UT Austin Portugal | 2019 Strategic Research Projects

NANOTECHNOLOGIES

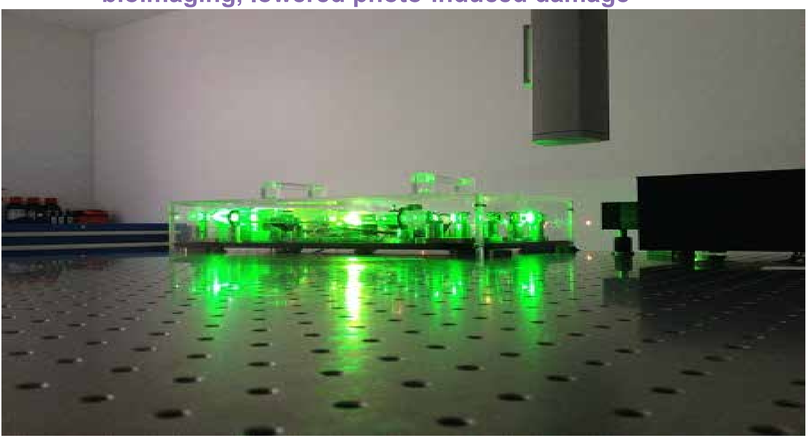
ExtreMed

Start Date: 01-APR-2020 **Duration: 36 months** **Operation Code: 45932**

Extreme Ultrashort Pulses for Advanced Medical Applications and Diagnostics

In neuroscience, medical imaging and clinical applications, fast non-invasive and non-destructive extraction of detailed cellular and functional behaviour, of complex samples, are of particular importance. The scope of ExtreMed is to meet these demands by the use of proprietary and patented technologies to develop the SyncRGB-FLIM multi-color bioimaging technique, where the few-cycle ultra-broadband femtosecond laser promoted single-scan operation, results in advanced imaging with lowered photo-induced damage and extending deep tissue imaging capabilities.

Keywords: few-cycle ultra-broadband femtosecond lasers, advanced multiphoton microscopy, deep tissue bioimaging, lowered photo-induced damage



Main challenge/problem the project seeks to address

Multi-photon microscopy has been extensively used in biological, pharmaceutical and medical applications due to its ability for detailed cellular and deep tissue imaging. For complex sample imaging and functional behaviour mapping, repeated scans are required in standard multi-photon microscopy, increasing the total imaging time and photo-induced damage while fast processes, such as protein-protein interaction, can be missed or only partly imaged due to the narrow wavelength laser excitation per scan. Within the ExtreMed project these limitations and challenges will be addressed by applying a state-of the-art few-cycle ultra-broadband pulsed femto-second laser together with advance pulse shaping.

Proposed solution

- A fully operational and characterised few cycle laser prototype;
- A broadband passive pulse shaper;
- A stand-alone SyncRGB-FLIM system with advanced scanning and data analysis software;
- An in vitro study using SyncRGB-FLIM on commercially available nanodrug delivery systems.

Innovative Potential

The application of ultrashort laser pulses and pulse shaping, within the ExtreMed project, aims to increase the amount of information extracted in a single scan with an enhanced deep tissue scanning capability and reduced photo induced damage, thereby promoting this form of imaging and diagnostics. SPH, UPorto and INL recently demonstrated for the first time that an ultra- broadband 7 femtosecond (fs) few cycle laser can be used for multi-color nonlinear imaging, in a single channel detection geometry, when employing a time-resolved fluorescence detection scheme. The developed SyncRGB-FLIM multi-color bioimaging technique opens up the possibility of real-time protein-protein interaction studies, where its single-scan operation translates into reduced laser exposure of the sample, resulting in more photoprotective conditions for biological specimens.

Consortium

PORTUGAL

Sphere Ultrafast Photonics, S.A. (SPH) (Lead Beneficiary)
International Iberian Nanotechnology Laboratory (INL) / PI: Jana Nieder
University of Porto / PI: Helder Crespo

USA - UT AUSTIN'S PRINCIPAL INVESTIGATORS
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Target beneficiaries

- Corporate and academic customers of the microscopy market;
- Laboratories and research centres;
- Manufacturing microscopy technology businesses interested in incorporating ultrafast lasers, d-scan, SyncRGBFLIM and pulse shaper technology into their products;
- Preclinical environments.

Funding Sources Distribution

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UT Austin
(UT Austin Portugal Budget)

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PT2020 Incentive

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FCT Incentive

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