完全カオス共振器レーザーにおける発振モード単一化現象に関する数値的および実験的研究

Numerical and Experimental Study on Single-Mode Lasing in Fully Chaotic Microcavity Lasers

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Stable lasing in fully chaotic two-dimensional(2D) microcavity lasers has been demonstrated by numerical simulations and experiments [1,2]. For fully chaotic cavities (i.e., cavities with fully chaotic ray trajectories), the lasing states inside cavities are not only determined by the cavity shape geometries but also influenced by the nonlinear interaction between the light field and a gain medium causing modal competition [3]. Lasing states in stadium microcavity lasers under continuous wave pumping condition have been numerically and experimentally studied recently [4,5]. In these studies, only one lasing mode consisting of locked resonant modes survives in the modal competition and all of other modes disappear in the course of time evolution. It was theoretically shown that single mode lasing states are stable whereas multimode lasing states are unstable under the assumption of the similarity of wave functions when the size of the fully chaotic 2D microcavity is much larger than the wavelength and the pumping energy is large enough [6]. Previous studies have supported the validity of this universal single-mode lasing conjuncture mainly for stadium cavities with relatively small sizes. However, its validity has not yet been systematically studied for larger cavities with different cavity geometries.

In this study, we numerically and experimentally investigated the lasing states for three different fully chaotic cavities, i.e., D-shaped, cardioid, and stadium cavities, all of which are proved to be fully ray-chaotic. We show that single-mode lasing occurs in all of these three cavities. This result provides systematic evidence for the validity of the single-mode lasing conjecture. Detailed conditions for the occurrence of the single-mode lasing will be reported in the presentation.

References

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