REPORT OF MODIS CALIBRATION PEER REVIEW PANEL

- CALIBRATION/VALIDATION MEETING
- MCST ACTIVITIES
- MODIS-N CALIBRATION
  - APPROACH
  - CONCERNS
- MODIS-T CALIBRATION
  - APPROACH
  - CONCERNS
  - SUGGESTIONS

MODIS Science Team Meeting, Oct. 1 - 3, 1991. Attachment QQ

CALIBRATION/VALIDATION

MEETING HIGHLIGHTS

- CROSS COMPARISONS

  Preflight: at instrument vendors
  at GE

  Inflight: site selection

- NEED FOR INPUTS FROM MST

- PRESENTATIONS ON MODIS-N AND -T

- LUNAR CALIBRATION - Hugh Kieffer reported that work has started

- PRESENTATIONS by NATIONAL STANDARDS LABORATORIES

  NPL

  NRC

  NIST

  NLRM

- DIFFUSER MATERIALS

MODIS CHARACTERIZATION SUPPORT TEAM

- OVERVIEW
- ACTIVITIES AND STATUS

MCST Overview

MCST Objectives

Support MODIS	• Team Leader • Team Members • Interface Between Engineers & Scientists • EOS Instrument Managers • EOS Flight Operations Managers
For MODIS Instrument	• Characterization / Calibration • Parametric Sensitivity • Simulated Imagery • Utility Products
During All Phases	• Pre-Launch Fabrication and Integration • On-Orbit Operational • End-of-Life

MCST Priorities

1. **Instrument-Related System Characterization/Calibration**
2. **Algorithms and Hardware for ICC/MCST Monitoring of In-Orbit Data**
3. Utility Products
4. Simulated MODIS Imagery
5. Cooperative TM-MCST Discipline-Related Product Sensitivity to Calibration

MCST Activities and Status

Geometric Knowledge and Control

A draft response to the platform integrator has been released.

Questions remain as to the appropriateness of goals vs. requirements.

Calibration Site Selection

Scenes are being analyzed for homogeneous areas for use in the testing of data.

MODIS Radiometric Models

Code 925 Spreadsheet Model (RAI)

Code 725 MODIS-T Radiometric Model

Code 713 MODIS-T Calibration Model

MCST Activities and Status

MODIS End-To-End Models

A spreadsheet at-satellite radiance model has been developed from the 5-S code with incorporation from Lowtran-7.

Code 700 has provided a spreadsheet model of at sensor radiances.

Work proceeds in linking the two models to obtain an end-to-end model.

The end-to-end spreadsheet model will be converted to C.

MODIS Operational Characteristics

MODIS-N in-orbit scenerios being developed.

Cross-Calibration

Pre-launch and in-orbit comparisons are being identified.

MODIS-N CALIBRATION APPROACH

- REQUIREMENTS
- CALIBRATORS
- SPECTRORADIOMETRIC CALIBRATION ASSEMBLY (SRCA)
- SOLAR DIFFUSER STABILITY MONITOR (SDSM)

ORIGINATOR _____ DATE _____

Parameter	Phase C/D Requirement	Predicted	
		Preflight	On-Orbit
Radiometric Calibration			
Below 1.0 μm	5%	4%	3%**
1.1 to 3.0 μm	5%	4%	3%**
Above 3 μm	1%	1%	1%
Reflectance	2%	4%	2%
Spectral Calibration			
Center Wavelength	0.5 nm preflight 1.0 nm on-orbit	0.5 nm	1.0 nm*
Spectral Band-to-Band Stability	0.5% FS 1.0% HS	0.5% FS 1.0% HS	0.5% FS
Geometric Calibration			
Band-to-Band Registration	0.1 IFOV	0.05 IFOV	0.1 IFOV
Diffuser BRDF			
<2.0 μm	1.0%		
2.0 to 2.5 μm	1.5%		

FS = Full Scale HS = Half Scale

* Dependent on good correlation with full aperture ground measurement and SRCA subaperture measurements

** Multiple calibration methodologies are required

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CALIBRATION REQUIREMENTS

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MODIS-N IN-FLIGHT CALIBRATORS

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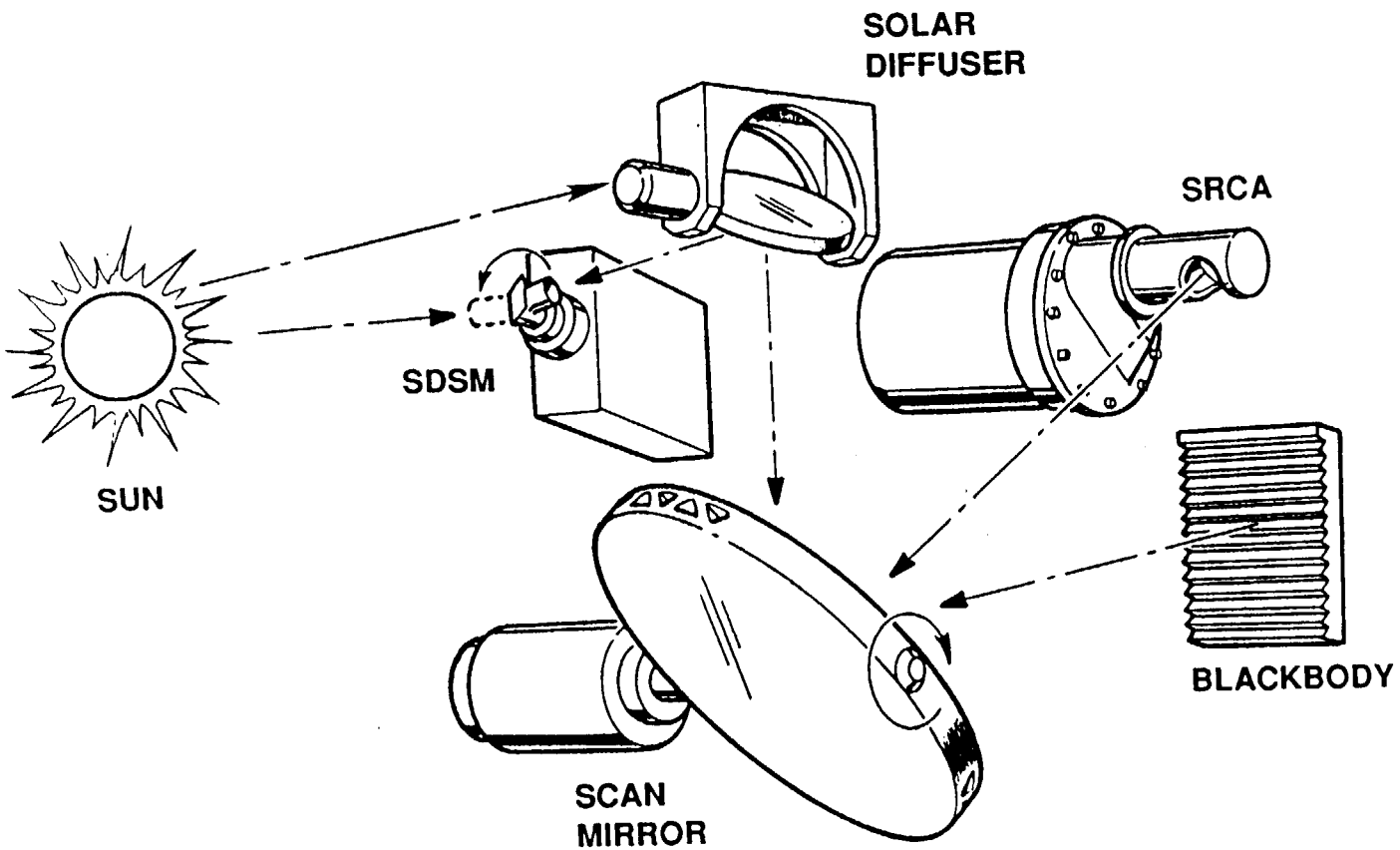

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SPECTRORADIOMETRIC CALIBRATION ASSEMBLY (SRCA)

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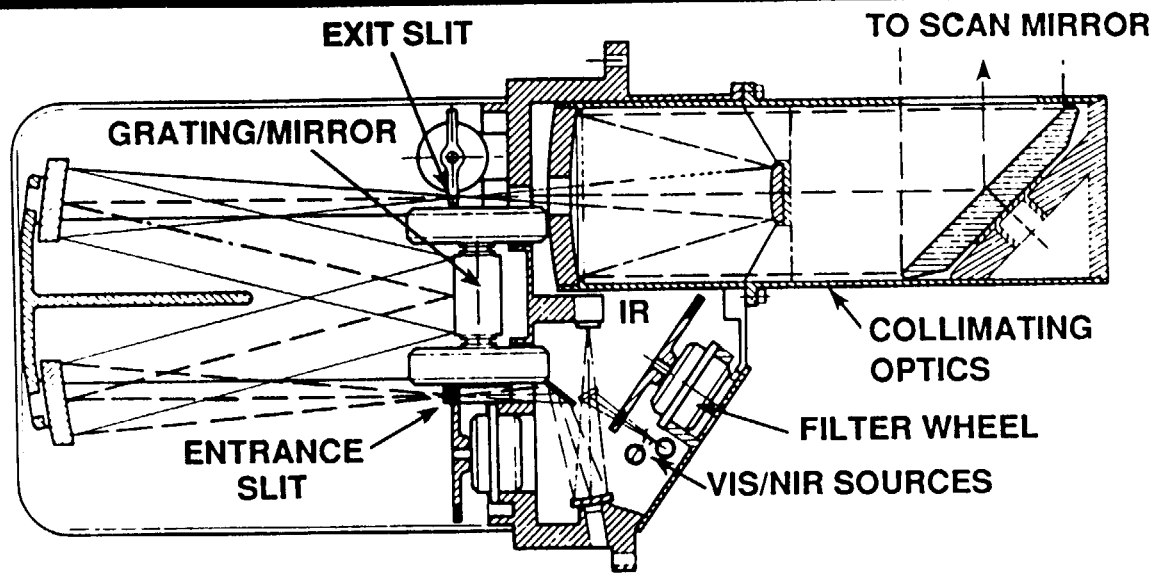

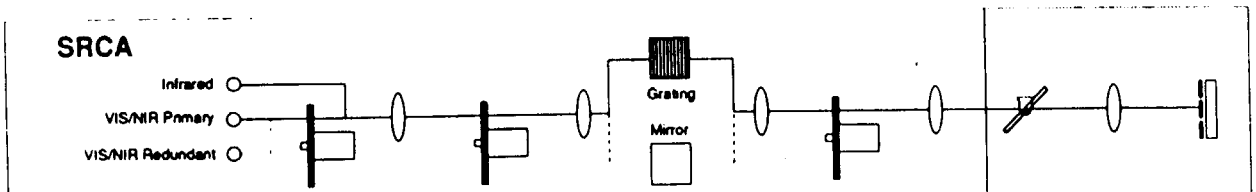

Operating Mode	Sources	Filter Wheel	Relay Optics	Entrance Slit	Collimating Optics	Grating/ Mirror	Focusing Optics	Exit Slit	Collimating Optics	Scan Mirror Assembly	Telescope / Aft-Optics	Filters / Detectors
Radiometric Check	VIS/NIR	Spectral Shaping Filters	X	Open	X	Mirror	X	Open	X	X	X	X
Spectral Calibration	VIS/NIR		X	Entrance Slit / Filters	X	Grating	X	Exit Slit / Photodiode	X	X	X	X
Spatial Registration	VIS/NIR & IR		X	Open	X	Mirror	X	Reticle Pattern	X	X	X	X
Self Calibration	VIS/NIR	Didymium Glass	X	Entrance Slit / Filters	X	Grating	X	Photodiode / Exit Slit	X			

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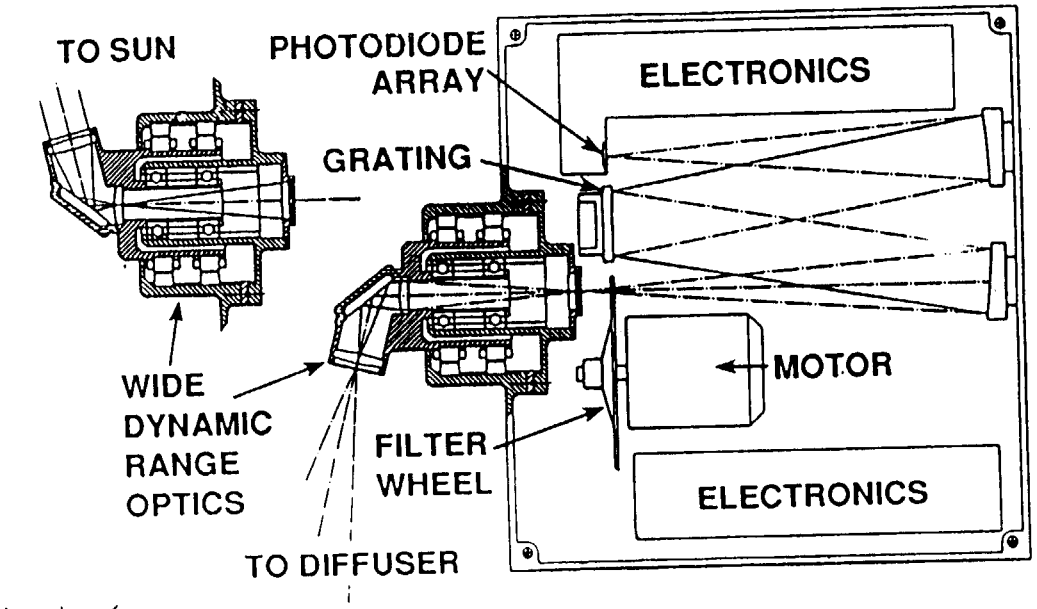

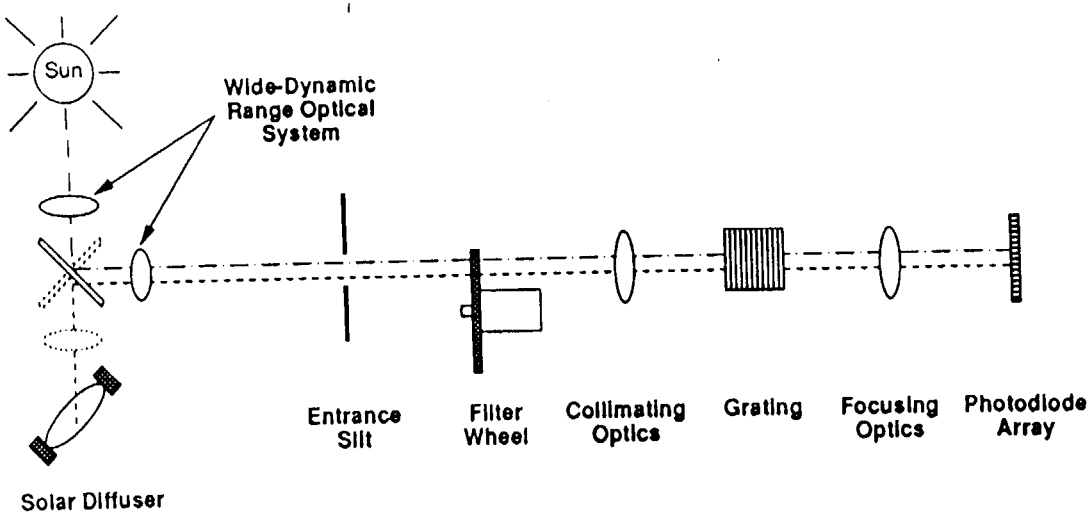

- Solar Diffuser Reflectance Monitored Using Sun as Reference

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SOLAR DIFFUSER STABILITY MONITOR (SDSM) ALTERNATELY VIEWS SUN AND DIFFUSER

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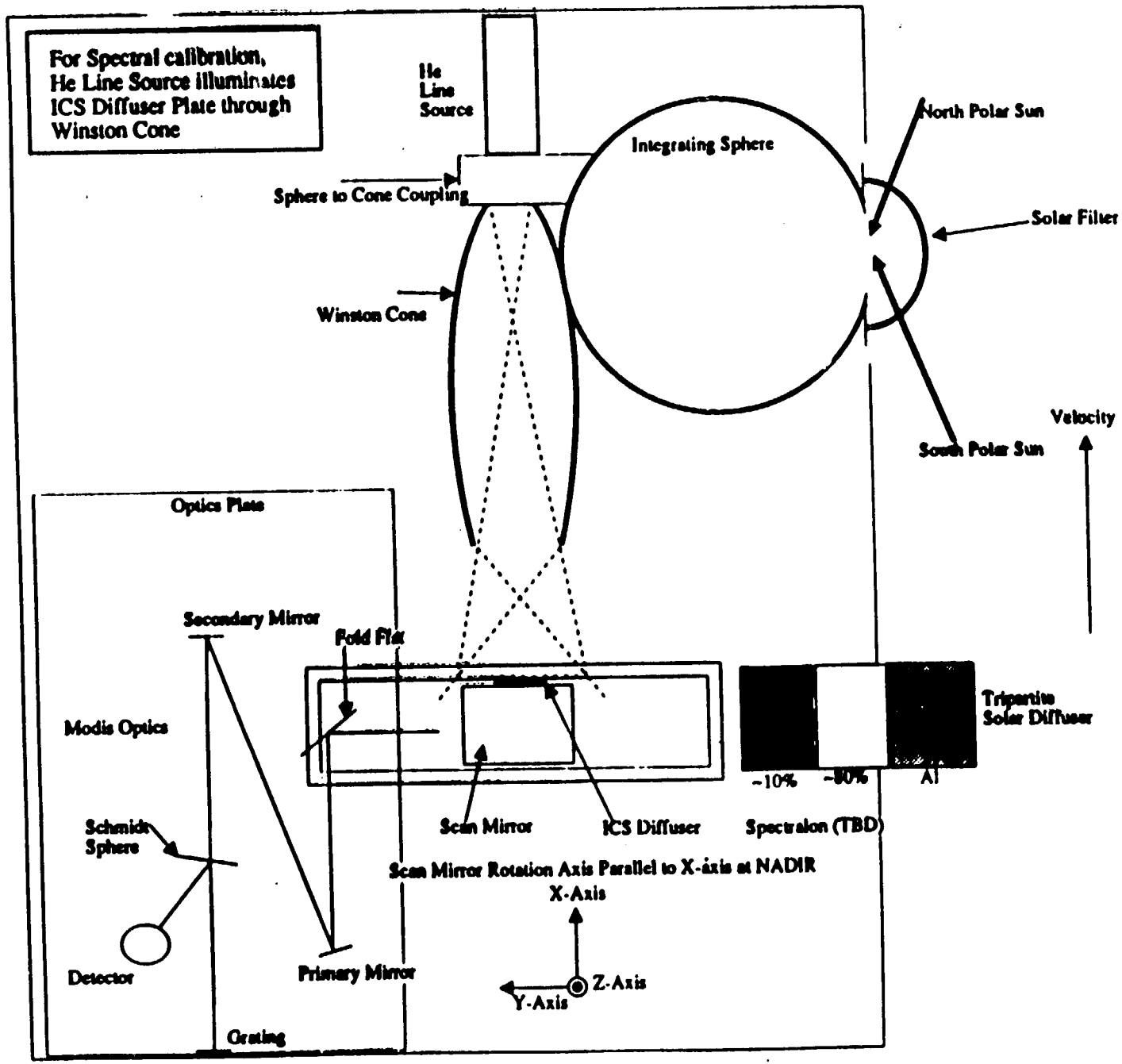
MODIS-N CALIBRATION CONCERNS

- STRAY LIGHT ON SOLAR DIFFUSER PANEL
- CROSS-TALK BETWEEN BANDS
- TIR FILTER SHIFT
- SPECTRAL CALIBRATION OF SOLAR DIFFUSER (VIS-NIR SPECTROMETER V. FILTERED DETECTORS)
- LOW FREQUENCY OF LUNAR OBSERVATIONS
- (ONLY TWO TIR BANDS IN COMMON WITH ASTER)

MODIS-T CALIBRATION APPROACH

- SPHERE SYSTEM (INTERNAL CALIBRATOR)
- SOLAR DIFFUSER PANEL

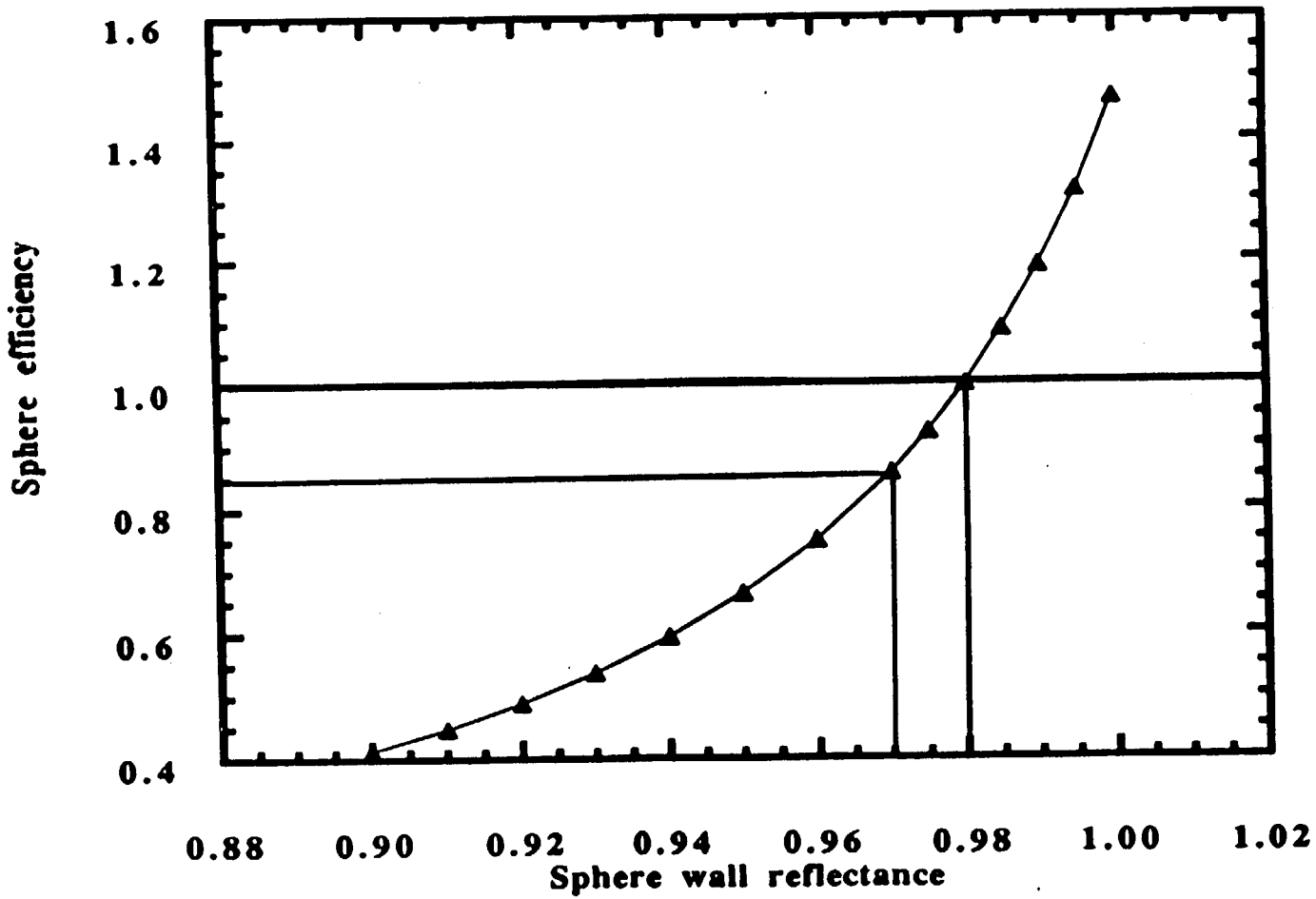


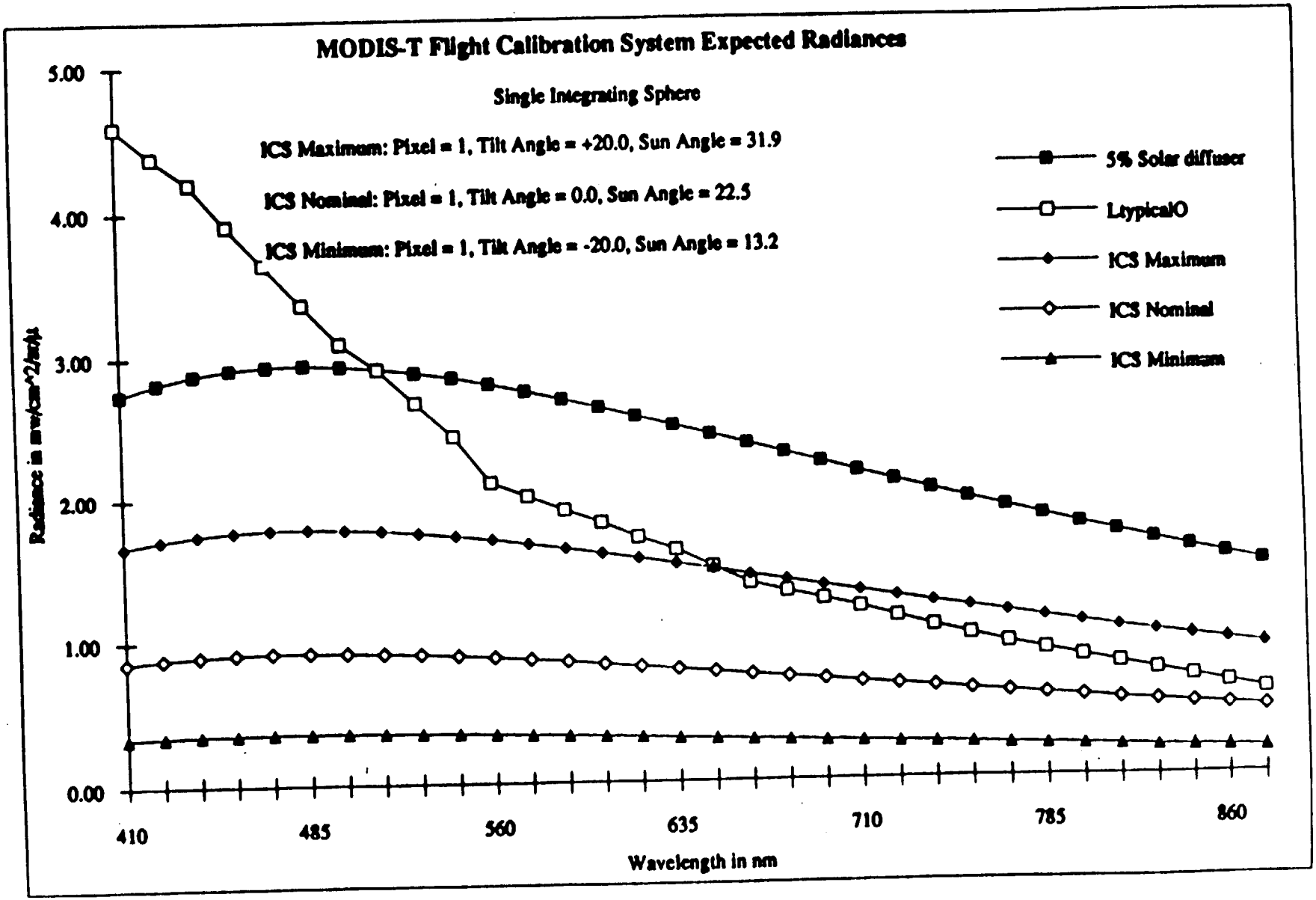
MODIS-T Calibration System Top View

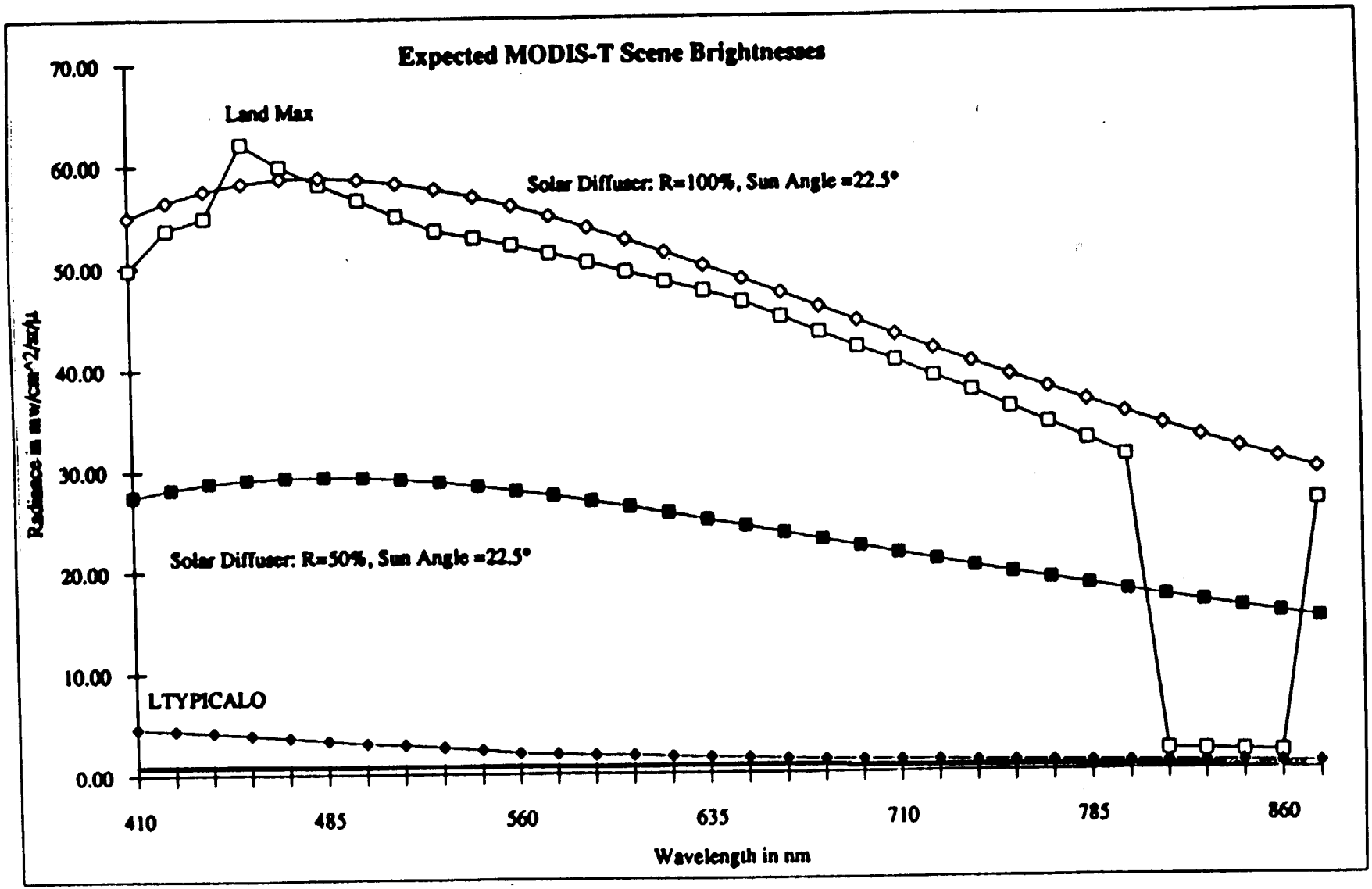
MODIS-T CALIBRATION CONCERNS

- LOW RADIANCE - LESS THAN L-TYPICAL FOR OCEANS
- POOR STABILITY - SPHERE REFLECTANCE CHANGE
  STRAY LIGHT ON SOLAR DIFFUSER
  STABILITY OF DIFFUSER PANEL
  CHANGE OF SPHERE OUTPUT WITH SOLAR ANGLE
- OTHER QUESTIONS - SPATIAL UNIFORMITY OF OUTPUT
  REQUIRED CHARACTERISTICS OF TRANSMISSION DIFFUSER

Sphere efficiency normalized to reflectance of .98




MODIS-T Flight Calibration System Expected Radiances
Single Integrating Sphere
ICS Maximum: Pixel = 1, Tilt Angle = +20.0, Sun Angle = 31.9
ICS Nominal: Pixel = 1, Tilt Angle = 0.0, Sun Angle = 22.5
ICS Minimum: Pixel = 1, Tilt Angle = -20.0, Sun Angle = 13.2
5% Solar diffuser
LtypicalO
ICS Maximum
ICS Nominal
ICS Minimum
5.00
4.00
3.00
2.00
1.00
0.00
410
485
560
635
710
785
860
Wavelength in nm


Expected MODIS-T Scene Brightnesses
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
Land Max
Solar Diffuser: R=100%, Sun Angle =22.5°
Solar Diffuser: R=50%, Sun Angle =22.5°
LTYPICALO
410
485
560
635
710
785
860
Wavelength in nm

MODIS-T CALIBRATION

SUGGESTIONS

- BUILD AND RADIOMETRICALLY TEST WORKING MODEL
- CONSIDER SINGLE SPHERE (CAVITY) DESIGN
- MCST CRITICALLY REVIEW RADIOMETRIC CALIBRATION MATH MODEL