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Instabilities and Chaos in Single–Mode CW Far–Infrared Lasers

Ra'ed M. Hassan

Dept. of Physics, College of Education, University of Basrah, Basrah-Iraq

Abstract:

Expressions are derived for a coherently pumped homogeneously broadened laser .A three – level laser model taking into account coherent interaction of pump and generated field is discussed. Possible simplifications of this model are discussed for some particular cases as well as Optical Pumped Molecular Lasers (OPML's). The characteristic features of general model and its simplified version a Lorenz model are investigated using computation method. The system exhibits an intermittence, period doubling and chaos in single – mode CW Far – infrared lasers.

Introduction:

Recently there has been a great deal with theoretical and experimental efforts put forth towards the study of the single mode, resonantly tuned unidirectional homogeneously broadened, bad cavity, laser instability which is isomorphic to Lorenz equations. The theoretical work has identified different parameter regimes for self-pulsing and chaos, bifurcation sequences, and instability thresholds between 10-25 times above laser threshold [1].

Coherent pulsation and chaos in a single mode homogeneously broadened laser were first discussed in refs.[2,3]. There was an increase interest in this problem. When it was established that the semi-classical laser equations are identical to the Lorenz system [4]. For the dynamical non-stationary operation two conditions need to be satisfied, one requires that cavity bandwidth will be sufficiently wider then the homogenous line of the laser medium. The second is that the laser threshold will be exceeded nine times or more. It has recently been understood that the two