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Coherent High-Q micro-resonator blue light sources

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Research team: Systèmes Photoniques-Lannion

Key words: *Coherent visible sources, whispering gallery modes resonators, optical feedback*

Project description:

The development of compact coherent sources has been strongly triggered by the emergence of optical telecommunications in the 70's. Continuous wave single mode lasers or frequency comb sources are unavoidable modern photonic tools for a wide variety of applicative domains ranging from trace gas detection to optical clocks. **A trend consists in harvesting the know-how acquired in the near infrared band to spread it to surrounding regions of the optical spectrum. The COMBO project is part of this process addressing the blue range of the spectrum.**

Currently, blue single frequency lasers and frequency combs are usually based on frequency doubling of solid state lasers in near infrared region. An alternative approach to generate compact coherent sources can be based on the use of high quality factor whispering-gallery mode resonators (WGMRs). WGMR based coherent sources in the infrared region have been demonstrated with even commercial sources already available.

COMBO aims to unveil the opportunity to develop coherent sources in the blue domain by use of whispering-gallery mode resonators. The ambition of the COMBO project is to develop a WGM resonator platform in the blue range (4xx nm) for the demonstration of compact single frequency laser diodes and blue Kerr frequency combs. The project is divided in three main objectives. **The first objective will draw up a panorama of the linear and nonlinear properties of WGMR in the blue range.** A particular focus will be done on fluoride crystalline resonators identified as best candidates for the realization of either linear or nonlinear optical functions. Indeed, **the second objective consists in the demonstration of WGMR based laser stabilization and narrowing** taking advantage of the impressive linear properties of such resonators as a large Q factor in excess to 10^9 and a Finesse over 10^5. **The third objective involves the study of degenerate four-wave mixing leading to frequency comb generation in high-Q WGMRs**.

Two main breakthroughs are targeted: the first demonstration of **a Kerr frequency comb in the blue range using a high-Q resonator**; and an electrically-pumped **sub-kHz** linewidth **single mode Fabry-Perot (SFP) laser** based on resonant optical feedback. **Combining these two contributions should yield to the demonstration of a compact blue Kerr frequency comb generator.**

Partnership

EPFL-LASPE, Switzerland (laser diode fabrication), Femto-ST, France (WGMRs fabrication)

Foton Institute (CNRS, UMR6082)

Center of photonics for information technology, the FOTON Institute is a CNRS laboratory involving the University of Rennes 1 and INSA Rennes. FOTON members are spread over two sites and are about 120 people, including 75 permanents. FOTON is one of the first public research forces in France in its field, producing over 100 scientific papers a year. It is divided into three teams: « DOP », « OHM » and « Photonic Systems ». The specificity of FOTON is to gather around shared programs, three teams and three platforms covering a wide field of telecommunications optical layer "from the atom to telecommunications systems," as well as skills in related areas of the Photonics Key-Enabling-Technology as defense, life sciences, industry, energy (sensors, lasers, nanosciences...).
More information about the institute can be found at: http://foton.cnrs.fr

Further information - Contact

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Application procedure

Please submit your application at your earliest convenience by e-mail to:
stephane.trebaol@enssat.fr or patrice.feron@enssat.fr
Your application should include:

- Cover letter
- Detailed CV
- Copy of M.Sc. degree or equivalent
- Grade transcripts
- List of publications, if applicable
- Contact details of two references

All qualified candidates are invited to apply