Cicerone Program

Laboratory internships at the CNIC for university students during the summer months

List of Scientists and Research Lines 2025

1. **Research line: Effect of posttranslational modifications on mechanical protein unfolding as a main contributor to the elasticity of the myocardium.**

Research Group: Molecular Mechanics of the Cardiovascular System

Supervisor: **Jorge Alegre-Cebollada**

Summary: The new concept that mechanical protein unfolding is behind the elasticity of tissues has been proposed based on indirect observations. Here, we plan to observe, for the first time, protein unfolding as a main contributor to the elasticity of muscle tissue and determine the effect of posttranslational modifications of constituent proteins on the mechanical response of cardiomyocytes and skeletal muscle. This is an interdisciplinary project involving instrument development, protein biochemistry, polymer physics and single-molecule methods.

More information at:

https://www.cnic.es/en/investigacion/molecular-mechanics-cardiovascular-system

2. **Research line: Molecular events leading to the development of familial cardiomyopathies.**

Research Group: Molecular Mechanics of the Cardiovascular System

Supervisor: **Jorge Alegre-Cebollada**

Summary: The human heart is a formidable mechanical machine that pumps thousands of liters of blood every day. We are far from understanding how the heart works at the molecular level, and much less so how diseases of the heart develop. Following an interdisciplinary approach that includes protein biochemistry, biophysics, animal models and human clinical research, we plan to uncover how point mutations in cardiac proteins lead to life-threatening cardiomyopathy.

More information at:

https://www.cnic.es/en/investigacion/molecular-mechanicscardiovascular-system

3. **Research line: Mechanical modulation of titin in living cardiomyocytes.**

Research Group: Molecular Mechanics of the Cardiovascular System

Supervisor: **Jorge Alegre-Cebollada**

Summary: The giant protein titin is key to the force-generating and mechanosensing properties of cardiomyocytes. However, the study of its mechanical contribution without interfering with other

properties of the protein is challenging. We have developed a first-of-its-kind tool to specifically and acutely induce mechanical loss of function (mLOF) of titin in living cardiomyocytes. The project, funded by a recently awarded ERC Consolidator grant, involves cardiomyocyte isolation, virus-mediated protein expression, imaging, and molecular and cell biology techniques.
More information at:
https://www.cnic.es/en/investigacion/molecular-mechanicscardiovascular-system

4. **Research line: Role of A-type lamins and progerin in aging and cardiovascular disease.**

Research Group: Molecular and Genetic Cardiovascular Pathophysiology
Supervisor: **Vicente Andrés**
Summary: Cardiovascular disease (CVD) is the main cause of morbimortality, in part due to the progressive aging of our societies. CVD and aging are much accelerated in Hutchinson-Gilford progeria syndrome (HGPS), a rare genetic disorder caused by the expression of progerin, a mutant form of lamin A which is also expressed at low level in tissues of non-HGPS individuals. The CICERONE student will learn about mechanisms through which A-type lamins and progerin regulate CVD and aging.
More information at:
https://www.cnic.es/en/investigacion/molecular-and-genetic-cardiovascular-pathophysiology

5. **Research line: Single cell functional genomics and imaging analysis during cardiovascular development and disease.**

Researh Group: Molecular Genetics of Angiogenesis
Supervisor: **Rui Benedito**
Summary: The group investigates different aspects of vascular biology using advanced mouse models, single cell omics/bioinformatics and imaging technologies. The Cicerone student will be involved in a project using novel transgenic mice to understand the function of specific genes during the development and disease of the cardiovascular system. The work will involve advanced mouse genetics, state-of-the-art imaging techniques, molecular/cell biology and bioinformatics (single cell RNAseq data analysis).
More information at: http://www.cnic.es/en/desarrollo/angiogenesis/index.php

6. **Research line: Validation of new mouse models for functional genetics and high-resolution cellular barcoding.**

Researh Group: Molecular Genetics of Angiogenesis
Supervisor: **Rui Benedito**
Summary: The group investigates different aspects of cardiovascular biology using advanced mouse models, single cell omics/bioinformatics and imaging technologies. The Cicerone student will be involved in a project using novel transgenic mice allowing the multispectral and RNA barcoding of

single cell lineages in different tissues. Advanced whole organs 3D Light-Sheet and 2-photon multispectral imaging will be used to detect the cellular barcodes in large organ volumes. Advanced image analysis software will be used to quantify precisely the clonal expansion and mobilization of individual cells in the entire organ.
More information at: http://www.cnic.es/en/desarrollo/angiogenesis/index.php

7. **Research line: Functional Insights into Ventricular Chamber Development, Congenital heart disease, and Cardiomyopathy.**

Research Group: Intercellular Signaling in Cardiovascular Development & Disease
Supervisors: **José Luis de la Pompa, Marcos Siguero-Álvarez**
Summary: Alteration of the signals and effectors regulating cardiomyocyte cytoskeleton dynamics and proliferation disrupts ventricular chamber maturation and may cause cardiomyopathy. Some of these molecular signals can be reactivated to drive myocardial regeneration. The highly motivated Cicerone student will work with newly generated genetically modified mouse models and carry out cell lineage, confocal microscopy, ISH and gene profiling studies.
More information at : https://www.cnic.es/en/investigacion/intercellular-signaling-cardiovascular-development-and-disease

8. **Research line: Mechanisms integrating blood flow sensing, arterial wall remodeling and inflammation during atherogenesis.**

Research Group: Mechanoadaptation and Caveolae Biology
Supervisors: **Miguel Ángel del Pozo, Michela Terri**
Summary: While most cardiovascular risk factors act systemically, atherosclerotic lesions develop at arterial regions subjected to disturbed flow (typically, inner curvatures and bifurcations), which promote atherogenic wall remodeling, eliciting LDL retention and immune cells-infiltration, driving disease progression. Conversely, regions subjected to laminar blood flow are protected from atherosclerosis. The CICERONE student will study in vitro and in vivo molecular mechanisms regulating blood flow sensing and transduction, LDL transcytosis & retention, endothelial to mesenchymal transition (endoMT) and arterial matrix remodeling under atherogenic conditions. This project falls within the context of the AtheroConvergence international consortium.
More information at: https://www.cnic.es/en/investigacion/mechanoadaptation-and-caveolae-biology

9. **Research line: Impact of matrix remodeling in immunotherapy.**

Research Group: Mechanoadaptation and Caveolae Biology
Supervisors: **Miguel Ángel del Pozo, Alba Martin Martin**
Summary: The effectiveness of immunotherapy is profoundly affected by different tumor features, such as the architecture of the tumor microenvironment (TM). Within the TM, cancer-associated fibroblasts (CAFs) subpopulations modulate antitumor immunity both directly through paracrine secretion, and through extracellular matrix (ECM) remodeling, which can physically hamper immune

infiltration. Our group has described caveolin-1 (CAV1) as a pivotal regulator of CAF phenotype, ECM remodeling, and TM sculpting. The CICERONE student will study how CAV1-dependent ECM remodeling influence tumor immunity in vivo and in vitro, combining cell culture and imaging techniques.
More information at: https://www.cnic.es/en/investigacion/mechanoadaptation-and-caveolae-biology

10. **Research line: Evaluating the spectrum of cardiometabolic diseases through advanced imaging techniques.**

Research Group: Cardiometabolic Diseases and Advanced Imaging
Supervisor: **Ana Devesa**
Summary: Our group focuses on the study of the impact of cardiometabolic diseases such as metabolic syndrome, insulin resistance and diabetes on different organs. The CICERONE student in our group will learn the uses of state-of-the-art imaging techniques such as positron emission tomography (PET), computed tomography (CT), magnetic resonance (MR) and magnetic resonance spectroscopy (MRS). They will learn the applicability of these techniques to evaluate the changes that occur in the cardiovascular system and other organs in individuals that are exposed to cardiometabolic risk factors. The student will have the opportunity to collaborate with our research team on ongoing research tasks and make his/her own proposals.
More information at: https://www.cnic.es/en/investigacion/cardiometabolic-disease-and-advanced-imaging

11. **Research line: Mitochondrial performance in heart disease.**

Research Group: Functional Genetics of the Oxidative Phosphorilation System (GENOPHOS)
Supervisor: **José Antonio Enríquez**
Summary: Our laboratory researches the mammalian mitochondrial physiopathology.
We view this system as a functional entity, and use a range of approaches aimed at determining its role in health and disease. We are particularly interested in the role of the OXPHOS system in the development of the cardiovascular system, its relevance to ischemia-reperfusion, and its influence on microvascular blood flow. We also investigate the relevance of mitochondria on inflammation, obesity and vascular physiopathology.
More information at: https://www.cnic.es/en/investigacion/functional-genetics-oxidative-phosphorilation-system-genophos

12. **Research line: Modelling data in cardiovascular health promotion.**

Research Group: Cardiovascular Health and Imaging Laboratory
Supervisors: **Rodrigo Fernández Jiménez, Jesús Martínez Gómez**
Summary: Our group focuses on health promotion and cardiovascular disease prevention. The CICERONE student granted in our research group will work on data analysis and visualization, and different statistical modelling strategies applied to epidemiological data, lifestyle habits, and cardiovascular prevention programs conducted in Spain. The student will have the opportunity to

collaborate with the research team on ongoing research tasks and to formulate their own research ideas.
More information at: https://www.cnic.es/en/investigacion/cardiovascular-health-and-imaging

13. **Research line: Functional and Structural Characterization of Individual-Specific Atrial Fibrillation Progression.**

Research Group: Advanced Development in Arrhythmia Mechanisms and Therapy Laboratory.
Supervisor: **David Filgueiras Rama**
Summary: The main objective of the project is to characterize the proteomic, structural and functional changes that enable atrial fibrillation (AF) to persist at different remodeling stages. The objective involves the identification and analysis of functional and structural parameters, bringing together experimental and clinical tools for interpretation and decision-making. The multidisciplinary and translational design of the project includes the study of an in vivo model of AF that resembles clinical progression of the arrhythmia.
More information at:
https://www.cnic.es/es/investigacion/desarrollo-avanzado-sobre-mecanismos-terapias-arritmias

14. **Research line: Studying the procoagulant state of Alzheimer´s disease.**

Research Group: Cardiovascular Imaging and Population Studies
Supervisors: **Valentin Fuster, Marta Cortes Canteli**
Summary: The vascular pathology associated with Alzheimer's disease (AD) contributes to neurodegeneration and cognitive decline. A significant aspect of this vascular component is a procoagulant state, characterized by fibrin accumulation in the brain vessels and parenchyma. Our study aims to detect this state by evaluating cerebral fibrin presence in AD mice, using molecular biology techniques and imaging studies. The CICERONE student will contribute to this objective, focusing on molecular biology and exploring insights into molecular imaging.
More information at: https://www.cnic.es/en/investigacion/cardiovascular-imaging-and-population-studies

15. **Research Line: Acquired mutations in immune cells as a driver of cardiovascular disease.**

Research Group: Hematovascular Pathophysiology Laboratory
Supervisor: **José J. Fuster**
Summary: Advanced age is the greatest risk factor for cardiovascular disease (CVD), but we have an incomplete understanding of how aging promotes CVD. In this context, we are investigating how age-related acquired mutations in blood and immune cells contribute to the development of cardiovascular disorders, such as atherosclerosis and heart failure. By participating in this project, the student will gain expertise in many research techniques (e.g. flow cytometry, immune cell culture) and in the use of mouse models in cardiovascular research.

More information at: https://www.cnic.es/en/investigacion/hematovascular-pathophysiology

16. **Research Line: Pulmonary hypertension and right ventricular dysfunction.**

Research Group: Translational Research in Heart Failure and Pulmonary Hypertension

Supervisor: **Ana García Álvarez**

Summary: The CICERONE student will work on data obtained from translational models of pulmonary hypertension in pigs (right heart catheterization, cardiac magnetic resonance, computed tomography, and positron emission tomography). She/he will be expose to histology and molecular biology techniques and interact with experts in metabolomics, proteomics and genetics.

More information at: https://www.cnic.es/en/investigacion/heart-failure-and-pulmonary-hypertension-translational-research

17. **Research Line: Imaging the early stages of human atherosclerosis.**

Research Group: Cardiovascular Prevention through Non-Invasive Imaging

Supervisors: **Inés García Lunar, Carlos Nicolás Pérez García**

Summary: Being the principal cause of death worldwide, the study of cardiovascular diseases (CVD) is of high priority. Atherosclerosis is the underlying cause responsible for most of the clinical CVD events. Our group uses state-of-the-art conventional and advanced diagnostic modalities (including ultrasound, cardiac magnetic resonance, and computed tomography) to study cardiovascular health and transition to subclinical macro- and microvascular damage (closely collaborating in major CNIC projects such as the Progression of Early Subclinical Atherosclerosis [PESA] cardiovascular cohort).

More information at: https://www.cnic.es/en/investigacion/cardiovascular-prevention-through-non-invasive-imaging

18. **Research line: Uncovering New Genetic Mechanisms in Dilated Cardiomyopathy.**

Research Group: Inherited Cardiomyopathies

Supervisors: **Pablo García Pavía, Juan Pablo Ochoa, Manuel A. Fernández-Rojo**

Summary: Dilated cardiomyopathy (DCM) is a complex condition with high morbidity and mortality; more than 60% of the cases are genetically elusive. This project aims to uncover novel disease mechanisms by exploring new genes and non-Mendelian inheritance patterns using large-scale genetic and clinical data from the largest Spanish DCM cohort. We seek a motivated candidate with a background in biology eager to learn bioinformatics and disease mechanisms. The student will gain expertise in genetic data analysis, phenotypic integration, and translational research in a dynamic and international academic environment

More information at: https://www.cnic.es/en/investigacion/inherited-cardiomyopathies-0

19. **Research line: Novel mitochondria-targeted therapies for cancer therapy-induced cardiotoxicity (MATRIX) Research Group: Translational Laboratory for Cardiovascular Imaging and Therapy.**

Research Group: Translational Laboratory for Cardiovascular Imaging and Therapy

Supervisor: **Borja Ibáñez**

Summary: Cancer therapy-induced cardiac toxicity is affecting up to 30% of cancer treated patients thus resulting in severe heart failure and premature death. We have recently demonstrated that imbalanced mitochondrial dynamics in cardiomyocytes results in a phenotype recapitulating cardiac toxicity induced by cancer treatment, including metabolic reprogramming and ultimately heart 7 | 11 failure. Building on these data, we will study the mechanisms leading to mitochondrial failure in cardiac toxicity and use the knowledge obtained to develop novel therapies.

More information at: https://www.cnic.es/en/investigacion/translational-laboratory-cardiovascular-imaging-and-therapy

20. **Research Line: Post-transcriptional regulation mechanisms in heart failure.**

Research Group: Molecular regulation of heart failure

Supervisor: **Enrique Lara-Pezzi**

Summary: Heart failure (HF) is the ultimate consequence of defects in the contraction or relaxation capacity of the heart. Although the changes in gene expression that accompany the development of HF are reasonably well known, the role of post-transcriptional regulation is very poorly understood. In this project, we will investigate the role of the RNA-binding protein SRSF6 in the development of heart failure using mouse models and adeno-associated viral vectors.

More information at: https://www.cnic.es/en/investigacion/molecular-regulation-heart-failure

21. **Research line: Disentangling heart failure to improve diagnosis, prevention and treatment.**

Research Group: Molecular regulation of heart failure

Supervisor: **Enrique Lara-Pezzi**

Summary: Heart failure with preserved ejection fraction (HFpEF) is a major public health problem affecting 13 M patients worldwide, especially among the elderly. Patients often present several simultaneous comorbidities and it is virtually impossible to identify the specific contribution of each of them. The available diagnostic tools are inaccurate at best and treatment is still largely based on “one-size-fits-all”, which is ineffective once HF manifests with clinical symptoms. The aim of the project is to disentangle the HFpEF mesh, to deepen our understanding of the molecular mechanisms underlying HFpEF progression associated with each comorbidity, and to develop precise diagnostic and therapeutic tools that will prevent or reverse HFpEF symptoms.

More information at: https://www.cnic.es/en/investigacion/molecular-regulation-heart-failure

22. Research line: Early diagnosis of Immune Checkpoint Inhibitor myocarditis.

Research Group: Regulatory Molecules of Inflammatory Processes

Supervisor: **Pilar Martín**

Summary: Cytotoxic chemotherapy and novel cancer therapies have various cardiotoxicities, ranging from heart failure to arrhythmias. Immune checkpoint inhibitors (ICIs) are monoclonal antibodies that target the host immune negative regulation receptors, such as CTLA-4 (cytotoxic T-lymphocyte–associated protein 4) and programmed cell death receptor 1 (PD-1). The most common fatal immune-related adverse event (IRAE) is ICI-related myocarditis, which is associated with a high reported mortality (50%). There is a need for increased awareness to suspect, diagnose, and treat ICI-related myocarditis. Our group studies the potential of miR-721 in the treatment and early diagnosis of ICI-myocarditis both in animal models and in patient samples from the Spanish Registry of Immunotherapy-Cardiotoxicity (SIR-CVT).

More information at: http://www.cnic.es/es/inflamacion/moleculas/index.php

23. Research line: Insights into Post-Stroke Dementia and Alzheimer's Disease: Exploring the Role of Serpins.

Research Group: Neurovascular Pathophysiology

Supervisors: **Mª Ángeles Moro, Carmen Nieto, María Isabel Cuartero**

Summary: Serpins constitute a family of proteins associated with various forms of dementia, including Alzheimer's disease and vascular dementia. Despite their relevance, their specific roles and regulatory mechanisms remain poorly understood. Recent findings from our group suggest that the aryl hydrocarbon receptor (AhR), a ligand-activated transcription factor influenced by gut microbiota, may drive the serpins signature in reactive astrocytes. This project offers the student the opportunity to investigate the role of AhR in the regulation of serpins within the context of Alzheimer's disease and post-stroke dementia. Through this research, the student will gain hands-on experience with a range of advanced techniques and animal models relevant to dementia research.

More information at: https://www.cnic.es/en/investigacion/neurovascular-pathophysiology

24. Research Line: Role of the Aryl Hydrocarbon Receptor (AhR) in Alzheimer's disease and vascular dementia.

Research Group: Neurovascular Pathophysiology

Supervisors: **Mª Ángeles Moro, Carmen Nieto, María Isabel Cuartero**

Summary: Aging decreases cerebral perfusion and raises vulnerability to cerebral vascular failure. The AhR is known for its role in xenobiotic metabolism as well as being a regulator of inflammation. Recent findings support a link between AhR and aging. The student will participate in a project examining AhR's potential involvement in Alzheimer's disease. The student will thus be exposed to a variety of techniques as well as to the use of animal models related to dementia.

More information at: https://www.cnic.es/en/investigacion/neurovascular-pathophysiology

25. Research line: Human antibody-enabled cardiovascular personalized theragnosis.

Research Group: Nanomedicine and Molecular Imaging

Supervisor: **Carlos Pérez Medina**

Summary: The ultimate goal of our research is to develop fully human antibodies (HuAbs) into diagnostic tools and personalized therapeutic agents to treat atherosclerosis. Specifically, we are isolating promising candidates from a macrolibrary of HuAbs selected in vivo from atherosclerotic samples. These candidates are subsequently characterized and produced in different formats suitable for therapeutic purposes or imaging with positron emission tomography (PET). In vivo testing of HuAb-based therapies and PET radiotracers is carried out in animal models of atherosclerosis.More information at: https://www.cnic.es/en/investigacion/nanomedicine-and-molecular-imaging

26. Research line: Atherosclerosis antibody response at single cell resolution.

Research Group: B Lymphocyte Lab

SupervisorS: **Almudena R Ramiro, Ana Rodriguez Ronchel**

Summary: In our lab we are interested in B cell biology, the generation of antibodies and their functional relevance during the immune response as well as in pathological contexts, most specifically during atherosclerosis. Now, we will take advantage of state-of-the-art single cell technologies implemented in the lab to build a precise atlas of the atherosclerosis-associated antibody immune response.

More information at: https://www.cnic.es/es/investigacion/biologia-linfocitos-b

27. Research line: Generation of bispecific antibodies for immunotherapy

Research Group: Immunobiology

Supervisors: **David Sancho, Ignacio Heras**

Summary: We are generating and characterizing a new generation of bispecific antibodies designed to boost immunotherapy. The initial characterization in vitro and in vivo in models of immunization will determine whether we obtain an immunogenic or tolerogenic effect that will guide our in vivo efforts to cancer or cardiovascular immunotherapy respectively. The student will learn many techniques working in vitro (cell culture, molecular biology, biochemistry and Immunology techniques) and will analyze models of disease in vivo.

More information at: https://www.cnic.es/en/investigacion/immunobiology

28. Research line: MicroRNAs in the control of innate immunity.

Research Group: Immunobiology

Supervisors: **David Sancho, Federico Virga**

Summary: High-throughput sequencing, perfomed in the lab, revealed specific miR expression patterns in the different subsets of dendritic cells (DCs). The project aims to reveal the functional role and test the therapeutic potential of selected miRs by performing both in vitro and in vivo experiments. The student will familiarize with cell culture, molecular techniques (such as RNA isolation, cDNA, qRT-PCR), immunology and flow cytometry assays along with in vivo disease models (such as cancer).
More information at: https://www.cnic.es/en/investigacion/immunobiology

29. **Research line: Cardiac regeneration**

Research Group: Genetic Control of Organ Development and Regeneration
Supervisors: **Miguel Torres, Cristina Villa del Campo**
Summary: How can we promote heart regeneration after a myocardial infaction? Myocardial infarction kills a massive amount of cardiomyocytes which are not naturally replaced, which leads to heart failure. We will investigate the molecular/cellular pathways that regulate the reactivation of cardiomyocyte proliferation in the adult mouse heart and their manipulation for the promotion of heart regeneration.
More information at: https://www.cnic.es/en/investigacion/genetic-control-organ-development-and-regeneration

30. **Research line: Characterization of coronary vasculature development.**

Research Group: Genetic Control of Organ Development and Regeneration
Supervisors: **Miguel Torres**
Summary: How is the mammalian heart formed? The heart is the first organ to start functioning in the mammalian embryo and its function is essential for embryo viability. Understanding how the heart can grow and acquire its final adult form, while at the same time pumping blood is one of the most intriguing problems in Developmental Biology. We will use live imaging of mouse embryos and computer modelling to understand how the embryonic heart forms.
More information at: https://www.cnic.es/en/investigacion/genetic-control-organ-development-and-regeneration

31. **Research line: Application of Advanced computational methods for the analysis of post-translational modifications to Cardiovascular Biology.**

Research Group: Cardiovascular Proteomics
Supervisors: **Jesús Vázquez, Ana Martínez del Val**
Summary: We are developing “open search” algorithms that allow true hypothesis-free identification and quantification of any post-translational modification from high-throughput mass spectrometrybased proteomics. In this project, we aim to further extend the development of semisupervised approaches to the interpretation of the data and to integrate the quantitative information in large-scale experiments. We will also apply these developments to study molecular

mechanisms underlying cardiovascular diseases, including subclinical atherosclerosis and other diseases related to vascular-remodelling.
More information at: https://www.cnic.es/en/investigacion/cardiovascular-proteomics

32. **Research line: Spatio-temporal dynamics of post-translational regulation by mass spectrometry-based proteomics.**

Research Group: Cardiovascular Proteomics
Supervisors: **Jesús Vázquez, Ana Martínez del Val**
Summary: Cell function relies on a highly coordinated network of proteins that sense environmental cues and respond to them. Studying such responses is crucial to understand how cells adapt to chronic stress, such as during the establishment and progression of atherosclerosis. Mass spectrometry-based proteomics combined with subcellular fractionation offers an unique technological platform to study stress sensing and downstream signaling at unique resolution. Our research focuses on the implementation of this platform to understand how chronic stresses in cardiovascular diseases affect cells at post-translational modification level. For that purpose we combine technological optimization, molecular biology and bioinformatics analysis.
More information at: https://www.cnic.es/en/investigacion/cardiovascular-proteomics

33. **Research line: Evaluating regenerative strategies in pluripotent stem cell-derived engineered heart tissue.**

Research Group: Cardiac tissue engineering and regenerative therapies
Supervisors: **Florian Weinberger**, **Romina di Mattia**
Summary: Cardiomyocytes exit the cell cycle postnatally and the adult heart lacks a regenerative capacity. In this project we will use a three-dimensional tissue model (engineered heart tissue) to study pro-proliferative interventions. Specifically, the project will investigate the interplay between sarcomere structure, metabolism and cell cycle activity. The candidate will work with induced pluripotent stem cells, stem cell derived cardiomyocytes and apply advanced imaging techniques to study sarcomere structure and cell cycle activity.
More information at: https://www.cnic.es/en/investigacion/cardiac-tissue-engineering-and-regenerative-therapies-0