Near and Far Fields of Perturbed Whispering-Gallery Modes in a 2-D Spiral-Shaped Active Microcavity

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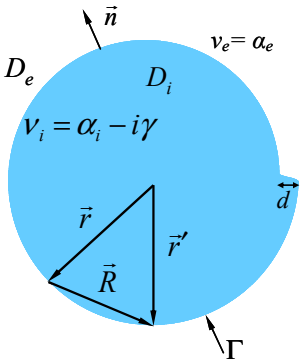
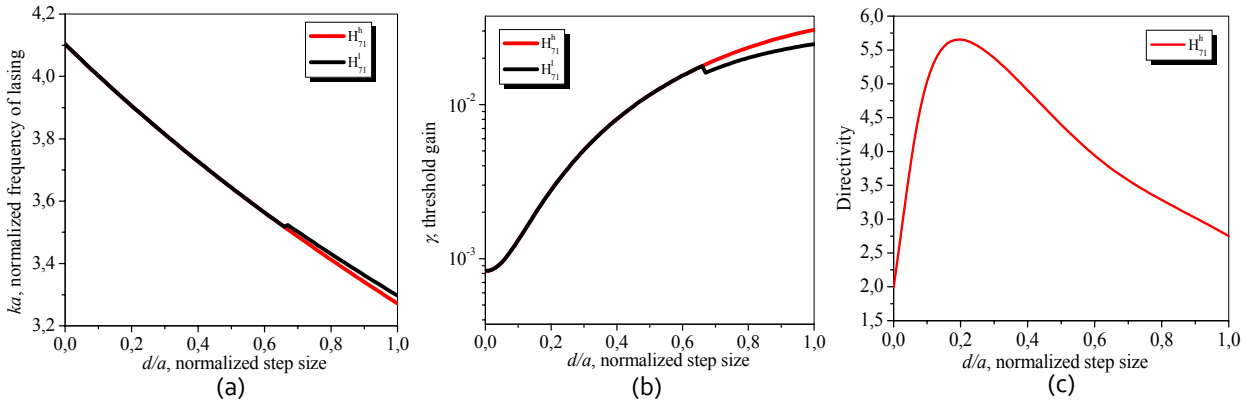
The object of research is the effect of radiation of monochromatic electromagnetic waves from a stand-alone active spiral-shaped dielectric cavity. We study the natural electromagnetic fields in a 2-D model and its spectra of natural frequencies and associated thresholds.

Method of research: theory of boundary-value problems of electromagnetics, which imply that the natural modes are the solutions of the homogeneous time-harmonic Maxwell equations with rigorous boundary conditions and radiation condition at infinity. The obtained 2-D boundary-value problem was equivalently reduced to the Muller integral equations of the Fredholm second kind with integration over the closed contour. Discretization by the Nystrom method enables one to obtain homogeneous matrix equation. The eigenvalues as the roots of corresponding determinantal equation were found numerically with controlled accuracy using two-parametric iterative Newton algorithm.

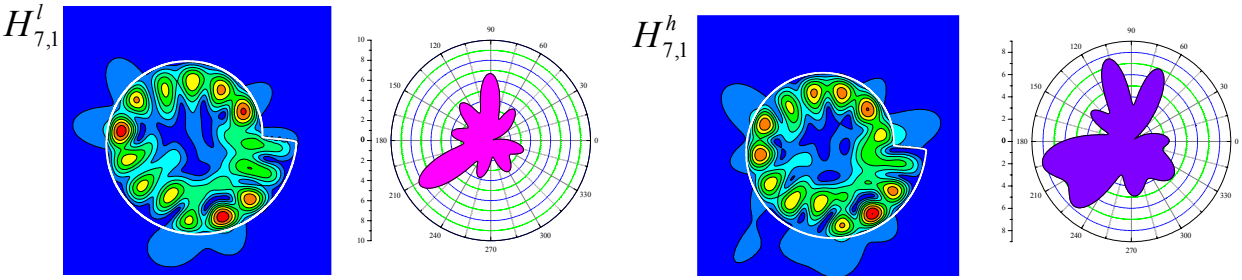


Numerical results:

$\beta=\pi/100$, $N=400$, $\alpha_i=2.63$



The H_{71} doublet mode frequencies (a), thresholds (b) and directivity (c) as a function of the step height in the spiral microlaser.



Near and far field patterns for the modes of the H_{71} doublet, $d = a$.

Conclusions: It has been demonstrated that deforming the disk into a spiral resonator one splits the modes into doublets of standing waves. Here, the directivity of emission of the WG modes increases however at the expense of higher thresholds. The main factor is the step height in terms of wavelengths.

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