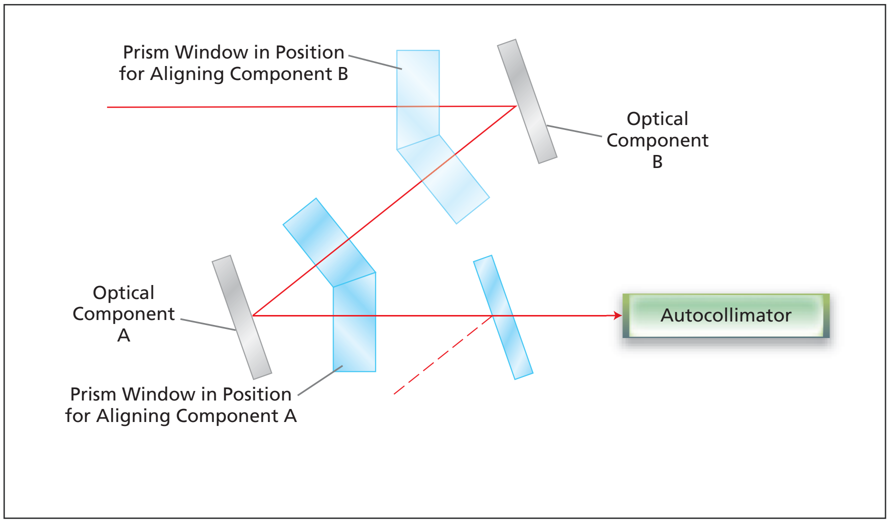


Figure 2. **Multiple Optical Components** are aligned in the manner of Figure 1 by repetition of the basic alignment procedure with the prism window suitably positioned in relation to each component to be aligned.

need to remove one or more optical components to prevent obscuration of other optical components or to make room for the alignment instrumentation.

"Prism window" as used here should not be confused with "prism window" used in U.S. Patent 4,772,094 to denote an assembly of prisms configured as a stereoscopic viewing device. Instead, as used here, "prism window" denotes an application-specific unit comprising two beam-splitter windows that are bonded together at an angle chosen to obtain the specified angle of incidence.

Figure 1 illustrates a simple example of the use of a prism window and an autocollimator to align one optical component in a horizontal plane of incidence. In this example, the autocollimator is nominally aimed horizontally and the prism window is mounted on a flat, smooth, nominally horizontal platform that can be adjusted slightly in rotation about any or all of three axes to bring the prism window into alignment with the autocollimator.

First, the surface S1 of the prism window is aligned with the autocollimator by performing such adjustments while using the autocollimator in the conventional manner to center light reflected from surface S1. Next, surface S2 is brought into alignment by rotating the platform about the axis parallel to the optical axis of the collimator until the table is as nearly level as possible, as indicated by a commercial level meter or any other suitable means. Finally, the optical component to be aligned is placed at or near the desired position and adjusted in tilt and tip. Alignment of this component is deemed to be achieved when, as observed via the autocollimator, light reflected from surfaces S1 and S2 is centered.

Figure 2 illustrates an example of the use of a prism window in conjunction with an autocollimator to align multiple optical components with respect to a multi-leg common optical path. In this case, the procedure described above for the single-component case must be repeated, with appropriate positioning of the prism window with respect to each component to be aligned.

This work was done by Hong Tang of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1). NPO-45546

Single-Grid-Pair Fourier Telescope for Imaging in Hard-X Rays and γ Rays

Images would be equal to or superior to those produced by multiple-grid-pair telescopes.

Marshall Space Flight Center, Alabama

The figure is a simplified depiction of a proposed Fourier telescope for imaging in hard-x rays and γ rays. This instrument would contain only one pair of grids made of an appropriate radiation-absorpting/scattering material, in contradistinction to multiple pairs of such as grids in prior Fourier x- and γ-ray telescopes. This instrument would also include a relatively coarse gridlike image detector appropriate to the radiant flux to be imaged. Notwithstanding the smaller number of grids and the relative coarseness of the imaging detector, the images produced by the proposed instrument would be of higher quality.

A mechanism that would include a gear drive would maintain a precise alignment between the grids and the detector while stepping them through rotation and axial translation. The rotation would provide continuous two-dimensional coverage of the spatial frequencies of interest, while the slit widths of the grids and their axial translation would determine the range of magnitudes of the detected spatial frequencies. If the outer grid were translated, then there would be no need to translate the inner grid and the detector. To simplify the mechanism and the problem of maintaining alignment, the detector, its readout circuitry, and the associated image-data processor could be attached to the back of the inner grid.

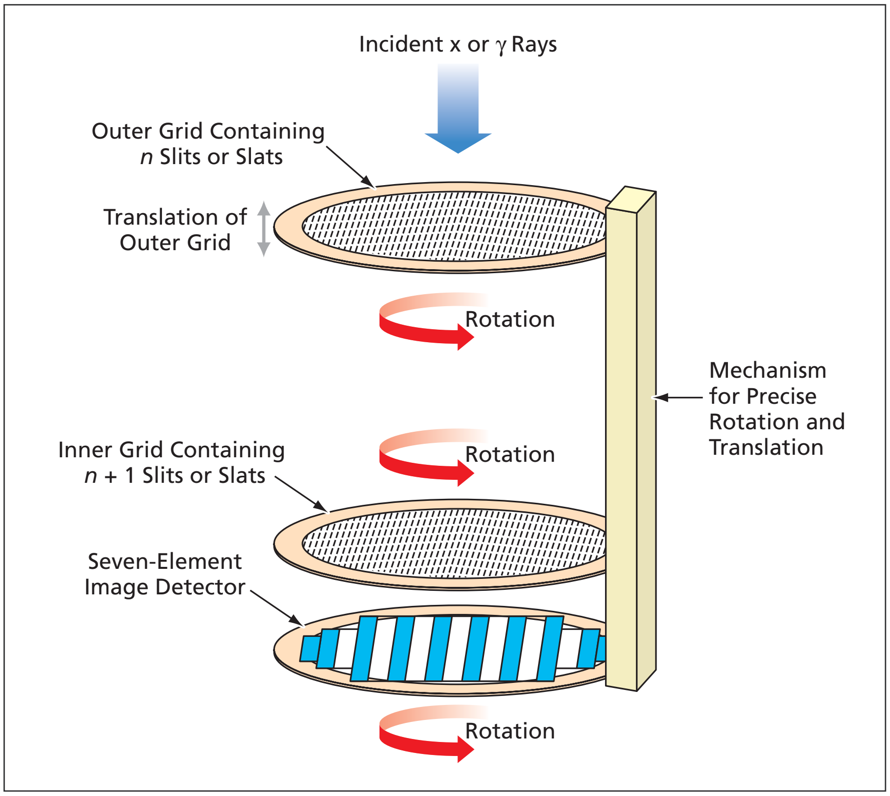
Both grids would have the same overall width. If n were the number of slits or slats in one of the grids, then the other grid must contain $n + 1$ slits, respectively. Because both grids would have the same overall width, the width of an individual slit or slat would be slightly greater in the n grid than in the $n + 1$ grid. It would not matter which grid was characterized by the greater number; for the initial design, n and $n + 1$ would be chosen for the outer and inner grid, respectively. The image detector could be composed of as few as two elements; however, prior research has shown that seven elements would represent a better compromise between the quality of image data and the complexity of the hardware.

Although practically any alignment could be used as long as it were known a

priori, it would be convenient to align the middle element of the detector with the central slits of the inner and outer grids. With this alignment, a point source on the axis of symmetry of the telescope would produce a fringe pattern having peak intensity on the middle detector element. As the point source moved off the axis, the fringe pattern would shift accordingly, enabling acquisition of data on the amplitude and phase of the spatial-frequency component corresponding to the slit width, distance between grids, and grid angle. The processor would sum the photon counts on the detector elements to produce a four-parameter output data stream indicative of the intensity and location of the peak amplitude on the detector (equivalently, of magnitude and phase) as functions of the angle of rotation and the distance between the grids.

This work was done by Jonathan Campbell of Marshall Space Flight Center.

This invention is owned by NASA, and a patent application has been filed. For further information, contact Sammy Nabors, MSFC Commercialization Assistance Lead, at sammy.a.nabors@nasa.gov. Refer to MFS-31805-1.



This **Fourier X-Ray/γ-Ray Telescope** would contain only one pair of parallel absorbing/scattering grids, whereas prior such telescopes contain greater numbers of such grids.

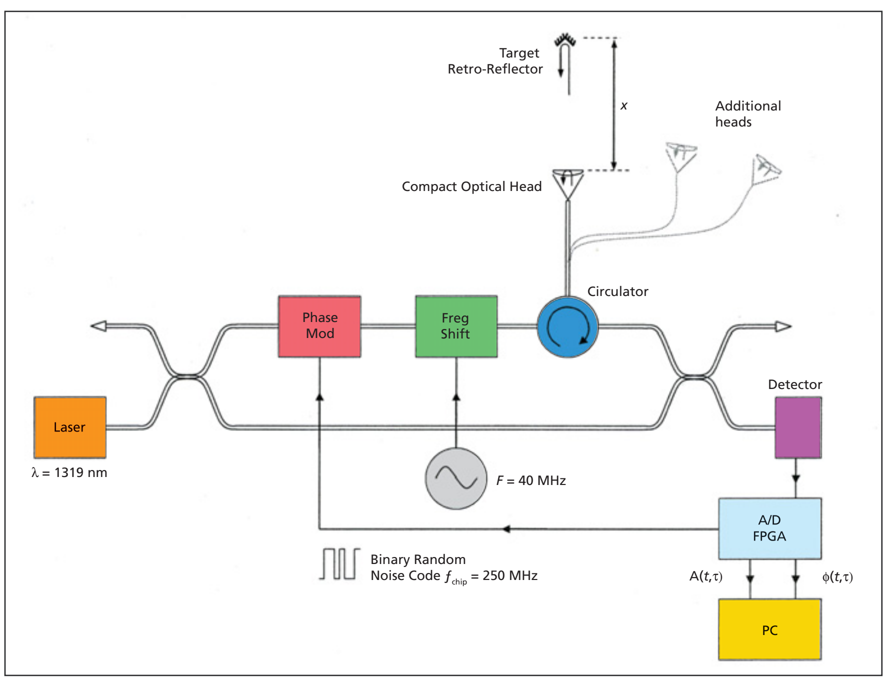
Range-Gated Metrology With Compact Optical Head

A compact, single-fiber optical head requires minimal internal alignment.

NASA's Jet Propulsion Laboratory, Pasadena, California

This work represents a radical simplification in the design of the optical head needed for high-precision laser ranging applications. The optical head is now a single fiber-optic collimator with dimensions of order of 1×1×2 cm, which can be easily integrated into the system being measured with minimal footprint. Previous heads were significantly larger, with multiple optical elements requiring careful alignment. The new design has only one optical fiber per head, rather than four, making it much easier to multiplex between tens or hundreds of heads. It is capable of subnanometer precision, consistent with the demanding requirements of new missions.

By combining a large number of multiplexed, low-cost, ultra-compact optical heads, it will be possible to form dense optical trusses, with minimal footprint, for the stabilization of large precision structures. The compact heads could be integrated with a piezoelectric actuator inside a tube to provide an "active strut"



A schematic of the **Range-Gated Metrology System**.