

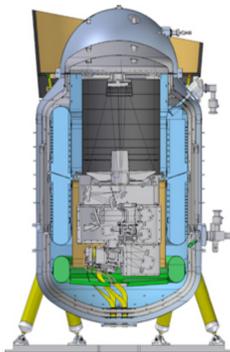
WISE Payload Pre-Launch Characterization and on-Orbit Results

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WISE Overview

WISE (Wide-field Infrared Survey Explorer) is a NASA explorer mission currently producing an all-sky survey with far better sensitivity and resolution than any previous IR survey. Space Dynamics Lab of Utah State University designed, built, and characterized the WISE science payload.

- 4 band Radiometer
 1. 2.8 – 3.8 μm
 2. 4.1 – 5.2 μm
 3. 7.5 – 16.5 μm
 4. 20 – 25 μm
- 40 cm aperture
- Solid Hydrogen Cryostats
- 4 1024x1024 arrays
 - 2.75 arc second pixels
 - 12 bit readout
 - 2 HgCdTe at 32 K
 - 2 Si:As at 7.1 K
- Sun-synchronous, outward-looking orbit
 - Observes strip of sky in each orbit
 - Observes whole sky in 6 months
 - Scan mirror freezes motion during 8.8 s integration time
- Launched December 14, 2010

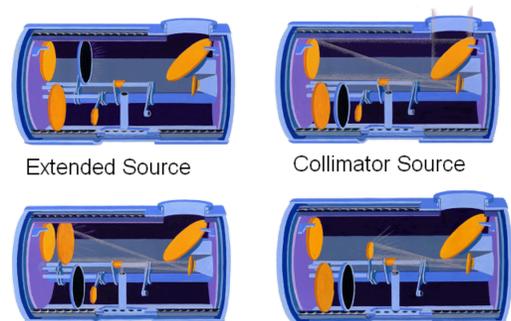


The WISE Payload

Ground Characterization

Significant properties characterized on the ground were:

1. Dark offset level
2. Dark level variation and gain variation
3. Detector non-linearity
4. Flatfield
5. Relative Spectral Response (the response to incident power as a function of wavelength for each band, including both response in and out of the spectral band)
6. Absolute Response
7. Optical distortion
8. Saturation level
9. Latent images
10. Droop
11. Scan motion linearity
12. Focus
13. Image Quality



The MIC2 source configurations are changed by moveable optical elements

Most characterization was performed using our MIC2 (Multi-function Infrared Calibrator)

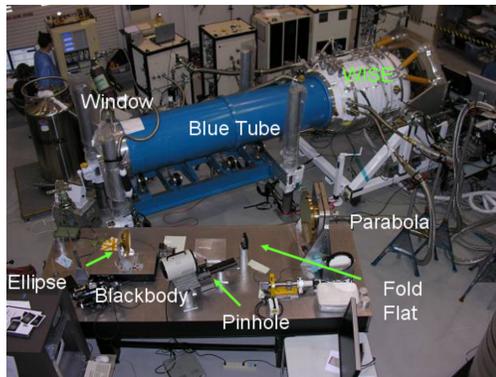
Focus and Image quality required additional Hardware

- WISE aperture larger than MIC2 aperture
- MIC2 focus not adequate to measure WISE focus

Characterization Tests

The characterization test setups used were:

1. The WISE imager in a chamber
 - A portion of the optics excluding the telescope are placed in a chamber and illuminated by an external collimator through a cold ND 7 filter
 - Two tests to obtain rough focus and confocality for all bands
2. WISE on the Blue tube
 - Three tests to find focus and image quality



The Blue Tube is a liquid nitrogen cooled shroud which keeps room radiation from excessively warming WISE.

An external collimator illuminates WISE through the Blue Tube window.

The window only passes band 1 of WISE.

Aluminized Mylar in the Blue Tube provides required ND filtering.

3. WISE on MIC2
 - Most properties tested here
 - Focus check for bands 2,3,4
4. WISE on MIC2 a 2nd time
 - Re-check of some properties after vibration and thermal testing to verify performance
 - Some properties re-measured here
5. WISE on Blue Tube a 2nd time



WISE attached to MIC2

Characterization Results

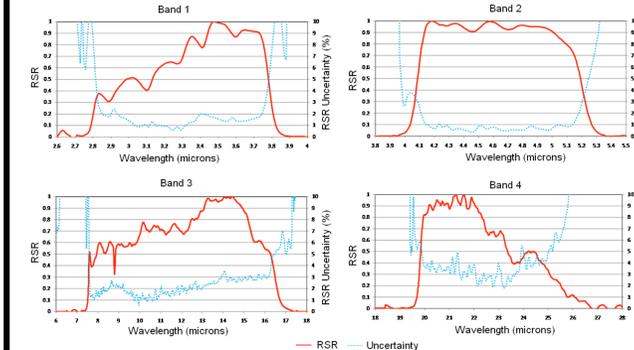
- All Characterization tests were successful
- Results usually showed WISE performed as expected
- Selected results are discussed below

Non-Linearity

- Unusual method used for non-linearity determination because of slow integration time and unusual pixel sampling method
- Non-linearity could be fit with 4th order polynomial
- Non-linearity varies from pixel to pixel; needed different parameters for each pixel
- Corrected response good to better than 1%

RSR

- In-band and out-of-band relative spectral response is found for all bands using a Fourier-Transform Spectrometer to illuminate MIC2



In-band Relative Spectral Response for all WISE bands

Focus

- Focus test and adjustment require repeated cold cycles
- Confounding effects must be carefully controlled, e.g. window temperature gradients affect focus

The band 1 focus result shows the shim increment (in mils) required to bring a point into perfect focus at each focal plane location where focus was measured. The variation seen here is mainly expected curvature in the focal plane. Requirement is for band 1 to be in focus within 2 mils.

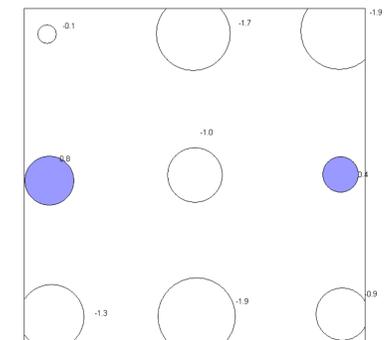
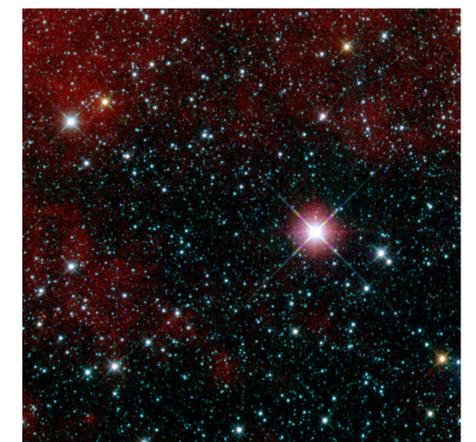


Image Quality

- Based on ground results we expected to meet on-orbit image quality requirement of 14.5 noise pixels for band 1. Other bands differ only by diffraction

Flight Results

- **WISE is performing as designed on Orbit**
- Sky survey started Mid-January
- 10 month lifetime expected
- Band 1 image quality is 12.7 noise pixels (smaller is better)



WISE first light image. More images can be found at http://www.nasa.gov/mission_pages/WISE/main/index.html