UNIVERSITÀ
POLITECNICA
DELLE MARCHE

Supervisor: Prof. Luca Maragliano

Dept. of Life and Environmental Sciences

Project idea: Molecular Simulations of Ion Channel Function and Dysfunction

UNIVERSITÀ POLITECNICA DELLE MARCHE

Supervisor: Luca Maragliano

Activities

Associate Professor of Physiology at the Department of Life and Environmental Sciences (DISVA), UNIVPM. Head of the Biomolecular Simulations Laboratory. **Affiliated Researcher of the Italian Institute of Technology**. Expert in molecular dynamics simulations of biomolecules, focusing on membrane proteins such as ion channels and transporters, or newly engineered membrane-targeting probes for neurological applications.

Recently Funded Projects:

2021-2023: PRIN2020, Unit Coordinator (DISVA-UNIVPM), Project title: “Membrane targeted light driven nanoactuators for neuro-stimulation”

Principal National and International Collaborators:

Prof. Fabio Benfenati, NSYN center IIT
Prof. Guglielmo Lanzani, CNST Center IIT
Prof. Maurizio Taglialatela, Università di Napoli Federico II
Prof. Alberto Giacomello, Università di Roma La Sapienza
Prof. David Fedida, University of British Columbia
Dr. Jorg Piontek, Charité – Universitätsmedizin Berlin

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

HR EXCELLENCE IN RESEARCH

UNIVERSITÀ POLITECNICA DELLE MARCHE

Supervisor: Luca Maragliano

Description

Past Relevant Roles:

2020-2023 Assistant Professor at UNIVPM
2011-2020 Researcher at the Istituto Italiano di Tecnologia, Genova, Italia
2008-2011 PostDoc at the University of Chicago, USA
2005-2008 PostDoc at the New York University USA

Supervision and mentoring over the years:

Total of 5 Postdocs, 6 PhD students, 4 Master students

Author of 68 publications, h-index: 24 (Scopus), 26 (Scholar)

Recent key publications:

- A physiologically-relevant intermediate state structure of a voltage-gated potassium channel. Kyriakis et al., Nat Commun 2025 16(1):8814.
- A claudin5-binding peptide enhances the permeability of the blood-brain barrier in vitro. Trevisani et al., Sci Adv. 2025 11(2):eadq2616
- Membrane-targeted push-pull azobenzenes for the optical modulation of membrane potential. Sesti et al., Light Sci Appl. 2025 14(1):8.
- Constitutive opening of the Kv7.2 pore activation gate causes KCNQ2-developmental encephalopathy. Nappi et al., Proc Natl Acad Sci U S A. 2024 121: e2412388121
- Nanoactuator for Neuronal Optoporation. Pfeffer et al., ACS Nano. 2024 18:12427-12452
- Charting Nanocluster Structures via Convolutional Neural Networks. Telari et al., ACS Nano 2023 17:21287-21296

HR EXCELLENCE IN RESEARCH

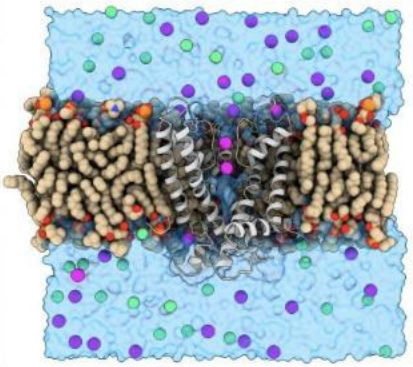
UNIVERSITÀ POLITECNICA DELLE MARCHE

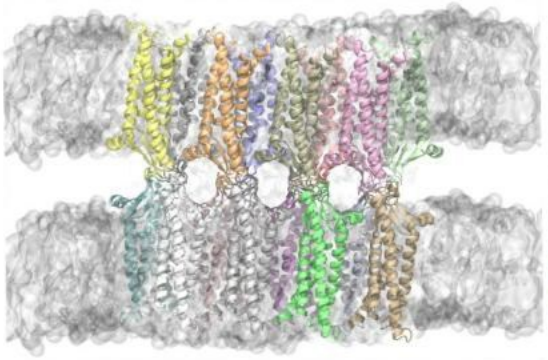
Supervisor: Luca Maragliano

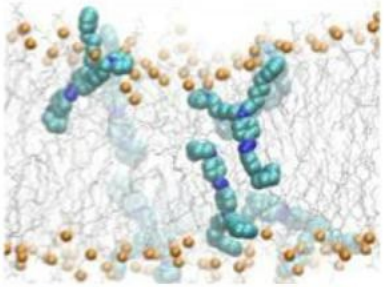
Staff, equipment and laboratories

THE RESEARCH GROUP: Biomolecular Simulations Laboratory

Our group currently includes one PhD student, one post-doc and one master student. We use molecular dynamics simulations to investigate the biophysical properties of membrane proteins such as ion channels and transporters, or newly engineered membrane-penetrating probes for neurological applications. The general purpose of our activity is to elucidate the structural determinants underlying the molecular mechanisms of neuronal function, enabling both mechanistic interpretation of variant-induced dysfunction and the design of novel molecular devices to modulate them.
We collaborate with experimental groups to provide complementary, mechanistic insights that are difficult to access directly from experiments, such as protein conformational transitions, intermediate structures, or networks of interactions.







Recent work from our group addressed the biophysical properties of potassium channels (Nappi et al., PNAS 2024, Kyriakis et al., Nat Commun 2025) and other synaptic proteins (Sterlini et al., Neurobiol Dis 2023; Franchi et al., J Biol Chem. 2023); the structural and functional properties of tight junction proteins of the blood-brain-barrier and other tissues (Trevisani et al., Sci Adv 2025; Berselli et al., CSBJ 2023); ions or metabolite permeation in biological channels (Alberini et al., JCTC 2023; Paz et al., JCTC 2018; Jiang et al., Biophys J 2023) and receptors (Cottone et al., JCIM 2020); interaction of light-activated synthetic molecules with model membranes (Sesti et al., LSA 2025; Pfeffer et al., ACS Nano 2024; DiFrancesco et al., Nat Nanotechnol 2020).

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

HR EXCELLENCE IN RESEARCH

UNIVERSITÀ POLITECNICA DELLE MARCHE

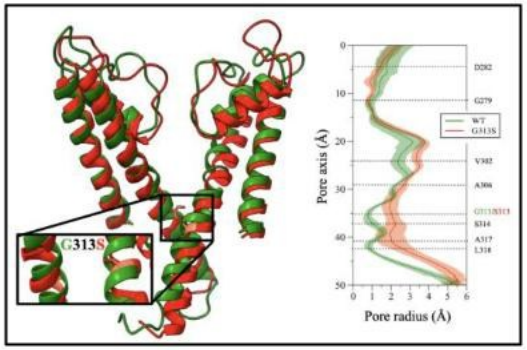
Supervisor: Luca Maragliano

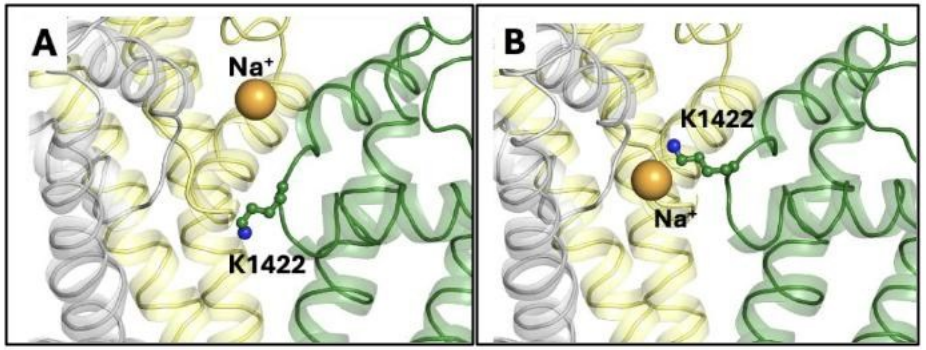
Project idea

Title: Molecular Simulations of Ion Channel Function and Dysfunction

Background: Molecular dynamics (MD) simulations have become a powerful tool to investigate the functional properties of ion channels, providing structural insights that complement and help interpret functional experiments, including electrophysiological recordings. Over the years, atom-based simulations helped understanding basic mechanisms such as ion permeation and selectivity, gating and voltage sensing. Disease-associated mutations can disrupt channel function and, depending on their location within the protein sequence, selectively alter specific biophysical properties, from gating and ion conduction to inactivation. In close collaboration with experimental partners, we are currently studying voltage-gated sodium and potassium channels as well as temperature- and mechanosensitive (stretch-activated) potassium channels.

Project objective: We will use molecular modeling and MD simulations to understand how selected mutations reshape ion channel structure, dynamics, and key functional features. By comparing wild-type and mutant channels, we will identify mutation-induced changes in conformational equilibria, gating motions, and local interactions that influence activation and conduction. These atomistic insights will be integrated with available functional data to elucidate the microscopic determinants of channel function and dysfunction, generate structure-based hypotheses to guide targeted experiments, and eventually support the rational design of drugs to counteract the pathogenic effects





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

HR EXCELLENCE IN RESEARCH