Master Thesis:

Hybrid External-Cavity Lasers using 3D-printed coupling elements

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Tunable lasers are key building blocks of integrated optics. Because of their ability to provide single longitudinal mode operation over a wide tunability range with exceptionally small linewidth, there is much interest in integrated external-cavity lasers (ECLs)[1][2] for, e.g., optical communication and sensing applications. We recently demonstrated a new class of hybrid ECLs exploiting 3D-printed photonic wirebonds (PWB) or facet-attached micro lenses (FaML)[3][4].

The goal of this thesis is the fabrication and characterization of new ECL modules using 3D-printed coupling elements. New chip architectures and material platforms are to be investigated for the feedback circuit to further investigate the performance potential of such highly integrated devices.

[1] Guan *et al.*, "Widely-tunable, Narrow-linewidth III-V/Silicon Hybrid External-cavity Laser for Coherent Communication," *Optics Express* **26**(7), pp. 7920–7933, (2018).

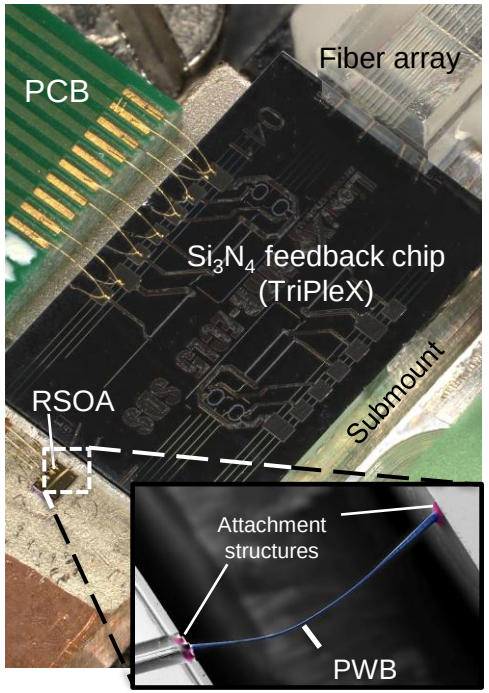
[2] Fan *et al.*, "290 Hz Intrinsic Linewidth from an Integrated Optical Chip-based Widely Tunable InP-SiN Hybrid Laser," *CLEO*, paper JTh5C.9, (2017).

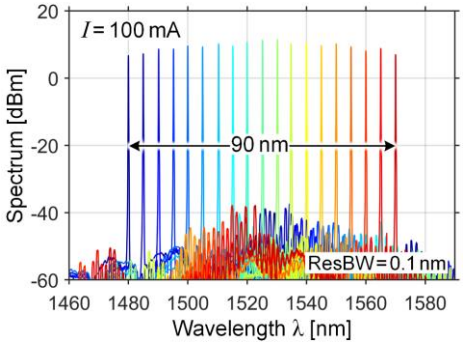
[3] Xu, Maier *et al.*, "Hybrid external-cavity lasers (ECL) using photonic wire bonds as coupling elements," *Scientific Reports* **11**(1), 16426 (2021).

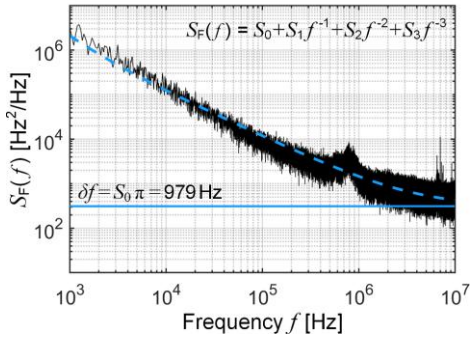
[4] Maier *et al.*, "Sub-kHz-linewidth external-cavity laser (ECL) with Si_3N_4 resonator used as a tunable pump for a Kerr frequency comb," *arXiv:2211.06040*, (2022).

Your tasks may include:

- Fabrication of new ECL modules including fabrication of 3D-printed coupling elements
  - Precharacterization of ECL components
  - Fabrication and Packaging
  - Characterization of the laser performance
- Investigation of new feedback circuit architectures and material platforms for the external-cavity filter chip







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