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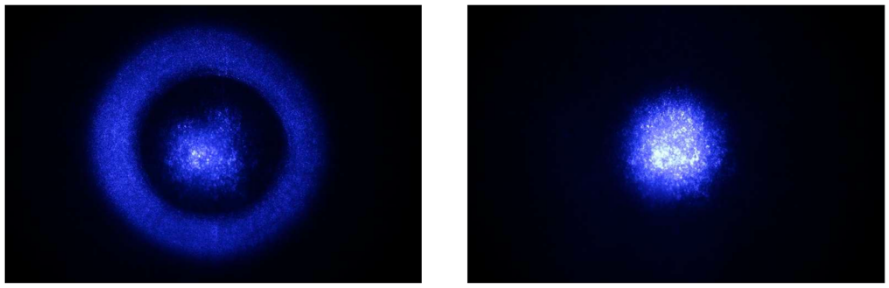
Tuesday October 7th, 2025 at 11h30
LMOPS, CentraleSupélec, 2 rue E. Belin, Metz
Salle de réunion (C102)
https://webvisio.univ-lorraine.fr/meeting/5149?secret=105cf05f-6dfa-40eb-b707-077423b1278f

From Rings to Peaks: Modal Transformation in Ring-Aperture VCSELs

We present a GaAs-based vertical-cavity surface-emitting laser (VCSEL) designed for emission at 850 nm. A distinctive feature of the studied devices is the aperture geometry: instead of a conventional circular optical aperture, it has the form of a ring with an outer diameter of 1000 µm and a width ranging from 3 to 5 µm, depending on the device [1]. Our research focuses on the far-field radiation pattern, examining both optical power distribution and spectral characteristics as functions of injection current and heat sink temperature. With increasing temperature and current, the far-field profile evolves from an initial ring-shaped distribution to one exhibiting a central maximum. We observed a clear correlation between the far-field shape and the emission spectrum, indicating that ring-shaped and centrally peaked fields originate from different lasing modes. This hypothesis was supported by theoretical modeling using the Fresnel approximation, which enables analytical calculation of the far field distribution from an assumed near-field profile at the aperture plane. While this model does not provide quantitative agreement with experimental results, it qualitatively confirms the modal origin of the observed far-field evolution.



Far-field maps collected using a simplified method at two heat sink temperatures (30°C on the left and 45°C on the right). The driving current was 0.8 A. The exposure parameters for the camera were the same for both pictures. The brightest (white) pixels are overexposed.

[1] L. Graham et al. "*Coherent ring VCSELs for high power, narrow linewidth applications*", Proc. SPIE 13384, Vertical-Cavity Surface-Emitting Lasers XXIX, 133840B (19 March 2025)

Séminaire organisé conjointement dans le cadre du programme interdisciplinaire MAT-PULSE (*Materials and Physics @ Ultimate Scale: Nanotech for a sustainable digital world*) et de l'Institut Photonique Grand Est