Spectra and thresholds of the WG modes in a microdisk laser with radially non-uniform gain area

Object of research:

Efficient modelling of promising ultra-low-threshold optical sources with wavelength & sub-wavelength-scale features

- **Semiconductor microdisk lasers of photopump and injection type**

T. Baba, *IEEE Journal of Selected Topics in Quantum Electronics*, **3** (3), 1997, pp. 808-830

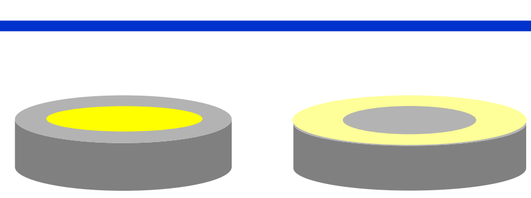

Fig.1. Disks with radially non-uniform gain as models of injection type lasers

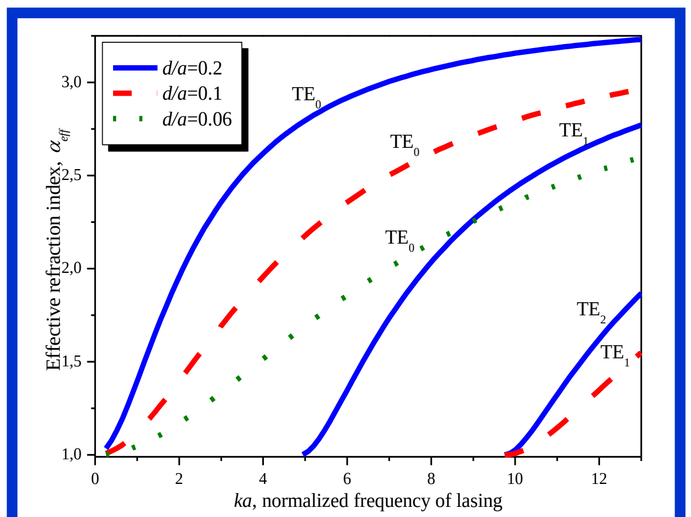

Fig.2. Dispersion characteristics of the guided modes of infinite dielectric slab made of GaAs with the bulk refraction index α=3.374.

Features of the quasi-3D analysis:

- **Quantification of the lasing thresholds including WG modes**
- **Low computer memory requirements**
- **High accuracy & high speed of computations**
- **The transparent boundary conditions are satisfied at the disk rim**

  no rough approximation by a metallized boundary; no ray-like descriptions
- **The radiation condition is satisfied implicitly**

  no non-physical backreflections due to a finite-size computation window as in FD & FEM
- **Full account of dispersion of the disk effective refraction index**

  for each guided mode of the equivalent slab waveguide
- **Non-uniform gain areas are treatable,**

  e.g., obtained with axicon-assisted photo-pumping or with ring contacts
- **Higher-order, across the disk, WG modes are accessible**

  that provides a description of lasing modes in thick disks
- **Wavelength-scale microdisks are analyzed accurately**

  in the region where the ray-optics techniques cannot be used
- **Modification for a stratified host medium is under way**

  enables modelling of microdisk lasers loaded with planar waveguides

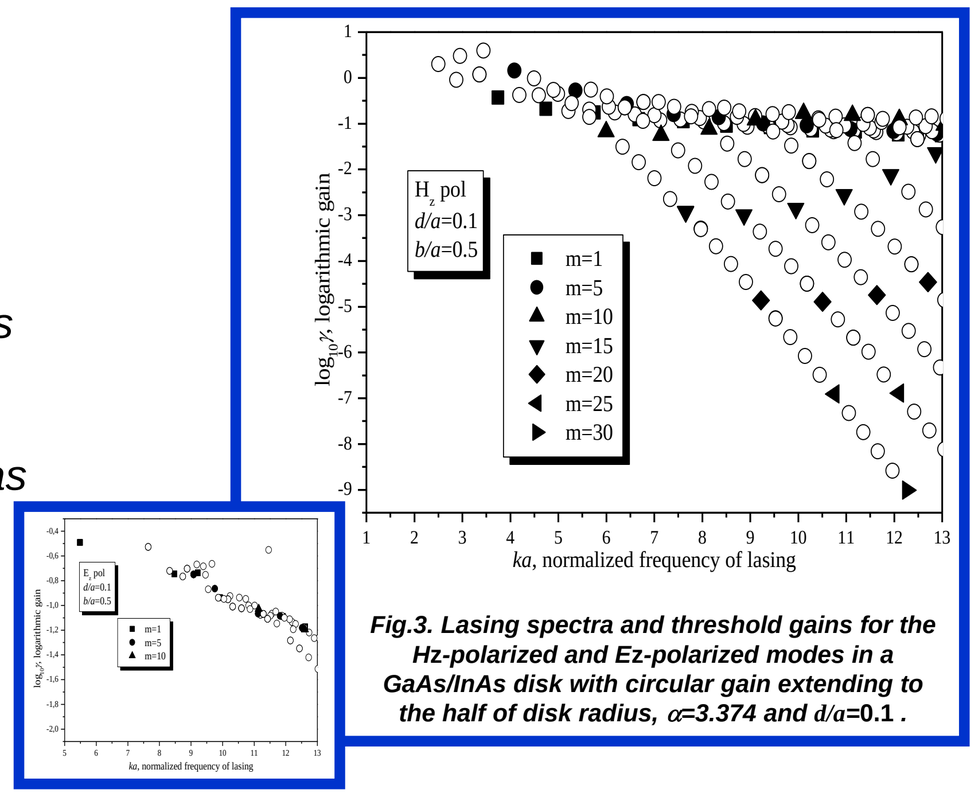

Fig.3. Lasing spectra and threshold gains for the Hz-polarized and Ez-polarized modes in a GaAs/InAs disk with circular gain extending to the half of disk radius, α=3.374 and d/a=0.1 .

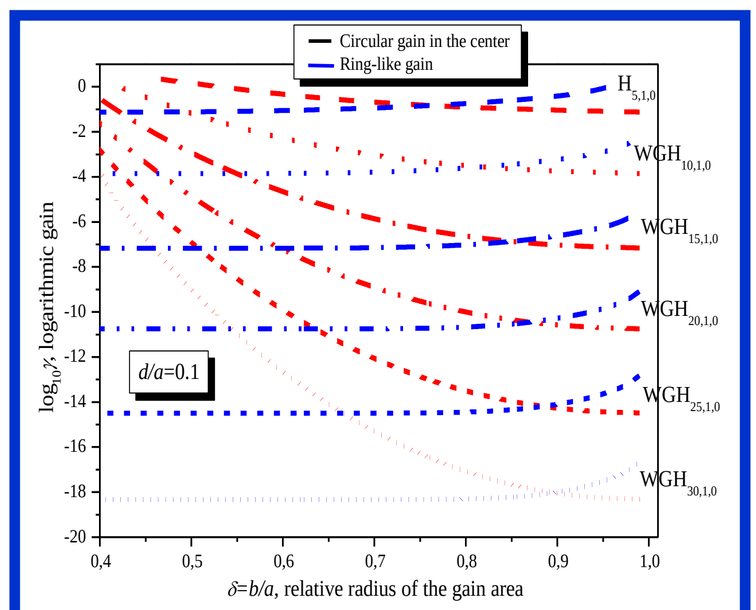

Fig. 4. Dependences of threshold material gains of the modes (Hz)m10 in a GaAs/InAs disk with a step-like gain on the relative radius of the gain area.

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