Proceedings of SPIE Volume 10518: Laser Resonators, Microresonators, and Beam Control XX, 27 January - 1 February 2018

A noval laser resonator for fractal modes

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Abstract

Mathematical self-similar fractals manifest identical replicated patterns at every scale. Recently, fractals have found their way into a myriad of applications. In optics, it has been shown that manipulation of unstable resonator parameters such as cavity length, curvatures of mirrors, the design of aperture and its transverse position can reveal self-similar fractal patterns in the resonators eigenmodes. Here, we present a novel laser resonator that can generate self-similar fractal output modes. This resonator has a special plane termed self-conjugate, during each round trip inside the cavity, is imaged upon itself with either a magnification or demagnification depending on the direction of beam propagation inside the cavity. By imaging an aperture placed in the self-conjugate plane inside the cavity, we qualitatively show the fractal behaviour occurring at various scales which, are given by powers of the magnification at the self-conjugate plane. We computed the fractal dimension of the patterns we generated and obtained non-integer values, as is expected for fractals.