

# AirPhoton Nephelometer Characterization and Other Awesome Updates

SPARTAN Meeting  
May 18, 2023

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# About AirPhoton

- About me, John Hall
- AirPhoton and GRASP
- *GAPMAP-0* has launched
- Instrumentation
  - Sampling Stations
  - Nephelometers
  - Accessories



# AirPhoton Product Synopsis

## Sampling Stations

- Physical sample collection
- Programmable automation
- Eight sampling filters
- Dual flow / PM size cut
- Outdoor, global operations
- Remote controllable



NOT TO SCALE



# AirPhoton Product Synopsis

## IN100 Integrating Nephelometer (and CR100)

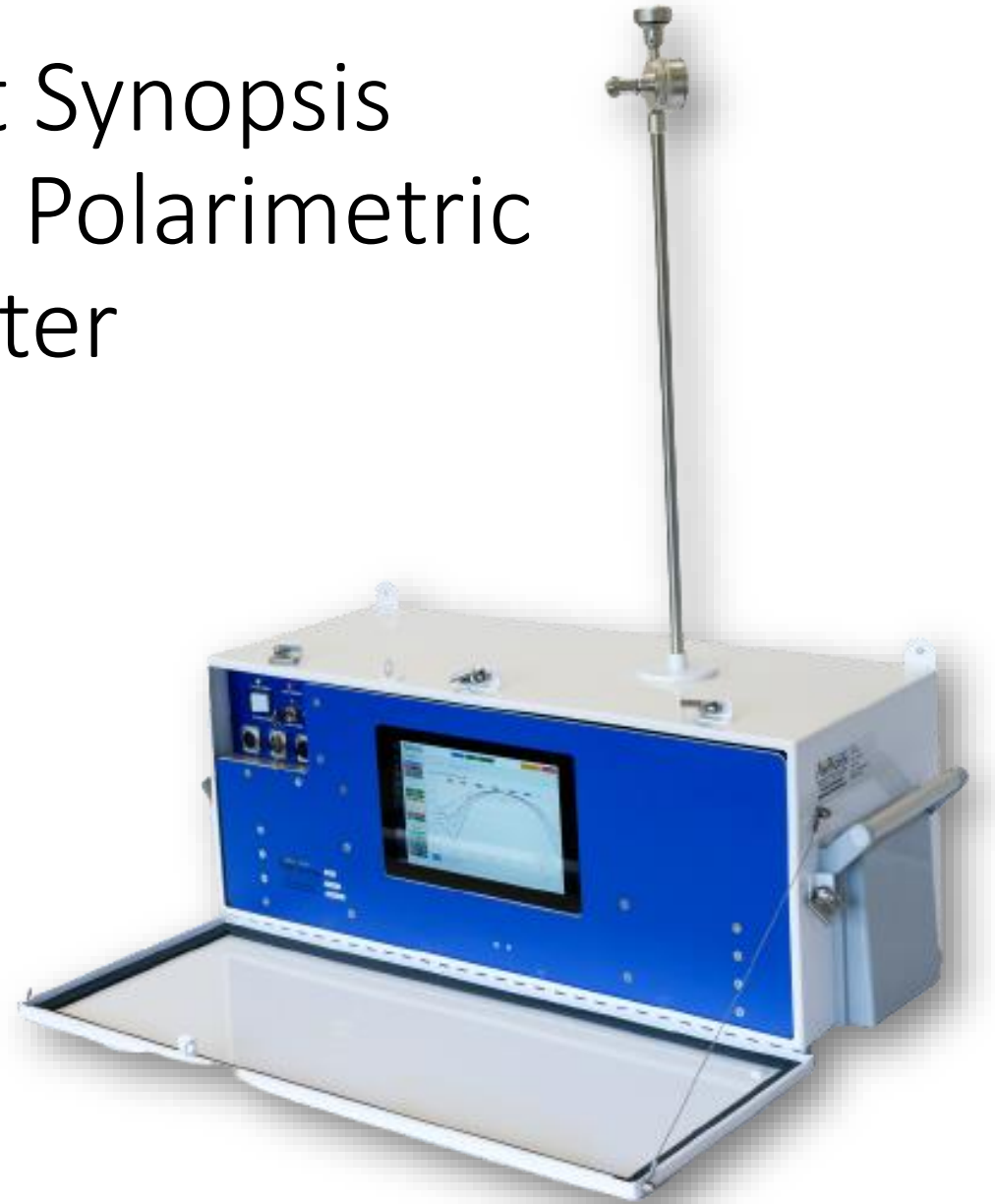
- Multi-wavelength light scattering measurements
- Scanning PM size cut
- Outdoor, global operations
- Remote controllable
- Works with CR100 for periodic clean air references



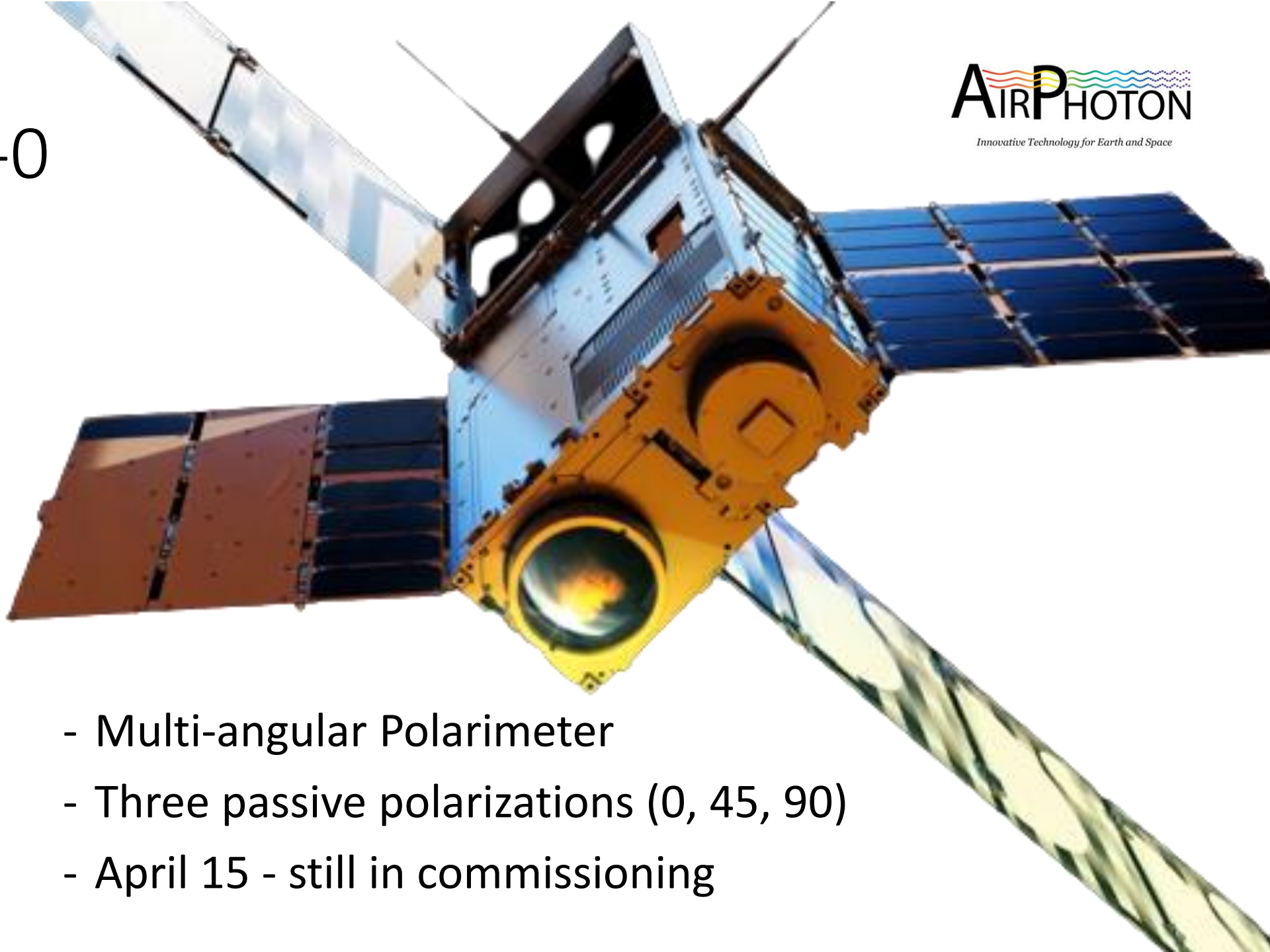
# AirPhoton Product Synopsis

## Inverse Multi-Angular Polarimetric Nephelometer

- Light scattering measurement
- Multi-wavelength with discrete angular measurements and polarization
  - Scattering measurement at 5-degree
  - Up to 16 discrete angles (8 typical)
  - Up to four polarization (2 typical)
- Scanning PM size cut
- Outdoor, global operations
- Built-in clean air reference
- GRASP data processing available onboard



# GAPMAP-0



- Multi-angular Polarimeter
- Three passive polarizations (0, 45, 90)
- April 15 - still in commissioning

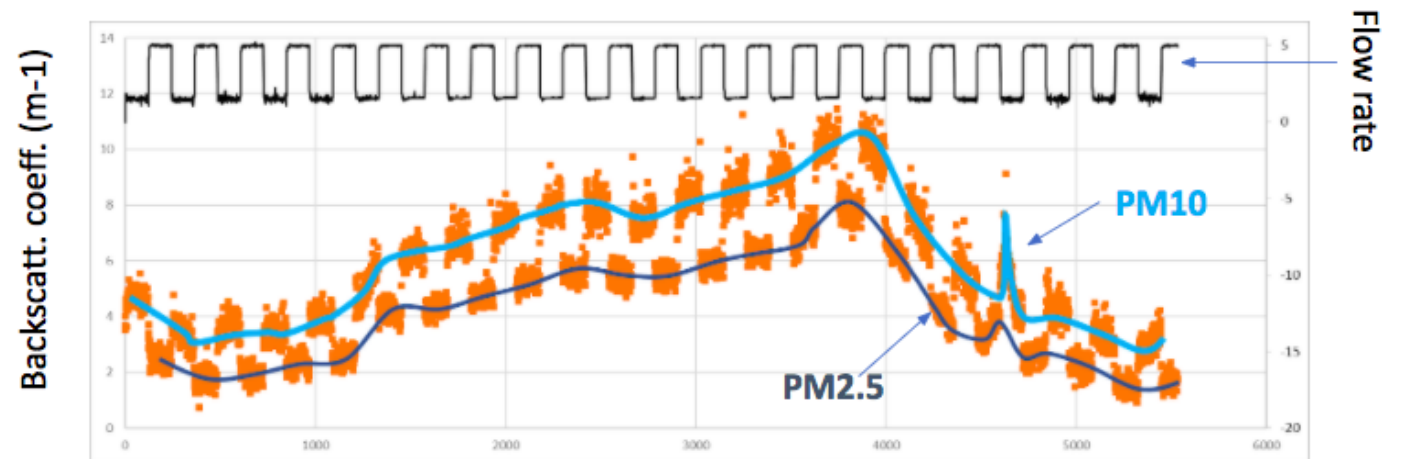
# AirPhoton Product Synopsis

## Satellite Payloads and Accessories

- Satellite payloads
- Specialty setups
- Remote communication modules
- Common accessories

# IN102 Series Nephelometer Size Distribution

- Size scanning operation
  - IN102: PM2.5 to PM10
  - IN102X: PM1 to PM10
- Aerodynamic size selection
- Figure shows optical measurements with two aerodynamic size cuts

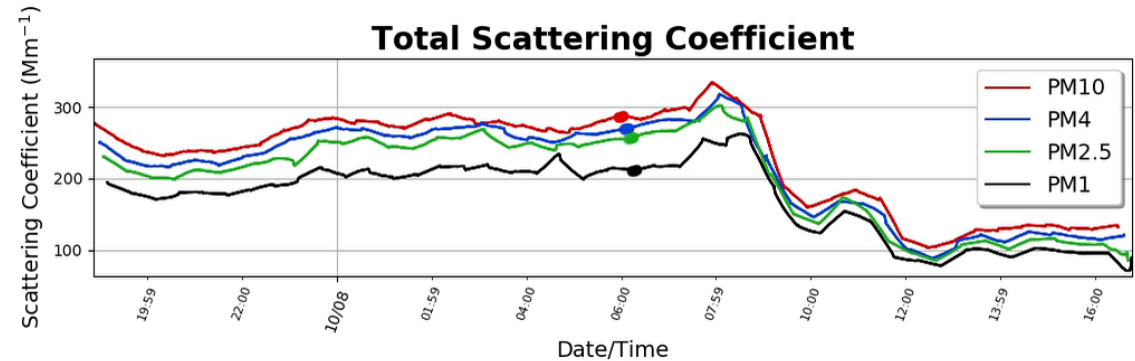


Data from model IN102 showing a clear separation of PM2.5 and PM10

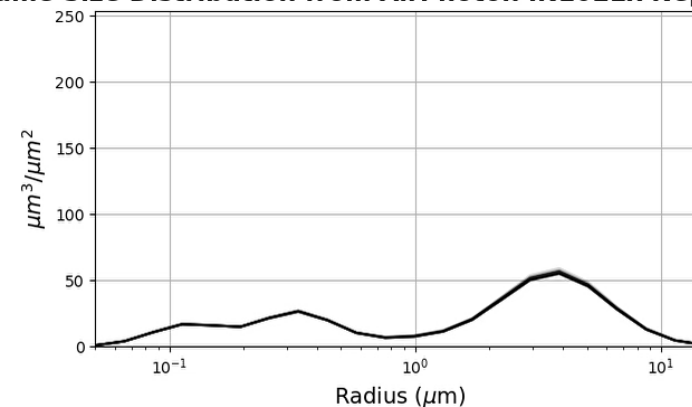


# IN102 Series Nephelometer Size Distribution

- Forward/Backward Scatter
- Three wavelengths
- Four aerodynamic sizes
- Sufficient information for a size distribution inversion



Volume Size Distribution from AirPhoton IN102Ex Nephelometer

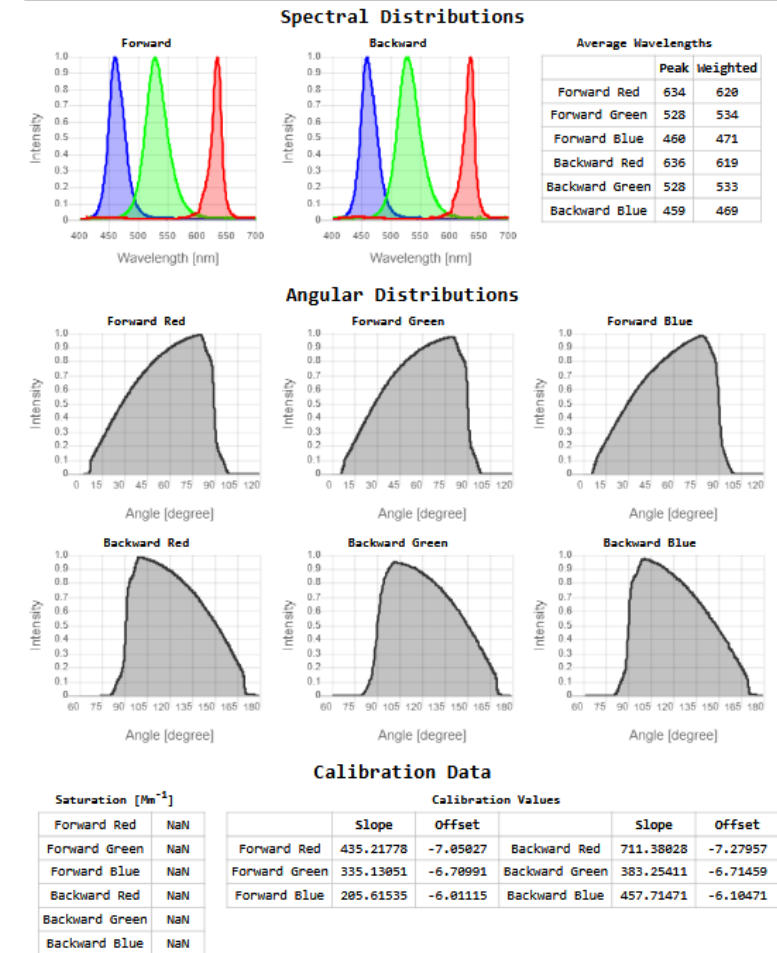


# Nephelometer Quality System

- First, yes, it applies to all instruments
- IN100 series quality certificate example
- Continuous quality improvement
  - Additional quality verifications
  - Quality check for calibrations
  - When requested, results are shared.

## Airphoton LLC Instrument Quality Certification

Date Issued: 2019-Sep-05  
 Serial Number: IN1055  
 Model: IN102  
 Procedure: AP-IN10X-2018A

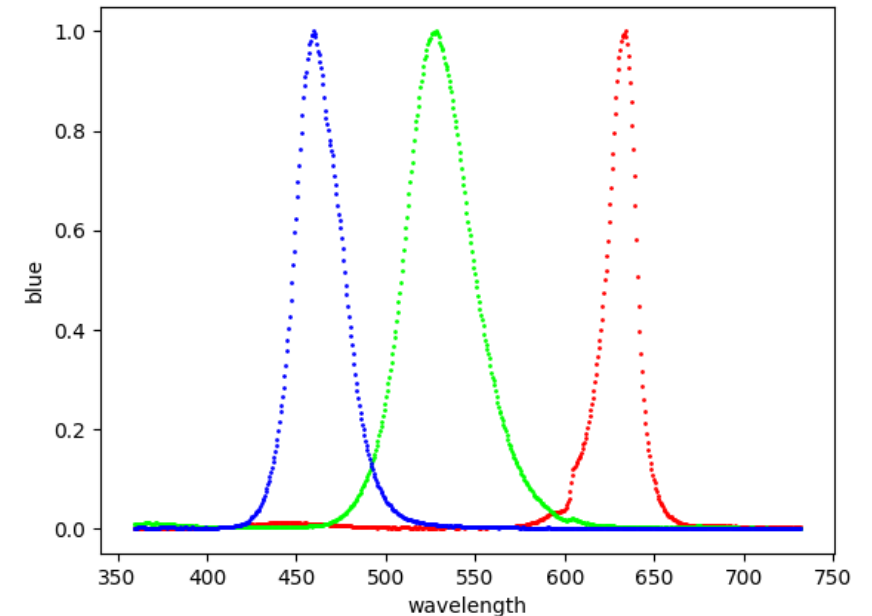


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# Nephelometer Quality System - Improvements

- Implementing wavelength calibration per instrument
- Specified vs calibrated wavelength
- Average observations
  - 464 +/- 4 nm
  - 530 +/- 5 nm
  - 630 +/- 3 nm
- 1% error per nm (measured) input into Rayleigh calibration
- **Effects every LED based nephelometer**



# Nephelometer Quality System - Improvements

- Studying temperature dependent wavelength shifts
- Calibrated vs operating wavelength
- Testing from -10C to 50C
- Shifts ranging from 4 to 8 nm
- Significantly less error suspected.
- **Negligible for aerosol measurement**

# Updates of Interest Sampling Stations

- KSA Station Order
  - Eight sets of Sampling Stations and accessories
  - Largest user of simultaneous flow configuration
  - New external extended temperature pump design
- Ammonia denuder modified sampling station
- Nitric acid denuder experiment
- Off-grid, solar testing

For all questions of a technical nature please  
write to [support@airphoton.com](mailto:support@airphoton.com)

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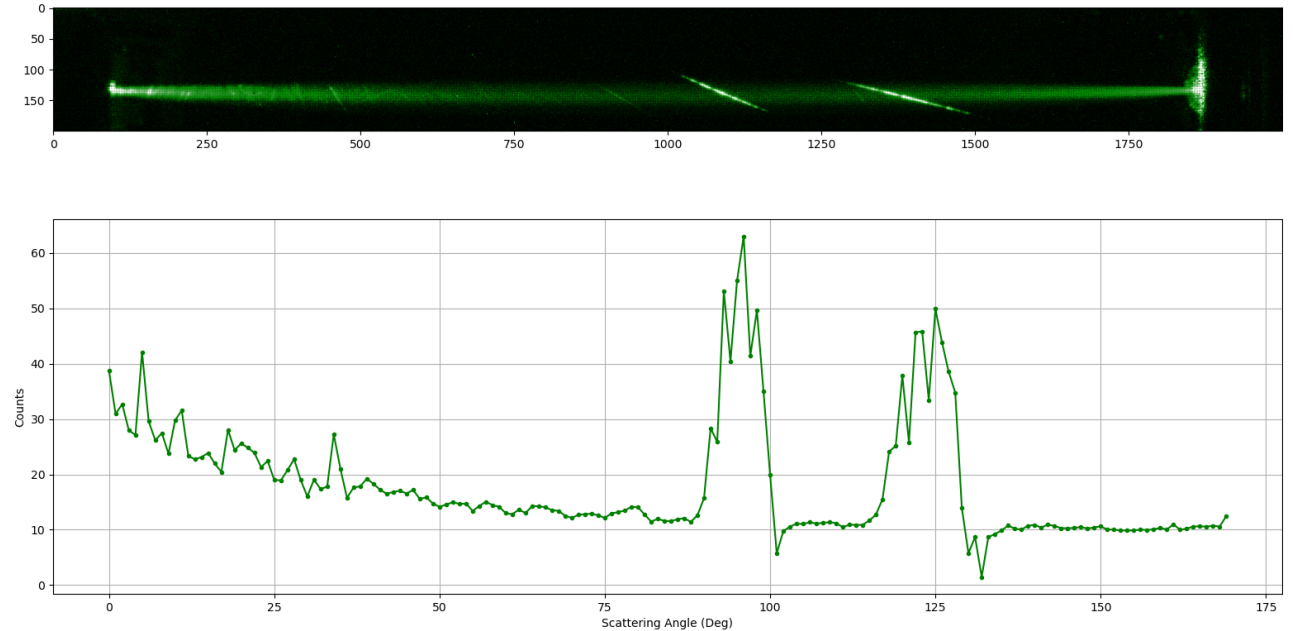


# Updates of Interest Polarized Integrating Nephelometer (PIN100)



- Customizable Wavelengths
- 170 discrete angles
  - 5 to 175 degrees
- Active polarization control between 0, 45, 90

Green Vertically Polarized Scattering Measurement





A satellite is shown in space, oriented vertically. It has a central body with a large yellow camera lens pointing towards the viewer. The lens shows a reflection of the Earth. Four solar panel arrays are extended from the satellite: two on the left and two on the right. The background is a dark space with a greenish glow from the Earth's atmosphere at the bottom.

**GRASP**  
*In principle, yes!*

**AIRPHOTON**  
*Innovative Technology for Earth and Space*

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