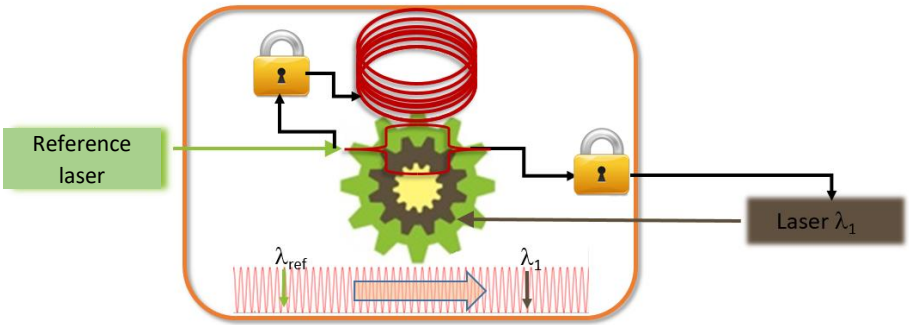
LABORATOIRE ASTROPHYSIQUE RELATIVISTE – THÉORIES – EXPÉRIENCES - MÉTROLOGIE - INSTRUMENTATION - SIGNAUX
Observatoire de Nice, Boulevard de l'Observatoire CS 34229 06304 Nice cedex 4

Doctoral Thesis Subject – sept. 2020

Qualifications: Master degree or Engineer degree in optics-photonics

Transfer of coherence between lasers with a fiber based interferometer

ARTEMIS Lab – Observatory of the Côte d'Azur – Nice, France



Spectral transfer interferometer

Key Words: *Laser; Noise; Optical Fiber ; Interferometry, Servo, Metrology ; Instrumentation*

Context: ARTEMIS is a commun laboratory of Observatoire de la Côte d'Azur, CNRS and Université Côte d'Azur located in Nice, France. It is a member of the French network of excellence in time-frequency science and technology *LABEX First-TF* . The lab has a strong involvement in the realization of the gravitational wave detector Advanced VIRGO, with a large expertise in ultra low noise measurement and laser locking. The founder of the laboratory has been awared the highest national scientific award in 2018. Our team is interested in new concept for stabilization and measurement of laser frequency with interferometric systems based on optical fiber and integrated photonic components. Coherence and stability of laser sources is an increasing challenge for many applications such as spectroscopy, optical sensor, and coherence optical telecommunication. This doctoral subject is part of an exploratory projet funded by the Provence-Alpes-Côte d'Azur Region and *LABEX First-TF* and aims at studying the potential of a new technique of coherence transfert between lasers of different wavelengths.

Subject : This doctoral research project is based on the use of a fiber based Michelson interferometer in order to transfer the spectral purity (or coherence) of a laser to one or several lasers of different wavelength. With an arm imbalance of several hundreds of meter the interferometer have numerous resonance frequencies spanning over a large spectral range. By locking one interferometer frequency on a high coherence laser (« master » laser), all the modes of the interferometer are stabilized thanks to the strong correlation between refractive index and dispersion in optical fiber. Another laser can be locked to another interferometer frequency and then acquires the coherence of the "master" laser. We have already experimentally validated a technique of double locking of the interferometer with very low noise allowing to highlight, for the first time to our knowledge, a fundamental noise floor due to servo non-linear effect. The doctoral work, mainly experimental, will consist in the development of the locking of the interferometer on the « master laser », the characterization of the frequency stability transfer performance using modulation side bands generated by a special enhanced phase modulator in a resonant cavity, the comparison between different interferometer configuration and the study of the different source of noise to enhance the performance of the technique.

Knowledges and skills : Laser metrology and noise, optical modulation technique, low noise photo-detection, servo control systems engineering, interferometer, fiber based system, photonic components

Candidate profile : the candidate should hold, at the beginning of the doctoral program, a master's degree in optics-photonics, experimental physics or electrical engineering with photonics or optoelectronics knowledges

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