

# Decadal Survey History and Strategy

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LUVOIR STDT

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# Early JWST History

- 1989, before HST launch, conference at STScI, published proceedings, outlined options, with some good cost estimates (!)
- 1990 HST launch – 26 years old now!
- 1993 HST repair mission (1<sup>st</sup> of 5 servicing missions)
- 1995 HST & Beyond report drafted, JWST study started at GSFC with HQ direction, under HST project manager
- Concept developed within weeks at STScI/GSFC meeting
- Dressler & Goldin met and understood concept and challenge
- Announcement of program by D. Goldin at AAS meeting, January 1996, got standing ovation (there's peer review!)
- Mather presented concept to ESA officials January 1996 – interest + cost and schedule skepticism

# 3 competing studies

- Presentation by NASA to industry at STScI in spring 1996 – industry requested a competition via “cooperative agreement notice”
- Huge interest – top scientists and engineers volunteered to work on most exciting project
- NASA/STScI team, Lockheed Martin team, TRW team, reported summer 1996; all agreed that Goldin challenge (\$500 M FY 96 for NASA) can be met (but we all obviously missed something!)
- Major aerospace contractors all could win work – JWST had many friends!
- OMB examiner saw web site, was very interested
- NASA presented baseline of 1-5  $\mu\text{m}$  telescope for budget purposes and was approved to continue; 5-28  $\mu\text{m}$  extension was not formally submitted

# Technology Developments

- Detectors (essential) – GSFC mgmt
- ASICs (essential) – GSFC mgmt
- Mirrors (eventually 12 contracts) – MSFC mgmt, DoD/NRO agreement for joint support
- Micromirror/microshutter arrays – HQ selection of GSFC team
- Later, 7 K coolers (solid Hydrogen too heavy) – JPL mgmt of Northrop Grumman cooler
- Wavefront sensing and control – JPL initiated in-house
- Deployments
- Sunshield materials and deployments

# Decadal Survey 2000

- Intense competition (of course)
- “Faster Better Cheaper” mantra was dominant for NASA
  - Huge ambitions, “proof by analysis”, desire to take risk to get reward, belief that there was a better way
- Costs were not formally submitted by NASA, but Decadal committee had to do something
- JWST was given top rating for large space missions
- SIM was a medium mission, endorsed and assumed to be launching ~ 2005
- UV/Optical proposal for a 4 m aperture system was not endorsed – not enough better than HST

# JWST at the 2000 Decadal

- Science case: HST & Beyond report is brilliant & poetic
- Uniqueness: impossible to do sensitive IR astronomy from the ground ( $> 1.7 \mu\text{m}$ )
- Discovery potential: huge jump in capability over Spitzer (not yet launched), with 10 x aperture, AND over HST (3.3 x aperture)
- Killer app: first stars and galaxies require 8 m aperture, cold IR telescope
- General purpose: imaging and spectroscopy over whole band from 0.6 to 28  $\mu\text{m}$  possible (though mid IR not confirmed yet)
- Technology roadmap, plan to complete to TRL6 before completing design (HST lesson learned)
- Initial progress on mirror technology good
- International partnerships with ESA and CSA very supportive, details still TBD

# UV/Optical Recommendation 2000

- “will require a UV-optical space telescope with a spectrometer that delivers a 100-fold increase in throughput and multiplex efficiency. To prepare the way for such a mission in the decade 2010 to 2020, the committee recommends an aggressive technology development program to develop UV detectors that are more sensitive, energy-resolving detectors such as superconducting tunnel junctions or transition edge sensors, and large, lightweight precision mirrors.”

# TPF in 2000

- “The Terrestrial Planet Finder (TPF) is the most ambitious science mission ever attempted by NASA. It is currently envisaged as a **free-flying infrared interferometer** designed to study terrestrial planets around nearby stars to find them, characterize their atmospheres, and search for evidence of life and to obtain images of star-forming regions and distant galaxies with unprecedented resolution. The committee’s recommendation of this mission is predicated on the assumptions that TPF will revolutionize major areas of both planetary and nonplanetary science and that, prior to the start of TPF, ground- and space-based searches will confirm the expectation that terrestrial planets are common around solar-type stars.”



# JWST Team Selections

- International partnership discussion led to assigned roles – CSA for FGS/NIRISS, ESA for NIRSspec and Ariane 5, JPL/ European consortium for MIRI
- Descope to 6.5 m prior to competition for prime contract
- US instrument NIRCcam competition, 2002
- Interdisciplinary scientists & SWG chosen, 2002
- Prime contract 2002 (TRW and Lockheed Martin both supported through Phase A)
- Immediate cost growth and further descopes after selecting TRW
- TRW group → Northrop Grumman
- NGST → JWST

# Near Death Experience 2011

- JWST budget requests continued to grow
- Head of House committee zeros the budget, Mikulski writes to NASA asking for technical review and new plan
- Review says engineering excellent, sometimes brilliant, but did not ask for enough money
- Congress agrees to new budget including adequate schedule contingency based on statistical tool: \$8.00 B to launch in October 2018
- Money came, project stays on track ever since

# JWST status

- Telescope assembled
- Instrument module tested 3x in cryo vac
- Instrument module and telescope to combine at GSFC, have vibration and acoustic test
- Ship telescope to JSC near New Year's for cold focus and functional test, about 1 year
- Integration to spacecraft at Northrop Grumman (Redondo Beach)
- Launch by Ariane 5 from French Guiana, Oct. 2018
- Commissioning complete Apr. 2019

# Key LUVVOIR similarities to JWST

- Huge jump in capabilities
- Unique: no way to do it on the ground
- Killer app, public excitement: first stars (JW) → exoplanet life search with coronagraphs (LUVVOIR)
- Something for every astronomer: general purpose instruments
- Industrial interest, many advocates
- Serious new technologies
- Could be based on scaled JWST design
- DoD connection possible
- Something for everyone to do: international partnership, multiple NASA centers, multiple contractors
- National pride