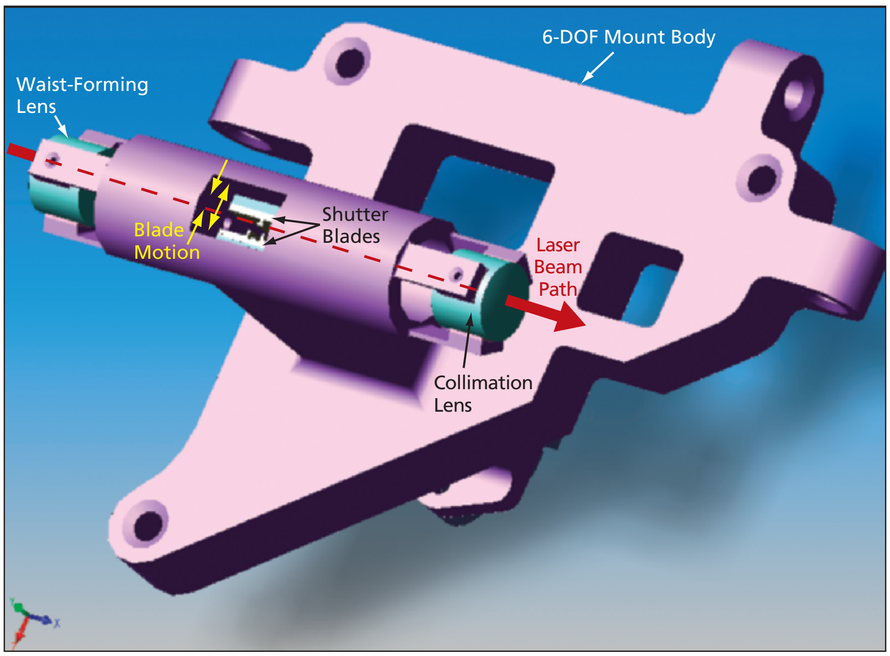
Mechanics

Fast Laser Shutters With Low Vibratory Disturbances

Opposing cantilevered piezoelectric bending actuators balance each other to minimize vibration.

NASA's Jet Propulsion Laboratory, Pasadena, California

The figure shows a prototype vacuum-compatible, fast-acting, long-life shutter unit that generates very little vibratory disturbance during switching. This is one of a number of shutters designed to satisfy requirements specific to an experiment, to be performed aboard a spacecraft in flight, in which laser beams must be blocked rapidly and completely, without generating a vibratory disturbance large enough to adversely affect the power and frequency stability of the lasers. Commercial off-the-shelf laboratory shutter units — typically containing electromagnet-coil-driven mechanisms — were found not to satisfy the requirements because they are not vacuum-compatible, their actuators engage in uncompensated motions that generate significant vibrations, and their operational lifetimes are too short. Going beyond the initial outer-space application, the present vacuum-compatible, fast-acting, long-life shutter units could also be used in terrestrial settings in which there are requirements for their special characteristics.



The **Prototype Shutter Unit** contains titanium blades on the tips of opposing cantilever-beam piezoelectric bending actuators inside a housing. Lenses to focus a laser beam to a waist are mounted on the outside of the housing. The housing shown permits fine adjustment of the laser shutter in six degrees of freedom within the laser optical bench of the flight experiment.

In designing these shutter units, unbalanced, electromagnetically driven mechanisms were replaced with balanced mechanisms that include commercial piezoelectric bending actuators. In each shutter unit, the piezoelectric bending actuators are configured symmetrically as opposing cantilever beams within a housing that contains integral mounts for lenses that focus a laser beam to a waist at the shutter location. In operation, the laser beam is blocked by titanium blades bonded near the free ends of the piezoelectric benders. The benders are driven by shaped electrical pulses with a maximum voltage differential of less than 60 V. Preliminary measurements indicate that rise and fall times are less than 1 ms.

This work was done by David Brinza, Donald Moore, Eric Hochberg, Tom Radey, and Albert Chen of Caltech for **NASA's Jet Propulsion Laboratory**. *Further information is contained in a TSP (see page 1).*

The software used in this innovation is available for commercial licensing. Please contact Don Hart of the California Institute of Technology at (818) 393-3425. Refer to NPO-40151.

Split-Resonator, Integrated-Post Vibratory Microgyroscope

This design is better suited to mass production.

NASA's Jet Propulsion Laboratory, Pasadena, California

An improved design for a capacitive-sensing, rocking-mode vibratory microgyroscope is more amenable to mass production, relative to a prior design. Both the improved design and the prior design call for a central post that is part of a resonator that partly resembles a cloverleaf or a flower. The prior design is such that the post has to be fabricated as a separate piece, then bonded to the rest of the resonator in the correct position and orientation. The improved design provides for fabrication of the post as an integral part of the resonator and, in so doing, makes it possible to produce a waferful of microgyroscopes, without need to fabricate, position, and attach posts.

The improved design offers an additional advantage over the prior design with respect to the fact that the prior design calls for the post to be fabricated in upper and lower halves. The lower half post is fabricated as part of a baseplate in a lower wafer that is subsequently bonded to an upper wafer. Once the wafers are bonded, it is nec-