UNIVERSITÀ
POLITECNICA
DELLE MARCHE

Supervisor: Prof. Francesco Spinozzi

Dept. of Life and Environmental Sciences

Project idea: Biophysical Investigations of Membrane-Peptide Interactions

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Activities

Francesco Spinozzi is Full Professor of Physics for Life Sciences, Environment, and Cultural Heritage. He teaches Mathematics and Statistics, Physics, and Molecular Biophysics to students in bachelor's and master's programs in Biology. His research focuses on the structure and aggregation of biologically relevant molecular systems, including proteins, lipids, nucleic acids, and protein-decorated nanoparticles. He primarily uses small-angle X-ray and neutron scattering techniques (SAXS and SANS) and has developed advanced methods and software for their analysis. He has participated in over 80 funded experiments at major synchrotron and neutron facilities.

Selected Scientific Projects

• *Selection of inhibitors of the main protease of SARS-CoV-2 for antiviral drugs against COVID-19*, Fondazione Cassa di Risparmio di Perugia, 2021.
• *Structural characterization of aIF5A, a translation factor from Sulfolobus solfataricus, and its interactions with DHS and nc98 RNA*, Cooperation between Institute of Inorganic Chemistry, Graz University of Technology, Austria, and Department of Life and Environmental Sciences, Marche Polytechnic University, Italy, 2019.
• *Building with DNA: Coordinated experimental, numerical, and theoretical study*, Research Projects of National Interest (PRIN), Italy, 2010.
• *Bio-Engineering by Atmospheric Plasma Treatment*, EU-FP6 Specific Targeted Research Project, 2004.

SUN RISE SMALLER (STRATEGIC) UNIVERSITIES NETWORK FOR REGIONAL INNOVATIVE AND SUSTAINABLE EVOLUTION

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Description

Scientific Leadership & Roles

- Past Vice-President, Italian Society of Neutronic Sciences (SISN).
- Director of basic and advanced neutron schools.
- Member of the Doctoral Board, PhD in Life and Environmental Sciences, Marche Polytechnic University.
- Member of the Doctoral Board, PhD in Heritage Science, Sapienza University of Rome.

Mentorship & Supervision

- Supervisor of 6 PhD students and 18 Master's students.

ORCID & Metric

- ORCID: 0000-0002-0693-5582
- Scopus ID: 7005534298
- Articles With Citation Data: 96
- Total Citations: 2439
- h-index: 29

Key Recent Publications

- F. Spinozzi et al., *Small-angle X-ray scattering unveils the internal structure of lipid nanoparticles*, J. Colloid Interface Sci. 662, 446, 2024
- F. Spinozzi et al., *Small-angle scattering from flat bilayers containing correlated scattering length density inhomogeneities*, J. Appl. Crystallogr. 56, 1348, 2023
- A. Marega Motta et al., F. Spinozzi, *Unveiling the mono-rhamnolipid and di-rhamnolipid mechanisms of action upon plasma membrane models*, J. Colloid Interface Sci. 624, 579, 2022
- L. Silvestrini et al., F. Spinozzi, *The dimer-monomer equilibrium of SARS-CoV-2 main protease is affected by small molecule inhibitors*, Scientific Reports 11, 9283, 2021
- P. Moretti et al., F. Spinozzi, *Comprehensive structural and thermodynamic analysis of prefibrillar WT α-Synuclein and its G51D, E46K, and A53T mutants by a combination of small-angle X-ray scattering and variational Bayesian weighting*, J. Chem. Inf. Model. 60, 5265, 2020

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Staff, equipment and laboratories

Molecular Biophysics Laboratory

Research Team

- Professors: Francesco Spinozzi, Paolo Mariani, Maria Grazia Ortore, Francesca Ripanti
- Postdocs: Adnan Khan.
- PhD Students: Yessica Roque Diaz, Matteo Vercelli, Giulia Gasperuzzo, Rodrigo Fernandes De Almeida
- Technical Staff: Paolo Moretti

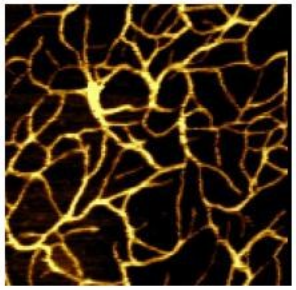
Laboratory Focus

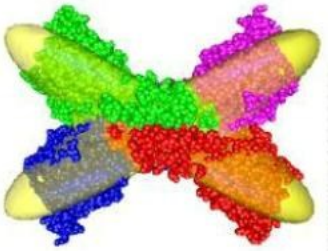
- Protein structure, interactions, and aggregation
- Self-assembly of guanosine derivatives
- Lipid phase structure and stability
- Cultural heritage conservation (wood and paper)

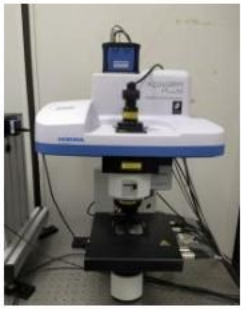
Key Laboratory Equipment

- Dynamic Light Scattering (Zetasizer Malvern)
- FTIR Microspectroscopy (INVENIO, Bruker Optics)
- Raman Microspectroscopy (XploRA Nano spectrometer, Horiba Scientific)
- Atomic Force Microscopy (AIST-NT, Horiba)
- Rheometer (Anton Paar MCR 702)
- UV-Vis and Fluorescence Spectroscopy (Shimadzu)
- 3D Bioprinter (Cellink BIO X)
- Quartz Crystal Microbalance (Novatech)
- Polarized Light and Phase-Contrast Microscopy (Leitz, Leica)

Molecular Biophysics MOB LAB







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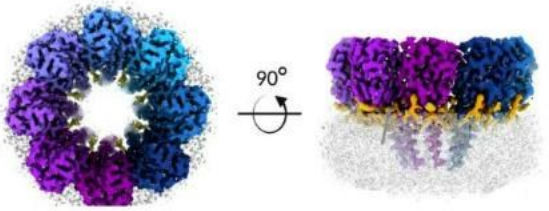
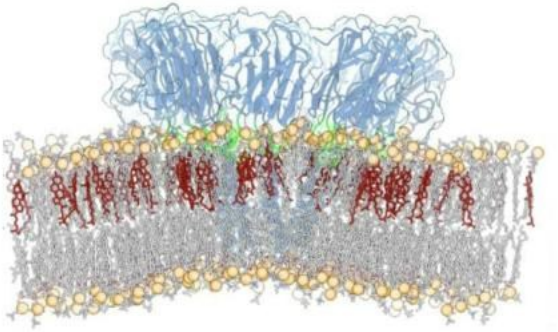
Project idea

Biophysical Investigations of Membrane-Peptide Interactions

This project aims to investigate how small peptides, including antimicrobial and pore-forming types, interact with model membranes. The goal is to understand how lipid composition, domain organization, and membrane asymmetry affect peptide binding, insertion, and membrane permeabilization.



We plan to study Large and Giant Unilamellar Vesicles (LUVs and GUVs) with defined lipid domains, and Langmuir–Blodgett films mimicking planar bilayers. Peptide-induced changes will be monitored using phase-contrast and fluorescence microscopy, Atomic Force Microscopy, synchrotron Small-Angle X-ray and Neutron Scattering, and neutron reflectometry.



Key experimental parameters -peptide concentration, lipid composition, and membrane asymmetry - will be systematically varied. Advanced structural and kinetic models will be applied to quantify pore formation, size, and temporal evolution.

The project will provide a multiscale understanding of peptide–membrane interactions, laying the groundwork for future antimicrobial or therapeutic strategies.

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