The Space Telescope (ST), which is scheduled for launch in early 1985, will include a large primary mirror of excellent optical quality and a complement of versatile scientific instruments that will effectively exploit their space environment. The ST will be used to pursue a wide range of astronomical investigations, of which a prominent subset will be planetary studies.

Detailed descriptions of the ST, from which the interested reader can learn enough to plan a scientific observing program, are given in references (1) to (5). The remainder of this abstract will briefly summarize a few of its properties, particularly those relevant to planetary work.

The primary mirror has a diameter of 2.4 m. Its MgF$_2$ coating provides high reflectivity from .12 $\mu$m (Ly $\alpha$) to submillimeter wavelengths. It has been constructed so that, at a wavelength of .62 $\mu$m, it will form an image of a point source that has 70 percent of the energy within a radius of 0.1 arc seconds. Toward longer wavelengths, performance will rapidly approach the diffraction limit. Furthermore, actual tests have shown that toward shorter wavelengths, the optical performance improves approximately as it would for an ideal telescope (such that image size scales as $1/\lambda$) well into the ultraviolet.

Because the ST will be outside the Earth's atmosphere, the point spread function of the optics will be very nearly constant with time. Once this function is empirically established through observations of stars, numerical deconvolution could in principle enhance the achievable resolution for non-stellar targets significantly. However, jitter in the pointing control system will degrade this capability somewhat. At the time of writing, attempts to improve the performance of this system constitute one of the major engineering concerns within the project.

The preceding summary of the resolving power of ST refers essentially to its ability to separate light sources of approximately equal brightness. Also of interest to planetary science is the ability to detect a faint object relatively close to another that is overwhelmingly brighter. This will depend to a major extent on the microscopic scattering characteristics of the optical environment and the detectors, and will have to be determined empirically in orbit. Prospects are not good that ST will ever image an extrasolar planet. Of all the stars in the sky, only $\alpha$ Centauri has even a marginal chance to possess a planet that can be imaged by ST. However, faint planetary rings and satellites within the solar system could be much better observed from ST than from the ground.

By virtue of its environment, ST will also have advantages over its ground-based contemporaries in two widely separated temporal domains. Terrestrial scintillation causes significant problems in measuring photometric variations on time scales less than one second. For example, occultations of stars by planets can be observed for much greater information recovery from ST than from the ground.

Also, ST will routinely be able to sample phenomena repeatedly at a frequency of once per orbit (90 minutes), which is, in actual practise, difficult to accomplish from the ground.
The ST will have a complement of five scientific instruments (SIs) plus an astrometric capability derived from the fine guidance system. Four SIs are jointly referred to as "axial" instruments. They each fit into rectangular boxes which have a common edge on the optical axis. Each has a quadrant of the focal surface, and is selectable through a small offset in the telescope pointing. The fifth SI, denoted the "radial" instrument, is located off the optical axis, but samples the center of the field of view by means of a flat pick-off mirror (which occults the central segment of the axial quadrants).

There are three other bays corresponding to the radial SI location, in each of which there is a fine guidance sensor, which samples the periphery of the focal surface and controls the fine pointing of the telescope with guide stars. At any time, two of the three are required for telescope control, and the third is free to perform astrometric observations. Such observations will provide the best chance of detecting extrasolar planets from ST.

The five first generation SIs can be replaced on orbit, if necessary. In fact, current plans are to select second generation instruments for study in 1982. The original five include two cameras, two spectrographs and a high speed photometer. Only a meager summary of their properties can be given here.

The cameras have fields of view ranging from 2.7x2.7 (arc min)^2 to 11x11 (arc sec)^2. Each has 48 filter locations to define spectral throughput, some of which are devoted to objective prisms and polarizers. Imaging from Ly α to 1 μm will be possible. There is a coronographic mode and long slit spectrographic mode in one camera. The spectrographs have resolving powers (λ/Δλ) from 10^3 to 10^5, with higher dispersions available only below .32 μm, but with lower dispersion capability out to the near infrared. The photometer can achieve a temporal resolution of 16 μ sec.

After launch, the scientific program for the ST will be managed by the Space Telescope Science Institute Facility, located on the campus of the Johns Hopkins University. The operational lifetime of the ST is expected to be at least 15 years.

REFERENCES:
(2) Belton, M. J. S., ibid., p. 47-70.
(3) Morrison, D., ibid., p. 77-86.