

# Analysis Of Optical Particle Counters

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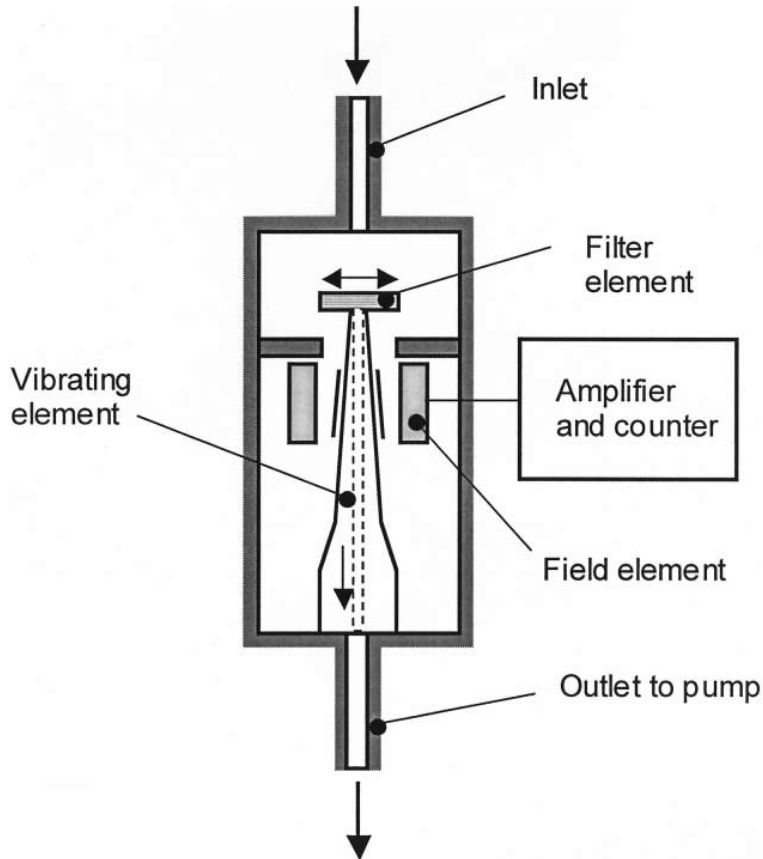
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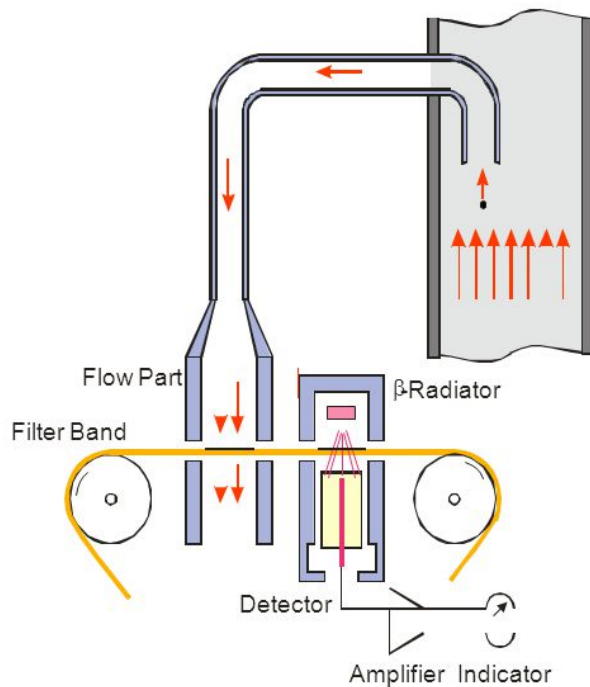
- Particle Matter (PM) Measurements
- Optical Particle Counter (OPC) Operating Principles
- Low-Cost (<\$50) OPCs
- Conclusions and Future Work

## Tapered Element Oscillating Microbalance (TEOM):



- Very accurate
- Expensive
- Not for field-use
- Measures concentration

## Beta-Attenuation Monitor (BAM):



- Accurate
- Expensive
- Measures concentration

## Gravimetric:



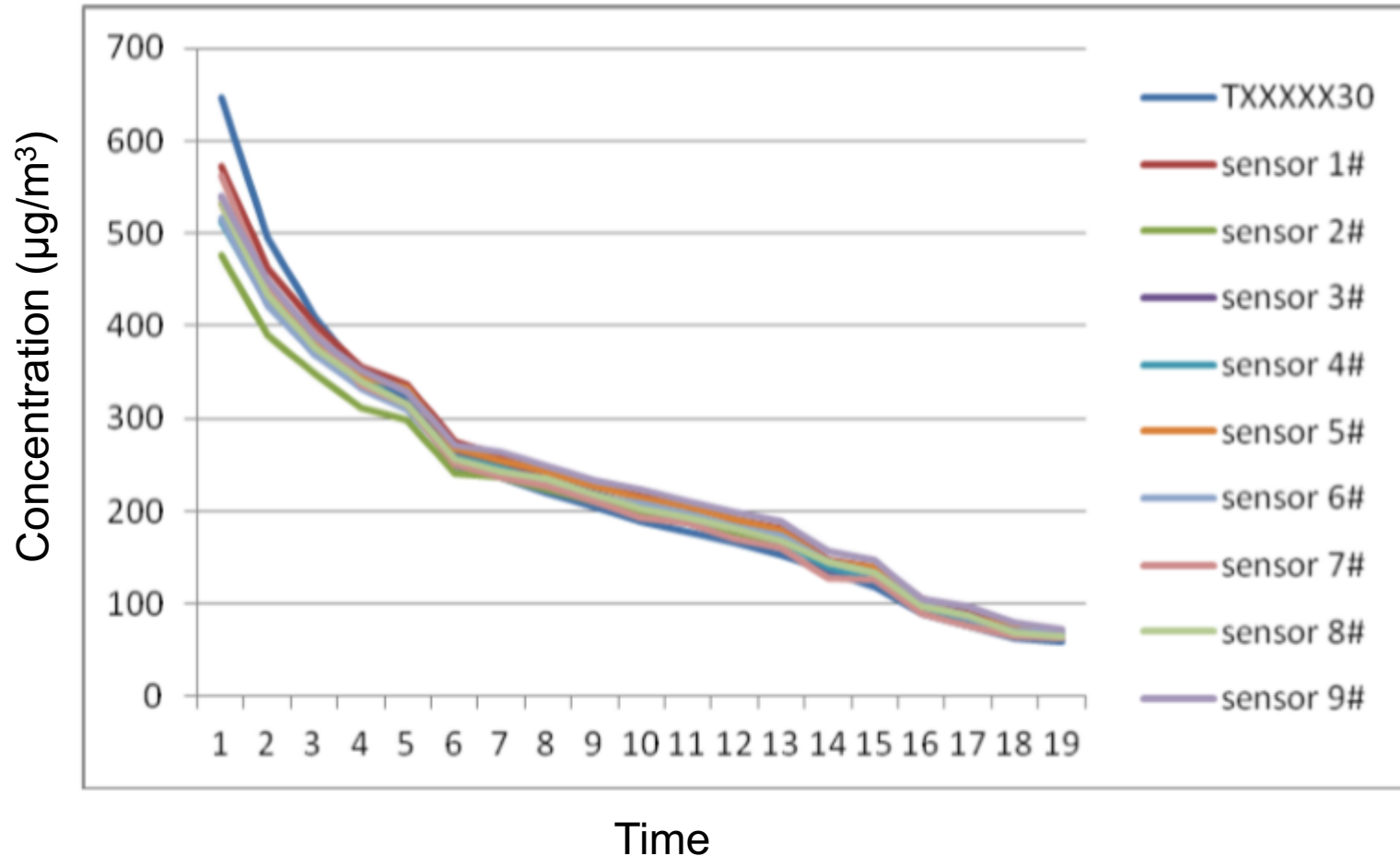
- Inexpensive
- End point analysis
- Measures total mass of PM

## Optical Particle Counter (OPC):



- Inexpensive
- Measures concentration
- Field-use
- Many types are available
- Accuracy is questionable

# OPC Measurements



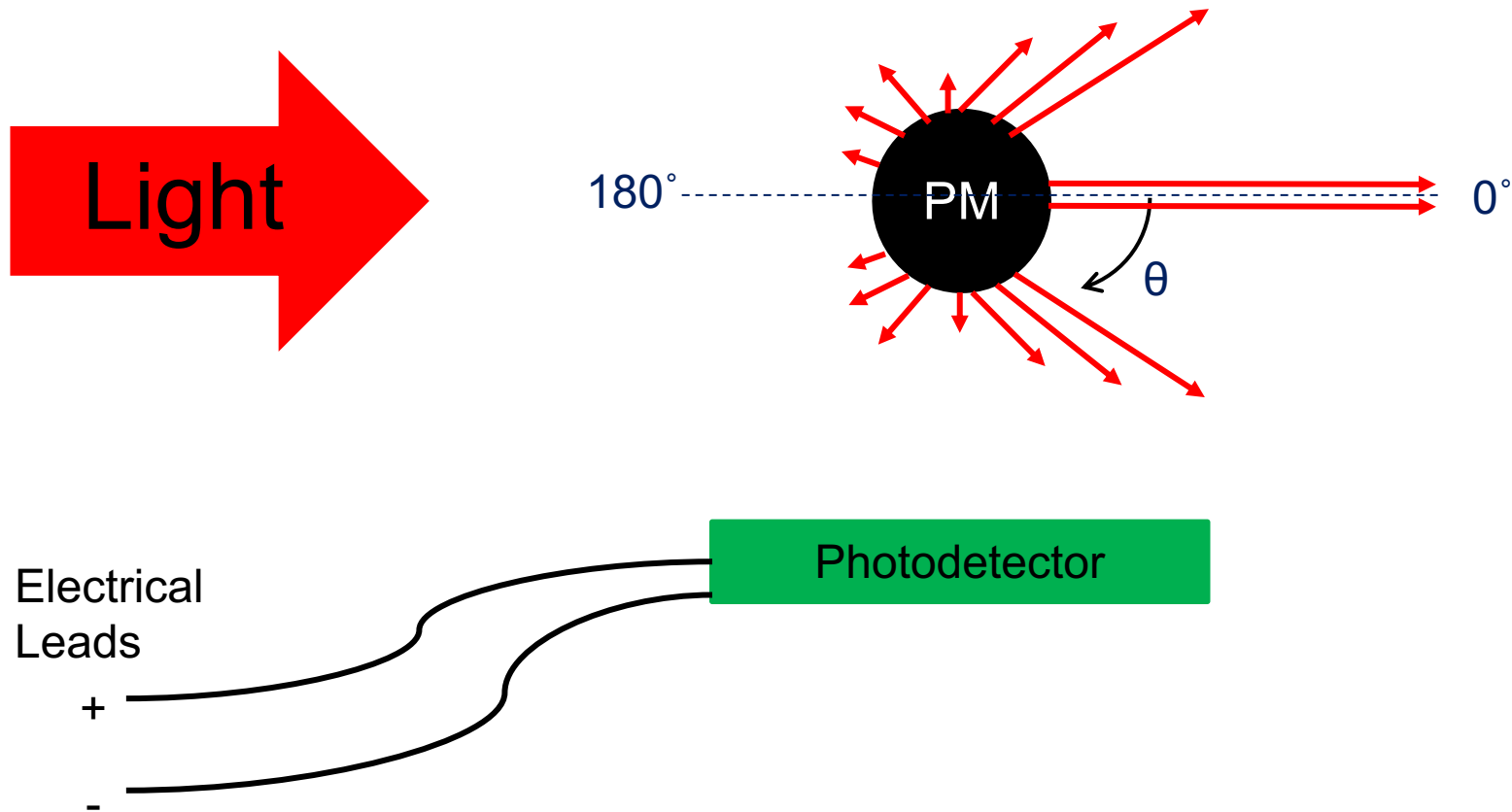
Plantower 1003 Datasheet

# Dual Use of an OPC

- Air Quality Monitoring
  - Lower concentrations
  - $PM_{2.5}$
- Combustion Diagnostics
  - Higher concentrations
  - Particle Size Distribution Function

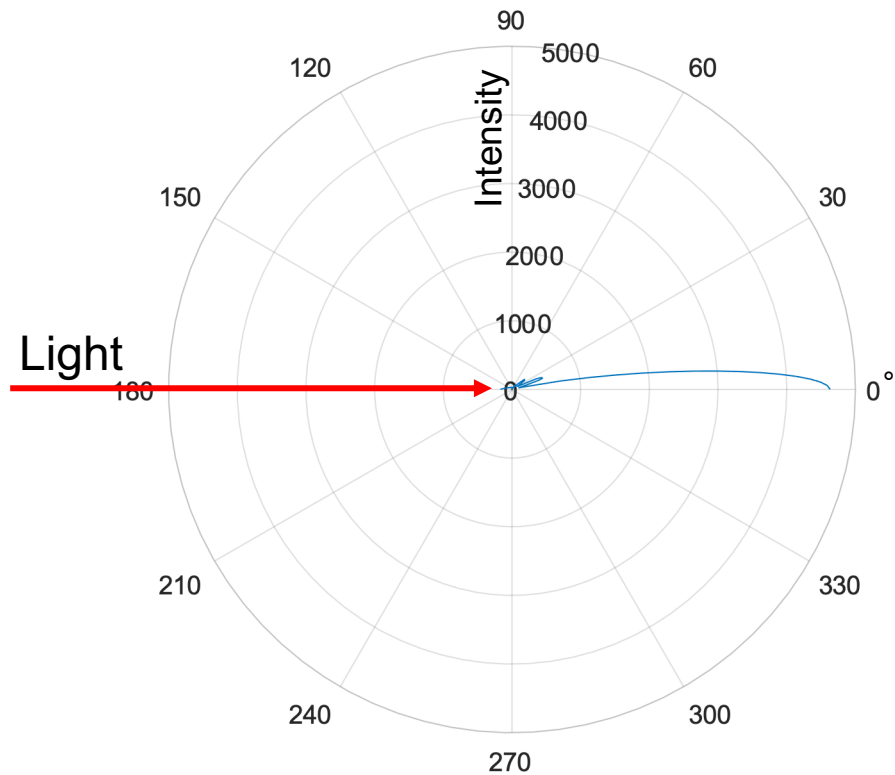


# OPC Operation

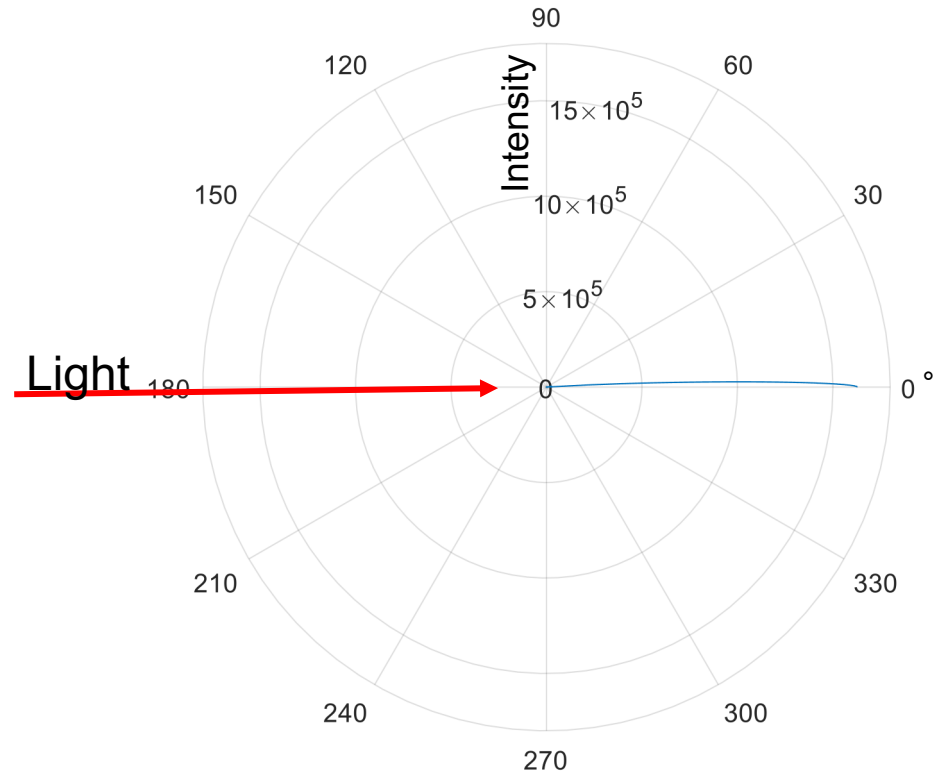


# Mie Theory Scattering

2.5  $\mu\text{m}$

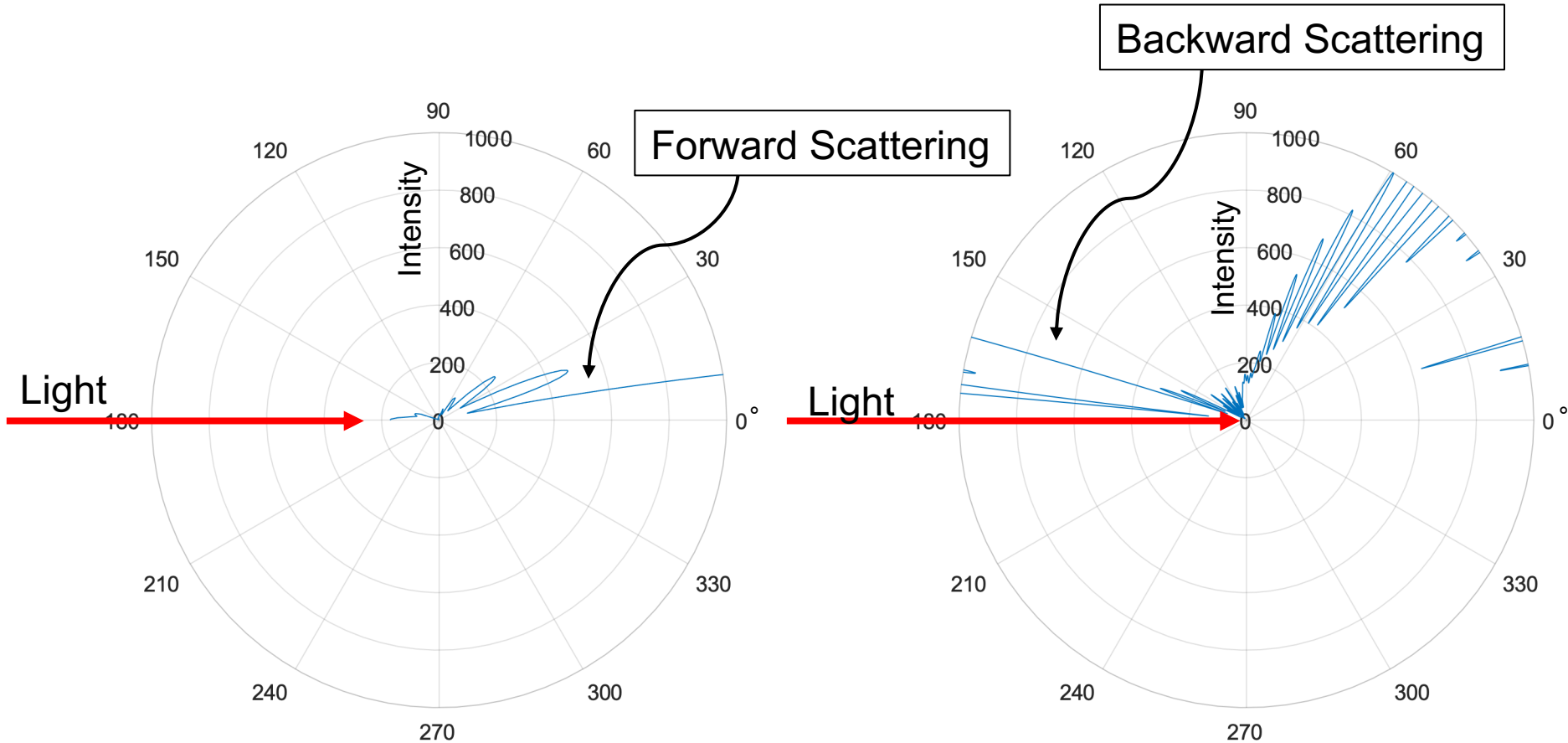


10  $\mu\text{m}$



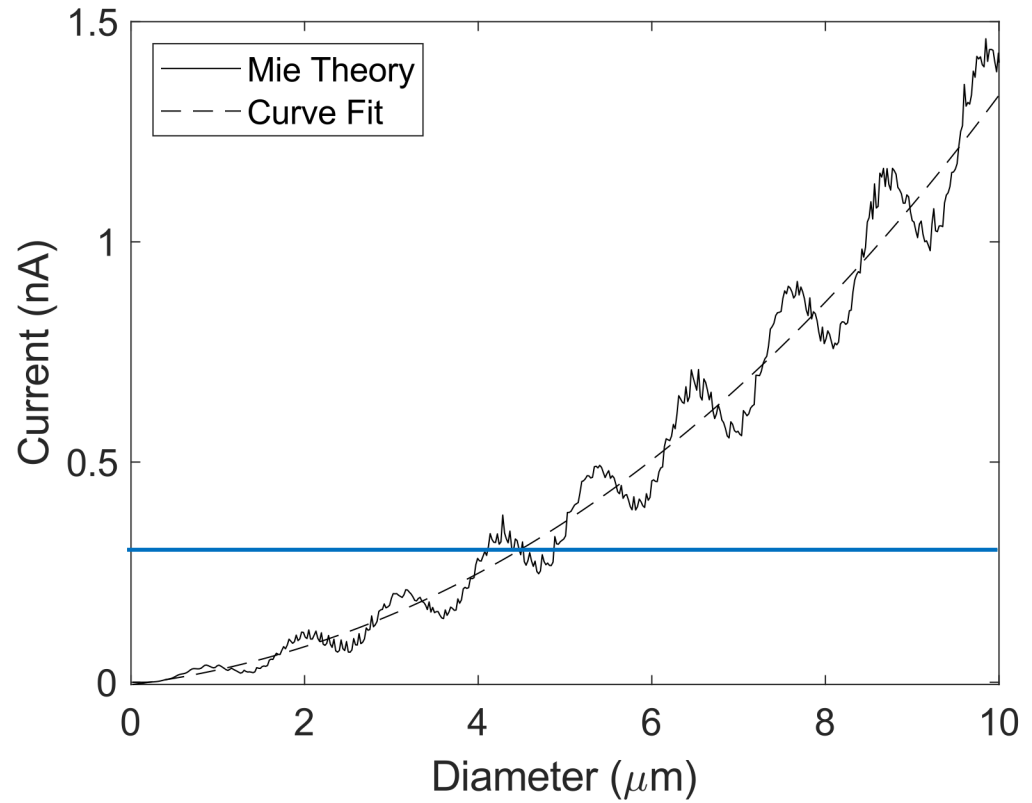
100x

# Mie Theory Scattering

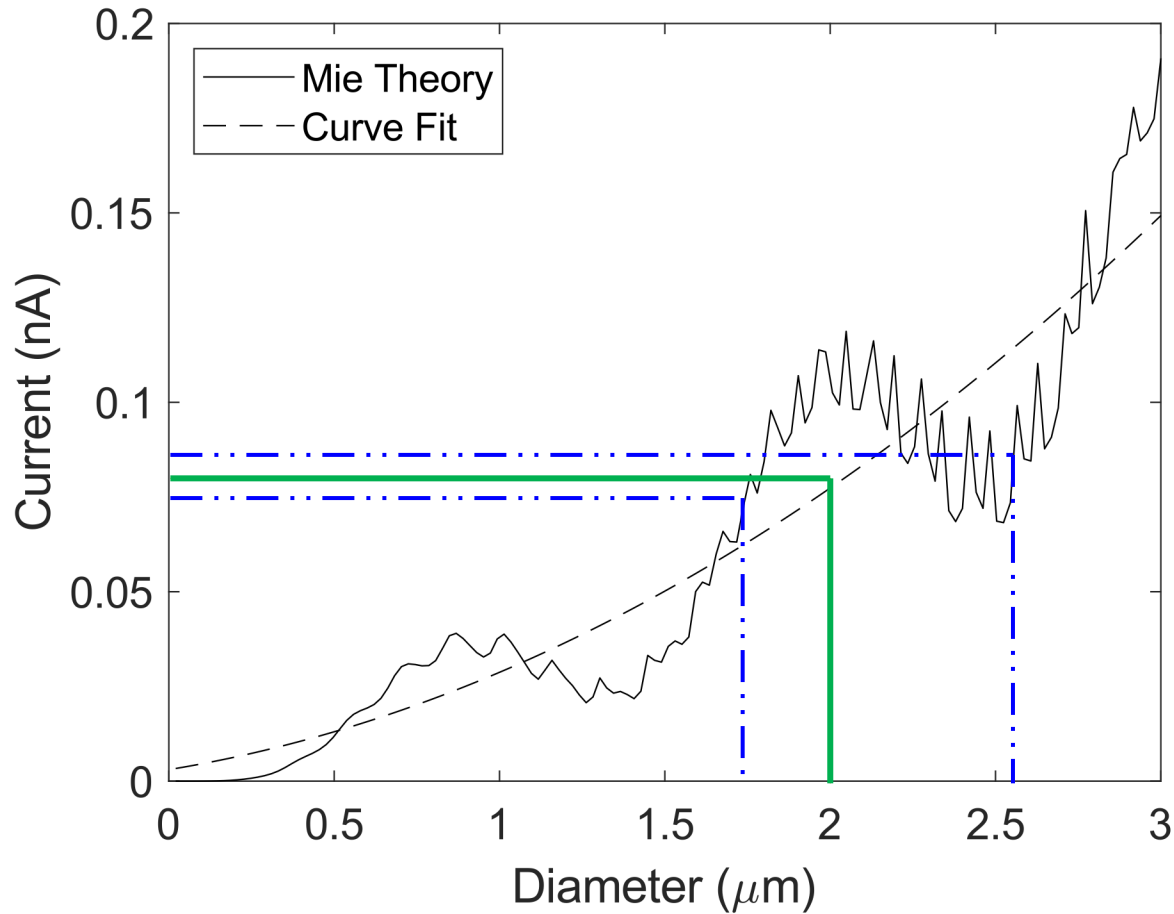


Zoomed-in views of previous graphs

# Sensor A

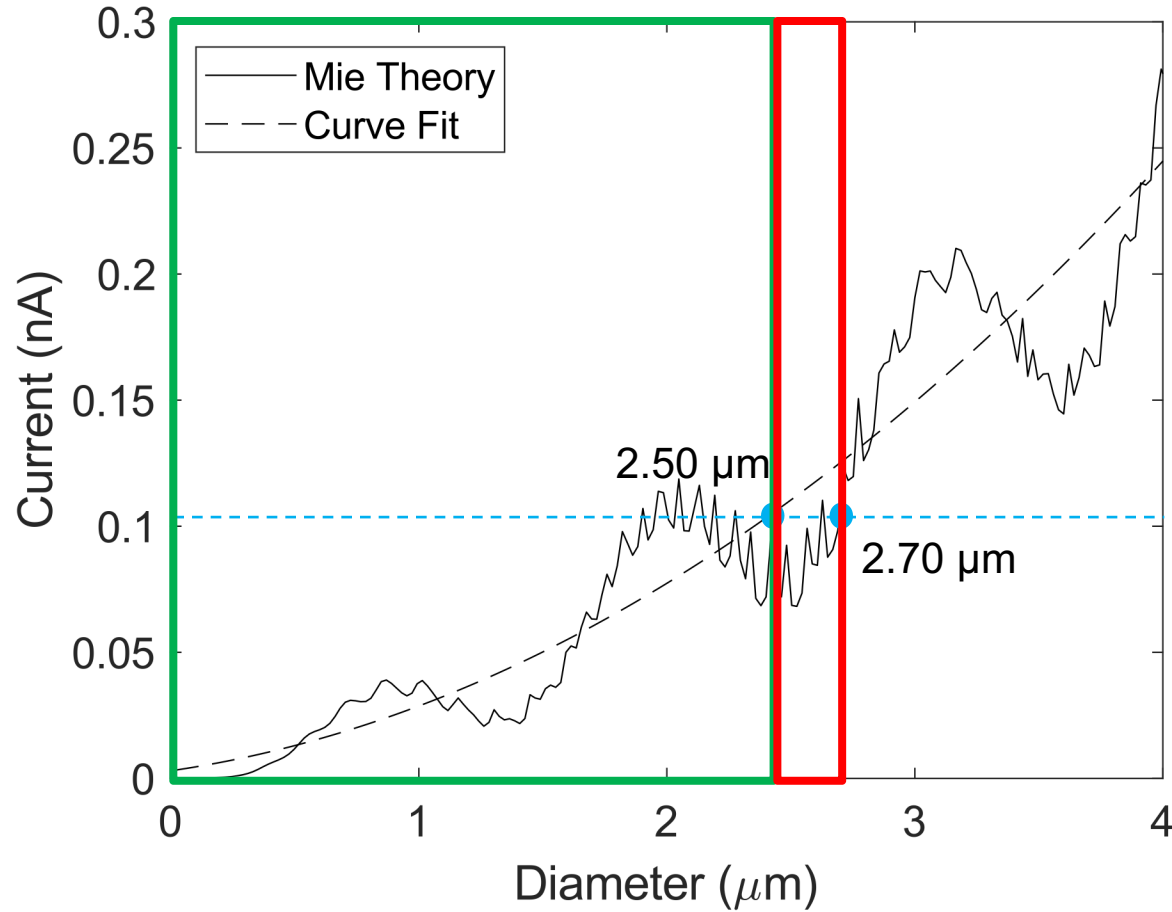


# Sensor A



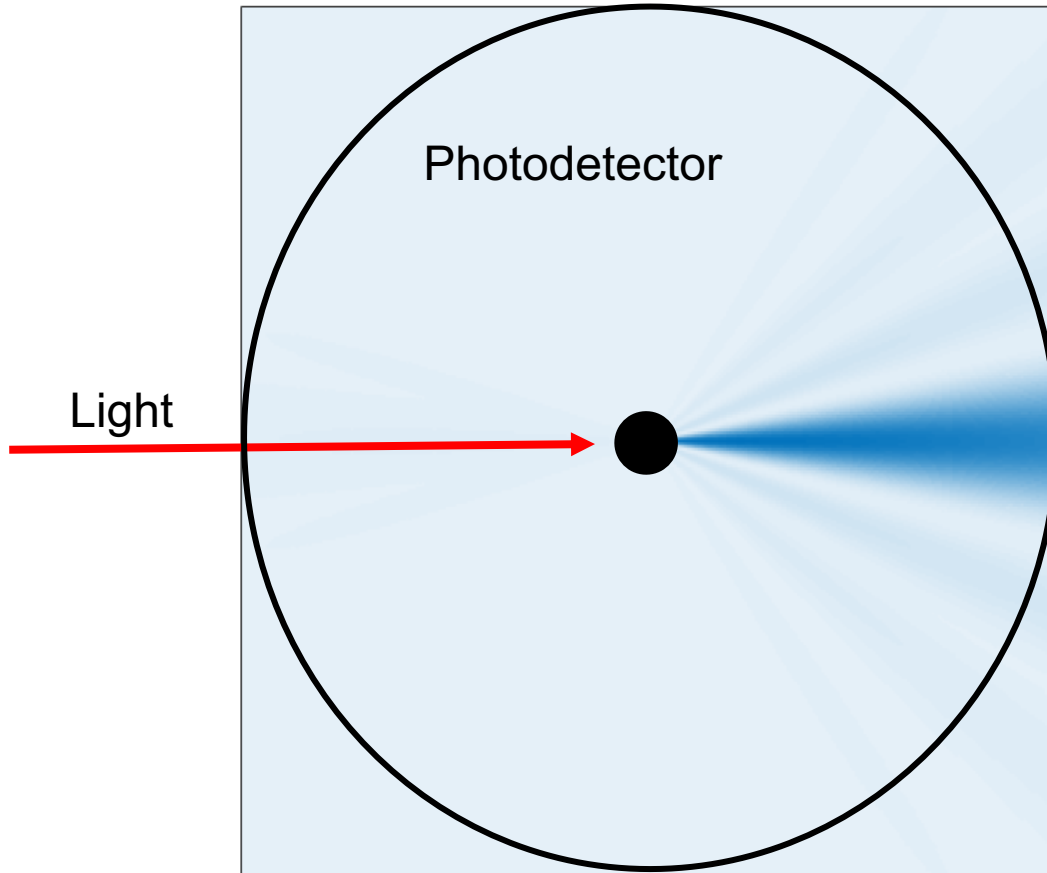
Approximately 50% error in diameter.

# Sensor A



# Sensor A

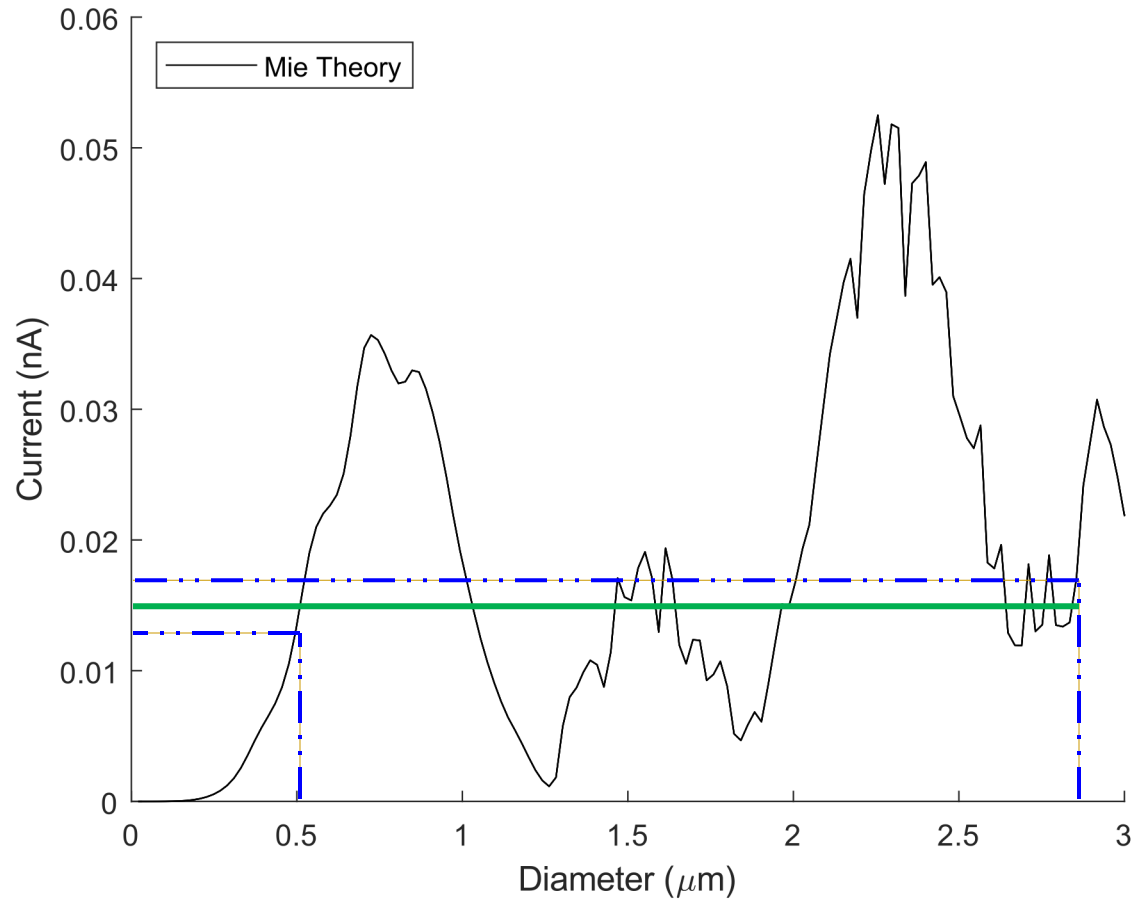
Diameter = 2.5  $\mu\text{m}$



- Detector is not well-utilized

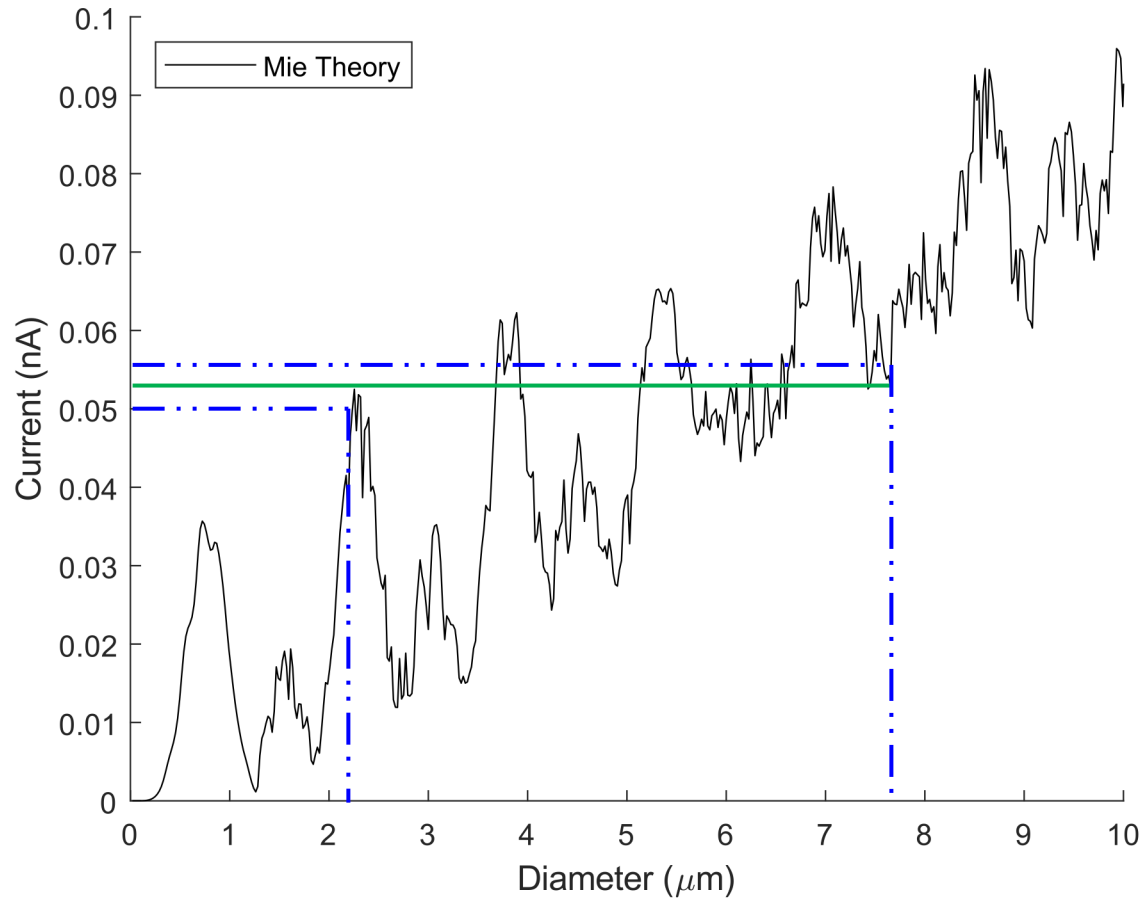
Top View

# Sensor B

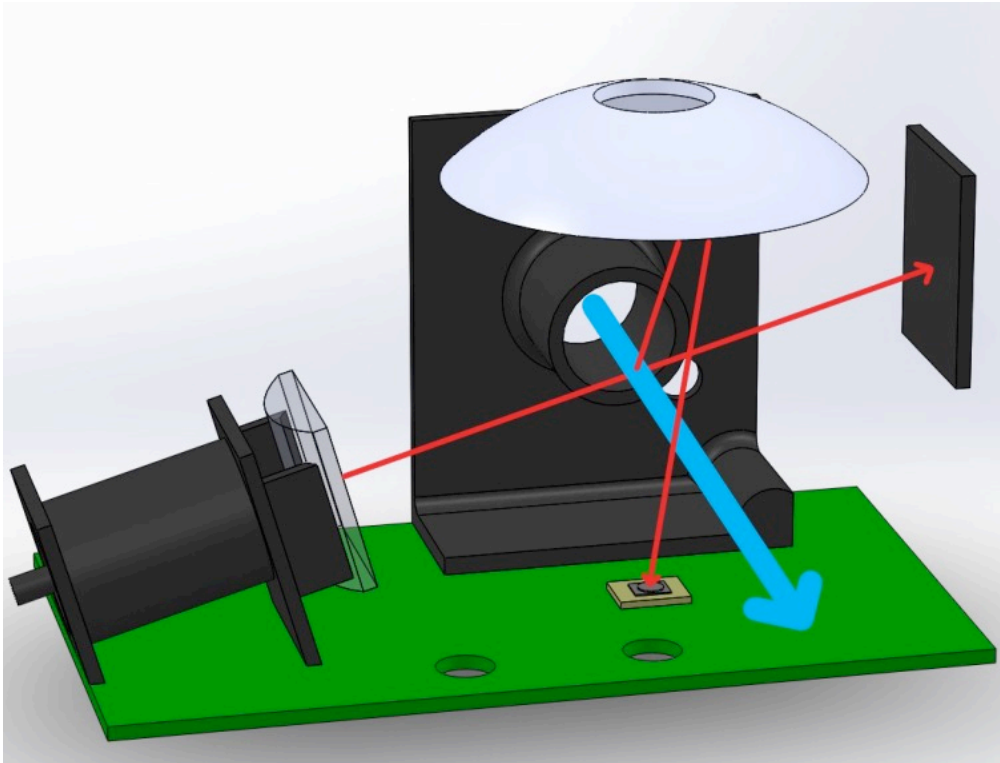




# Sensor B



- All OPCs are not designed equally
  - Varying accuracy
  - Suitability depends on the purpose
- Very little area of the photodetector is used
- Collection angles are important
  - Photodetector location matters



## Optimization

- Position of Photodetector
- Multiple Photodetectors
- Inclusion of Mirror