

Proof of Concept Grant

ICFO Prof. Michael Krieg receives ERC funding to develop a light-efficient microscope for fast volumetric imaging of photon starved samples

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The European Research Council, in its efforts to help ERC grant-holders to bridge the gap between their research and the earliest stage of a marketable innovation, created the Proof of Concept (PoC) funding scheme for researchers who have already been awarded an ERC grant. The grants are part of the EU's research and innovation program, Horizon Europe. Not only does this program help bring ERC grantees closer to the possibility of commercializing their research findings, the program complements the efforts of ICFO's Knowledge and Technology Transfer Unit (KTT), which proactively searches for ways to translate newly generated knowledge into new technologies.

The ERC has announced the 66 new PoC Grants in the second round of the 2023 competition, including a grant for ICFO Prof. Michael Krieg, leader of the Neurophotonics and Mechanical Systems Biology group, to finance the project titled **LowLiteScope**. This project

aims to develop a light-efficient microscope for fast volumetric imaging of photon starved samples.

Currently, commercial solutions for bioluminescence imaging suffer from low spatiotemporal resolution, due to photon-starved samples. LowLiteScope aims to overcome these limitations by radically redesigning the optical path, data acquisition and post processing based on artificial intelligence.

LowliteScope leverages a Fourier light field approach to capture the spatial and angular information of light rays that pass through the sample. In contrast to conventional light field microscope, this technique records three-dimensional images with high spatial resolution and a large depth of field. To reconstruct the 3D volume from single exposure light field images, researchers in Prof. Krieg's gorup will use new deep learning models based on artificial intelligence (WP1). The use of generalized and optics-informed deep learning techniques will also increase the spatial resolution beyond conventional light field microscopes. They will test the performance of the **LowLiteScope prototype** using photosensitive samples and samples with high intrinsic autofluorescence (WP2) - two properties that often render long-term, high-resolution imaging via fluorescence microscopy difficult. Ultimately, success is measured by the ease to adopt this technology. To facilitate the adoption of **LowLiteScope** by the enduser, they propose a new lens design (MONOMIR for Microscope Objective iNtegrated fOurier MIcrolens aRray), which can be used as a modular add-on to any conventional, fluorescence microscopes.

In summary, **LowLiteScope** marks a significant breakthrough in bioluminescence microscopy. Its ability to non-invasively capture 3D images of live cells and tissues with high resolution will be an invaluable asset for biomedical research when an excitation light source is prohibitive due to intrinsic photosensitivity of the subject under study.