

HARD Solids Micro-Scale Spectral Measurements



PL14-V-HARD solids-PD3WA
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Goals and Objectives

- ▶ Construct ideal material systems having well-characterized properties (e.g., complex refractive index – $n(\lambda)$ and $k(\lambda)$, particle size and shape distribution, packing density)
- ▶ Measure their reflectance spectra for use in radiative-transport model validation
- ▶ Measure the dependence of spectroscopy on specific ideal-system material parameters, serving to:
 - prioritize the importance of various parameters
 - stimulate development of new modeling approaches

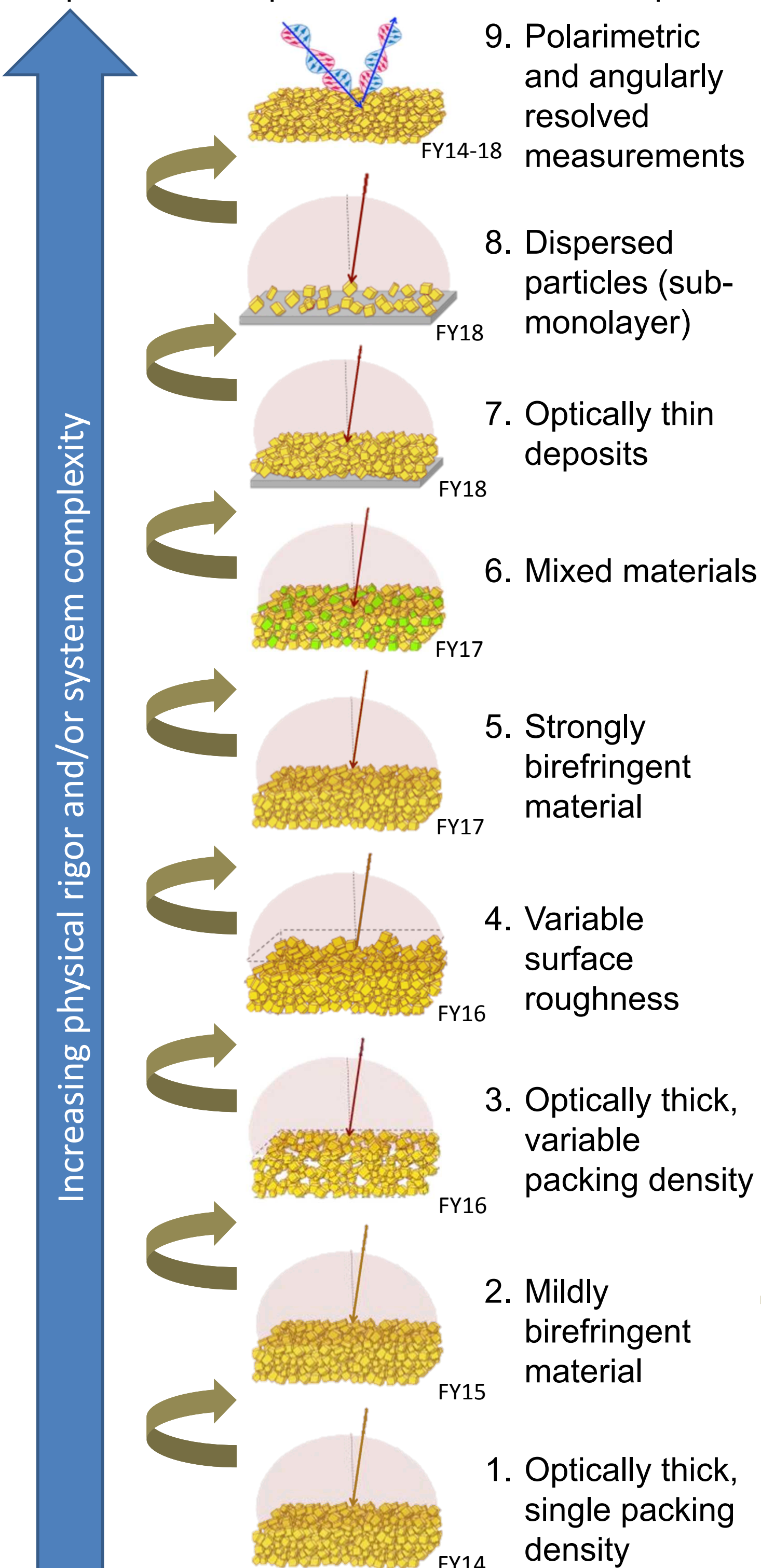
Introduction

- ▶ Reflectance spectra of particulate solids are determined by radiative transport among its grains
- ▶ Radiative transport depends on $n(\lambda)$ and $k(\lambda)$ and the morphology (PSD, packing density, particle shape) of the solid material
- ▶ The refractive indices of materials of interest (MOIs) are not known and their morphologies are usually very complicated
- ▶ Numerical models often assume a simplified morphology (e.g., spherical particles)
- ▶ Measurements on ideal systems allow testing of solids having known refractive indices in tailored geometries (simple → complex)

Methods

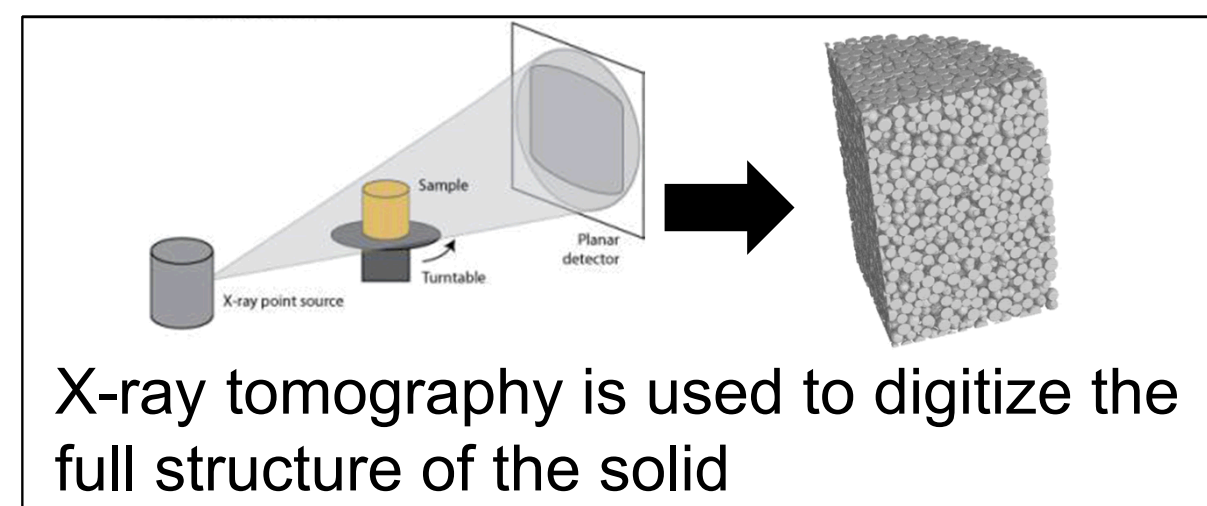
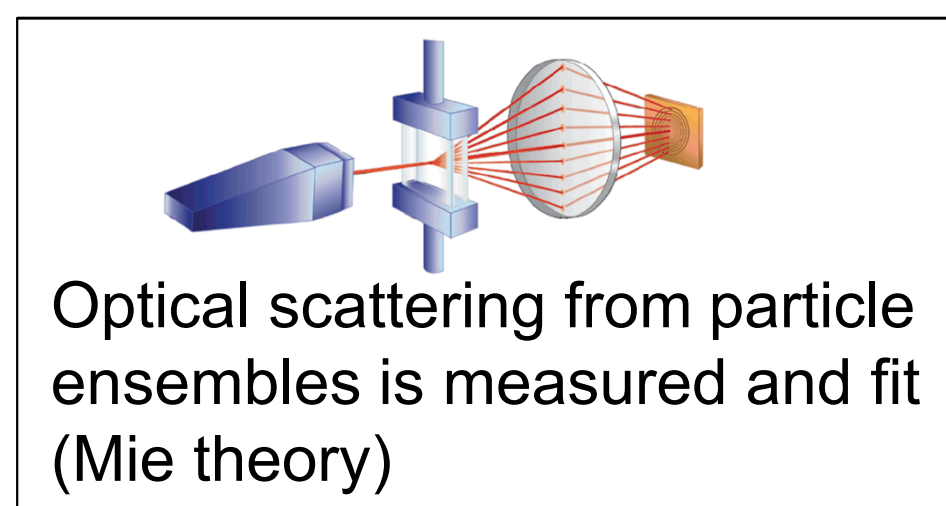
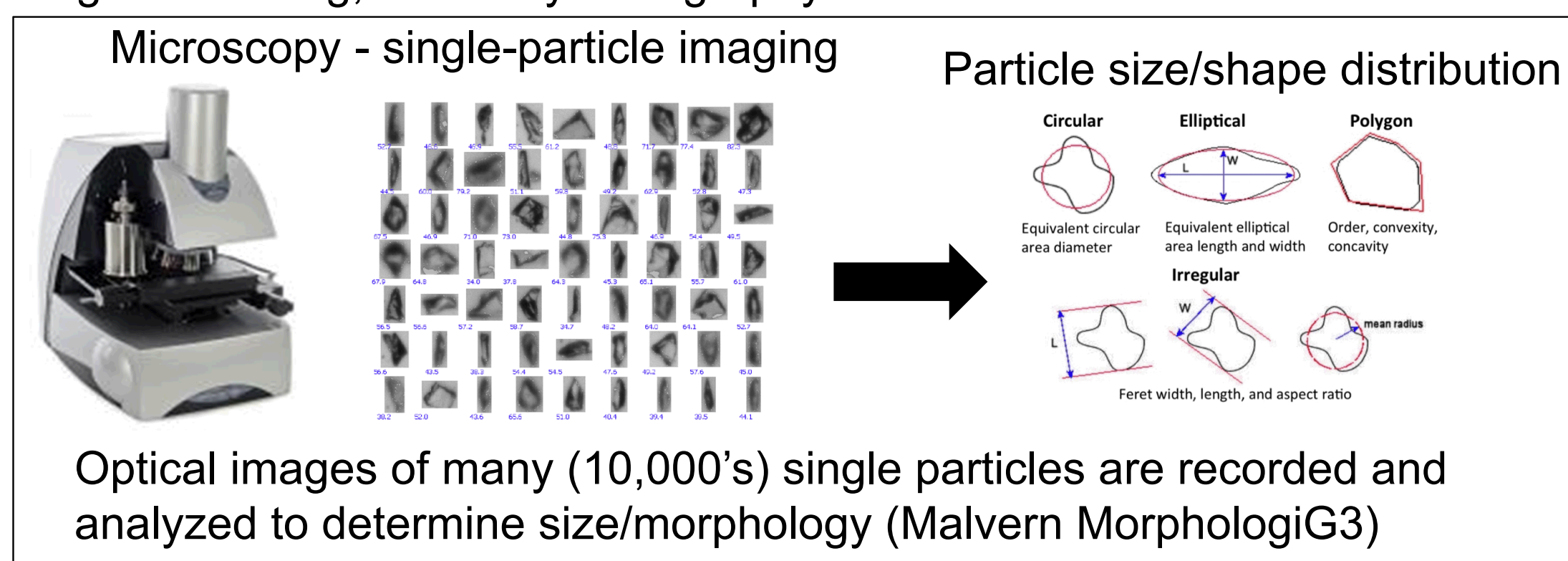
Spiral development

- ▶ A coordinated spiral measurement-model development path is used to incorporate progressively more complex phenomena
- ▶ A root-mean-square error of <0.03 between modeled and measured spectrum is required to advance to new spiral levels



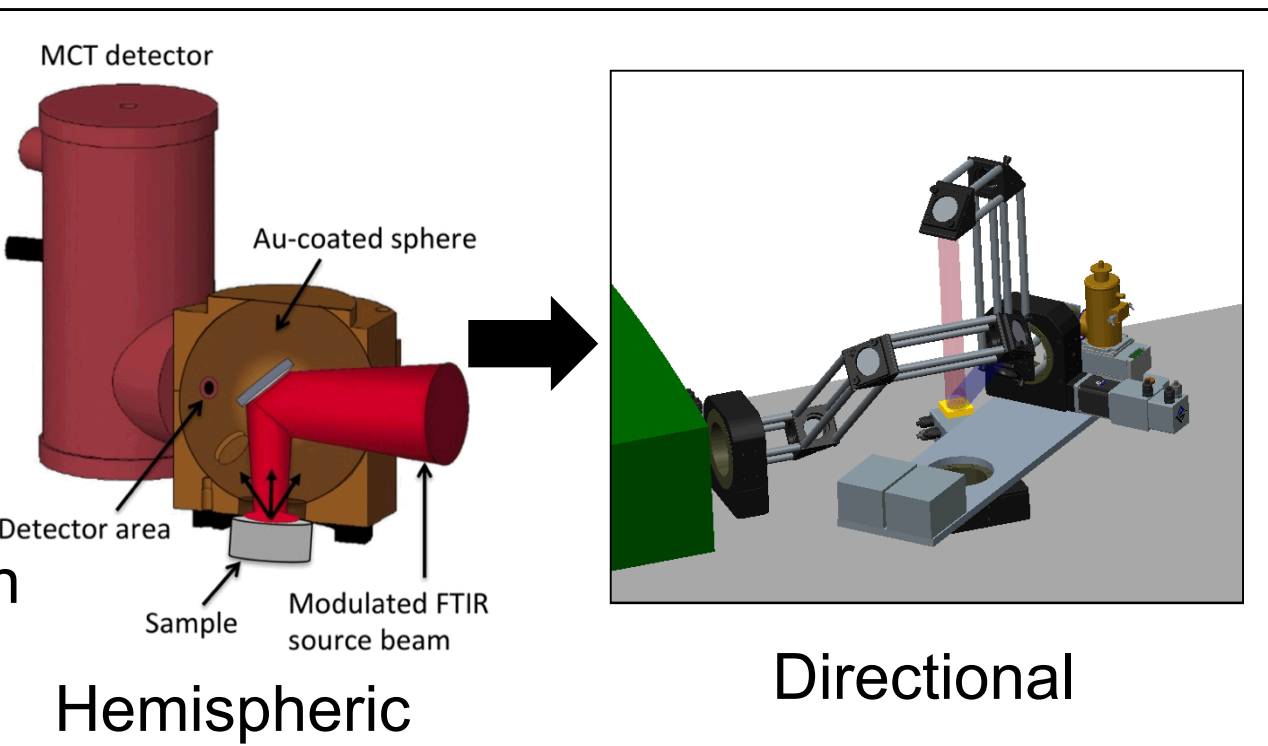
Particle size and shape measurement

- ▶ Particle size, shape, and packing are measured using microscopy, light scattering, and x-ray tomography



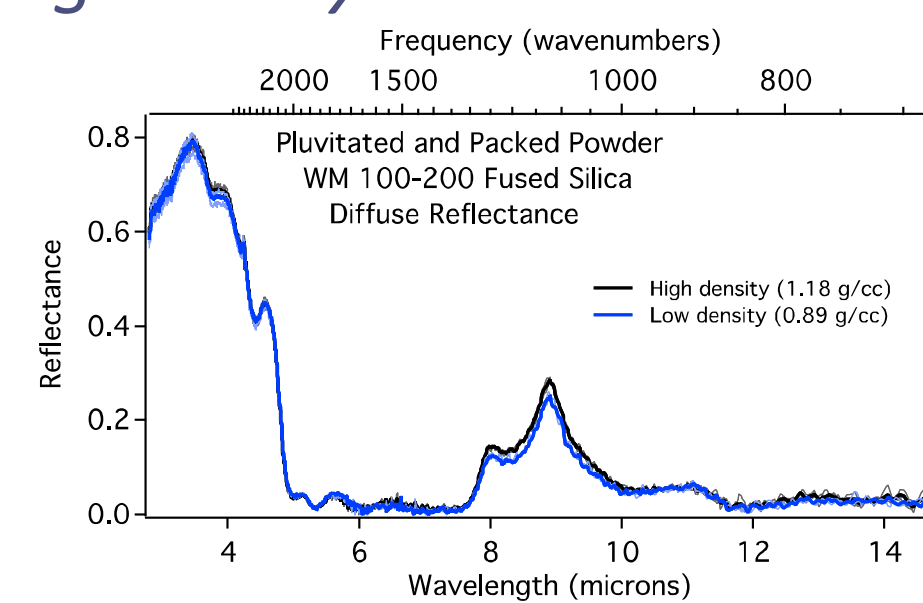
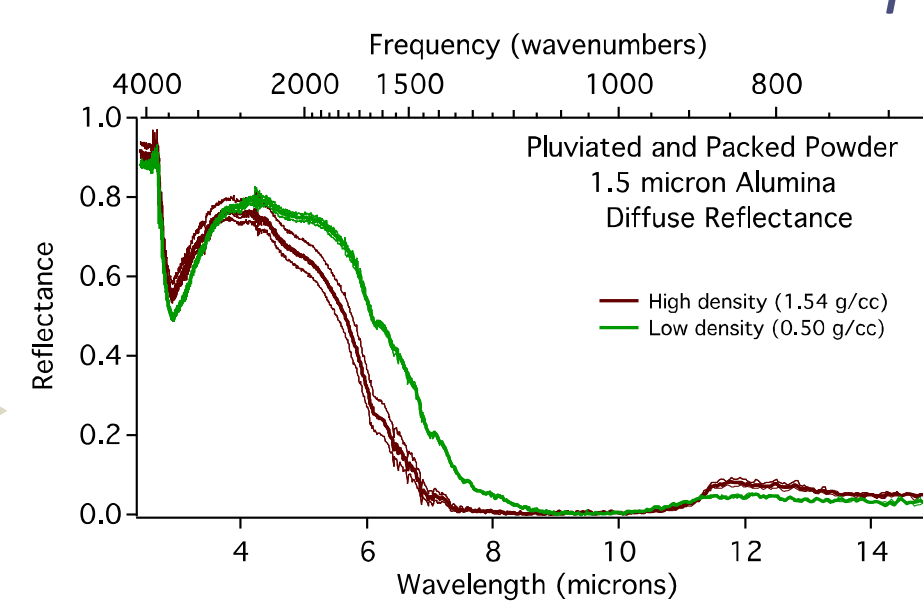
Reflectance measurement

- ▶ Unpolarized hemispheric diffuse reflectance measurements being made now
- ▶ Will evolve to polarized directional measurements in FY 17

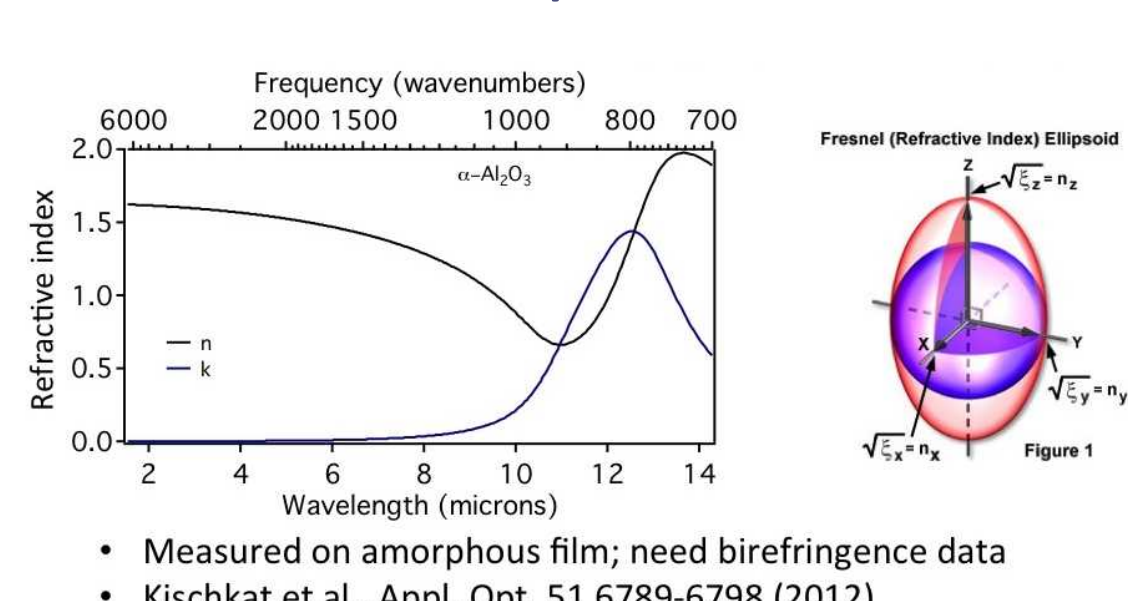
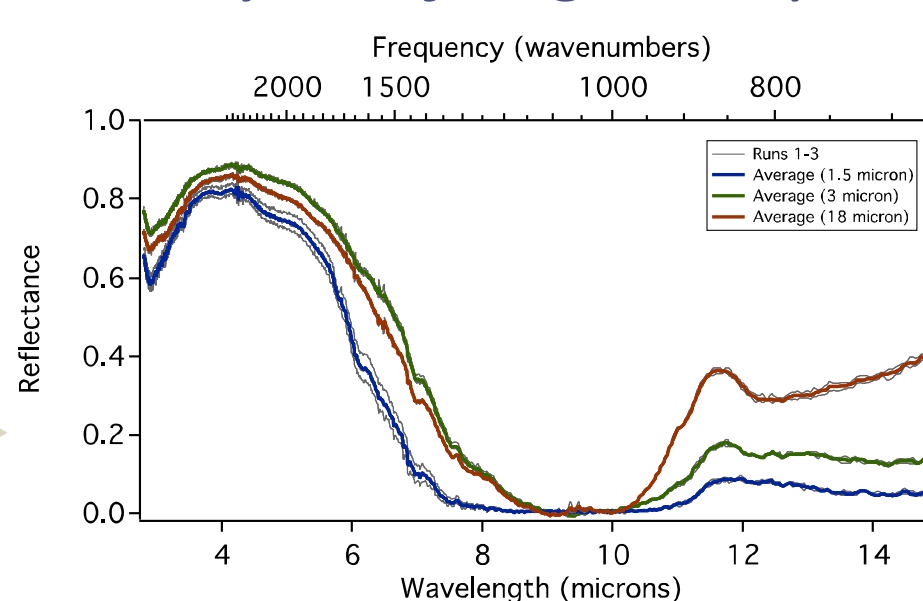


Results / Major Findings

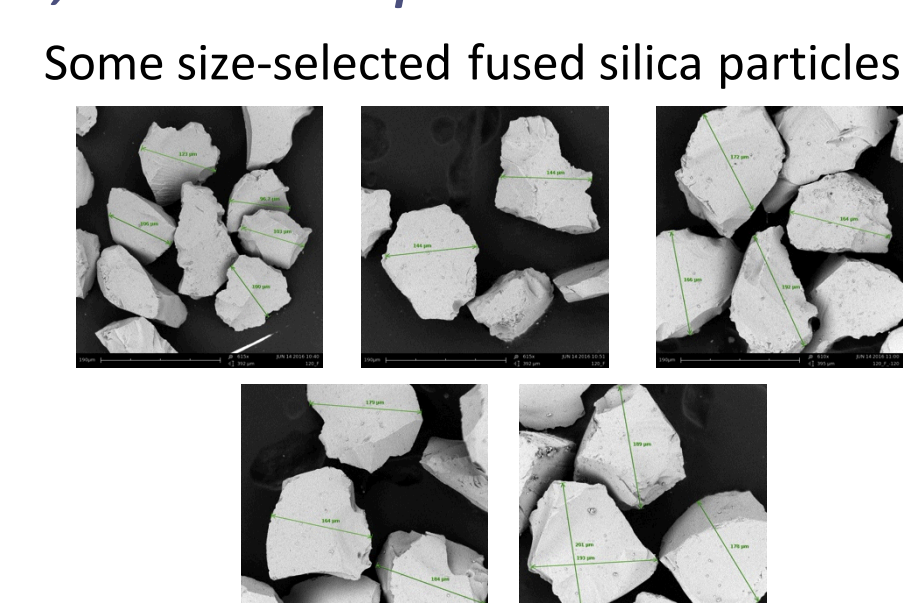
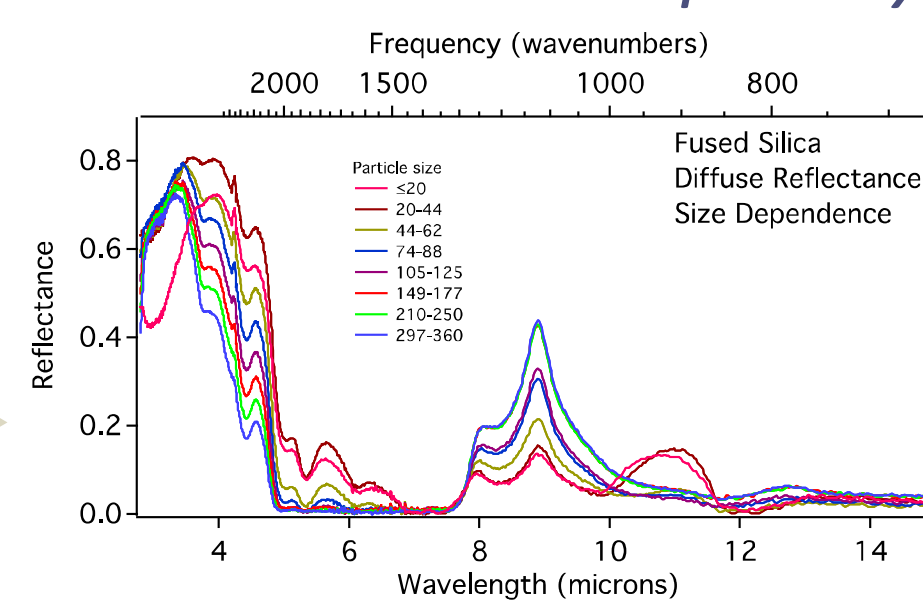
Variable packing density



Mildly birefringent, optically thick, variable particle size



Fused silica - optically thick, variable particle size



Conclusion, Next Steps, and Relevance to Program Objectives

- ▶ Through use of a coordinated measurement spiral, the ideal system measurements provide data to verify models and stimulate new model generation
- ▶ This tasks contributes to the overall HARD Solids objective of generating new physical models to support the remote sensing of solid

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