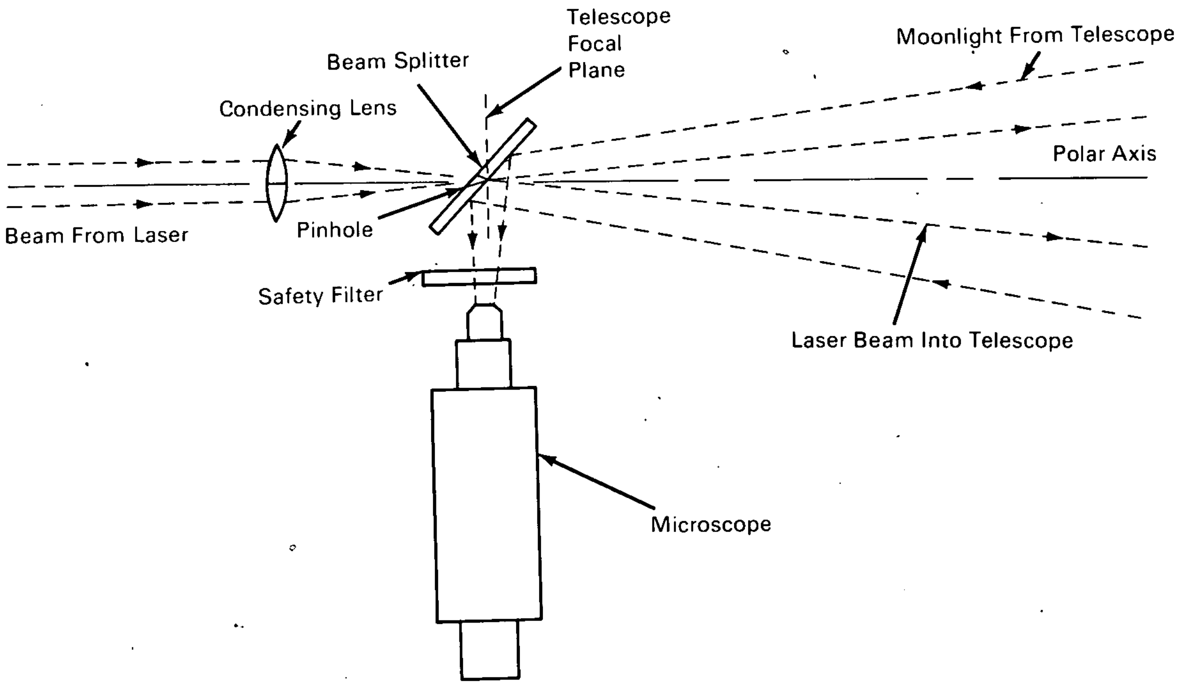
NASA TECH BRIEF

Method of Directing a Laser Beam with Very High Accuracy



A system has been devised for aiming an argon laser beam at a specific point on the illuminated surface of the moon. The system will collimate and direct the laser beam with very high angular tracking accuracy at objects on the moon's surface. It could be adapted to precision tracking of missiles and satellites. The system combines a long focal-length reflector telescope with a beam splitter positioned at the focal plane of the telescope. The laser beam is focused, through a condensing lens, at a pinhole in the beam splitter and is directed through the telescope to the target area. The beam splitter is provided to separate the outgoing laser beam from the incoming guide beam (moonlight from the telescope).

The laser is mounted so that it could be positioned linearly along three orthogonal axes and rotated through small angles about two axes, thus permitting complete freedom for alignment of the laser to the telescope. The viewing optics presents a field of view to the observer which lacks a small portion in the center corresponding to the position of the pinhole in the beam splitter. The telescope is guided so that the image of the object toward which the laser beam is directed is positioned over the "hole" in the field of

(continued overleaf)

view. To eliminate the laser light scattered back into the viewing optics, and to provide for the safety of the observer's eye, a yellow filter is placed between the beam splitter and the viewing optics. The filter, although quite dense at the argon laser wavelengths, passes enough light in the yellow and red portions of the spectrum to permit proper guidance.

The beam splitter used in an experimental setup was a conventional microscope slide that was aluminized and held in a modified microscope stage mounted at 45 degrees to the polar-axis of the telescope. The pinhole was ultrasonically drilled through the slide at 45 degrees. A low power microscope served as the eyepiece.

To provide for the best possible alignment between the laser/viewing system and the telescope, the following alignment procedure was used:

(1) The laser mirrors were aligned first in order to optimize the laser output.

(2) The laser beam was aligned to the optic axis of the telescope, with the condensing and beam splitting optics removed, by using the various motions of the pedestal on which the laser was mounted.

(3) The condensing lens was placed in position and adjusted in x and y so that the telescope aperture was as uniformly illuminated as possible. The light leaving the telescope aperture could be viewed by looking at the spot where it fell on the inside of the dome.

(4) The beam splitter was placed in position and adjusted in x and y until the laser beam went through the hole. The focus control of the condensing lens was then adjusted so that its focus lay approximately in the plane of the beam splitter.

(5) The positions of the condensing lens and beam splitter were fine-adjusted to uniformly fill the telescope aperture.

When this system was used with a 24-inch-diameter f/36 astronomical telescope, the outgoing beam was collimated to a beam angle that was limited solely by the atmospheric turbulence effects and the boresighting accuracy of approximately 2 seconds of arc.

Note:

Documentation is available from:

Clearinghouse for Federal Scientific
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Price $3.00
Reference: TSP69-10508

Patent status:

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