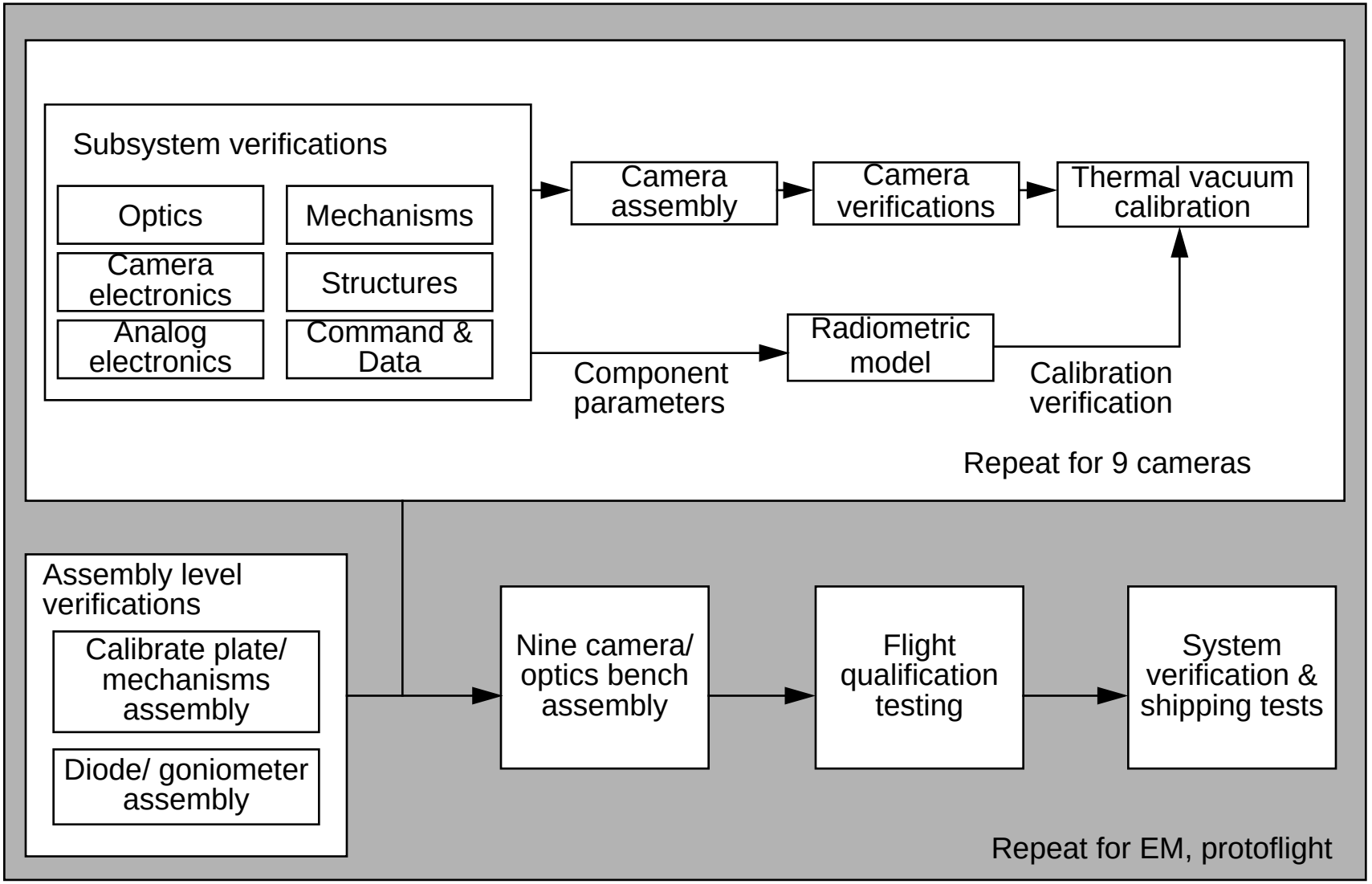
PREFLIGHT CALIBRATION TEST FLOW



HIGH BAY FACILITY

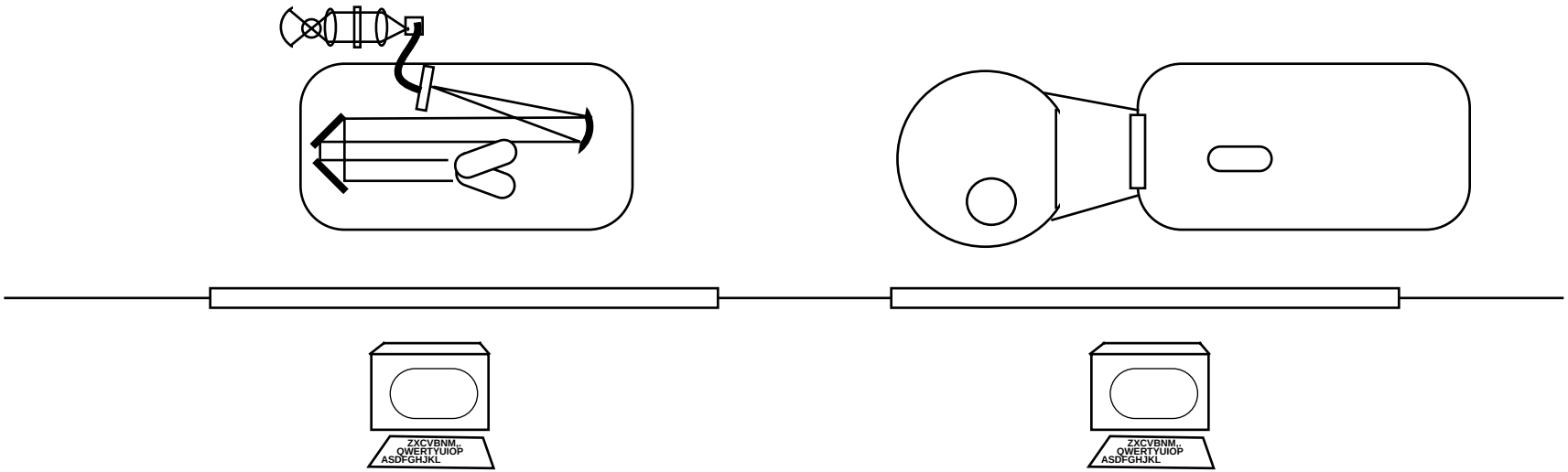
50x100 ft layout
x 30 ft height
Class 10,000 cleanroom

Optical Characterization Chamber

Features: Pinhole target, camera gimbal
Tests: EFT. MTF, PSF, Distortion, saturation

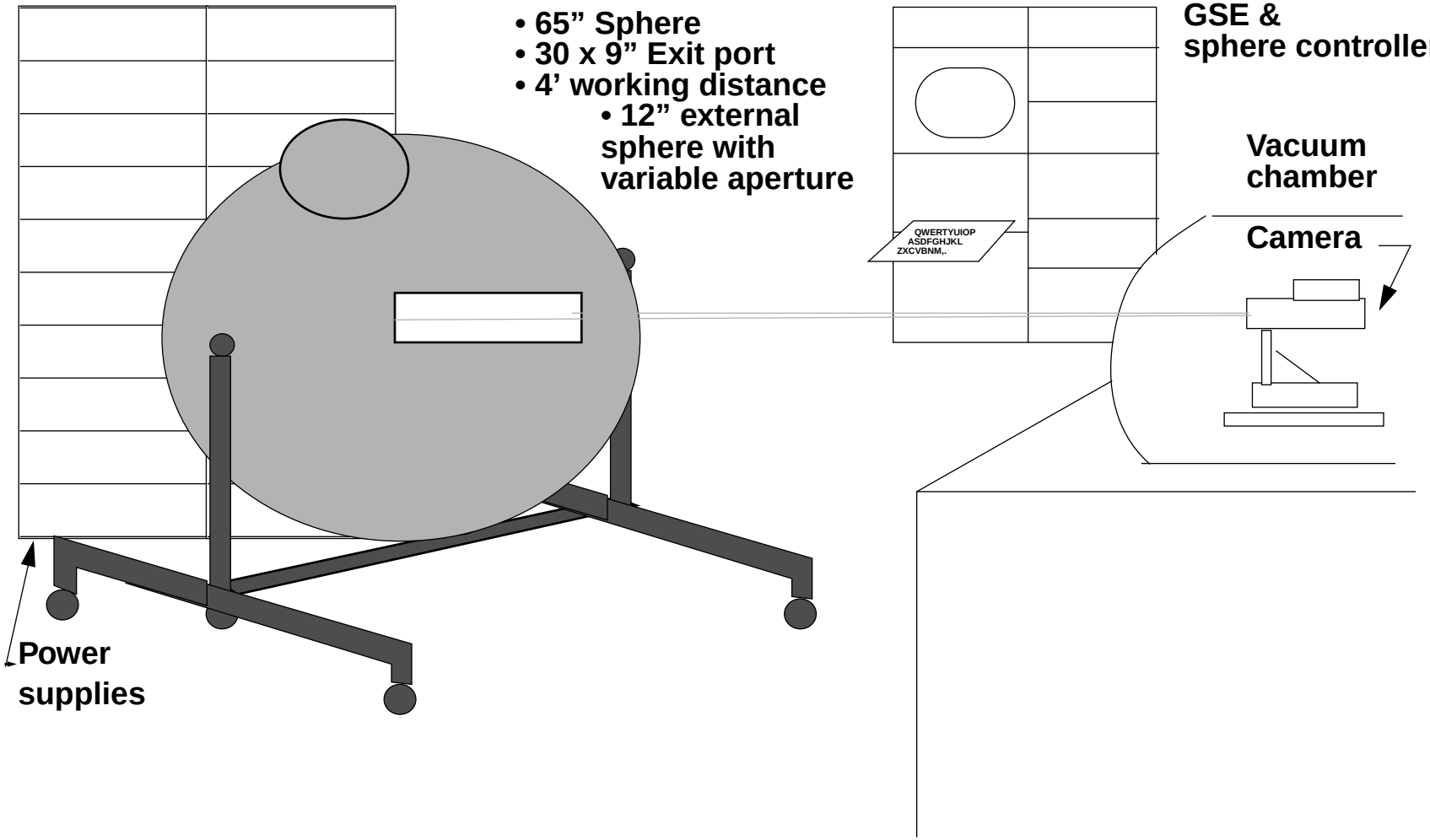
Radiometric Characterization Chamber

Features: 1.65 m sphere, monochromator
Tests: Radiometric and spectral calibration, polarization verification



Ground Support Equiment room

RADIOMETRIC CALIBRATION FACILITY



MISR CALIBRATION EQUATION

- **MISR will be calibrated in-flight by a regression of incident radiance against output DN.**
  - Preflight data analysis has shown that the cameras are linear, except at extremely low inputs (scene reflectance < 5%).
  - The use of a linear or non-linear equation, e.g. the quadratic

$$DN - DN_o = G_o + G_1 L_\lambda + G_2 L_\lambda^2$$

has been investigated. This equation is linear at high radiances and quadratic at small radiances. This latter equation will be baselined, upon completion of the current study.

- L_λ is the sensor band-averaged spectral incident radiance, averaged over both in-and-out-of-band wavelengths and reported in units of [W m^{-2} sr^{-1} μm^{-1}]:

$$L_\lambda = \frac{\int L_{source} \Re\lambda d\lambda}{\int \Re\lambda d\lambda}$$

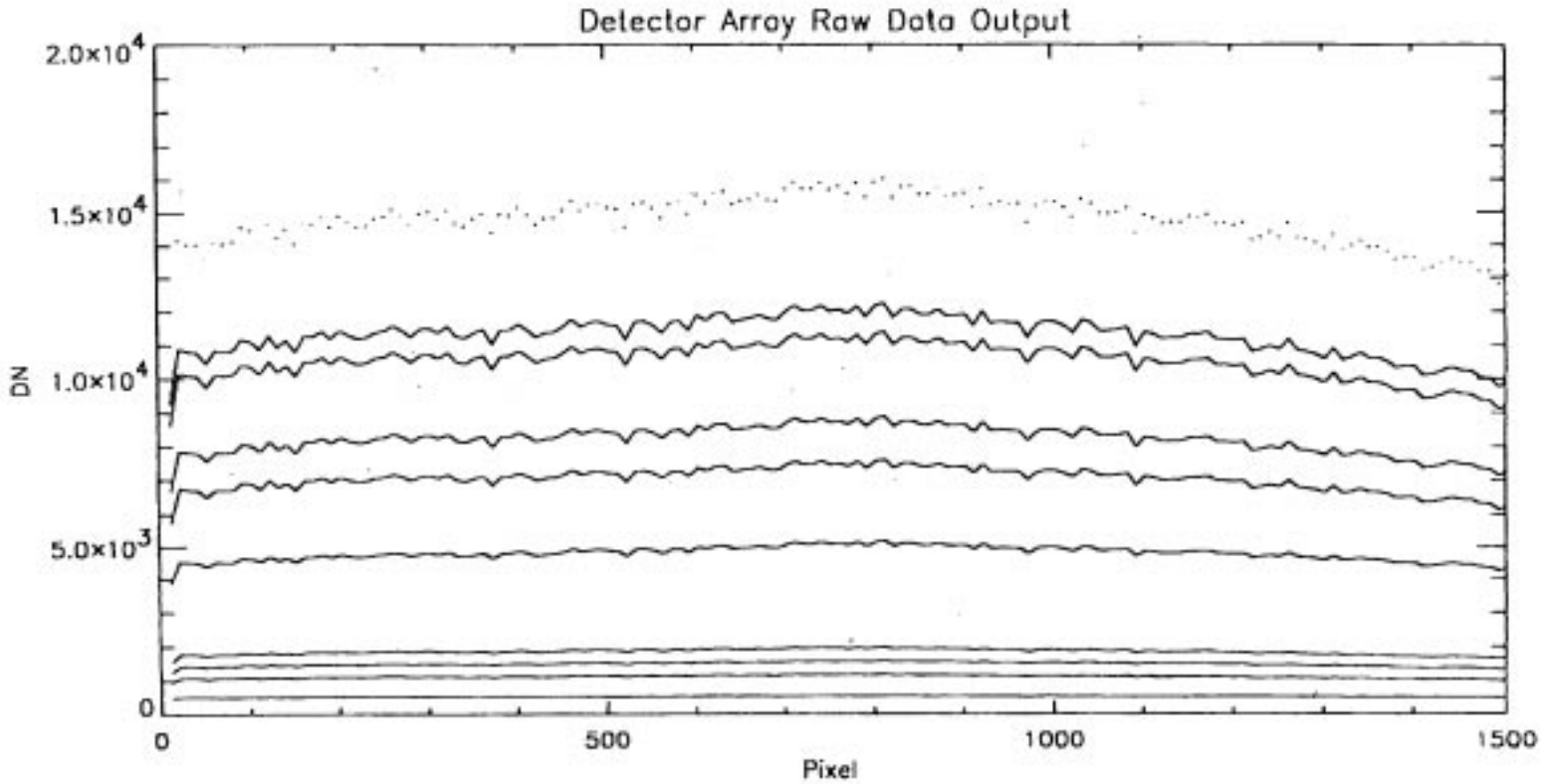
- R is the relative pixel spectral response; DN is the camera output digital number; G_0, G_1, and G_2 are the pixel response coefficients; DN_o is the DN offset, unique for each line of data, as determined by an average over the first eight "overclock" pixel elements.

RADIOMETRIC CALIBRATION: CAMERA OUTPUT DN

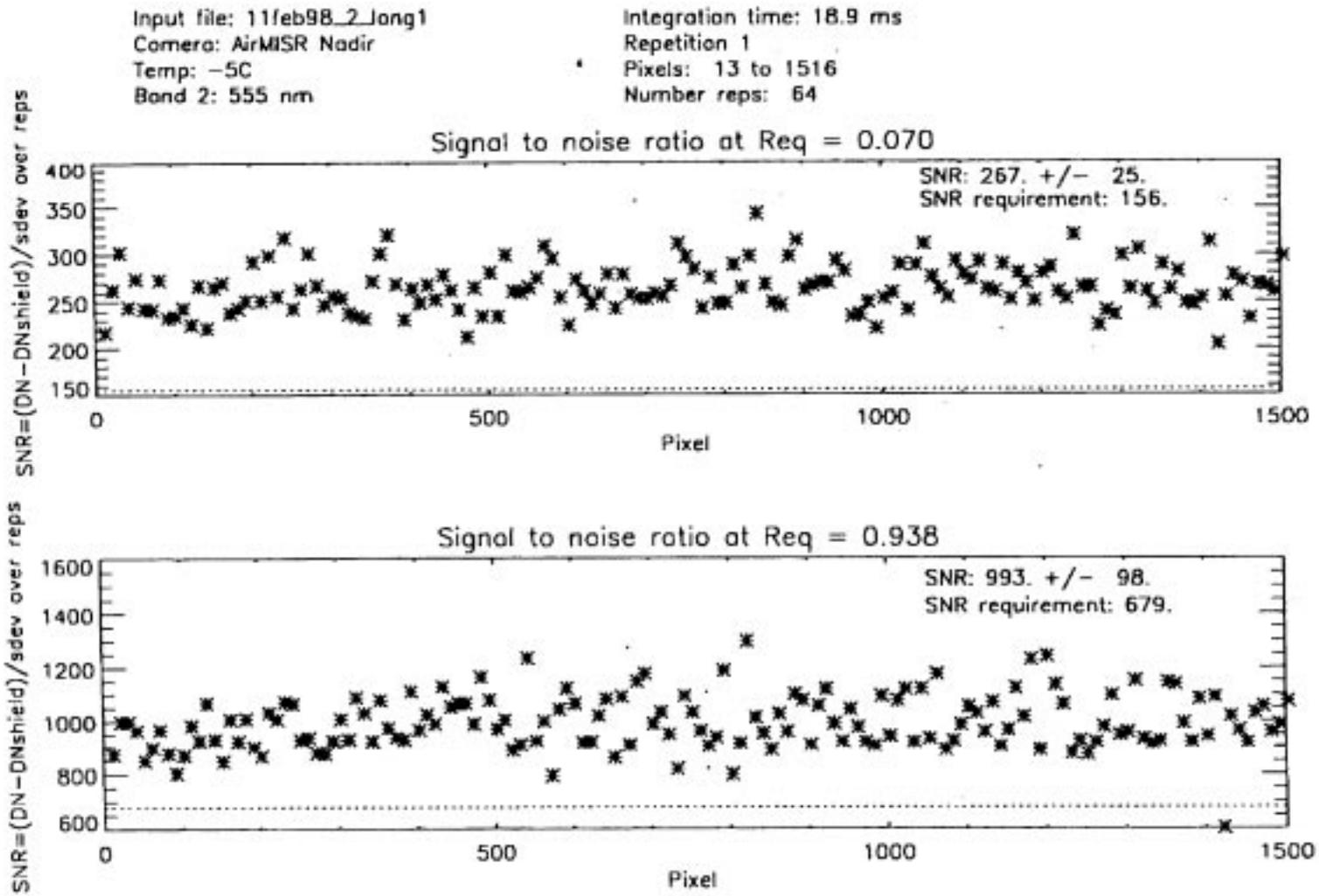
Input file: 12feb98_4_long1
Camera: AirMISR Nadir
FP temp: −5C
Band 4: 865 nm
Integration time: 21.8 ms
Pixels: 13 to 1516
Calibration Repetition 1

Repetition number: Averaged over all reps
For highest light level:
- mean: 14759. +/− 739. DN
- min: 68.26 % of maximum DN
- scatter over reps: 15. +/− 1. DN

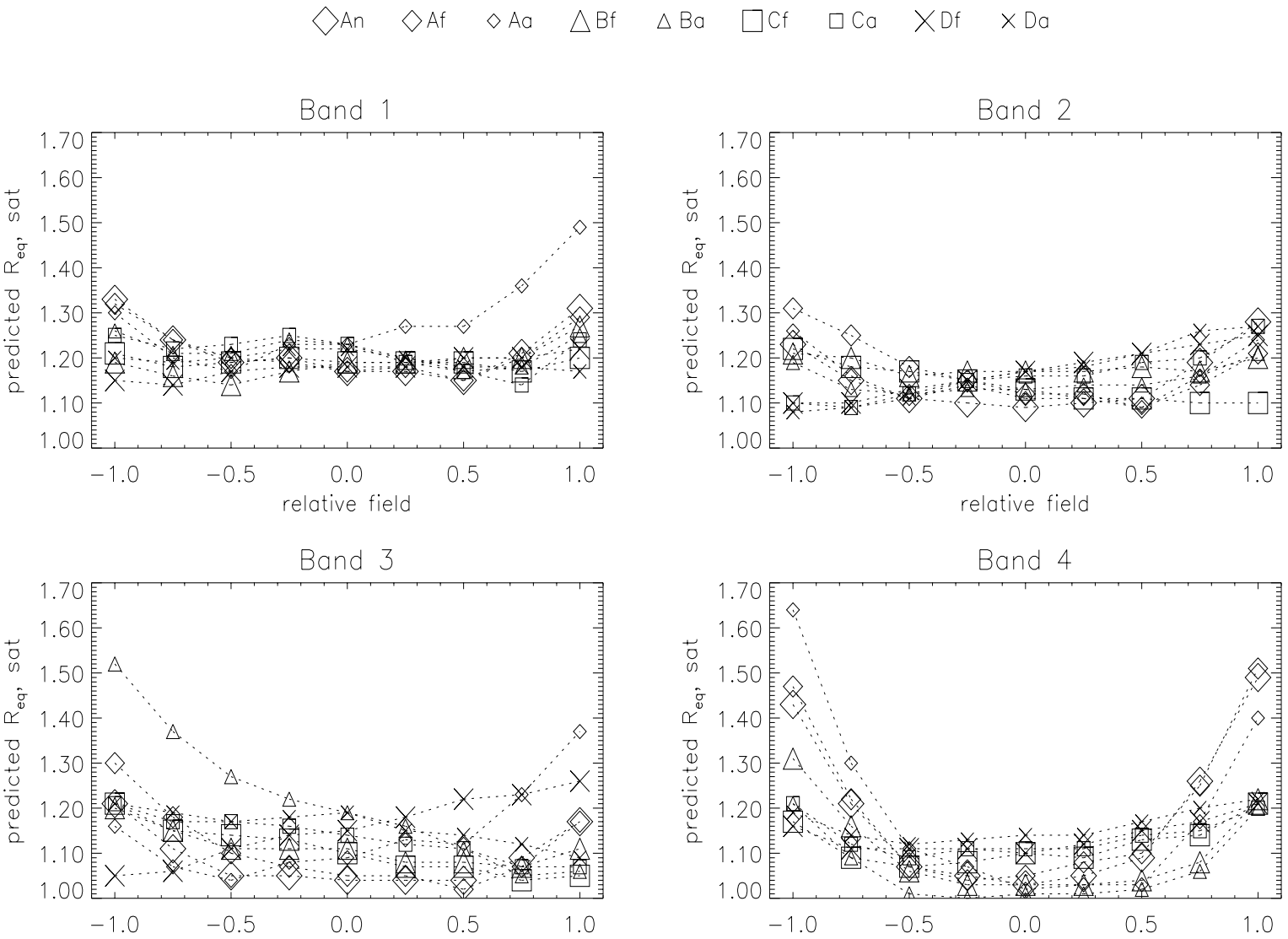
Average DN: 528 1121 1486 1854 4788 7031 8196 10521 11293 14759



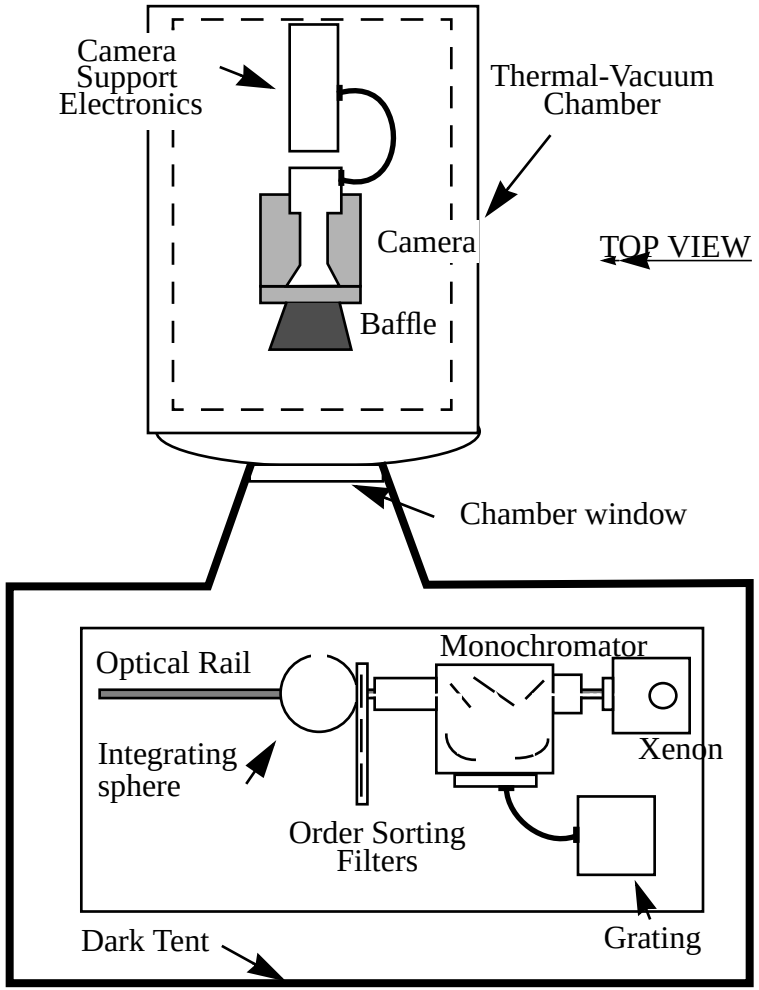
MEASURED CAMERA SNR



MEASURED CAMERA SATURATION LEVELS



SPECTRAL CALIBRATION



COMPOSITE RESPONSE PROFILE:

- **Measured data 400 to 900 nm**
- **In-band at 2.6 nm resolution, 0.5 nm sampling, 7 field position**
- **Out-band at 19.5 nm resolution, 5 nm sampling, 3 field positions**
- **Spectral model insludes focal-plane measurements to 1100 nm, and Code V lens model 365 to 400 nm.**

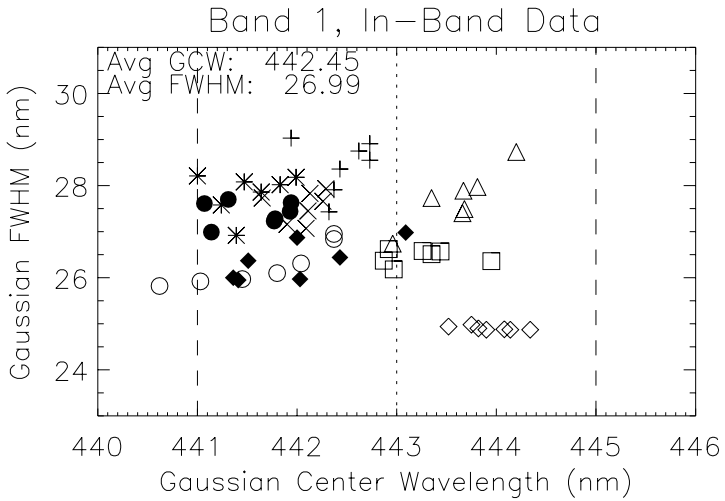
IMPROVED TESTING:

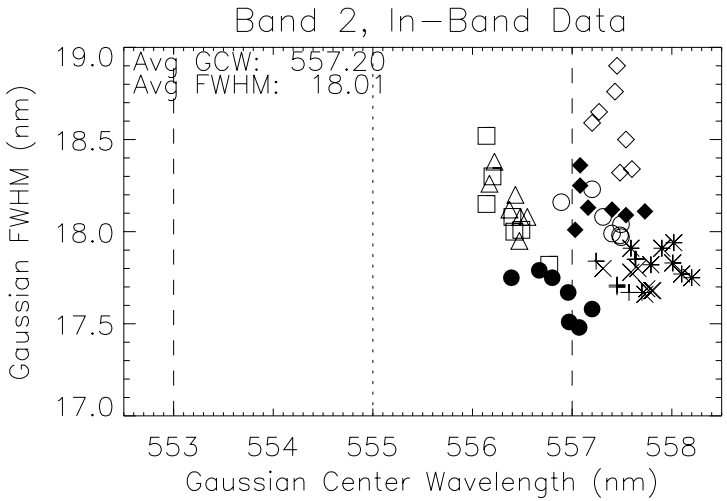
- **Obtained by use of an integrating sphere at monochromator exit slit. Spectral uniformity of illumination improved reduced from several nm to several tenths of nm.**

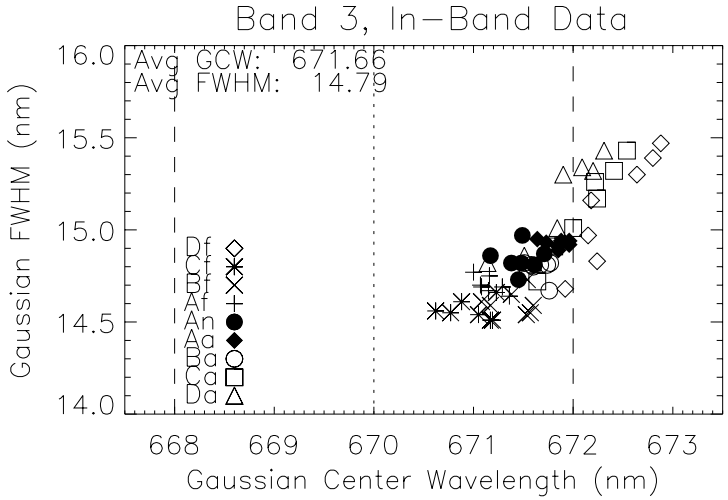
SPECTRAL RESPONSE FUNCTION DETERMINATION

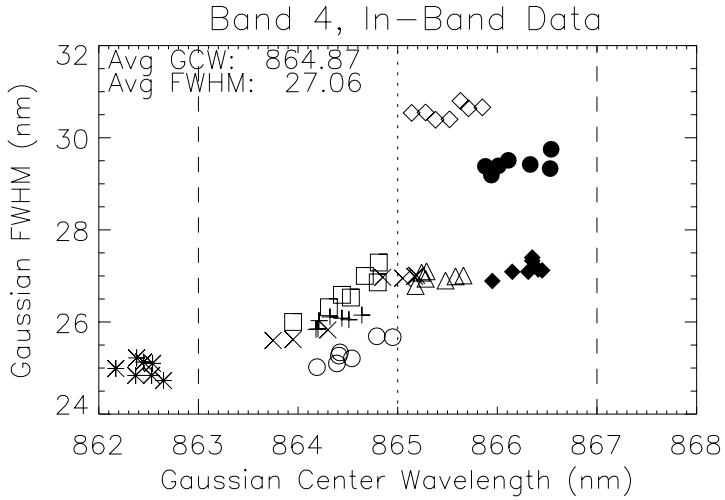
- **Separate in- and out-band measurements allowed us to cover 10^{-4} sensitivity range**
- **In-band spectral response measurements:**
  - 400 to 900 nm wavelength range
  - 2.6 nm spectral resolution
  - 0.5 nm sampling
- **Out-band spectral response measurements:**
  - 400 to 900 nm wavelength range
  - 19.6 nm spectral resolution
  - 10 nm sampling
- **Radiometric model utliized to extend response region from 365 nm to 1100 nm.**
  - lens model using CODE V at 5 field positions.
  - focal plane measurements of quantum efficiency (350-1100 nm)
  - analog-to-digital gain using camera response to varying integration time (while viewing the integrating sphere)
- **Both measured and band-averaged spectral response measurements published within the ARP**

MEASURED SPECTRAL PARAMETERS









SUMMARY

- **MISR testing of 10 cameras (9 flight and 1 spare) has been successfully completed after 1 year development and 1 year testing and analysis**
- **6 weeks per camera required to provide OCC (EFL, distortion, PSF), RCC (radiometric, spectral calibration, polarization verification), hot and cold margin, dynamics, and magnetics testing.**
- **Several verification failures appear to have little impact on the mission**
  - swath overlap meets requirements, though camera boresight failures noted
  - response uniformity meets requirement for all but a handful of pixels. Only 8 pixel zones (4 pixel block) out of 13,536 have a local uniformity exceeding 10%
- **Several verification failures result from unprecendented camera specifications, driven by 3 % radiometric requirement. Successful test program allows mission objectives to be met, following ground processing**
  - out-of-band errors can be reduced from 4% to 0.5% when needed. No correction necessary for Band 1, or bright targets
  - PSF deconvolution requires minimal processing: 1D, 51 pixels PSF, 20 iterations (no FFT required)
- **Saturation appears to affect many pixels within the line array.**
  - Saturation unlikely on orbit. Data Quality Indicators will identify affected pixels.