

CSIC Doctoral Network in Synthetic Biology: Engineering Biomolecular and Cellular Systems
CALL #1 - Doctoral Project Proposals

REFERENCE: IBMCP#1-P2

TITLE: Optogenetic regulation of plant virus-derived expression vectors

SUPERVISORS:

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SYNBIO-CSIC Axes ¹

Top-down Synthetic Biology

- Reprogramming plants with synthetic circuits for an enriched composition

PROJECT DESCRIPTION

Overview: Because of autotrophic growth based on sunlight and the absence of human and livestock pathogens, plants are excellent bioreactors for the generation of products of interest for biotech and pharma. However, novel avenues of genetic control are required to exploit the biosynthetic potential of plants fully. Plant virus-derived vectors have the potential to amplify their genomes exponentially, move through the plant cell-to-cell and long-distance, and manipulate transcription, RNA silencing, translation, and protein degradation pathways in favor of viral transcripts.

The **objectives** of this PhD thesis are to design a new generation of plant virus-derived vectors that, while maintaining their replication, movement, and gene expression regulation properties, are fully controlled in terms of activation and deactivation using specific light signals.

The **approach** will be supported by modeling techniques for dynamic responses, and predictive and generative machine learning (AI) models for genetic parts design, including light-sensitive transcription factors, promoters, terminators, and regulatory RNAs.

Expected outcomes include a synthetic biology toolkit for light-responsive viral vectors able to reprogram plant biosynthetic pathways. **Expected impacts** will be in progress towards sustainable plant-based bioreactors for the biomanufacturing of bio-based compounds for biotech and pharma.

Secondments: They will be conducted at key collaborating laboratories of associated partners, determined in coordination with the selected candidate, to enhance project outcomes and training quality.

¹ SYNBIO-CSIC TOPICS

Bottom-up synthetic cell engineering: reconstituting life-like molecular systems and functional modules, and integrating them within artificial and natural cells

Top-down synthetic biology: from protein engineering to the reprogramming of cell circuitry and essential processes to achieve novel functions, from cell therapeutics to cell factories.

Computational synthetic biology: applying robotics, AI, and machine learning tools.

Preferred profile of the candidates: Master's degree related to Biotechnology and Synthetic Biology. Candidates should hold a degree in molecular biology, biochemistry, biotechnology, or a related subject area. Experience in computer programming and mathematical modeling will be valued.