Can a Laser Strain Gauge be useful for E-951 and other target studies ?

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Intense particle beams cause heating and shocks in targets.

- Pressures can exceed tensile strengths.
- Shock waves can bounce around in target structures.
- Time constants can be very fast,
  σ_{beam}/v_{sound} ~ 100 ns.
- Nonlinear instabilities may dominate.
- Solids, fluids ??

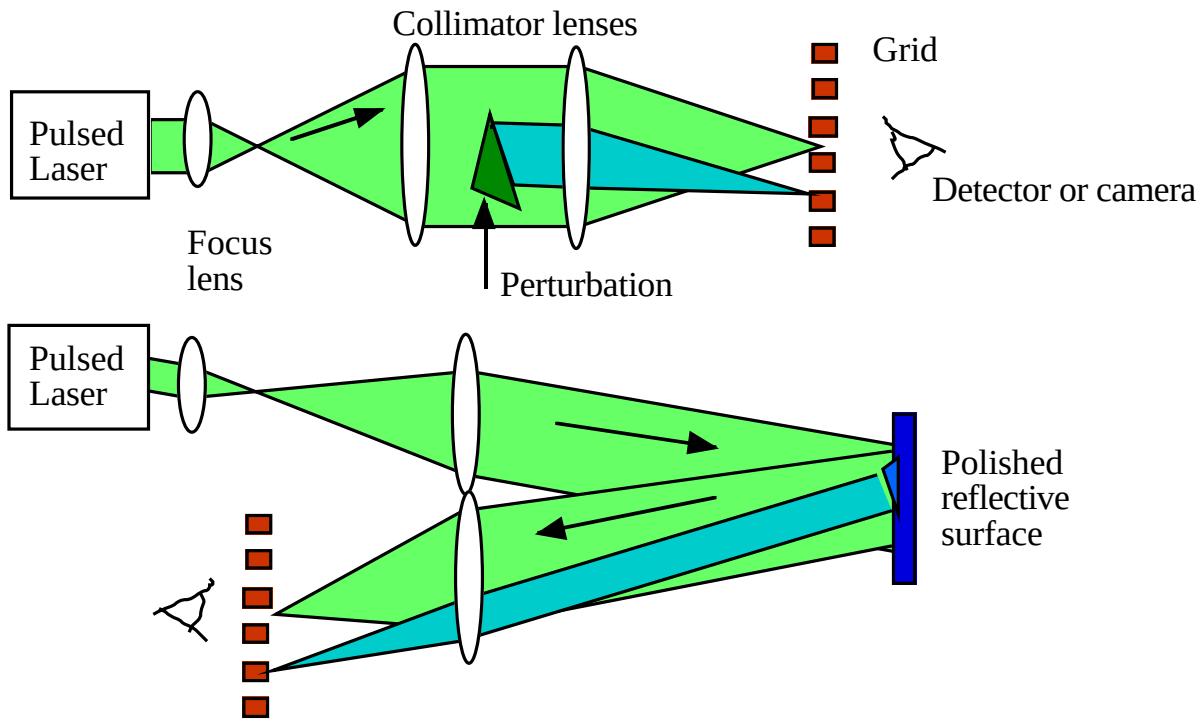
These phenomena may be somewhat inaccessible to the existing instrumentation.

- SMD 64KM1 camera limited to 10^6 fps.
- FISO strain gauges can be used up to 500 KHz

$\Rightarrow$ Faster techniques might be useful.

A variety of optical tests can be used to look at perturbations from ideal optics. These can use fast lasers.

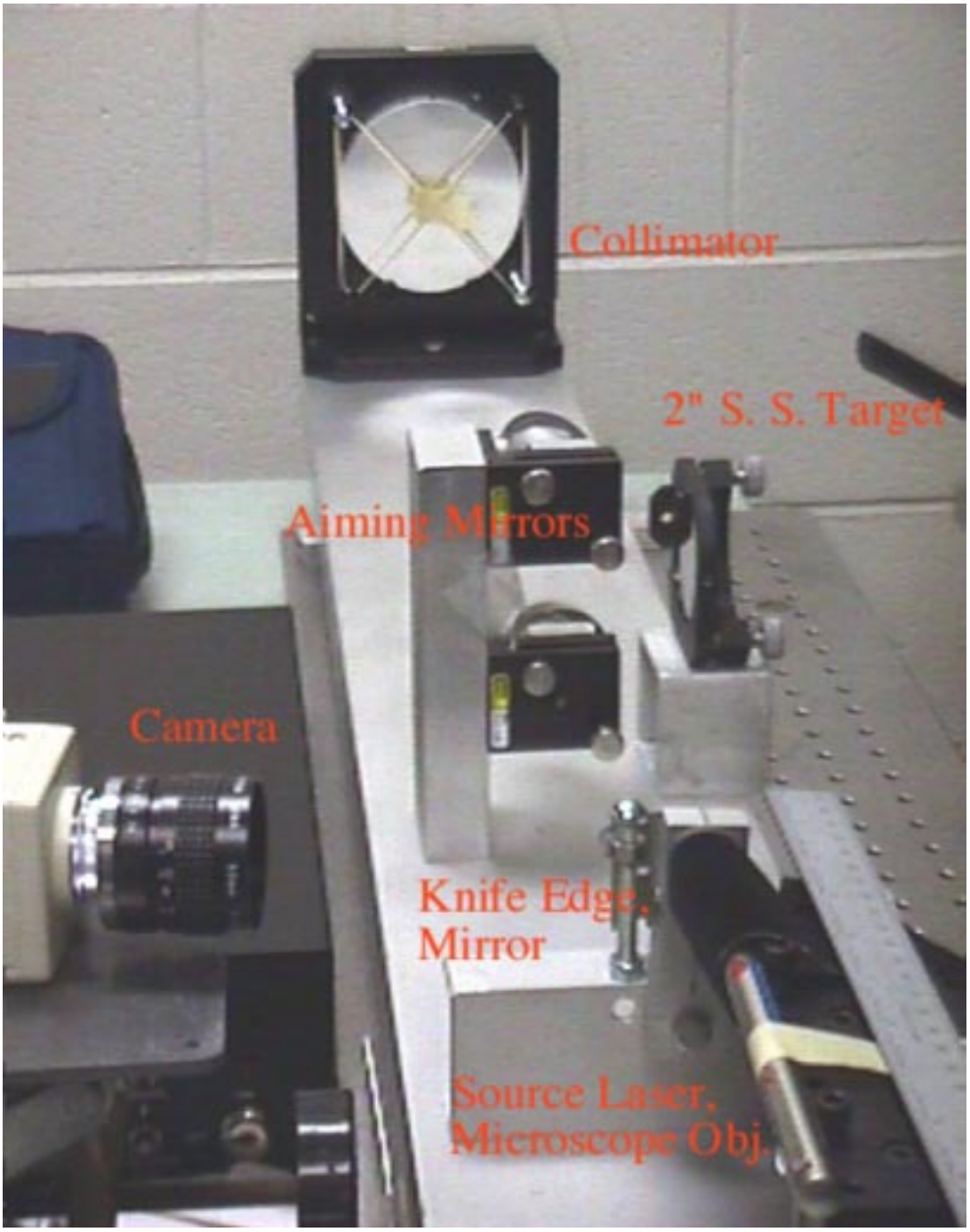
- Foucault – measures deviations from spherical optics
- Ronchi – similar but quantitative, uses grids
- Schlieren – darkfield illumination of perturbations



These tend not to be described in optics books.

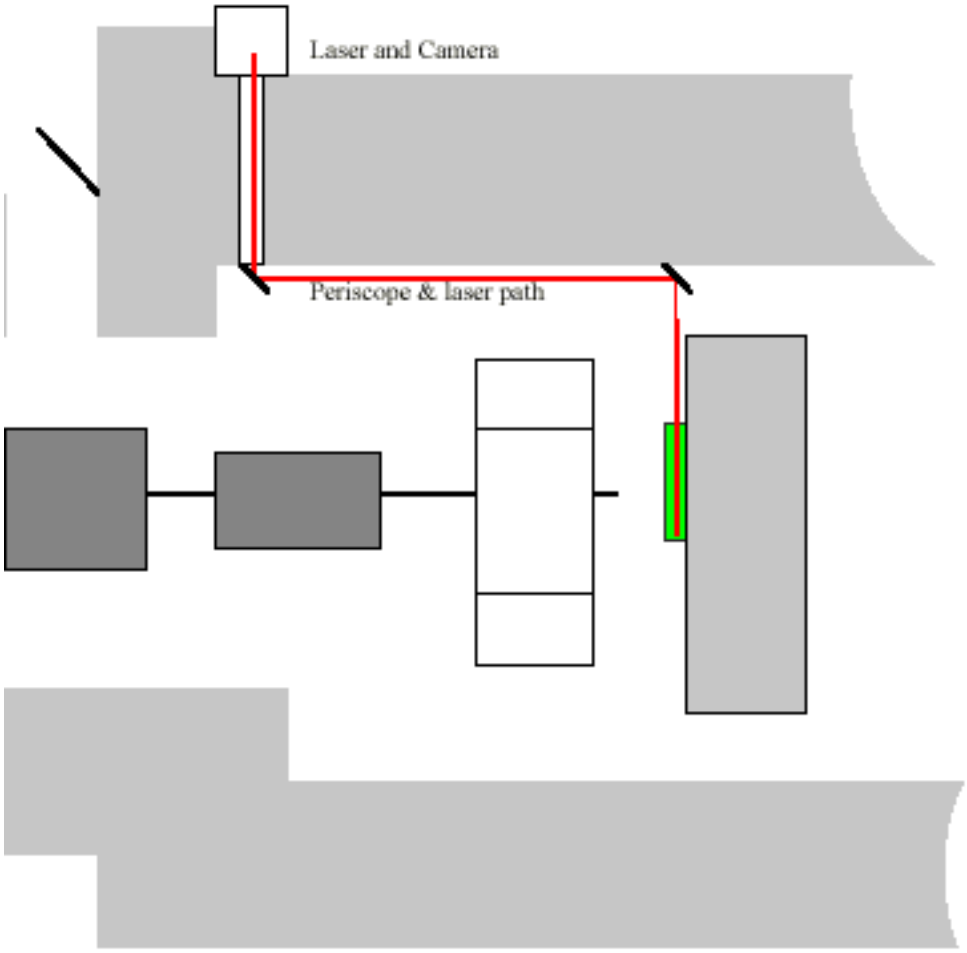
We have constructed such a system and run it in the E-951 environment.

The optics



Installed against the back wall of the A3 cave it looks like

In order to be orthogonal, we used different access ports.



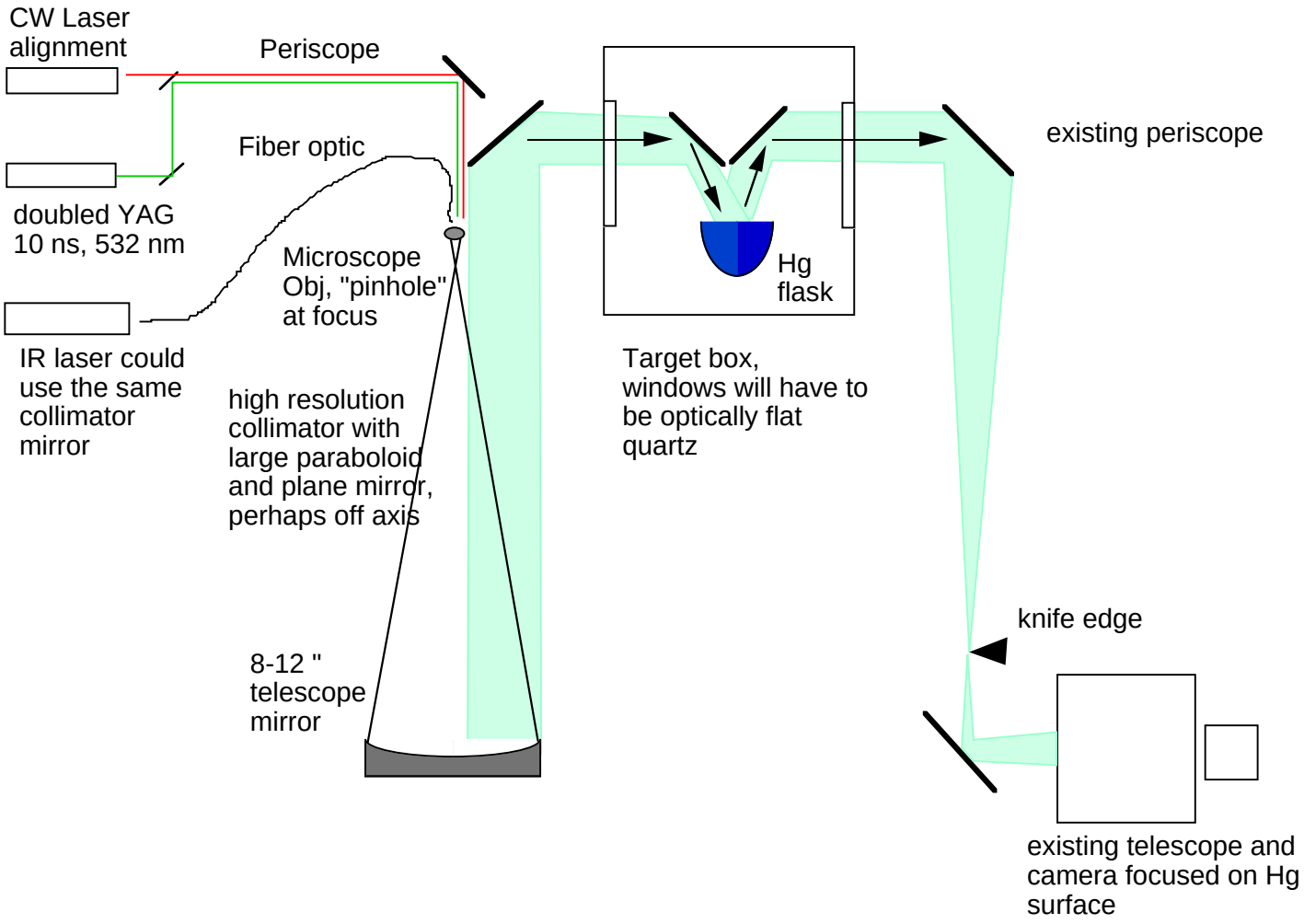
Unfortunately, the periscope intended to carry the image back out could not be completed in time so the CCTV camera was used in the A3 Enclosure.

This meant two problems; 1) the camera was temporarily deadened for about 1-2 sec after each proton bunch, and 2) it seems to have been permanently killed after about 100 shots.

While we were able to qualitatively demonstrate the sensitivity of the system, the downstream location, somewhat lower beam intensity, and beam induced dead time reduced the signal to a level where it could not be seen.

After beam pulse 5 μ deflection
" dead time >0.25 μ

This system could potentially be made compatible with the standard optics . . .



Summary

A laser strain gauge potentially offers a better way to look at fast phenomena, while still maintaining something like the present optical system