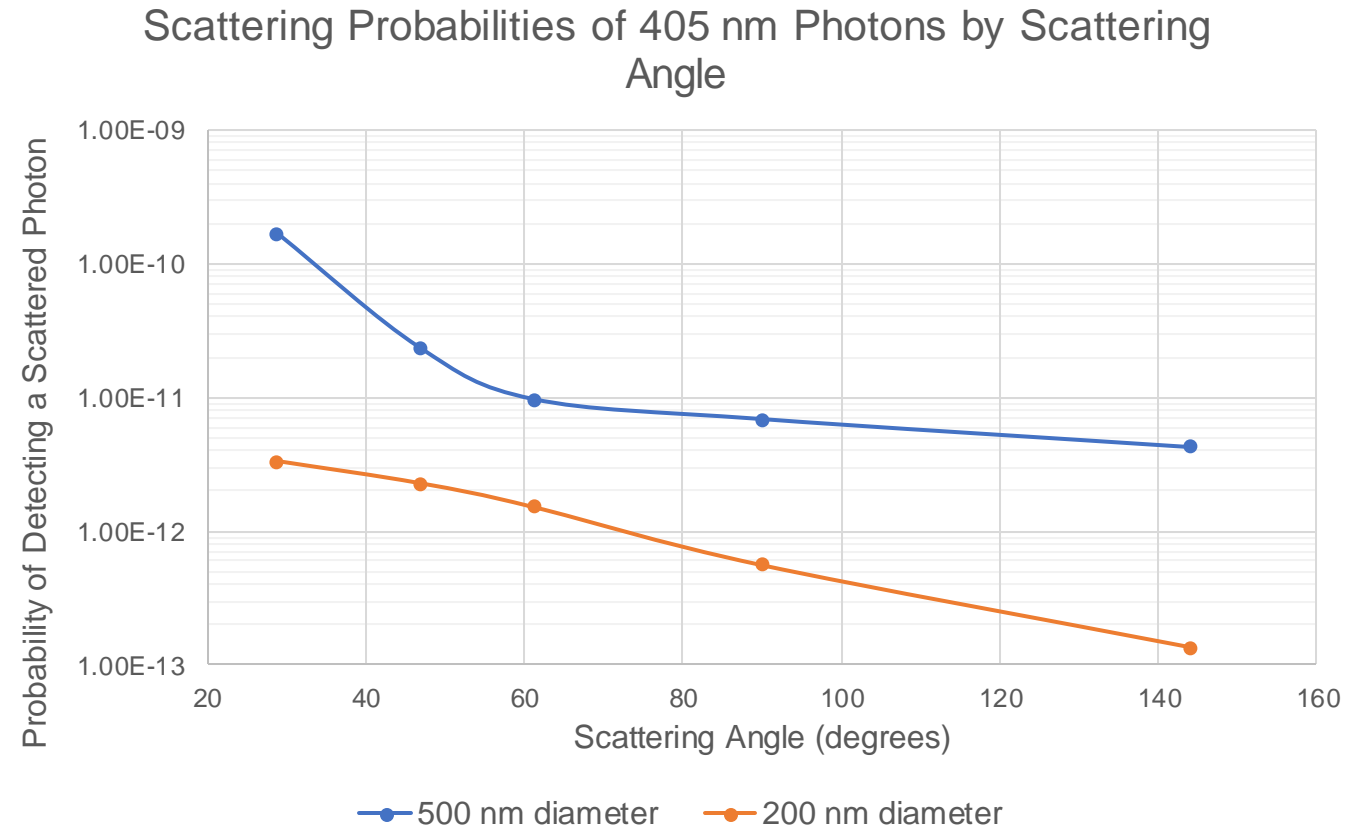
## How is SPAA different?

- Measure particulate size based on the distribution of photon scattering angles
- Identify other optical properties based on SiPM signal shape/size



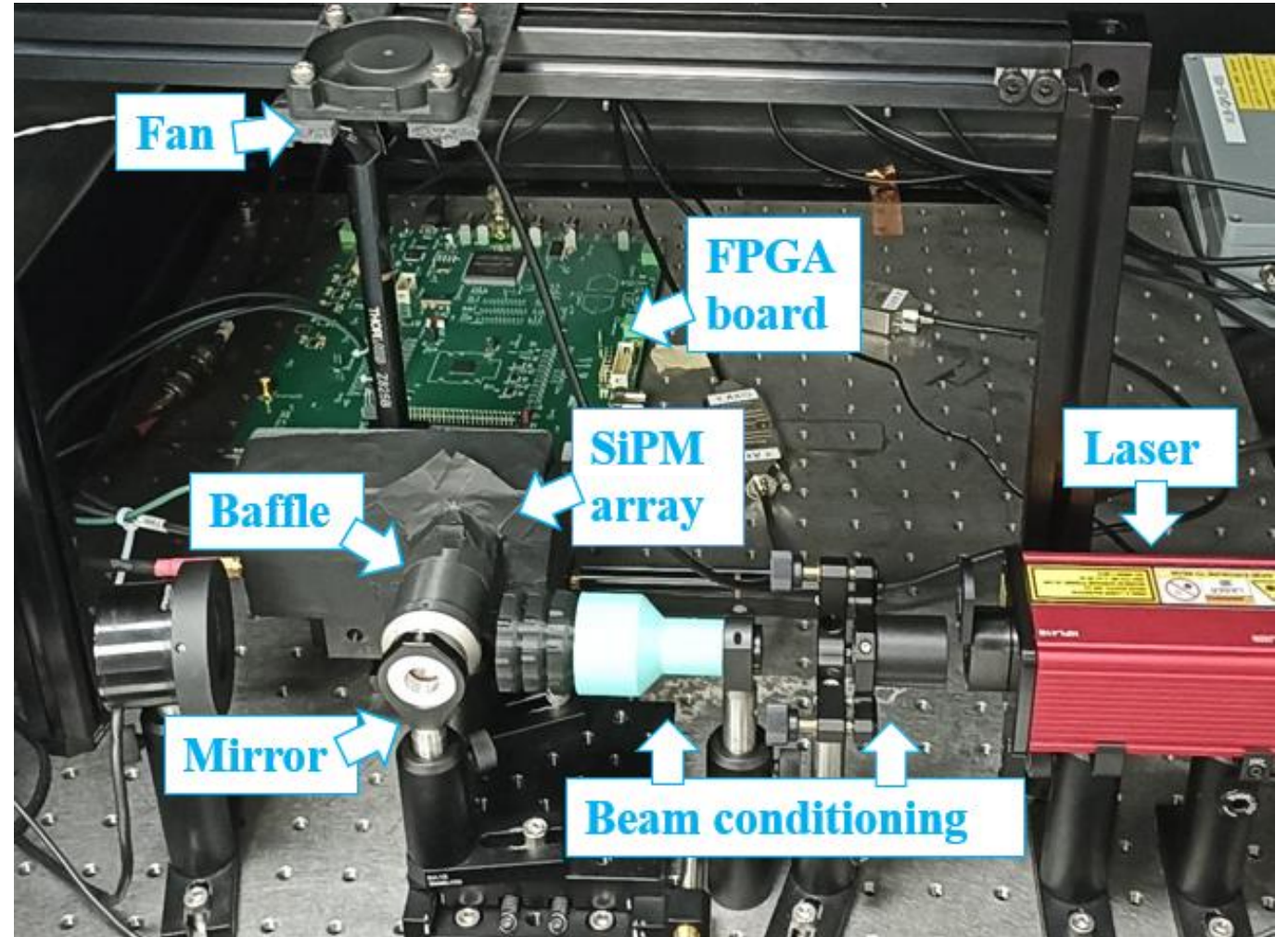
## MIE Scattering

- When photons encounter a particle, they have a small probability of scattering
- The angle they are most likely to scatter at depends on the size of the particle
- This is governed by MIE scattering equations



# Does SPAA work?

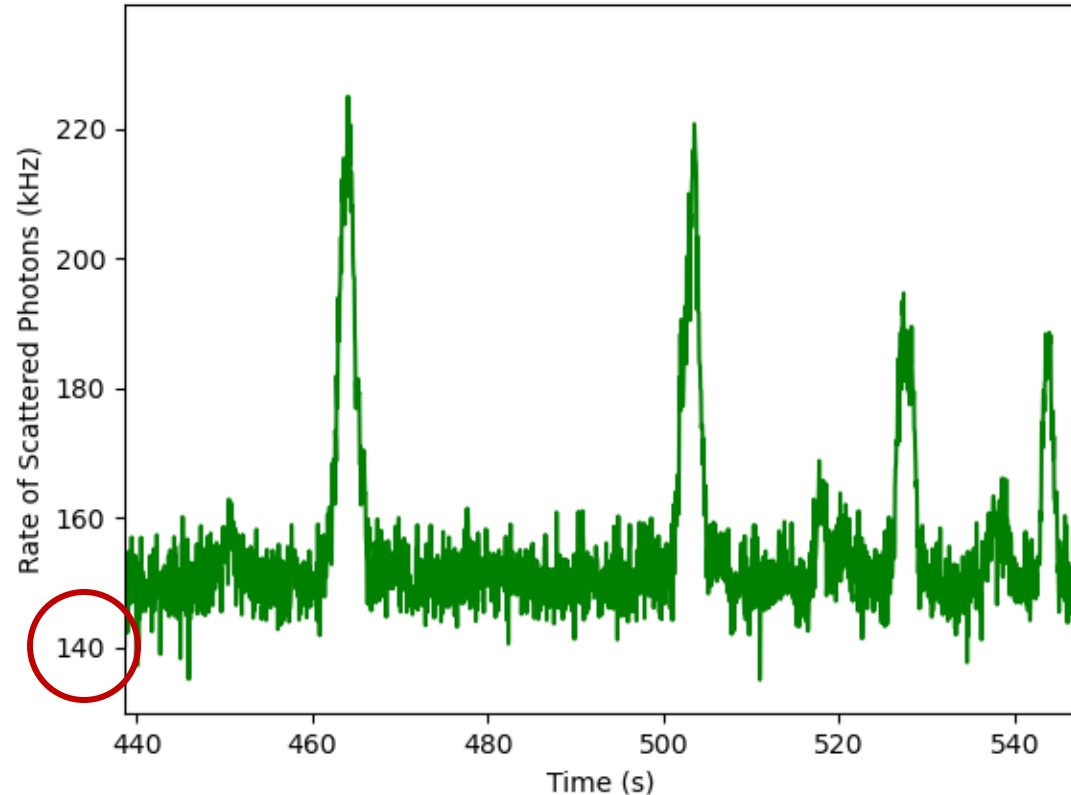
(Early data)



## Detecting Particulate

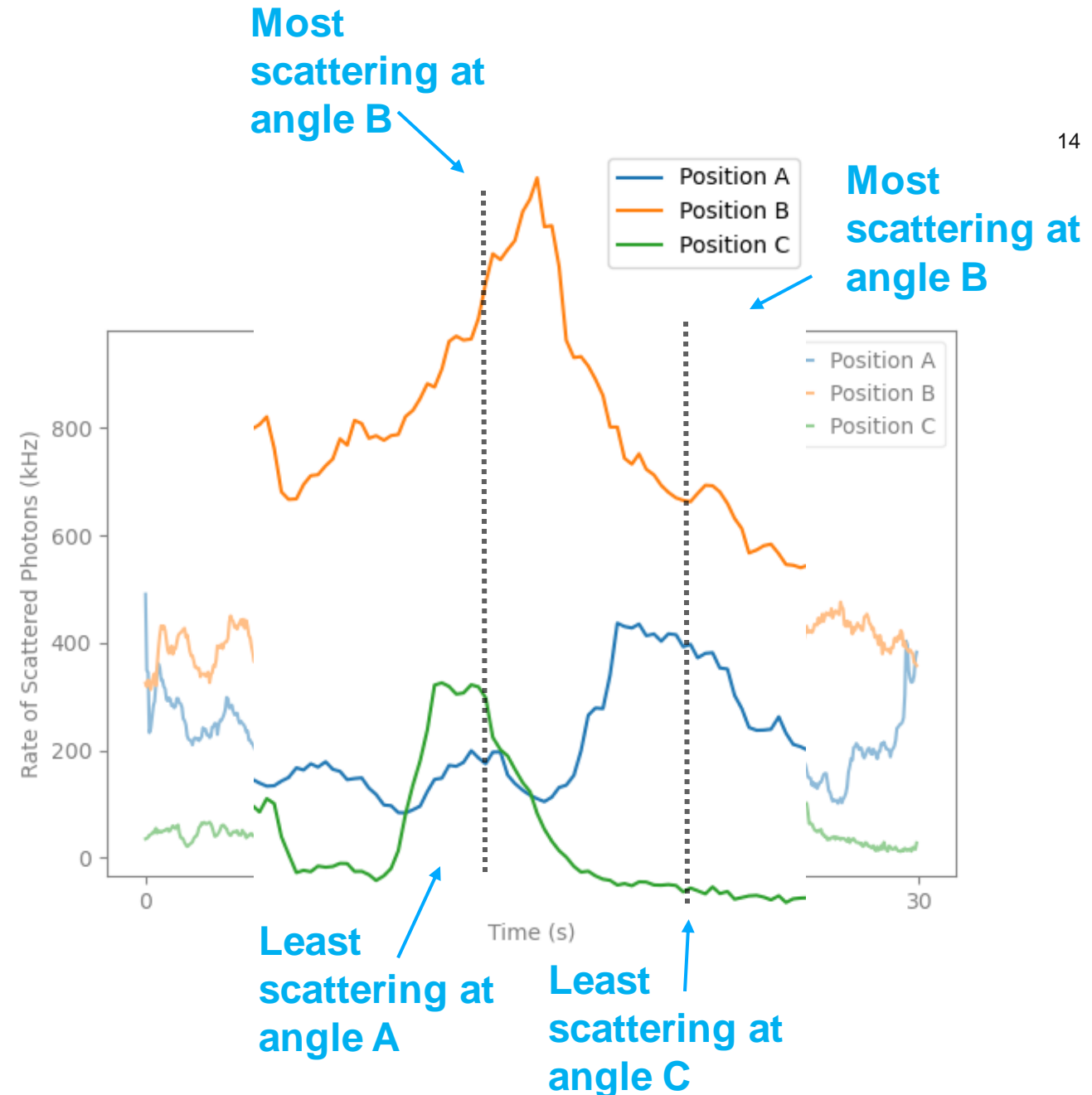
- We are seeing signal pulses from particulate!
- Still working to identify and reduce **parasitic light**

SiPM signal pulses due to particulate



## Next Steps – Angle resolution

- Use all three SiPMs for angle resolution
- Test with particulate of known size and velocity
- Develop particulate identification algorithms!





# Thank you

## Merci

### Team

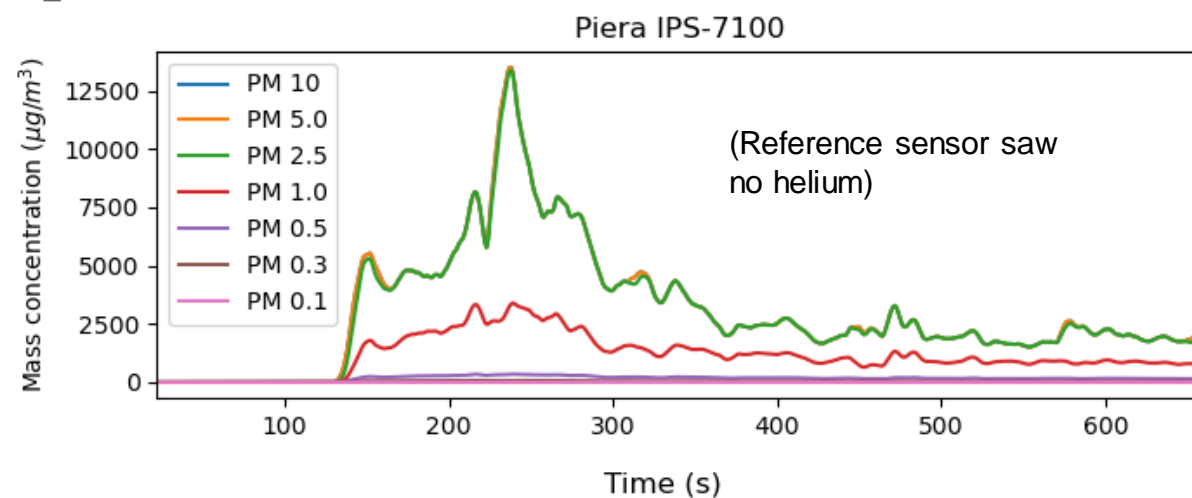
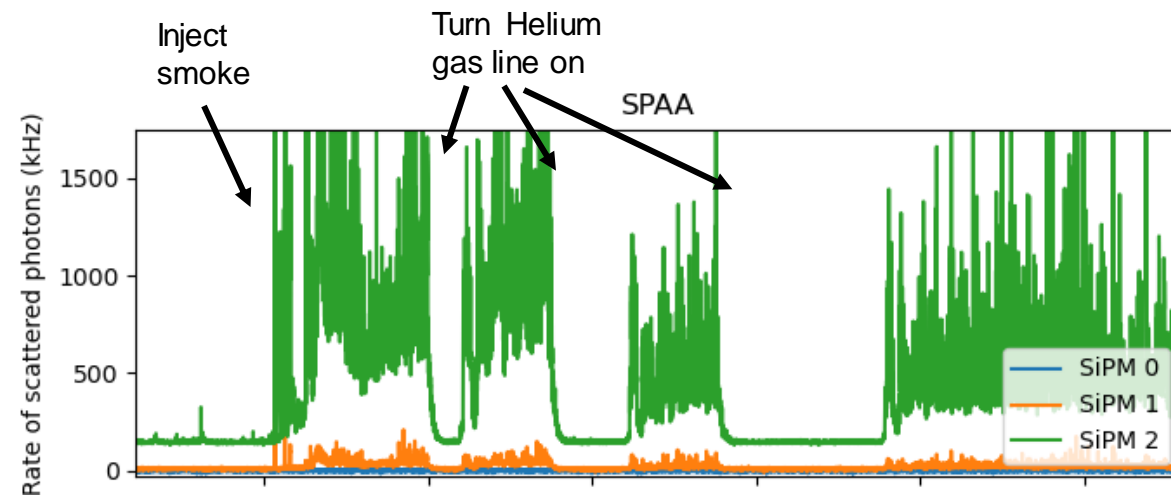
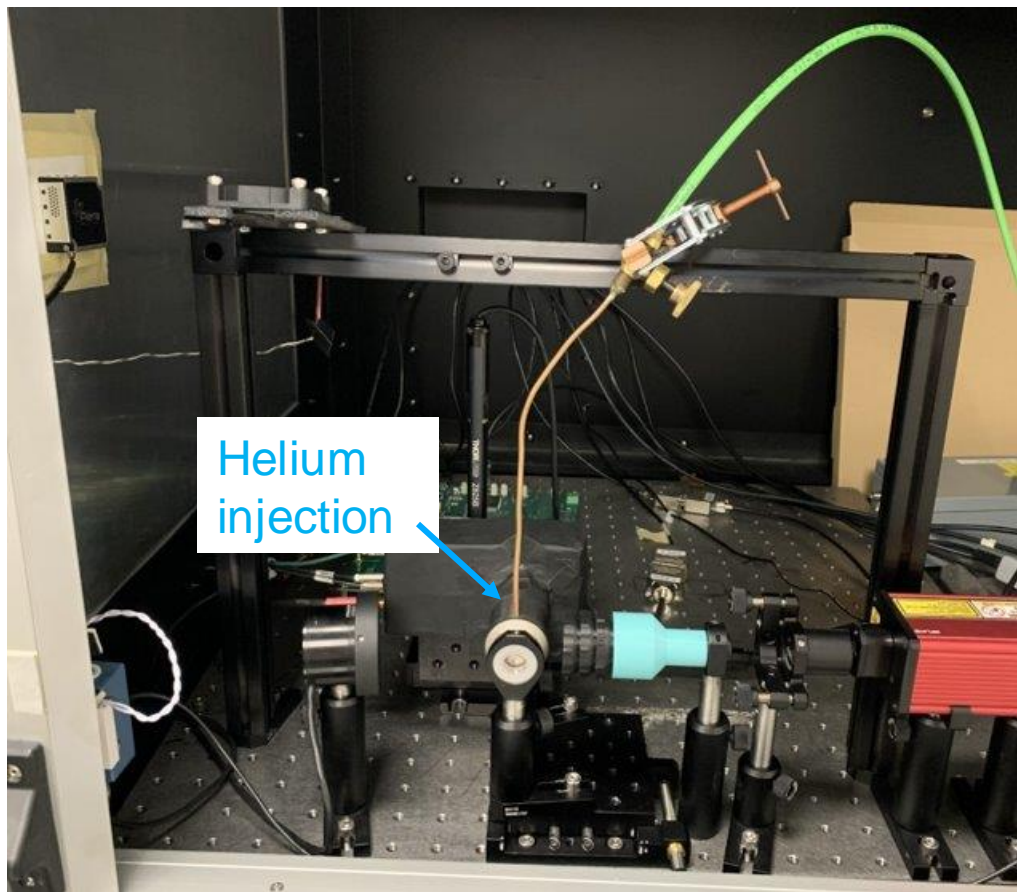
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## Appendix: Are those spikes really particulate? Testing with clean gas (Helium)



No spikes are present when using pure Helium (no particulate) – Evidence that the ‘spikes’ are due to particulate!