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NASA TECH BRIEF

Ames Research Center

Oscillation of Laser-Beam Intensity as Observed with Beam Splitters

A fast-response, small-element detector is often used to determine laser pulse shape (intensity *vs* time); since laser outputs are usually extremely intense, a portion of the laser energy is reflected to the detector by a beam splitter. It is well known that large errors in the measurement of total reflectivity with a small-element detector are the result of variations of local intensity across the reflected beam caused by optical interference between front-surface and back-surface reflections. However, a high-frequency, and often large-amplitude, intensity variation is frequently superimposed on the true pulse shape when small-element detectors are used.

A systematic study of the origin of the high frequency noise revealed that nearly flat beam splitters can cause considerable noise in measured pulse shapes when the interference fringe spacing is about the same as the detector element size. For example, since the parallelism guaranteed by most manufacturers of germanium wedges is typically of the order of 1 to 5 minutes, fringe spacings of the order of the 1-mm^2 detector are readily encountered in experiments where the incident angle is 45°. Moreover, since fringe position relative to the detector is affected by very small changes in wavelength, jitter or instabilities of the order of 15 angstroms in the laser output (e.g., the wavelength shift over a single line width) can provide sufficient fringe movement to cause the observed noise.

High frequency noise can be avoided by use of a nearly perfectly flat beam splitter (which may be difficult to obtain), or more readily by use of a large-angle, wedged splitter which casts so many fringes that the detector element is essentially under constant illumination when the fringe pattern shifts. Alternatively, if the splitter is far enough removed, no fringes will be cast on the detector.

Note:

Requests for further information may be directed to:

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Patent status:

NASA has decided not to apply for a patent.

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Category 03