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The Institute
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Master in Photonics – “PHOTONICS BCN” Master ERASMUS+ “EuroPhotonics”

MASTER THESIS PROPOSAL

Dates: April 2020 - September 2021

Laboratory: Quantum Engineering of Light
Institution: ICFO-Institut de Ciències Fotoniques
City, Country: Castelldefels, Barcelona, Spain

Title of the master thesis: The quantum state of light in nonlinear interferometers

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Summary of the subject (maximum 1 page):

In the last few years there has been renewed interest in using nonlinear interferometers, interferometers that contain elements such as parametric amplifiers, for doing quantum sensing and quantum imaging. One particular case of this interest are some new types of optical coherence tomography (OCT) schemes proposed recently. OCT is a highly successful 3D imaging technique that was first considered in 1991. Standard OCT schemes make use of a Michelson interferometer, and achieve high axial resolution using light with a large bandwidth.

Some of the OCT proposal considered recently are based on the idea of induced coherence, a quantum effect first analyzed the very same year than OCT was introduced. Other configurations are based on a SU(1,1) interferometer. Most experimental demonstrations have been done in the low parametric gain regime, however one can also do optical coherence tomography in the high parametric gain regime.

The fact that induced coherence can be observed in the low and high parametric gain regimes raises the fundamental question of how *quantum* is the phenomenon of induced coherence? Is quantum distinguishability the main issue, or is it parametric amplification the main reason to observe induced coherence? We address this issue in this Master Thesis by looking in detail at the quantum state of photons in different regimes and using several measures aimed at quantifying the *degree of quantumness* of a quantum state.