



# HST Lifetime and End-of-Mission Scenarios

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# Discussion Outline

- Charge to the committee
- Specific Studies Related to HST lifetime and End-of-Mission
- NASA Assessment of studies
  - Possible competition scenario
  - Implications of competition
- Additional Considerations



# Charge to the Committees

- Astronomy & Physics Division has received thoughtful input from three HST specific reports.
  - APD also takes into account Decadal Reports and Roadmaps.
  - In addition Columbia Accident Investigation Board Report, Return-to-Flight effort play an important role.
    - There is considerable uncertainty associated with the future Shuttle schedule.
  - APD has taken all the input and developed a plan.
- ☞ What are your comments on our plan?



# Relevant Review Panels

- Congressionally Requested [Feb 2003]
  - Evaluate Science - “costs and potential scientific benefits”
    - “Black Panel” [March-April 2003]
  - Deorbit Study - “study means for disposing of Hubble”
    - “Propulsion module study” [March-October 2003]
- Astronomy & Physics Division Initiated
  - HST-JWST Transition Plan Evaluation
    - “Bahcall Panel” [June-August 2003]



# HST Post-SM4 Scientific Review Panel

- Charter Questions

- 1.) What is the scientific potential of HST if an SM5 is launched with/without new instruments? Would the scientific return of lengthened operations with the post-SM4 instrument complement be worth the cost of such a mission, in the context of the overall Origins Programs?
- 2.) Would either of the candidate new instrument possibilities studied in late-2002 make an SM5 especially valuable in ways beyond simple life extension discussed above? Would such instrument(s) be feasible and of minimal risk while at the same time offering new performance capabilities not before realized on HST or on the ground?



# HST Post-SM4 Scientific Review Panel Findings\*

- On the assumption of a fully successful SM4, the Panel was unanimous in its view that HST would continue to provide the highest quality scientific return at and beyond the time of a proposed SM5.
- Based upon the Panel's understanding of the cost of a minimal SM5 (i.e., no new instruments), and the expected gradual reduction of HST's contributions to the major scientific objectives of the Origins Program if no new instruments were installed, the Panel concluded that in the absence of full additional funding, we could not endorse an SM5 at the expense of currently budgeted missions in the Origins Program.
- The panel was unable to reach a consensus that either of the suggested SM5 instruments would "make SM especially valuable in ways beyond simple extension" of HST. Therefore, the Panel cannot fully endorse a justification for an SM5 based solely on potential added science that might derive from these instruments.
- The opinion of the Panel was that it would be a substantial challenge to overcome these technical difficulties in time to make a ~2008 launch date.

\*Congressional deliverable



# Alternate End-Of-Mission Concepts Charter

- Study Focus: “...extend the life of the telescope by use of an upper stage propulsion system to allow for disposal of the system without requiring an additional STS retrieval mission.”
  - Evaluate the feasibility, utility, cost and risk of adding an upper stage propulsive system to the HST



# Alternate End-Of-Mission Concepts Results\*

- An upper stage that permits continued operations of HST is not viable in this design iteration
- Shuttle installed version of a stage is viable and simpler than a robotic version, but this version would include costs and risks associated with Shuttle missions
- Autonomous Rendezvous & Capture device needed for ELV launch option requires development.
- All options considered cost ~\$300M (launch excluded)

\*Congressional deliverable



# HST-JWST Transition Plan Panel Charter

- Evaluate the scientific impact of the current NASA plan for ending HST operations and beginning JWST operations.
- Present answers to the following questions:
  - Does the current plan provide for the best scientific use of unique HST abilities in the context of the overall NASA program?
  - Is there sufficient flexibility in the plan to respond to, for example, unforeseeable failures of HST instruments, for limitations on shuttle servicing missions, and for possible delays in the JWST program?



# HST-JWST Transition Panel Findings

- NASA should examine implications for continued HST science operations, and develop backup plans if no further servicing (e.g., two-gyro science mode)
  - Existing projects/missions should not be affected by additional HST servicing
- {1} If 2 Shuttle servicing mission visits to HST:  
SM4 ~2005, SM5 ~2010. The extended HST science program resulting from SM5 would only occur if the HST science was successful in a peer-reviewed competition with other new space astrophysics proposals.
- {2} If 1 Shuttle servicing mission visit to HST:  
SM4, before the end of 2006, replacement of HST gyros and installing improved instruments. Deorbit HST, after science operations by a propulsion device installed on the HST.\*
- {3} If 0 Shuttle servicing mission visits to HST:  
Robotic mission to install a propulsion module to bring down the HST in a controlled descent when science is no longer possible.

\*Involve GSFC, MSFC, STScI, astronauts, and outside experts in studies for lengthening scientific lifetime of HST after SM4



# NASA Assessment of Studies

- Each study provided thoughtful input
- NASA Astronomy & Physics Division:
  - 1) Has drafted scenarios for competition for SM5
  - 2) Is Studying deorbit strategies (study participants include engineers, scientists and astronauts)
    - Stages that permit continued HST operation
    - Stages that only deorbit the HST
  - 3) Has initiated work on modes that would permit HST operations under degraded observatory performance (e.g., two gyro mode, alternate operational scenarios, etc.)



# Principles of Competition

- Don't affect priorities already established from previous Decadal Surveys. Don't adversely affect already approved projects.
- Competition will be between proposals with related science goals, and would feature complete science and technical peer reviews
- Funding re-allocated between OSS divisions to an extended HST mission if, and only if, experts from that discipline decide that they prefer an extended HST mission to other proposed future science missions.
- AO cost cap based upon the estimated cost for a full SM5, including person power, spacecraft, science instruments, operations, and data analysis and archiving for the full term of the mission. The cost cap will reflect the risk that a scheduled SM5 will be delayed or that new instruments might not be installed because of a technical glitch during the servicing mission.



# Proposed Competition Scenario

- Competition Type: Solicit Science Investigations (Traditional AO, Science Peer Review, Technical, Management, Cost, [TMC] reviews)
- Competing Science Elements: Explorers, Discovery, Einstein Missions
- Funding Sources: Depends on nature of winning science (100% Explorers or 100% Discovery)
- Solicited elements: Science Investigations using HST extension (instruments + ops, ops), Discovery, Explorer, Einstein Missions



# Such a Competition...

- Would provide the opportunity to revisit/re-order the OSS science plan outside of normal strategic planning cycle and methodology
- Would permit traditional peer-reviewed competition to select strategic missions
- Would entail significant funding reallocation, changes to programmatic balance
- Would need approval from higher NASA management, OMB, Congress

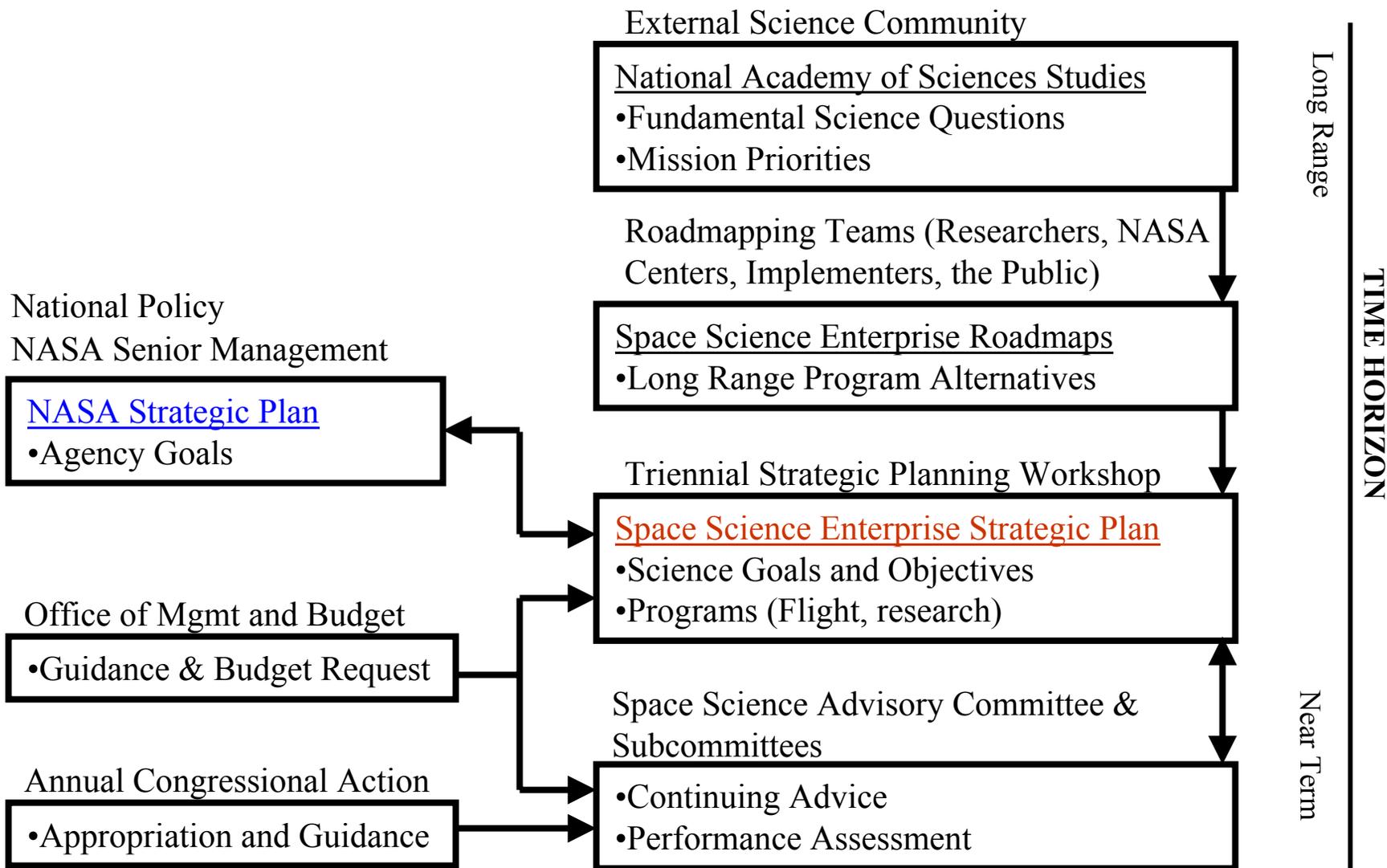


# Implications for OSS

- Explorer/Discovery lines halted for ~5 years during development, funded at some reduced level in operational years if an SM5 option is selected. Close down/reduce staffing Explorer/Discovery offices for ~5 years.
- Potential reordering of Office of Space Science strategy, scientific theme balance, programmatic lines.



# How NASA Creates its Programs





# Previous Advice

- Decadal Plans

- “The committee recommends that NASA increase the rate of Explorer missions for astronomy and astrophysics to six Delta-class and five SMEX missions per decade.”

*The Decade of Discovery in Astronomy and Astrophysics, NRC, 1990*

- “The committee recommends that NASA maintain diversity in its flight programs by ensuring that a suite of opportunities, including small, moderate, and major missions, is available to accomplish scientific goals.

*Astronomy and Astrophysics in the New Millennium, NRC, 2000*

- “Given Discovery’s highly successful start the SSE endorses the continuation of this program...A flight rate of no less than one launch every 18 months is recommended.”

*New frontiers in the Solar System, NRC 2003*



# Astronomy & Physics Plan

- Complete HST SM4
- Safely deorbit HST after useful science ceases
- Rationale
  - Maintains vitality and balance of entire Astronomy & Physics Program
  - Follows strategic planning process and advice
  - Additional SM5 Cost (~\$1.2B, RY) is large
  - Return-to-Flight uncertainties add much cost and risk to HST schedule



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