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Possibility ofchaos in Rubidium Vapor

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ABSTRACT: We report on the possibility of occureance of chaos in rubidium vapor based on theoretical model developed by charmicheal et al. The presence of a strange attractor as the complex transmitted field amplitude evolves on a Figure suggestion such behaviour.

1. INTRODUCTION

The nature of chaos or equivalently of turbulence has been the subject of wide interest through the last 30 years and still[1], and has played a significant role in many disciplinces[2] ranging from cosmology and hydrodynamics in physics to population genetics and evolutionary biology and medicin. Ikeda et al.[3] have shown theoretically that instabilities and chaotic behaviour can occure in an optically bistable device due to the infinite round trip time (delayed feed-back) of an optical cavity. Chaos occurs in different types of laser systems[4] too.

This article reports on numerical predictions on the possibility of chaos in rubidin based on self defocusing[5] by solving the interactivity field equation in connection witht the equation of population.

2. MATHMATICS

Consider rubidium vapour in a cell 100 cm in length inside a ring cavity of 3 m length pumped undirectionally by a beam from cw dye laser. The ring cavity delay differential equation which connect input and output feilds is written as follows

$$E\left[t+(n+1)\tau\right] = E_i + RE(t+n\tau) \cdot Exp(\alpha L/2) \cdot Exp(-i\theta)(1-i\Delta) \cdot D(t+n\tau) \qquad (2)$$

Where E_i represent the input electric field, αL is the linear susceptibility, α^{-1} and L are the off-resonance absorption length and cell length, $\Delta = 2\pi\, T_2\, (\nu_{ac}-\nu_l)$ is the detuning between atomic and light frequency. $(2\pi T_2)^{-1}$ is the homogeneous half width (FWHM). T_2 is the transvers relaxation time. $\tau = l/c\ (=t_R)$. l is the cavity total length, Θ is the cavity detuning, and D(t) is given by

$$1-D(t+n\tau) = |E(t+n\tau)|^2 (\alpha L)^{-1} [1-Exp[(-\alpha L) D(t+n\tau)]] \qquad (2)$$

The total electric field transmitted from the cavity is given by