

2024 DOCTORAL INPhINIT FELLOWSHIPS PROGRAMME – INCOMING

Thinking Outside the Photonic Box: Unlocking Insights from Frustule-Less Cell Stages for Diatom Frustule Formation (TOP)

Area of Knowledge: LIFE SCIENCES

Group of disciplines: Biotechnology, Bioinformatics, Pharmacy, Food Technology

Research project

Photonic crystals are **complex optical nanomaterials** that function through the interference with light. Photonic crystals exhibit remarkable optical properties, finding applications in diverse modern technologies like **telecommunications, photovoltaics, and quantum computing**. Interestingly, photonic crystals also exist in nature, in the silicon dioxide shells surrounding diatoms. Their photonic crystals are exceptionally well-defined, confining photonic properties to narrow spectral ranges. While reproducibility is advantageous for photonics applications, it also poses limitations for industrial use, where more diverse photonic properties are required on demand. To address this bottleneck, **we aim to unravel the molecular mechanisms governing the growth of diatom photonic crystals**.

This approach is based on studying the processes during meiotic cell reproduction stages in diatoms. At this point, the glass shells temporarily disappear, only to be reassembled once the reproductive cycle concludes. We anticipate that crucial genes, responsible for synthesizing natural photonic crystals, are activated during these stages. Additionally, we plan to monitor the reinstallation of diatom photonic crystals with advanced microscopic imaging techniques, including confocal microscopy, Scanning and Transmission Electron Microscopy (SEM and TEM).

Through this investigation, we hope to **pinpoint key genes orchestrating the formation of highly ordered natural photonic crystals**. This insight will lay the groundwork for future genetic manipulation of this unique natural resource. Such advancements hold promise for producing advanced photonic materials, especially beneficial in situations where cleanroom facilities and complex international supply chains are impractical or vulnerable to disruptions, such as during international conflicts. The outcomes of our research will contribute to **forging new pathways in technology**, promoting sustainability, and fostering societal improvements.

Job position description

The candidate should demonstrate a strong motivation to thrive in a **competitive, international, and interdisciplinary team** that includes both biologists and physicists. A natural inclination toward contributing to the **transformation of society** through sustainable technology is highly valued. While no prior background knowledge in this emerging field is required, a foundation in biology, particularly molecular biology, genetics or experience in establishing clonal lines, or in the work with diatoms more in general, would be advantageous.

The candidate will undergo comprehensive training in diverse areas, encompassing **molecular biology, electron microscopy, confocal microscopy, and photonics**. Engaging in a variety of tasks, from cell culture to

DNA extraction and molecular analysis, as well as mastering different microscopic techniques and SEM analysis, is expected.

Active participation and learning extend beyond laboratory techniques, as the candidate will have the opportunity to immerse themselves in various aspects of the research. This includes **potential collaboration and stays with our national and international network** partners engaged in similar projects. Extended visits to esteemed institutions such as the University of Texas at Austin (USA), Norwegian University of Science and Technology (Norway), Universidad Autónoma de Madrid (Spain), and the International Iberian Nanotechnology Laboratory (Portugal) are foreseeable, enriching the candidate's experience and contributing to the success of the thesis.

The anticipated outcome includes the **publication of research results** in peer-reviewed international journals, emphasizing the commitment to scholarly dissemination and knowledge sharing within the scientific community. The candidate is poised to benefit not only from the project's training program but also from the extensive collaborative network, fostering personal and professional growth in this cutting-edge research endeavour.

Supervisor team

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Website of the laboratory: <https://mplab-kleptoslug.com/>

Website of CESAM: www.cesam-la.pt

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