ICFO



INSIGHT SEMINAR: Pushing the Limits of Super-Resolution Microscopy

JOSE IGNACIO GALLEA

November 26, 2026
12:00 to 13:00
Elements Room

BIO:

Jose Ignacio Gallea is a biophysicist and Marie Sk?odowska-Curie Fellow at the University of Gottingen, Germany. He obtained his PhD in Chemical Sciences from the National University of Cordoba, Argentina, where he used fluorescence-based techniques to investigate the structural organization of ?-synuclein amyloid aggregates and their interactions with lipid membranes in the context of Parkinson's disease.

Building on this background in molecular biophysics, he subsequently expanded his research into advanced fluorescence microscopy, developing quantitative optical methods to study biological systems at the nanoscale. His work includes fluorescence lifetime-based single-molecule localization microscopy, three-dimensional biological nanorulers, and approaches to probe molecular organization and dynamics.

His research aims to combine super-resolution microscopy with molecular biophysics to understand how nanoscale structure, local physicochemical environments, and molecular dynamics relate to biological function.

ABSTRACT:

Super-resolution fluorescence microscopy has opened new possibilities for investigating biological structures at the nanoscale, with techniques such as single-molecule localization microscopy (SMLM) providing unprecedented spatial resolution. Yet the value of SMLM as a quantitative tool depends on three key aspects: how precisely molecules can be localized, how reliably imaging performance can be benchmarked, and how much information each molecule can report.

In this talk, I will present two complementary advances in super-resolution microscopy. First, I will discuss how combining SMLM with image scanning microscopy using a SPAD array detector enhances lateral resolution by up to a factor of two, while enabling fluorescence-lifetime-based multiplexing that avoids the chromatic registration errors associated with conventional spectral multiplexing.

Next, I will introduce bacteriophage T4 as a versatile three-dimensional biological nanoruler. Using DNA-PAINT combined with astigmatic imaging, we resolved its capsid and hollow tail in 3D, demonstrating how its well-defined architecture, preferential orientation, and multiple structural protein targets make it a promising reference for benchmarking super-resolution microscopy.

Finally, I will briefly outline future research directions aimed at extending SMLM beyond molecular localization towards probing local physicochemical environments at genetically defined sites within biological nanomachines.

Hosted by: Prof. Dr. Maria Garcia-Parajo