High-Resolution, Wide-Field-of-View Scanning Telescope

Narrow-angle scanning over a wide field would be achieved without slewing the entire telescope.

NASA's Jet Propulsion Laboratory, Pasadena, California

A proposed telescope would afford high resolution over a narrow field of view (<0.10°) while scanning over a total field of view nominally 16° wide without need to slew the entire massive telescope structure. The telescope design enables resolution of a 1-m-wide object in a 50-km-wide area of the surface of the Earth as part of a 200-km-wide area field of view monitored from an orbit at an altitude of 700 km. The conceptual design of this telescope could also be adapted to other applications — both terrestrial and extraterrestrial — in which there are requirements for telescopes that afford both wide- and narrow-field capabilities.

In the proposed telescope, the scanning would be effected according to a principle similar to that of the Arecibo radio telescope, in which the primary mirror is stationary with respect to the ground and a receiver is moved across the focal surface of the primary mirror. The proposed telescope would comprise (1) a large spherical primary mirror that would afford high resolution over a narrow field of view and (2) a small displaceable optical relay segment that would be pivoted about the center of an aperture stop to effect the required scanning (see figure). Taken together, both comprise a scanning narrow-angle telescope that does not require slewing the telescope structure. In normal operation, the massive telescope structure would stare at a fixed location on the ground. The inner moveable relay optic would be pivoted to scan the narrower field of view over the wider one, making it possible to retain a fixed telescope orientation, while obtaining high-resolution images over multiple target areas during an interval of 3 to 4 minutes in the intended orbit.

The pivoting relay segment of the narrow-angle telescope would include refractive and reflective optical elements, including two aspherical mirrors, to counteract the spherical aberration of the primary mirror. Overall, the combination of the primary mirror and the smaller relay optic would provide narrow-angle, diffraction-limited high resolution at a wavelength of 500 nm.

This work was done by Philip Moynihan, Cesar Sepulveda, Robert Wilson, and Suresh Seshadri of Caltech for **NASA's Jet Propulsion Laboratory**. *Further information is contained in a TSP (see page 1).*
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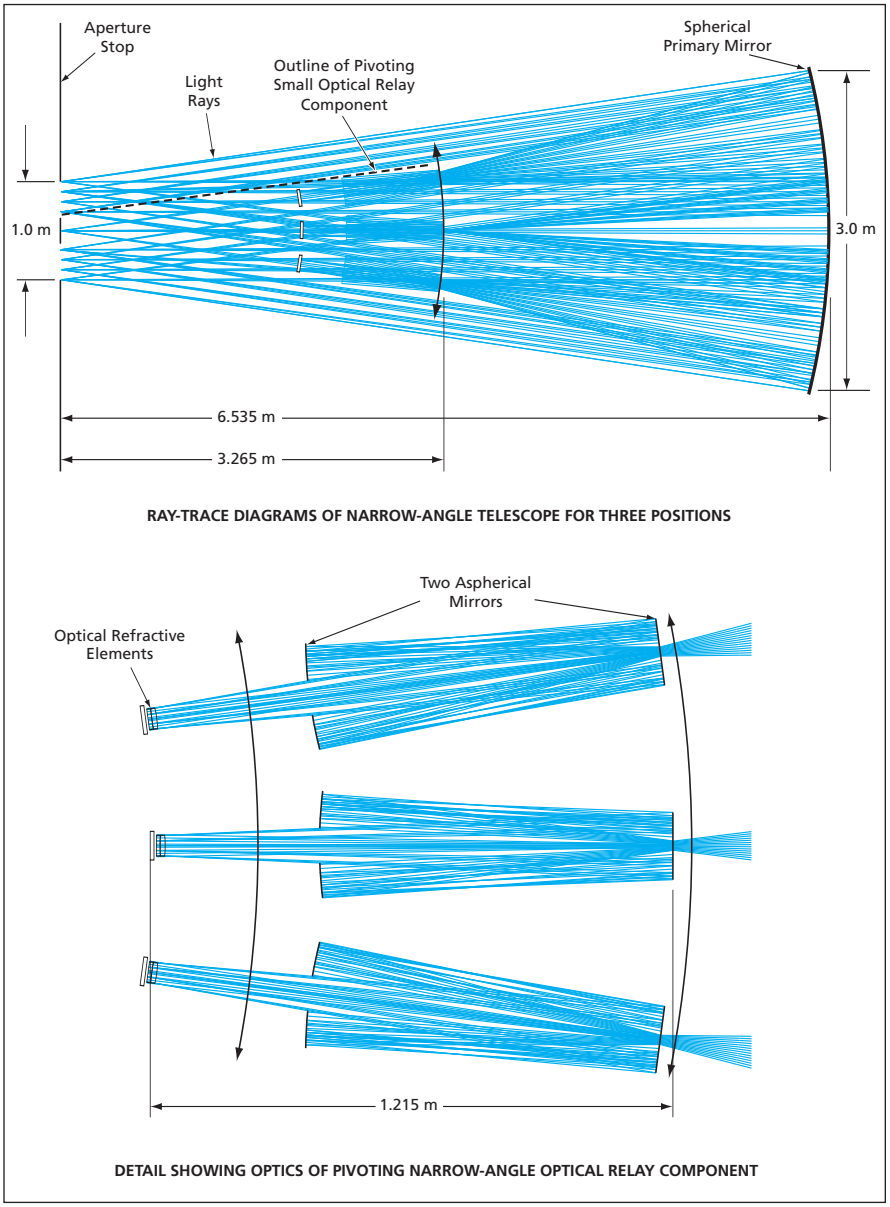

The **Design of the Spherical Primary Mirror** is dictated by the requirement to cover a 16°-wide field of view without slewing the telescope. The small displaceable relay optic of the narrow-angle telescope would be pivoted about the center of the aperture stop to scan a narrower field of view (1-meter ground resolution) over the 16° field of view without the need to slew the heavier primary mirror. What is shown here is a superposition of ray-trace diagrams for the pivotable narrow-angle optical relay at its central position and two opposite extreme positions.