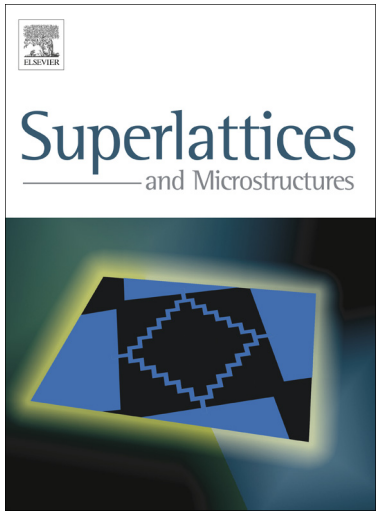

Optical bistability and multistability via both the coherent and incoherent fields in optical fibers

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Optical bistability and multistability via both the coherent and incoherent fields in optical fibers

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Abstract

We investigated the optical bistability and multistability in an Er^{3+}-doped optical fiber inside an optical ring cavity. It is found that the optical bistability and multistability can be easily controlled via adjusting properly the parameters of the corresponding system. Our scheme may provide some new possibilities for technological applications in optical-fiber communication.

Keywords. Optical bistability, Optical multistability, Optical fiber ■

1 Introduction

In recent years, phenomena based on quantum coherence have attracted much attention of many researchers in the quantum optics [1-8]. One of the interesting quantum optical phenomena, the optical bistability (OB) in multilevel atoms confined in an optical ring cavity, has been the subject of many recent studies due to its potential wide applications in all-optical switches, memories, transistors, and logic circuits [9]. Studies [10-19] show that one can control the OB via the electromagnetic-field-induced transparency, the phase fluctuation, the squeezed state field, the spontaneously generated coherence, and so on.

On the other hand, it should be pointed out that OB confined in an optical cavity has also been extensively studied in solid-state systems recently. For instance, Joshi and Xiao [20] reported a scheme in a three-level ladder-type quantum well structure, and the results show that the threshold for switching to upper branch of the bistable curve can be reduced due to the presence of quantum interference. OB was also studied by Li and coworkers [21] in several quantum well structures via tunable Fano-type interference. In addition, two quantum well structures were investigated very recently by Wang [22], with emphasis given to the optical multistability (OM).

In this work, we investigate the optical bistability and multistability in an Er^{3+}-doped optical fiber inside a unidirectional ring cavity. Many schemes [10-24] for realizing the OB and OM in optical systems have been studied recently, however, our scheme is different from those works. First, we mainly

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