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POWER LIMITS OF CHAOS IN NH_3 USING CW-CO_2 LASER BEAM

A.D. Salman and C.A. Eashary
College of Education, Basrah University

ABSTRACT

It was predicted recently that ammonia gas, as a nonlinear medium, can exhibit instabilities under pumping by cw CO_2 laser beams. We present here a study of the effect of relaxation time, mirror reflectivities and cavity detuning on existence of chaos and power limits under which chaos occurs.

INTRODUCTION

In 1979 Ikeda showed that previously neglected time-retardation effects in a ring cavity lead to instabilities in the output time dependence under conditions of dispersive optical bistability[1,2]. The requirement for such oscillation is that the medium response time must be shorter than the cavity round-trip time t_R. In 1980, Ikeda, Daido, and Akimoto further analyzed the ring cavity and point out that in one limit the dynamical equations of cavity reduce to those for a hybrid bistable optical device in which a delay of t_R is introduced in the feedback circuit[3]. They analyzed the hybrid dynamics and found periodic outputs as well as chaotic or turbulent outputs.

Chaos is distinguished from noise in that occurs in a purely deterministic noise free system. Chaos is distinguished from periodic oscillation in that the smallest change in the initial conditions will result in exponentially diverging outputs in the chaotic case. The chaos and the path to chaos are exciting areas of study not only because of their possible importance in the design and operation of bistable devices but more because of their importance in many diverse fields including mathematics, population dynamics, physiological control systems, hydrodynamics, etc.