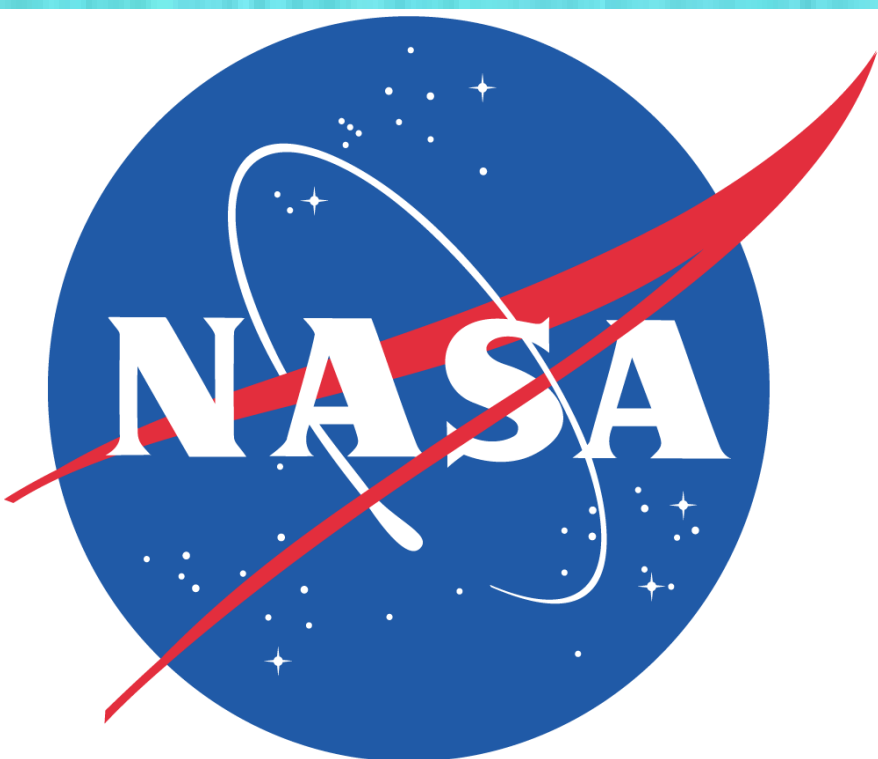




NEW MIE SCATTERING DIFFUSER TARGETS DEVELOPMENT AND CHARACTERIZATION

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OBJECTIVES

- To develop spectral albedo calibration standard targets with variable Earth scene specific reflectance capable of covering the entire solar reflective wavelength region;
- To investigate, identify, and test substrates of different thickness, surface finish, and materials with appropriate specifications Spectralon and aluminum are the main materials used as on-orbit calibration systems. However, they do not address all calibration requirements when different Earth scenes are observed;
- To integrate different types of calibration targets based on the design and tooling we developed;
- To fabricate and characterize the optical properties of the new radiometric calibration targets
- To acquire high accuracy data of the new radiometric calibration targets using our traceable to NIST equipment

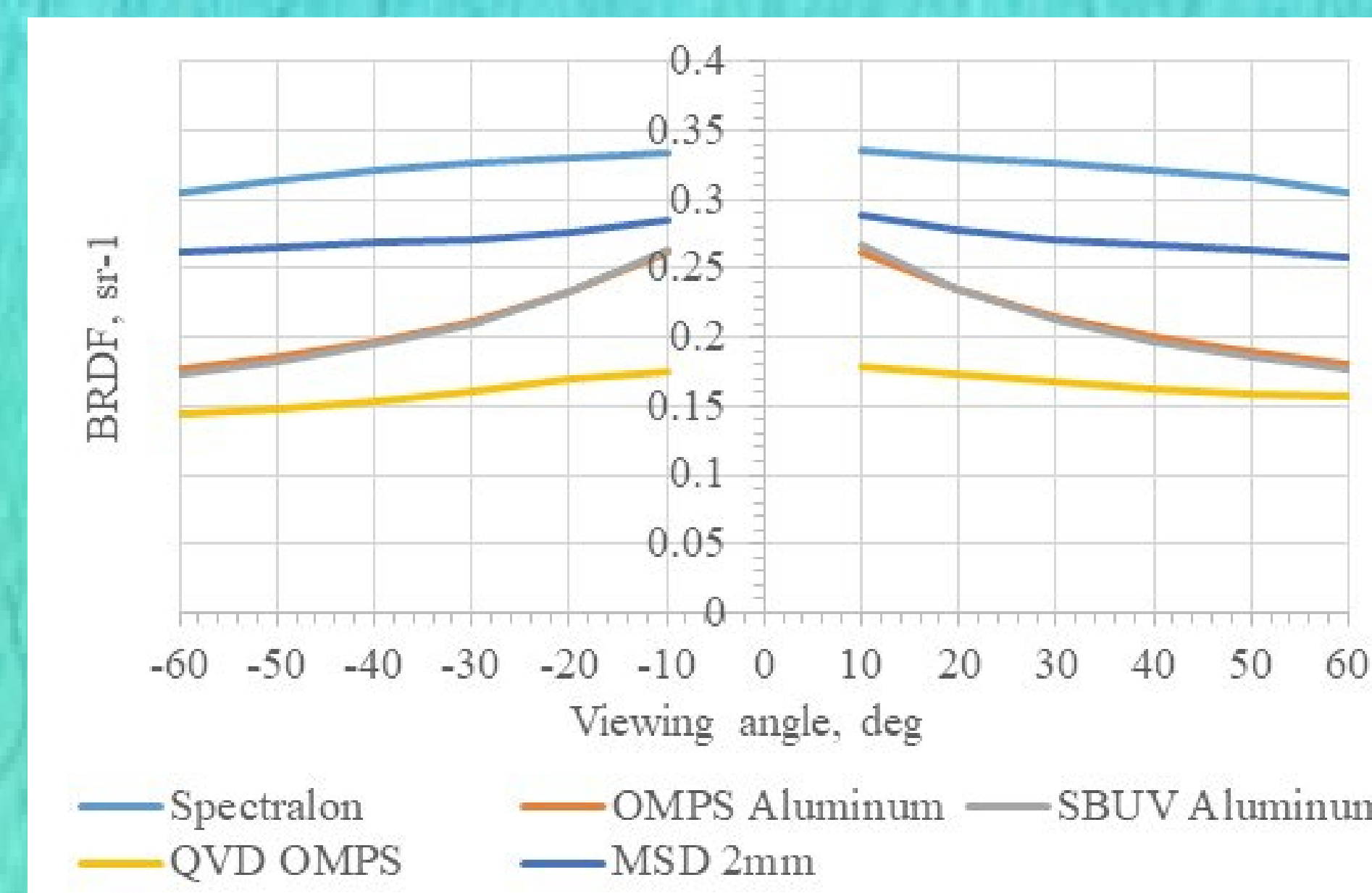


Albedo of different Earth scenes

Surface	Typical Albedo
Open ocean	0.063
Conifer forest	0.08 to 0.094
Deciduous forest	0.15 to 0.185
Bare soil	0.175
Green grass	0.255
Desert sand	0.406
Ocean ice	0.5 to 0.75
Fresh snow	0.85

DEVELOPMENT

Materials



Spectralon



SBUV Aluminum

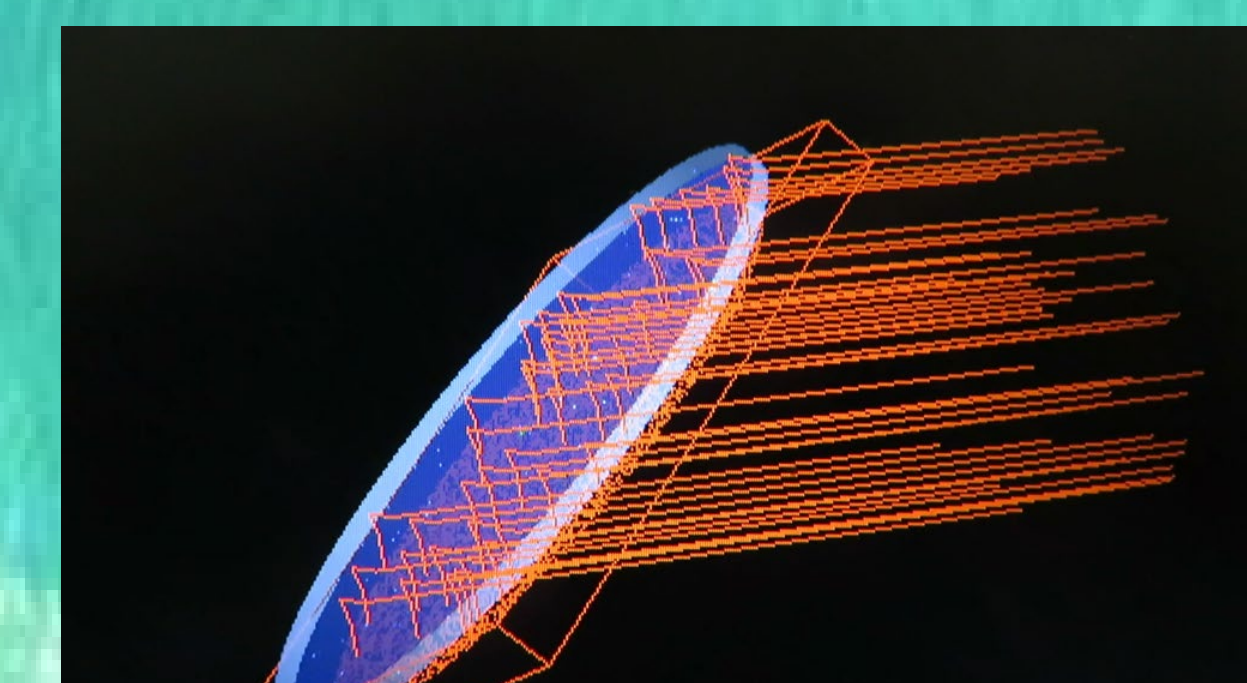
OMPS Aluminum

Mie Diffuser

METHODOLOGY

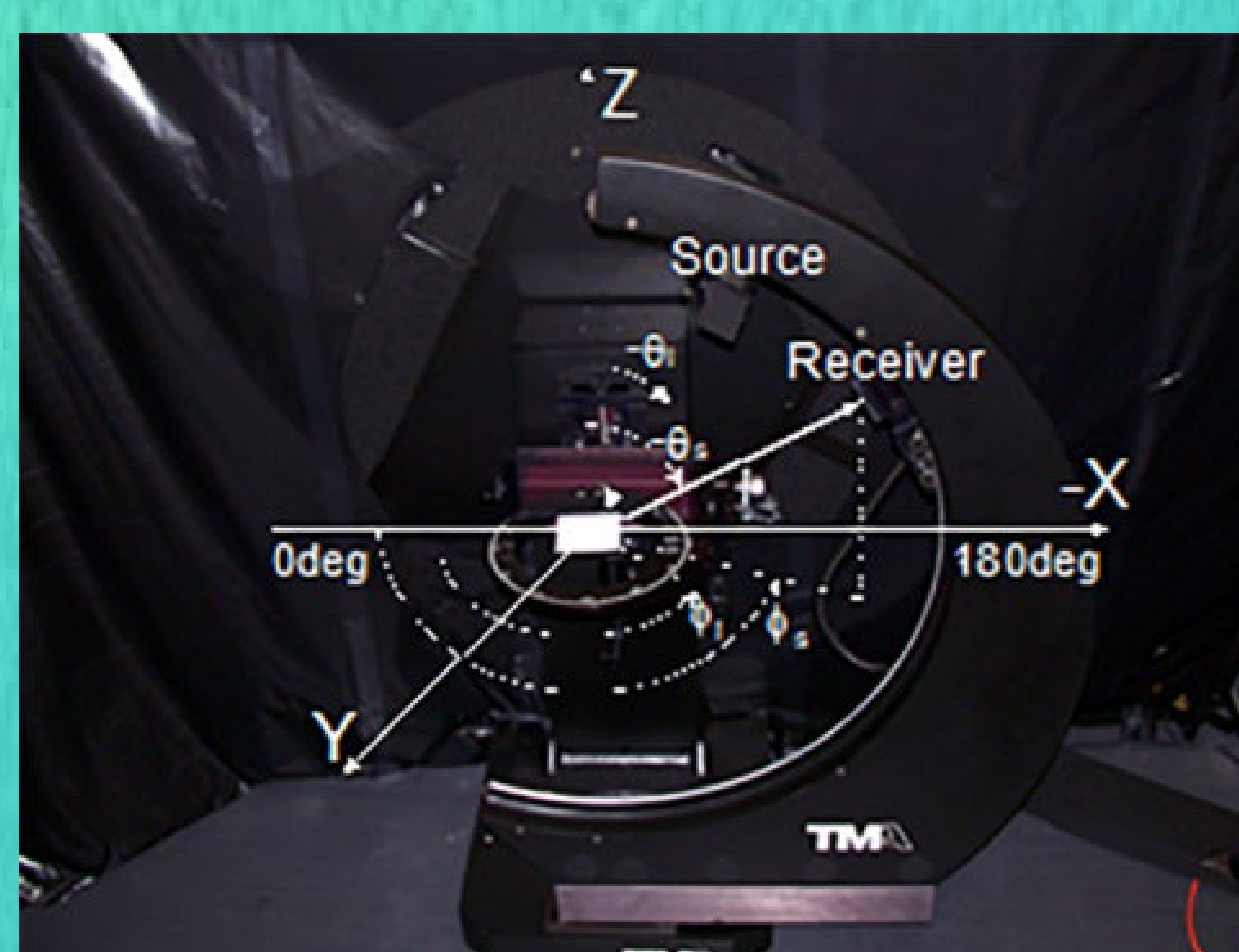
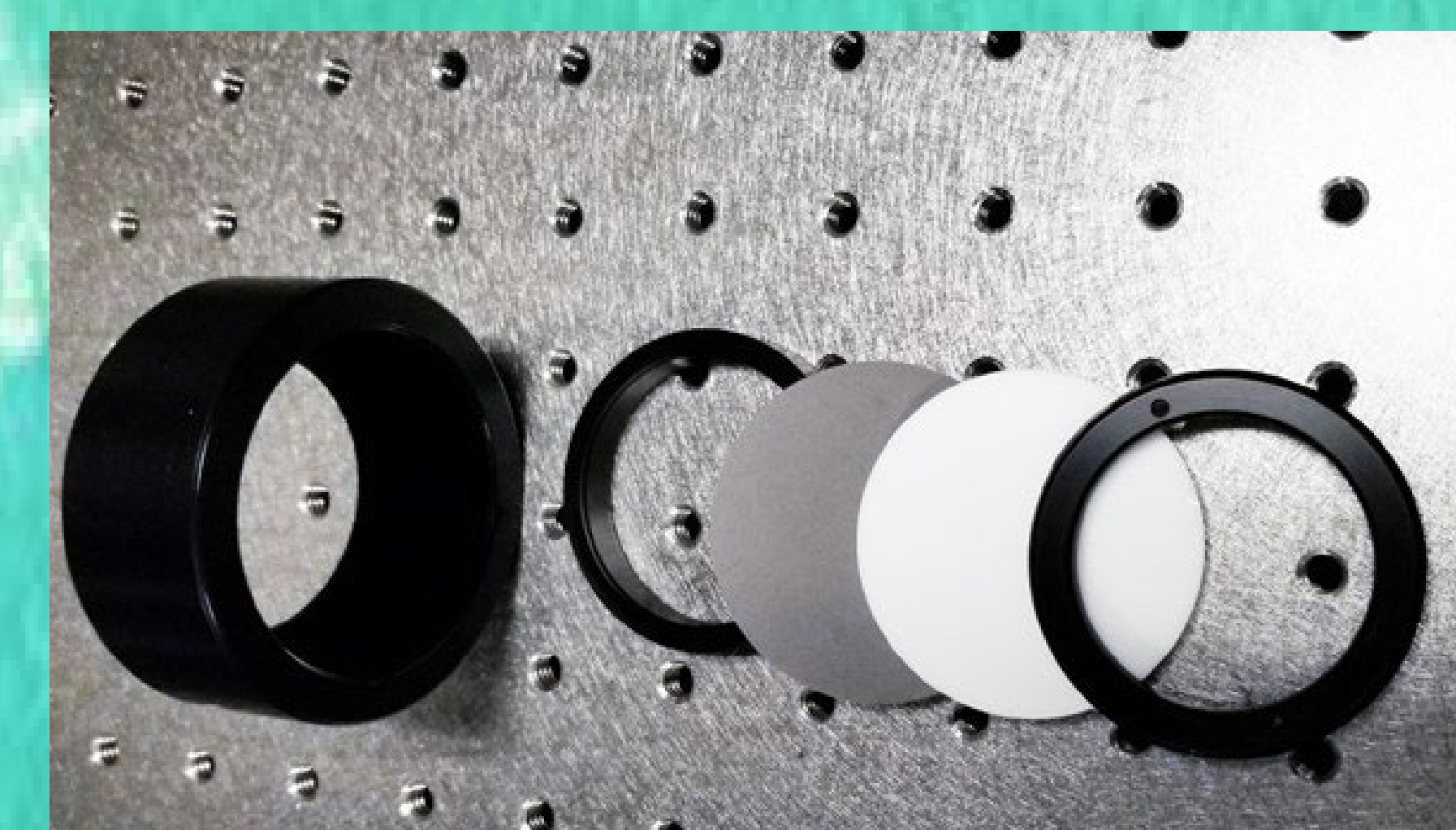
- Model new calibration targets addressing different Earth scenes radiometric dynamic ranges. Chose the best substrate materials and backing materials to address multiple requirements. Address technological requirements
- Specified the materials we need to achieve our goals. Procured the needed substrate and supplemental materials and equipment. Performed the initial qualification measurements. Designed and manufactured diffuser holders. Integrated calibration targets with different substrate, backing, surface finish, number of voids. The different combinations allow us to achieve optical characteristics by choice. Performed the Final qualification measurements characterizing the calibration targets by acquiring high accuracy reflectance and transmittance data of the new targets by employing our precision optical equipment. Analyzed the data and draw plans for future work

Fused Silica Diffuser modeled in FRED



1. Incident light is at 45 deg to the diffuser surface.
2. First surface is setup to transmit monochromatic light (633nm)(Collimated source – red), 45 mm, going almost to the very edge of the diffuser.
3. Diffuser has 50mm radius and is 3 mm thick.
4. On the back there is a reflective surface.
5. There are arbitrary number of air bubbles inside the diffuser.
6. Everything is allowed for the first surface except absorption.
7. Include 2 scattering events, the back surface is reflective, the rays will reflect and scatter the second time off the diffuser.

Sandwich target components



Scatterometer

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RESULTS AND DISCUSSION

8° directional/hemispherical reflectance and hemispherical transmittance

The samples was evaluated through measurements of their 8° directional/hemispherical reflectance from 250nm to 2500nm using Perkin Elmer 1050 spectrophotometer with a 150mm Spectralon integrating sphere with a 25mm sample port.

Bidirectional Reflectance Distribution Function (BRDF)

BRDF can quantify the specularity and/or diffuseness of the samples.

The samples were measured at two orthogonal polarizations of the incident light, then averaged thus reporting the BRDF for unpolarized case of the incident light

Conclusions and Future Work

Earth scene specific albedo diffuse targets were developed and tested. Fused silica and sintered PTFE substrates were used to achieve different Hemispherical Reflectance and BRDF properties. The characterization was done using NIST traceable measurement equipment at the Diffuser Calibration Lab of GSFC. The calibration targets were characterized at cleanroom environment and at simulated on-orbit environment. On orbit testing on board of International Space Station is scheduled for the second half of 2023.

