
# PhD Thesis Defense  IVAN AMAT ROLDAN 'Ultrashort laser pulse measurement for multiphoton microscopy'

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June 21, 2013

Friday, June 21, 11:00. ICFO Auditorium

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In this thesis, we address specific efforts towards developing the precise aspect of ultrashort laser pulse measurement in the context of biomedical research. The motivation for pursuing these new developments was triggered by the vision of developing fundamental tools that will enable to control matter by means of light with exquisite precision with the added

difficulty of being next to biological samples which are extremely sensitive and fragile. For this, light matter interaction needs to be extremely well controlled to avoid undesired effects, like cell damage due to the high peak intensity values of ultrashort laser pulses, as well as promoting specific physical processes like two-photon fluorescence excitation of a desired fluorophore embedded in some biochemical environment.

We focus in the two major bottlenecks regarding ultrashort laser pulse measurements for multiphoton microscopy, that aim for developing (1) new techniques for full characterization of ultrashort pulses under different experimental conditions and (2) new material with specific nonlinear properties that enable to obtain ultrashort pulse measurements that properly catch the temporal shape of light and at the same time can be readily found in biomedical lab, specially cost effective, non-fragile and non-toxic. Combination of these two complementary strategies provides a new ground where it is possible to characterise an ultrashort pulse at the sample plane of a multiphoton microscopi in a regular biomedical research facility.

Importantly, we approach ultrashort pulse characterisation by developing a different theoretical framework to the state-of-the-art and we propose few initial experiments that preliminary support our theoretical statements in the form of new optical techniques. These findings are then experimentally tested under different conditions, such different optical setups and different pulsed regimes in order to evaluate the feasibility of the tools to measure ultrashort pulses in conditions that were prohibitive at the time this thesis was started. The scope of this thesis outlines the potential of such techniques, but further efforts shall be addressed to assess feasibility, robustness and further limitations.

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