# Polymer Based Micro-Billiard Lasers: A Test-Bed in Nonlinear Physics and Applications

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**Keywords.** Open systems; micro-cavity; nonlinear dynamics.

The generic "billiard problem" is a paradigm of nonlinear mathematical physics, which connects to deep issues in quantum and wave physics all the way to quantum or wave chaos. It can be implemented in mechanics, optics or electromagnetism, either within classical or quantum mechanics, depending on experimental configurations and on the billiard length-scale. The elusive borders between wave and geometric optics on the one hand, and between quantum and classical mechanics on the other, exhibit deep analogies which can be both addressed in actual billiard-like physical systems. We will show the relevance in this context of micro-billiard shaped lasers [1–4] whereby spatially distributed modes can be connected to classical orbits within the semi-classical approximation, by use of Gutzwiller's celebrated "trace theorem", herein extended to open systems including chaotic ones. A number of interesting contours will be discussed, including stadiums, polygons (in particular squares and triangle) referenced to the Fabry-Pérot etalon cavity, where full fledged Maxwell-Helmholtz calculations on the one hand, closed orbital considerations on the other hand and last but not least experimental results are reconciled to provide consistent insights onto deep issues of current interest, some of which still elusive from mathematical and physical points of views, such as relating to diffraction from singularities.

## References

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