

Thesis Defense of Gaëlle BRÉVALLE on next 9 december.  
You can communicate this information to colleagues, who may be interested.

Thesis Defense  
Institut Foton – OHM team  
Monday 9<sup>th</sup> december 2019, 1:30 pm (room Bonnin)

## Investigation of quantum dots VECSEL for the realization of a coherent dual wavelength laser

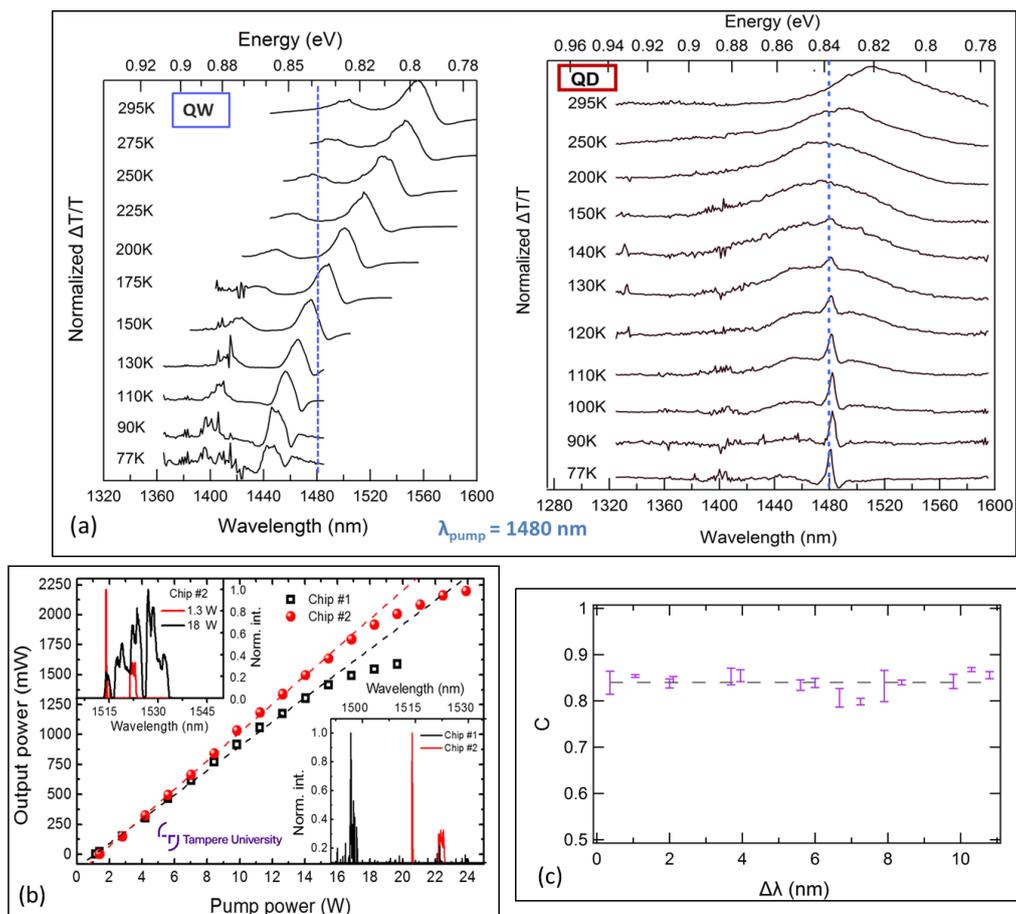
**Gaëlle BRÉVALLE**

### Jury :

|                            |   |                |
|----------------------------|---|----------------|
| <b>Sophie BOUCHOULE</b>    | <i>Director of research, C2N, Université Paris-Saclay</i> | Examinator     |
| <b>Guillaume CASSABOIS</b> | <i>Professeur, L2C, Université de Montpellier</i>         | Examinator     |
| <b>Ghaya BAILI</b>         | <i>Research Engineer PhD., TRT, Palaiseau</i>             | Member         |
| <b>Krassimir PANAJOTOV</b> | <i>Professeur, B-Phot, Vrije Universiteit Brussel</i>     | Member         |
| <b>Cyril PARANTHOEN</b>    | <i>Assistant Professor, Institut Foton, INSA Rennes</i>   | PhD Manager    |
| <b>Mathieu PERRIN</b>      | <i>Assistant Professor, Institut Foton, INSA Rennes</i>   | PhD Manager    |
| <b>Mehdi ALOUINI</b>       | <i>Professeur, Institut Foton, Université/organisme</i>   | PhD Supervisor |
| <b>Hervé FOLLIOU</b>       | <i>Professeur, Institut Foton, INSA Rennes</i>            | PhD Supervisor |

## Abstract

This PhD work focuses on several experimental studies, allowing to relate the performances of a dual-frequency laser to the structural and physical properties of quantum dots (QDs). These works aim to develop a new kind of VECSEL (vertical external cavity surface emitting laser), integrating InAs/InP QDs emitting at 1.55  $\mu\text{m}$ , in order to make tunable and robust (i.e. involving a weak coupling between the two modes) dual-frequency lasers. Firstly, a growth study of the QDs is realized. The control of the growth parameters ensures the control of the density and the inter-QDs distance, and thus of the electronic coupling. Following this study, the growth parameters are carefully selected to get high density QDs; then the stack of the QDs planes forming the active medium is realized. The next study allowing the quantification of the photonic coupling by the homogeneous broadening and the electronic coupling is performed in quantum wells, quantum dashes and quantum dots, depending on the temperature and the carriers density. For this, saturated absorption spectroscopy, based on the Spectral Hole Burning (SHB) phenomenon, is used. The results obtained are linked to the last study that addresses the coupling between the two modes of the dual-frequency VECSEL by the measurement of the Lamb coupling constant. This measurement is performed in a quantum well based VECSEL first, to calibrate the experimental setup and to get the value for comparisons with QDs. Finally, preliminary results obtained in multimode operation of QDs based VECSEL are presented. They reveal to be very promising for the achievement of a dual-frequency operation.



**KEYWORDS :** VECSEL ; InAs/InP quantum dots ; dual-frequency laser ; saturated absorption spectroscopy ; SHB ; coupling