FAIRE LA LUMIÈRE
SHEDDING LIGHT

ISIPS AN INNOVATIVE DUST CHARACTERIZATION AND MONITORING TOOL:

PRELIMINARY PROOF OF CONCEPT AND LOOKING FOR LUNAR APPLICATIONS

Daniel Cantin, Ovidiu Pancrati, Denis Panneton, Jean-François Cormier, Sébastien Roy, Simon Turbide, Jason Olfert and Nafiseh Sang-Nourpour

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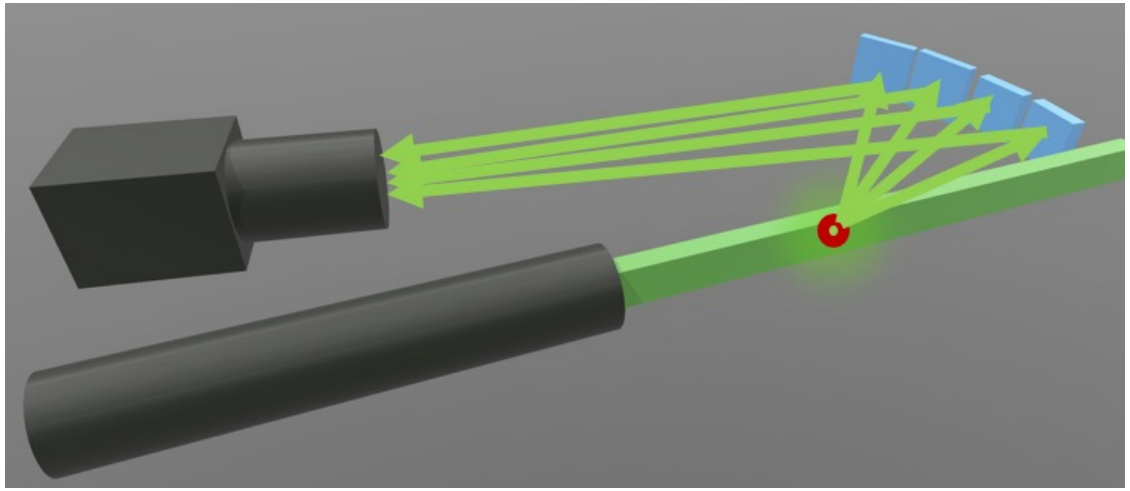
Outline

- Context
- Concept of Operation
- Description of the iSIPS breadboard prototype
- Preliminary results
- Important takeaways
- The future: Some potential Lunar applications



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Context

Preparation

Monitoring

Correction

- There is a need to characterize and quantify Lunar dust and aerosols to understand them
- This will allow to prepare ourself and our equipements properly for Lunar Surface Operations
- Monitoring these, ideally in real-time, will also be required to understand and track potential issues
- This would allow to put in place proper Corrections, such as filtration systems, to address corresponding issues.

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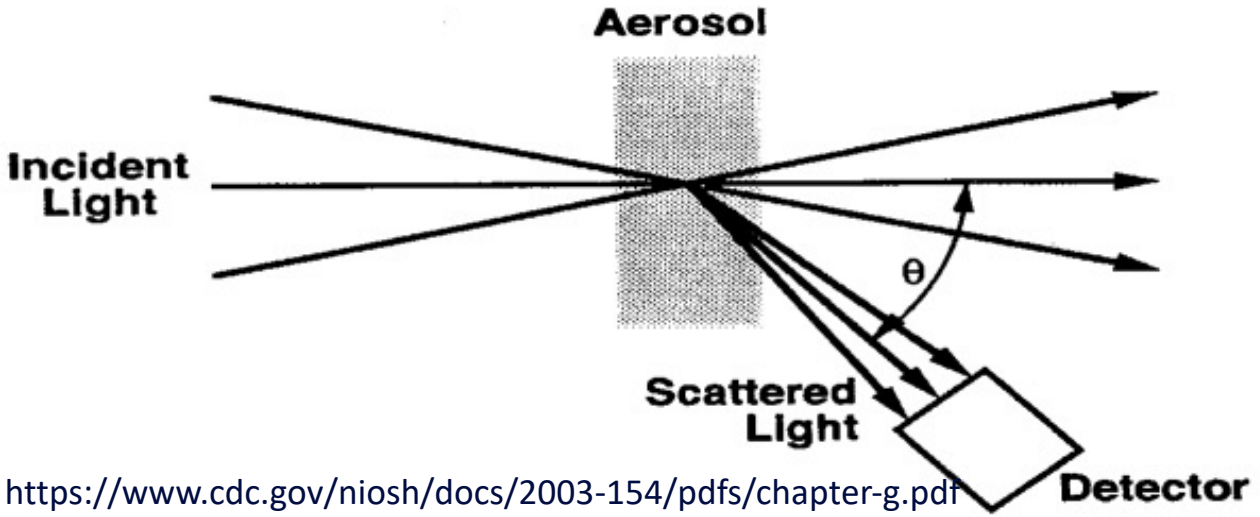
Context

Preparation | Monitoring | Correction

- Current optical-based commercialized solutions to characterize aerosols/dust

Global scattering from an aerosol to infer particle size distribution and concentration



https://www.cdc.gov/niosh/docs/2003-154/pdfs/chapter-g.pdf

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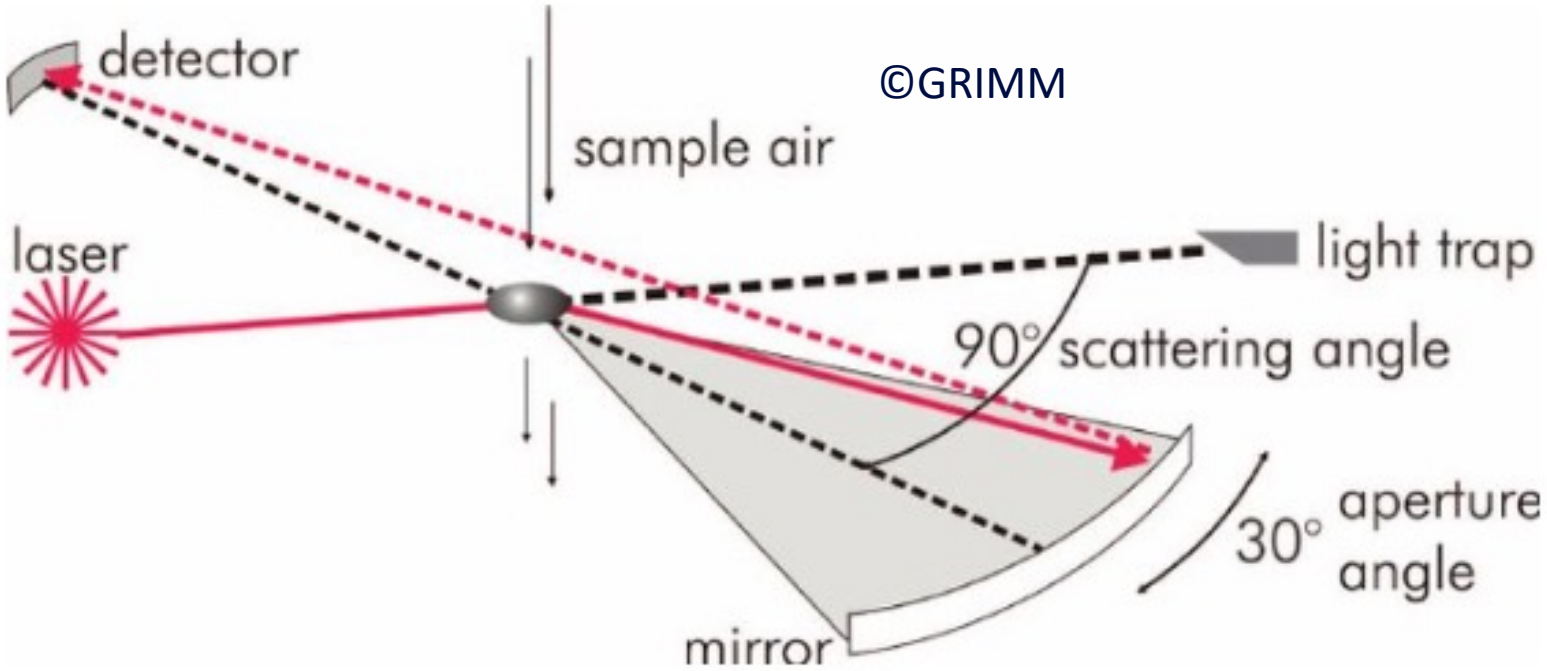
Context

Preparation | Monitoring | Correction

- Current optical-based commercialized solutions to characterize aerosols/dust

Single-particle-induced scattering through particle flow on a collimated light beam + compilation over time*.



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*https://www.researchgate.net/publication/24009442_Aerosol_Measurement_The_Use_of_Optical_Light_Scattering_for_the_Determination_of_Particulate_Size_Distribution_and_Particulate_Mass_Including_the_Semi-Volatile_Fraction/figures?lo=1

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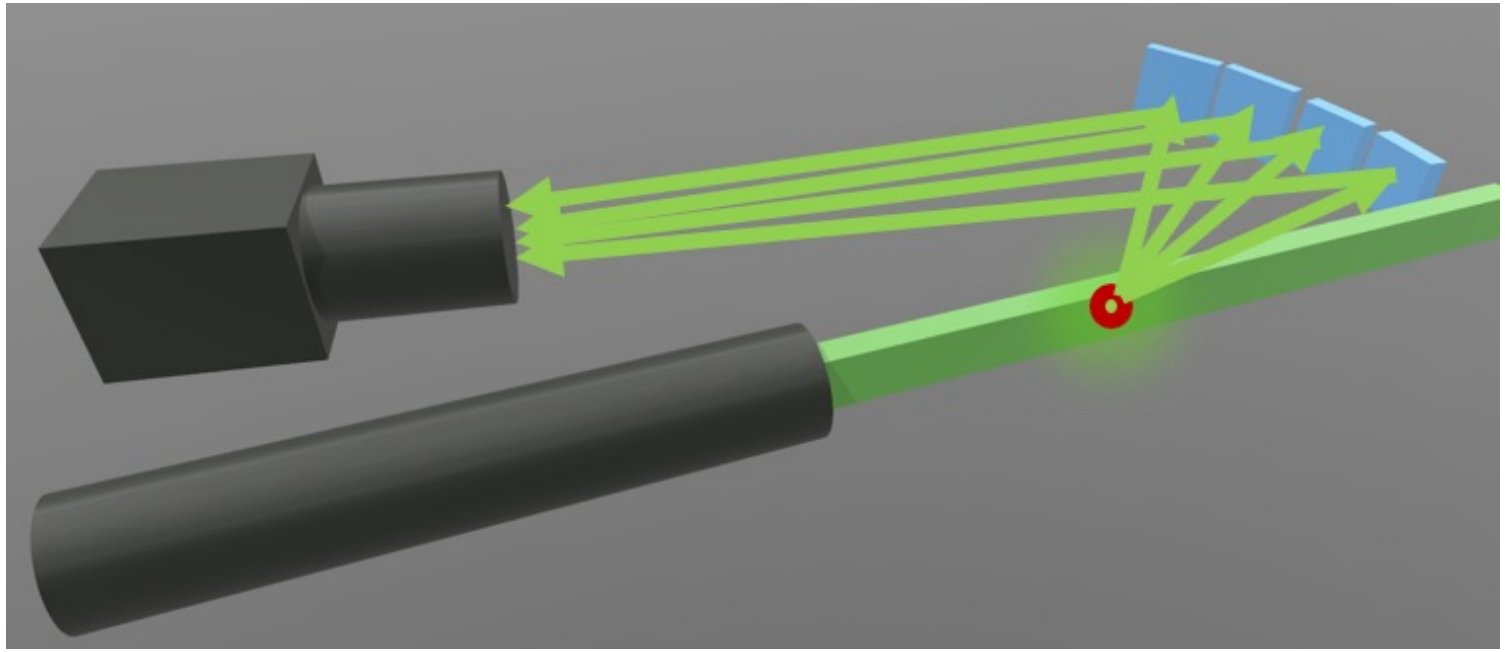
Context

Preparation | Monitoring | Correction

iSIPS is a patented approach :

- **individual characterization of multiple particles in a volume,**
- **cost-effective,**
- **mechanical-free system with high representativity of data.**



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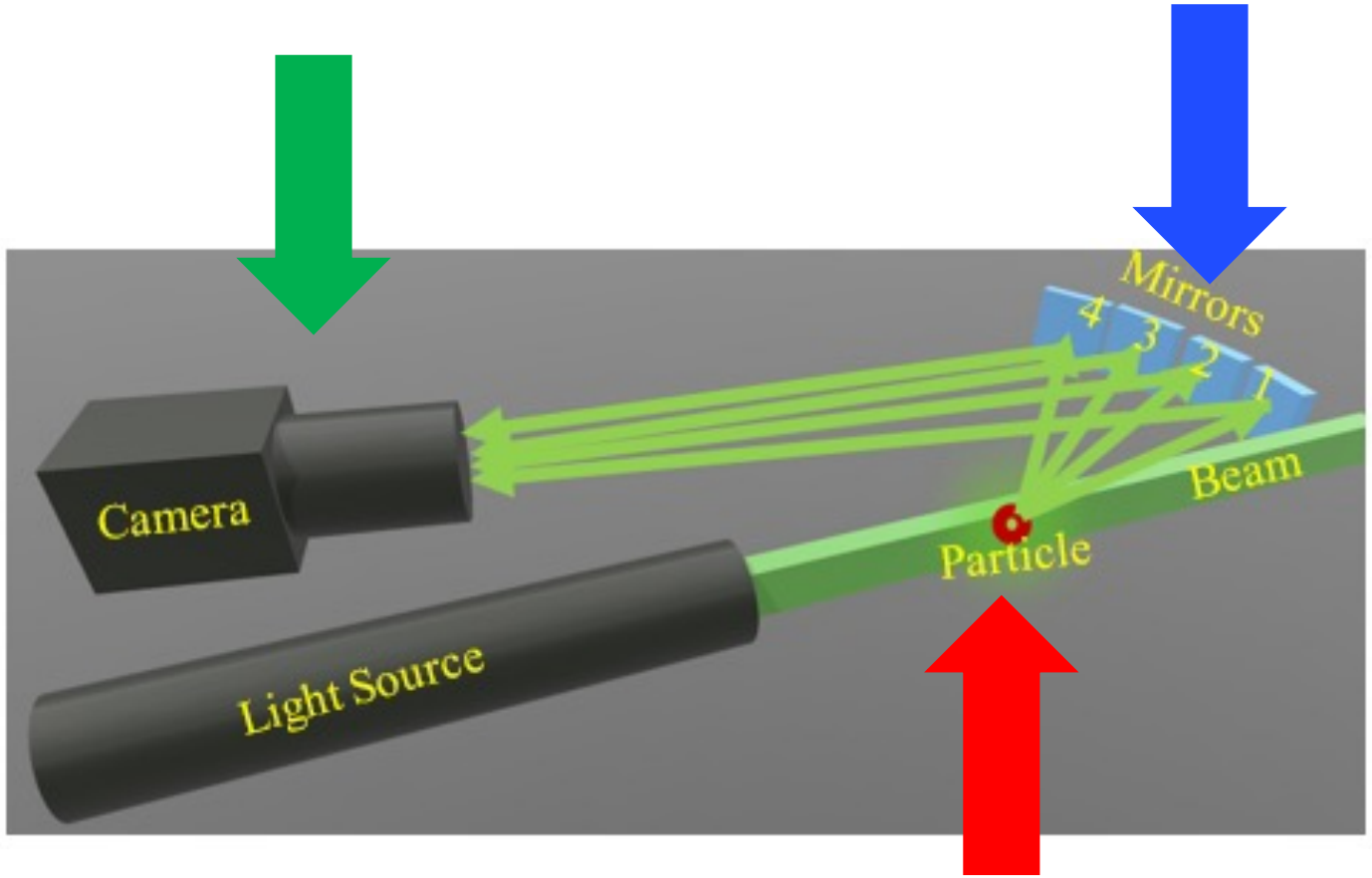
Concept of operation (1/3)



Particles are illuminated by the light source.

Scattered light from particles is collected by mirrors from different scattering angles.

Mirrors reflect the scattered light to a camera that forms an image of **each individual** illuminated particles.

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Concept of operation (2/3)

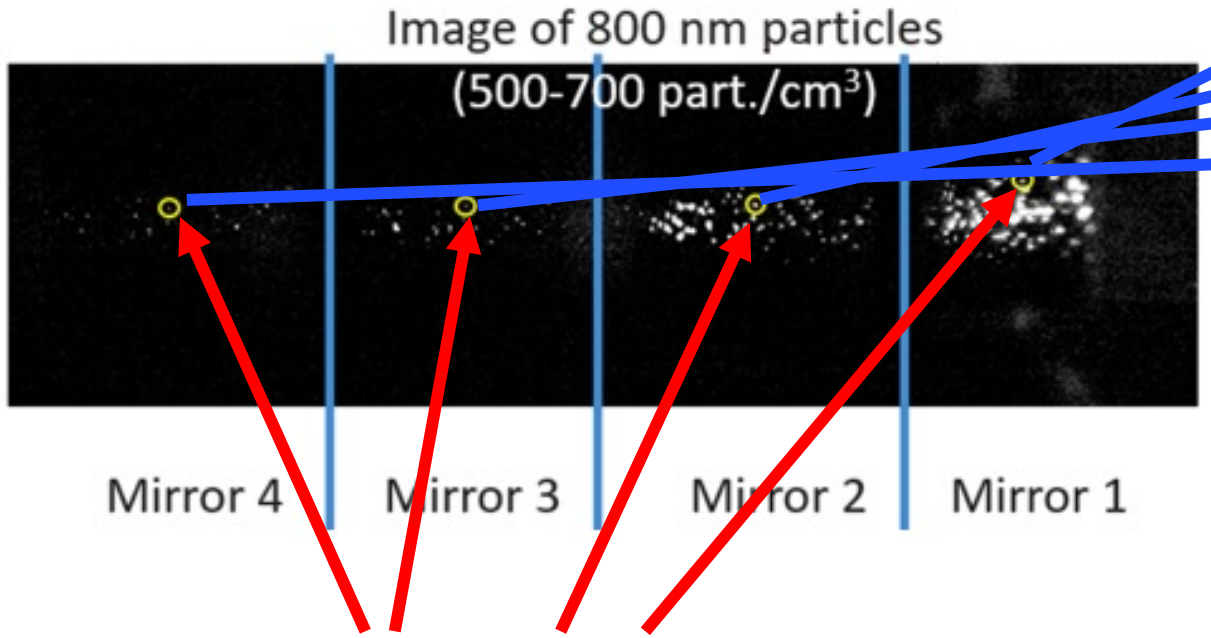
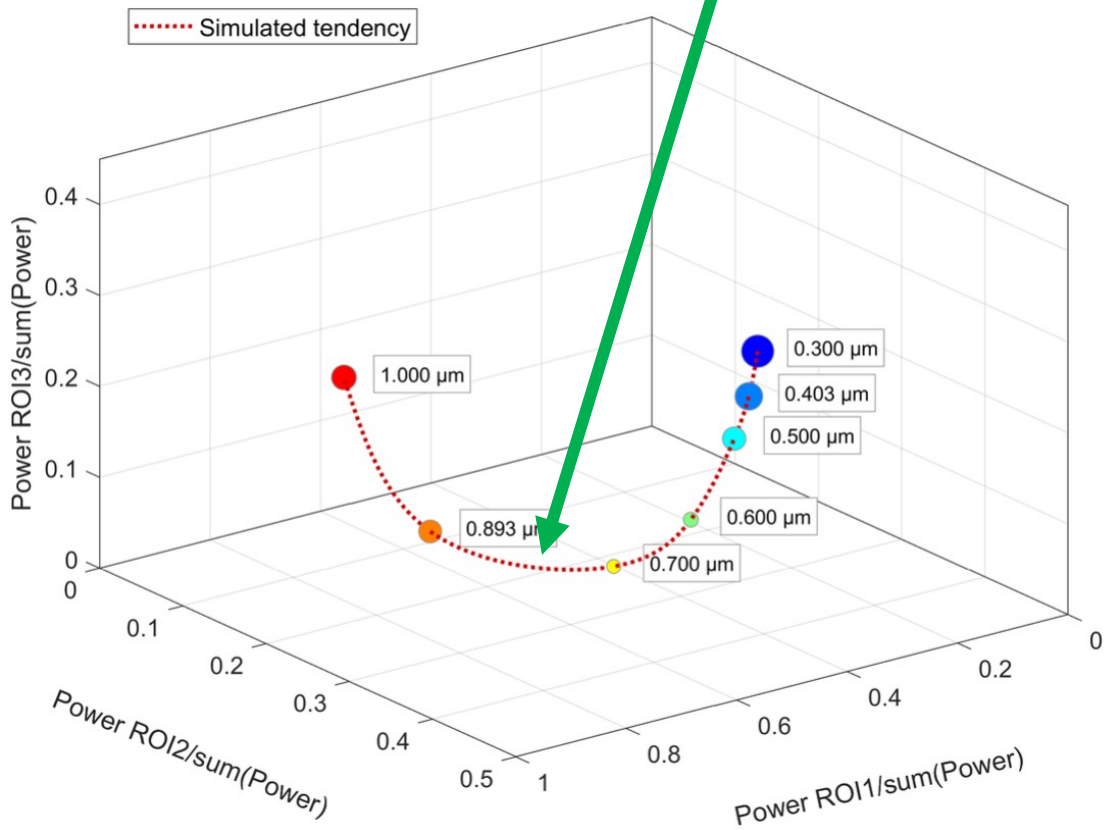


Image #	Scattering Angle (Degrees)	Measured Intensity (Counts)
1	5	370
2	12	250
3	20	140
4	30	45



Positionning of each individual particulate in 3D through our cluster-matching algorithms can lead to fine estimation of the measured scattering angles

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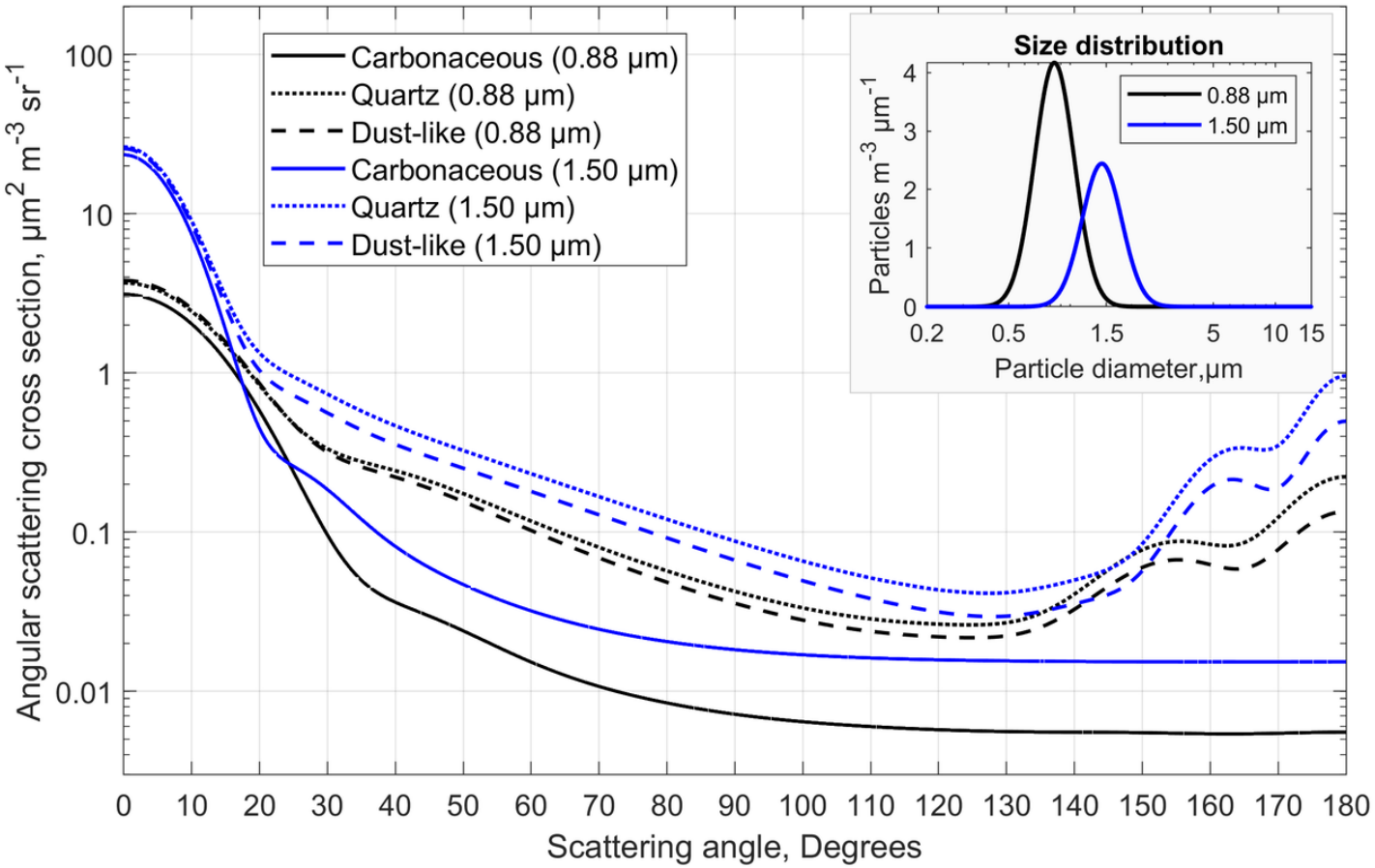
Concept of operation (3/3)

- **Robustness** to particle composition at small scattering angles
- **Discrimination capacity** to particle composition at larger scattering angles



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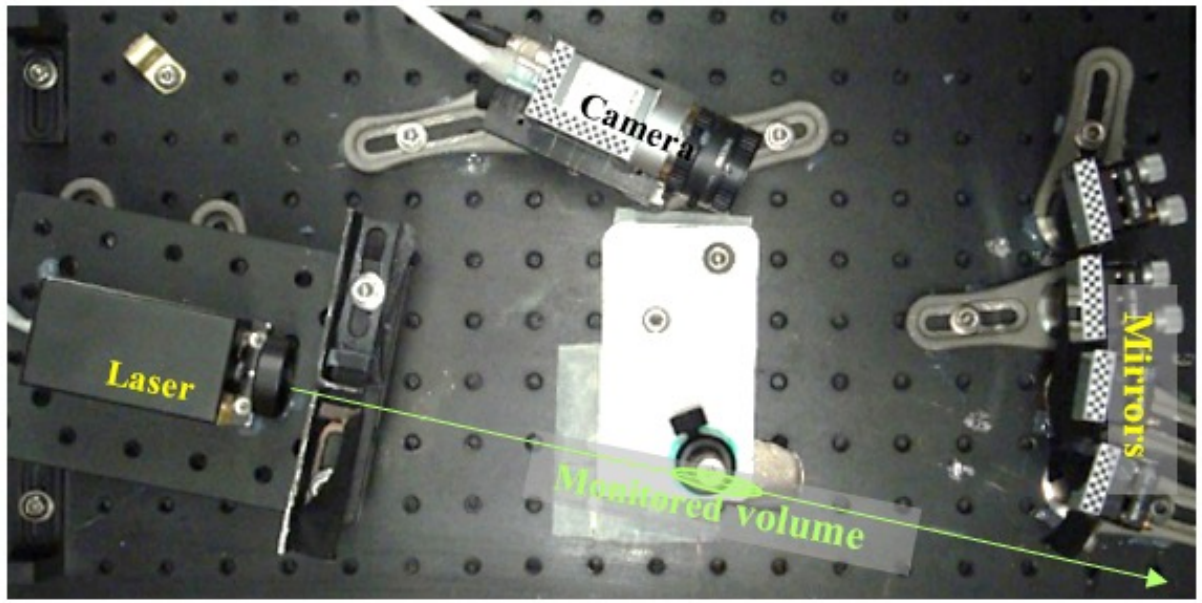
iSIPS breadboard prototype



Laser Pavillon Integration Corp. 532 nm, 50 mW

Camera Basler, 2.3MP, 42FPS (up to 100FPS), 10/12 Bit Depth

Mockup: RaspberryPi + RaspberryPi Camera

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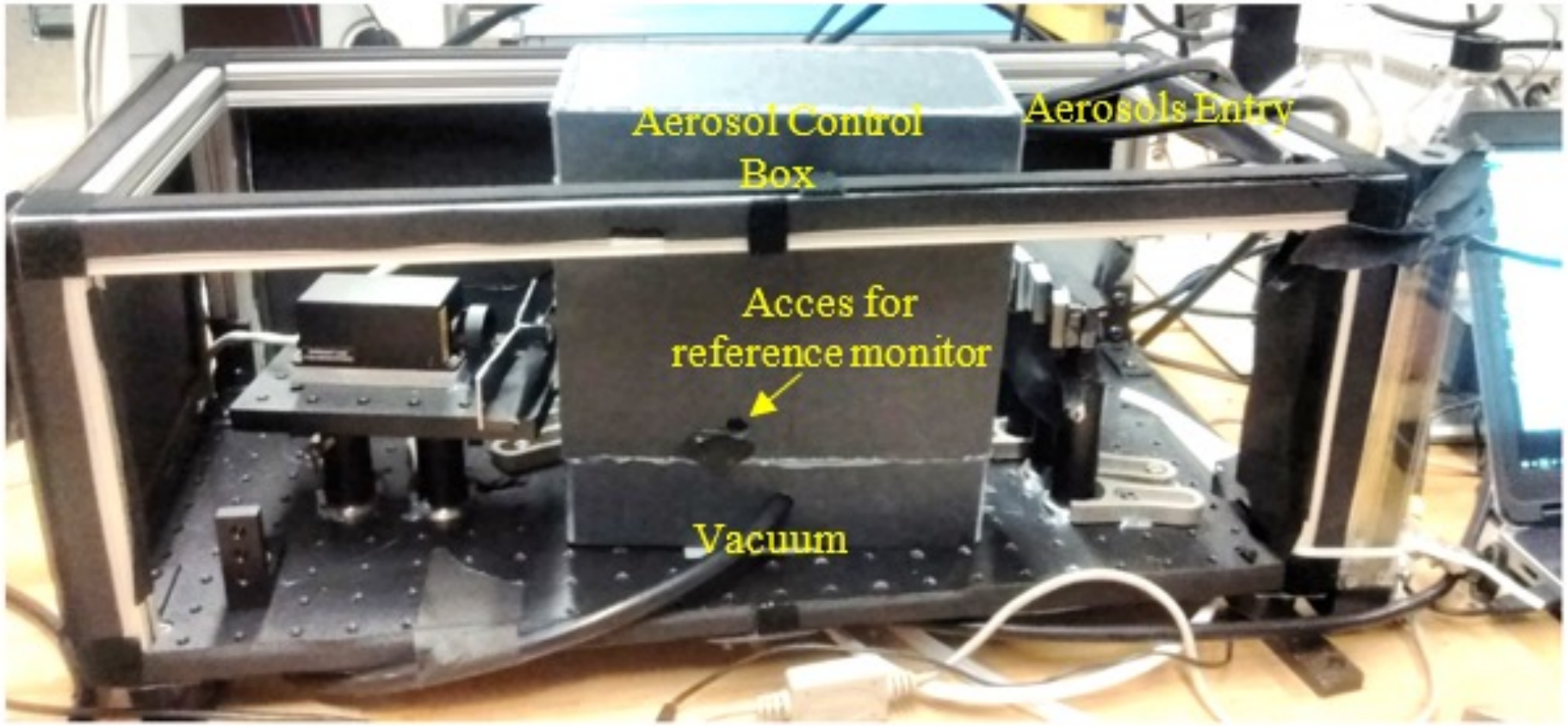
Preliminary results (1/4)



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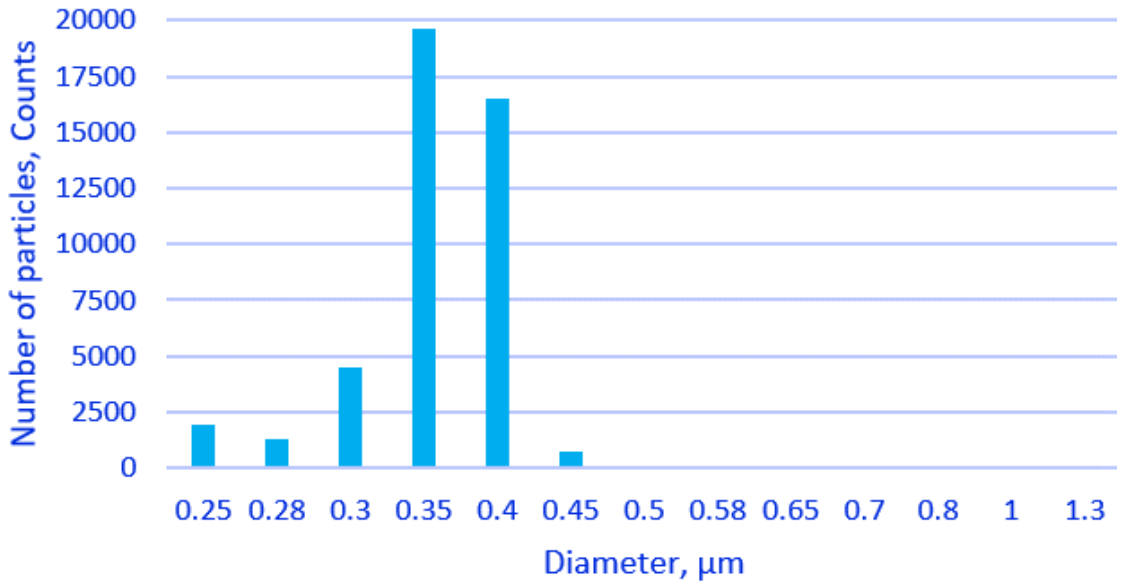
Preliminary results (2/4)

- **On the following slide…**
  - Quasi-monodisperse sebacate particles
  - Aerodynamic diameter of 420 nm
  - Number concentration of 300 to 600 part/cm3
  - GRIMM measurements (not corrected for refractive index) →



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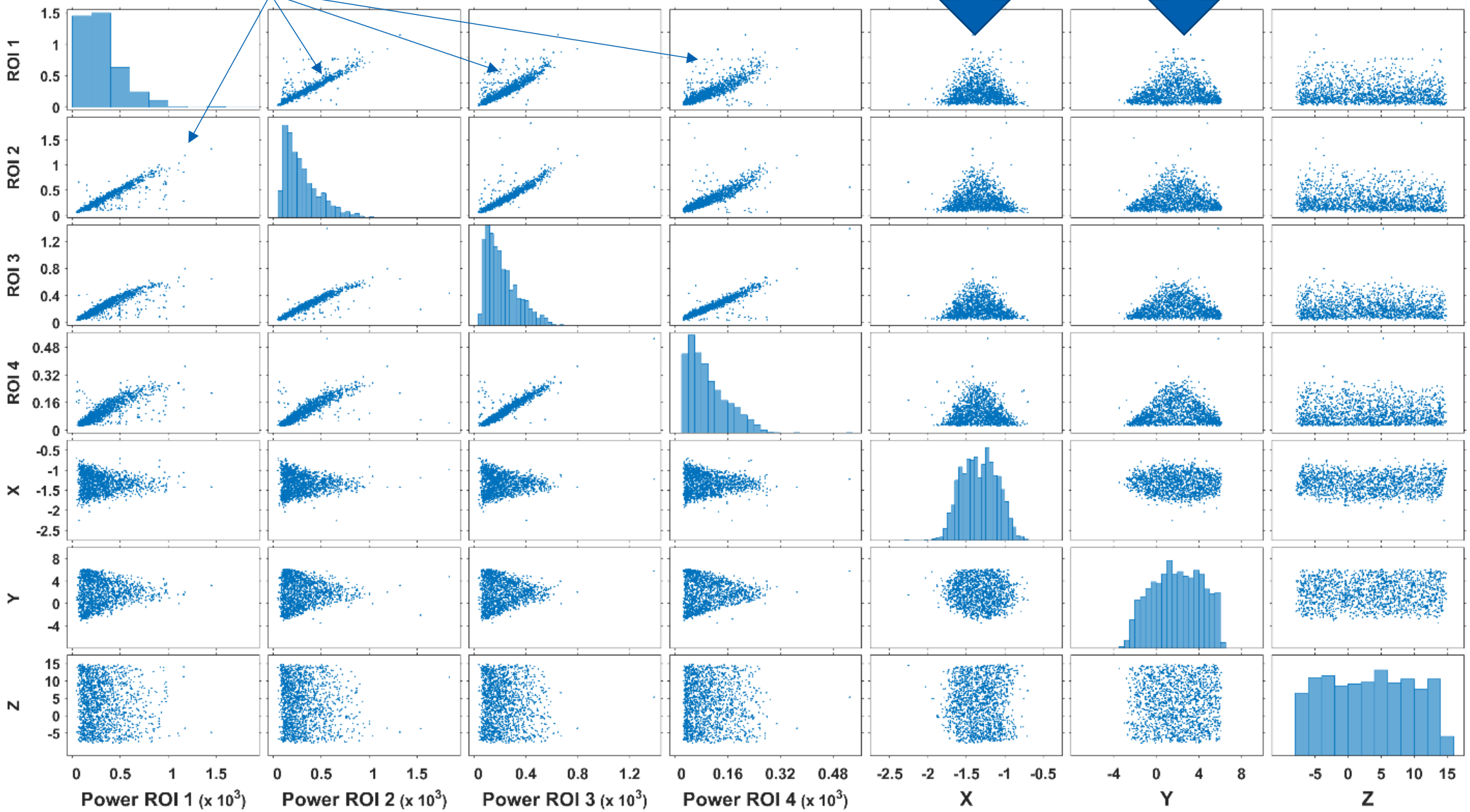
Preliminary results (3/4)

3D positioning within 200 µm

Intensity Ratios are related to diameter of particles

Physical Diameter
420 nm
± 50 nm



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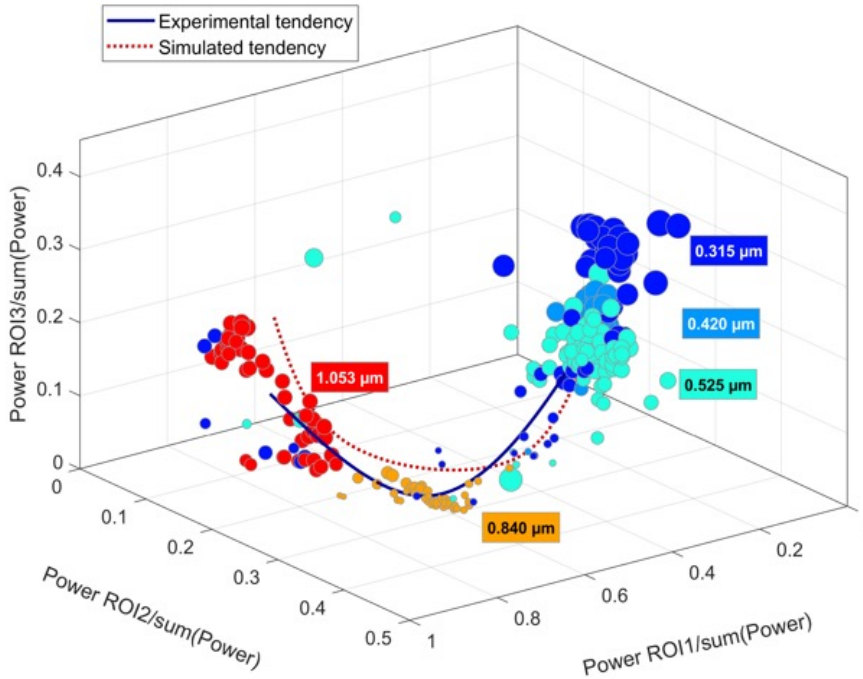
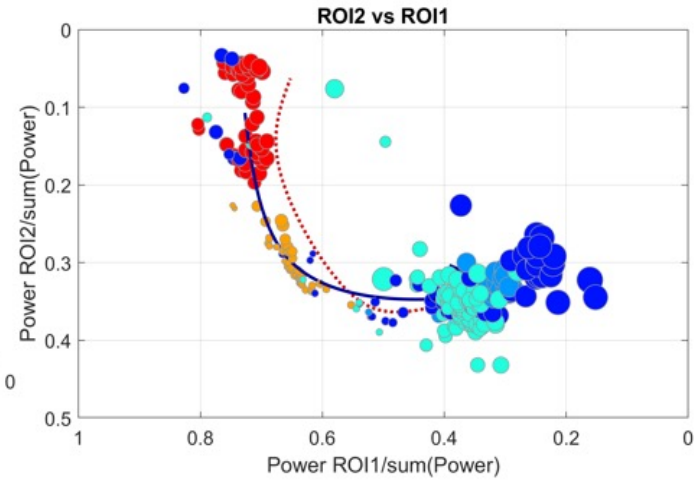
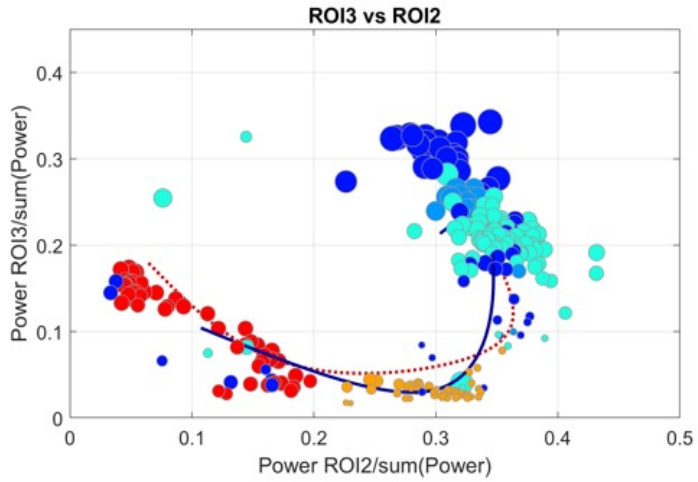
Preliminary results (4/4)

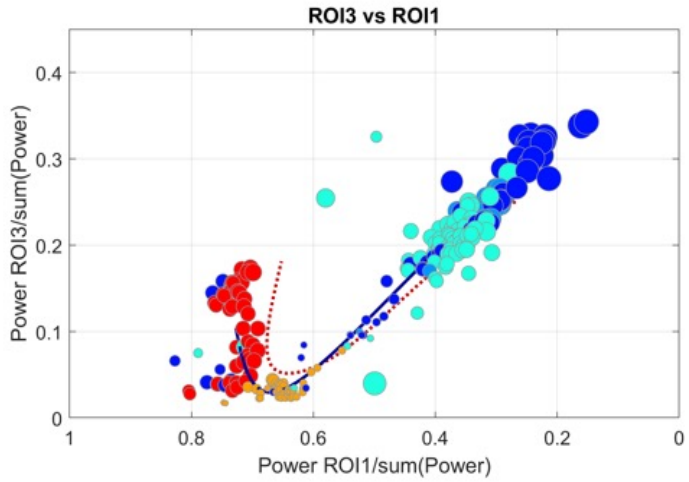
- Particle sizing approach

- Localizing particles in the 4D relative intensity space and comparison to expected intensity ratios









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Important takeaways

- Easily customizable vs: size range, composition, shapes
- Simple mechanical assembly and maintenance
- Detailed particle characterization + self-adjustment
- Minimal impact on its environment
- Individual and global informations

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The future (1/3)

Technology is still under active development.

We are seeking the needs of the R&D and space community.

Current axes of development:

- Probed volume correction vs particle sizes for particle size distribution measurements
- Specific angles/positions calibration approach
- Image and results diagnosis

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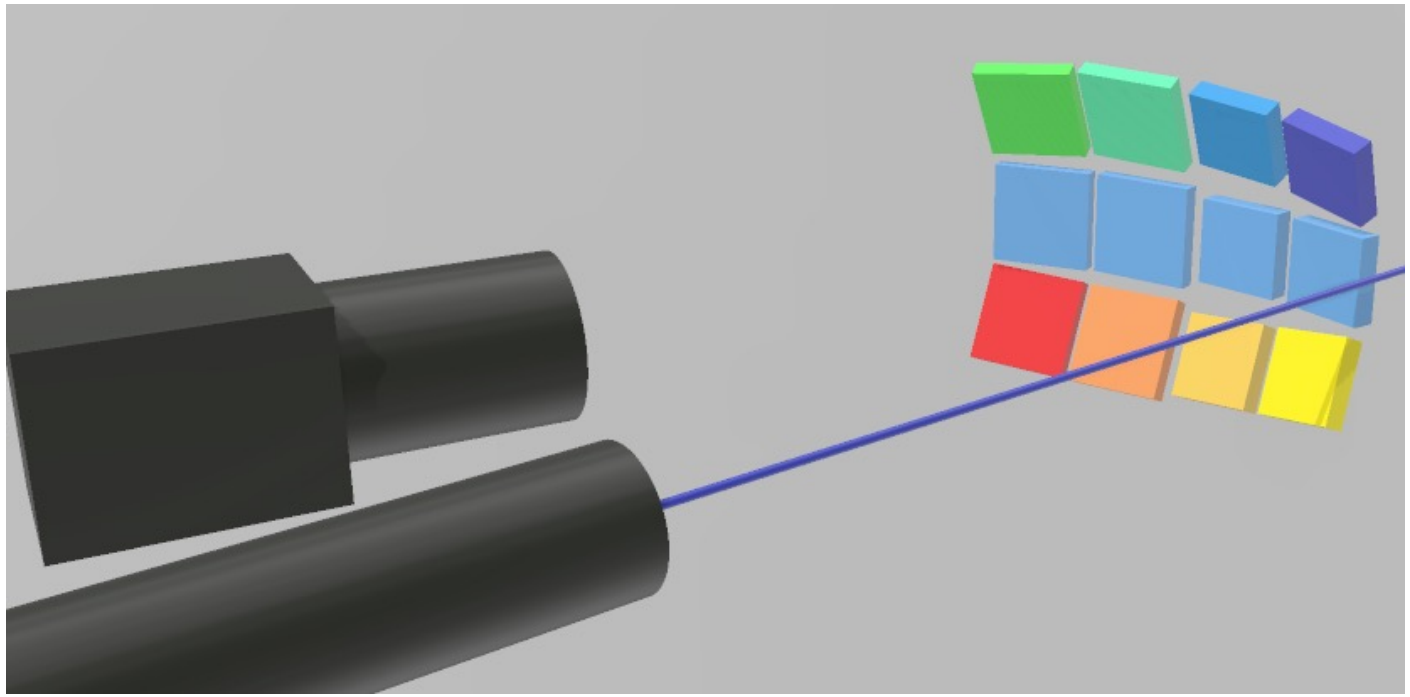
The future (2/3)

- Particle shape and submicron sizing: polarization
- Composition assessment: Reflectance spectra
- Mineral and biological composition: Fluorescence spectra and lifetimes
- Raman spectra
- …



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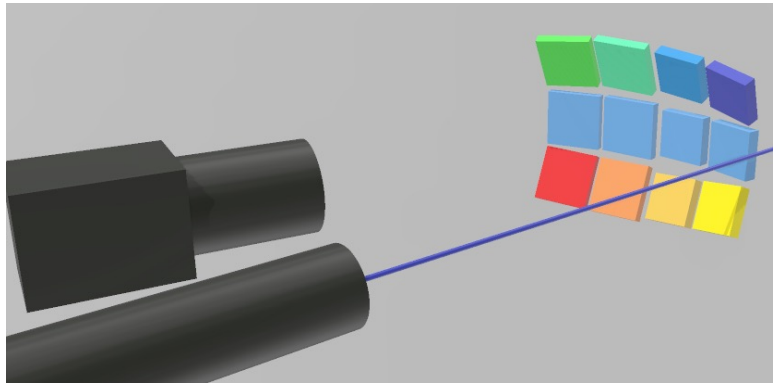
The future (3/3)

Potential Lunar Applications:

- **Air quality monitoring:**
  - Regolith vs other dust types
  - Even in vacuumed air locks
  - Pulmonary inflammation diagnosis
  - Early Fire Detection of smokes
- **Suspended regolith characterization and monitoring:**
  - Suspenparticles shape and size
  - Mineral composition for Lunar mining
  - Generation from Lunar Landing/lift-off and surface vehicle activities
  - Electrical charge of Regolith dusts vs size and composition



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daniel.cantin@ino.ca

denis.panneton@ino.ca

Québec
Head Office
2740 Einstein Street
Québec, Québec
CANADA G1P 4S4
+1 418 657-7006