

CNIC Cicerone Program

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

List of Scientists and Research Lines 2024

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: 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.cn̄ic.es/en/investigacion/molecular-and-genetic-cardiovascular-pathophysiology>

4. Research line: In vivo analysis of vascular development in mice

Research Group: Molecular Genetics of Angiogenesis

Supervisor: **Rui Benedito**

Summary: The group investigates different aspects of vascular biology using advanced mouse models and imaging technologies. We generated several new mouse lines that will allow us to induce precise genetic modifications during angiogenesis. The Cicerone student will be involved in a project using transgenic mice to understand the function of specific genes during the development of the cardiovascular system. The work will involve mouse genetics, state-of-the-art imaging techniques, as well as advanced molecular and cell biology techniques.

More information at: <http://www.cn̄ic.es/en/desarrollo/angiogenesis/index.php>

5. Research line: New methods for cellular barcoding and decoding of single cell lineages

Research Group: Molecular Genetics of Angiogenesis

Supervisor: **Rui Benedito**

Summary: The group is developing advanced methods for the multispectral and RNA barcoding of single cells and their lineages during tissue development and in disease models. The Cicerone student will be involved in a project using advanced molecular biology and bioinformatics approaches to detect and integrate the cell barcodes information retrieved from scRNAseq and spatial Seq data. This information will allow us to understand, at high molecular and clonal resolution, the specific genetic programs that control cardiovascular cell proliferation, differentiation and migration in physiology and disease.

More information at: <http://www.cn̄ic.es/en/desarrollo/angiogenesis/index.php>

6. Research line: Cellular dynamics in ventricular wall development, cardiomyopathy & regeneration

Research Group: Intercellular Signalling 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>

7. Research line: Nuclear mechanotransduction and its impact in cardiovascular disease

Research Group: Mechanoadaptation and Caveolae Biology

Supervisors: **Miguel Ángel del Pozo, Laura Sotodosos-Alonso**

Summary: Caveolae are important mechanosensing and mechanotransducer structures playing a key role in membrane tension homeostasis, contributing to various mechanotransduction pathways. Our laboratory has identified a close proximity between caveolae and the nuclear envelope in several cell and mouse models, suggesting a potential novel function in nuclear mechanotransduction with significant clinical implications, such as progeria and atherosclerosis. The CICERONE student will pursue a project aimed at exploring how mechanical signals are detected and transmitted throughout the cell by caveolae, focusing on how these signals reach the nucleus and the impact of caveolae on this organelle. S/he will combine proximity labelling, molecular biology and imaging approaches.

More information at: <https://www.cnic.es/en/investigacion/mechanoadaptation-and-caveolae-biology>

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: 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 OXPPOS 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>

10. Research line: Modelling cardiovascular health promotion

Research Group: Cardiovascular Health and Imaging Laboratory

Supervisors: **Rodrigo Fernández Jiménez, Jesús Martínez Gómez, Juan Miguel Fernández Alvira**

Summary: Our group focuses on health promotion and cardiovascular disease prevention. The CICERONE student granted in our group will work on different data visualization and statistical modelling strategies applied to lifestyle habits, health promotion, and prevention programs conducted in Spain. The student will have the opportunity to collaborate with the research team on ongoing research tasks and to formulate his/her own research ideas.

More information at: <https://www.cnic.es/en/investigacion/cardiovascular-health-and-imaging>

11. Research line: Structural Characterization and Wave Propagation Dynamics during Atrial Fibrillation

Research Group: Advanced Development in Arrhythmia Mechanisms and Therapy Laboratory.

Supervisor: **David Filgueiras Rama**

Summary: The main objective of the project is to characterize wave propagation dynamics generated by reentrant patterns of activation (rotors), and the 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>

12. Research line: Developing fluid-based biomarkers of the procoagulant state of Alzheimer's disease

Research Group: Cardiovascular Imaging and Population Studies

Supervisors: **Valentin Fuster, Marta Cortes Canteli**

Summary: The vascular pathology present in Alzheimer's disease (AD) contributes to the neurodegeneration and cognitive decline found in this disorder. Part of this vascular component is a procoagulant state, but such state is not present in all patients, stressing the importance of an accurate diagnosis for a proper treatment. Our aim is to develop non-invasive fluid-based

biomarkers to unequivocally identify the subpopulation of AD patients with a prothrombotic state. The CICERONE student will participate in that specific project in which we use post-mortem brain tissue samples and plasma samples from the same AD patients in combination with different molecular biology techniques.

More information at: <https://www.cn̄ic.es/en/investigacion/cardiovascular-imaging-and-population-studies>

13. Research line: Neuroimaging tools to decipher the connection between cardiovascular disease and brain health at the preclinical level

Research Group: Cardiovascular Imaging and Population Studies

Supervisors: **Valentin Fuster, Marta Cortes Canteli, Juan Domingo Gispert**

Summary: Increasing evidence links Alzheimer's disease with atherosclerosis during symptomatic stages. Both disorders share risk factors and start to develop many years before symptoms appear pointing to a common trajectory during their long asymptomatic phases. To deepen in our understanding of the pathophysiological mechanisms linking both disorders, we are acquiring amyloid-positron emission tomography and performing a comprehensive brain magnetic resonance imaging protocol to study brain morphology, connectivity and perfusion, vascular lesions and intracranial atherosclerosis in the PESA-brain cohort. The CICERONE student will participate in developing neuroimaging pipelines with the final goal of correlating brain changes with subclinical atherosclerosis measurements.

More information at: <https://www.cn̄ic.es/en/investigacion/cardiovascular-imaging-and-population-studies>

14. 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.cn̄ic.es/en/investigacion/hematovascular-pathophysiology>

15. Research Line: New modulators of the effects of acquired mutations on inflammation

Research Group: Hematovascular Pathophysiology Laboratory

Supervisor: **José J. Fuster**

Summary: Some age-related acquired-mutations confer a competitive advantage to blood stem cells, leading to their clonal expansion. This process, called clonal hematopoiesis, leads to exacerbated inflammatory responses and contributes to several age-related conditions, such as cardiovascular disease and cancer. Virtually everyone acquires clonal hematopoiesis-inducing mutations, but the clonal expansion of the mutant cells occurs only in some individuals, for mechanisms that remain unknown. The student will contribute to the investigation of the factors that regulate the expansion of immune cells carrying specific mutations, by using innovative mouse models and several biomedical research techniques (e.g. flow cytometry, immune cell culture).

More information at: <https://www.cn̄ic.es/en/investigacion/hematovascular-pathophysiology>

16. Research Line: New inflammatory drivers of human atherosclerosis

Research Group: Hematovascular Pathophysiology Laboratory

Supervisor: **José J. Fuster**

Summary: Atherosclerosis, the primary cause of the most frequent cardiovascular disorders, results from a maladaptive inflammatory response. However, the specific inflammatory pathways that drive atherosclerosis in humans remain largely unknown. The student will join a collaboration with other researchers at CNIC that is leveraging unique omics datasets to identify the specific immunomodulatory mechanisms that, when dysregulated, drive the development of human atherosclerosis during its asymptomatic stages. This position is particularly suitable for students with a background in computational biology/bioinformatics.

More information at: <https://www.cn̄ic.es/en/investigacion/hematovascular-pathophysiology>

17. Research Line: Maladaptive Right Ventricular Hypertrophy in Pulmonary Hypertension

Research Group: Translational Research in Heart Failure and Pulmonary Hypertension

Supervisor: **Ana García Álvarez**

Summary: Our group focuses on the poorly known mechanisms that cause maladaptive right ventricular hypertrophy and dysfunction in patients with pulmonary hypertension, beyond pressure overload. The CICERONE student granted in our group will work on translational models of pulmonary hypertension in pigs performing and interpreting right heart catheterization and advanced imaging (cardiac magnetic resonance, computed tomography, and positron emission tomography), she/he will be exposed to histology and molecular biology techniques and interact with experts in metabolomics, proteomics and genetics. 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.cn̄ic.es/es/investigacion/investigacion-traslacional-insuficiencia-cardiaca-e-hipertension-pulmonar>

18. Research Line: Imaging the early stages of human atherosclerosis

Research Group: Cardiovascular Prevention through Non-Invasive Imaging

Supervisor: **Inés García Lunar**

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>

19. Research line: Genetic basis of Dilated Cardiomyopathy

Research Group: Inherited Cardiomyopathies

Supervisors: **Pablo Garcia Pavia, Manuel A. Fernandez-Rojo**

Summary: Dilated cardiomyopathy (DCM) is caused by genetic variants in >40 genes & associated with significant morbidity and mortality, including heart failure (HF) and sudden cardiac death (SCD). Consequently, genetic DCM subtypes are different diseases and, as such, their appropriate management may require tailored therapies. The Inherited Cardiomyopathies Laboratory led by Prof. Pablo Garcia-Pavia is looking for a highly motivated candidate in bioinformatics to develop an ambitious and innovative project aimed to understand the genetic basis of DCM at the CNIC. For this, the candidate will analyse large databases of biological parameters and genetic data of patients with DCM. The candidate will work in close collaboration with bioinformaticians of the group. This position provides a unique opportunity to carry out cutting edge bioinformatics with translational applications in clinical cardiology within a dynamic and international academic environment. More information at: <https://www.cnic.es/en/investigacion/inherited-cardiomyopathies-0>

20. 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 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>

21. 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.cnice.es/en/investigacion/molecular-regulation-heart-failure>

22. 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.cnice.es/en/investigacion/molecular-regulation-heart-failure>

23. 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.cnice.es/es/inflamacion/moleculas/index.php>

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

Research Group: Neurovascular Pathophysiology

Supervisors: **M^a 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 and vascular dementia. 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: Targeted pro-resolving nanoimmunotherapy to treat atherosclerosis

Research Group: Nanomedicine and Molecular Imaging

Supervisor: **Carlos Pérez Medina**

Summary: Our research integrates molecular imaging into nanomedicine development, both for evaluating *in vivo* behavior and non-invasively monitoring treatment and efficacy. We exploit the natural ability of our nanoplatforms to interact with myeloid immune cells to selectively deliver inflammation pro-resolving drugs and promote atherosclerosis regression. You will be involved in the generation of a library of pro-resolving nanoformulations as well as in their *in vitro* characterization and *in vivo* evaluation in a mouse model of atherosclerosis.

More information at: <https://www.cnic.es/en/investigacion/nanomedicine-and-molecular-imaging>

26. Research line: A new potential therapy to prevent cardiac arrhythmias in long QT syndrome type 8

Research Group: Molecular Cardiology Laboratory

Supervisor: **Silvia Priori**

Summary: We hypothesize that inhibitors of the calcium-dependent cellular phosphatase can prevent the prolongation of the QT interval of the ECG in a swine model of Long QT8: a disease caused by mutations in the CACNA1C gene encoding for the cardiac Ca²⁺ Channel. The mutation increases calcium in cardiac cells, causing arrhythmic death. Students will participate in cardiac cells isolation and single-cell electrophysiology. They will participate in the electroanatomical heart mapping performed by MD electrophysiologists.

More information at: <https://www.cnic.es/es/investigacion/cardiologia-molecular>

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

Research Group: B Lymphocyte Lab

Supervisor: **Almudena R Ramiro**

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 (Gómez-Escolar et al, 2022) to build a precise atlas of the atherosclerosis-associated antibody immune response.

More information at: <https://www.cn̄ic.es/es/investigacion/biologia-linfocitos-b>

28. Research line: Human-based tools and strategies for cardiac regeneration studies

Research Group: Myocardial regeneration via cardiomyocyte cell cycle regulation

Supervisor: **Hesham Sadek, M^a Piedad Menéndez Gutiérrez**

Summary: Our group focused on understanding the basis of heart regeneration in neonatal mammals to identify methods to re-activate endogenous cardiomyocyte proliferation in adult hearts. For example, we identified Meis1 and Hoxb13 as critical regulators of cardiomyocyte cell cycle. Thus, we aim to modulate some of the molecules that play significant roles in cardiomyocyte hyperplastic versus hypertrophic growth in human iPSC-derived cardiomyocytes to obtain high yields of mature cardiomyocytes for in vitro screening of candidate drugs.

More information at: <https://www.cn̄ic.es/en/investigacion/myocardial-regeneration-cardiomyocyte-cell-cycle-regulation>

29. Research line: Study the role of dendritic cells in atherosclerosis development

Research Group: Immunobiology

Supervisor: **David Sancho**

Summary: The student will help to explore how the different subtypes of dendritic cells (DCs) affect to the development of atherosclerosis. For that we use models of gain or loss of function of DCs. After deciphering if DCs have any role in atherosclerosis, the molecular and immunological mechanism by which DCs alter atherosclerosis will be studied. 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.cn̄ic.es/en/investigacion/immunobiology>

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

Research Group: Immunobiology

Supervisor: **David Sancho**

Summary: High-throughput sequencing, performed in the lab, revealed specific miR expression patterns in the different subsets of dendritic cells (DCs) as well as upon activation. 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 of primary cells and

cell lines, 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.cn̄ic.es/en/investigacion/immunobiology>

31. Research line: Bioinformatics analysis of mouse single-cell RNAseq on the effect of metabolites in disease

Research Group: Immunobiology

Supervisor: **David Sancho**

Summary: Summary: We have identified a new metabolite causally associated with atherosclerosis, and now we are exploring its role in the development of other diseases such as heart failure. The student will help to explore its mechanism of action through bioinformatics analyses of mouse single-cell RNA-seq data from different organs, and will learn how to face and perform complex bioinformatics analyses. Hence, the student should have a genuine interest in computational biology and basic R/Python programming skills.

More information at: <https://www.cn̄ic.es/en/investigacion/immunobiology>

32. Research line: Image analysis for the quantitative analysis of cardiac development

Research Group: Genetic Control of Organ Development and Regeneration

Supervisors: **Miguel Torres, Morena Raiola**

Summary: The student will train on segmenting complex 3D data-sets and in extracting and analyzing quantitative data thereof. A background in computer science and programming abilities is required.

More information at: <https://www.cn̄ic.es/en/investigacion/genetic-control-organ-development-and-regeneration>

33. Research line: Characterization of coronary vasculature development

Research Group: Genetic Control of Organ Development and Regeneration

Supervisors: **Miguel Torres, Covadonga Díaz-Díaz**

Summary: The student will train on the phenotypic characterization of mutant mice that affect coronary vasculature formation. Advanced microscopy, advanced mouse genetics and immunophenotyping of cell lineages will be used to characterize the mutant phenotypes.

More information at: <https://www.cn̄ic.es/en/investigacion/genetic-control-organ-development-and-regeneration>

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

Research Group: Cardiovascular Proteomics

Supervisor: **Jesús Vázquez**

Summary: We are developing “open search” algorithms that allow true hypothesis-free identification and quantification of any post-translational modification from high-throughput mass spectrometry-based 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>

35. Research line: Evaluation of the interplay between cardiac work and cell cycle activity

Research Group: Cardiac tissue engineering and regenerative therapies

Supervisor: **Florian Weinberger**

Summary: Ischemic heart disease is the main cause of death globally. In contrast to other organs as skin and liver, the heart possesses only a minimal regenerative capacity. Myocardial injury results in an irreversible loss of cardiomyocytes and eventually leads to heart failure. We use pluripotent stem cell-derived approaches to develop novel regenerative approaches. The student will use human engineered heart tissue, chemogenetics and advanced microscopy to study cardiac regeneration.

More information at: <https://www.cnic.es/en/investigacion/cardiac-tissue-engineering-and-regenerative-therapies-0>