Optics Splitter Focusing Experiment Report

Article Overview

This experiment demonstrates the splitting and recombination of light beams using a beam splitter to observe interference patterns and analyze beam focusing properties.

Objective

The primary objective of the experiment is to investigate the behavior of light when split by a beam splitter, observe interference patterns, and analyze the focusing characteristics of the resulting beams. This includes measuring optical path differences, understanding phase shifts, and evaluating the performance of optical waveguides or splitters in guiding light .

Experimental Setup

The experiment typically uses a Michelson interferometer configuration or a femtosecond laser-fabricated waveguide splitter:

o Light Source: A coherent laser, often at 632.8 nm, provides a monochromatic beam .
o Beam Splitter: A 50/50 non-polarizing beam splitter divides the incident beam into two paths. One beam is reflected toward mirror M1, and the other is transmitted toward mirror M2 .
o Mirrors: M1 and M2 reflect the beams back to the beam splitter, where they recombine and interfere on a viewing screen or photodetector .
o Focusing Elements: Lenses or microscope objectives may be used to focus the beams into waveguides or onto the detector for precise measurement .
o Waveguides (Optional): In advanced setups, femtosecond laser direct writing (FLDW) can create single-line waveguides and 1x3 beam splitters in YAG crystals, allowing controlled propagation and splitting of light with minimal loss .

Procedure
o Align the laser to the beam splitter at a 45? angle of incidence.
o Adjust mirrors M1 and M2 to ensure the reflected beams recombine at the same spot on the screen.
o Observe the interference pattern, noting bright and dark fringes corresponding to constructive and destructive interference .
o For waveguide experiments, focus the laser into the crystal using a microscope objective and translate the sample using a computer-controlled XYZ stage to fabricate the splitter .
o Measure the intensity distribution and mode profiles of the output beams to analyze focusing and guiding efficiency.

Observations

o Interference Patterns: Alternating bright and dark fringes appear on the screen, indicating the relative phase difference between the two beams .
o Beam Splitting: The beam splitter divides the incident light into reflected and transmitted components, each carrying approximately 50% of the optical power in non-polarizing setups .
o Waveguide Propagation: In FLDW-fabricated splitters, the beams propagate through the crystal with low loss (~1.9 dB/cm) and support fundamental-mode laser propagation at 632.8 nm .

Analysis

o The intensity at any point on the screen is given by I=I1+I2+2I1I2cos(?1-?2) , where ?1 and ?2 are the phases of the two beams .
o Phase shifts occur due to reflection and transmission at the beam splitter, which must be accounted for in precise measurements.
o Focusing efficiency is evaluated by measuring the mode profile and propagation loss in waveguides, ensuring minimal distortion and polarization-insensitive behavior .

Conclusion

The optics splitter focusing experiment demonstrates the fundamental principles of beam splitting, interference, and focusing. Using a beam splitter, light can be divided and recombined to produce interference patterns, which provide insights into optical path differences and phase relationships. Advanced techniques, such as femtosecond laser direct writing, allow the fabrication of integrated optical splitters with precise guiding and low-loss propagation, offering applications in photonics and optical communication .

Spectral splitters, as well as solar concentrators, are commonly designed and optimized using numerical methods.

Abstract The existence of x-rays has only been known for the last 150 years. Compared this to visible optics, which have been

This book provides a comprehensive guide to a wide range of optical experiments. Topics covered include classical geometrical and

As was already discussed in the previous section, the whole experimental set-up has two main components, a beam

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Attach the focusing lens to the magnetic backing of its ho der. You should see the interference patterns, as Fig. 9 shows. The

Abstract Optical splitters are passive optical components, which have found applications in a wide range of telecom,

Abstract. - We report on two experiments using an atomic cascade as a light source, and a triggered detection scheme for the

In setting up an optical experiment such as the Michelson Interferometer, why is it crucial to ensure that mirrors and beam splitters

Here, we present an alternative optical fiber-based apparatus that gives a consistently reproducible experiment with

When a lens is placed between the laser source and beam-splitter, the light ray spreads out, and an interference pattern of dark and

Objective: Torunderstand and demonstrate fundamental optical phenomena using simple experimental setups. To observe and

Chapter 1 Optical Interferometry Experiment objectives: Assemble and align Michelson and Fabry-Perot interferometers, calibrate

In this paper we have exclusively scanned over optical path length diference to create the HOM dips. However, it is

In this work, we report on the formation of new single-line waveguides and a beam splitter (1 × 3) in pure YAG crystals

Beam splitters are ubiquitous in optical measurements, communications, and biomedicine. To miniaturize optical

This document provides instructions for a series of optics experiments to be conducted over two weeks. Students will perform

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