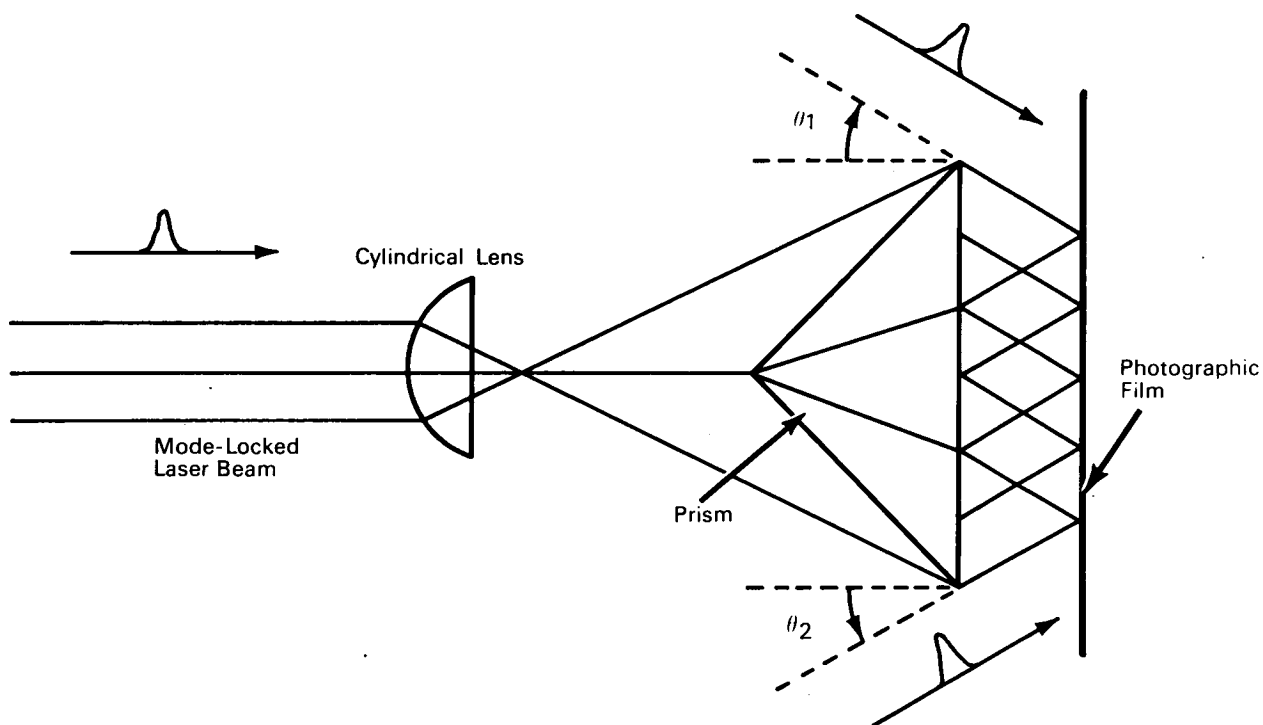


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Picosecond Pulse Measurement by Two-Photon Excitation of Photographic Film



Experimental Arrangement for Measuring Short Duration Light Pulses

A simplified technique for observing picosecond light pulses has been developed. The two advantages of this new technique, namely, simplicity and easily varied resolution, make it a useful research tool for the laser industry and organizations interested in spectroscopy and short duration light pulses.

The basic technique is to shoot two broad light beams onto a photosensitive surface which responds nonlinearly to the intensity in the beams. The resultant

signal will contain a component depending on the intensity correlation function between the two light beams. By changing the angles at which the beams hit the surface, the relationship between the correlation time difference and the position on the detector can be varied; thus, the resolution can be made as high as desired.

Almost all photosensitive surfaces (e.g., photographic emulsions, photoelectric and photoconductive

(continued overleaf)

surfaces) have a threshold wavelength, λ_0 , beyond which they have zero linear intensity response. For longer wavelengths up to $2\lambda_0$, they can respond by a two-photon response. This broad bandwidth (leading to very short time resolution) is a significant advantage over the clashing beam fluorescent dye technique.

Two plane light beams are allowed to fall onto a photographic plate at angles θ_1 and θ_2 with respect to the normal. The simple experimental arrangement used to produce the two incident beams is shown in the figure. Observation of picosecond light pulses depends on the two-photon photographic response resulting from two-photon excitation of the organic photosensitizing dye in the emulsion which makes the film sensitive at the second harmonic.

Notes:

1. The two-photon film technique has been used to study the pulses from a diffraction limited, mode-locked neodymium glass laser ($\lambda = 1.06\mu$). At nanosecond resolution the laser output (2-mm diameter) consisted of three or four spikes of roughly 5 millijoules energy each and 10 nanosecond spacing.

2. The primary disadvantage of the film technique is low sensitivity. The technique requires a spread-out beam which can use each photon to excite only one resolution element of the detector. Since the response depends quadratically on the intensity, spreading out the beam results in rapid loss of sensitivity.
3. Requests for further information may be directed to:

Technology Utilization Officer
Headquarters
National Aeronautics and
Space Administration
Washington, D.C. 20546
Reference: TSP70-10377

Patent status:

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