Abstract Submitted
for the MAR15 Meeting of
The American Physical Society

Single-mode laser by parity-time symmetry breaking[1] LIANG FENG, NSF Nanoscale Science and Engineering Center, UC Berkeley and Department of Electrical Engineering, SUNY Buffalo, ZI JING WONG, NSF Nanoscale Science and Engineering Center, UC Berkeley, REN-MIN MA, NSF Nanoscale Science and Engineering Center, UC Berkeley and Depratment of Physics, Peking Univeristy, YUAN WANG, XIANG ZHANG, NSF Nanoscale Science and Engineering Center, UC Berkeley — Effective manipulation of cavity resonant modes is crucial for emission control in laser physics and applications. Using the concept of parity-time symmetry to exploit the interplay between gain and loss (i.e. light amplification and absorption), we demonstrate a parity-time synthetic laser with resonant modes that can be controlled at will. In contrast to conventional ring cavity lasers with multiple competing modes, our parity-time microring laser exhibits robust broadband single-mode lasing regardless of the gain spectral bandwidth. Thresholdless parity-time symmetry breaking due to the rotationally symmetric structure leads to stable single-mode operation with the selective whispering-gallery mode order. Exploration of parity-time symmetry in laser physics may develop a new paradigm of strategically utilizing optical losses and open a door to next-generation optoelectronic devices for optical communications and computing.

[1]Support by the Office of Naval Research (ONR) MURI program under grant no. N00014-13-1-0649.

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Date submitted: 13 Nov 2014 Electronic form version 1.4