
**HUBBLE SECOND DECADE COMMITTEE: THE
HUBBLE DATA ARCHIVE AND THE HUBBLE
TREASURY PROGRAM**

Bibliographic Information:

Brown, Robert A., *Hubble Second Decade Committee—The Hubble Data Archive: Toward the Ultimate Union Archive of Astronomy*, Baltimore, Md.: The Space Telescope Science Institute, 2000a.

Brown, Robert A., *Hubble Second Decade Committee—The Hubble Treasury Program: A New Class of Hubble Observations*, Baltimore, Md.: The Space Telescope Science Institute, December 2000b.

PURPOSE

The purpose of the two Hubble Second Decade Committee reports was to formulate strategies for the future of the Hubble Space Telescope (HST), offer guidance on allocating HST resources, and identify opportunities and concerns that are important to HST's second decade. Specifically, the Second Decade Committee examined the current process for selecting observing-time projects from a pool of competing proposals in order to develop recommendations for increasing the number of large-observing projects (those with 100 orbits or more) and for matching project selection more closely to HST strategic goals. In turn, the committee looked at the current and future role of the Hubble data archive, including needed upgrades.

BACKGROUND

To optimize the scientific return from the HST in its remaining years, the National Aeronautics and Space Administration (NASA) asked the Space Telescope Science Institute (STScI) to develop a strategic

plan for the future of the telescope. In response, STScI formed the Second Decade Committee, a group of scientists drawn from the astronomy community. The committee's work stemmed from NASA's 1997 decision to extend the Hubble mission until 2010 with low-cost operations. This extension means that the HST will operate in parallel with its successor, the Next Generation Space Telescope, planned for launch in 2007.

The second decade of HST provides an opportunity to stimulate new ways of using the facility for projects with lasting scientific impact. The Second Decade Committee's mission was to help the HST program take advantage of this opportunity.

METHODS/APPROACH

The Second Decade Committee, chaired by Robert A. Brown of the Space Telescope Science Institute, sought input from the astronomy community via the Internet. It also conducted a general review of the status of, and plans for, Hubble systems and infrastructure.

- The committee focused on improving the selection process to ensure that the observing-time projects chosen were in keeping with future goals. The main source of projects had been the General Observer (GO) program, for which the Telescope Allocation Committee (TAC) reviewed about 1,000 proposals each year. Past selections, however, had resulted in projects that did not necessarily meet the Hubble community's strategic objectives. Specifically, there had been too few large-observing projects. Further, with HST operations ending in 2010, various strategic issues were emerging that the committee felt should be considered in project selection.
- The committee examined potential developments in the HST data archive in the coming years and made specific recommendations for technological needs and resource considerations. In recent years as the archive has grown its usage has increased, and the committee believed usage would continue to increase. By 2010, HST research results would be fully archived, providing immense value for scientific study, education, public information, and new modes of archival research. For maximum usability of the data, however, the archive would need to be upgraded.

More-detailed approaches specific to observing-time projects and the HST archive are discussed next.

Observing-Time Projects

The Second Decade Committee reviewed the GO/TAC process to investigate why it had failed to yield larger projects. Committee members developed a range of opinions on the reasons for this failure (e.g., writing proposals for more than 100 orbits is too time consuming) and agreed that major steps should be taken to increase the number of proposals for these projects. The committee also reviewed earlier efforts to guide Hubble science via the observing-time competition. Ultimately, the committee determined that a new process, the Hubble Treasury Program (HTP), should be formulated to, first, increase the number of large-sized observing projects and, second, to supply a means to address strategic issues, such as the transition to the Next Generation Space Telescope.

In its formulation of the HTP, the committee looked at lessons from the experiences of the few large-observing projects that emerged from HST's first decade: the Key Projects and Hubble Deep Fields. Key Projects were those areas identified in the mid-1980s as holding "such scientific importance that it would be a serious omission if they were not undertaken by HST."¹ The projects were drawn from a pool of prevetted proposals that met proposal criteria in terms of scientific value, coordination needs, and feasibility. In contrast, Hubble Deep Fields worked toward a specific goal set by the STScI director: to push the limits of Hubble's deep-imaging capabilities. The purpose of Hubble Deep Fields was to package and disseminate findings for immediate and broad use. The committee studied selection processes, while considering such aspects as the demands placed on proposers, the review process, and each program's larger purposes.

The Second Decade Committee also examined literature citations to determine if publications on large-observing projects were cited more frequently than publications on small- and medium-observing projects in the scientific literature. The review determined that large-

¹Brown (2000b).

observing projects are more frequently cited by at least a factor of three per orbit; even the papers derived from smaller projects regularly used data or results from larger projects. These findings were supported by the solicited opinion of the astronomy community, which agreed that the most important Hubble results are often based on large projects.

Data Archive

To address the needs for the HST data archive in the next decade, the committee looked at the archive's history, including its original prototype (based on the belief that scientists should be involved in all stages of data management for space science missions) and its implementation (e.g., regular coordination meetings, goal-setting, technical cooperation). The committee's report provides a detailed history of past efforts to enhance the archive. In turn, for each of its recommendations (see the next section), it examined the specific technological advances that promise cost-effective and important benefits, including consideration of which developments to pursue with Hubble resources versus which ones might be developed by Hubble partners instead.

FINDINGS AND RECOMMENDATIONS

Observing Time

Findings. The committee determined that large projects offer crucial scientific dividends. Further, the committee's analysis demonstrated that large projects share at least four desirable characteristics:

- They address widely recognized scientific issues that could not be addressed through any combination of smaller programs.
- They produce standardized, carefully calibrated data sets that are relevant to broad areas of archival research.
- They achieve efficiencies of scale, resulting in operational savings.
- They offer disproportionately high scientific impact.

Recommendations. A summary of the committee's observing-time recommendations follows.

- **Establish the Hubble Treasury Program with 20–30 percent of orbits allocated to large projects.** The recommended HTP program will bridge the gap between Key Projects and Hubble Deep Fields. It will combine the Key Projects' focus on community-defined priorities and standards for research carried out in the principal investigator mode with the Deep Fields' emphasis on increasing technical capability, minimizing the proprietary period, and providing data products of immediate use to a broad swath of the astronomy community. The HTP should be made more highly proactive and adaptive. In turn, the program should include a new peer review process, the active encouragement of new ideas, and elasticity in terms of planning locus and proprietary periods.
- **Convene an oversight/advisory committee.** To help facilitate the HTP, the Second Decade Committee recommended the formation of a community-based standing committee with revolving membership to provide oversight and advice. This committee should stimulate community awareness of, and involvement in, the program and help coordinate the efforts of observing teams and the STScI. The STScI director and the community-based committee should have significant latitude in establishing their responsibilities, but several functions are recommended for the new committee, including the following: soliciting ideas from the astronomy community; advising the director on proposal solicitation, peer review, and selection criteria; and monitoring and reporting on the progress of research. The committee should have continuity in its membership to enable that membership to oversee projects over several cycles of observing time. Further, the community-based committee should consist of both external and STScI scientists.
- **Consider several HTP implementation suggestions.** The STScI director should govern and facilitate interactions among the community-based committee, STScI staff, and the peer review panel. Although the Second Decade Committee did not offer implementation recommendations for the director, it did provide general suggestions, including the following:

- The ongoing GO/TAC program and the new HTP should be mutually supportive. For instance, the HTP orbits that are not allocated in a given cycle should revert to the GO/TAC pool. Likewise, GO/TAC and the HTP should be coordinated for maximum scientific results (e.g., the chair of each committee could serve as a member of the other committee to avoid plan duplication).
- The HTP committee may recommend additional criteria for project selection, such as coordination with other observations, cost-effectiveness, an education/outreach program, and, when appropriate, the setting of a proprietary period to produce a standardized, accessible, and calibrated data set.
- The HTP project selection process should not be limited to approval or rejection of proposals but should allow for suggested changes and potential coordination with proposal teams, and should encourage proposal resubmission when merited.
- Early strategic planning could increase efficiency (e.g., examining projects simultaneously, identifying observations common to more than one project), resulting in more “science” per orbit. When the potential for such partnerships emerges, the principal investigators could meet as a working group under the HTP committee to combine or coordinate their observations.
- HTP project teams and the STScI staff should be closely coordinated in order to meet cost-effectiveness goals.

Data Archive

Findings. The HST data archives facilities serve two crucial functions: as a venue for scientific research and as a vanguard of worldwide efforts to improve the art and practice of archival research. Overall, the Second Decade Committee recommended that NASA proceed briskly with promising developments under way. Specifically, for NASA to make the move to the future “ultimate archive,” the committee offered the following recommendations.

Recommendations

- **Enhance the interoperability of NASA's astronomy archives.** Establishing stronger links to other archives, catalogues, and abstract services allows for a broader-parameter research space. In turn, links between data sets and the published literature can inform researchers about previous studies that focused on the same objects or that used the same data.
- **Pursue new communications and computer technologies.** Computer, network, data compression, and storage media developments will improve computational speed and use, and will reduce the cost of information retrieval and analysis. For example, the committee recommended targeted research and investments in data-delivery technologies, favoring improvements in network delivery over improvements in hard media because of potential cost savings and the overall advantages of the Web for archival research.
- **Generate more science-ready data.** More precise instruments, more constant observing conditions, and more consistent data processing have already helped make the Hubble data archive more science-ready, but the committee recommended further enhancements through improved calibrations, ultimately culminating in a definitive calibration. The committee also recommended the creation of more high-level data products, especially those that support large data sets.
- **Participate in data-mining developments.** Increased interoperability, advancing technologies, and improved calibrations all point the Hubble archive toward the new field of data mining. The committee therefore recommended the development of new software tools and catalogs of object properties, both of which will enable higher-order research based on questions posed in scientific terms. However, the committee stressed that Hubble resources should be used for participation in, rather than leadership of, a long-range data-mining plan carried out in conjunction with other major players in archiving and computer science.