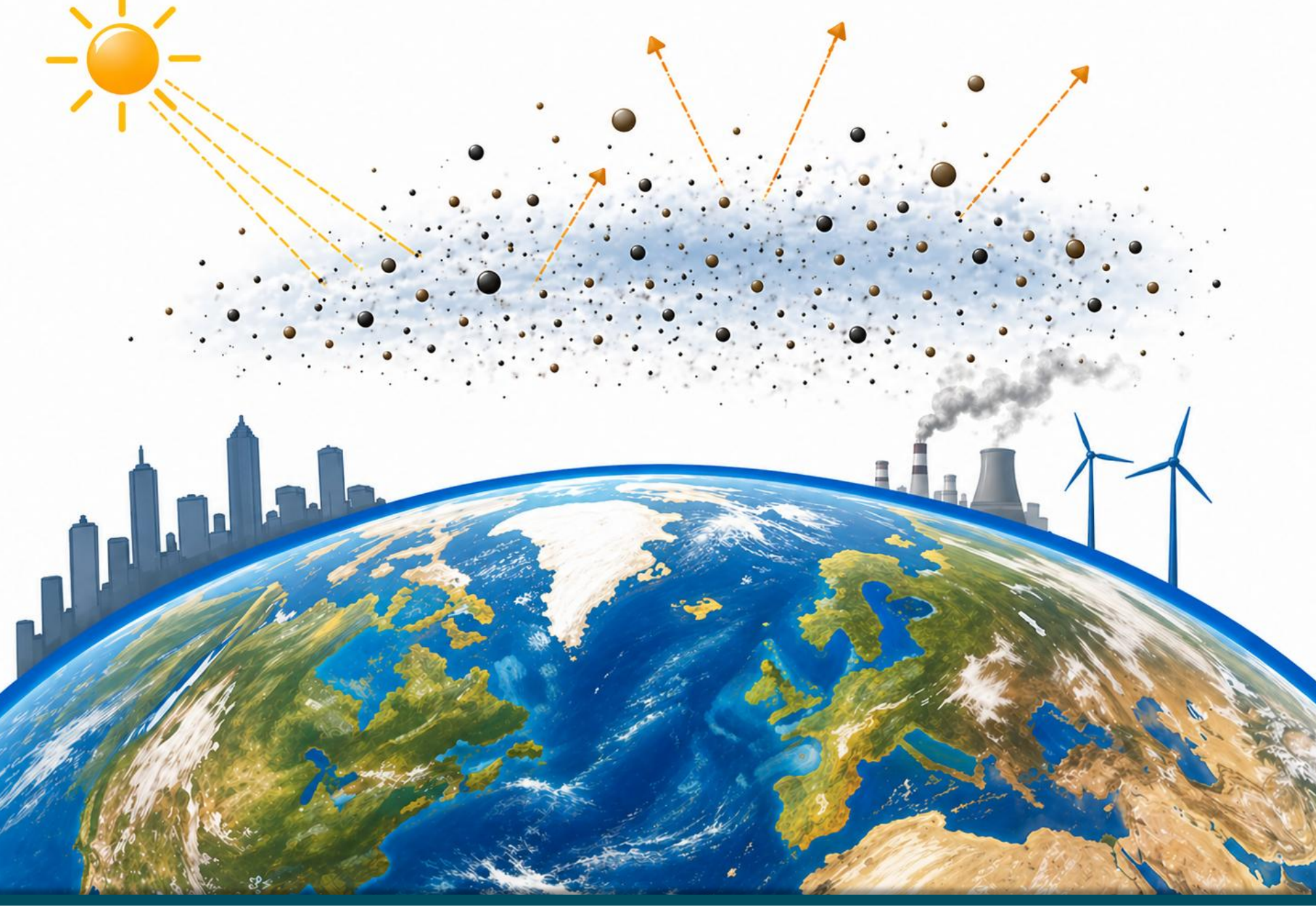


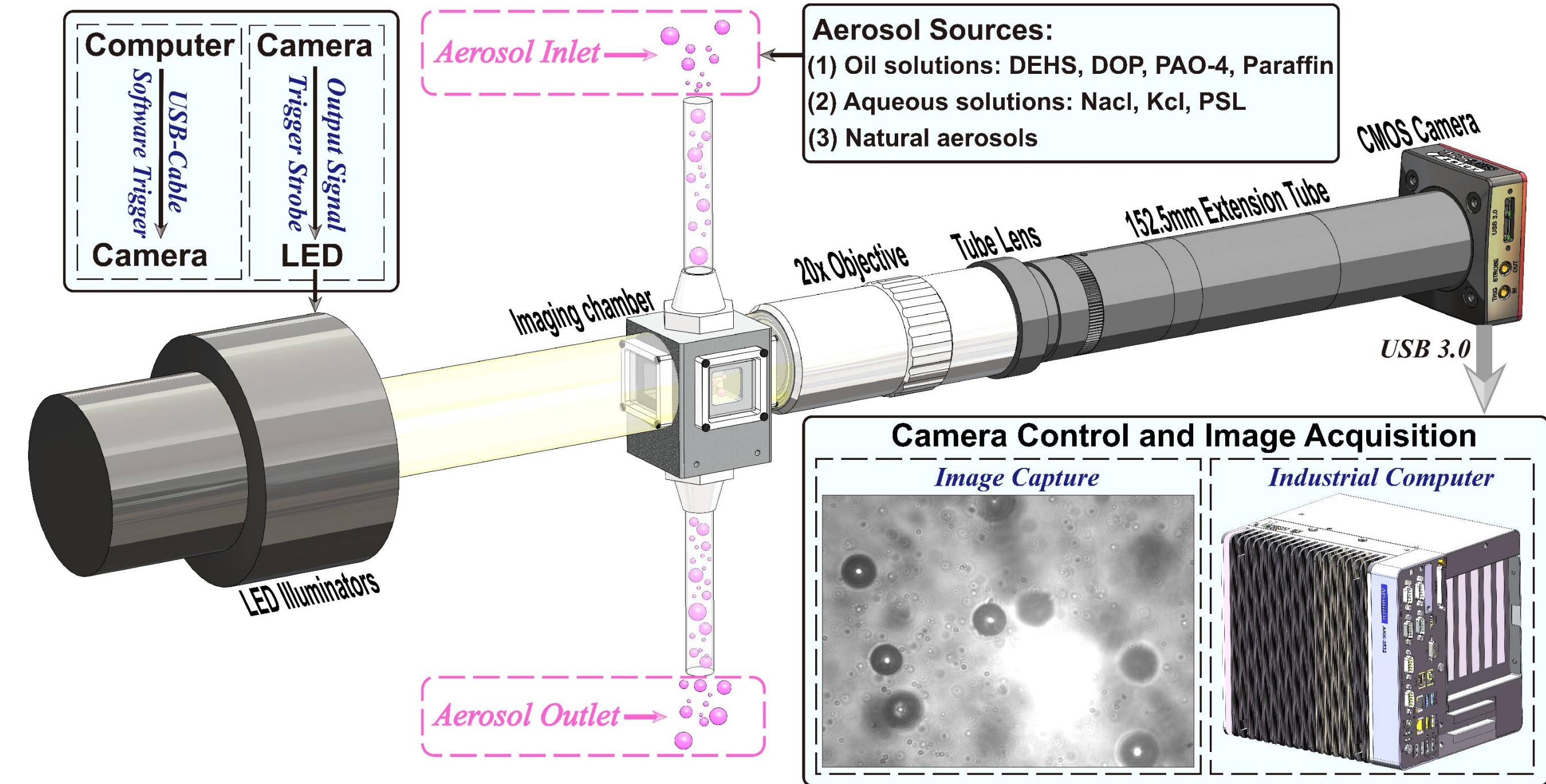
1. Introduction

- Atmospheric aerosols affect the Earth's radiative balance through scattering and absorption of solar radiation. Most particles are non-spherical, which significantly increases the uncertainty in their optical responses.
- Current measurement techniques are limited in characterizing non-spherical aerosols. Most systems rely on simplified spherical models and cannot accurately capture real atmospheric conditions.
- This study develops a synergistic method linking particle shape and optical response, enabling improved analysis of non-spherical aerosol radiative effects.




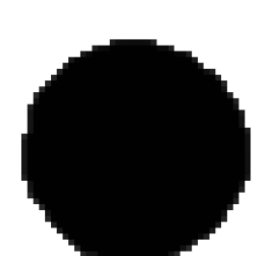

2. Experimental Setup & Methodology

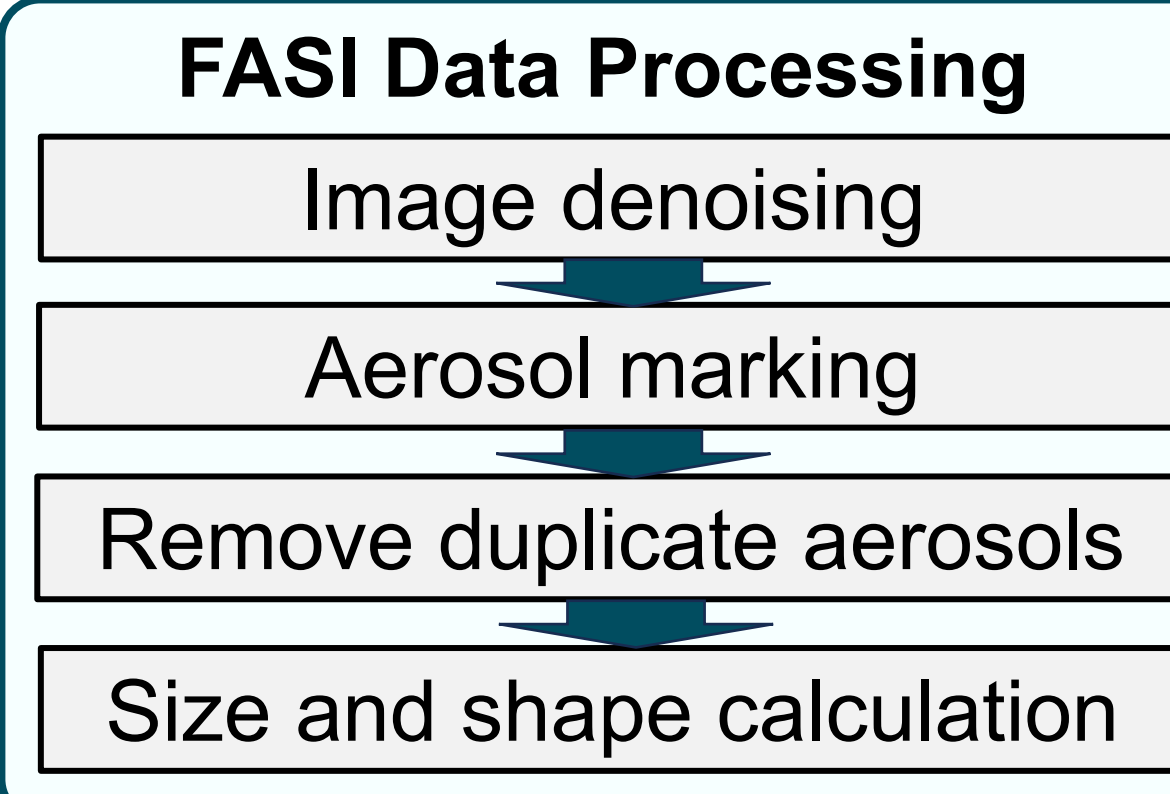
Instrument 1: Fast Atmospheric Aerosol Size and Shape Imaging Instrument (FASI)



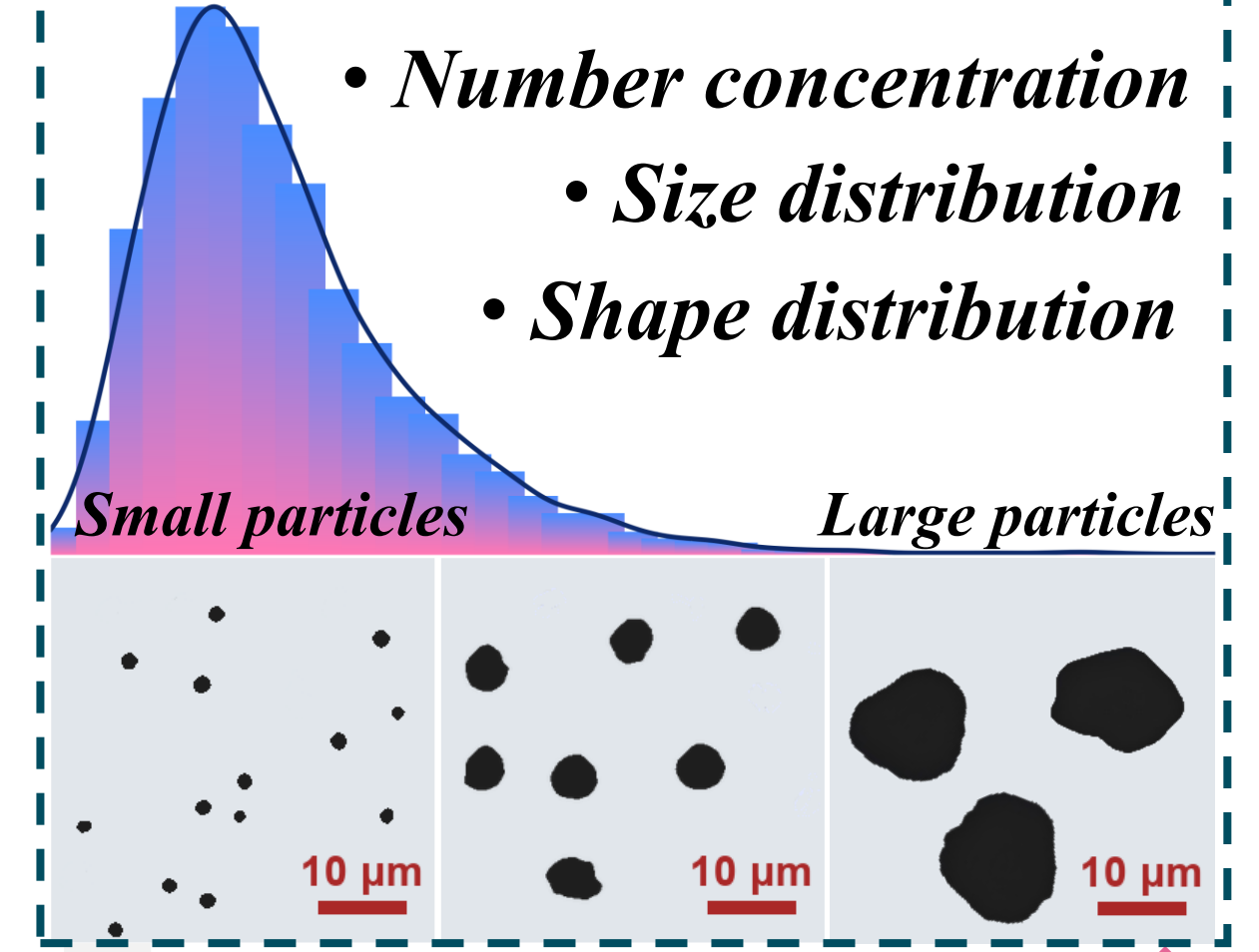
- Principle: Transmission optical imaging + dynamic image analysis.
- Size range: 0.5-20 μm (now extended to 0.2-186 μm).
- Shape metrics: circularity, roundness, sphericity, convexity.
- Processing efficiency: 20-35 FPS.

Shape Measurement Example

	Roundness = 0.62 Sphericity = 0.83 Convexity = 0.95 Circularity = 0.78		Roundness = 0.91 Sphericity = 0.95 Convexity = 0.98 Circularity = 0.91		Roundness = 0.52 Sphericity = 0.76 Convexity = 0.83 Circularity = 0.58
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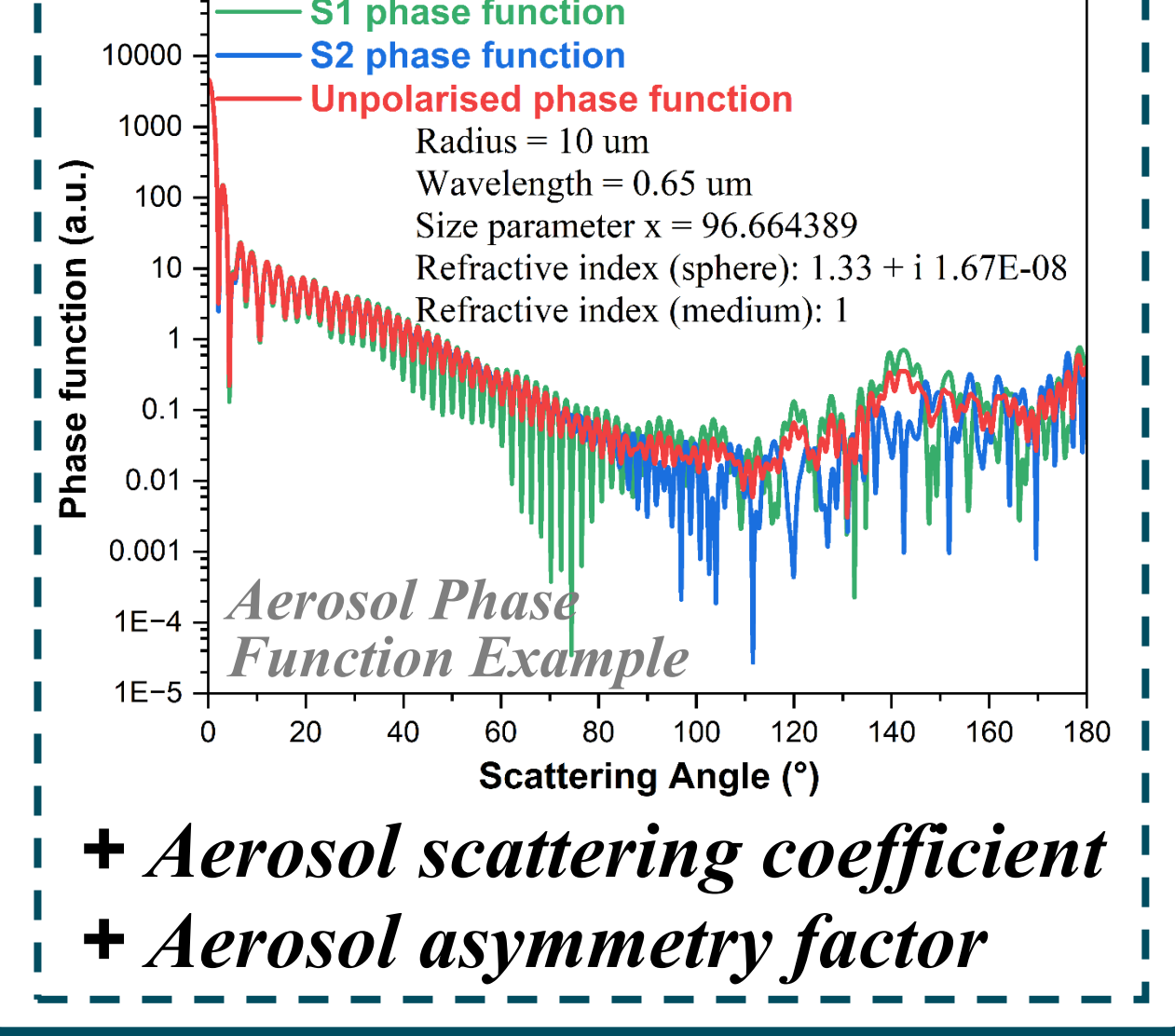
Physical Properties



Synergistic Geometry-Optics Characterization of Non-spherical Aerosols

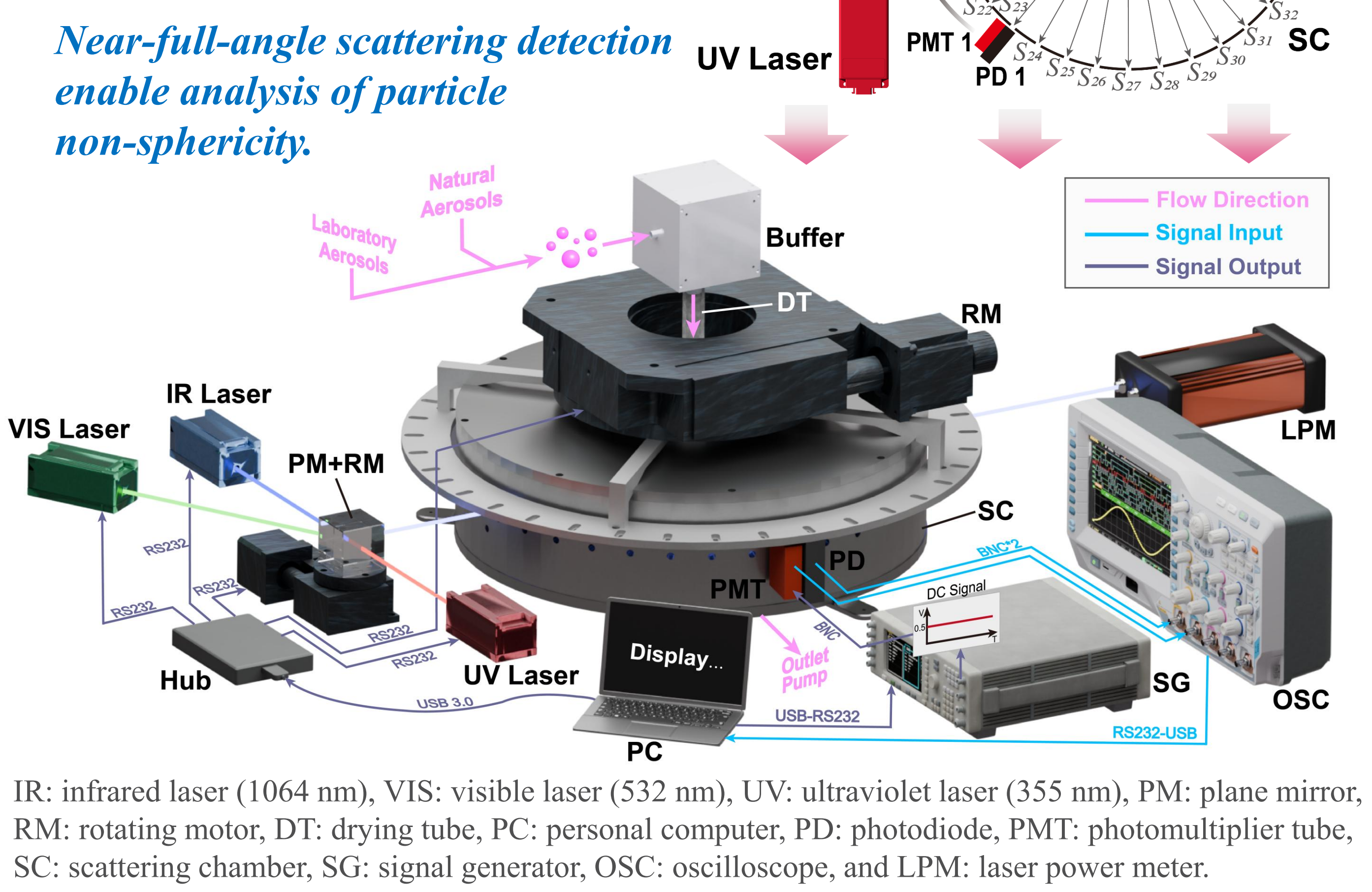
- Size-dependent scattering
- Shape-dependent scattering

Optical Properties

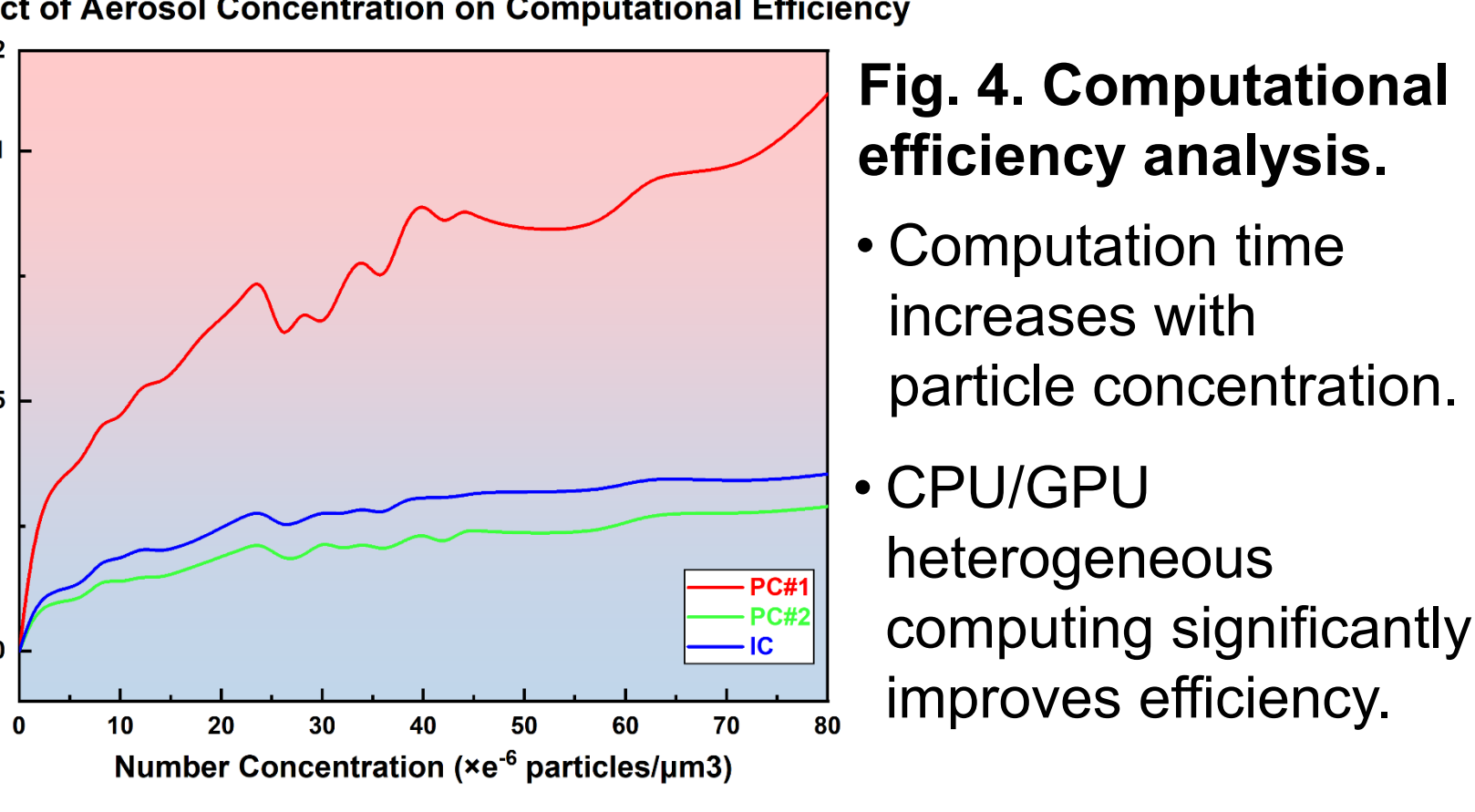
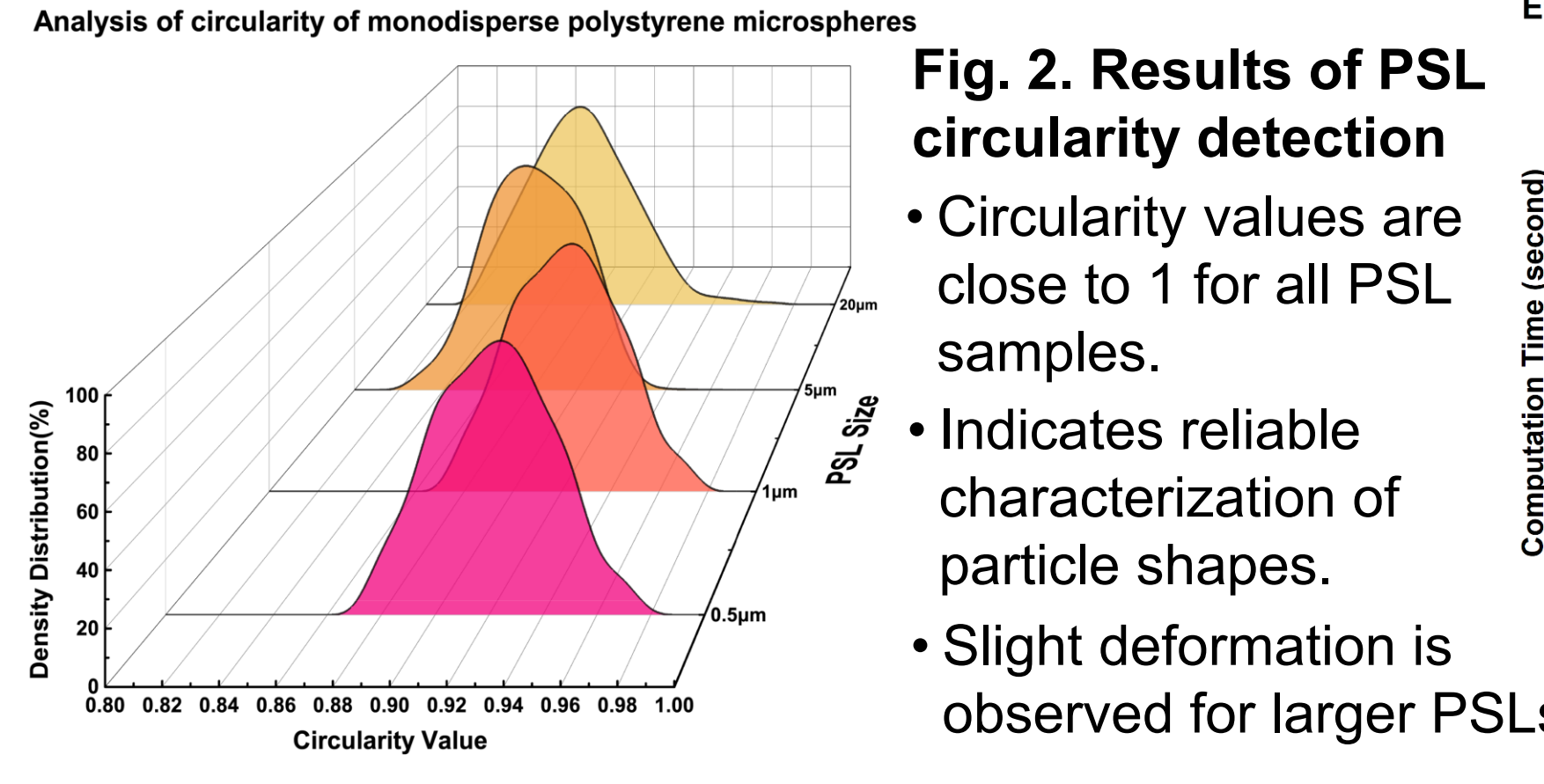
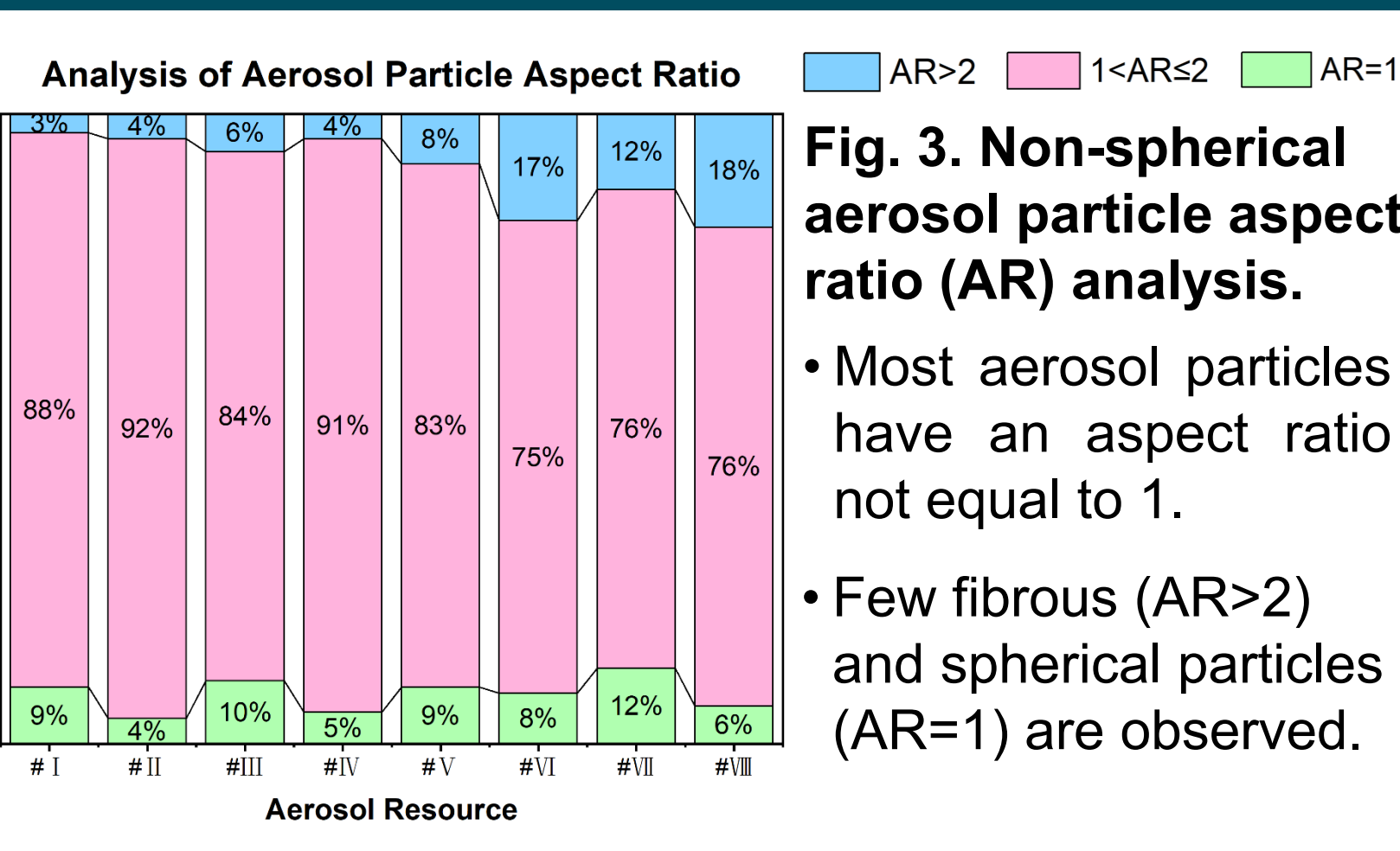
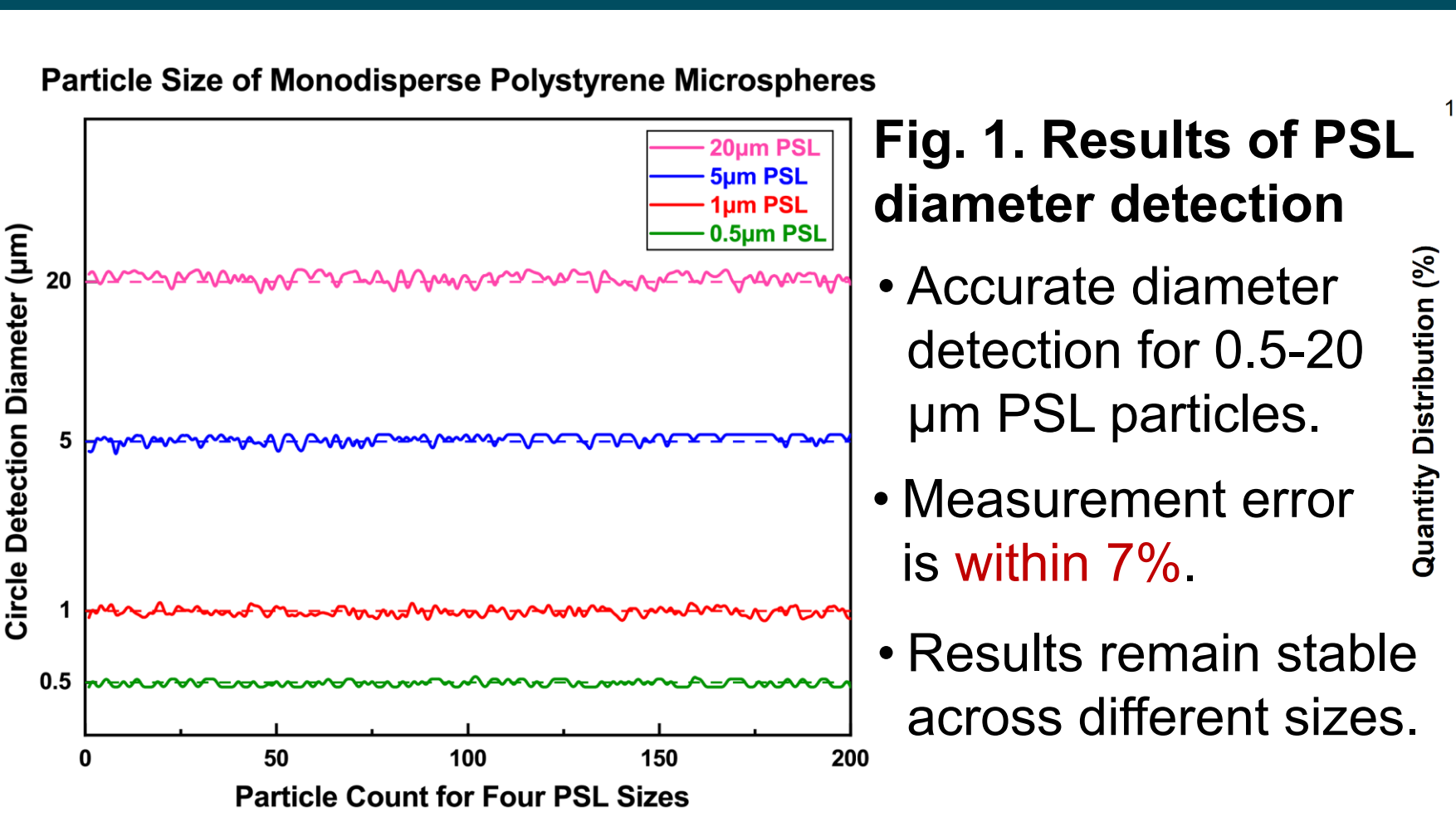


Instrument 2: Multi-Wavelength Near-Full-Angle Aerosol Scattering Phase Function Laser Measurement System

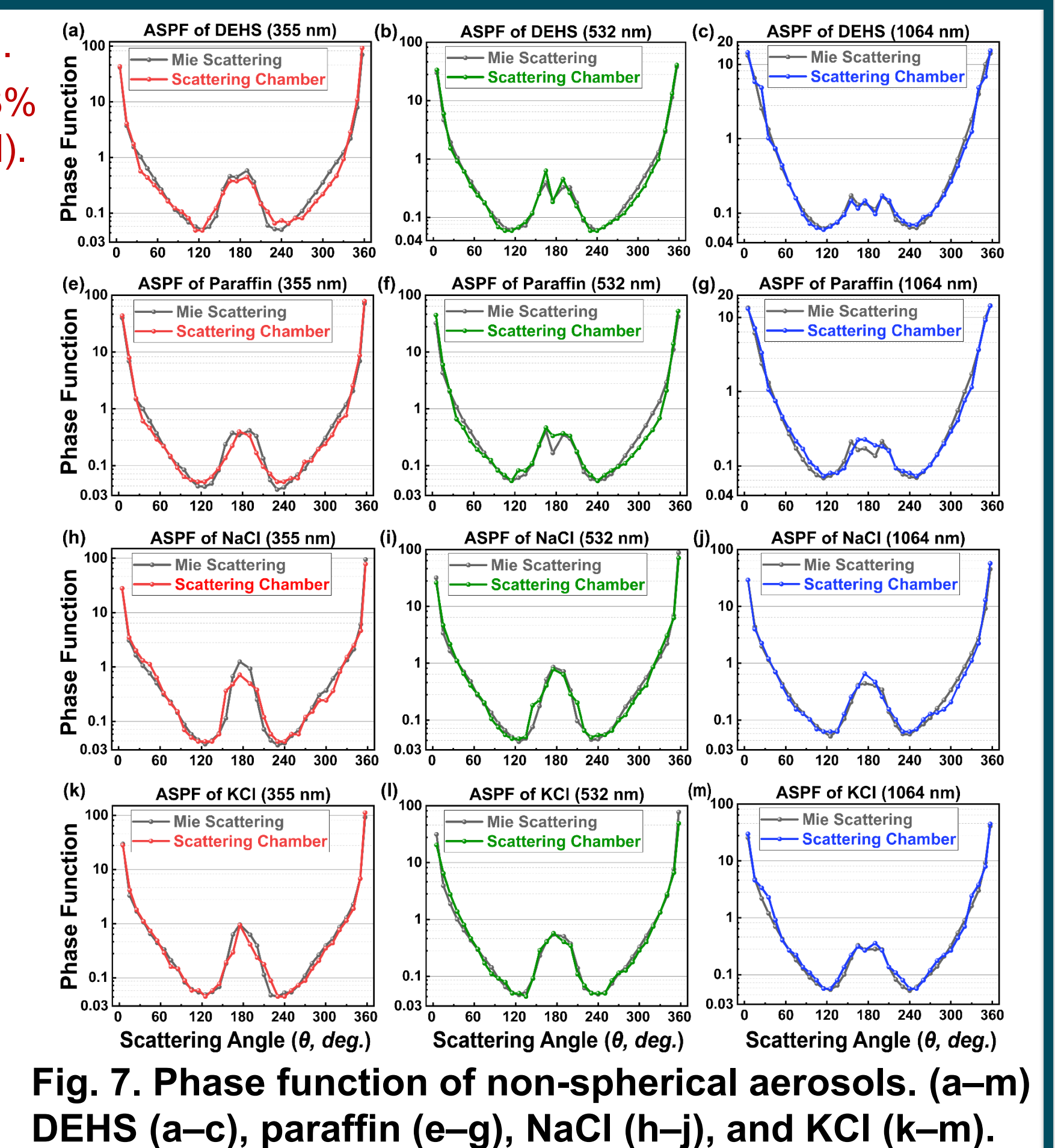
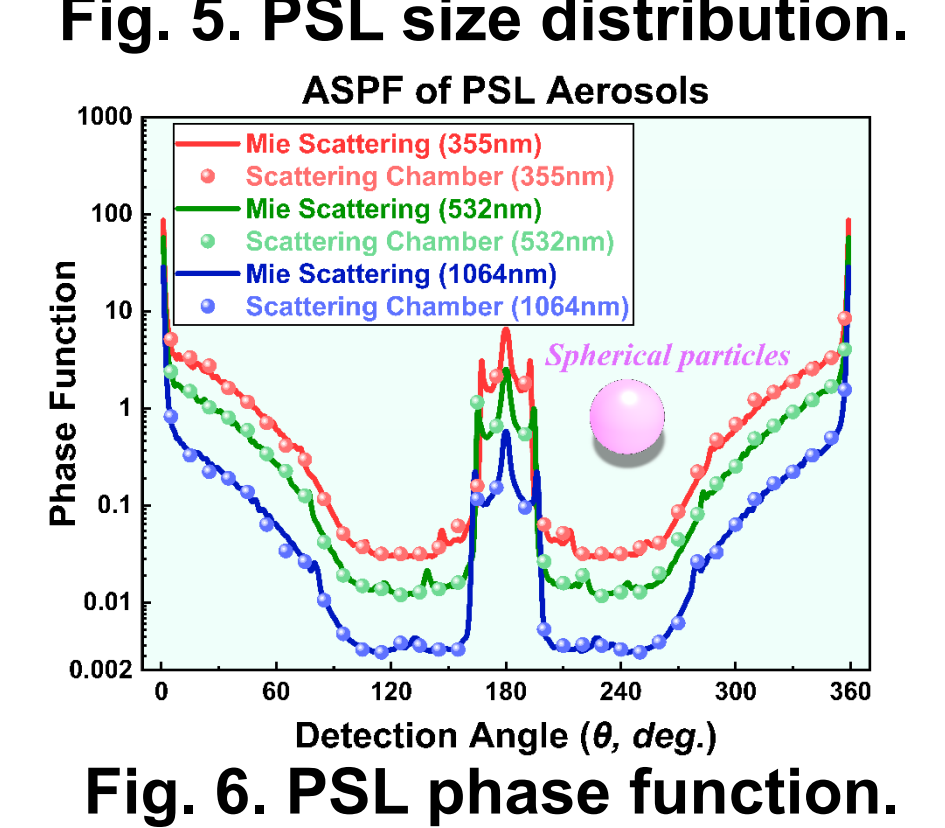
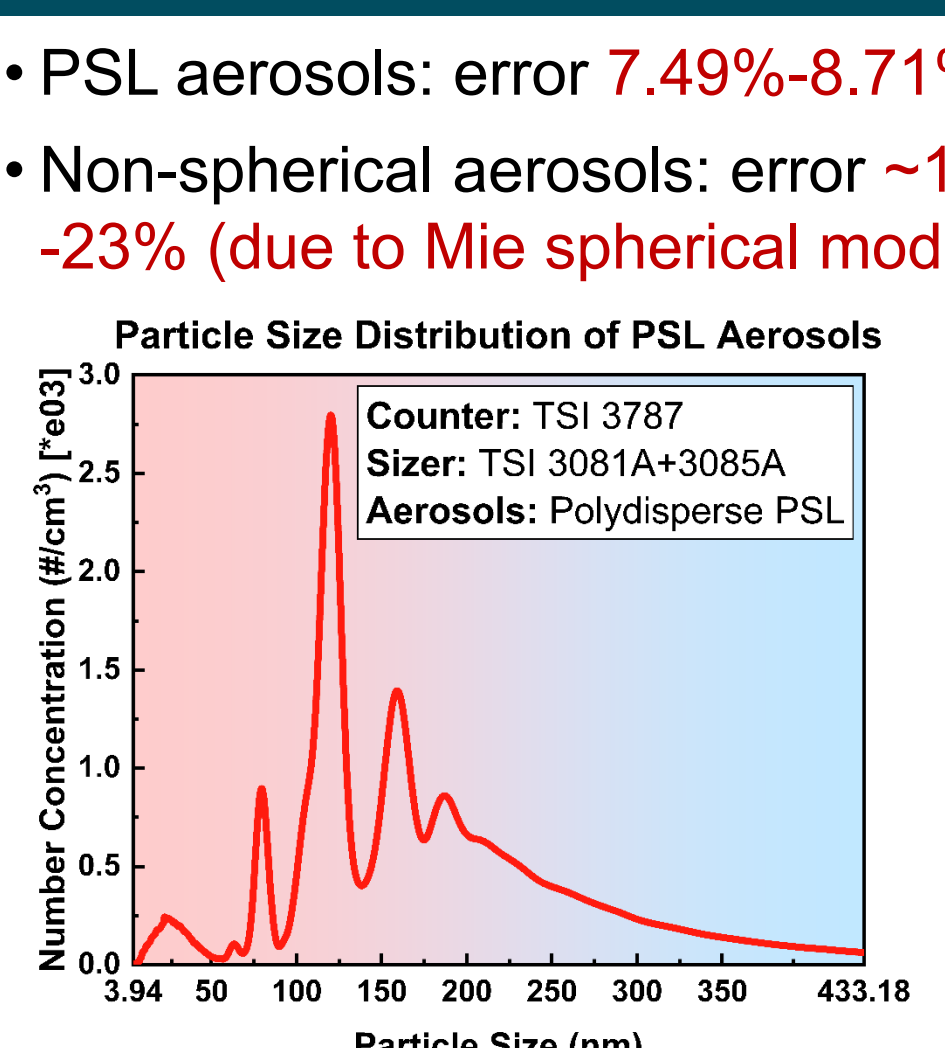
- Principle: Direct measurement of aerosol scattering phase function via multi-angle rotating detectors.
- Angle range: 5°-357°.
- Wavelength: 355nm, 532nm, 1064nm (covering UV to IR).
- Sensor: PD + PMT.
- Measurement time: 20-50 s.



3.1 Aerosol Geometric Characterization

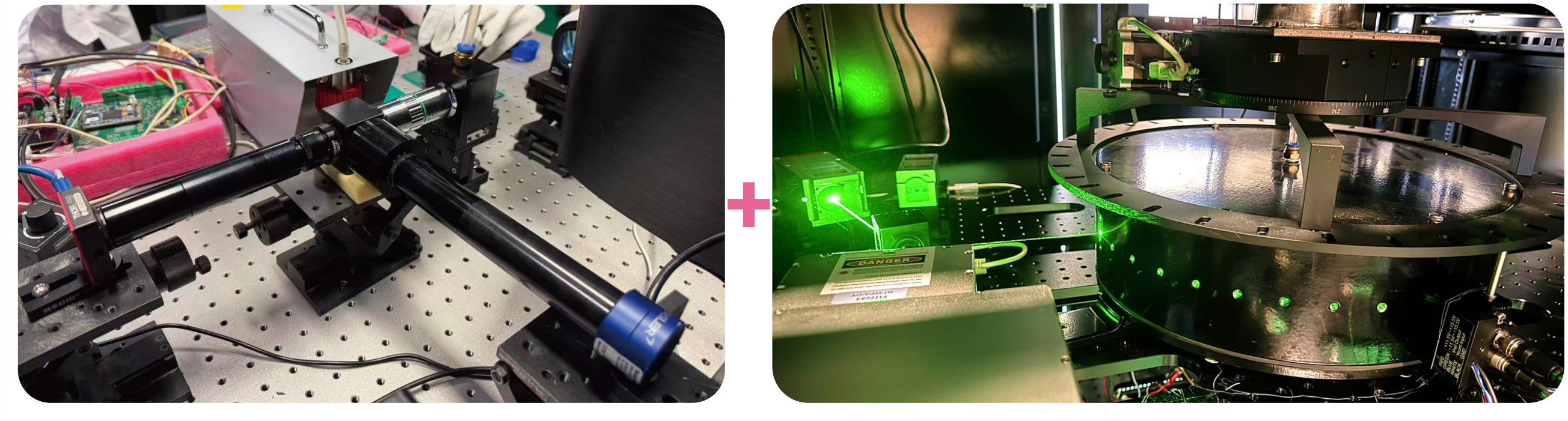


3.2 Aerosol Optical Characterization



4. Conclusion

- Accurate measurement of aerosol size, shape, and number concentration is achieved via dynamic image analysis.
- Optical scattering measurements show high consistency with theoretical predictions across multiple wavelengths.
- Synergistic geometric-optical characterization enables direct analysis of non-spherical aerosol optical response.



References

- Dong et al., IEEE Transactions on Instrumentation and Measurement, 2025.
- Dong et al., Chinese Optics Letters, 2025.

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