OVERVIEW

- At NASA's request, ST ScI is conducting a community-based study to develop a strategic plan for the second decade of HST
- The "HST Second Decade Study" will
  - —provide a *vision* for HST following the final servicing mission, including the early years of NGST
  - —provide forethought about *opportunities*, *constraints*, and *issues* important for HST's future
  - —provide *guidance* on allocating HST observing resources
- HST Second Decade Study committee

Stefi Baum	Robert Fosbury	Mario Mateo	Ethan Schreier
James Beletic	Richard Green	John Mather	Charles Steidel
Robert Brown, chair	Timothy Heckman	Claire Max	John Stocke
Tim de Zeeuw	Garth Illingworth	Donald McCarthy	
Larry Esposito	Shrinivas Kulkarni	Richard McCray	
Michael Fall	Henny Lamers	Keith Noll	

- Key features
  - —community input solicited via WWW storefront @ http://sso.stsci.edu/second_decade/
  - —first meeting was held at ST ScI, July 7-8, 1998 (WFC3 IR channel recommendation)
  - —second meeting was held at ECF/ESO in Garching, Nov. 17 & 18, 1998 (Large program interim statement)
  - —third meeting was held at ST ScI April 13 & 14, 1999 ("Treasury Program", "multipliers")
  - —report in preparation; to be distributed in booklet and electronic forms
  - —committee on call through end of 1999 at NASA's request

STUDY APPROACH

- Conduct general review of status and plans for systems and infrastructure.
  - —spacecraft (power issues, servicing missions)
  - —instruments (uniqueness space, gaps-- > WFC3 IR option)
  - —ground system (user services, low-cost operations)
- Develop understanding of program selection and science outcomes.
  - —policies and procedures of GO/TAC process
  - —qualitative and quantitative assessment of science merit
  - —Interim statement on large programs
  - —Recommendation of the new “Treasury Program”
- Multipliers
  - —data library (archive)
  - —education and outreach

TREASURY PROGRAM

- Lessons learned from experiences with Key Projects, HDFs, and other GO/TAC large programs
  - —large programs are 3 times more productive of literature citations than typical small and medium size programs
  - —large programs can save costs by efficiencies of scale
  - —"multiplex advantage" from coordinating the definition of observations (ex. NGST DRM)
  - —special benefits from archival research on well-prepared, multi-user data sets
- A new program—the Treasury Program—is needed to bring forth large observing plans optimized in the "proposal space" spanned by the Key Projects and the Hubble Deep Fields.

	Typical GO	Key Project	"HDF-Like"	Treasury
Size	Sm/med/(lg)	Large	Large	Large
PI-led	Yes	Yes	No	Optional
Archive focus	No	No	Yes	Yes
Science focus	Specific	Specific	Broad	Either
Idea cultivation	Passive	Proactive	Consult	Proactive
Planning locus	Community	Community	ST ScI	Best mix
Initial data reduction	Community	Community	ST ScI	Best mix
Proprietary period	1 year	1 year	Minimal	Minimal
Topical definition	PI	Community	Director	Community

- The Second Decade Committee recommends:
  - — that 20-30% of the total HST observing time should be devoted to the Treasury Program.
  - — that the Treasury Program be implemented (including the function of peer review) by a new process other than the existing GO/TAC process

TREASURY PROGRAM FEATURES

- Strongly proactive approach
  - —interactions (workshops, etc) with the community to cultivate seminal ideas.
  - —coordination of competing and overlapping proposals, possible development of a "design reference mission"

- Selection criteria: scientific and technical merit, PLUS...
  - —community interest
  - —plan for high-level calibrated science data products into archive
  - —plan for value-added analysis software to community
  - —coordination with other observations
  - —minimum proprietary period consistent with the need to produce a uniform, easily accessible and calibrated data set
  - —design of education/outreach component
  - —cost effectiveness (including possible outside resources)
  - —management plan

- Treasury Program Committee (TPC), advisory to ST ScI Director, to develop
  (...advertise, solicit, optimize, approve, broker, review, report...)

CHARTER

The HST Project is requesting that the ST ScI conduct a community-based study to develop a strategic plan for the second decade of HST that is consistent with the following boundary conditions and objectives, taking account of existing developments and studies. The Project solicits the particular advice of this study group on:

1. observing strategies for the HST that would extract maximum scientific value from the observatory while it is still in operation

2. other relevant topics that merit investigation.

The HST Project has been authorized by the Office of Space Science to plan for an extension of the HST mission beyond the previous 2005 end-of-mission date. The boundary conditions for the extended mission are as follows:

1. final solicitation for new instruments in 1997
2. final in-orbit servicing and reboost of HST in 2002
3. major reductions in HST budget to create development wedge for NGST
4. low-cost operations to end of mission
5. de-orbit in 2010

This extension is consistent with the recommendations of the "HST and Beyond" (Dressler Committee) study, and will allow synergy between the HST and NGST missions. In its second decade, HST will be the premier UV-Optical space observatory, complementing and supporting NGST's extraordinary capabilities in the near-IR.

The HST Second Decade Study will create a strategic plan for the second decade of HST science addressing the following desired outcomes:

1. continuation of healthy observatory operations (spacecraft and ground system), with graceful degradation, at least to 2010

2. continuation of HST's capabilities at the forefront of world-class scientific research at least to 2010, with emphasis on those areas where HST is likely to remain unique

3. optimization of HST for UV-optical imaging and spectroscopy, assuring both primary and adequate backup instrumentation sufficient to assure its performance to 2010 or beyond

4. achievement of objectives 1-3 within a highly constrained budget, taking maximum advantage of resources that already exist within the HST Project.

Several key elements which would form a basis for the extended mission are already in place, under development or under study, and are consistent with this approach. These are:

1. The Space Telescope Imaging Spectrograph (STIS) - the primary tool for UV-optical spectroscopy; development complete and paid for; 13 years old by 2010

2. Advanced Camera for Surveys (ACS) - the primary tool for UV-optical imaging; under development for SM3/2000; developed at about half the cost of comparable earlier instruments by use of spare hardware, design drawings, and other heritage from STIS

3. Wide Field and Planetary Camera 2 (WFPC2) - currently primary imager on HST; between SM3/2000 and SM4/2003 serves as primary backup to ACS and provides continued unique science because of its filter set

4. NICMOS Cooling System (NCS) - under study and development for potential flight in SM3/2000; very low cost approach ($6-10M) to extend HST near-IR capability essentially indefinitely

5. Cosmic Origins Spectrograph (COS) - extends HST faint-source UV spectroscopy beyond any prior capability; selected via AO process for flight in SM4/2003; limited backup to STIS UV MAMA channels; low cost instrument, utilizing returned GHRS flight hardware and design heritage plus detector design and grating technology previously developed for FUSE

6. Wide Field Camera 3 (WFC3) utilizes returned WFPC1 flight hardware, spare CCD detectors from the ACS program and NICMOS mechanism design heritage; will be developed as a facility instrument to fly in SM4/2003; serves as a newer, more reliable backup to ACS and will continue to provide unique imaging science complementary to ACS.

7. Low-Cost Operations - new HST ground system (Vision 2000) currently under development, with some elements already being phased into operation; exploits process improvements and efficiencies plus capabilities of new spacecraft 486 computer (flying on SM3/2000), to dramatically reduce costs of HST operations; no further on-orbit servicing

WFC-3 Near-IR Imaging Capability: Interim Report

July 8, 1998

The HST Second Decade study committee has been charged with considering strategic options to maximize the performance of the HST in the years 2003-2010. At its first meeting, the committee heard presentations on a broad range of topics relevant to its charge, including HST instrument plans and the current and anticipated performance of Adaptive Optics (AO) systems and HST/NICMOS. Based on these presentations, the committee discussed the potential benefit of a new capability for the HST: a high-sensitivity, wide-field, near-diffraction-limited imager in the near-infrared (to approximately 1.8 micron). The committee concluded that such a capability would enable HST uniquely to address a broad range of important astrophysical questions and issues, and would have a particularly large impact on studies of the star-formation history in galaxies from our Galaxy out to those at very high redshifts.

As it continues its study, the committee will develop an interim report on ground-based AO systems, a comparison of HST with the ultimate limitations of near-IR imaging from the ground, and the unique capabilities of HST in this performance domain. These study results will be included in the final report of the HST Second Decade study committee.

However, because WFC-3 appears to offer the sole opportunity to assure the necessary near-IR imaging capability in the period 2003-2010, and because of the rapid pace of events related to WFC-3, the committee members present voted unanimously to urge the HST project to explore immediately the possibility of adding a wide-field, near-IR (J- and H-band) camera to WFC-3

Resolution Concerning the Near-Infrared Channel Addition to WFC3

At its second meeting, the HST Second Decade Committee has given further consideration to the scientific case and proposed characteristics of the near-infrared channel on WFC3 developed by the WFC3 team and the WFC3 SOC. It is greatly encouraged by the resolutions endorsing the concept of this new channel as passed by the SOC, STIC, and STUC. The HST Second Decade Committee unanimously concludes that the addition of a near-infrared channel appears to be technically feasible, can be expected to have high scientific return, and will help maximize HST's scientific productivity and competitiveness until 2010, which is the central goal of the HST Program.

The addition of a near-infrared channel to WFC3 will assure HST second-decade access to wavelengths longer than 1 micron. Observations at these wavelengths are of increasing importance to a number of fundamental research areas, including the formation and evolution of galaxies at high redshift, star formation, and the environs of stellar and protoplanetary systems. Furthermore, due to WFC3's improved infrared-detector quantum efficiency and wider field of view, its discovery efficiency will increase more than tenfold over that of NICMOS. With this expansion of discovery space, HST will provide a unique capability that is complementary to ground-based observations, both with and without adaptive optics. This powerful near-infrared imaging capability will also provide a strong scientific link between HST and its successor, NGST.

Given the short period of time remaining for the design and construction of WFC3, the Committee believes it is crucial that the WFC3 project move quickly to resolve outstanding technical issues concerning the near-infrared channel, such as the required detector properties and the thermo-electric cooler. The Committee also underscores the conclusion of the recent STIC resolution, which recommends that STScI and NASA pursue imaginative ways to minimize the cost of adding the near-infrared channel to WFC3, and that they identify funding sources, including possible ones within the Hubble Project and the HST user community.

LARGE PROGRAMS

Interim Statement on Large Programs

The second decade of HST will provide an opportunity to stimulate fundamentally new ways of using this unique facility for projects with lasting scientific impact. The Second Decade Committee believes that significantly increasing the number of large programs—defined here as more than 100 orbits per program—would help achieve this goal. The Committee recommends that the fraction of HST time devoted to large programs be increased to 20-30% of total observing time during the second decade of operations. Such a large allotment of time would encourage many more large programs, and enable a qualitatively new class of program requiring 1000 orbits or more.

The value of large programs has been demonstrated, for example, by the three original Key Projects (Quasar Absorption Line Survey, HST Medium-Deep Survey, and Determination of Extragalactic Distance Scale), the Supernova Intensive Search, and the first Hubble Deep Field. Together, these five programs used only 4% of the HST observing time in the first eight years of HST, yet they were the major contributors to three out of the top six and five out of the top twenty most cited and most noteworthy areas of HST science.

Because they can produce large, coherent data sets for archival research in addition to immediate scientific results, large programs could provide an exciting legacy for HST and a foundation for future space missions and ground-based research programs for decades to come.

The Committee recommends that the selection of large HST programs should be through a peer-review process separate from the normal TAC process.

The Committee will continue to discuss and solicit community input on the variety of other issues related to implementing significantly more large programs on HST. These issues include…

1) What activities would facilitate new approaches to large programs and create opportunities for broad community participation and synergy with ground- and space-based observatories, e.g., workshops, sessions at larger conferences, and web sites?

2) Should there be a group constituted to aid or advise the STScI director on the development and implementation of large programs? (For example, this group might organize the above workshops, etc.)

3) Given that resources will be much more limited in the next decade, what steps can be taken to assure the scientific value of large programs, while at the same time ensuring that the overall program is cost-effective and consistent with plans for low-cost operations?

4) How should STScI be involved in the definition and/or implementation of large programs? (Possible benefits of STScI involvement include optimized data quality, calibration, and archiving functions, cost control, and use of a mature infrastructure already in place to feed back the experience for the benefit of the entire community.)

5) How and when should the observations be released? In what form and at what level of calibration? Will the data be proprietary for a period or not?

6) What should be the responsibility of large-program teams in creating data sets for the archive and in facilitating data utilization?

7) Given that much of the value is envisioned to be in follow-on research, how much GO and AR funding should be available for large programs? How should this funding be allocated?