



Mass Attenuation Coefficient of Uranium Particulate

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Introduction

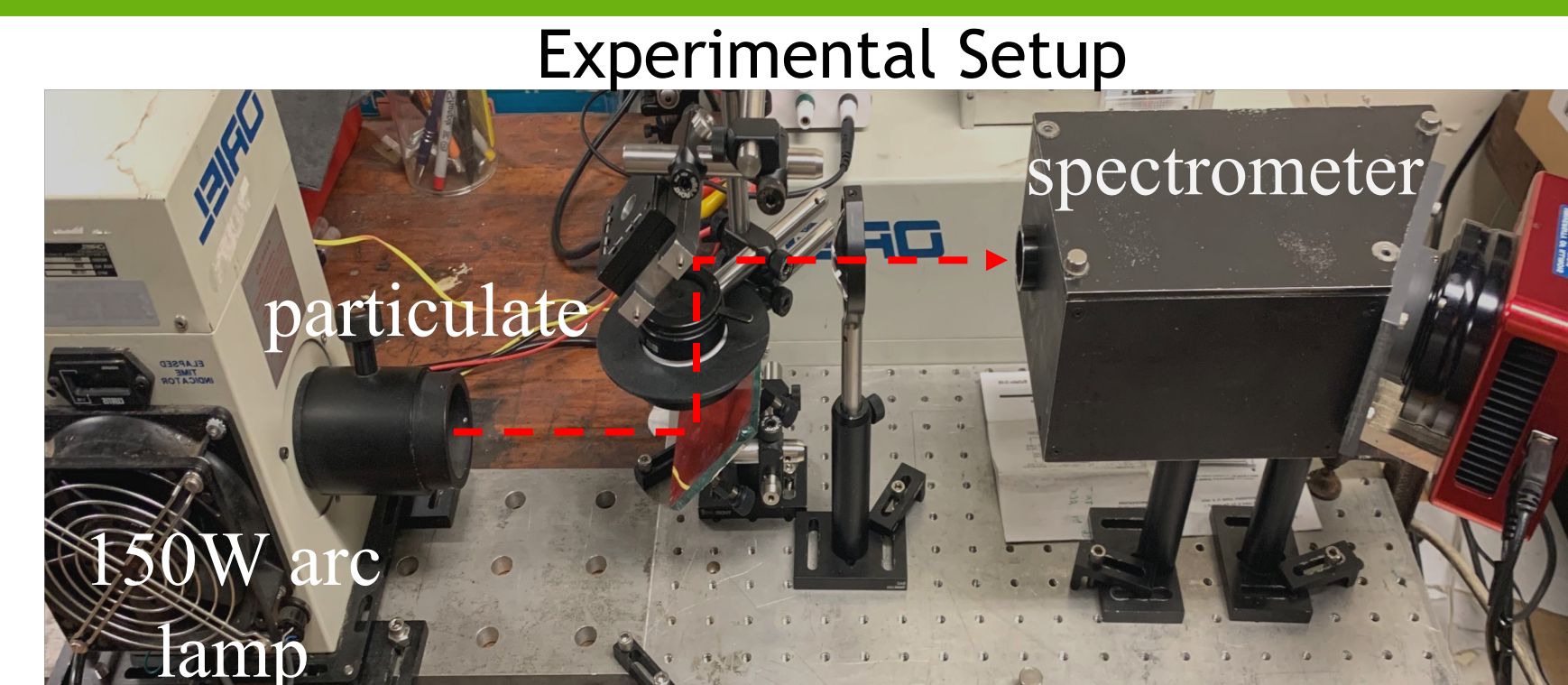
- Mass attenuation coefficient (MAC) is the light absorbance per unit mass
- MAC of aerosolized actinides is poorly understood, and fundamental data are needed, especially at elevated temperatures where measurements are challenging
- MAC can be wavelength and particle size dependent
- Visible spectrum measurements (400nm-750nm)
- Two size distributions measured to investigate size dependence

- Interested in absorbed light, *not* scattered light
- “Integrating Plate Method” utilized for measurements
- Particulate ultra-sonicated in a solvent and dispersed onto Whatman quartz filter
- Compare clean filter (I_o) to particulate filter (I) to calculate MAC where A =filter area, m =mass of particulate:

$$MAC = \frac{A}{m} \ln \left[\frac{I}{I_o} \right]$$

- Scanning Electron Microscopy (SEM) was used to image particulate for sizing
- Sample 1 was sieved at $25\mu m$ to make sample 2

Approach



Uranium in Quartz Filter

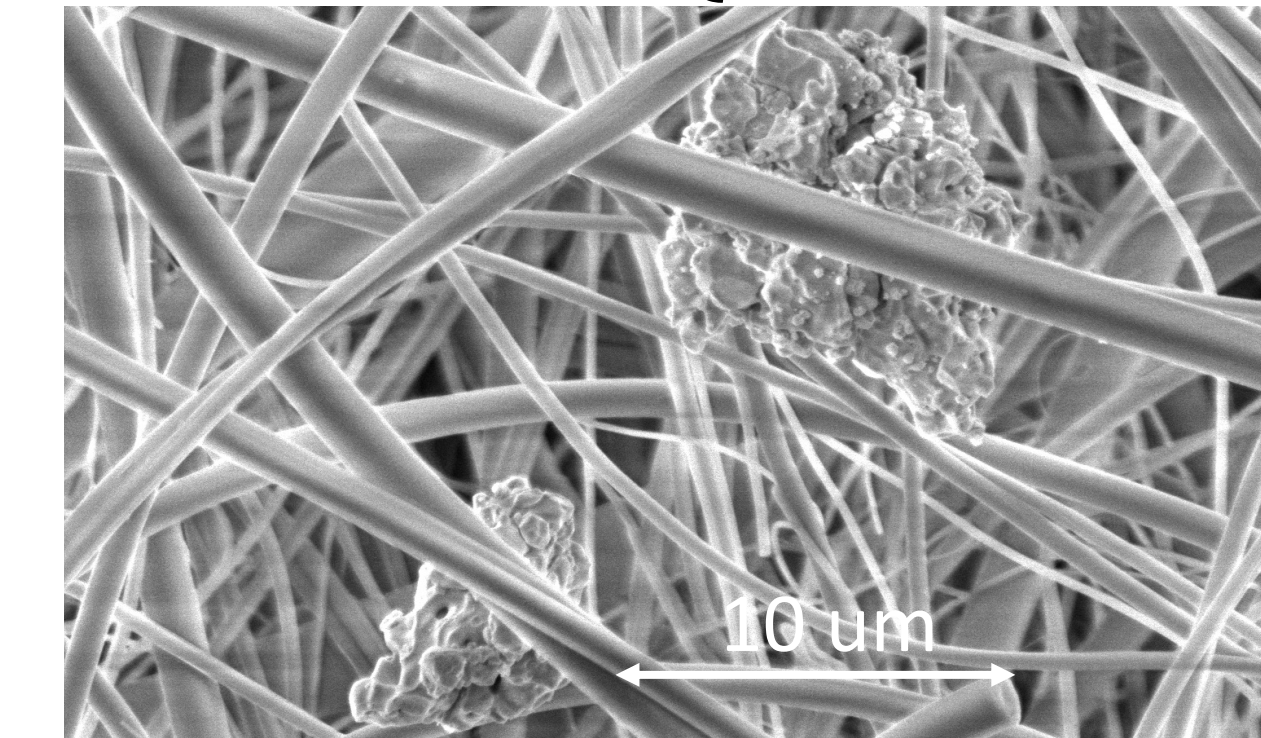
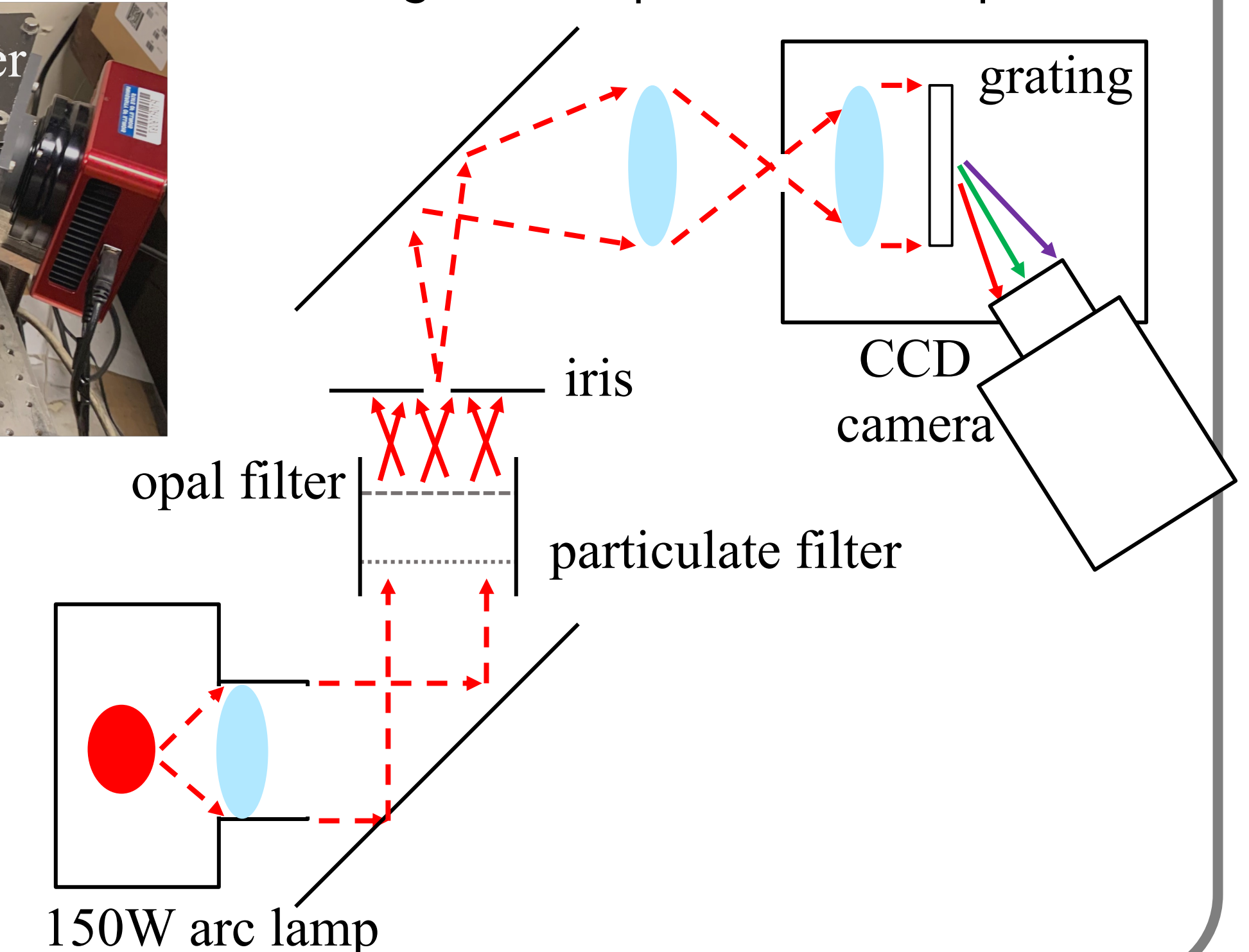


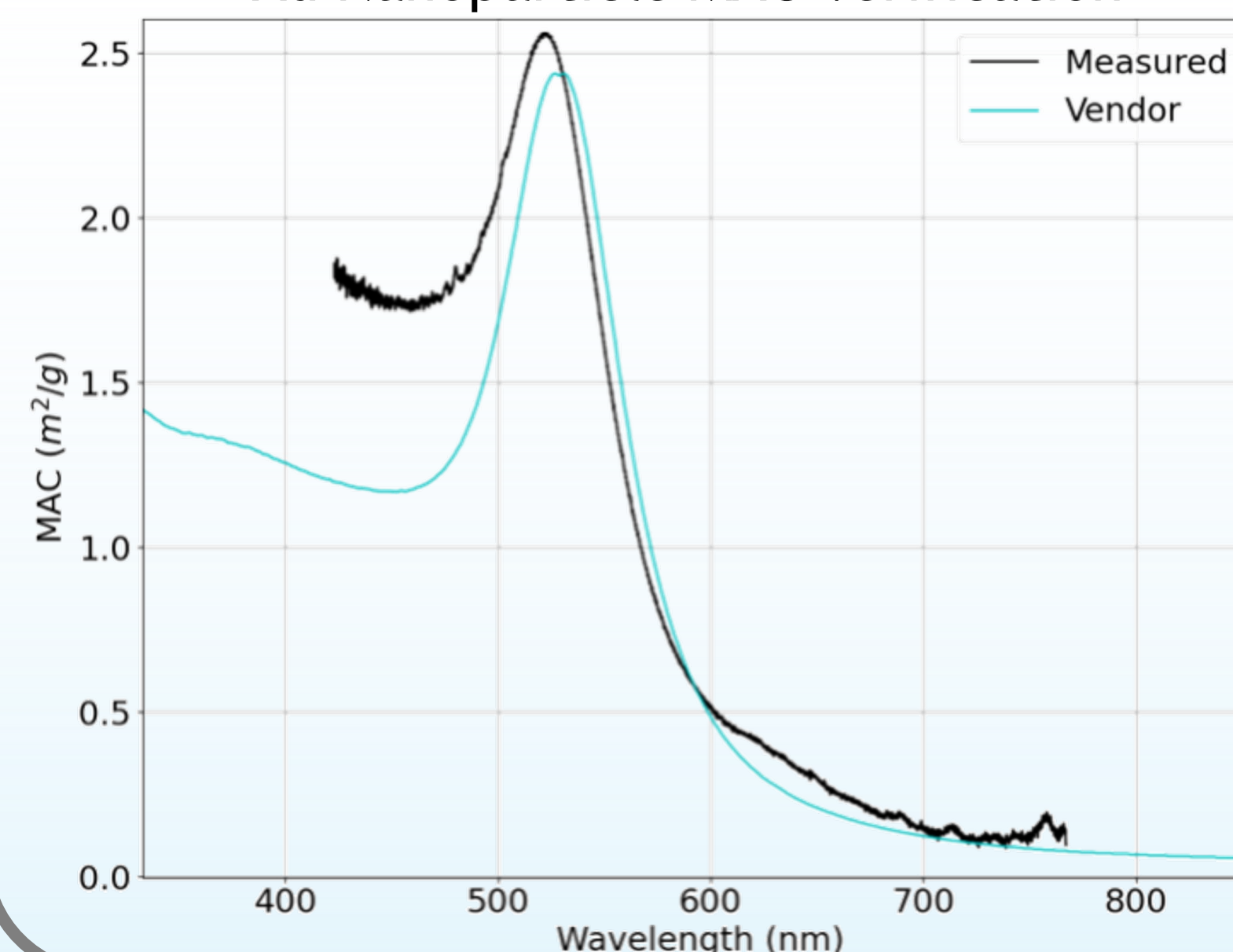
Diagram of Experimental Setup



Experimental Verification

- 52nm Gold nanospheres with a known absorbance curve were used to verify the efficacy of the setup
- Absorbance data from vendor of particulate in a solvent
- Average taken of 5 trials
- Measured curve is within expected margin

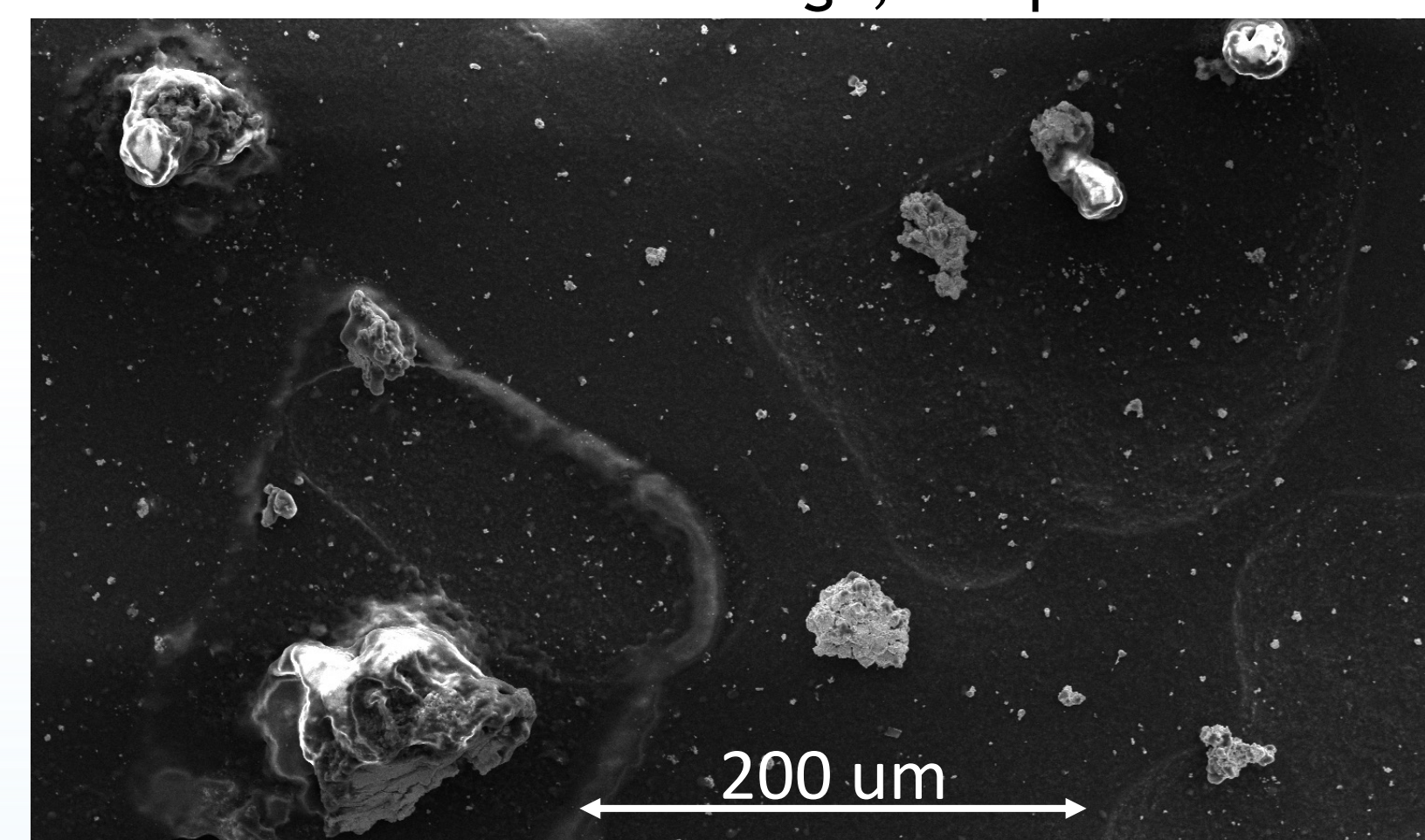
Au Nanoparticle MAC Verification



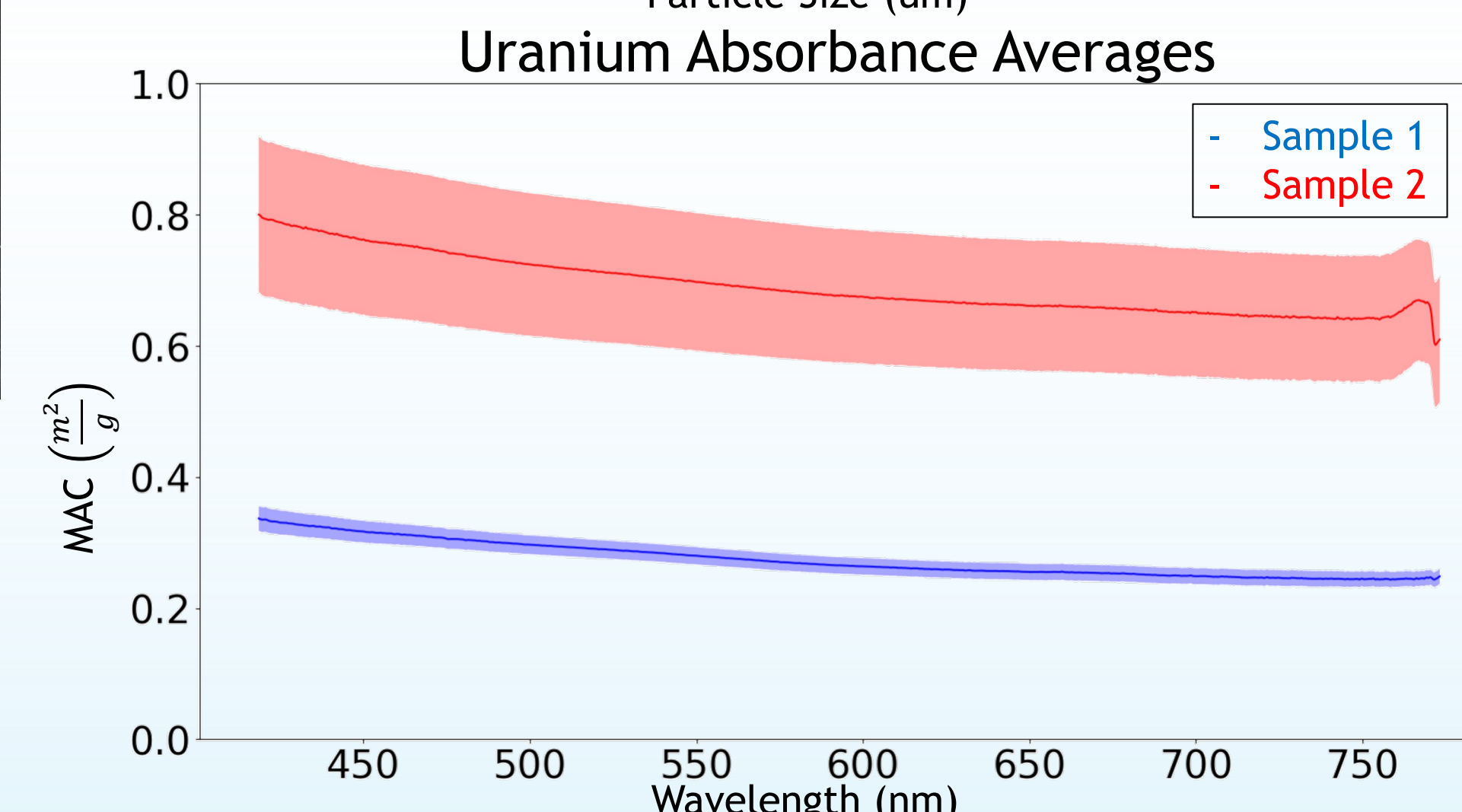
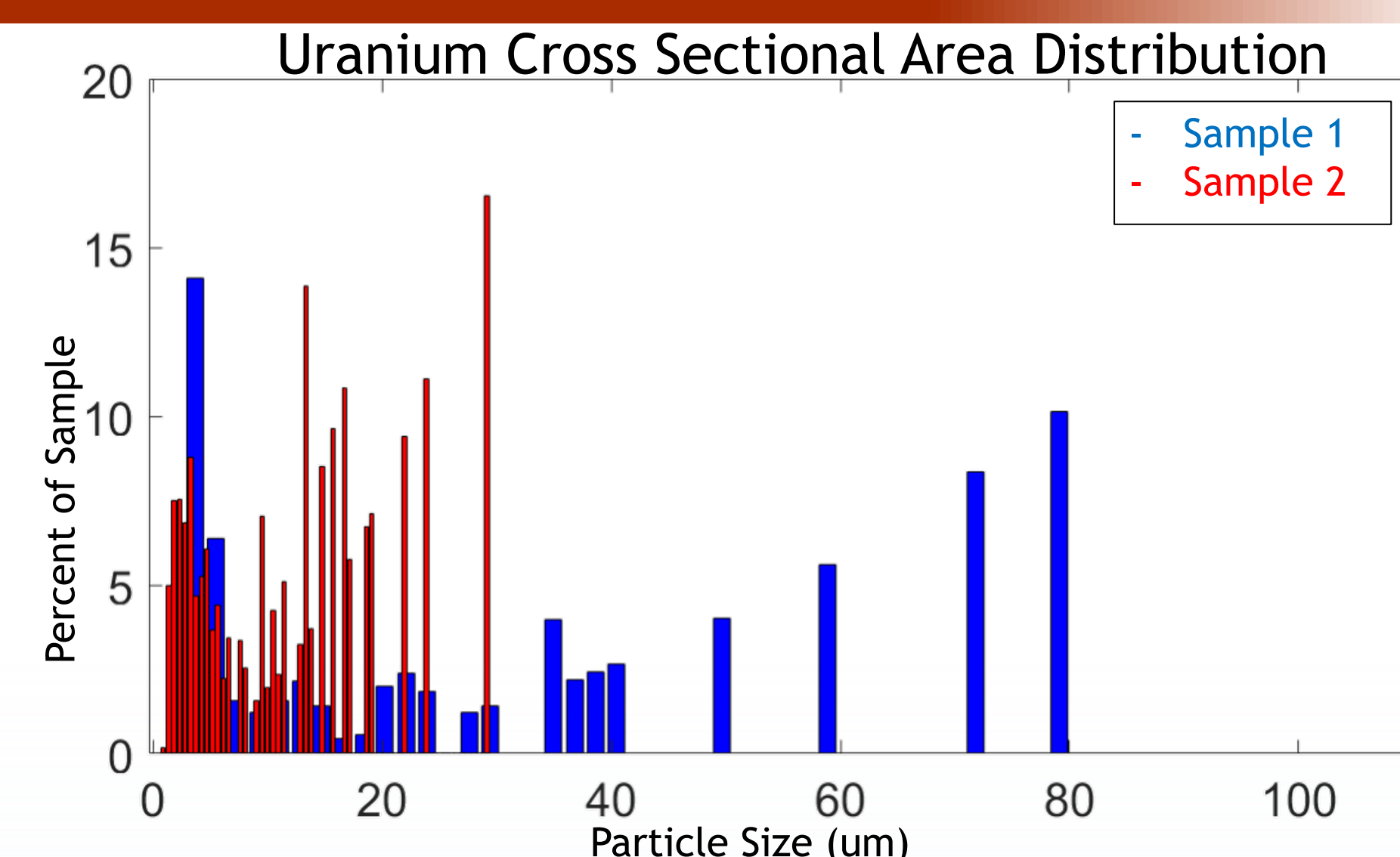
Results

- Particulate ultra-sonicated in solvent and evenly dispersed onto carbon paper for SEM imaging.
- Particle finding algorithms and manual sizing to compute size distribution.

Uranium SEM image, sample 1



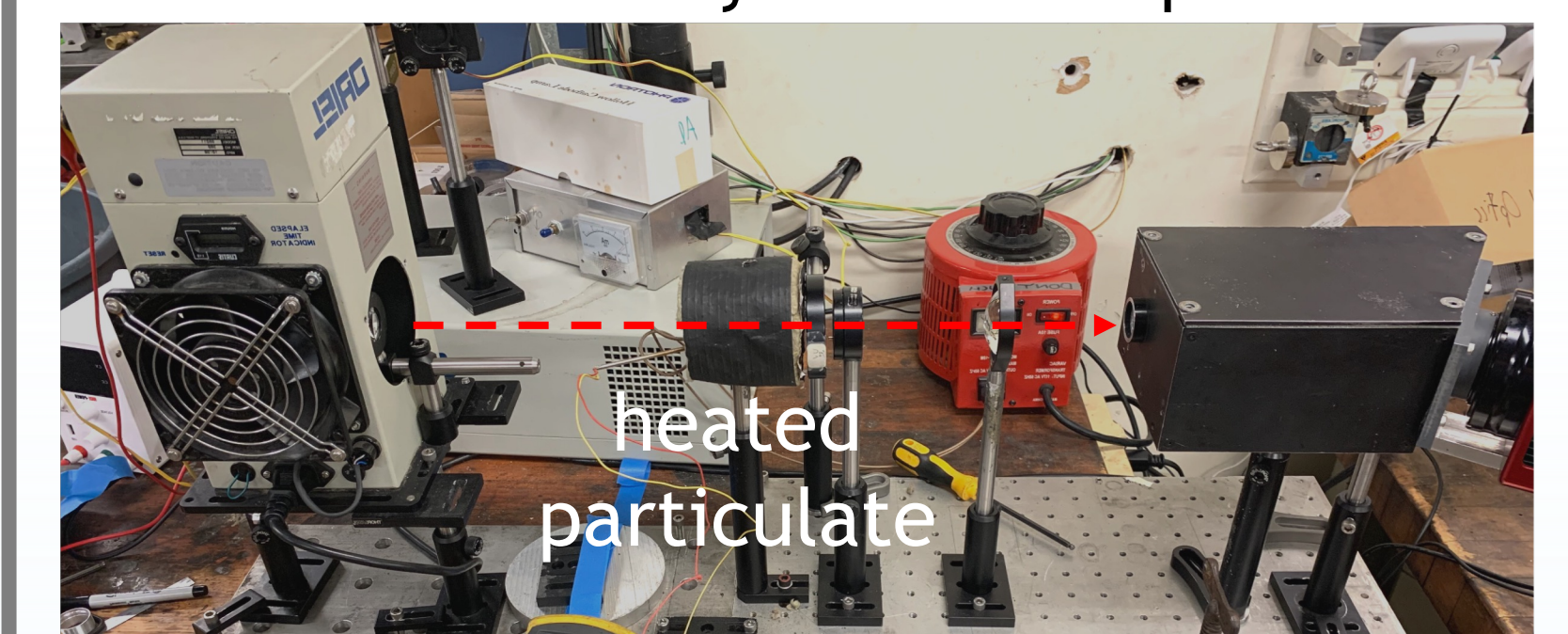
- 16 trials of each sample averaged for final MAC curves
- 95% confidence interval $1.96 * \frac{\sigma}{\sqrt{n}}$ with σ =standard deviation, n =dataset size



Next Steps / Future Work

- MAC can be temperature dependent
- Heated measurements (600 – 1000°C)
- Requires building new apparatus for heating particulate
- Quartz filters can be heated to 1000°C

Preliminary Heated Setup



- Manganese Violet $NH_4MnP_2O_7$ will be used for verification of setup at high temperatures
- Solid -> solid phase change at 400°C changing the color from violet to white