The NGST Yardstick Integrated Science Instrument Module (ISIM) Feasibility Study

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NEXT GENERATION

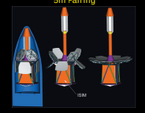
NGST

SPACE TELESCOPE

The Next Generation Space Telescope (NGST) Integrated Science Instrument Module (ISIM) consists of a cryogenic instrument module that is integrated with the Optical Telescope Assembly (OTA) and science processors, software, and other electronics located in the Space Support Module (SSM). The ISIM system provides structure, environment, and data handling for several modular science instruments as well as several components of the OTA optics train.

NGST Observatory

NGST 8m: EELV Medium 5m Fairing



An ISIM baseline design and feasibility study is ongoing by GSFC. This pre-Phase A design was developed for integration with the Yardstick NGST architecture and packaging in a 5 m class EELV fairing. The goals of this study are to: [1] demonstrate mission science feasibility, [2] assess ISIM engineering and cost feasibility, [3] identify ISIM technology challenge areas, and [4] enable smart customer procurement of the NGST. In depth results from this work beyond those displayed here can be found at: http://www701.gsfc.nasa.gov/isim/isim.htm

The flight ISIM will be developed by a GSFC led Integrated Product Team (IPT) that will grow during Phase A/B to include members from: the STSci, the NGST Prime Contractor, and science instrument development teams from European, Canadian , and NASA science communities. Science instruments will be competitively procured from the science community, and will be integrated into the ISIM by GSFC. The flight qualified ISIM will then be delivered by GSFC to the NGST Prime Contractor for observatory level integration.

At the start of NGST Phase A (April, 1999), two competing prime contractors will begin development of separate NGST architectures, and the ISIM IPT will develop two ISIM designs corresponding to these architectures. Down selection to a single design will occur during April 01.

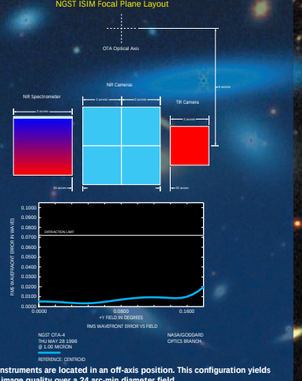
The ISIM team welcomes science community feedback. Contact the IPT lead: Matt Greenhouse, matt@stars.gsfc.nasa.gov.

ISIM Baseline Science Instruments

Instrument	Wavelength (µm)	Bandwidth	ITA	Pixel Pitch (µm)	Plate Scale (.10" arc-sec)	Aperture Control (arc-min)
Near-IR Camera (1 of 4*)	0.6 – 5.3	6 or 2_5 fixed filters, 4 0.6µ - 200 tunable filters	4096 x 4096	27	29	quad-beam divider: four 2 x 2 fields
Near-IR Spectrometer	0.6 – 5.3	R = 300, 3000 gratings	4096 x 4096	27	100	reflective slit mask; 20R0 x 2048 micro-mirror array, 100µm pixels
Mid-IR Camera/Spec.	5 – 28	quad-band filters, prisms, cross-disperser	1024 x 1024	27	230	slit selection = 2 x 2 camera

1. A quad-beam divider (pyramid mirror) apportions a 4 x 4 arc-min field of view over 4 identical cameras.

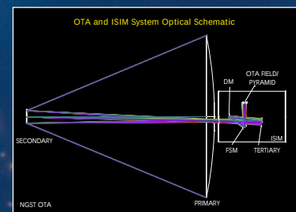
NGST ISIM Focal Plane Layout



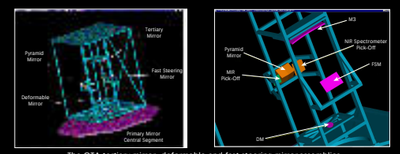
The ISIM instruments are located in an off-axis position. This configuration yields excellent image quality over a 24 arc-min diameter field.

Optical Design

OTA and ISIM System Optical Schematic



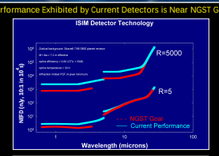
Opto Mechanical Layout



The OTA tertiary mirror, deformable and fast steering mirror assemblies, and pyramid mirror integrate into the ISIM in a modular fashion

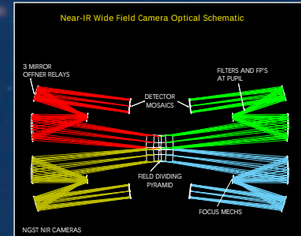
Focal Plane Arrays

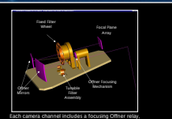
Performance Exhibited by Current Detectors is Near NGST Goals



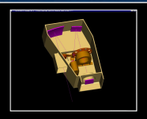
	QE	Read Noise (e) multiple read	Dark Current (e/s)
Aladdin InSb	0.8	15	0.1
Near-IR goal	0.8	3	0.02
Current SI:As	0.5	8	10
Mid-IR goal	0.5	3	1

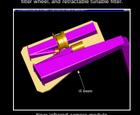
Near-IR Wide Field Camera Optical Schematic



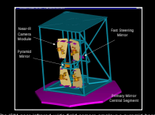


Each camera channel includes a focusing Offner relay, filter wheel, and retractable tunable filter.





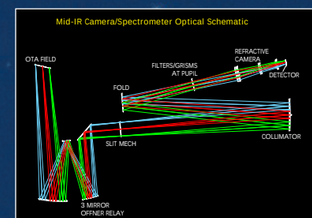
Near-infrared camera module with solid model beams

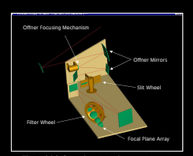


The ISIM near-infrared wide field camera employs a pyramid beam divider to apportion a 16 square arc-min field of view over four identical camera modules. Each module utilizes a 4096 x 4096 focal plane array covering 4 square arc-min.

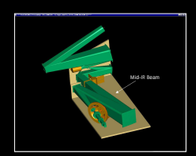
4096 x 4096 Near-Ir FPA Mother Board Assemblies

Mid-IR Camera/Spectrometer Optical Schematic



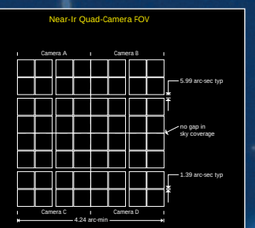


The mid-infrared camera/spectrometer module utilizes a 1024 x 1024 focal plane array and contains selectable slits, filters, and cross-dispersed grisms.

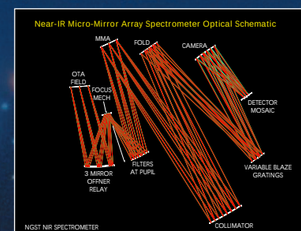


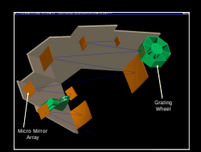
Mid-infrared camera/spectrometer module with solid model beams

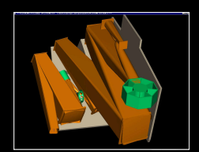
Near-Ir Quad-Camera FOV



Near-IR Micro-Mirror Array Spectrometer Optical Schematic

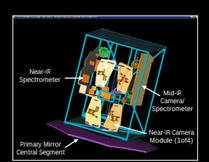






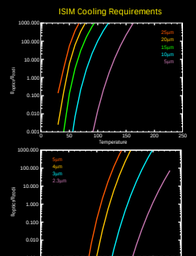
Detector Technology Development

- Five technology development grants issued by NGST
- Near-ir 0.6 - 5 um
  - Raytheon IRCoE & University of Rochester
    - 1024 x 1024 InSb, buttable to 4k mosaic, 30K operation
  - Rockwell Science Center & University of Hawaii
    - 2048 x 2048 HgCdTe and Si p-i-n diodes, buttable to 4k mosaic, 30K operation
- Mid-ir
  - Raytheon IRCoE & NASA ARC & Cornell University
    - 512 x 512 Si:As, buttable to 1k mosaic, 6-8K operation, 5-28 um
  - Boeing Research & Technology Center
    - Si:Ga, 1k mosaic, 10-12K operation, 5-18 um
  - Rockwell Science Center & University of Rochester
    - HgCdTe, 25-30K operation, 5-10 um
- Funded by Ball Aerospace:
  - Raytheon IRCoE
    - 2048 x 2048 ROIC for InSb

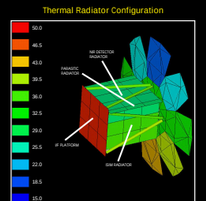


Thermal Design

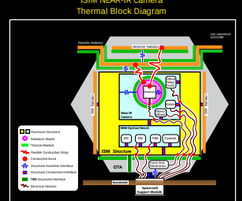
ISIM Cooling Requirements



Thermal Radiator Configuration



ISIM NEAR-IR Camera Thermal Block Diagram



ISIM optical bench temperature as a function of thermal background power relative to the Zodical light at various wavelengths.