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Experimental Evidence of an Optical Bistability Based on Self - Focusing

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Abstract:

Optical bistability based on Self – Focusing of low power CW He-Ne laser radiation ,at the wavelength of 0.632μm ,has been experimentally evidence in liquid CS_2 using a new simple and effective technique. New experimental results supporting the hypothesis that optical bistability based on self –focusing of laser radiation occurs in liquid are present in this article. Mirrorless limiting mode is observed too.

Keyword: Optical bistability; Self – Focusing; CS_2 liquid; Mirrorless limiting

Introduction:

Optical bistability (OB) in a system arises as a result of the nonlinear dependence of the response (transmission, reflection ...etc.) on the input power .The basic mechanisms responsible for the nonlinearity are numerous, as reviewed by Chang [(1)]. Almost all studies involve a resonant medium or a resonant cavity (a Fabry-Perot).The first reports on optical bistability were due to Sedil [(2)] and Szoke [(3)] in 1969 and 1974 respectively. Optical bistability can be displayed by a number of techniques: using a Fabry Perot resonator cavity filled with various media[(4)], in a microwave cavity[(5)], using a nonlinear interface[(6)] , in lasers with intracavity saturable absorbers[(7)] and incoherent mirrorless optical devices[(8)] ,These methods were studied extensively but the method of optical bistability based on self focusing is rarely mentioned[(9,10)].

The purpose of the present work is to present experimental evidences of observing optical bistability in CS_2 liquid based on the effect of self-focusing [(11-18)].

Principles of operation: self focusing occurs when a light beam having a uniform spatial profile (such as a Gaussian laser beam) and sufficient intensity propagates through a nonlinear medium having an intensity dependent index of refraction. Previously proposed devices that exhibited intrinsic bistability are operable in principle with light beams having uniform intensity profiles. The new class of devices used in the present work (Fig.1) differs from previous intrinsic devices in that the earlier devices have all required resonant optical cavities[(4)] ; no such cavity is required for this class of devices. In principle, eliminating the resonant cavity removes