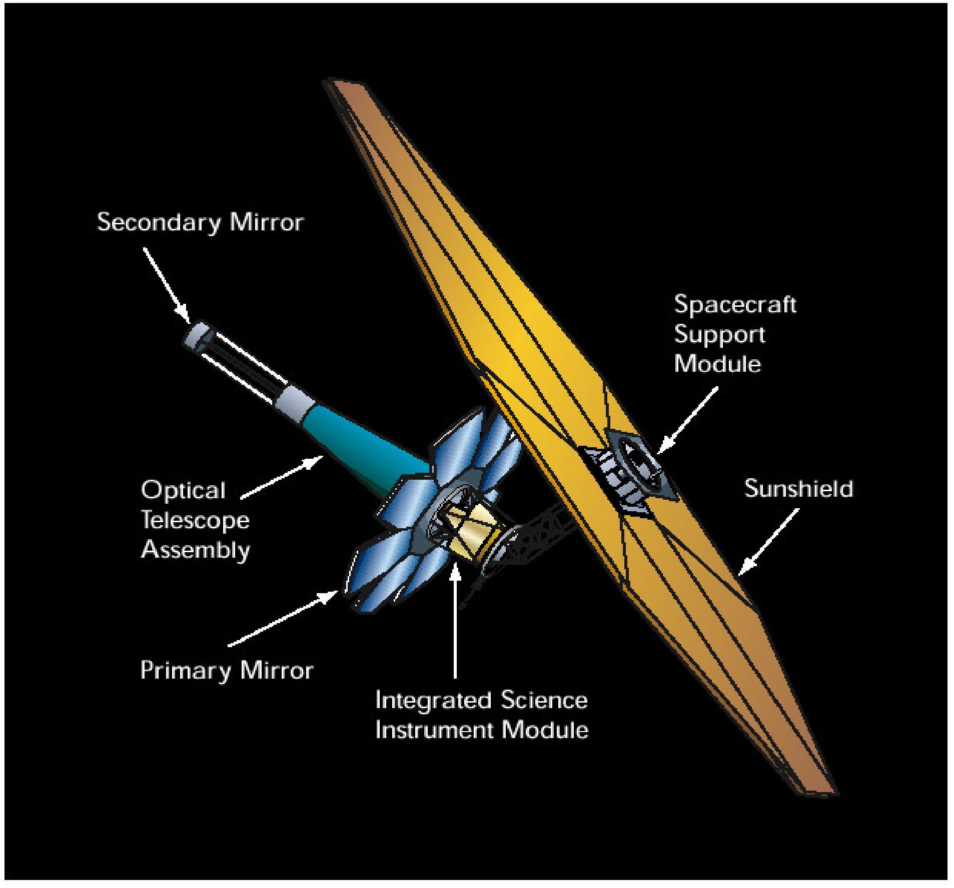
NGST — June 1999



What will NGST be?

Who is involved?

What will ESA contribute?

What will NGST do?

Schedule

- **What happens during the next year?**
- **Then what?**

NGST at a glance

8m primary mirror

0.6–10^{+}µm wavelength range

Zodi-limited -> ~ 12µm

Diffraction-limited @ 2µm

5 year lifetime, 10 year goal

Passive cooling to <50K

L2 Orbit — 1.5Mkm from Earth

Who pays what?

NASA part of construction

- $500M (FY96)

ESA contribution before launch

- ~$200M (a “Flexi-mission”)

CSA contribution

- ~ $50M

Total, including launch, operations, grants, tech. dev., inflation…

- ~ $2B (ie, 1/4 HST)

The Observatory

Key document is by Bély et al. Nov. 98

"Implications of the Mid-Infrared capability for NGST"

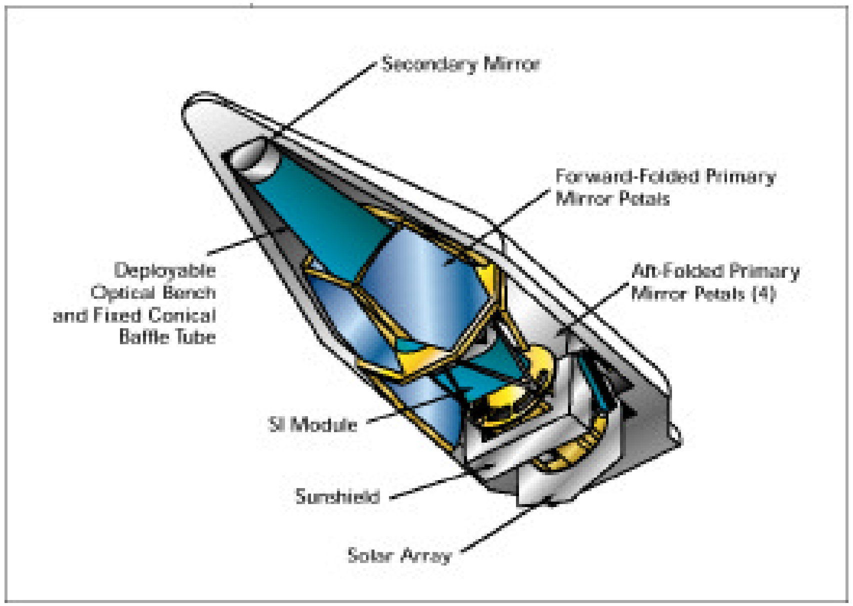
Three options

1. Near-infrared optimised
2. Mid-infrared compatible
3. Mid-infrared optimised

Conclusion

Mid-infrared compatible solution — with passive cooling to 30K (instrument) and 40K (optics) — is preferred

Launch and orbit



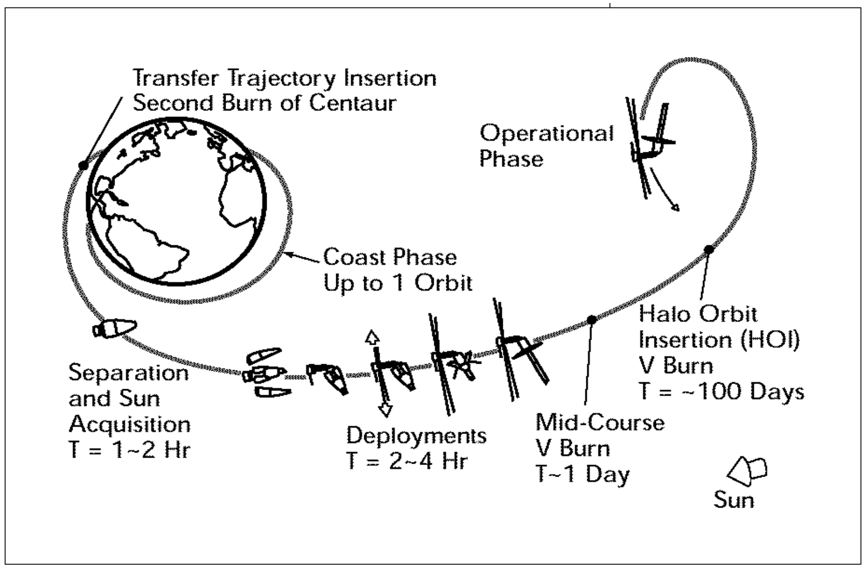
Events on the way to L2

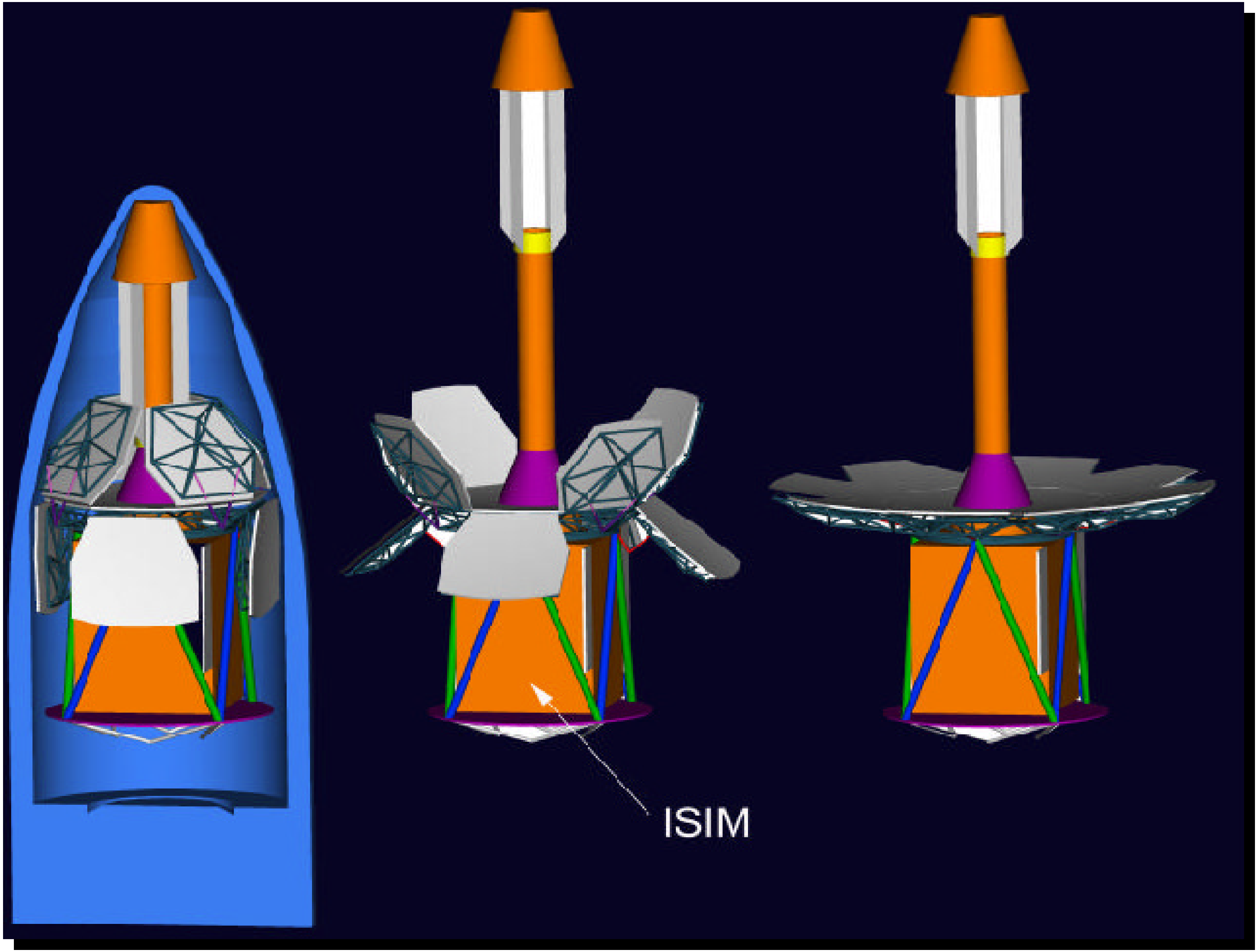
Deployment while warm

~3 months to L2 halo orbit

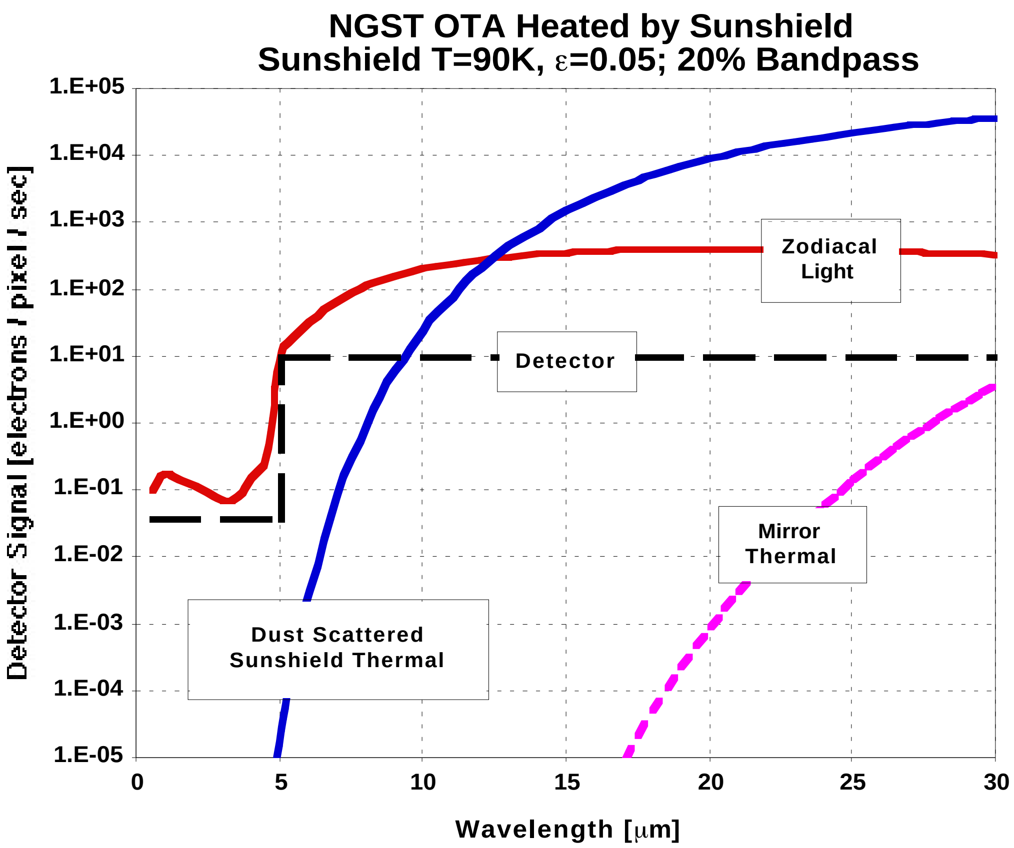
The Yardstick launch configuration: 3300kg

Atlas IIAS or EELV Med.




ISIM

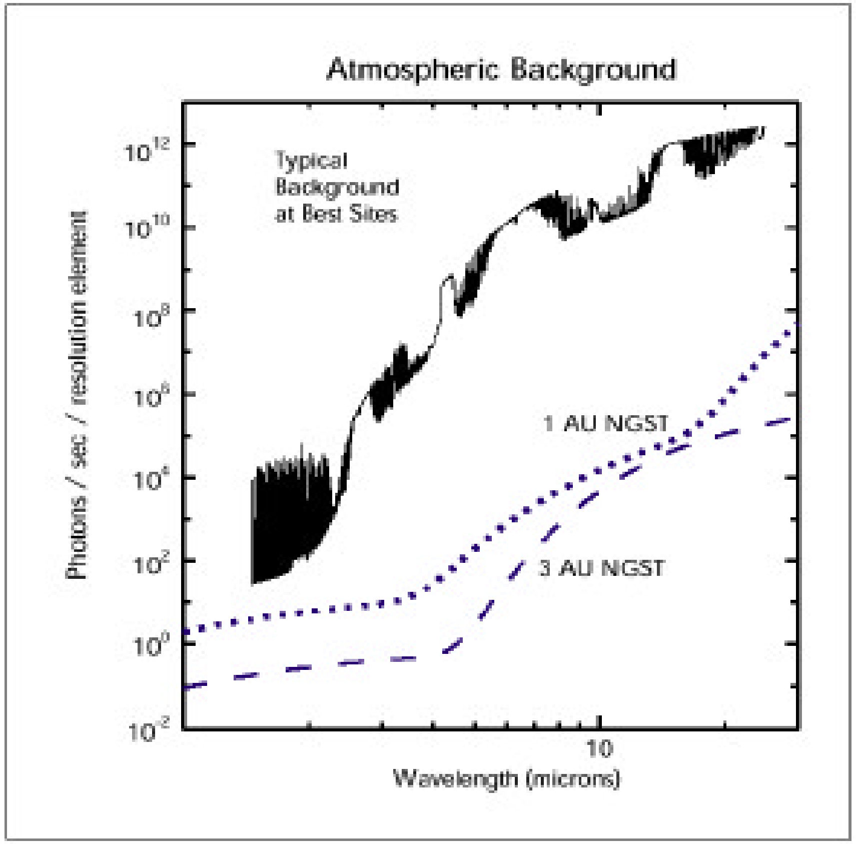
Backgrounds



Radiation from back of sunshield is critical

Sunshield temperature of 90K gives Zodi limit to ~ 12μm

The background advantage



Upper curve:

Mauna Kea, 1mm water

Lower curves

Zodi @ 1AU and 3AU with 50K optics

Science goals

Observe the origin & evolution of galaxies

Study structure & chemical enrichment of Universe

Study star and planet formation

In practice, these goals are represented by the Design Reference Mission (DRM) — revised this spring by the ASWG

Science oversight

Ad hoc Science Working Group (ASWG)

Team in the US with European & Canadian participation, responsible for the DRM and the selection of instrumental capabilities. Will be replaced in ~2 years with a flight SWG

ESA Science Study Team (SST)

Science oversight of ESA studies. Contributes members to ASWG(+)

The top-ranked DRM progs.

Rank	DRM Title	Scientific Capabilities
1	Form. & Evol. Galaxies- Imaging	2 micron dif.-limited imaging, wide FOV, 8-m sensitivity, 0.6-5 microns
2	Form. & Evol. Galaxies- Spectra	NIR multiplexed spectroscopy, 1-5 microns, R = 100-3000, 5-10 MIR spectroscopy, R=3000
3	Mapping Dark Matter	Widest FOV, stable PSF
4	Searching for the Reionization Epoch	Very sensitive NIR spectroscopy, R = 100-300
5	Measuring Cosmological Parameters	Ability to follow fields over months
6	Form. & Evol. Galaxies- Obscured Stars & AGN	MIR (10-28+microns) imaging and spectroscopy, R = 300
7	Physics of Star Formation: Protostars	MIR (10-28+microns) imaging and spectroscopy, R = 3000+
8	The Age of the Oldest Stars	Low scattering in PSF
9	Detection of Jovian Planets	5 micron coronagraph
10	Evolution of Circumstellar Disks	MIR spectroscopy, R=30000+
11	Measuring the Rates of Supernovae	Ability to followup imaging with weeks
12	Origins of Substellar Mass Objects	Core NIR imaging
13	Form. & Evol. Galaxies- Clusters	Core NIR imaging and spectroscopy
14	Form. & Evol. Galaxies- AGN	Core NIR imaging and spectroscopy

CORE

ESA–NASA collaboration

Partnership concept

1. HST after 2001
2. Europe -> NGST

NGST collaboration on 'HST model'

Instrumentation, spacecraft h/w, operations

Financial target $200M

15% min. observing time for ESA members

Industrial studies to identify potential ESA contributions

NASA funded studies

Conceptual Study of the NGST Science Instrument Module
Jill Bechtold/University of Arizona

An Integral Field Infrared Spectrograph for the NGST
James R. Graham/University of California, Berkeley

NGST-MOS: A Multi-Object Spectrometer using Micro Mirror Arrays
John W. MacKenty/Space Telescope Science Institute

A High Efficiency, Wide-Band, Multi-Object NIR Spectrograph for the NGST
S. Harvey Mosely/NASA Goddard Space Flight Center

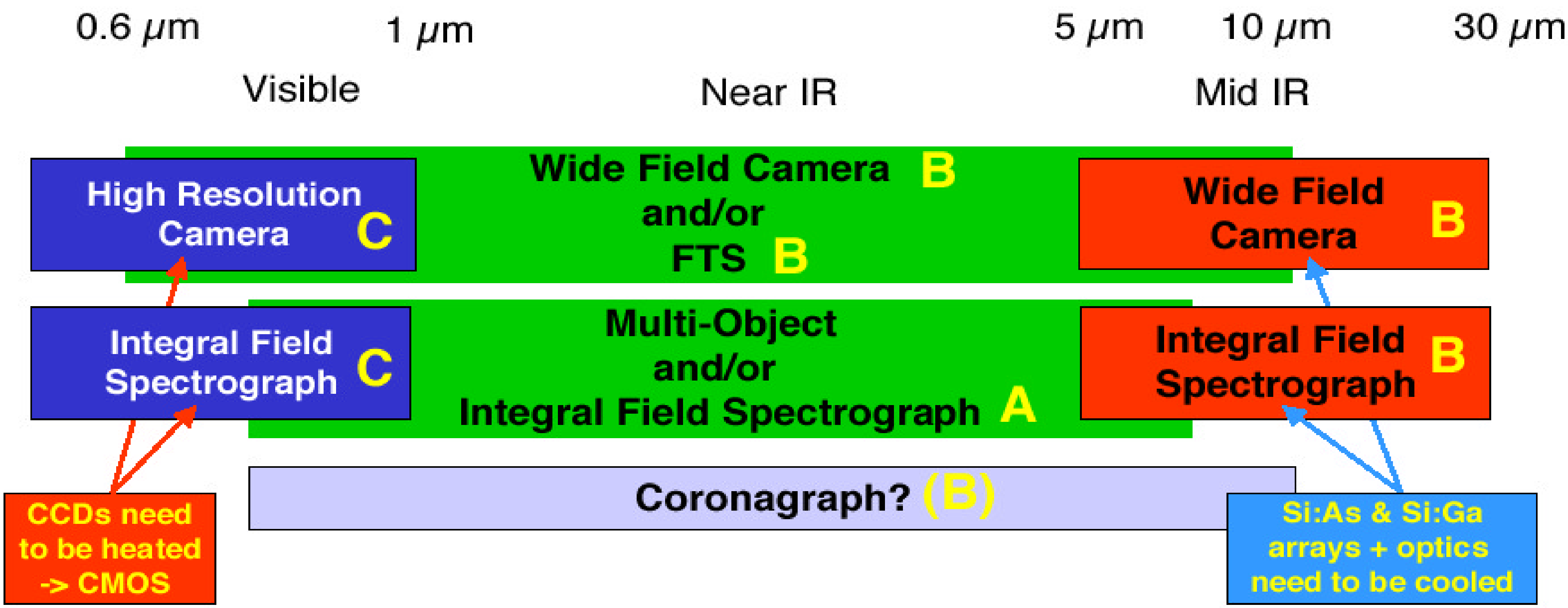
A Mid-Infrared Camera for the NGST
Gene Serabyn/Jet Propulsion Laboratory

High-Contrast Origins Science Strategies for NGST
John Trauger/ Jet Propulsion Laboratory

ESA-funded studies

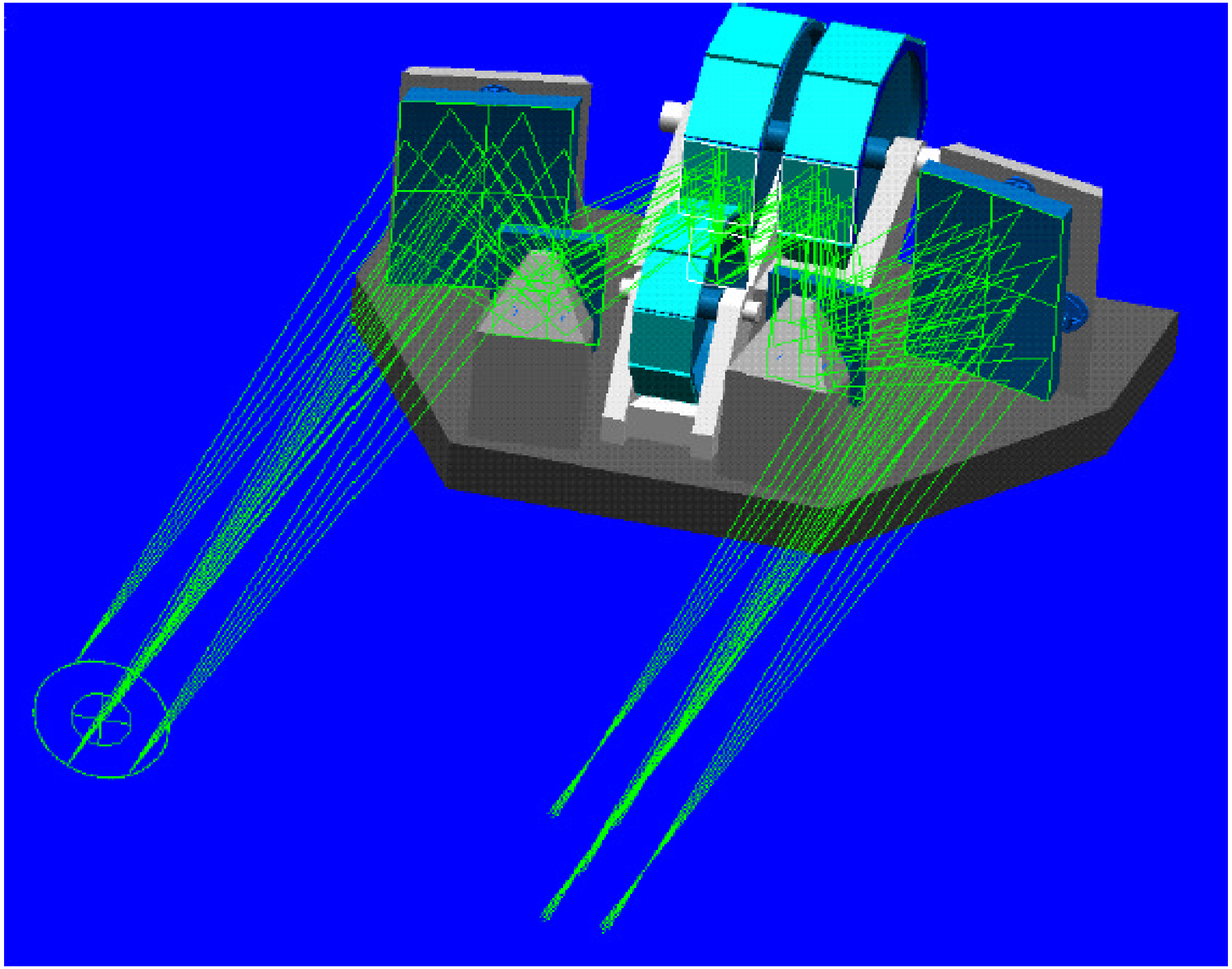
- **Telescope and payload suite (750kEur)**
  - *Dornier, Alcatel, LAS, UKATC*
- **Multi-object/Integral field spectrograph (200)**
  - *LAS, Dornier (+ Durham, ESO, Leiden, MPE)*
- **Visible wavelength camera/spectrograph (150)**
  - *Matra-Marconi, Dornier, Leicester, MSSL, LAS, UCL, Obs. Paris*
- **On-board data management (150)**
  - *Laben, Dornier, IFC (Milan) Arcetri, LAS, Leicester, UCD*
- **Other spacecraft systems**
  - *ESA (in house)*

Instrument studies overview



A) ESA Spectrograph Study
B) ESA Telescope & Payload Suite Study
C) ESA Visible Camera/Spectrograph Study

NIR camera concept



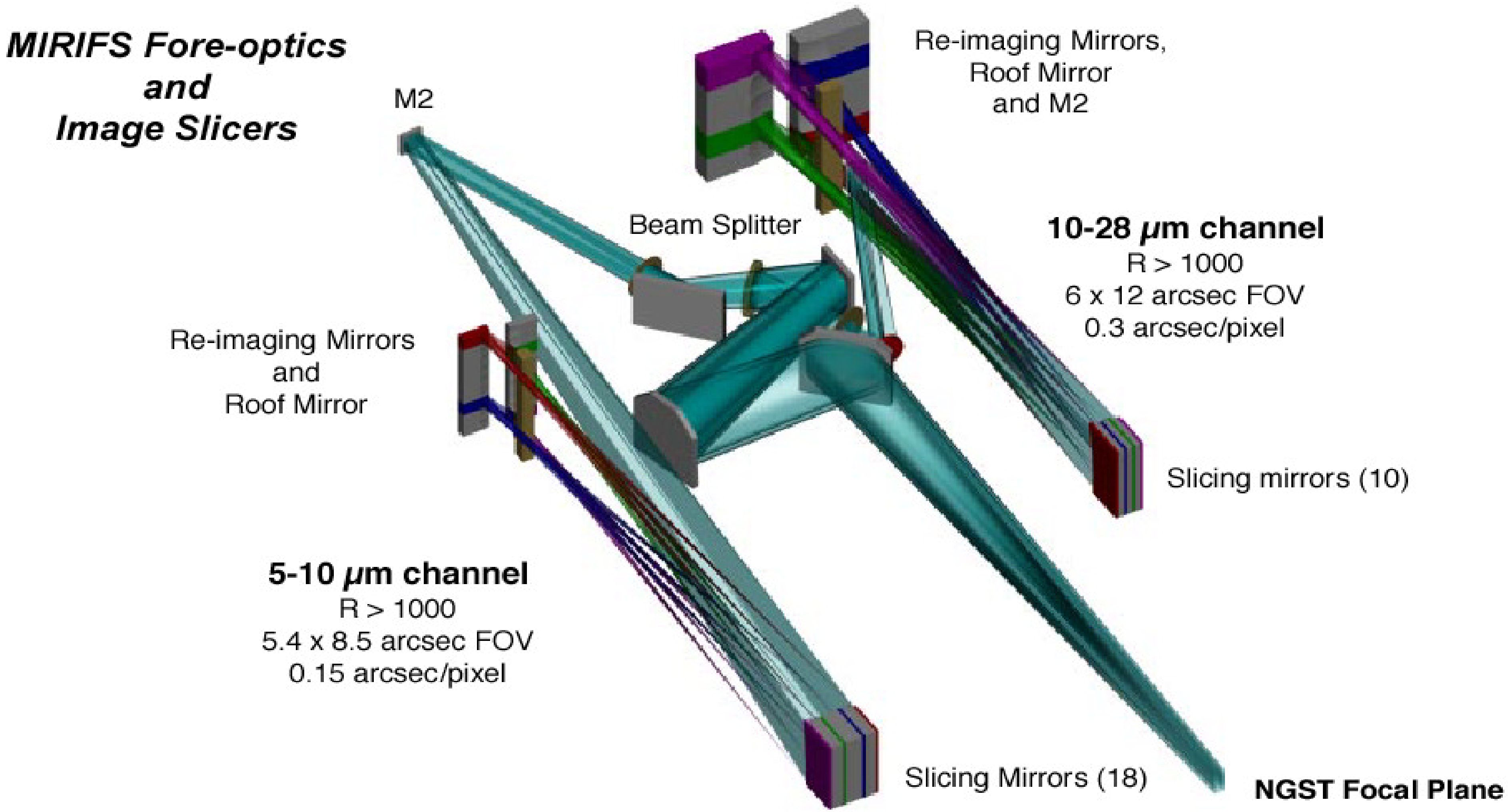
0.6-5 μm
3 x 6 arcmin FOV
0.03 arcsec/pixel

6k x 12k detector

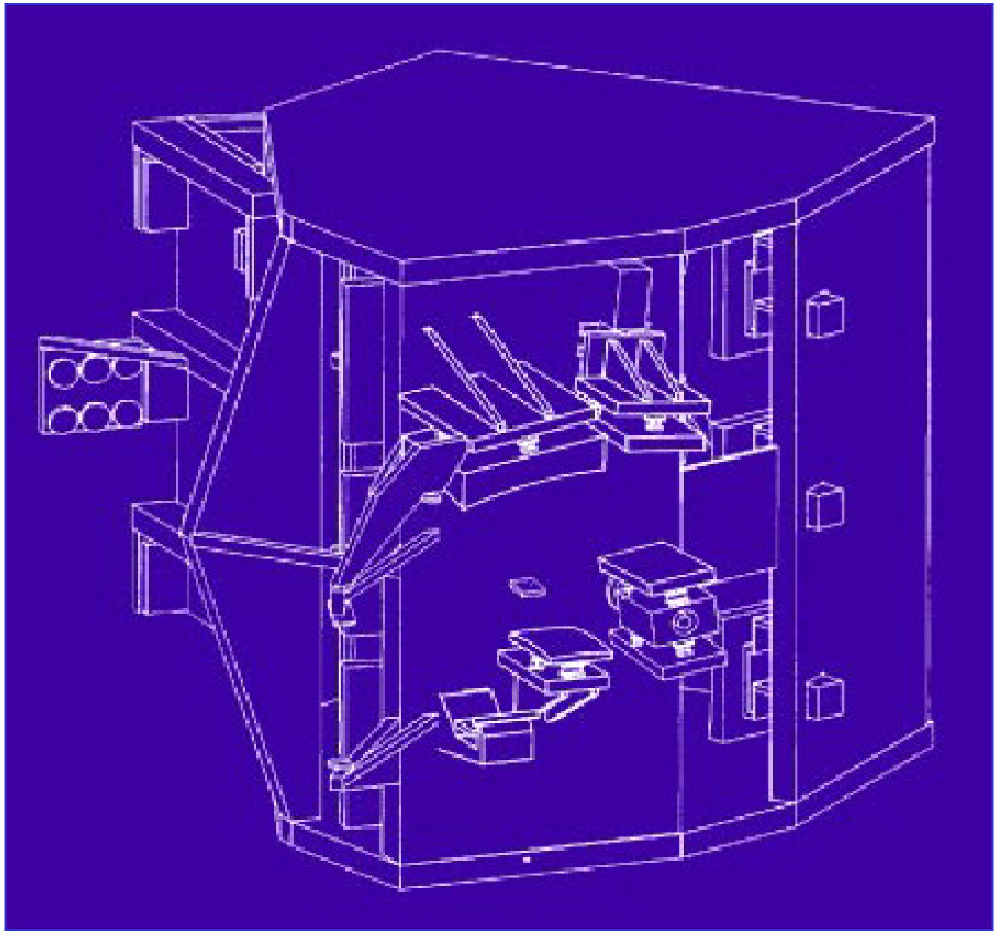
3 (reflective) filter wheels

One FOV and bandpass
-> Requires separate FGS

MIR spectrograph concept



NIR spectrograph concept

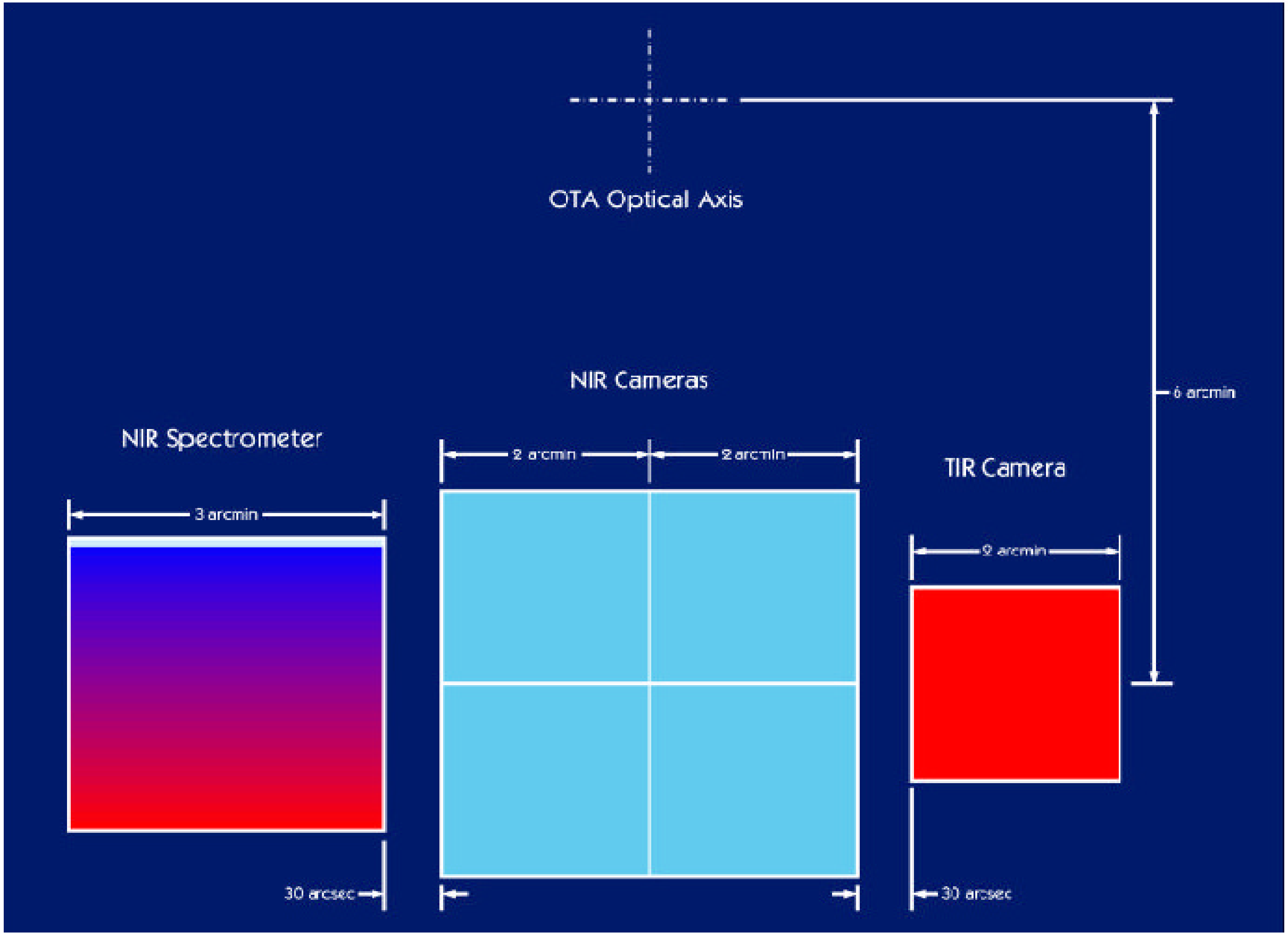


Low Res Channel:	High Res Channel:
R=150	R=3000
1.25-2.5 +2.5-5.0 μm	1.25-2.5/2.5-5.0 μm
(two octaves)	(one octave)
46 x 40 arcsec FOV	3.2 x 3.2 arcsec FOV
0.18 arcsec/pixel	0.05 arcsec/pixel
Six 2k x 2k detectors	Four 2k x 2k detectors

Dimensions: 1360 x 1360 x 1050 mm
Total Mass: 106 kg (preliminary)
Power Dissipation at 30 k: 24 mW (preliminary)

– Single mechanism (High Res grating flip)
– Simple “Point and Shoot” operations

NGST ISIM Focal Plane Layout



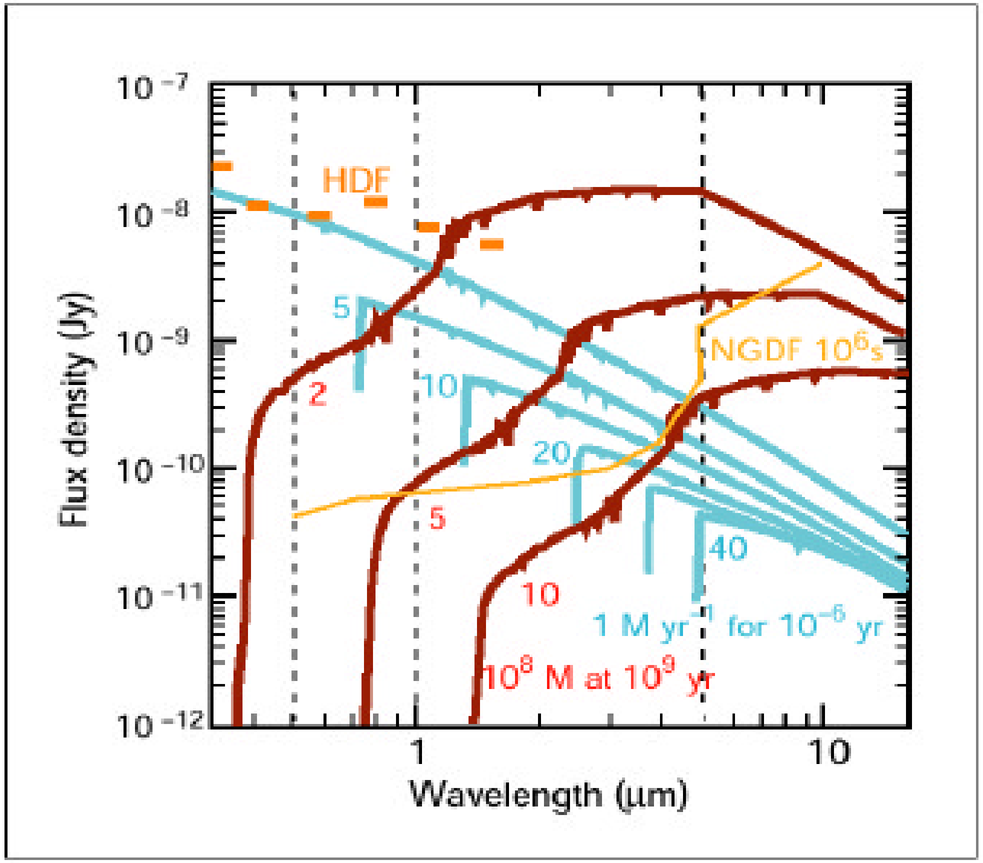
The science instrument module

Total mass: ~500kg

Power dissipation <~ 200mW (~50mW per instrument)

Implies serious limitations on mechanisms, electronics and operational strategies

NGST sensitivity



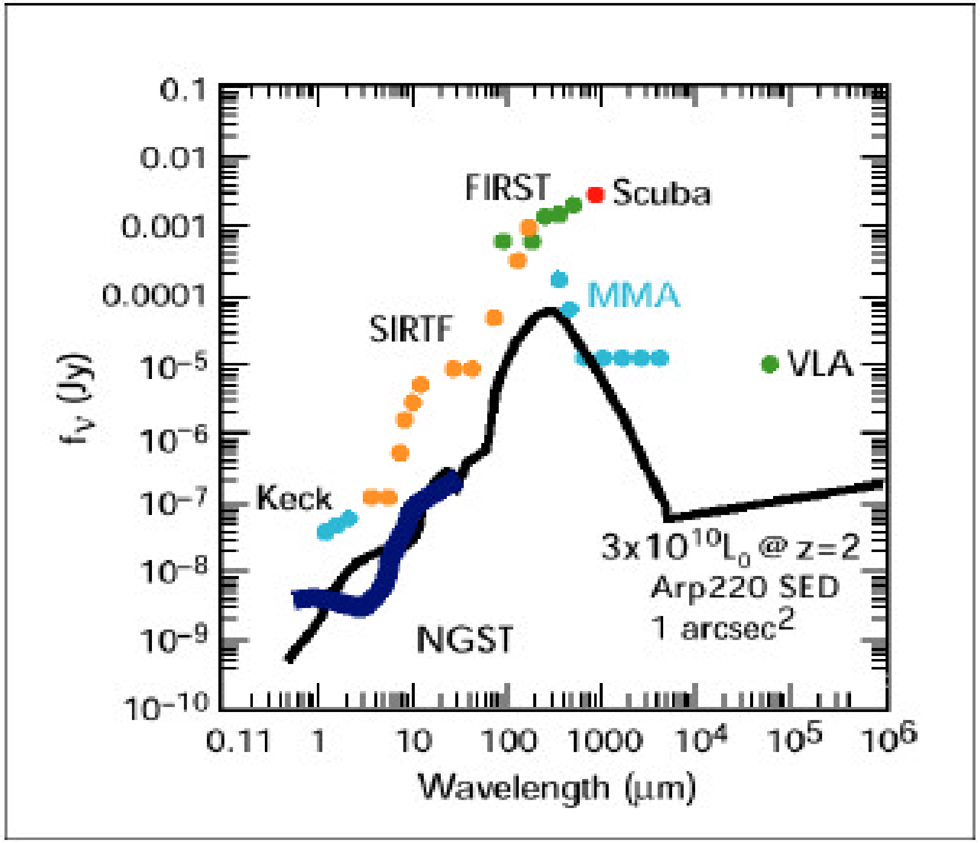
Sensitivity of an NGST deep field (10^6 sec, 30% bandwidth, 10σ detection

Blue: starburst of 10^6M_sun for 10^6yr

Red: Older population of 10^8M_sun @ 1Gyr

NICMOS HDF also shown

Comparison (MIR)

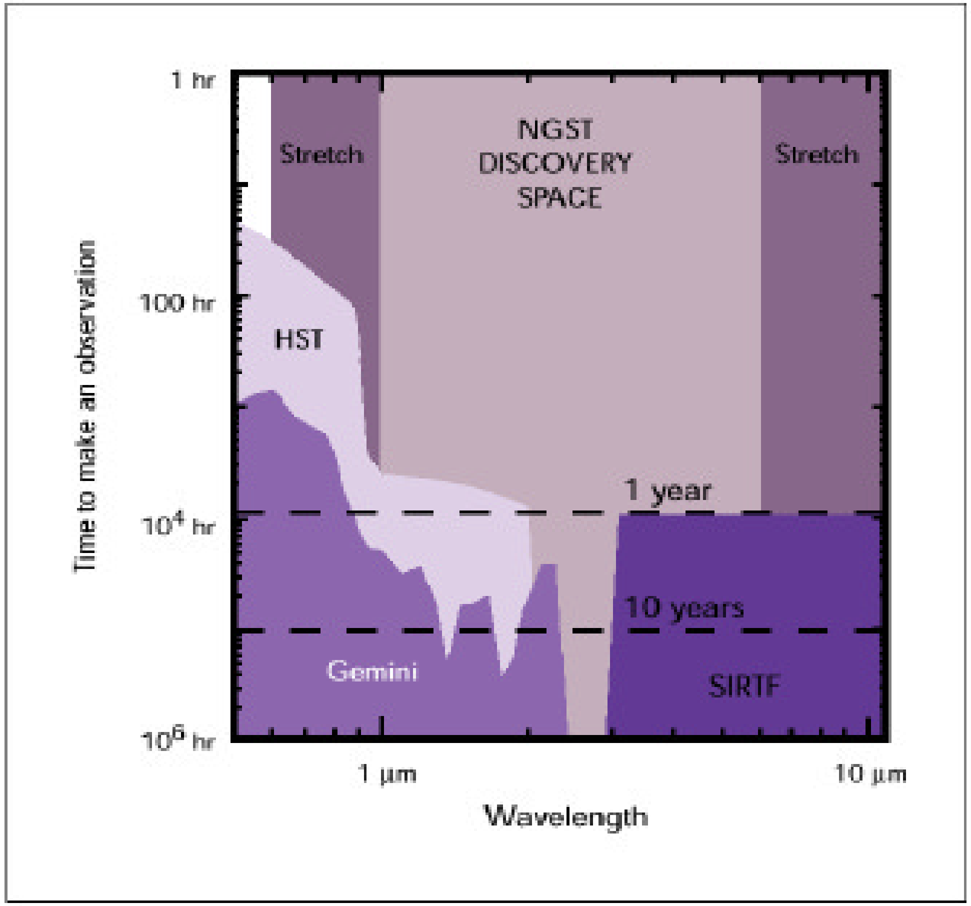


Imaging sensitivity of NGST in the MIR for a 1arcsec2 source

The SED (black) shows 1% of Arp220 @z=2

Only ALMA has similar sensitivity to such enshrouded regions

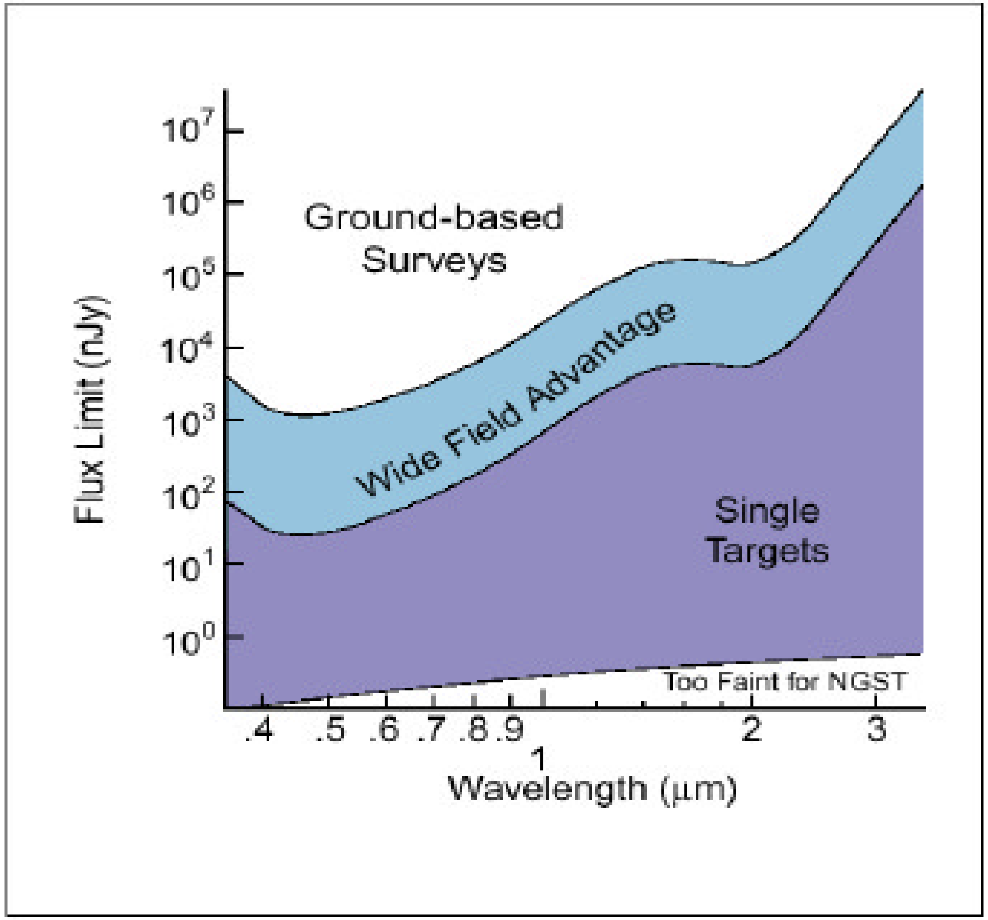
NGST discovery space



The relative speed of NGST broadband, widefield imaging compared with other observatories

HST = NICMOS + ACS

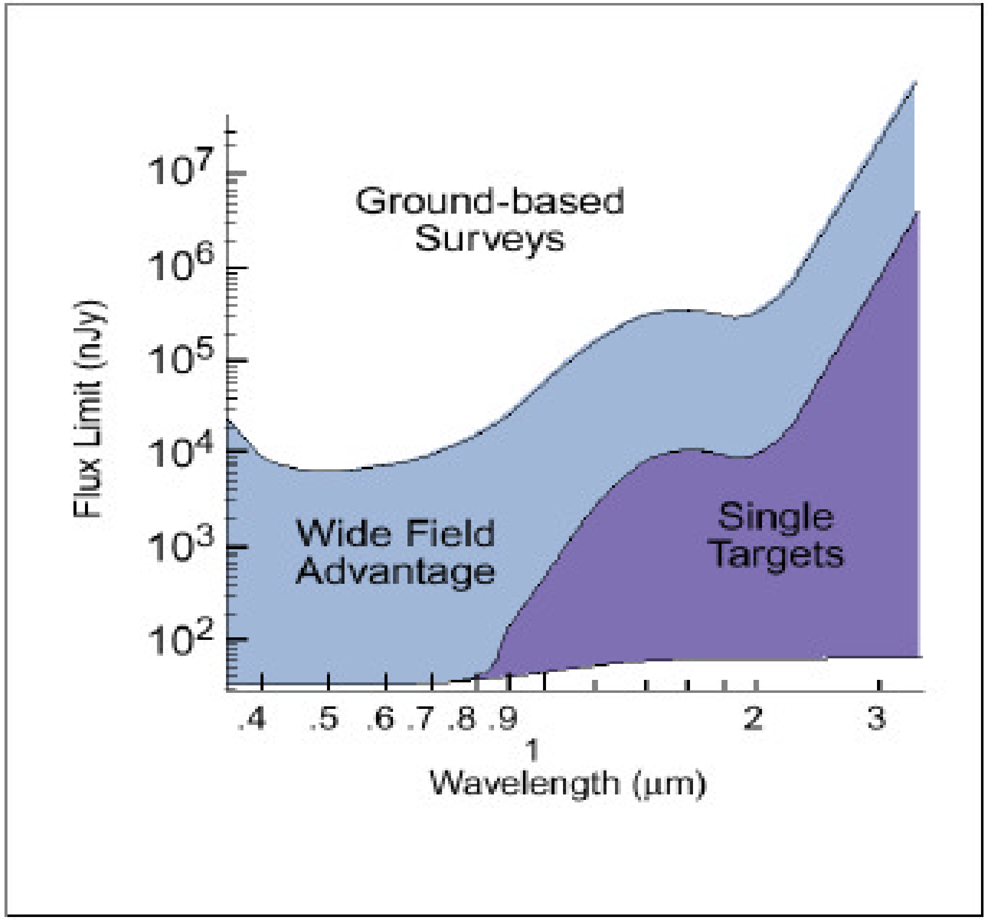
Comparison with 8m gb AO



Imaging

NGST uniqueness (x100 better) for high resolution imaging for wide field (4' x 4') and single sources

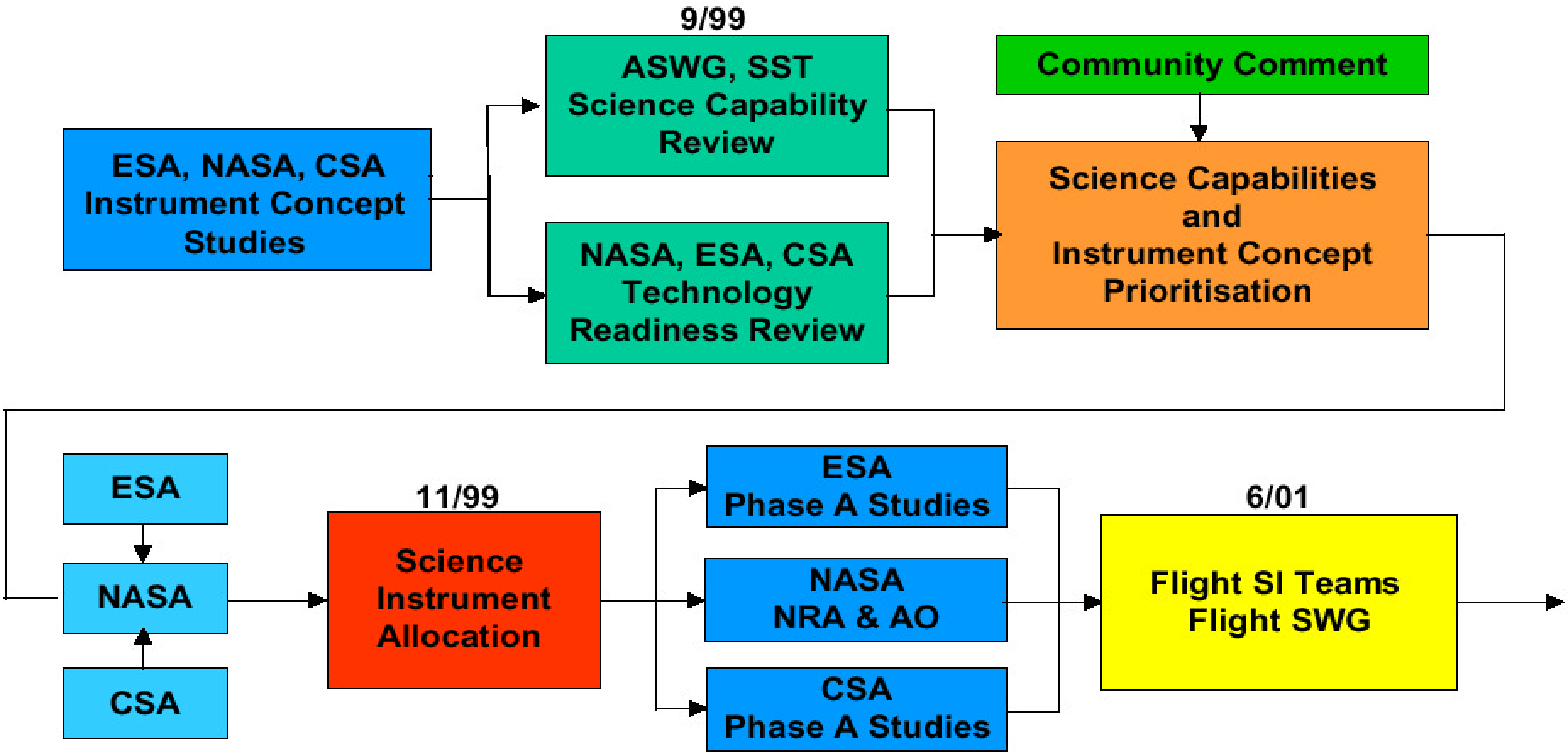
Spectroscopy (R~1000)



Moderate resolution spectroscopy comparison with gb 8m

- ***For higher resolution spectroscopy at shorter wavelengths the comparison is very sensitive to detector dark current***

Instrument selection process



Instrument selection process

1. NASA, ESA and CSA instrument study reports

   Mid-99

2. Huchra IFS/MOS committee report

   1 Sep 99

3. Woods Hole Exposition

   13–16 Sep 99

4. ASWG$^+$ and ASWG$^-$ recommendations

   1 Dec 99

Contd.

5. Public comment on ASWG report

Jan 00 AAS with deadline 21 Jan 00

6. NASA, ESA and CSA management agree on boundaries of instrument responsibility

Apr 00 — "ringfencing the AO's"

7. ESA SPC approval of participation proposal

Before end 2001

Current instrumental issues

Multi-object vs.
Integral Field spectroscopy

'Red-leaks' in wide bandpass instruments

Implications of short wavelength capability

Cooling requirements for MIR

Technology development

Prime contractor selection mid-2001

Development Comparative Active Telescope Testbed (DCATT)

Deployable OTA (DOTA)

Inflatable sunshield

- *ISIS* — STS-107 (2000)

Controlled optics flight experiment

- *NEXUS* mission (3.6m)