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# THZ COHERENT SOURCE BASED ON LIGHT STRUCTURATION USING III-V SEMICONDUCTOR LASER TECHNOLOGY

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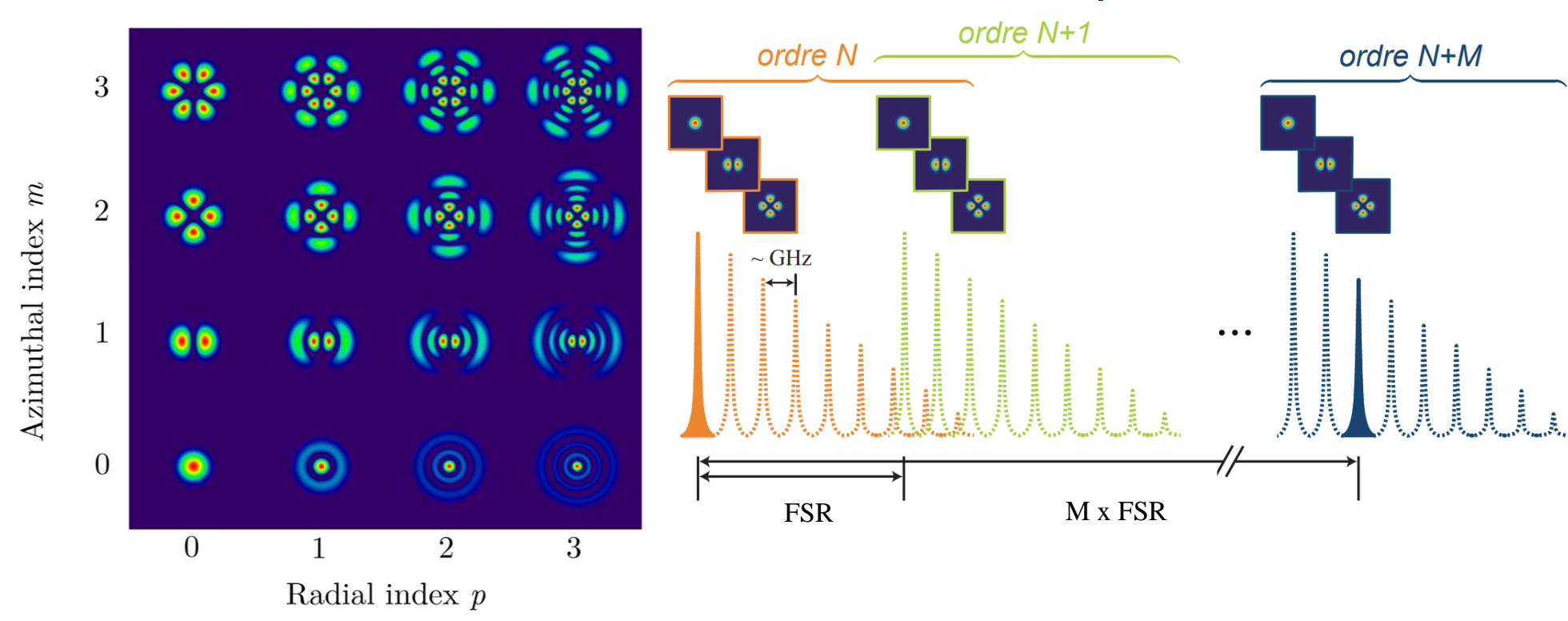


**Abstract:** THz photonics-based sources are attractive as they offer room-temperature solutions that rely on mature photonics technology and provide broadband tunability and large modulation bandwidth to address specific THz applications such as high-data-rate communications or spectroscopy. In this work we present a laser source based on GaAs semiconductor technology for THz applications. We have developed a continuous wave optically-pumped Vertical-External-Cavity Surface-Emitting Laser (VECSEL). It is possible to have a THz emission thanks to beating of two different Laguerre-Gauss (LG) transversal modes using a photoconductive antennas (PCA) as a photomixer, so it is necessary to select only two modes where the frequencies difference is in THz regime. We demonstrate THz emission using plasmonic-electrodes PCA optically-pumped at 1064 nm.

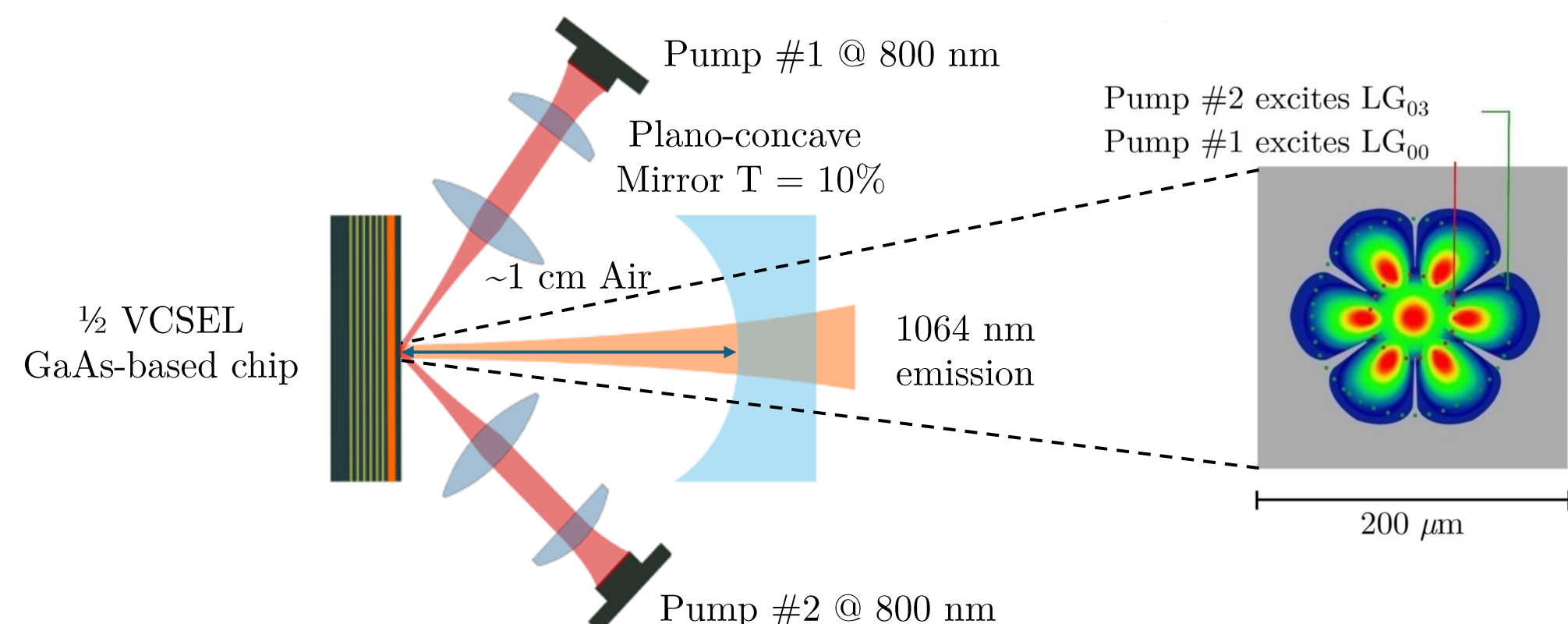
## Bimodal tunable dual-frequency VECSEL technology:

- Epitaxially MOCVD grown of III-V semiconductor structure (low finesse micro-cavity VCSEL): 27 pairs AlAs/GaAs bottom Bragg mirror + 12 GaAsP/InGaAs Quantum Wells (optically-pumped @800nm) + 3 pairs top Bragg mirror.
- High Finesse 1 cm long external cavity: cold frequency linewidth < 150MHz
- Mode competition management: transverse loss modulation thanks to on-chip integrated non-diffracting Chromium masks (<10nm thickness)

Laguerre-Gauss transverses modes and their frequencies difference

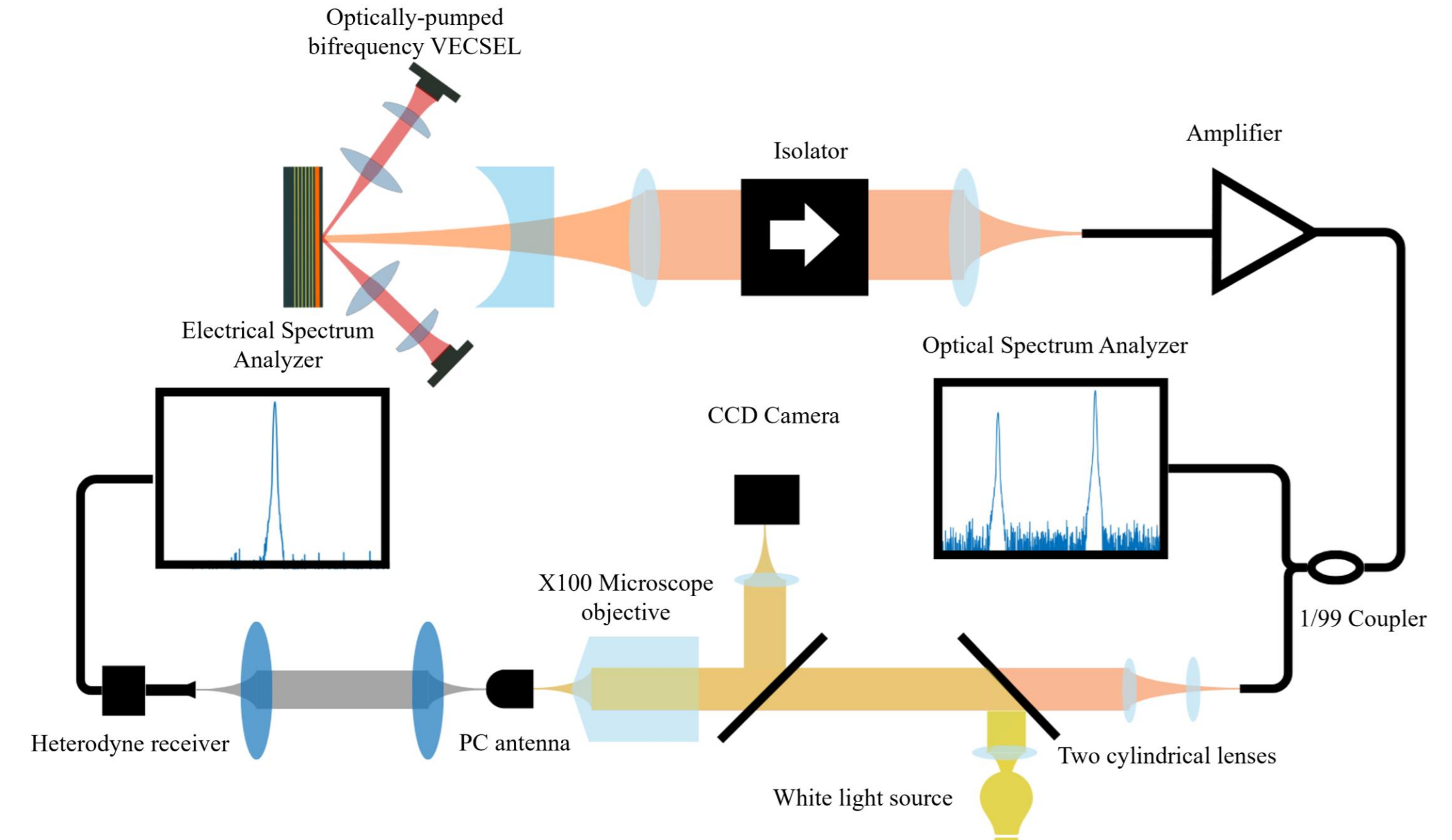


The experimental setup of the bifrequency VECSEL and a scheme of the Chromium mask

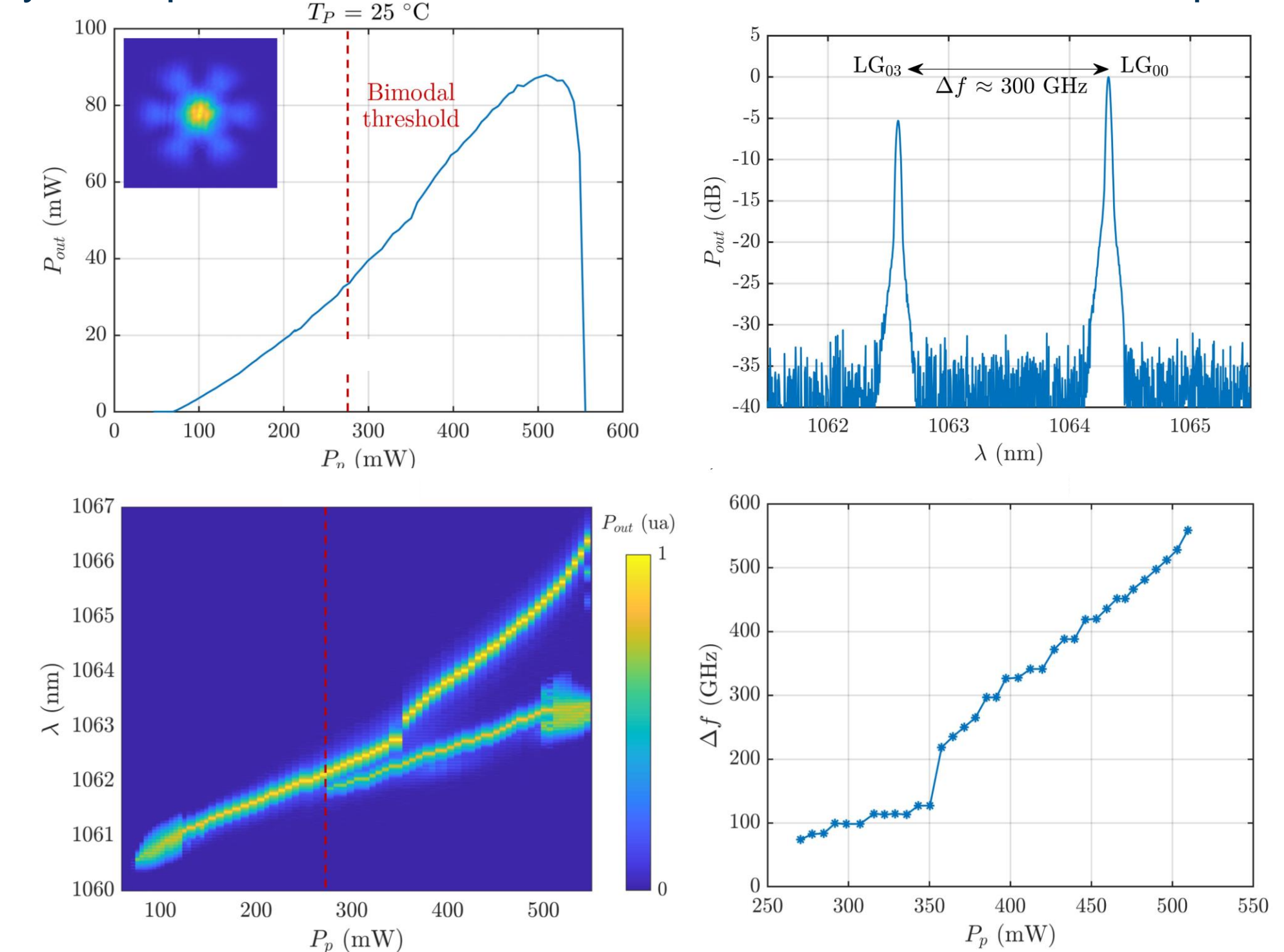


## THz emitter:

The experimental setup of the THz emitter using a VECSEL and Plasmonic-electrodes PCA.

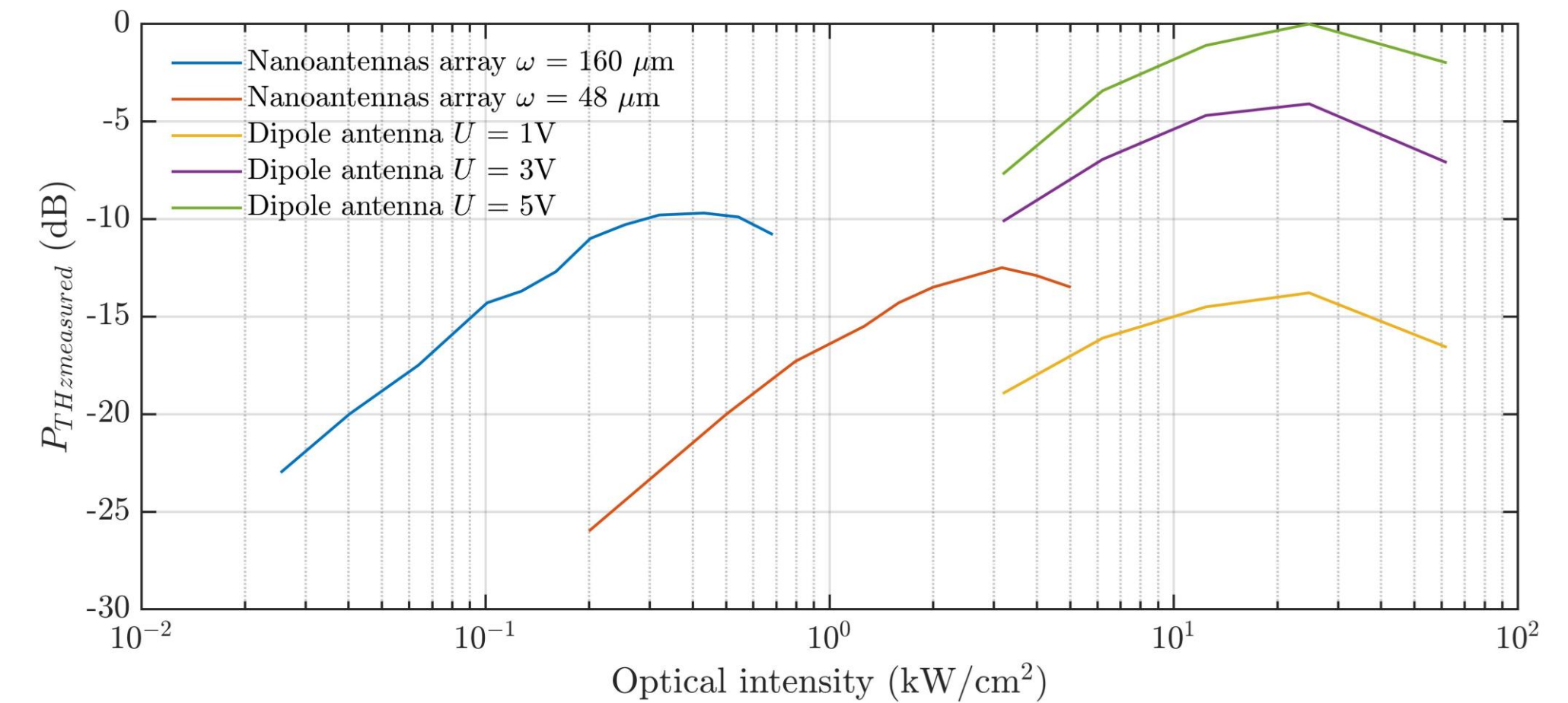


Efficiency and spectral characterization of the VECSEL at room temperature.



- Bimodal operation achieved with a maximum output optical power of ~90 mW and an efficiency of 26%.
- A tunable coherent source from 75 to 600 GHz with a FSR step of 15 GHz.

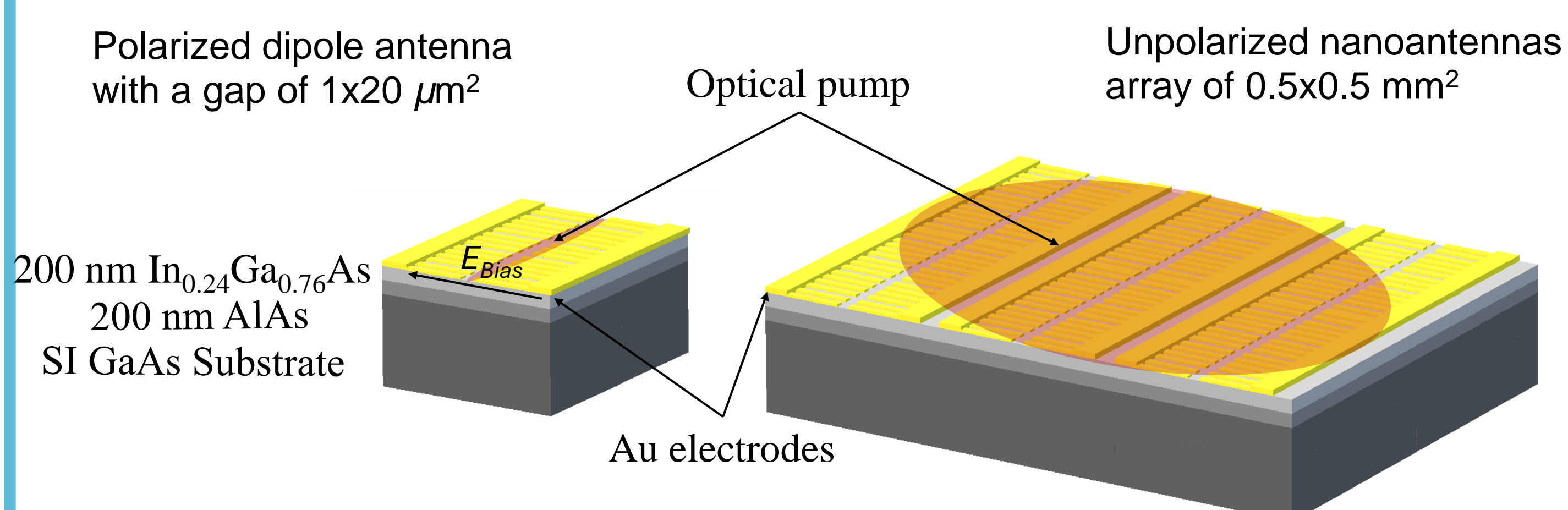
THz emitter characterization at 300 GHz



- Large array excitation decreases the required optical intensity although the bias allows to increase the THz emitted power.
- THz power saturation due to screen effect.

## Plasmonic-electrodes PCA based photomixer:

- Efficient solution to generate a tunable continuous THz wave (T=300K).
- The tunability of the THz source = the tunability of the laser modes.
- Surface plasmon electrons excitation at the interface of gold (Au) electrodes/semiconductor: Enhancement of optical absorption + shortening the transit time.
- 2 plasmonic-electrodes PCA manufactured by MBE based on In<sub>0.24</sub>Ga<sub>0.76</sub>As photo-absorbing layer.



## Conclusion and perspectives:

- The unbiased nanoantennas array offer a huge advantage for THz emission through photomixing thus by decreasing the threshold and by avoiding the breakdown bias.
- We aim to develop a new technology to increase the coherent tunable THz power and overpass the saturation limits.

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