Pupil slicer design for the NASA-NSF extreme precision Doppler spectrograph concept WISDOM

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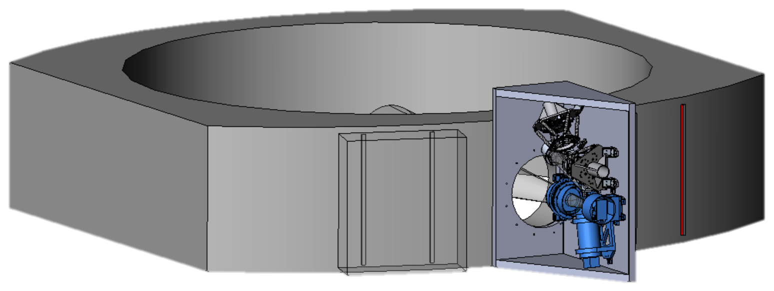
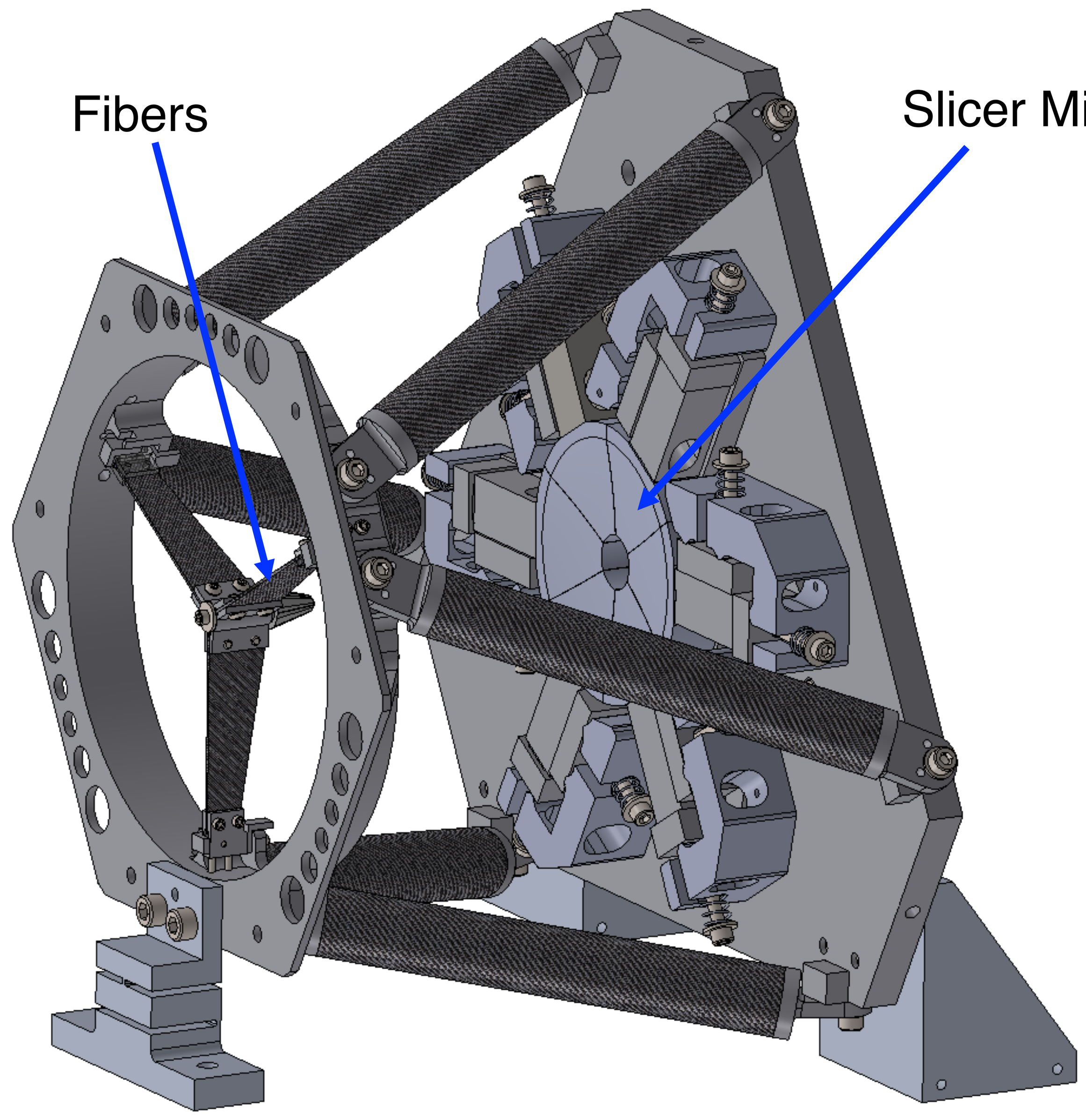
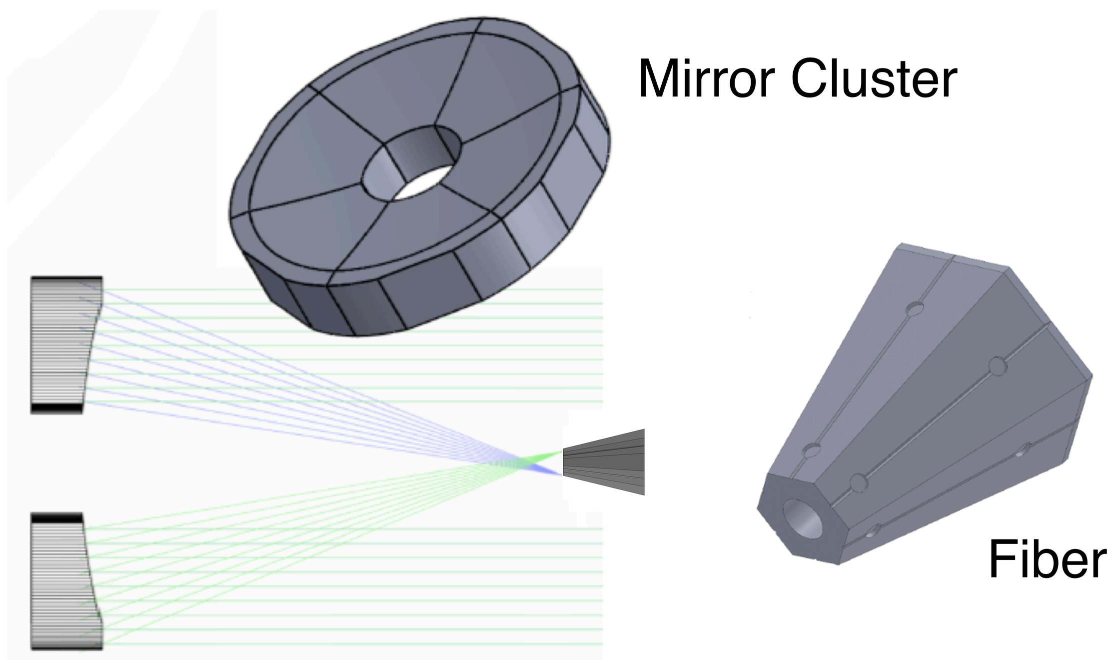
OVERVIEW



WISDOM is an extreme precision Doppler spectrograph concept with the "front end" of the instrument mated to a folded Cassegrain port on the WIYN telescope. *(See talk 9908-41.)* Two pupil slicer assemblies sit on the front end.



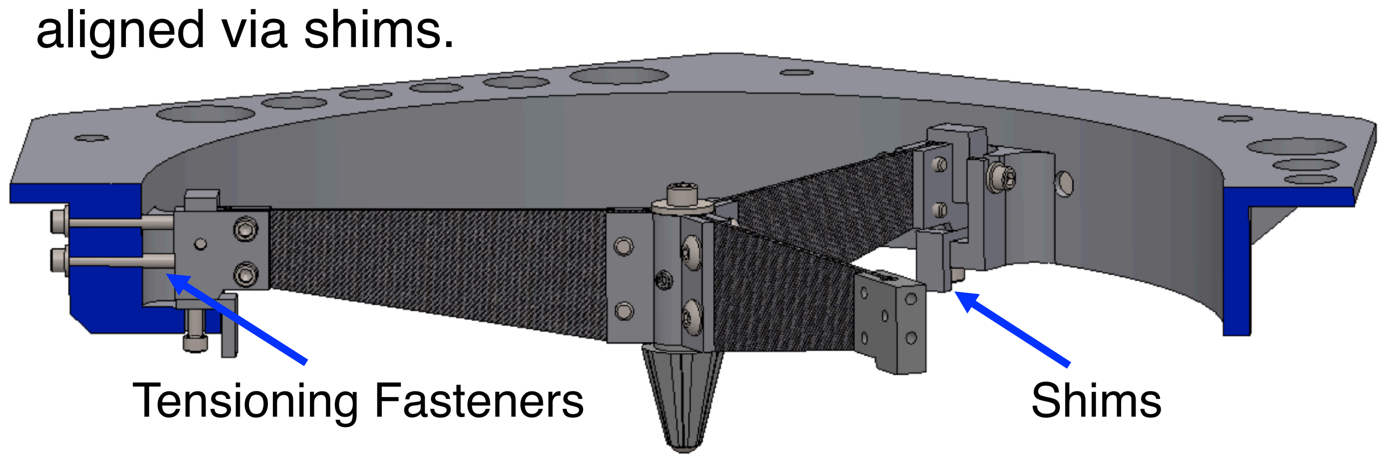
For a given spectral resolution, the size of the spectrograph scales with the telescope diameter. Pupil slicing allows for a smaller instrument while maintaining high resolution and throughput. The WISDOM pupil slicer uses 6 mirrors to slice and focus the beam onto 6 optical fibers that map to a long slit in the spectrograph. *(See poster 9908-281 for fiber link design details.)*



The mirrors and fibers must maintain positional stability to <10 microns in an environment with a temperature range of -15/+20C and a gravity vector varying as much as 60 degrees due to the telescope's range of pointing.

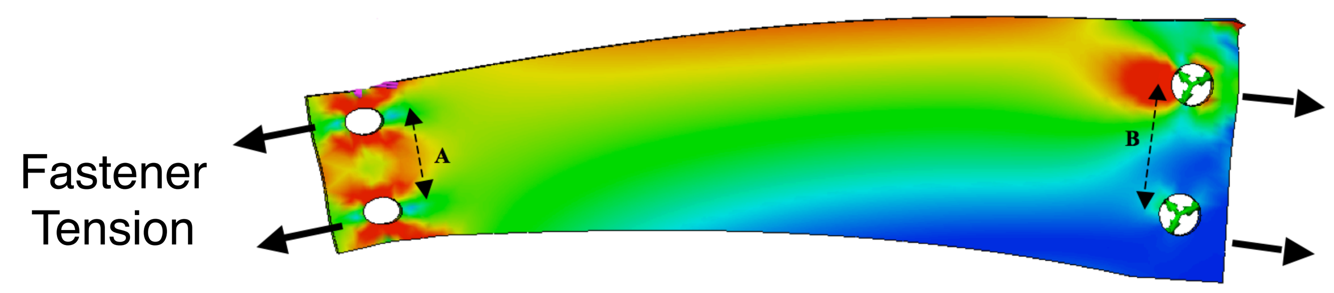
FIBER MOUNTING

The 6 fibers are mounted to a Zerodur cone, which is supported by a tri-vane carbon fiber / Invar structure and aligned via shims.

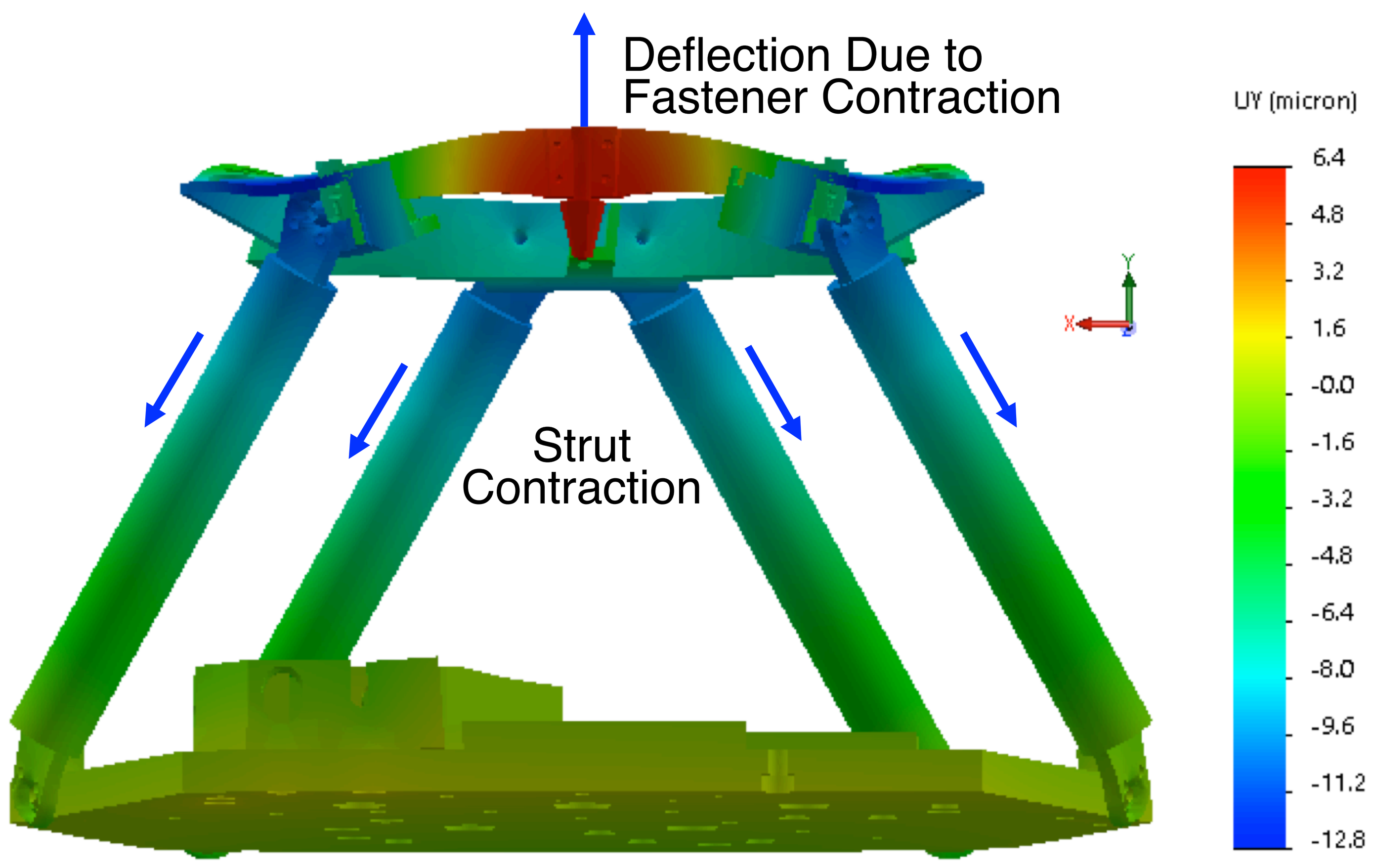


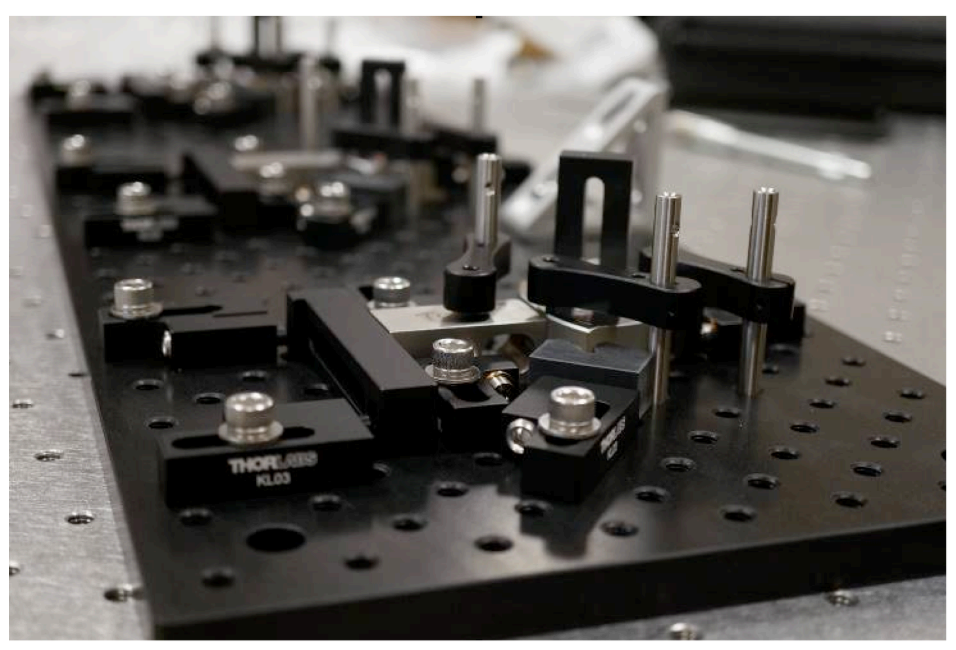
ATHERMALIZED DESIGN

Tensioning the fasteners causes deflection of the vanes via an assymetric load path. This deflection can be modified by changing fastener torque and part geometry.



The tension of the steel fasteners increases as temp. decreases, which increases vane deflection in the +Y axis. This counteracts the –Y deflection due to the thermal contraction of the struts. This constitutes a passive method of limiting defocus error due to thermal variation.

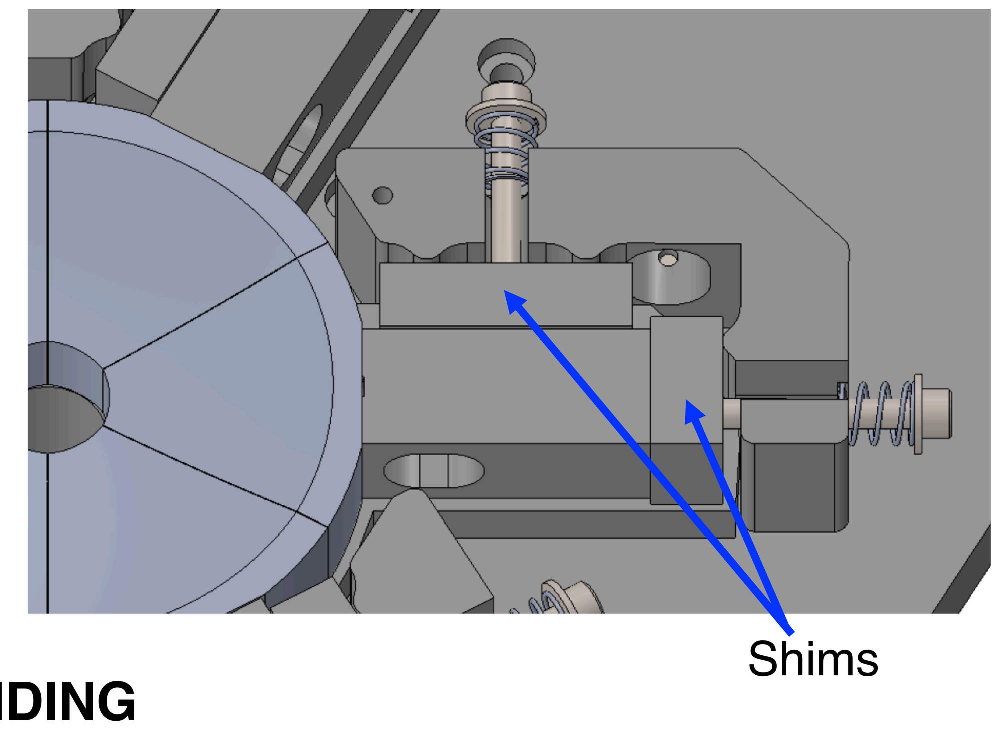




Mirror bonding using off-the-shelf components

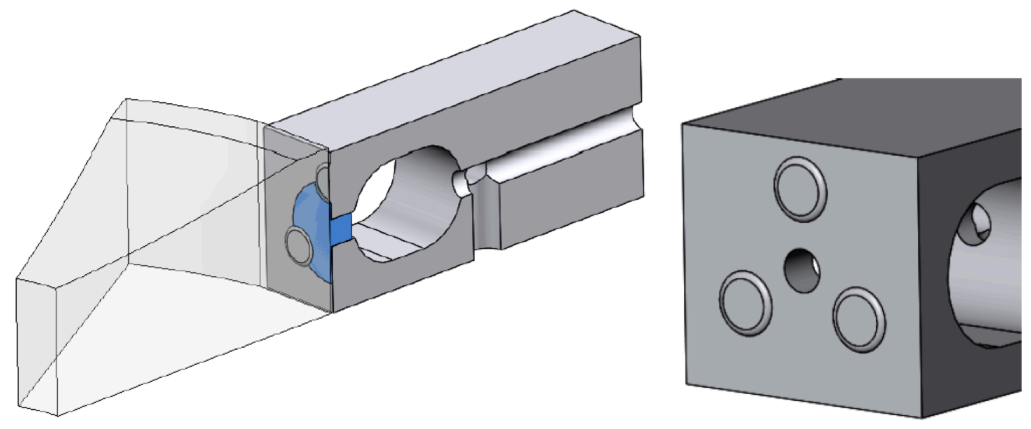
MIRRORS

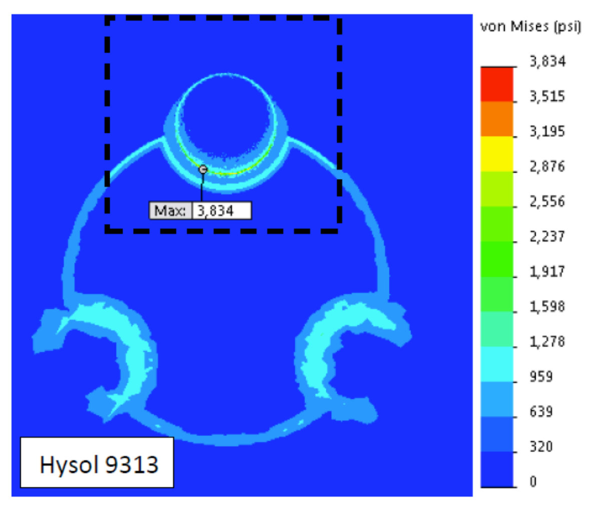
The mirrors are kinematically mounted to an Invar backplate and aligned using shims. After the final shim thicknesses are determined, an Invar shim is made.

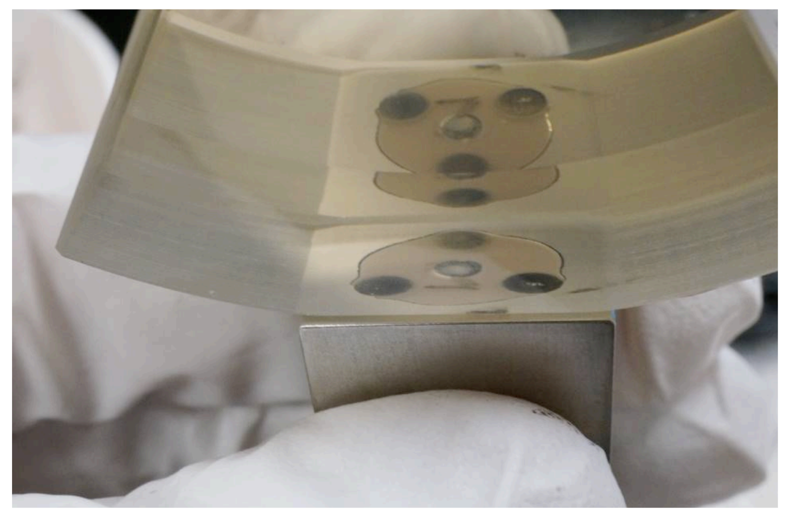


BONDING

Once cured, the adhesive preloads the mirror against contact pads on the mounting tab. Thus, preload varies with temperature but mirror position does not.







FEA analysis was performed to ensure curing stresses would not exceed the 1ksi tensile rule of thumb.

ALIGNMENT

The ability to focus and align the beams onto the fibers was demonstrated. Two fibers with two beams can be seen in the process of alignment at right.