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Kaleidoscope lasers are geometrically unstable cavities with a feedback mirror that has the shape of a regular polygon [1]. Early calculations of the transverse eigenmodes of these systems hinted toward a fractal (or multi-scale) characteristic, but computational-resource limitations of the day imposed fairly strong restrictions on the cavity parameter regimes that could be considered [2]. In this presentation, we will report on a new semi-analytical modelling approach for kaleidoscope lasers that combines a 2D generalization of Southwell's classic virtual source method [3] with exact mathematical descriptions of constituent (Fresnel) edge-waves from polygonal apertures [4]. Key considerations include computations of mode patterns (see Fig. 1), eigenvalue spectra, and convergence phenomena (where the feedback mirror tends towards the circular limit). We have also performed what appear to be the first numerical calculations of (power spectrum) fractal dimension for arbitrary cavity parameters, uncovering some surprising results in the process.

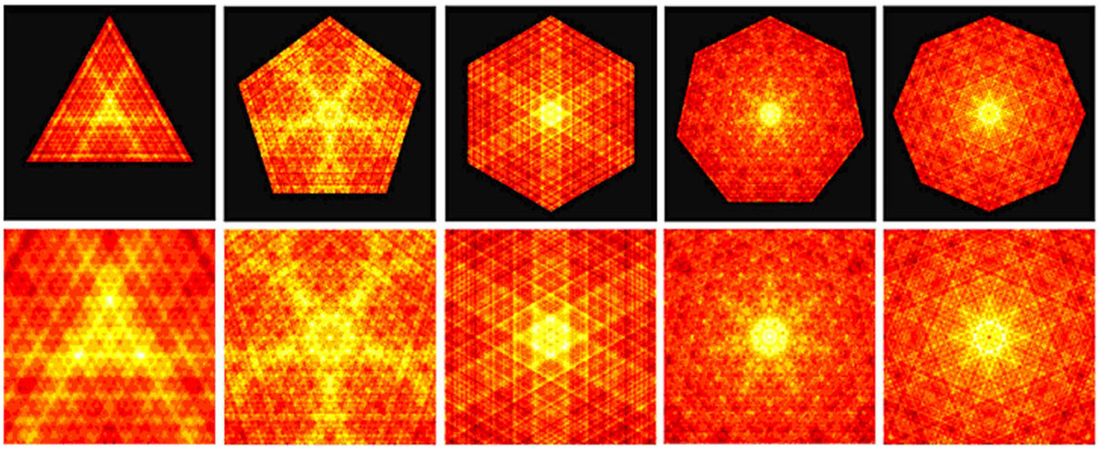

Figure 1. Top row: Computations of the lowest-loss modes for a range of kaleidoscope lasers. Bottom row: magnification of the central portion of each of the corresponding patterns in the top row.

References

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