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ROUTES TO CHAOS IN AMMONIA

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ABSTRACT-*It is shown theoretically that transmitted light from optical ring cavity containing ammonia gas as a nonlinear medium exhibits instabilities leading to periodic and chaotic pulsation using continuous wave (CW) CO_2 laser beams and Ikeda model.*

1. INTRODUCTION

In a well-known paper, Ikeda[1] predicted that a plane-wave light beam transmitted by a ring cavity containing resonant two-level atoms can exhibit a subharmonic cascade terminating on a nice spirallike strange attractor. Numerical studies of that Ikeda model displayed period doubling sequences which were found to be consistent with the conjecture of universality[2]. There exist three different routes the physical system takes from a coherent to a chaotic state, namely, period doubling[3], the three-bifurcation route[4], and the intermittency route[5]. These routes were recognized theoretically and in experiment too[6].

Although the physical details producing these routes are not understood, it is worth noting to mention the following: It has been recognized that sidebands amplification due to a four-wave mixing in a two level medium is a process which may lead to self oscillation[7].

This mechanism was suggested as a source for instabilities both in optical bistability and laser operation[8]. Self oscillation is thus interpreted as a beating between the input field and the excited sidebands. Four wave parametric oscillation was mentioned also as the physical basis of Ikeda instabilities in Kerr medium[9].

The instabilities have three origin in delayed feedback of the light transmitted from the nonlinear medium and takes place only if