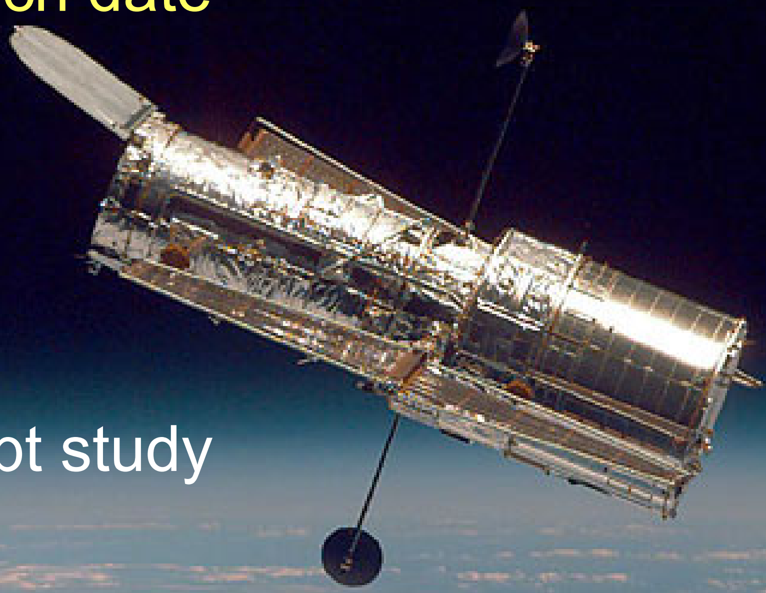
Space Telescope Users Committee

- Hubble Highlights
- Staffing outlook
- Cycle 17 and SM4 launch date
- Issues for the STUC

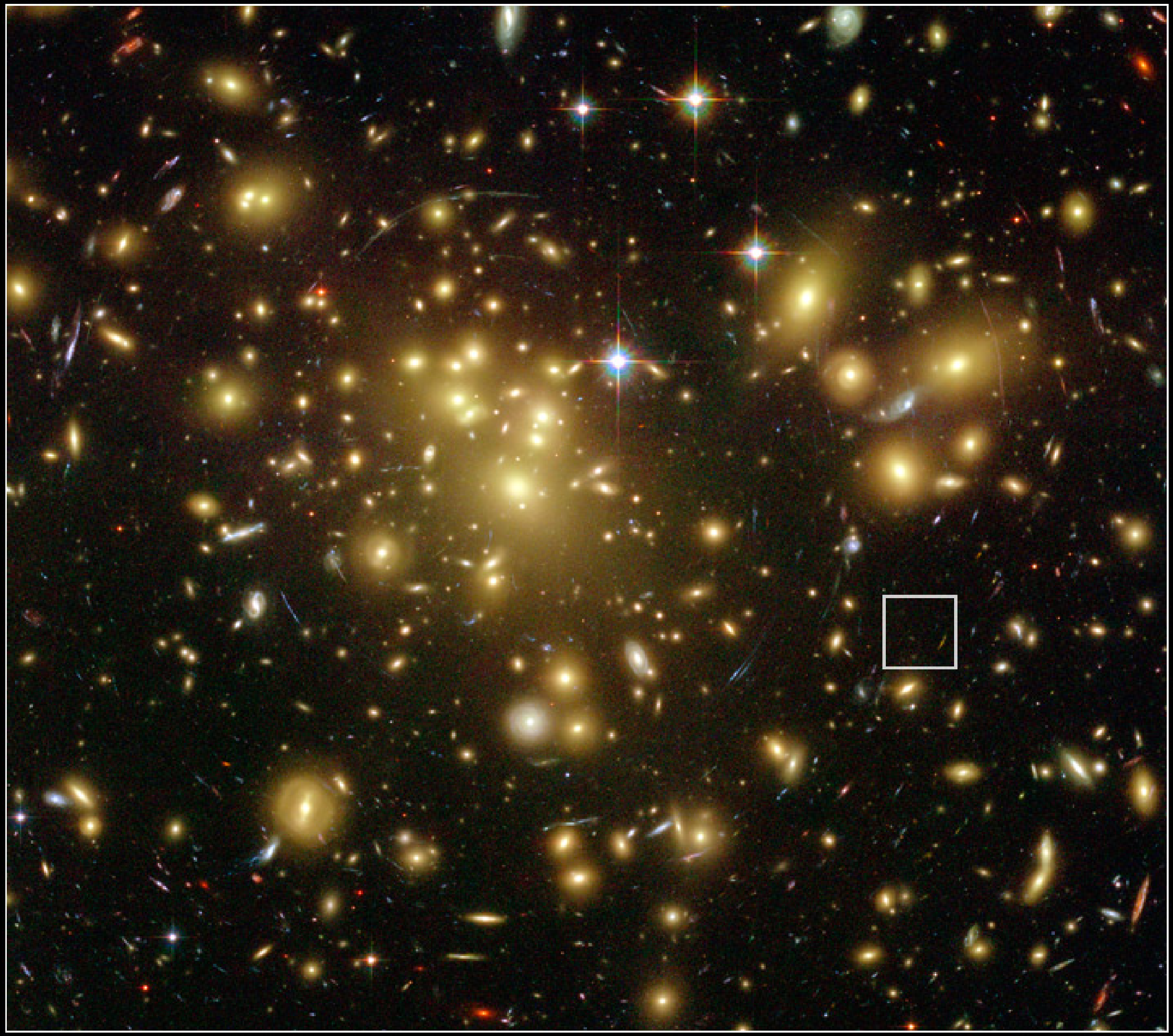
For information:

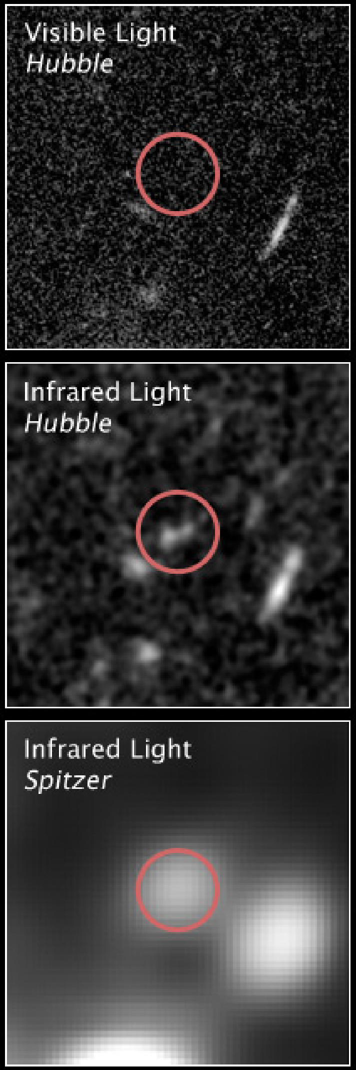
JWST status
The "ATLAST" concept study



Matt Mountain
10 April 2008
Space Telescope Science Institute

One of the Youngest, Brightest Galaxies: Lensed Galaxy at *z*~7.6





Bouwens et al. 2008arXiv0802.2506B

Double Einstein Ring SDSSJ0946+1006 *Hubble Space Telescope* ▪ ACS/WFC

NASA, ESA, R. Gavazzi and T. Treu (University of California, Santa Barbara), and the SLACS Team STScI-PRC08-04

The unique geometry of two Einstein rings allows:

- Measurement of the Dark Matter halo of the primary galaxy
- The first measurement of the mass of a dwarf galaxy at redshift of z=0.6 (galaxy S1 = 1B M_{SUN})

ACS image of the gravitational lens SDSSJ0946+1006 reveals two partial rings.

$L1_{\text{main lens}}$ z = 0.22
$S1_{\text{inner ring}}$ z = 0.609
$S2_{\text{outer ring}}$ z < 6.9

Gavazzi, et al., 2008arXiv0801.1555G

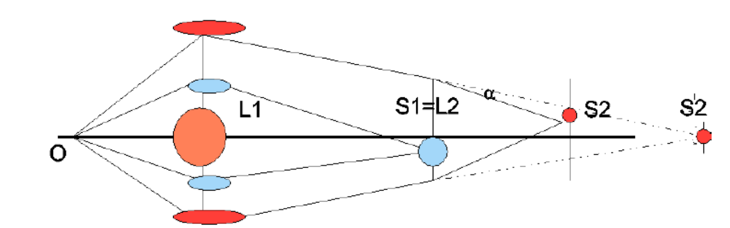
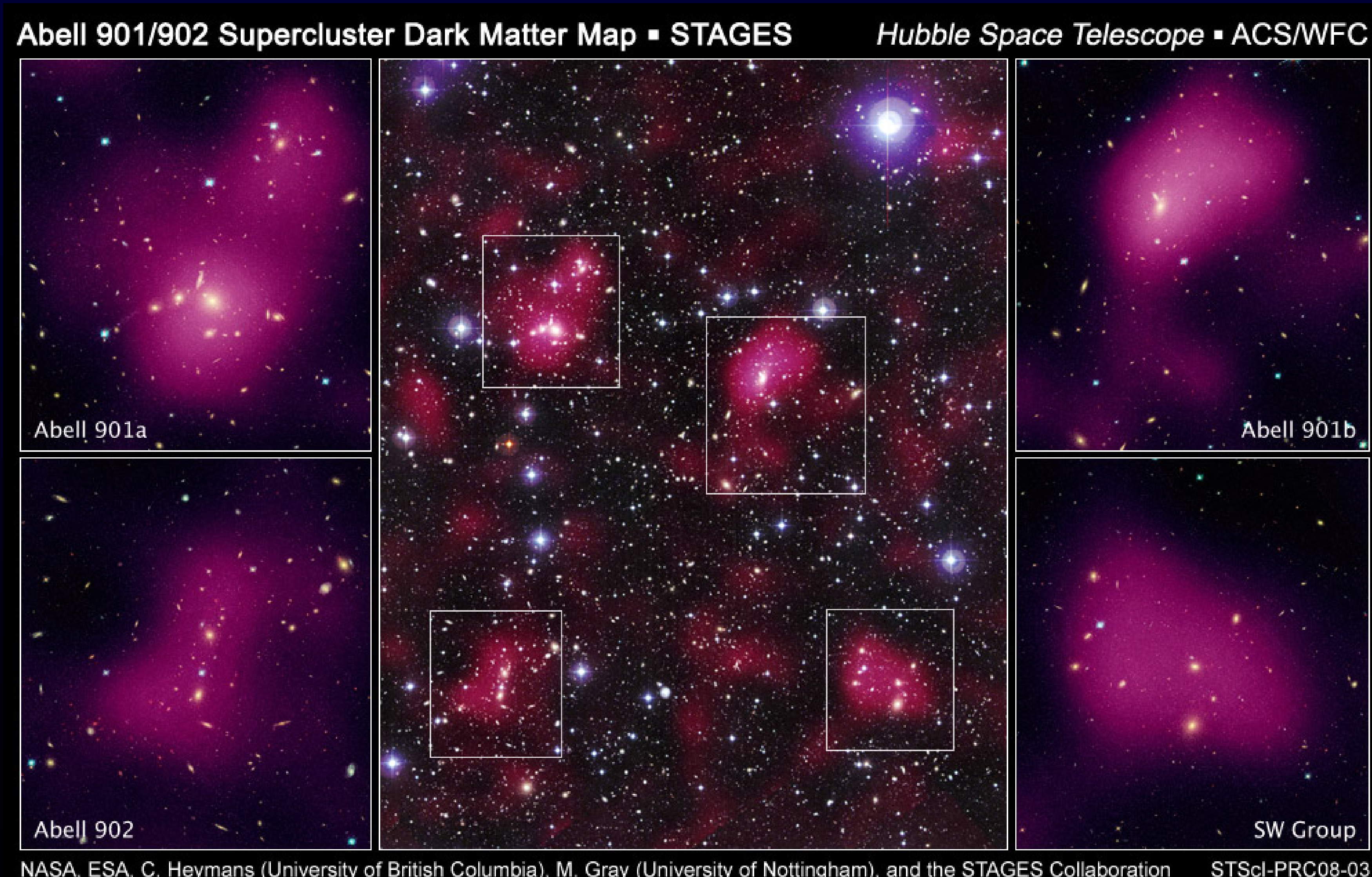


FIG. 8.— Sketch of the lensing optical bench with source 1 acting as a perturbing lens on source 2 which complicates the relation between redshifts, deflection angles and angular distances.

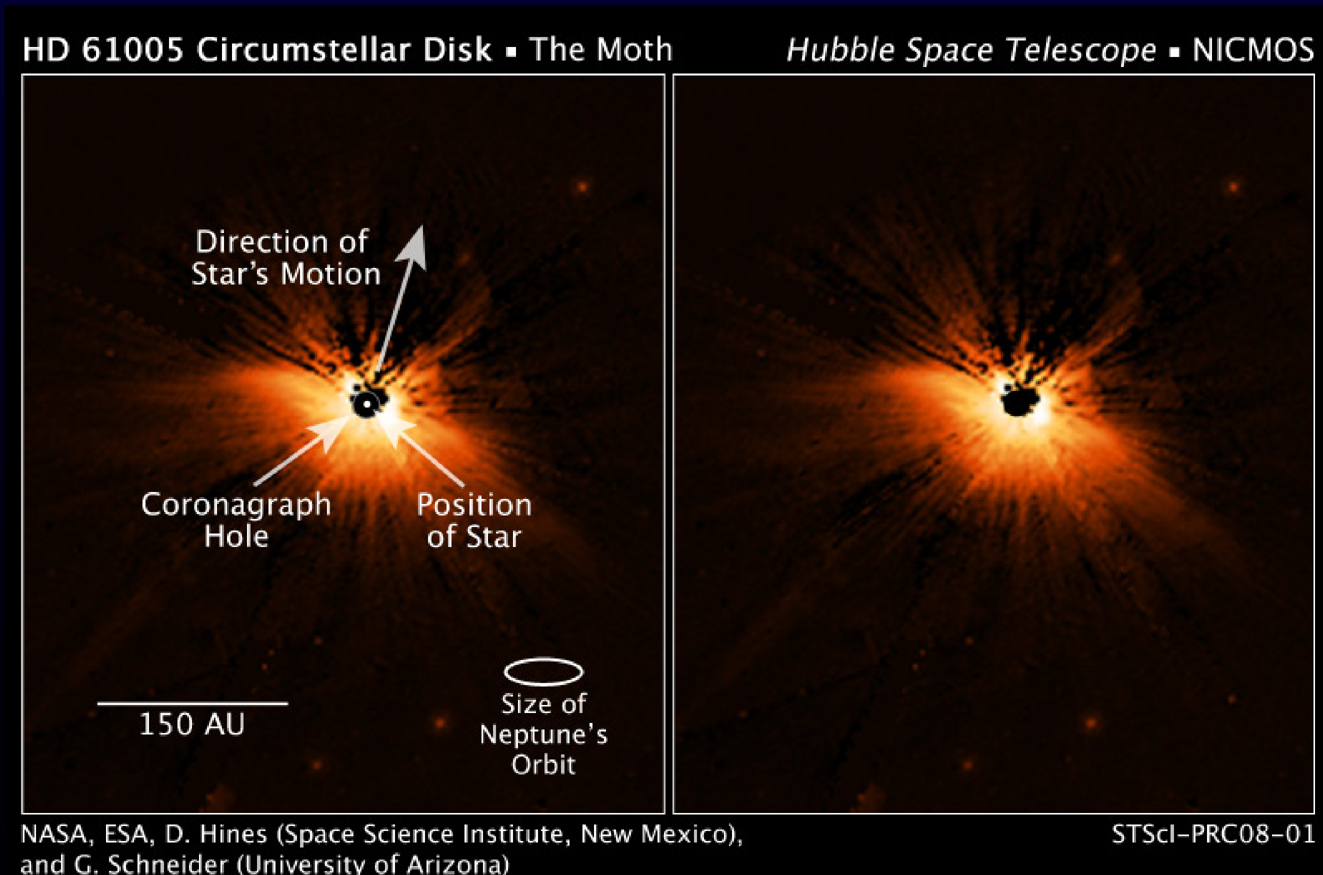
SPACE TELESCOPE SCIENCE INSTITUTE



SPACE TELESCOPE SCIENCE INSTITUTE

"Thanks to Hubble's Advanced Camera for Surveys, we are detecting for the first time the irregular clumps of dark matter in this supercluster," Heymans said. “The brightest cluster members are marking out the peaks of the Dark matter distribution”

NICMOS Coronagraphic imaging of nascent planetary system around Solar type star: Spitzer Legacy Survey - Hines at al 2008



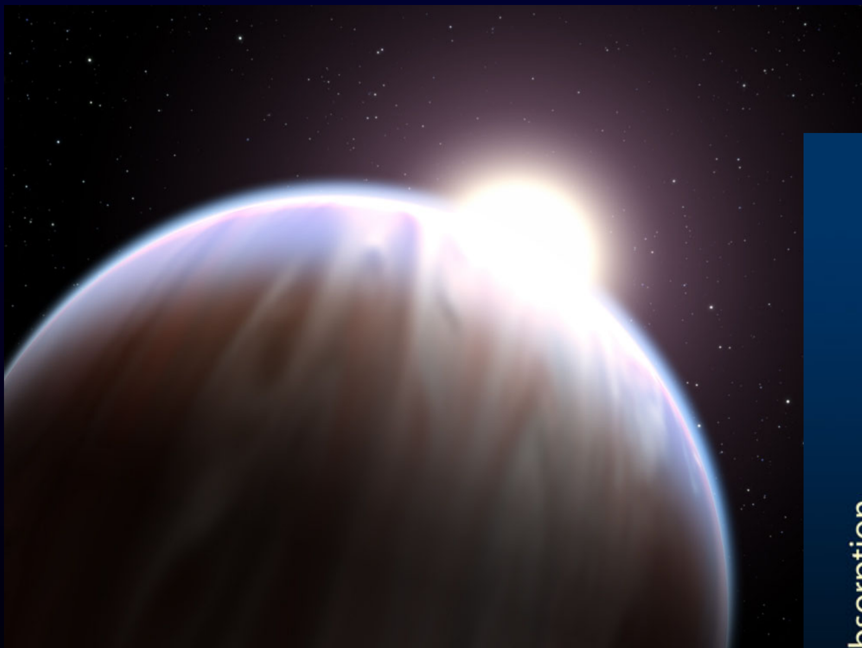
Spitzer results, based on 24um excess fluxes suggest terrestrial planets can form around 30% ~ 70% of solar type stars (Myers at al 2008)

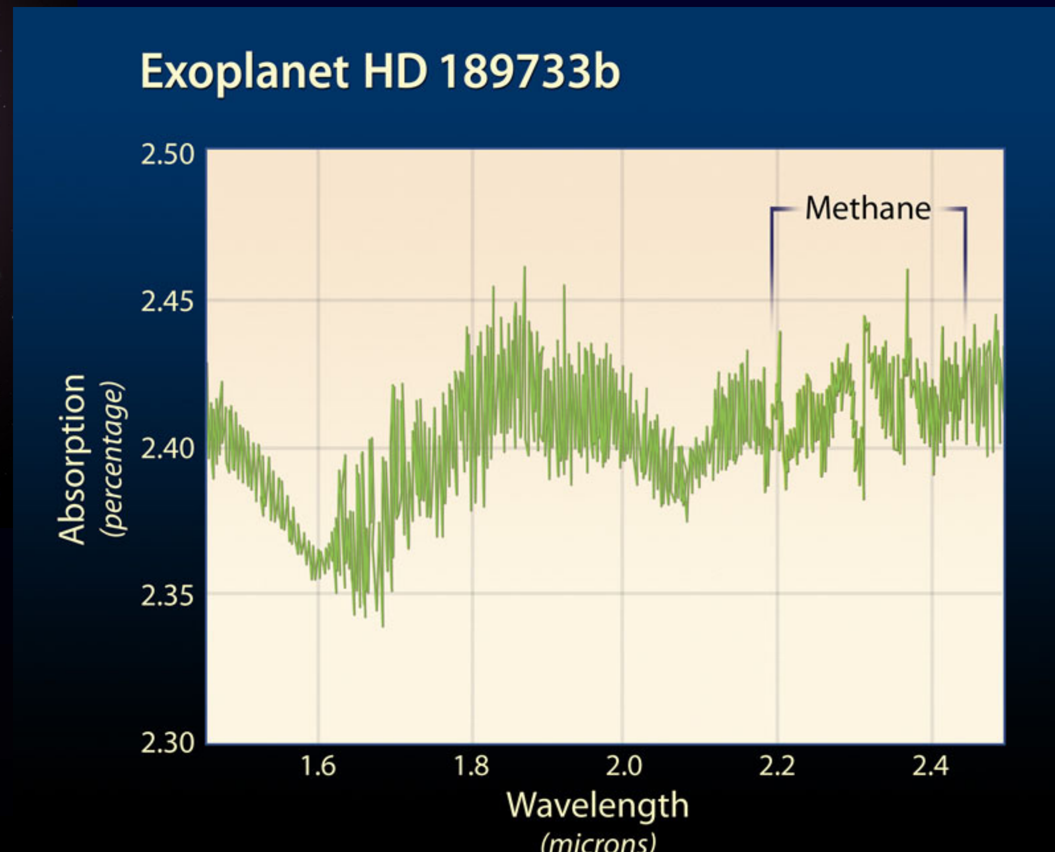
But are all these FIR excess's due to viable planetary or proto-planetary systems?

SPACE TELESCOPE SCIENCE INSTITUTE

This young (~90Myrs) G dwarf is plowing into the interstellar medium disrupting the symmetric proto-planetary disk

First Organic Molecule: Methane in Exoplanet Atmosphere





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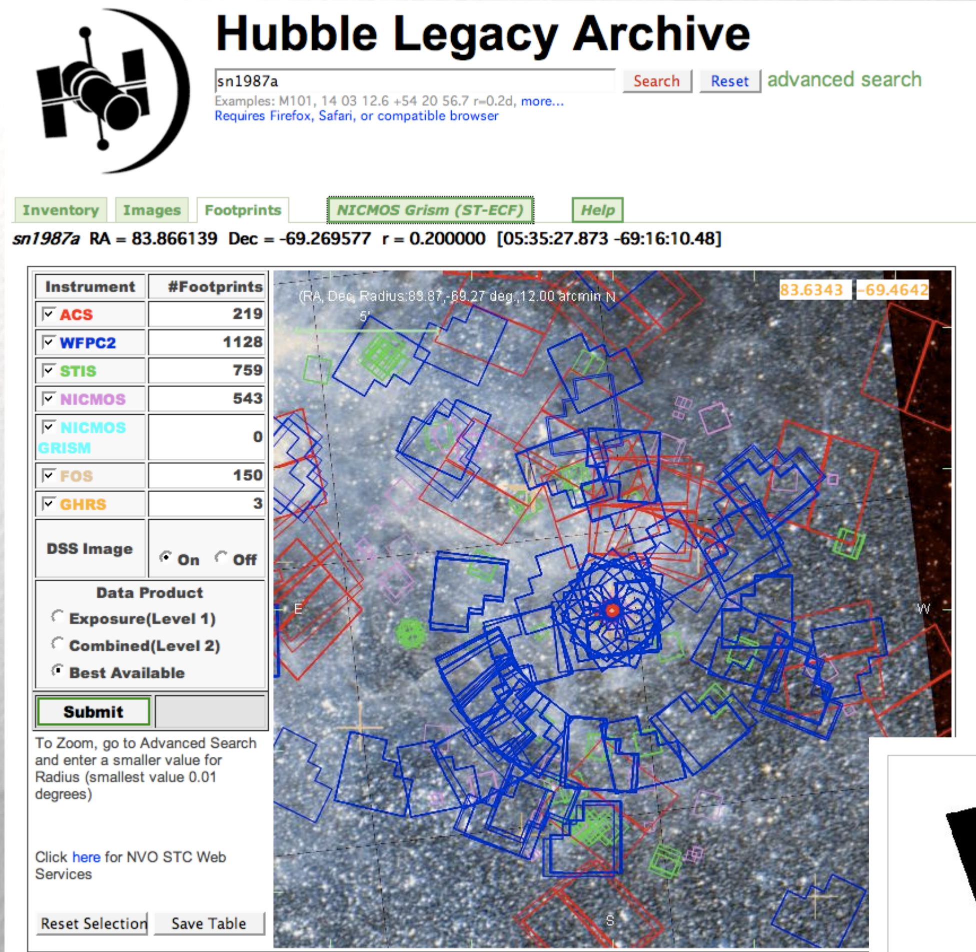
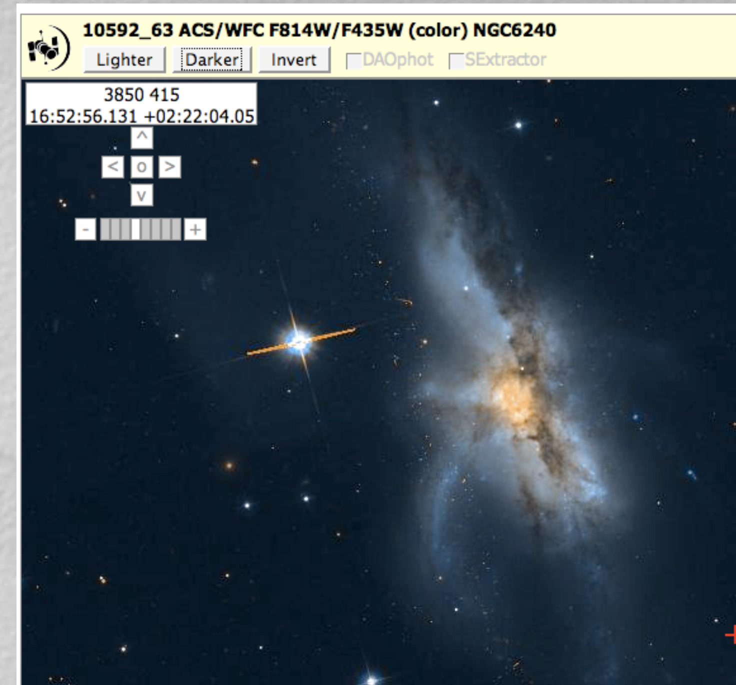
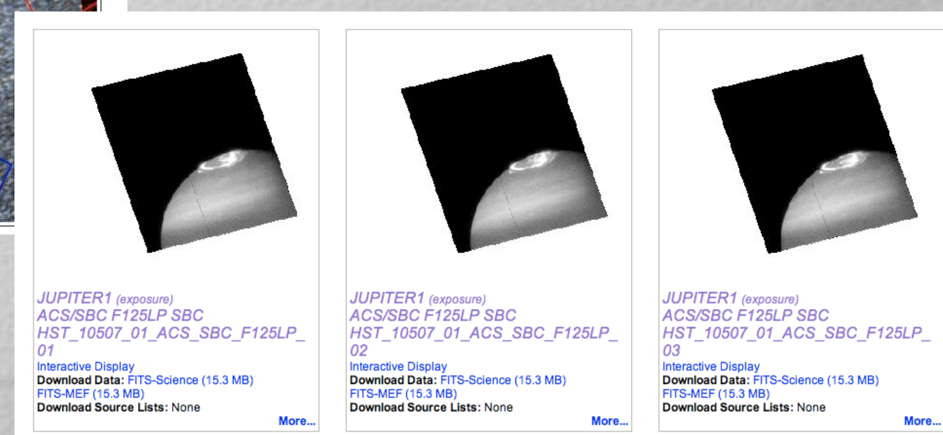
Swain, et al., 2008Natur.452..329S







First Release February'08

Data Archive Evolution at STScI

Data distributed (Log GBytes)

QuickTime™ and a
H.264 decompressor
are needed to see this picture.

Data made available (Log GBytes)

Date

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

hubble DISCOVERIES

Witness the scientific leaps that never would have been possible without Hubble's farseeing capabilities.

- A new section to place the accomplishments of the HST mission in the context of the greater search for astronomical knowledge
- The goal is to provide the public with explanations of HST’s scientific and cultural impact
- These sites will continue to be a resource beyond the mission’s lifetime

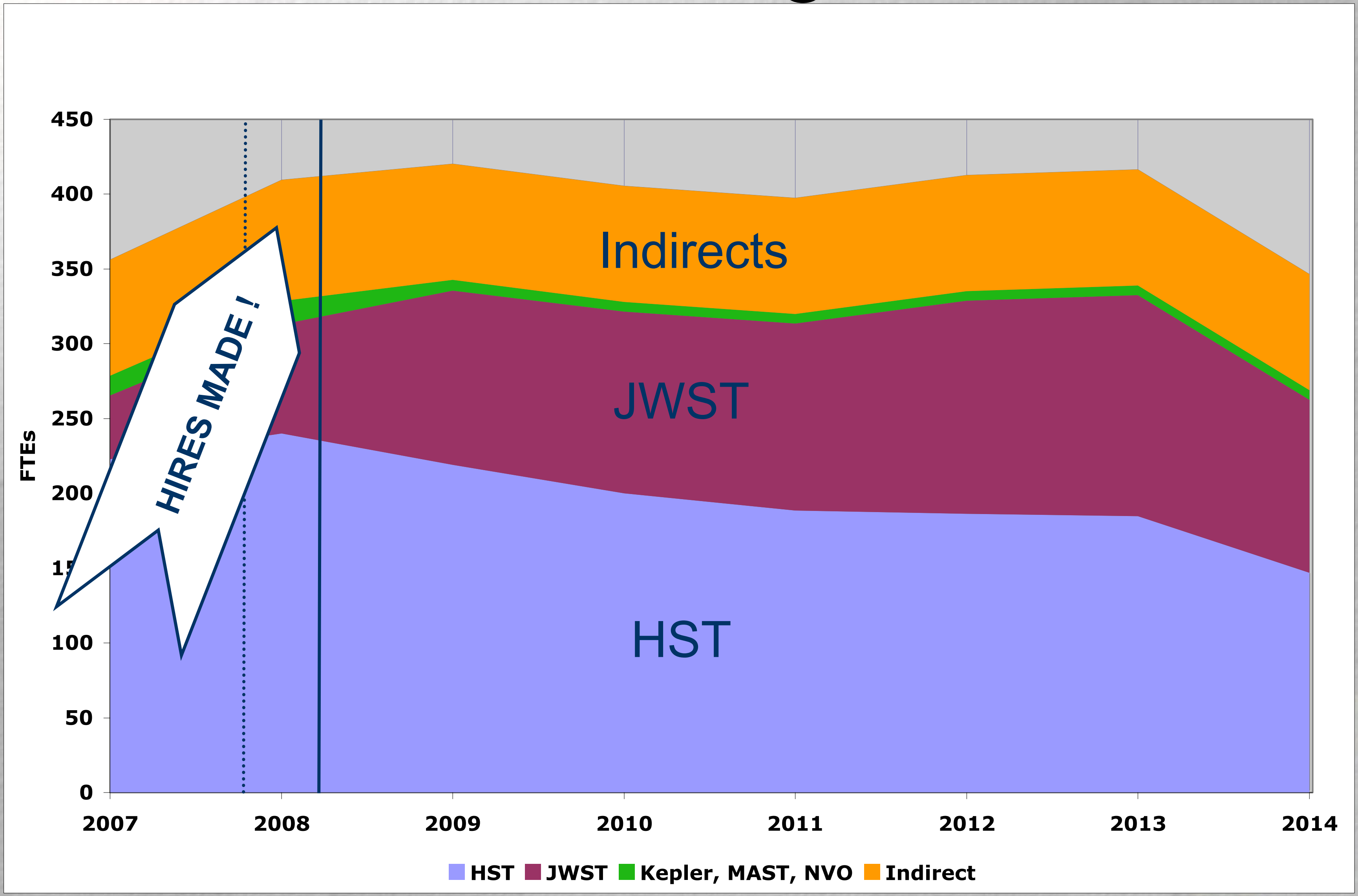
QuickTime™ and a
decompressor
are needed to see this picture.

The WALTERS ART MUSEUM

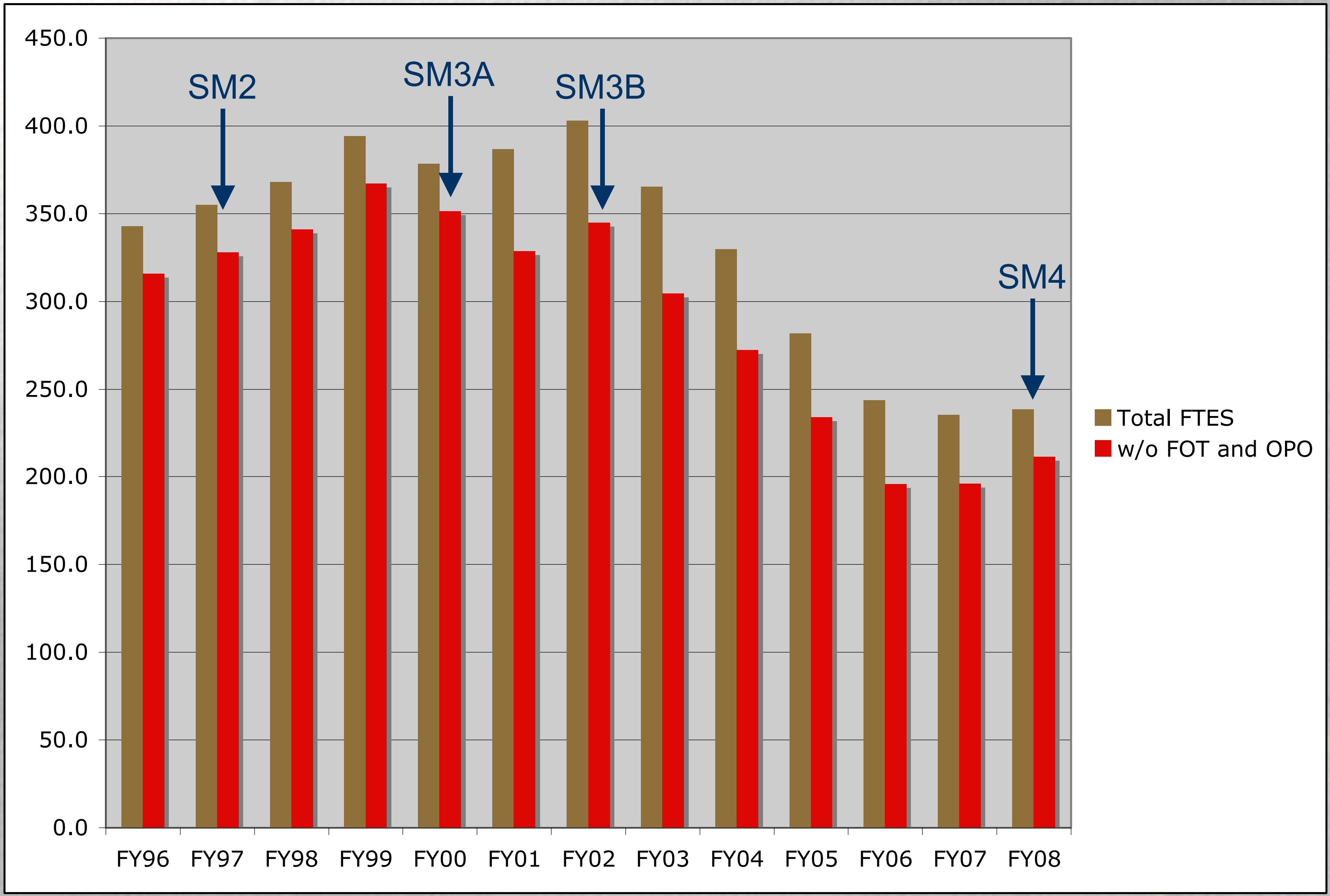
The WALTERS ART MUSEUM


HUBBLE
HUBBLE FELLOWS SYMPOSIUM
FELLOWS

STScI Staffing Profile

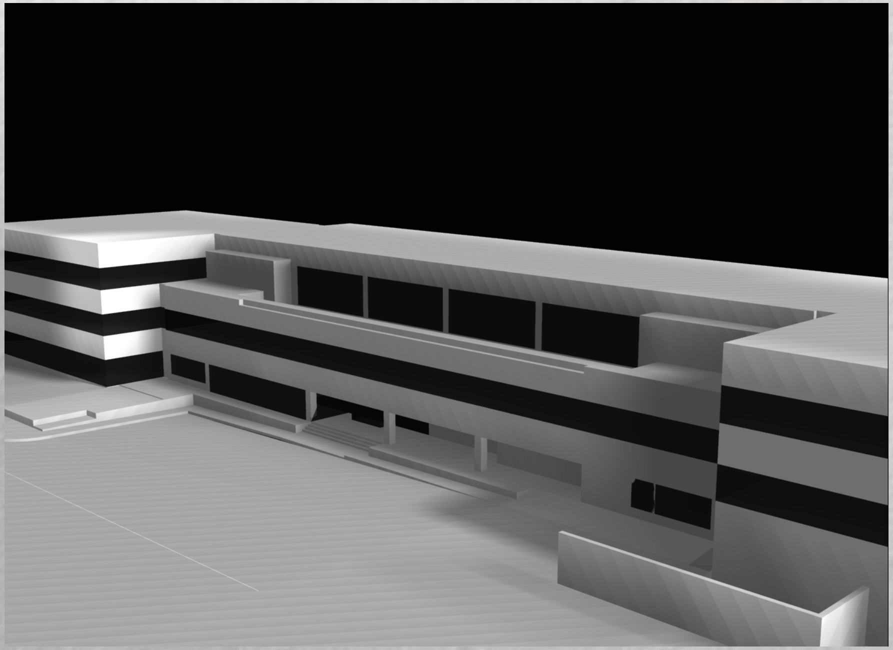


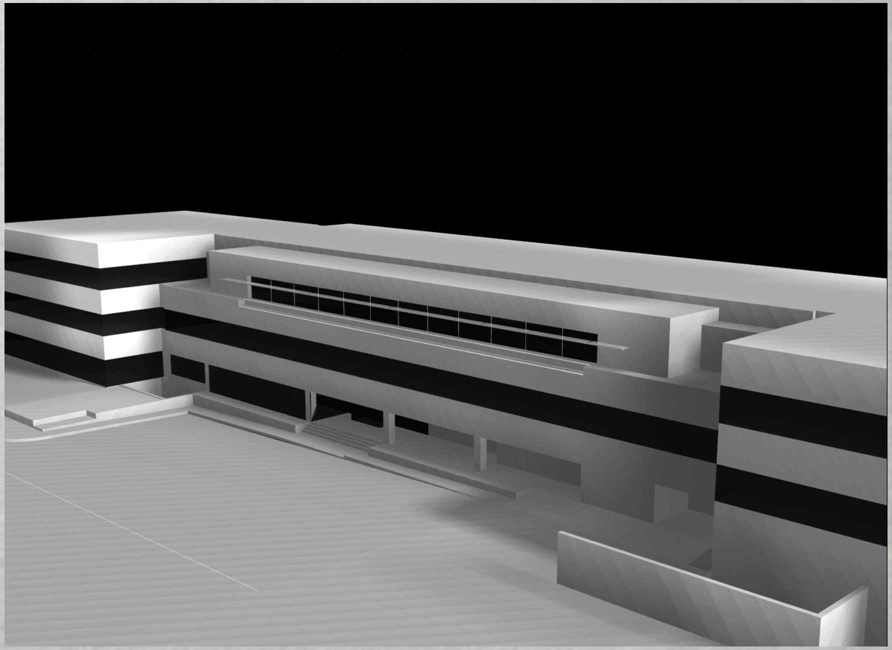
HST Staffing Trend



Strategy for Increasing Support for SM4

- Recruited 3 new Data Analysts for HST support.
- Recruited 7 Term-Hire Scientists (3-year terms).
- Our subcontract with JHU provides 3.0 FTE.
- Recruiting 4 ESA positions, 3 for instrument support.





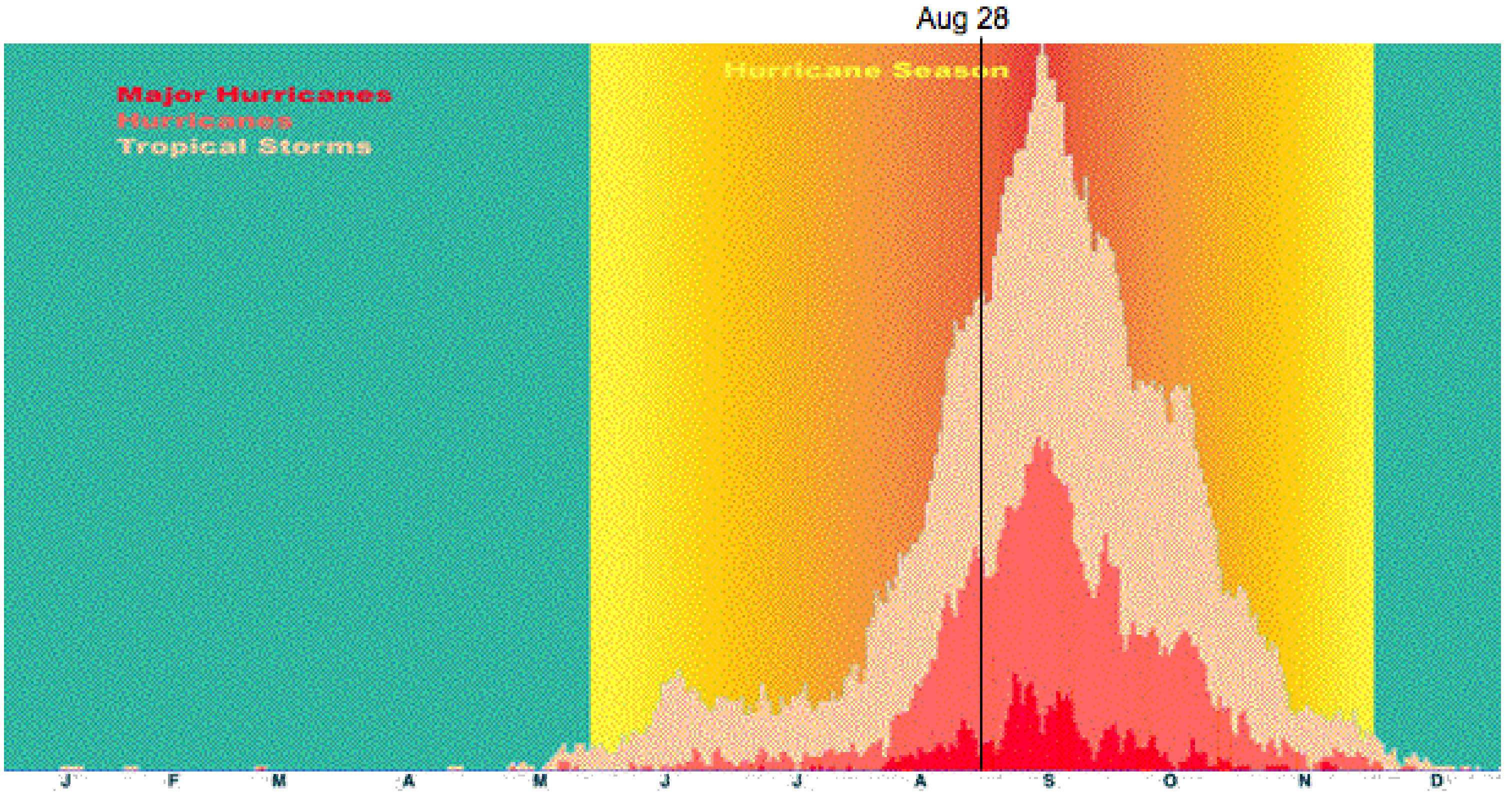
- Also recruiting for JWST

Cycle 17 Schedule

- Launch - working to date of August 28, 2008
  - 4 to 6 week probable delay

- Cycle 17:
  - Phase I deadline: 7 March 2008
  - TAC/Panel meetings (at STScI/JHU): 12-16 May 2008
  - First Observations: SM4 + 1 month (TBD)
  - End of Cycle 17, start of Cycle 18: 1 January 2010

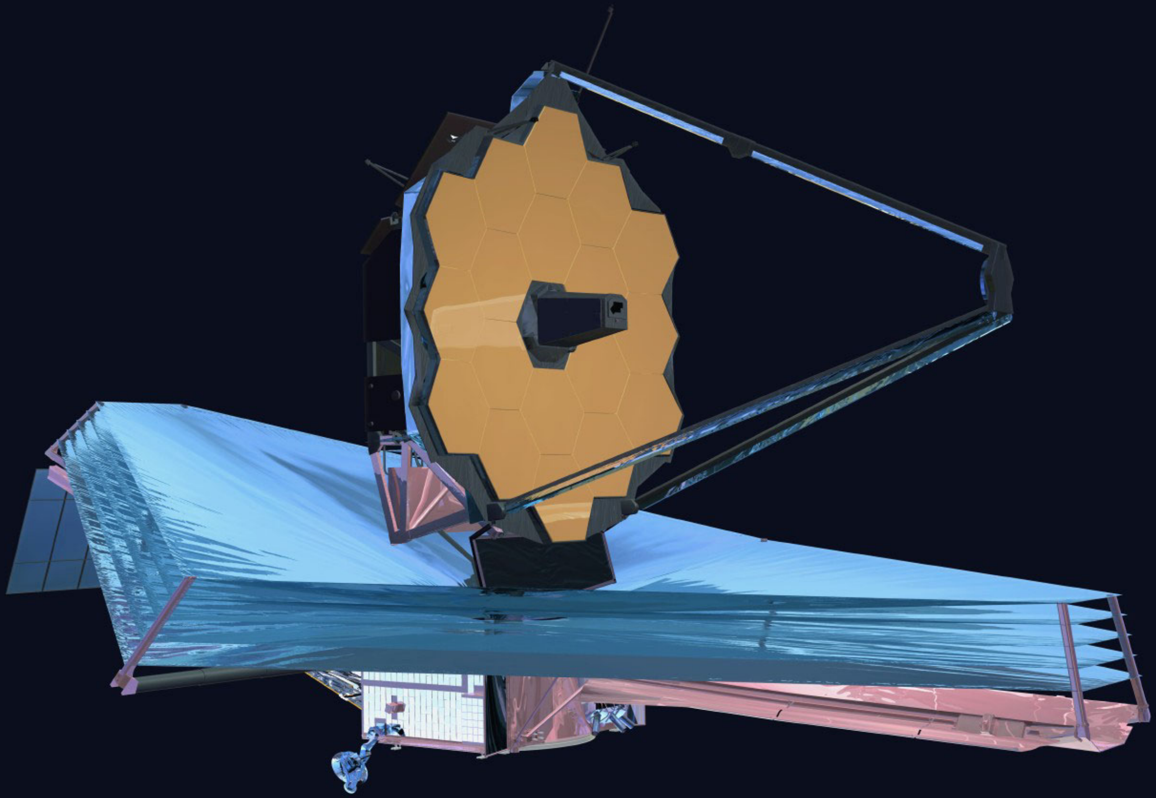
Hurricane Statistics in Florida

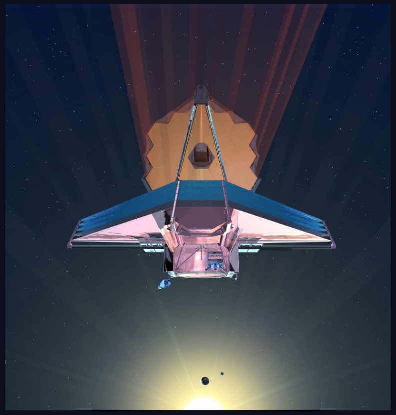


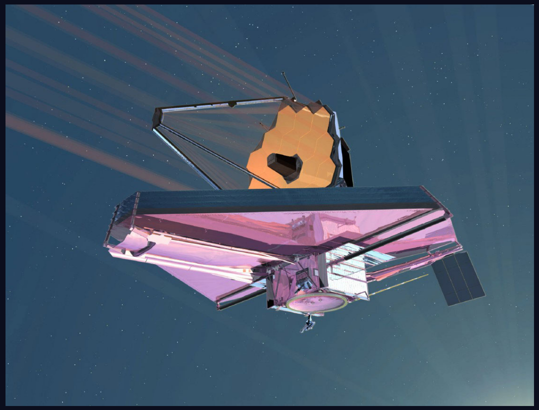
Issues for the STUC

- On going vitality and competitiveness of the HST program
  - Cycle 17 TAC
  - Hubble Legacy Archive
- Priorities for SM4
- Post SM4 activities and priorities

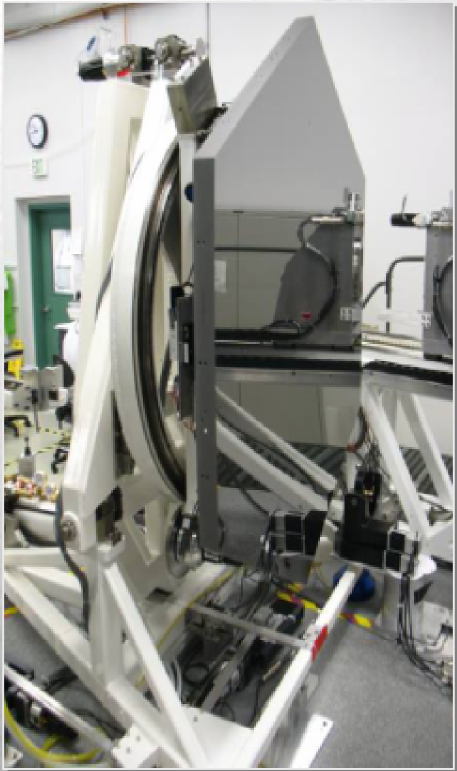
James Webb Space Telescope

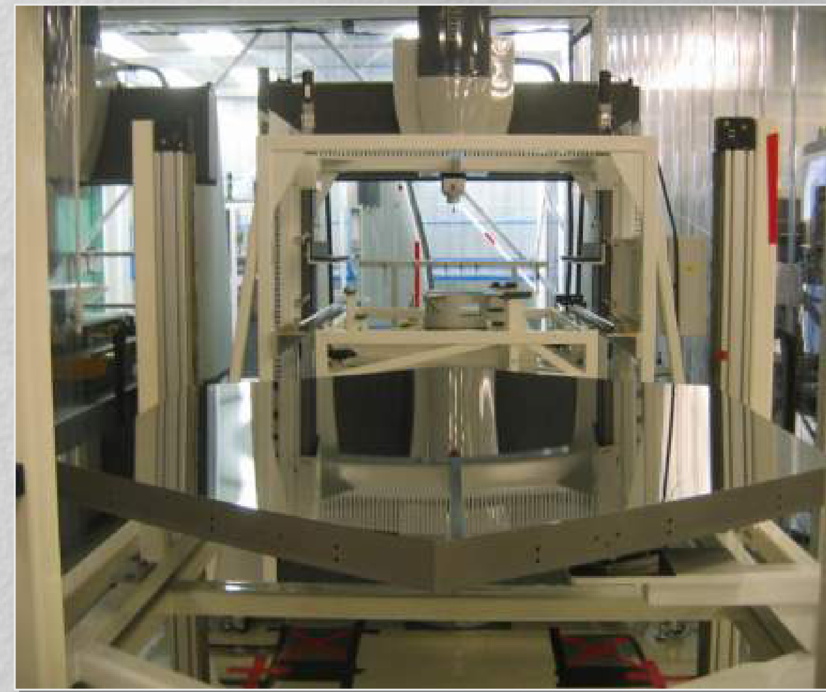


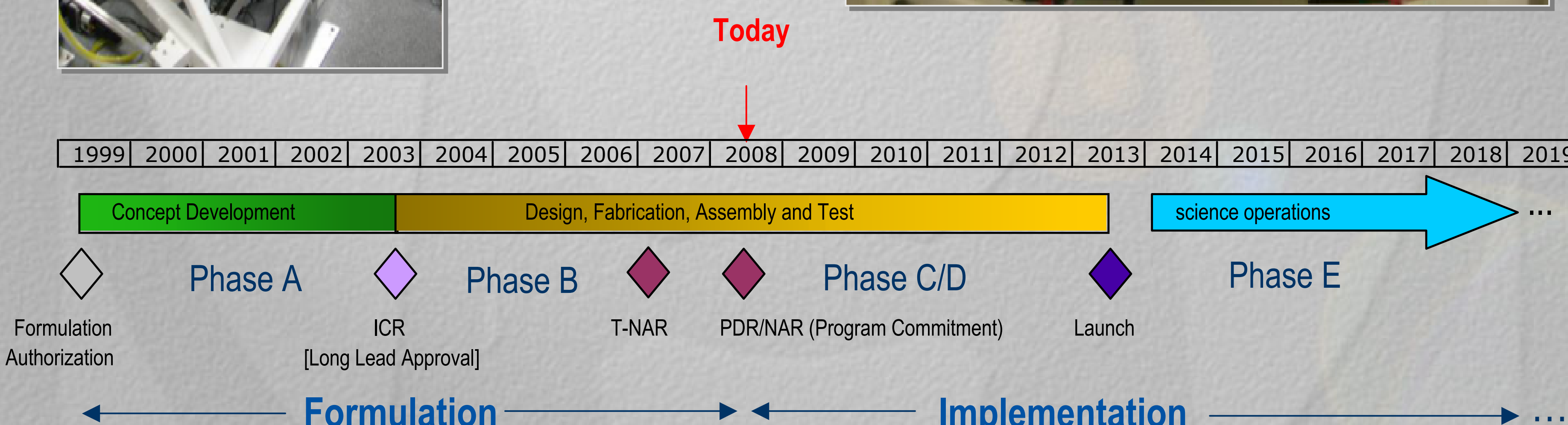




Preliminary Design Review *passed*







All flight mirrors are in process at Tinsley

PMSA #1 (EDU-A / A1 / A1)

PMSA #2 (11 / B3 / B3)


PMSA #3 (12 / C3 / C3)


PMSA #4 (5 / A2 / A2)

PMSA #5 (6 / B2 / B2)

PMSA #6 (7 / C2 / C2)


PMSA #7 (13 / A4 / A4)

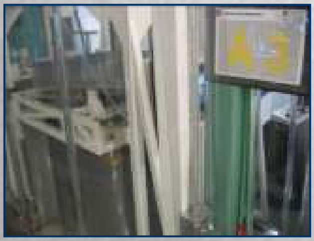
PMSA #8 (17 / B5 / B5)


PMSA #9 (4 / C1 / C1)


PMSA #10 (16 / A5 / A5)


PMSA #11 (20 / B6 / B6)

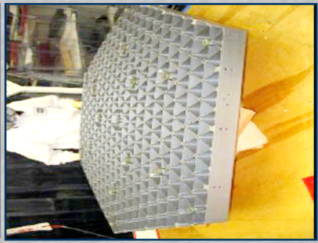
PMSA #12 (15 / C4 / C4)


PMSA #13 (8 / A3 / A3)

PMSA #14 (22 / B7 / B7)

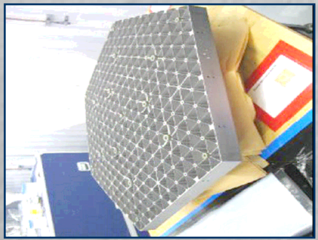
PMSA #15 (18 / C5 / C5)


PMSA #16 (19 / A6 / A6)


PMSA #17 (23 / B8 / B8)

PMSA #18 (21 / C6 / C6)


PM EDU (EDU-B / EDU / EDU)


PM PFL-C (24 / C7 / C7)

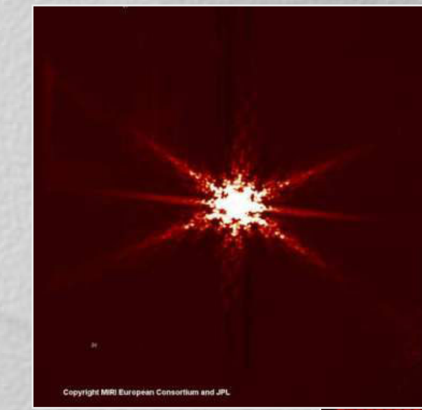

SM PFL (SM2 / SM1 / SM1)


SM Flight (SM1 / SM2 / SM2)

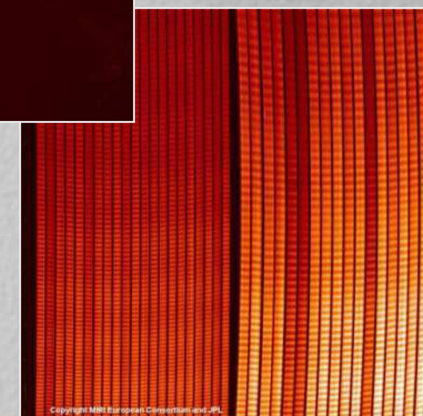

TM Flight (TM1 / TM1 / TM1)

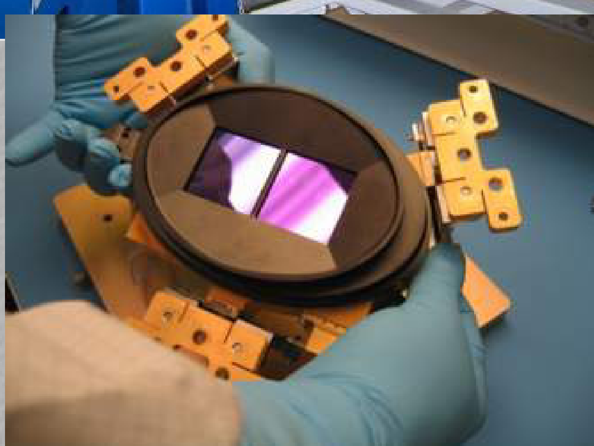
Sunshield Prototype

Instrument Hardware



Data!





NIRSpec Focal Plane Assembly

NIRCam PIL Mechanism

NIRSpec Fore Optics

Next Steps 1 of 2

- Non-Advocate Review (next week) and formal NASA confirmation (summer'08)
- A little history:

2005 - 2006 re-plan led the Project to estimate a cost to launch (in 2013) of ~$3.5B

NASA's Independent Cost Estimate for a "70% confidence" level that JWST would not overrun phases A-D ~$4.1B

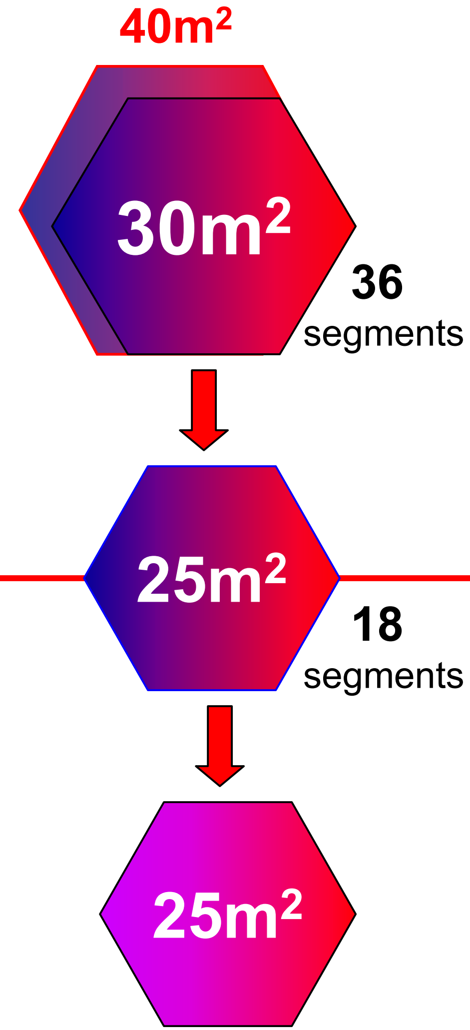
[derived from parametric models and historical mission data]

In this 'new paradigm' the Independent Review Team also recommended

JWST should enter PDR/NAR with 30% cost reserves (equivalent to the "70% confidence level")

In April'06 Mike Griffin (NASA Administrator) authorized JWST to proceed to PDR *provided* that Science Mission Directorate (SMD) carry sufficient reserves to accommodate the "70% confidence" level cost for the mission should the additional funds be needed. This was a new constraint

JWST descopes to date - circa. 2005



- Mirror has gone from 8m to 6m, while retaining priority science goals
- 2.5 Instruments now being built by Europe and Canada
- Instruments simplified and detector procurements coordinated

Pre-2005

Post-2005

- Shortwave sensitivity has been relaxed to enable greatly simplified Integration & Test
  - "Cup-up" I&T at JSC
- Visible/Shortwave IR wavelength requirements removed – significantly lowers production risk and improves optical performance margins
- One Tunable filter removed
  - Mass and power margins improved

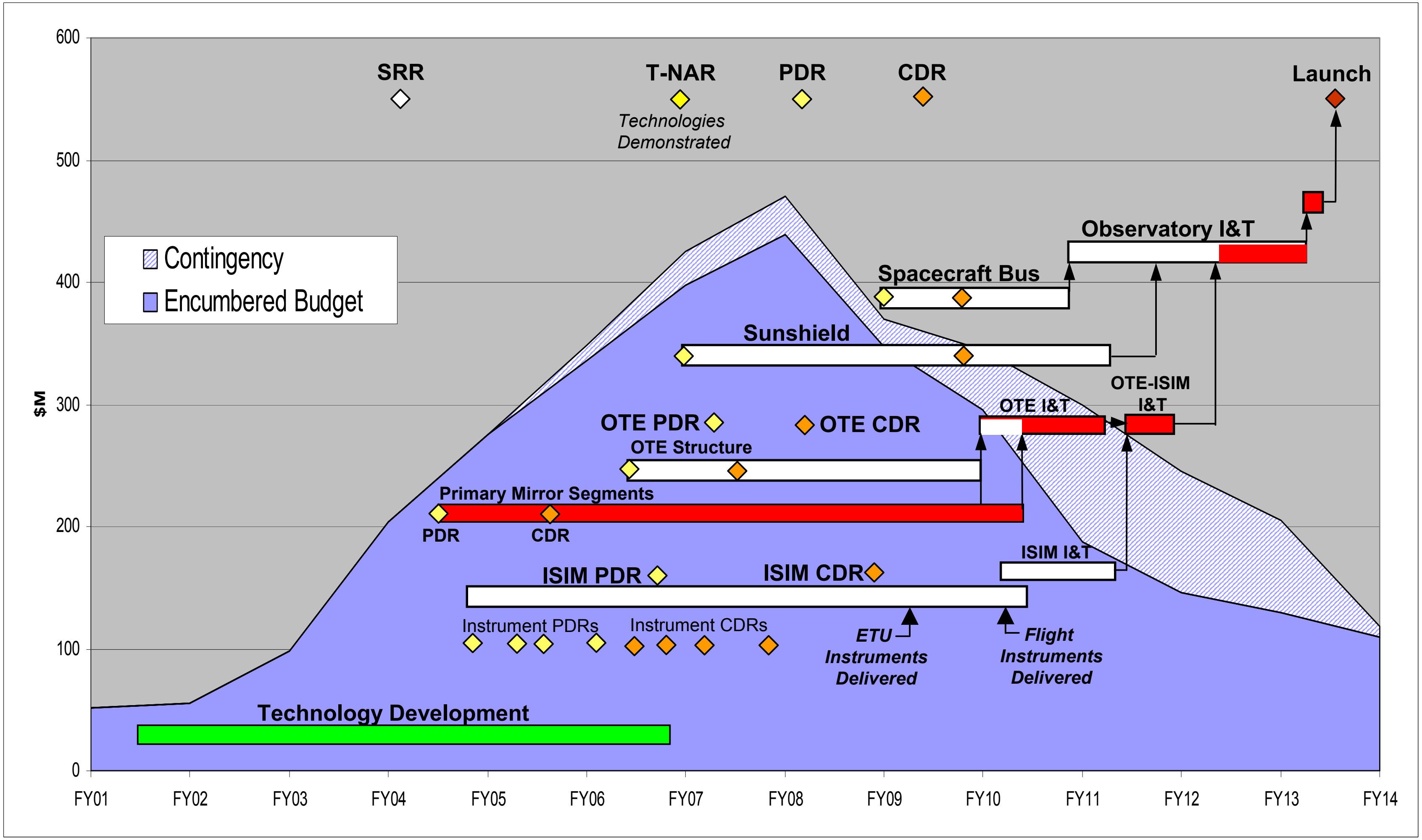
NASA's Independent Review Team has been through the entire program (including STScI) and believe the project has been responsive to the SAT, the technical challenges are being handled, and the multi-national team is working well. The main IRT concern is low contingency in early years -- a situation similar to Chandra.

Special Review Team Re-plan Assessment Conclusions

1. The program content and scope are adequate as re-planned and can be successful given adequate annual and total funding
2. The project is working to resolve many of the current risks by NAR
3. From a budget perspective, the JWST re-plan is not viable for a 2013 launch:
   - Contingency of 1.5% in FY06-10 is inadequate
   - 25% to 30% total contingency is appropriate
   - Ability to resolve issues, address program risk areas, and accommodate unknown problems is very limited
4. Before NAR, steps should be taken by SMD to assure the JWST Program contains adequate time-phased funding contingency to secure a stable LRD

SRT Reports ~ April'06, Chaired by Jean Oliver

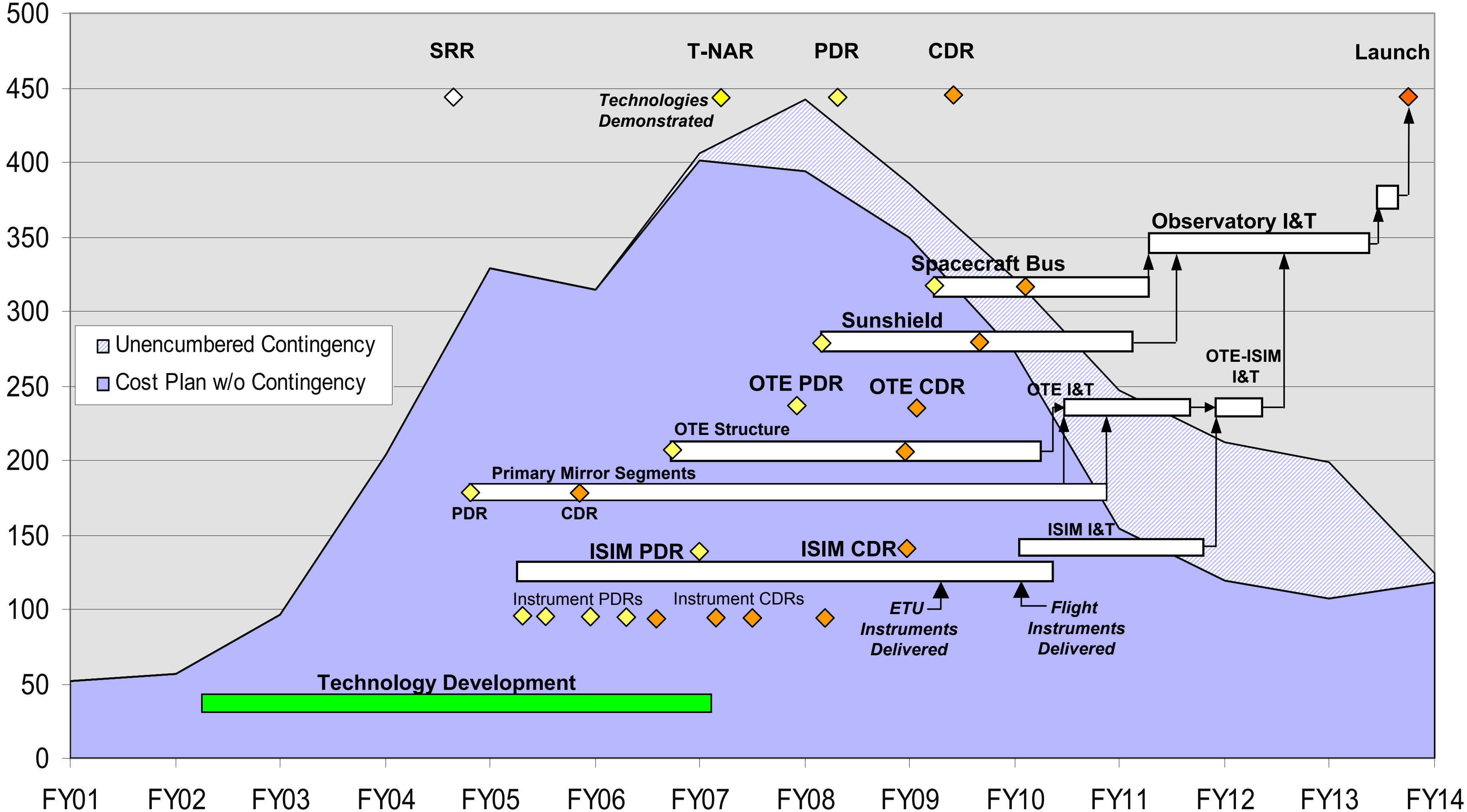
JWST Project Budget Profile



Project presentation to SSB 13 June 2006: Note the total integral under the curve is $3.5B (RY) to FY14

Project Budget going into NAR

POP 07-1



Project presentation to Partners Workshop, Oct’07: note total integral under the curve is $3.5B

Next Steps 2 of 2

- Since September'06 - SMD has kept ~$600M of additional JWST reserves. In FY'08 these additional reserves were kept in the "Astrophysics Future Missions" line (not JDEM, D&A etc -- see next chart)

- JWST will enter the NAR, after having drawn on only ~$49M of these reserves since 2006
  - Considerable pressure has been put on everyone to reduce cost, with some success.
  - STScI was asked to cut ~$20M out of our ~$70M SOC budget

- However at confirmation Congress will require all costs and reserves to be reported under a single JWST Project budget.

The cost of JWST to NASA *will remain unchanged since 2006,* however the JWST line will increase and the "book keeping line" Astrophysics Future Missions will go down.

Astrophysics Program Content

	* FY07	* FY08	FY09	FY10	FY11	FY12	FY13
FY09 President's Budget *	1,356.8	1,363.4	1,164.5	1,122.4	1,057.1	1,067.7	1,116.0
Physics of the Cosmos	196.5	157.2	157.0	219.8	249.0	271.1	326.0
GLAST	84.4	41.9	23.2	23.3	24.1	24.9	24.9
Herschel	11.5	14.9	27.2	17.4	17.6	17.5	16.4
Planck	6.7	8.8	9.4	8.9	6.6	6.5	6.5
JDEM		3.7	8.5	63.0	83.0	109.0	125.0
LISA	6.5	5.7	5.7	15.9	18.7	26.7	35.0
Constellation-X	8.3	8.1	8.3	12.0	16.8	15.9	42.0
Other Missions and Data Analysis	79.1	74.1	74.9	79.3	82.1	70.6	76.2
Exoplanet Exploration	184.6	159.5	48.1	67.7	68.4	96.4	126.2
SIM	30.4	24.3					
Kepler	121.8	79.5	25.2	14.9	13.9	12.6	8.8
Future Exoplanet Missions	1.0	23.8	6.6	41.7	44.0	72.0	107.5
Other Missions and Data Analysis	31.3	31.9	16.3	11.2	10.5	11.7	9.9
Cosmic Origins	788.9	816.9	674.4	571.1	515.4	485.6	458.5
James Webb Space Telescope	398.6	447.4	371.9	311.1	265.1	236.1	194.9
Hubble Space Telescope	277.5	230.2	154.9	125.6	114.7	94.8	93.9
SOFIA	38.9	64.0	72.8	72.8	57.0	58.8	60.6
Spitzer	73.8	75.4	71.7	15.9	10.3	3.2	3.3
Astrophysics Future Missions			3.0	45.8	68.3	92.7	105.8
Astrophysics Explorer	88.0	117.2	132.6	93.3	43.3	11.7	6.4
WISE	52.9	72.7	65.2	13.0	5.2	1.6	
NuSTAR		16.7	43.5	57.8	31.0	6.8	6.4
Operating Explorers	35.1	27.8	23.9	22.5	7.1	3.2	
Astrophysics Research	98.8	112.6	152.3	170.4	181.0	203.0	198.9
Research and Analysis	52.2	56.6	61.4	65.4	69.3	72.6	77.5
Balloons	22.2	24.0	24.6	26.7	28.8	32.4	33.2
Other Missions and Data Analysis	24.5	32.0	66.3	78.4	82.9	97.9	88.2

* FY07 and FY08 reflect latest Operating Plan, in FY09 structure

Presentation by Jon Morse to STIC, February 2008

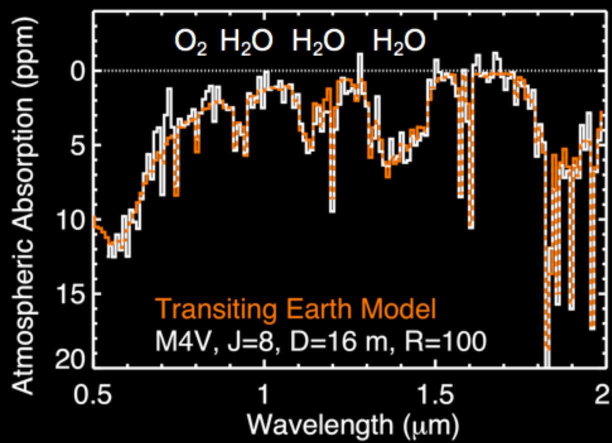
Advanced Technology Large-Aperture Space Telescope

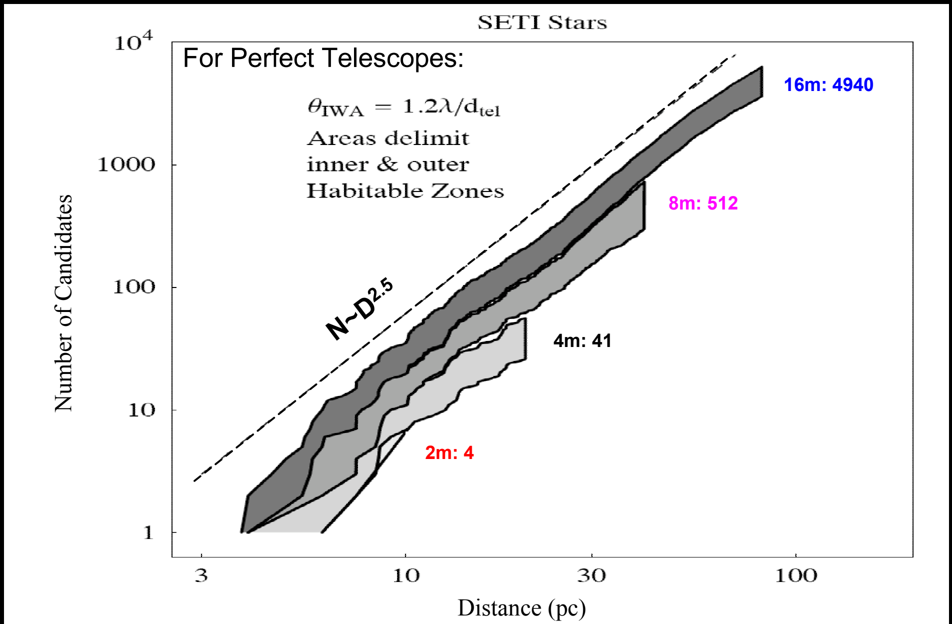
Astrophysics Enabled by an 8 - 16m UV/Optical Space Telescope

Marc Postman, PI, STScI

NASA Strategic Mission Study

Characterizing Exoplanets



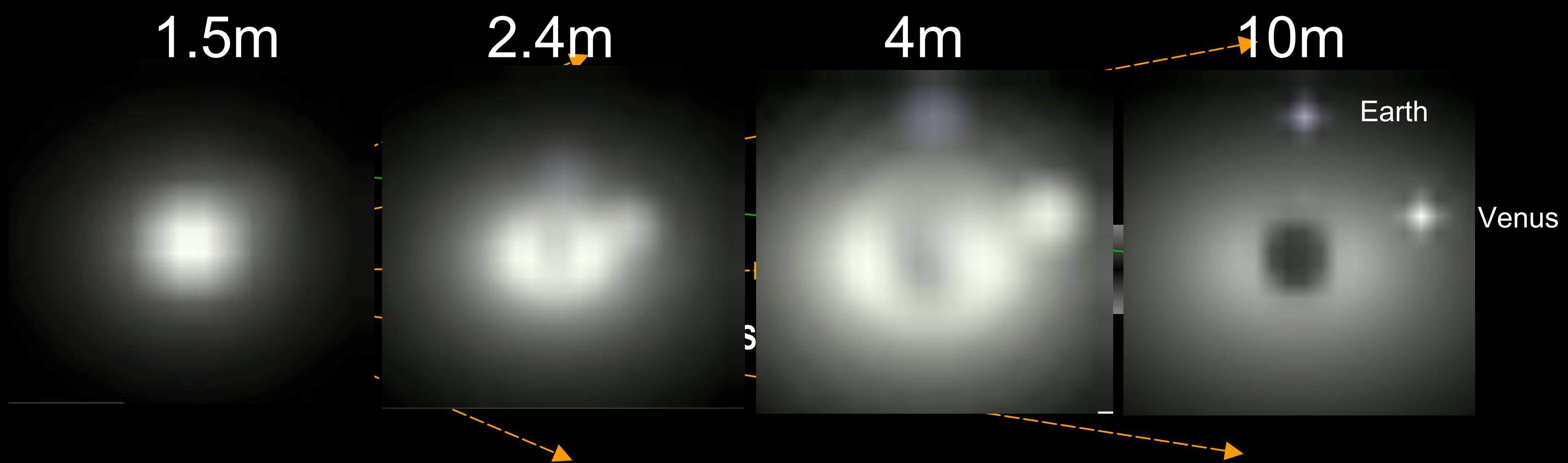


Characterizing Exoplanets: A large space telescope has hundreds (8-m) to thousands (16-m) of candidate stars to search for life's signatures among those with Earth-like planets in the habitable zones, orders of magnitude more than a 4-m telescope for *any* observational technique (Beckwith 2007; see table right) for both the transit spectroscopy and coronagraphic imaging spectra. The spectra of terrestrial exoplanet atmospheres can be obtained by observing transits (see figure above for 16-m simulation). If additional wavefront corrections can be used to diminish the light from the star through a coronagraph or use of an external occulter, direct imaging and spectroscopy will allow us to characterize the atmospheres of hundreds to thousands more exoplanets.

EXOPLANET HOST STAR SAMPLE SIZE vs. TELESCOPE DIAMETER (For Realistic Telescope Performance)			
Primary Mirror Diameter (Meters)	Expected Number of Transits	# Coronagraphic Candidates	
		All Stellar Types	Solar Type Stars
2	1	3	0
4	11	27	10
8	85	216	78
16	682	1726	1092

Courtesy ATLAST Team

Characterizing Exoplanets



Characterizing Exoplanets: Via the use of an external occulter, one can suppress the light of the central star, enabling the detection of any orbiting exoplanets. Detecting and characterizing these, however, becomes progressively easier with increasing telescope aperture.

Above: a simulation of our solar system at a distance of 10 pc observed with an external occulter and a telescope with the indicated aperture size. The two planets are Earth and Venus. The challenges of deploying and maneuvering the star shade, however, also increase with increasing telescope aperture. Using a combination of an internal coronagraph and an external occulter may be the optimal solution.

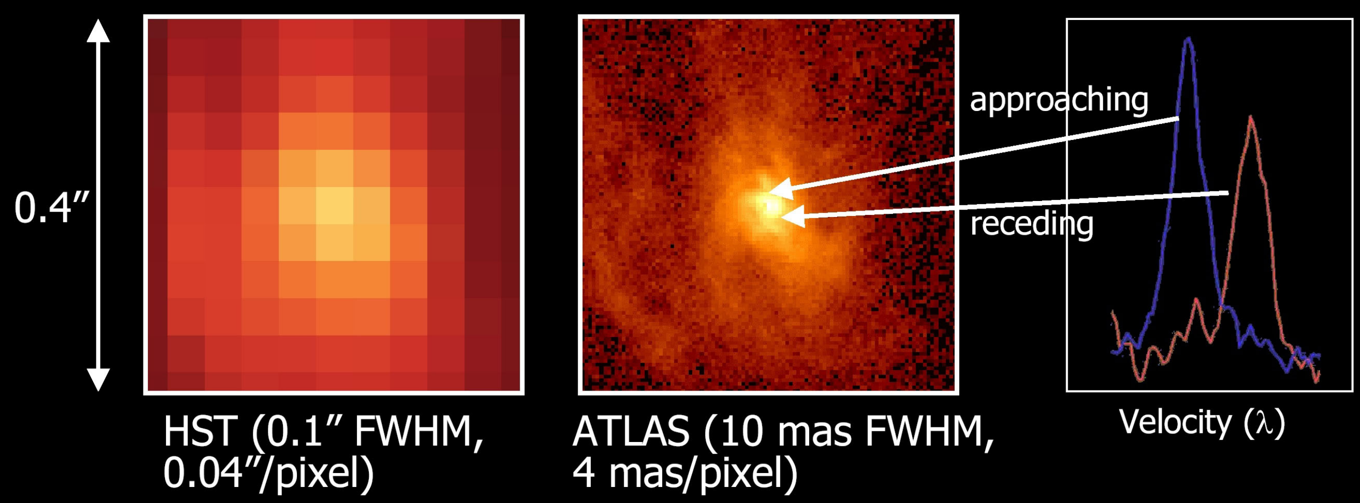
Courtesy ATLAST Team

Probing Super Massive Black Holes

Probing Distant Super Massive Black Holes: Most galaxies have massive black holes in their centers. The mass of the central black hole is highly correlated with the mass of the host galaxy. Understanding the origins of this fundamental relationship is one of astrophysic's fundamental unsolved problems.

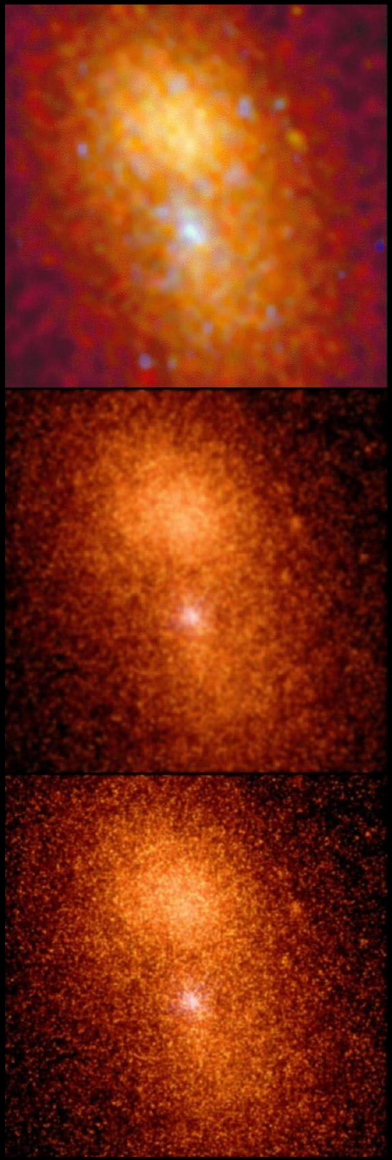
An 8 - 16m space telescope will be able to probe the environments of such black holes down from the central 100 parsecs to within just a few Schwarzschild radii (via reverberation mapping). Such a telescope will, most importantly, allow us to do this over a broad range of cosmic time.

Shown below is a galactic nuclear disk of radius 190 parsecs (0.03") at redshift 5, observed in rest-frame Lyα emission. This figure is based on a real image of a gas disk around a supermassive black hole in a nearby active galaxy, placed at redshift 5 and scaled appropriately.
(Left) how this would appear if observed with HST at z~5;
(Middle) how it would appear if observed with a 16-m space telescope;
(Right) Example spectra of gas approaching and receding, enabling measurement of the black hole mass at z~5.



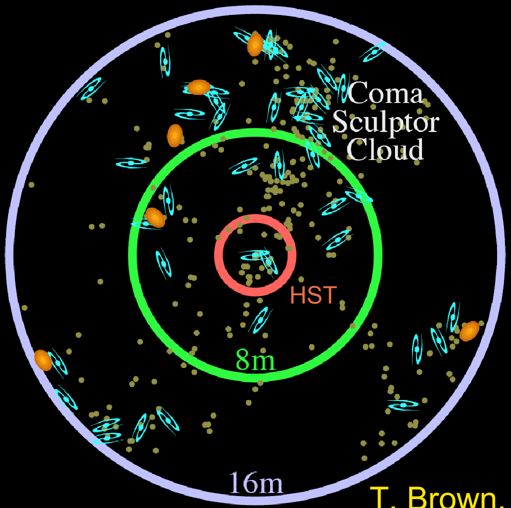
Courtesy ATLAST Team

Re-tracing the Star Formation History of Galaxies *in High Definition*



Resolved Stellar Populations: An 8-m to 16-m space telescope will bring about a major revolution in the study of stars, enabling observations of solar-luminosity stars outside the Local Group of galaxies. Observations of solar-luminosity stars on the main sequence are essential to reconstructing the star formation history over the entire lifetime of a galaxy. By extending our reach far beyond the Local Group, ATLAS-T will open up the entire Hubble sequence of elliptical and spiral galaxies to study, revealing their detailed star formation histories. In the era of JWST, where integrated populations of stars will be observed at high redshift, we will need to understand the detailed evolutionary history of nearby galaxies. The figure below shows the reach of an 8-m and 16-m space telescope compared to HST for these studies.

LEFT: Core (6 pc) of M31 as seen by HST (top), an 8-m (center), and a 16-m (bottom) space telescope. Images are composite BVI data (Lauer 2006).



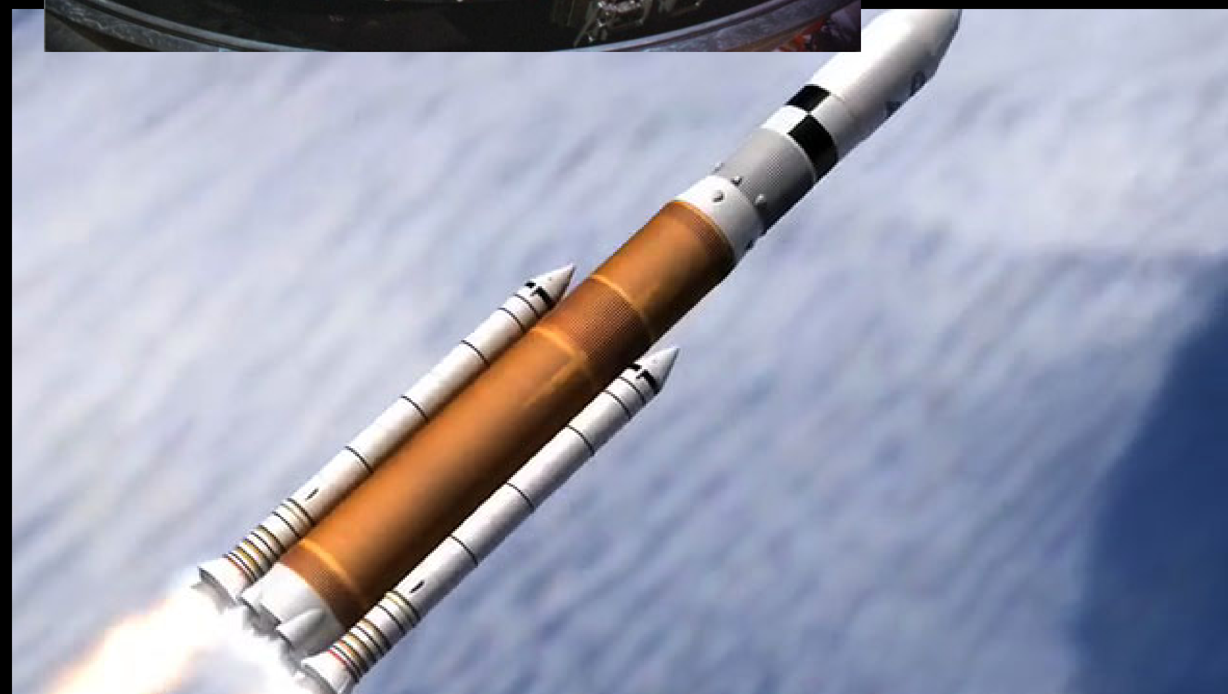
T. Brown, 2006

Courtesy ATLAST Team

Ares V enables a new science paradigm:

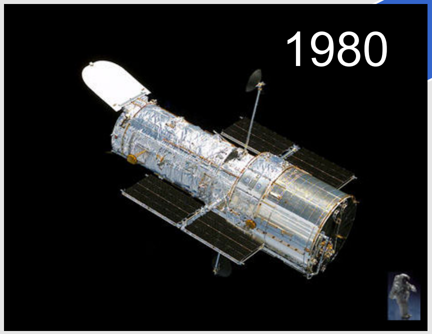
- to save cost maybe we can optimize the telescope design to simply I&T?

- maybe we can take some risk and rely on adaptive optics technologies to deliver final on-orbit performance?

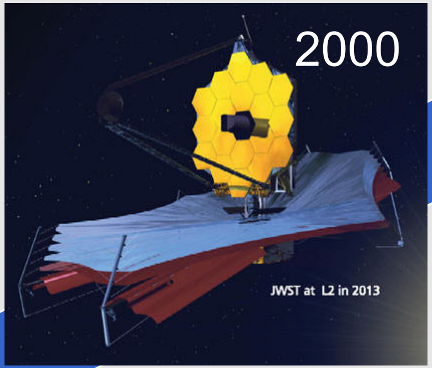


- perhaps we could launch with a simplified science capability and rely on future servicing to upgrade the telescope’s scientific performance?

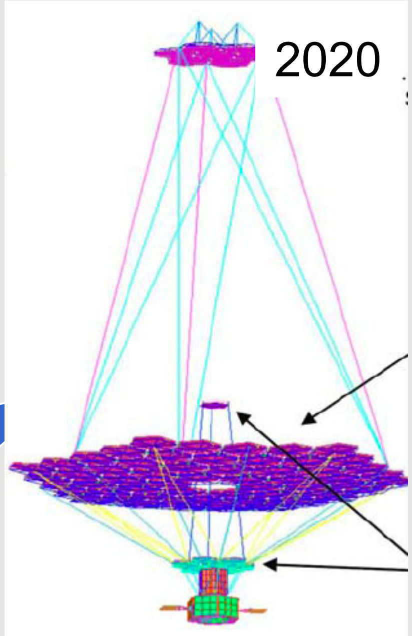
The Challenge



2.4m ~ $4B (FY07)



6.5m ~ $4B (FY07)



16m ~ $4B (FY07)

Mission Comparison ($B)			
	HST	**Chandra**	**JWST** (Projected)
Phase A-D	**4.1 (FY06)**	**3.4 (FY06)**	**3.5 (FY06)**
Lifecycle	**7.5 (RY)**	**3.1 (RY)**	**4.5 (RY)**

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