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To: Bruce Guenther
Subject: Cross-calibration survey (VISNIR)

Attached here is a summary of the VISNIR survey I conducted this past summer. Included is 1) a statement of the preferred cross-calibration approach, as endorsed by select members of the VISNIR group, 2) two vugraphs which summarize the wavelength and fields-of-view of the various instruments, and 3) a listing of these same data, as given by the respective calibration representatives in the survey responses. The group would like to wait until payload selection before taking any further actions.

The Cross-Calibration Goal write-up was extracted from a June 6, 1991 memo from Frank Palluconi which expressed the consensus of the U.S. Aster Team members (A. Kahle, H. Kieffer, F. Palluconi, P. Slater, and H. Tsu).

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Instrumentor Cross-Calibration Goal

The EOS Project is fundamentally commited to the acquisition of data which can be reduced to geophysical data products of high and known accuracy.

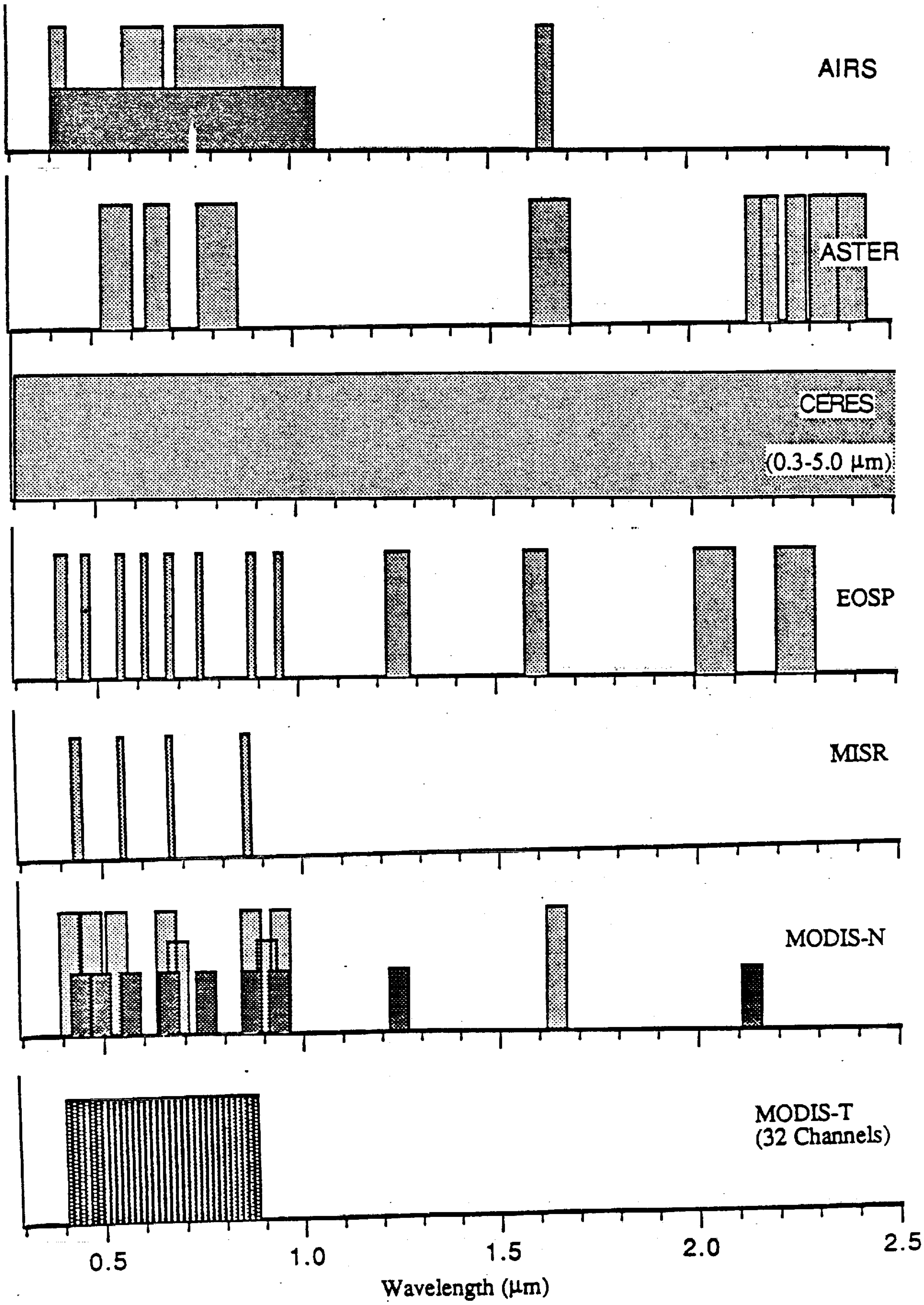
One possible method of insuring the primary data products are of known accuracy is to use the instruments themselves against the same sources to provide an independent check that a common understanding of accuracy exists.

The goal then of the radiometric "Cross-Calibration" at the integrator facility (GE) would be to convincingly establish as late as feasible in the Integration and Test (I&T) cycle that, when stimulated with common sources, the appropriate EOS instrument measurements agree within their previously established accuracy estimates across a useful radiance range, accounting for the additional uncertainty associated with the unique properties of the test set-up itself.

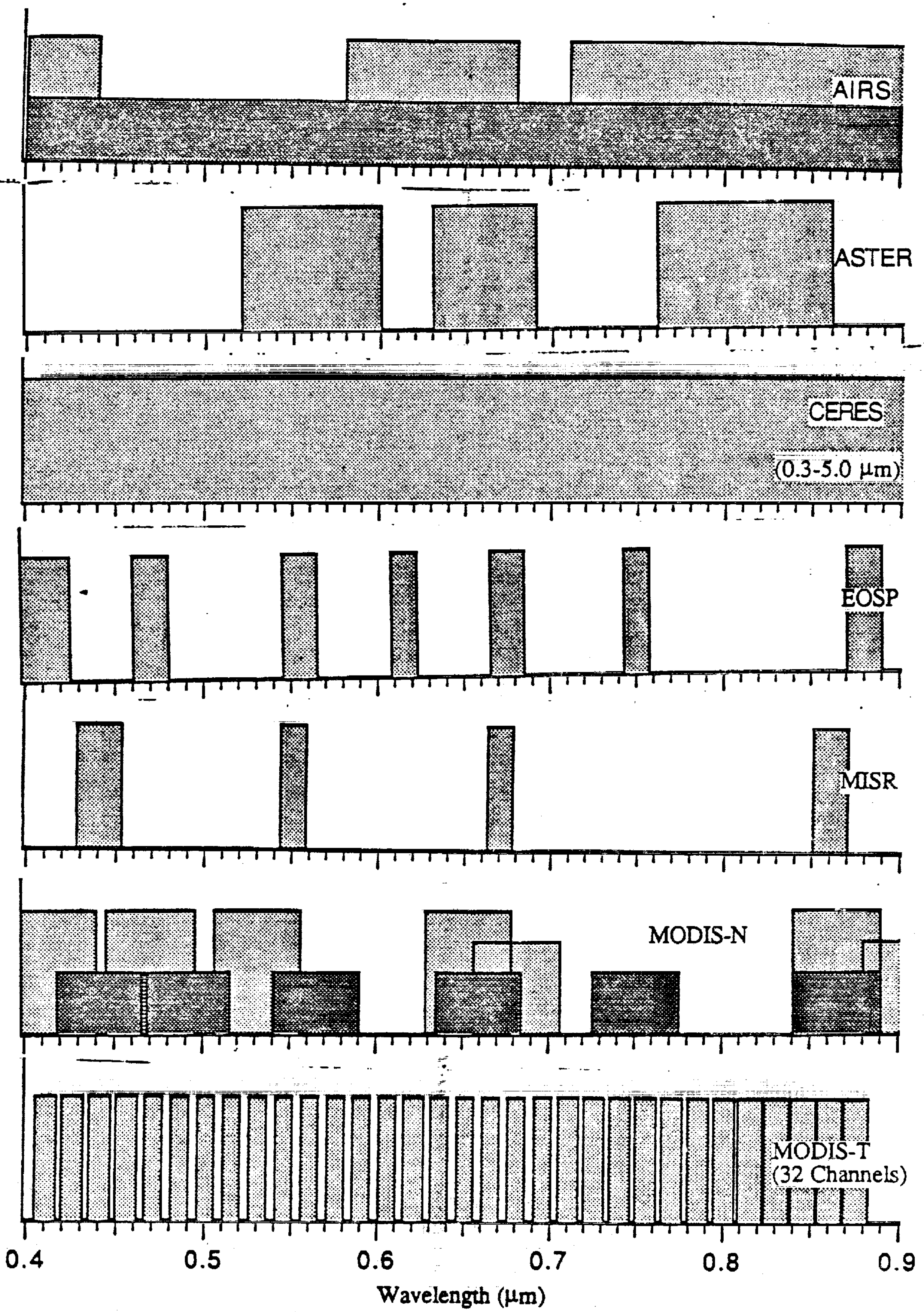
We do not consider that the instrumentor "Cross-Calibration" constitutes a replacement for the radiometric calibration completed at the instrument builders before shipment to GE. If a disagreement is found between instruments, it should be part of the "Cross-Calibration" plan to resolve this disagreement, but should not be the plan's intention that data developed in "Cross-Calibration" at GE replace the previous instrument radiometric calibration.

Likewise, we recognize that instrument to instrument agreement before launch does not insure agreement after launch. It is recommended, therefore, that emphasis be placed upon cross-calibration post launch, since it is the in-flight instrument accuracy which is of primary concern to the data user.

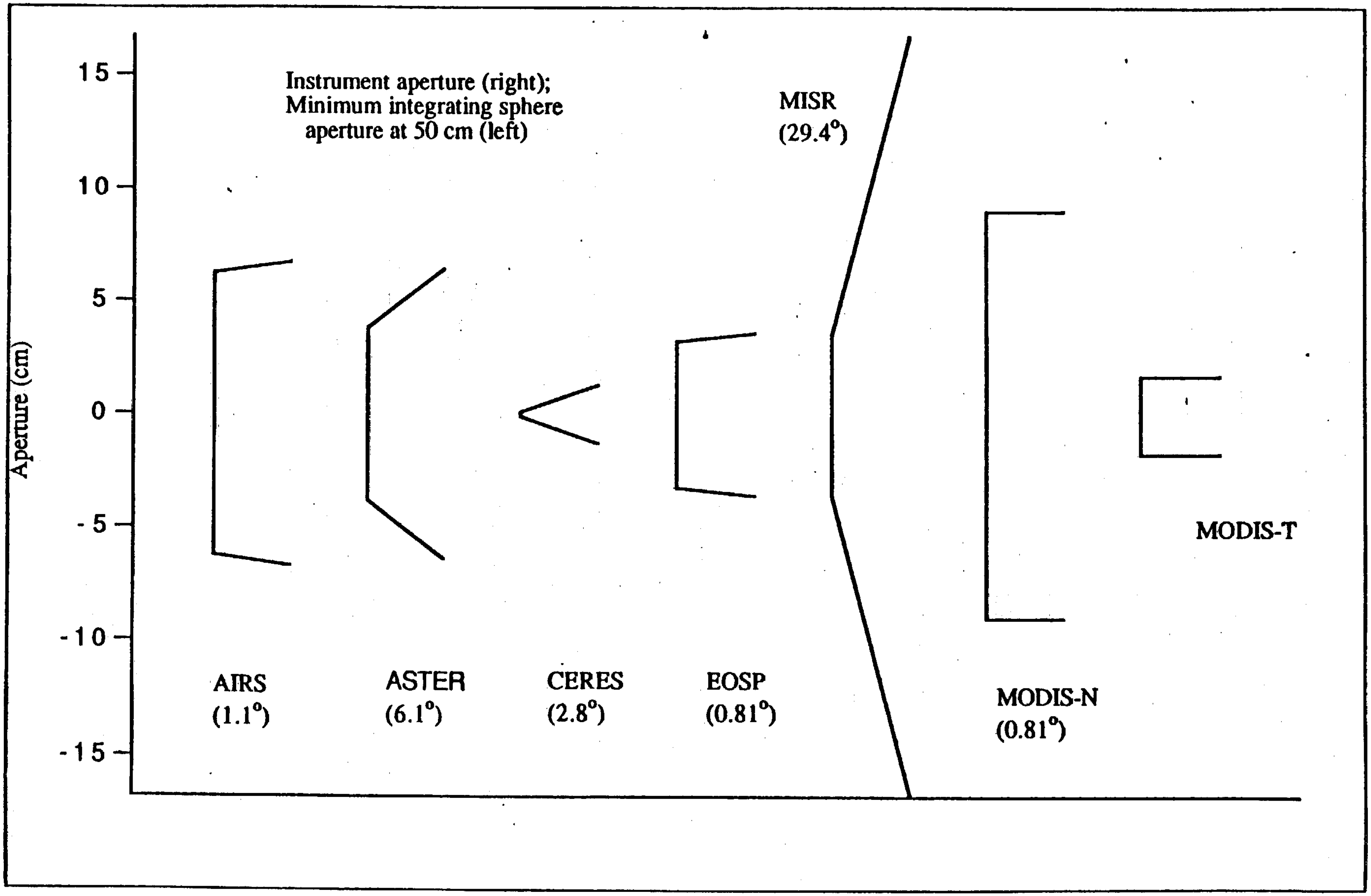
Wavelength Comparison (VISNIR)



Wavelength Comparison
(VIS)



Field-of-view Comparison (VISNIR)



Survey responses

1. AIRS

Radiometric calibration: 1-2%
Entrance aperture: 12.5 x 12.5 cm
IFOV: 1.1°

Wavelength (μm)	Bandpass (nm)
0.42	40
0.4 to 1.06	
0.63	100
0.85	270
1.64	40

2. ASTER

Radiometric calibration: 4% VNIR & SWIR
Entrance aperture: 7.6 cm VNIR; 17 cm SWIR
IFOV: 6.1° (nadir), 5.2° (forward) with 0.6 aspect ratio; 4.94° SWIR
Notes: At instrumentor only ambient tests are planned

VNIR		SWIR	
Wavelength (μm)	Bandpass (nm)	Wavelength (μm)	Bandpass (nm)
0.56	80	1.65	100
0.66	60	2.16	40
0.81	100	2.20	40
		2.26	50
		2.33	70
		2.40	70

3. CERES

Radiometric calibration: 1% (shortwave); 0.5% (total)
Entrance aperture: <0.15 cm
IFOV: 1.12 x 2.8°
Notes: At instrumentor only ambient tests are planned

Wavelength (μm)
0.3 to 5
0.3 to 200.

4. EOSP

Radiometric calibration: 5%; Goal: 3%
Entrance aperture: 6.5 cm
IFOV: 0.81° (3° needed for calibration as scans)

Wav. (μm)	Bandpass (nm)	Wav. (μm)	Bandpass (nm)
0.410	30	0.880	20
0.470	20	0.950	20
0.555	20	1.250	60
0.615	15	1.600	60
0.675	20	2.050	100
0.750	15	2.250	100

5. MISR

Radiometric calibration: 3%
Entrance aperture: 7 cm
IFOV: 29.4° (A), 23.8° (B), 18.4° (C), 14.4° (D)
Dynamic range can be expressed in term of an equivalent reflectance, $\rho = \pi L / E_0$:

Wavelength (μm)	Bandpass (nm)	ρ_{max}	ρ_{min}
0.440	25	1.0	0.02
0.550	15	1.0	0.02
0.670	15	1.0	0.02
0.860	20	1.0	0.02

(What is ρ_{max}, ρ_{min} for other instruments?)

6. MODIS-N

Radiometric calibration: 5% (relative to NIST)
Entrance aperture: 18. cm
IFOV: 0.081° square

Wav. (μm)	Bandpass (nm)	Wav. (μm)	Bandpass (nm)	Wav. (μm)	Bandpass (nm)
0.415	50	0.653	50	0.905	50
0.443	50	0.659	50	0.936	50
0.470	50	0.681	50	0.940	50
0.490	50	0.750	50	1.24	50
0.531	50	0.865	50	1.64	50
0.565	50	0.865	50	2.13	50

7. MODIS-T

Radiometric calibration: 5% (relative to NIST)
Entrance aperture: 3.4 cm
IFOV: 0.0894°

Wav. (μm)	Bandpass (nm)	Wav. (μm)	Bandpass (nm)	Wav. (μm)	Bandpass (nm)	Wav. (μm)	Bandpass (nm)
0.410	13	0.530	10	0.650	11	0.770	12
0.425	12	0.545	10	0.665	11	0.785	12
0.440	12	0.560	10	0.680	11	0.800	12
0.455	11	0.575	10	0.695	11	0.815	15
0.470	11	0.590	10	0.710	11	0.830	15
0.485	11	0.605	10	0.725	11	0.845	15
0.500	11	0.620	10	0.740	11	0.860	15
0.515	11	0.635	10	0.755	12	0.875	13

GE Integrating Sphere

Assumption

- 40" diameter integrating sphere assumed largest available (60" have been built)
- exit port 1/3 the diameter of sphere (13" ~ 33 cm)
- sphere - instrument working distance is 50 cm
- Fill factor of 2 desirable (largest FOV to accommodate is 6.5" at sphere). Smallest fill factors (**bold**) are difficult to accommodate

Problem

What is fill factor for various instruments?

Instrument (FOV, °; aperture, cm)	Fill factor	Comments
AIRS (1.1; 12.5)	2.4	
ASTER (6.1; 7.6)	2.6	
CERES (2.8; 0.15)	12.7	
EOSP (3; 6.5)	3.6	3 x FOV required to accommodate scanning
MISR (29.4; 7)	**0.9**	1696 pixels
MISR (29.4/4; 7)	2.5	424 pixels
MODIS-N (0.081,18)	1.8	

$$\text{Fill} = 33\ \text{cm}/(\text{aperture}+2 \cdot 50\ \text{cm} \cdot \tan(\text{FOV}/2.))$$