7. THE HUBBLE SPACE TELESCOPE - STATUS AND PERSPECTIVES

Scientific Organizing Committee

G. Miley (Chairman)

J. Bergeron, R. Giacconi, C. Humphries, Y. Kondo,
P. van der Kruit, H. van der Laan, M. Rees, G. Setti, R.A. Sunyaev, S.G. Wang

Supporting Commissions:

9, 28, 44, 47

https://doi.org/10.1017/S153929960000811X Published online by Cambridge University Press

THE SCIENCE PROGRAM OF THE HUBBLE SPACE TELESCOPE

Neta A. Bahcall
Space Telescope Science Institute
3700 San Martin Drive
Baltimore, MD 21218

ABSTRACT. Highlights of the science program to be carried out by the Hubble Space Telescope are reviewed. Some of the main scientific projects to be carried out by the General Observers (GOs) and the Guaranteed Time Observers (GTOs) during the early phases of the Space Telescope are discussed. The method and criteria for selecting science projects are also discussed.

1. SCIENCE WITH THE HUBBLE SPACE TELESCOPE

The Hubble Space Telescope (HST) will be the first long-lived international optical observatory in space. Its location above the obscuring and distorting effects of the earth's atmosphere will provide HST with unique capabilities that will yield a major improvement in observational optical astronomy. The main unique capabilities of HST are:

(i) High angular resolution: ~0.1";
(ii) Faint stellar limiting magnitude: ~28";
(iii) UV observations: ≥1150Å.

The telescope will be equipped with a complement of six scientific instruments, including cameras and spectrographs that will take advantage of HST's unique capabilities. Only scientific projects that require at least one of HST's unique capabilities will be carried out by the telescope. Projects that can be done from ground-based or other telescopes will generally not be accepted for HST observations.

The high angular resolution and sensitivity of HST and its broad wavelength coverage will allow astronomers to perform scientific observations currently unfeasible with ground-based telescopes. These programs will be carried out by General Observers (GOs) as well as the Guaranteed Time Observers (GTOs). I summarize below some of the main science projects that will be investigated by the GOs and GTOs during the initial cycles of the HST. I divide the projects according to their scientific subdiscipline.

D. McNally (ed.), Highlights of Astronomy, Vol. 8, 435–439.

Cosmology

- Determination of accurate distances to nearby galaxies and the Hubble constant. HST will provide an extension of a factor of ten in the distance over which properties of the standard candles can be measured.
- Determination of the cosmological deceleration parameter, q_o. This fundamental determination may be attempted by observing the dependence of standard candles (such as the size of galaxies) with redshift to $z \sim 1$ or by using supernovae as standard candles (if they prove to be standard).
- Confirmation of the expansion of the universe by studying the surface brightness dependence on the inverse of $(1 + z)^4$ to large redshifts.

Evolution

- The evolution of galaxies and clusters of galaxies with redshift to $z \sim 1$. Galaxy morphology determination at high redshifts will be a most exciting study with HST and will provide new insight into the nature of galactic evolution.
- Evolution in QSO absorption lines. This will allow an understanding of the evolution of matter in the universe from nearby to very large redshifts.
- Deep surveys with HST will allow the investigation of galaxy and quasar counts to faint limiting magnitudes.

QSOs and AGNs

- A study of the physics of the nuclear regions of QSOs and AGNs, including the central source and the line regions. High resolution imaging and spectroscopy will be uniquely suited to HST capabilities and they are expected to reveal exciting discoveries.
- A study of the host galaxies around QSOs, which can be seen with high resolution only with HST.
- QSO absorption line survey and high resolution observations in the UV.
- Gravitational lenses. The high resolution structure and properties of these systems will be investigated.

Galaxies and Clusters

- The evolution of galaxies and clusters (see above).
- Detailed properties of nearby galaxies using the unique high resolution

https://doi.org/10.1017/S153929960000811X Published online by Cambridge University Press

and sensitivity of HST.
- Detailed studies of galactic nuclei at high resolution.
- Stellar population studies in nearby galaxies.

Stars and Interstellar Medium

- Stellar populations in our and other galaxies.
- Detailed studies of globular clusters, their cores and stellar populations.
- Star formation regions
- Stellar binary systems
- High resolution studies of supernovae and supernovae remnants.

Planetary Astronomy

- Atmospheres, features, satellites, and rings of planets.
- Primitive bodies in the solar system.
- Companions of nearby stars.

Surveys

- Deep surveys of the sky will reveal faint stars, galaxies, supernovae, variable objects, and, most importantly, unknown types of objects.

Included within the above list are the three Key Projects identified by the community and listed in the HST Call for Proposals; these are:

(i) Distances to galaxies and H_0;

(ii) QSO absorption line survey;

(iii) Medium deep survey.

2. SELECTION OF SCIENCE PROGRAMS

Observing time on HST will be allocated to openly solicited, peer-reviewed, and competitively selected proposals from the international astronomical community. During the first two and half years of HST operations, the scientists associated with the development of HST and its instruments (GTOs) are guaranteed an average of 30% of observing time. Scientists from ESA member states will receive, on the average, at least 15% of the available time

https://doi.org/10.1017/S153929960000811X Published online by Cambridge University Press

over the lifetime of the observatory.

All proposals will be submitted to the Space Telescope Science Institute (ST ScI). A two-phase selection process will be carried out:

Phase I:
- Proposal submission
- Time Allocation Committee (TAC) review and recommendation

Phase II:
- Detailed program submission (for those who pass Phase I)
- Detailed feasibility and resource evaluation
- Final acceptance

The peer-review process will also be a two-stage procedure. First, proposals of the various science disciplines will be reviewed by scientific peer-review panels; the panels will include the following disciplines (which may change according to proposal volume):

- Quasars and AGNs
- Galaxies and Clusters
- Stellar Populations
- Stellar Astrophysics
- Interstellar Medium
- Solar System

The panels will review the proposals following the selection criteria listed below, and recommend time and resource allocations. The panels will then rank the proposals in their discipline in order of recommendation. A cross-discipline TAC will then follow; the TAC will recommend the final, cross-discipline program to be considered for observations with the HST.

The selection criteria for the review and selection of science proposals include the following:

- Scientific merit
- Need of unique HST capabilities
- Technical feasibility
- Observation plans and data analysis
- Capability of proposers to carry out project
- Demand on HST resources; program efficiency

In addition to the general GO program, a small amount of time will be reserved for Director's Discretionary Time. This time will be used, for instance, for special programs such as targets-of-opportunity observations, exploratory observations and other programs judged to be appropriate by

the Director.

All data will be kept proprietary to the observers for a period of one year after the observations. At that time, the data will be placed in a public archive and will be available to interested scientists. It is expected that the HST public archive, with its enormous volume of astronomical data, will be a highly useful source of scientific investigations for many years to come.

https://doi.org/10.1017/S153929960000811X Published online by Cambridge University Press