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## **Class-A Operation of InAs Quantum Dash-based Vertical-External-Cavity Surface-Emitting Laser**

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► **To cite this version:**

Salvatore Pes, Kevin Audo, Cyril Paranthoen, Christophe Levallois, Nicolas Chevalier, et al.. Class-A Operation of InAs Quantum Dash-based Vertical-External-Cavity Surface-Emitting Laser. Conference on Lasers and Electro-Optics (CLEO 2017), May 2017, San Jose, United States. OSA (ISBN: 978-1-943580-27-9), OSA Publishing, Tuesday Posters Session (JTU5A), pp. JTU5A.109, 2017, CLEO: Applications and Technology 2017. 10.1364/CLEO\_AT.2017.JTU5A.109 . hal-01532491

**HAL Id: hal-01532491**

**<https://hal.science/hal-01532491>**

Submitted on 2 Jun 2017

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# Class-A Operation of InAs Quantum Dash-based Vertical-External-Cavity Surface-Emitting Laser

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## Motivations

Realization of an optical laser source with high spectral purity, low intensity noise and highly tunability for microwave photonics and coherent communication systems

## Applications

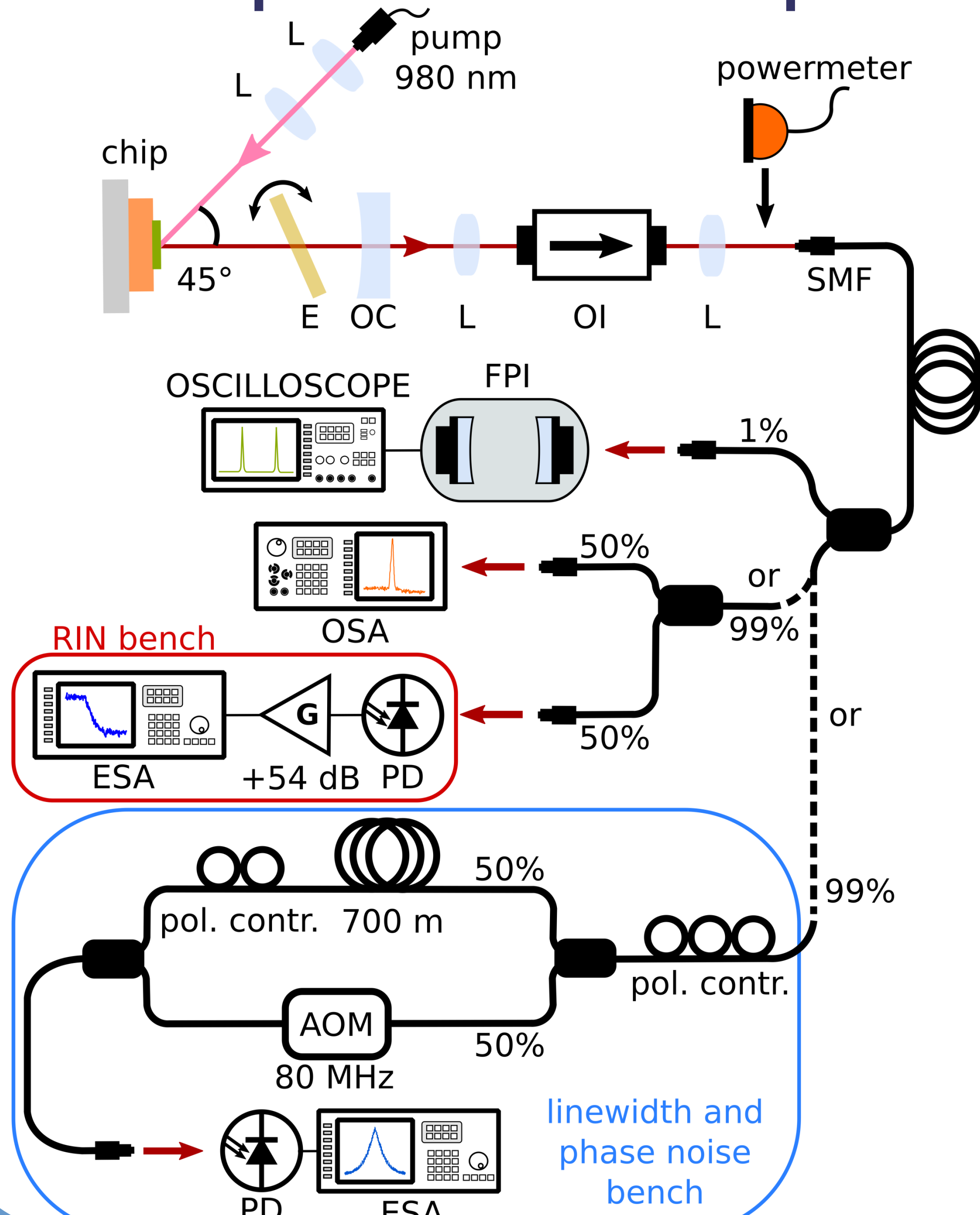
### MICROWAVES:

- RADAR/LIDAR systems
- Ultra low-noise sources
- Dual-frequency lasers
- THz generation

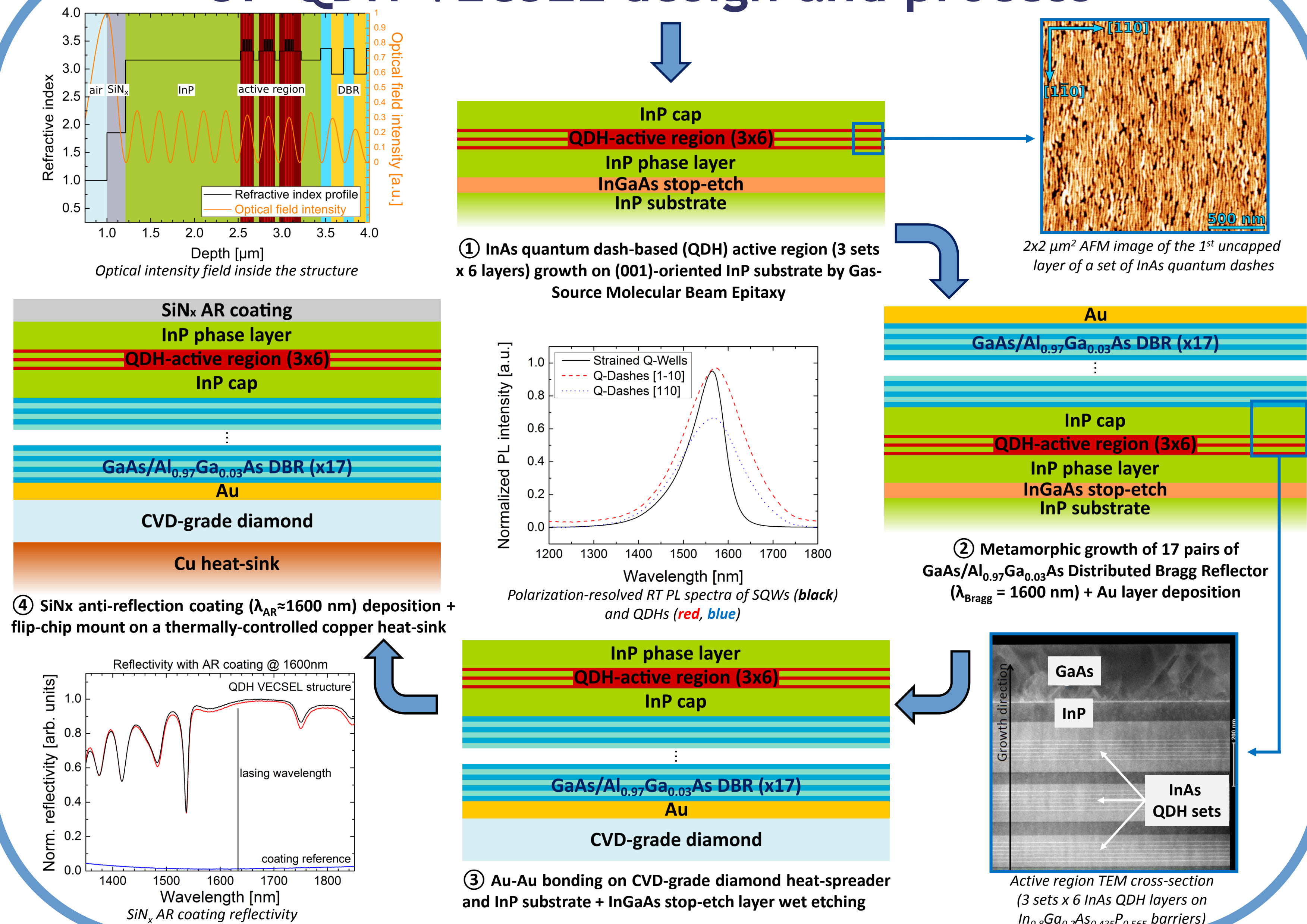
### METROLOGY:

- High resolution spectroscopy
- High pure optical reference signal distribution
- Time/frequency metrology

## Experimental setup

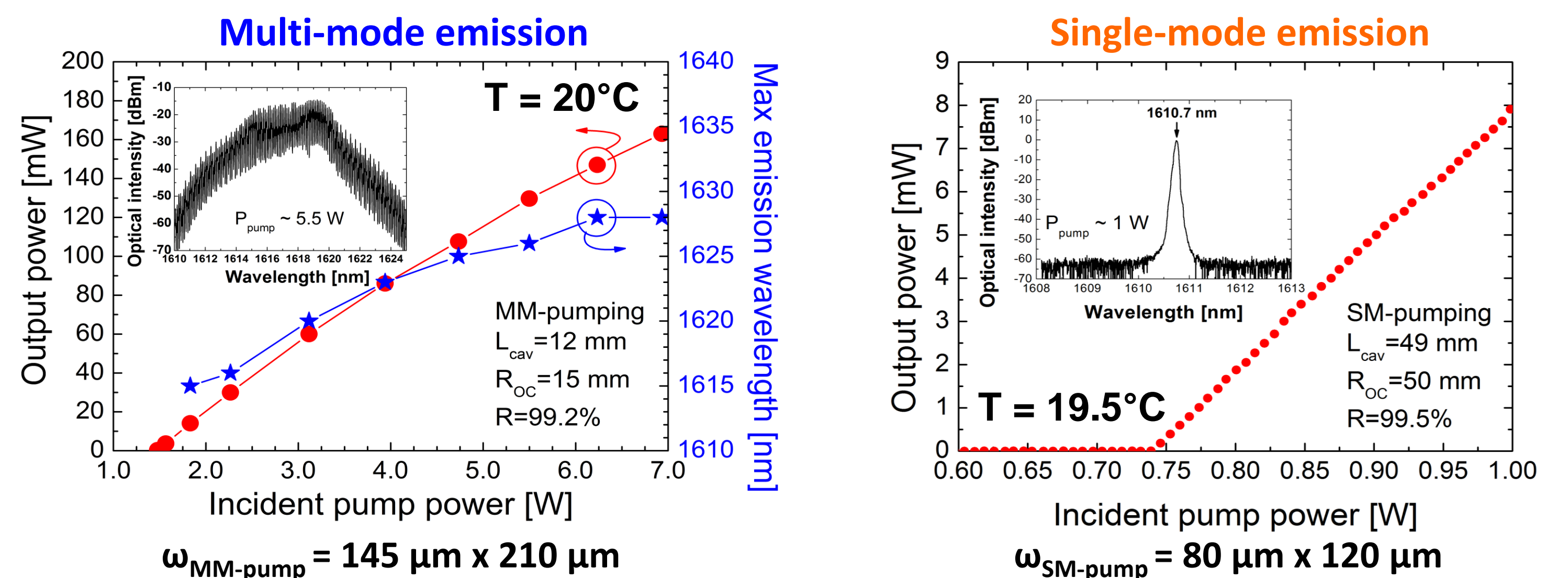


## OP-QDH-VECSEL design and process

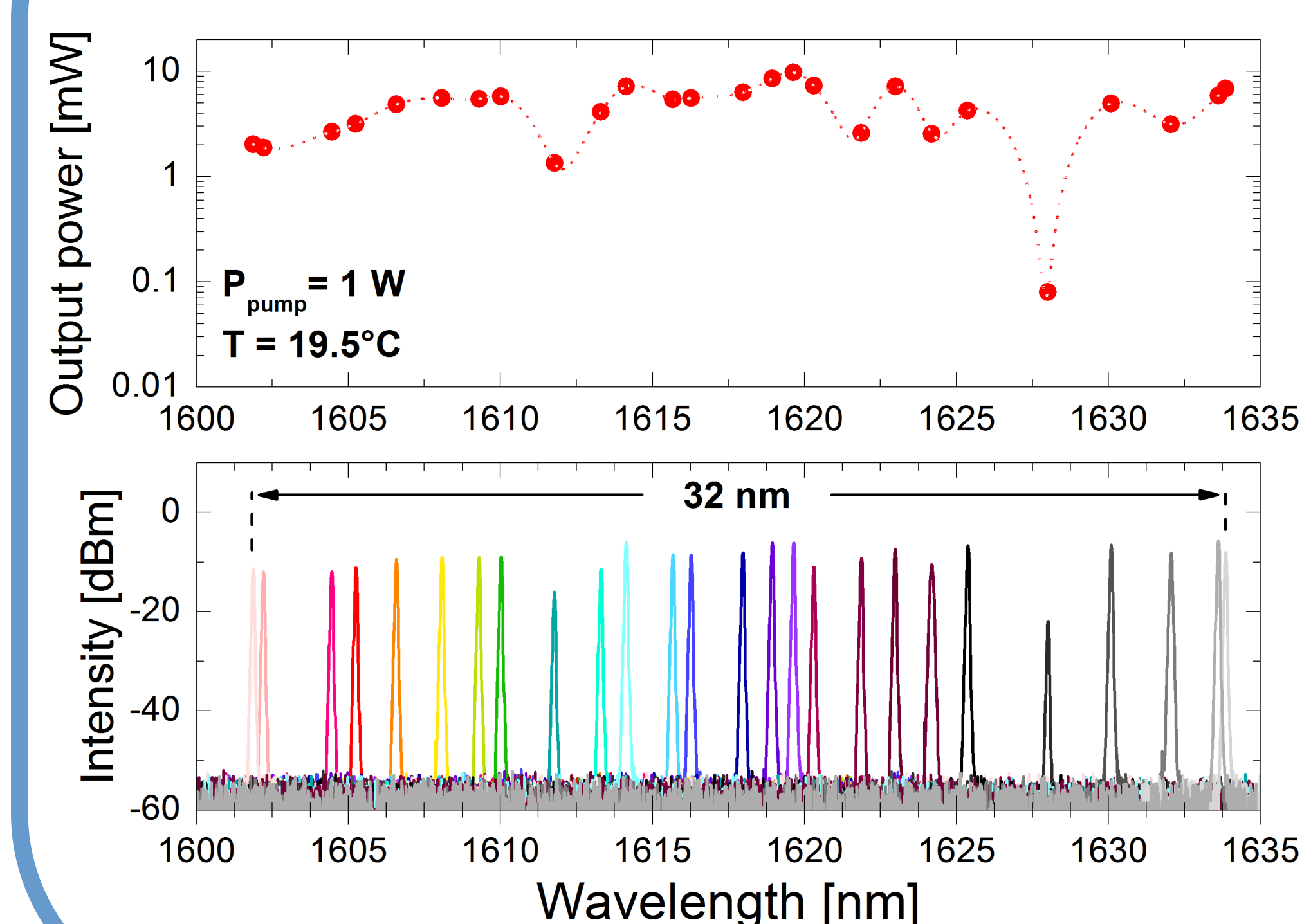


## Laser characterization

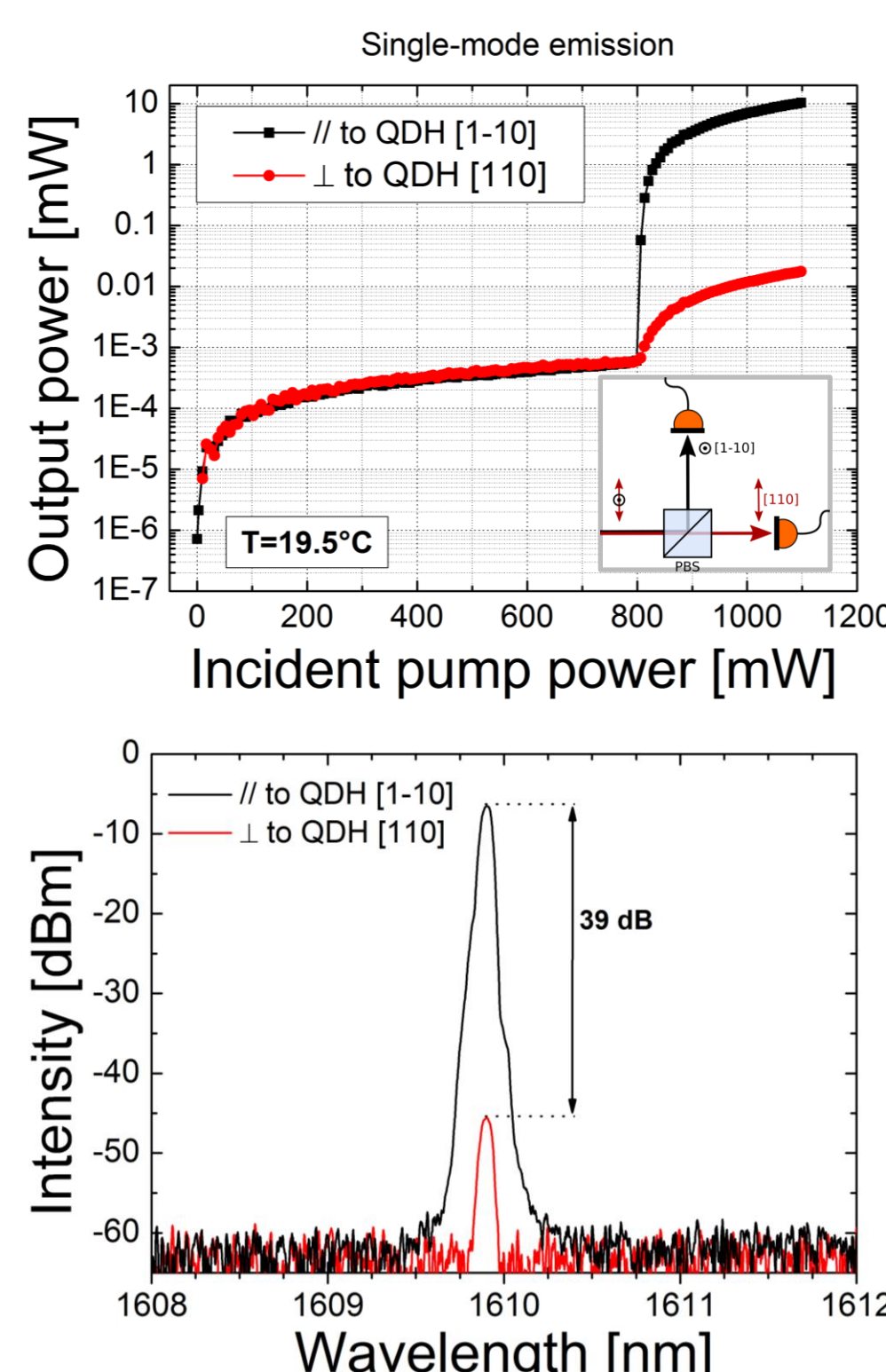
### Output characteristics and emission spectra



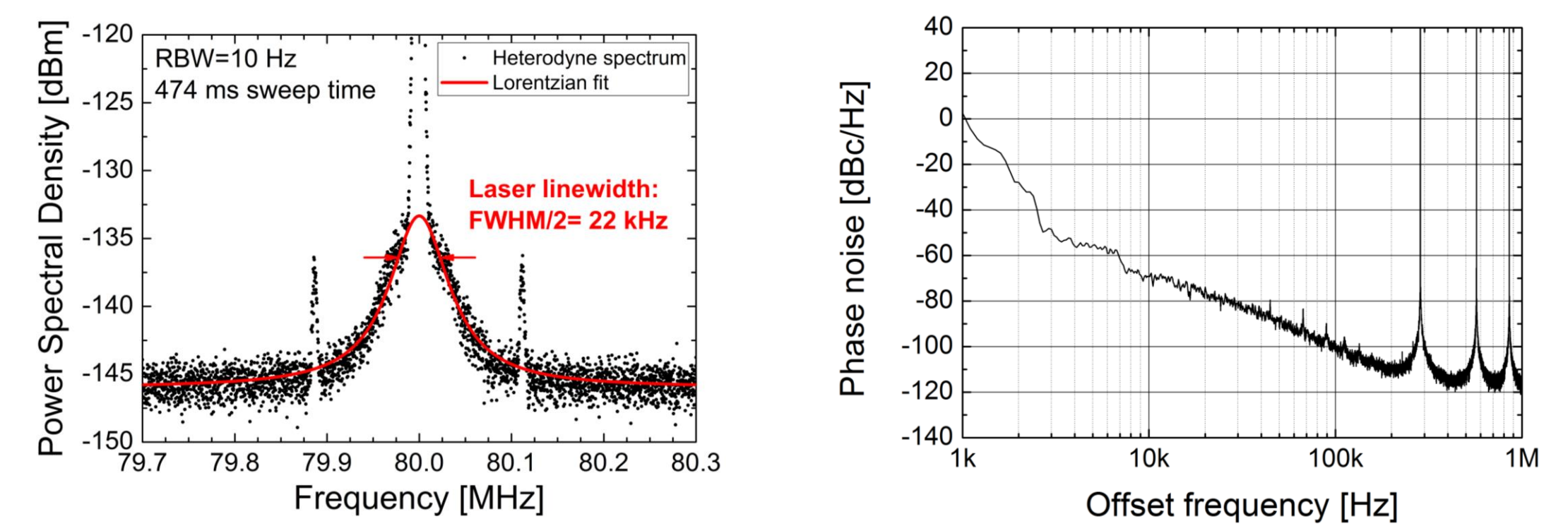
### Single-frequency wavelength tuning



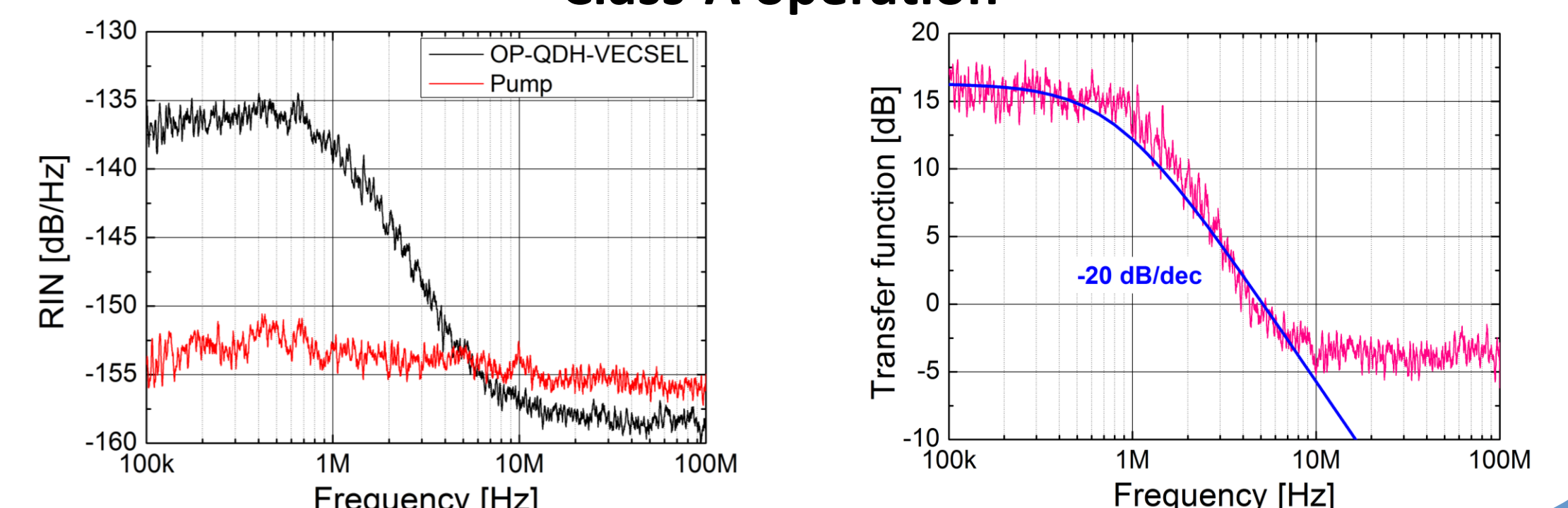
### Polarization-resolved SM-emission



### Laser linewidth and phase noise



### Class-A operation



## Conclusion

Demonstration of a Class-A Optically-Pumped InAs Quantum Dash-based Vertical-External-Cavity Surface-Emitting Laser on InP.

**MM-emission:**  $P_{out} = 163 \text{ mW}$  @  $P_{inc} = 7 \text{ W}$ ,  $T=20^\circ\text{C}$

**SM-emission:**  $P_{out} = 10.4 \text{ mW}$  @  $P_{inc} = 1.1 \text{ W}$ ,  $T=19.5^\circ\text{C}$ , 32 nm tuning

Polarization stably aligned along dash [1-10] direction, OPSR = 39 dB

Laser linewidth estimation: 22 kHz (49 mm-long cavity)

Phase noise: -110 dBc/Hz @  $f > 200 \text{ kHz}$  (free-running)

Class-A operation:  $f_c = 800 \text{ kHz}$ , RIN = -158 dB/Hz ( $I_{phd} = 2 \text{ mA}$ )

## Future perspectives

Dual-frequency operation  
Laser stabilisation on ULE cavity (metrology)  
Electrical pumping

## Funding

ANR and DGA within the **ANR-ASTRID HYPOCAMP project** (grant ANR-14-ASTR-0007-01) and a DGA-MRIS/Région Bretagne scholarship (grant ARED-VELOCE 8917).

## References

S. Pes et al., "Class-A Operation of an Optically-Pumped 1.6  $\mu\text{m}$ -emitting Quantum Dash-based Vertical-External-Cavity Surface-Emitting Laser on InP", Opt. Express **25**(10), 11760-11766 (2017)