Fisica e Astronomia

Physics and Astronomy

Progetto di ricerca **Research project**	**ITA:** *"Calorimetria innovativa a cristalli per futuri collisori di particelle"* **ENG:** *"Innovative crystal calorimetry for future particle colliders"*
Tipo/Type	PRIN 2022 PNRR Finanziamento dell'Unione Europea – NextGenerationEU – missione 4, componente 2, investimento 1.1 PRIN 2022 PNRR European Union Financing – NextGenerationEU – mission 4, component 2, investment 1.1
Borse/Scholarships	1
Abstract	**ITA**: L'attività di ricerca si inserisce nel contesto dello sviluppo di rivelatori di nuova generazione per i futuri collisori di particelle, quali ad esempio il Future Circular Collider (FCC) al CERN, dedicati soprattutto (ma non solo) allo studio dettagliato delle proprietà del bosone di Higgs. In particolare la borsa è dedicata allo sviluppo e alla costruzione di un prototipo di un calorimetro elettromagnetico costituito da cristalli scintillanti e fotomoltiplicatori al silicio. Tale calorimetro ha l'obiettivo di migliorare le prestazioni in termini di risoluzione energetica e di ricostruzione degli eventi grazie ad un'elevata granularità degli elementi attivi combinata con una duplice lettura della luce di scintillazione e della luce Cherenkov per sfruttare il metodo del dual-readout nella ricostruzione di sciami adronici. L'attività di ricerca includerà sia lavoro di simulazione che misure in laboratorio e con test su fascio presso le infrastrutture del CERN. **ENG:** This research activity is part of the ongoing R&D in the context of next generation detectors for future particle collider experiments, such as the Future Circular Collider (FCC) at CERN, designed to further improve our understanding of the Higgs boson properties and fundamental interactions between elementary particles. This felllowship is dedicated to the development and construction of an electromagnetic calorimeter prototype made of scintillating crystals read out with Silicon Photomultipliers (SiPMs). Such a "maximum information calorimeter" aims to improve the energy resolution and the overall detector performance by exploiting an enhanced spatial granularity compared to previous crystal calorimeters and by simultaneously reading out both scintillation and Cherenkov light. This novel design will allow to effectively combine the dual-readout method and the particle flow approach to enhance the detector performance in measuring hadrons and jets. The research activity will include simulation studies as well as measurements performed in laboratory and on beam at national and international facilities.
Tutor	Prof. Marco Lucchini

Informatica

Computer Science

Progetto di ricerca Research project	*"eXplainable Artificial Intelligence in Decision making for Controllable AI"*
Tipo/Type	PRIN 2022 PNRR Finanziamento dell'Unione Europea – NextGenerationEU – missione 4, componente 2, investimento 1.1 PRIN 2022 PNRR European Union Financing – NextGenerationEU – mission 4, component 2, investment 1.1
Borse/ Scholarships	1
Abstract	The PhD will be aimed at the study, design and evaluation of technical and user experience solutions to make AI-based decision support systems more explainable, controllable and trustworthy so as to help their users and all related stakeholders understand their output and integrate it into their situated practices, decisions and experiences.
Tutor	*Da definire/To be defined*

Medicina Traslazionale e Molecolare – DIMET

Translational and Molecular Medicine – DIMET

Progetto di ricerca Research project	*"Novel insights on the role of CXCL12-CXCR4 signaling in hematopoietic development"*
Tipo/Type	PRIN 2022 PNRR Finanziamento dell'Unione Europea – NextGenerationEU – missione 4, componente 2, investimento 1.1 PRIN 2022 PNRR European Union Financing – NextGenerationEU – mission 4, component 2, investment 1.1
Borse/Scholarships	1
Abstract	During embryonic development, blood vessel morphogenesis occurs in close spatiotemporal proximity with the emergence of hematopoietic progenitors, which arise from hemogenic endothelium and contribute blood and immune cells to the growing embryo. The chemokine CXCL12, also known as stromal derived factor 1 (SDF1), primarily acts through the G protein coupled receptor CXCR4 and CXCL12-CXCR4 signaling is implicated in several biological processes, including angiogenesis and hematopoiesis. Adding to the complexity of the system, secreted CXCL12 exists as a mixture of monomeric and dimeric species in equilibrium, but also forms heterocomplexes (heteromers) with other interactors, such as the secreted, fully reduced form of high mobility group box 1 (HMGB1). However, the precise mechanism(s) by which the CXCL12-CXCR4 axis functions in blood vessel formation as well as embryonic hematopoiesis remains elusive, and the role of HMGB1 in these processes is unknown. Moreover, the CXCL12-HMGB1-CXCR4 axis is involved in inflammatory signaling, recently shown to play important roles in normal and malignant hematopoiesis. This Ph.D. project will focus on establishing the impact of different CXCR4 ligand variants on hematopoietic development. In particular, the candidate will combine molecular and phenotypical analyses of genetically modified mice with in vitro and ex vivo assays using recombinant CXCR4 ligand variants. Moreover, the impact of CXCL12-HMGB1-CXCR4 interaction as a mediator of inflammatory signaling in hematopoietic development will be assessed. These processes will be evaluated in both normal physiology and preclinical models of pediatric hematological malignancies, such as juvenile myelomonocytic leukemia (JMML). The results of this project will have important implications for the efficient in vitro generation of hematopoietic cells for therapeutic purposes, as well as providing a better understanding of hematological disorders with a pre-natal origin.
Tutor	*Da definire/To be defined*

Neuroscienze, curr. Neuroscienze Sperimentali

Neuroscience, curr. Experimental Neurosciences

Progetto di ricerca Research project	*"Interplay between neuroactive steroids and endoplasmic reticulum-mitochondria interaction: a novel therapeutic horizon in CIPN"* – **NEURO.1**
Tipo/Type	PRIN 2022 PNRR Finanziamento dell'Unione Europea – NextGenerationEU – missione 4, componente 2, investimento 1.1 PRIN 2022 PNRR European Union Financing – NextGenerationEU – mission 4, component 2, investment 1.1
Borse/Scholarships	1
Abstract	Chemotherapy-induced peripheral neurotoxicity (CIPN) is a common dose limiting side effect of several chemotherapeutic (CTs) agents. Growing body of evidence suggests that the effect of different chemotherapies' families converge on a common mitochondrial dysfunction program. Specifically, it has been proposed that a possible target for several CTs is represented by the mitochondria-ER contact sites (MERCS), given by strong association of processes occurring at MERCS and mitochondria. Furthermore, since neuroactive steroids (NAS) hold promise for anti-CIPN therapy, it is conceivable that MERCS-mitochondria axis may be a target for NAS protective effects. The main goal of this proposal is to test the hypothesis of the involvement of MERCS-mitochondria axis in CIPN and elucidate the role of steroid hormones in mitigating of CT-induced cellular dysfunction both in sensory neurons and glial cells. The project will exploit an innovative approach based on a funnel-like strategy and multidisciplinary approach, and will combine in vitro, ex-vivo and in vivo models of CIPN with different combinations of neuroactive steroids in order to identify novel mechanisms and targets to counteract CIPN. First, multiple CT/NAS combinations will be tested on several cell lines in a high throughput screening for their effects on MERCS-mitochondrial morphology and functions to identify the most efficacious combinations. Next, using a battery of omics (transcriptomics, proteomics and lipidomics) and functional (Ca2+ signaling, bioenergetics, proteostasis) assays we will test shortlisted CT/NAS combinations on selected neuronal and glial cell lines to dissect pathways and identify molecules, related to MERCS-mitochondrial physiology, affected by CT and rescued by NAS. Last, the identified molecules and pathways will be tested in vivo in animals treated with selected CT/NAS combination to correlate CIPN behavioral alterations with MERCS-mitochondrial cellular pathology in DRG sensory neurons, satellite glial cells and Schwann cells. Therefore, this project will shed light on the role of MERCS-mitochondria in CIPN etiopathogenesis and protective mechanisms of NAS, useful to develop a solid therapeutic approach.
Tutor	*Da definire/To be defined*

Neuroscienze, curr. Neuroscienze Sperimentali

Neuroscience, curr. Experimental Neurosciences

Progetto di ricerca **Research project**	*"Role of Mesenchymal Stem Cell-derived Extracellular Vesicles in restoring altered GABA switch in neurodevelopmental disorders"* – **NEURO.2**
Tipo/Type	PRIN 2022 PNRR Finanziamento dell'Unione Europea – NextGenerationEU – missione 4, componente 2, investimento 1.1 PRIN 2022 PNRR European Union Financing – NextGenerationEU – mission 4, component 2, investment 1.1
Borse/Scholarships	1
Abstract	Relevant neurodevelopmental diseases (NDD), such as epilepsy, autism-spectrum disorders (ASD), intellectual disability and schizophrenia are associated with an altered GABA switch. The developmental GABA switch is the phenomenon that determines the transition of the excitatory depolarizing activity of GABA signalling, typical of perinatal stages, to the well-known inhibitory hyperpolarizing action, which progressively emerge during the second postnatal week and characterize the adulthood. In order to achieve proper brain development, the GABA switch must take place within a precise time window. If not, any alterations may lead to long-lasting detrimental consequences associated with NDD. Effective therapeutic strategies focused on restoring the correct timing of the GABA switch have been attempted with several limitations related to conventional drug therapy. In recent years, cell therapy exploiting stem cells is increasingly considered a useful opportunity for the treatment of various diseases. Among these, Mesenchymal Stem Cells (MSC), avoiding ethical concerns, possess a plethora of abilities that surely make them the most promising clinical candidates. Recent data proposed that most of the peculiar protective features of MSCs may be ascribed to the secretion of Extracellular Vesicles (EVs). Therefore, the ultimate goal of this project is to test the hypothesis that MSC-EVs can be considered a novel therapeutic tool useful for restoring the correct timing of the GABA switch in specific pathological contexts. During the 3 year-PhD program the candidate will exploit solid preliminary results, obtained from the collaboration of the two Units involved in the project: the lab of Dr. Coco (UNIMIB) and the lab of Dr. Pozzi (Humanitas University). In the first phase, the candidate will investigate the molecular mechanisms by which EVs extracted from murine bone marrow MSCs can affect the developmental GABA switch in vitro. The analysis will then focus on the potential therapeutic effects of MSC-EVs on an animal model of NDD, characterized by a delay in the GABAergic switch, with a GABA signalling still depolarizing at mature stages. This model will be used to test the potential protective effects of MSC-EVs in the mice by administering MSC-EVs via intranasal delivery. The anti-inflammatory actions of MSC-EVs will be also evaluated both in vitro and in vivo.
Tutor	*Da definire/To be defined*

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Psicologia, Linguistica e Neuroscienze Cognitive, curr. Mente, Cervello e Comportamento

Psychology, Linguistics and Cognitive Neurosciences, curr. Mind, Brain and Behaviour

Progetto di ricerca Research project	*"BUGIFY: Psychological Strategies for Sustainable Food Consumption"*- **PSICO.1**
Tipo/Type	PRIN 2022 PNRR Finanziamento dell'Unione Europea – NextGenerationEU – missione 4, componente 2, investimento 1.1 PRIN 2022 PNRR European Union Financing – NextGenerationEU – mission 4, component 2, investment 1.1
Borse/Scholarships	1
Abstract	**ITA:** La società contemporanea deve affrontare sfide come gli effetti del cambiamento climatico, la perdita di biodiversità e la malnutrizione. Tutto ciò, insieme a una popolazione globale in crescita, richiede una transizione verso pratiche di consumo più sostenibili. Data la sua ridotta impronta ambientale, l'entomofagia (consumo di cibo a base di insetti) offre un'alternativa sostenibile alle fonti tradizionali di proteine animali. L'obiettivo principale del progetto BUGIFY è sviluppare e testare interventi mirati a migliorare le reazioni iniziali delle persone verso alimenti contenenti ingredienti derivati dagli insetti. Guidato/a da un approccio socio-cognitivo con un'attenzione rigorosa alla misurazione psicometrica, il candidato/la candidata al dottorato sarà responsabile dello sviluppo di un programma di ricerca in linea con gli obiettivi del progetto. Da un lato, il progetto di dottorato mira a far progredire la comprensione scientifica delle strategie più idonee a superare reazioni negative spontanee, come il disgusto, attraverso un quadro teorico e metodologico innovativo basato su apprendimento sociale e persuasione. Dall'altro, si propone di promuovere l'applicazione di questa conoscenza in contesti reali, con l'obiettivo finale di migliorare il benessere individuale, sociale ed economico e di apportare un contributo significativo al progresso della società. **ENG:** Contemporary societal challenges, such as the effects of climate change, biodiversity loss, and malnutrition, coupled with a growing global population, necessitate a shift towards more sustainable consumption practices. Given its minimal environmental footprint, entomophagy (the practice of eating food based on insects) offers a sustainable alternative to conventional animal protein sources. The primary objective of the BUGIFY project is to examine and refine interventions aimed at improving people's initial responses to foods containing insect-derived ingredients. Guided by a socio-cognitive approach with a focus on rigorous psychometric measurement, the doctoral candidate will be responsible for developing a research program aligned with the project's goals. On one hand, the doctoral project aims to advance scientific understanding of how to overcome instinctive negative reactions, such as disgust, through an innovative theoretical and methodological framework rooted in social learning and persuasion. On the other hand, it seeks to facilitate the application of this knowledge in real-world settings, with the ultimate goal of enhancing individual, social, and economic well-being and making a meaningful contribution to societal progress.
Tutor	*Da definire/ To be defined*

Psicologia, Linguistica e Neuroscienze Cognitive, curr. Mente, Cervello e Comportamento
Psychology, Linguistics and Cognitive Neurosciences, curr. Mind, Brain and Behaviour

Progetto di ricerca Research project	*"Can the dynamics underlying face perception help prevent gender stereotypes?"* – **PSICO.2**
Tipo/Type	PRIN 2022 PNRR Finanziamento dell'Unione Europea – NextGenerationEU – missione 4, componente 2, investimento 1.1 PRIN 2022 PNRR European Union Financing – NextGenerationEU – mission 4, component 2, investment 1.1
Borse/Scholarships	1
Abstract	**ITA:** L'obiettivo primario del progetto consiste in una miglior comprensione dei meccanismi di base sottostanti l'attivazione degli stereotipi di genere, con particolare riferimento agli stereotipi che vanno sotto la definizione di Gender Science Stereotype (GSS), per i quali le donne, nel campo scientifico, sono sempre considerate meno competenti degli uomini e conseguentemente ostacolate e discriminate nel perseguimento della carriera in questo settore. L'obiettivo è lo studio degli stereotipi da una diversa prospettiva e attraverso l'impiego di un approccio tecnologico innovativo, che possa avvalersi dell'uso pervasivo di app e videogiochi da parte delle nuove generazioni. Il progetto si focalizza in particolare sulla percezione/categorizzazione di volti, e si configura attraverso due fasi: 1) Comprensione delle dinamiche sottostanti l'attivazione degli stereotipi di genere; 2) Prevenzione della sottovalutazione delle competenze e capacità del genere femminile collegate al GSS. Il progetto si configura quindi come il primo passo verso l'identificazione di mezzi e procedure atte a contrastare l'insorgere di pregiudizi e stereotipi di genere. Il/la dottorando/a sarà quindi chiamato a sviluppare un programma di ricerca in linea con gli obiettivi del progetto, che si articolerà pertanto in due fasi. Nella prima fase la ricerca prevede un approccio sperimentale per l'identificazione delle caratteristiche percettive dei volti che possano indurre maggiore o minore stereotipizzazione, considerando anche il possibile sviluppo nella direzione di una diversa percezione delle espressioni emotive veicolate da volti con diverse caratteristiche stereotipicamente associate a volti femminili o maschili. La seconda fase, di carattere più applicativo, dovrà prevedere l'ideazione dello story-board per un videogioco/applicazione (costruito sulla base dei risultati attesi nella fase 1) teso a sensibilizzare gli educatori verso l'esistenza del GSS e possibilmente a contrastare, nelle generazioni più giovani, l'insorgere del GSS. **ENG:** The core of the project is the scientific understanding of the the dynamics underlying the activation of gender stereotypes, particularly those that go under the definition of Gender Science Stereotype (GSS), according to which women are always considered as less competent than men in scientific fields, for the only reason of being women, hence being obstacled and discriminated while pursuing that career. The ultimate goal is the study of gender stereotypes taking a different perspective and by employing novel technological approaches, thus relating to the ubiquitous use of apps and videogame by young generation. The focus of the project is on face perception/categorization, and is articulated into two main phases: a) Understanding the dynamics underlying the activation of gender-stereotypes and b) Preventing the underevaluation of competence and

	capacity of female gender raised by the GSS.
	The project is hence meant as a first step toward the identification of means and procedures that can counteract the rise of gender biases.
	The PhD student involved in the project will be responsible for conducting research aligned with the project's objectives, and thus articulated into two phases. In the first phase an experimental approach will be taken, in order to identify the perceptual features of faces more or less related to the activation of GSS, and to explore the possibility that emotions conveyed by a stereotypical female face are perceived in a different way as compared by those conveyed by a stereotypical male face. The second, more applicative phase, should involve the development of a story-board for a videogame/app (designed on the basis on Phase 1's expected results) aimed at sensibilizing educators on GSS, and hopefully counteracting the development of gender stereotypes in young teenagers.
Tutor	*Da definire/ To be defined*

Scienza e Nanotecnologia dei Materiali

Materials Science and Nanotechnology

Progetto di ricerca **Research project**	*"Photo(Electro)catalysts for Renewable FuEls produCTion (PERFECT)* – **MAT.1**
Tipo/Type	PRIN 2022 PNRR Finanziamento dell'Unione Europea – NextGenerationEU – missione 4, componente 2, investimento 1.1 PRIN 2022 PNRR European Union Financing – NextGenerationEU – mission 4, component 2, investment 1.1
Borse/Scholarships	1
Abstract	The rapid depletion of fossil fuel reserves and the environmental impact due to the increasing release of CO_2 in the atmosphere promoted the search for alternative renewable energy sources. In this context much interest has been focused on the development of photo(electro)catalytic (PEC) materials for the CO_2 reduction (CO_2 RR) and hydrogen evolution (HER). This project aims at developing different Cu-containing compounds by varying the Cu oxidation state and the chemical surroundings following soft-chemistry approaches. Promising materials are tested in both CO_2 RR and HER. The activities will be performed in the frame of the national project PRIN PNRR 2022 PERFECT.
Tutor	Prof. Roberto Nisticò

Scienza e Nanotecnologia dei Materiali

Materials Science and Nanotechnology

Progetto di ricerca Research project	*"Bi-metallic nanoclusters for catalytic biomass upgrade: investigating model systems at the atomic scale"* – **MAT.2**
Tipo/Type	PRIN 2022 PNRR Finanziamento dell'Unione Europea – NextGenerationEU – missione 4, componente 2, investimento 1.1 PRIN 2022 PNRR European Union Financing – NextGenerationEU – mission 4, component 2, investment 1.1.
Borse/Scholarships	1
Abstract	This project concerns the computational study of the structure, physical properties and chemical reactivity of subnanometric clusters supported on oxide thin films. In particular, the deposition of selected smallorganic molecules relevant to the upgrade of biomasses will be simulated. The project will be carried out in close contact with experimental groups specialized in surface science. Density Functional Theory calculations will be performed along with molecular dynamics simulations to predict the structure and the catalytic properties of the metal subnanometric aggregates and unravel their interaction with the support.
Tutor	Prof. Sergio Tosoni

UNIVERSITÀ DEGLI STUDI DI MILANO BICOCCA

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Scienze Chimiche, Geologiche e Ambientali, curr. Scienze dell'Ambiente Terrestre e Marino **Chemical, Geological and Environmental Sciences, curr. Terrestrial and Marine Environmental Sciences**	
Progetto di ricerca **Research project**	*"Microbial ecosystem services of phyllosphere in Milan urban area"* – **SCGA.1**
Tipo/Type	PRIN 2022 PNRR Finanziamento dell'Unione Europea – NextGenerationEU – missione 4, componente 2, investimento 1.1 PRIN 2022 PNRR European Union Financing – NextGenerationEU – mission 4, component 2, investment 1.1
Borse/Scholarships	1
Abstract	The PhD project is in the frame of the PRIN 2022 PNRR project entitled "Ecology, biodegradative ecosystem services and exploitation of phyllosphere microbiome in urban areas (ECLOPSE)". The project focuses on the exploitation of the phyllosphere microbiota for improving air quality in urban environments. It has been estimated that there are, on average, 106–107 bacteria per square cm of leaf surface and, thus, the global bacterial population present in the phyllosphere could comprise up to 1026 cells. Despite this high potential, the ecosystem functions of phyllosphere microbes related to biogeochemical cycles and, particularly, to the degradation of organic air pollutants have been poorly investigated. The combination of air pollutants adsorption on leaves and their microbial biodegradation represents a new branch of biological remediation technologies called "phylloremediation", that specifically aims at reducing air pollution. This project aims to broaden the basic knowledge for the development of effective phylloremediation strategies and to demonstrate the biotechnological potential of the phyllosphere microbiome, pursuing the following general objectives: 1. Determination of the ecological factors and the plant traits influencing the structure and the functionalities of pollutant-degrading phyllosphere microorganisms in urban areas; 2. Estimation of the contribution of phyllosphere microbes to the removal of organic pollutants from urban air; 3. Production of a plant prototype with enhanced phyllosphere microbiome for air pollution treatment; The project is structured in 4 scientific Work Packages-milestone (WPs) that includes scientific and technical as well as project coordination and dissemination actions. The aforementioned objectives 1) and 2) are mainly addressed by WP1, which is aimed at addressing the ecology of the phyllosphere microbiome and its related environmental ecosystem services. Objective 3) is targeted by WP2 and WP3 that aim to isolate and characterize PAHs-degrading epiphytic microorganisms and to exploit them as an inoculum for generating a plant prototype featuring an enhanced phyllosphere microbiome for the amelioration of urban polluted-air. Hedera helix will be used as a source of PAHs-degrading bacteria as well as the model plant for generating the enhanced phyllosphere prototype that will be used for phylloremediation experiments carried out both in a green-house and in-situ in Milano. The activity of the PhD student will focus mainly on WP1.
Tutor	Prof. Michael Seeger

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Scienze Chimiche, Geologiche e Ambientali, curr. Scienze dell'Ambiente Terrestre e Marino	
Chemical, Geological and Environmental Sciences, curr. Terrestrial and Marine Environmental Sciences	
Progetto di ricerca **Research project**	*"Estimating solar-induced fluorescence from multi-source observations"* – **SCGA.2**
Tipo/Type	PRIN 2022 PNRR Finanziamento dell'Unione Europea – NextGenerationEU – missione 4, componente 2, investimento 1.1 PRIN 2022 PNRR European Union Financing – NextGenerationEU – mission 4, component 2, investment 1.1
Borse/Scholarships	1
Abstract	The PhD project is in the frame of the PRIN 2022 PNRR project entitled "MUlti-SEnsor remote sensing approach from drone to earLY detect plant diseases: A tool for sustainable agriculture and food security (MUSELY)". The project aims at integrating imaging spectroscopy, Solar-Induced Fluorescence (SIF), thermal-infrared (TIR) as foreseen from the upcoming ESA's 8th Earth Explorer FLEX mission, to develop novel methods to identify and quantify plant diseases. Specifically, SIF and TIR are strongly related to key physiological processes involved in the vegetation dissipation pathways, for this reason they enable to detect instantaneous decline of photosynthesis as well other physiological regulations mechanisms. Complementarily, imaging spectroscopy allows to measure vegetation biophysical and biochemical variables and their alteration caused from stress-factors in the timeframe of few days, as well to detect visible symptoms at leaf and canopy level due to specific diseases. Remote sensing of SIF represents one of the main challenges in the past decade because it requires high-spectral resolution measurements at the solar and telluric absorption features. Advanced spectroscopy retrieval algorithms are necessary to disentangle reflectance and SIF contributions. Furthermore, ability to estimate the entire full SIF spectrum (650-800 nm), not just at the absorption bands, opens new possibilities for better interpreting SIF and quantum yield with respect to plant physiology. In this framework, the first aim of the PhD project focuses on the development of an advanced SIF spectrum retrieval algorithm with the special focus on spaceborne measurements (i.e., ESA's FLEX mission), the approach should be also adaptable for tower-based and top-of-canopy spectral measurements. The second objective involves the definition and design of novel and advanced SIF products such as the Total Emitted SIF (e.g., Hemispherical SIF) from statistical integration of multi-view observations.
Tutor	Prof. Claudia Paquero

Tecnologie Convergenti per i Sistemi Biomolecolari (TeCSBi)

Converging Technologies for Biomolecular Systems (TeCSBi)

Progetto di ricerca Research project	**ITA:** *"EmbryoDiet: previsioni basate sul sesso degli effetti della dieta durante la gestazione tramite l'integrazione di dati multi-omici di strutture simili a embrioni umani"* – **TECSBI.1** **ENG:** *"EmbryoDiet: sex-based predictions of dietary effects during gestation via multi-omics data integration of human embryo-like structures"* – **TECSBI.1**
Tipo/Type	PRIN 2022 PNRR Finanziamento dell'Unione Europea – NextGenerationEU – missione 4, componente 2, investimento 1.1 PRIN 2022 PNRR European Union Financing – NextGenerationEU – mission 4, component 2, investment 1.1
Borse/Scholarships	1
Abstract	**ITA :** Il successo dell'impianto dell'embrione implica l'interazione complessa e poco compresa di vari processi. La componente metabolica è di particolare importanza poiché la maggior parte dei processi cellulari sono collegati al metabolismo e poiché le cellule in proliferazione hanno esigenze metaboliche specifiche. Inoltre, ci sono prove che le carenze nutrizionali nella dieta delle future mamme correlano con difetti nell'organogenesi e nel metabolismo dell'embrione. La regolazione del metabolismo avviene a più livelli, inclusa la disponibilità del substrato e il controllo dell'espressione degli enzimi. Di conseguenza, una comprensione completa del metabolismo richiede metodologie innovative di integrazione di dati multi-omici radicate nella scienza dei dati e nella biologia dei sistemi computazionali. Il progetto mira a scoprire i cambiamenti metabolici negli embrioni umani pre, peri e post- impianto e a studiare le variazioni basate sul sesso nelle esigenze metaboliche degli embrioni. Per raggiungere questi obiettivi, il progetto raccoglierà dati di trascrittomica, proteomica ed eso-metabolomica da strutture simili a embrioni derivate da cellule staminali pluripotenti maschili e femminili, in collaborazione con il Dipartimento di Biologia dell'Università di Padova, rinomato per la sua esperienza in strutture simili ad embrioni post-impianto. Questi dati verranno poi integrati in modelli computazionali. Il candidato selezionato per questo progetto sarà responsabile dell'analisi/integrazione dei dati omici e contribuirà attivamente al miglioramento delle tecniche computazionali esistenti o allo sviluppo di nuove per affrontare potenziali sfide che potrebbero sorgere nel corso della ricerca. **ENG:** Successful embryo implantation involves a complex and poorly understood interplay of various processes. The metabolic component is of particular significance as most cellular processes are linked with metabolism and because proliferating cells have specific and demanding metabolic needs. Moreover, there is evidence that nutritional deficiencies in the diets of expectant mothers are correlated with defects in both embryo organogenesis and metabolism. Regulation of metabolism occurs at multiple levels, including substrate availability and enzyme expression control. Consequently, a comprehensive understanding of metabolism requires innovative multi-omics data integration methodologies rooted in data science and computational systems biology.

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	The project aims to uncover metabolic changes in human embryos pre-, peri-, and post- implantation and to investigate sex-based variations in embryo metabolic needs.
	To achieve these aims, the project will collect transcriptomics, proteomics, and exo-metabolomics data from embryo-like structures derived from male and female pluripotent stem cells, in collaboration with the University of Padova's Department of Biology, renowned for its expertise in post-implantation embryo-like structures. These data will then be integrated into computational models.
	The Ph.D. candidate selected for this project will be responsible for omics data analysis/integration and will actively contribute to enhancing existing computational techniques or developing novel ones to address potential challenges that may arise during the course of the research.
Tutor	Prof. Marco Vanoni

Tecnologie Convergenti per i Sistemi Biomolecolari (TeCSBi)

Converging Technologies for Biomolecular Systems (TeCSBi)

Progetto di ricerca Research project	**ITA**: *Produzione di cellulosa batterica funzionalizzata mediante una piattaforma biologica circolare* – **TECSBI.2** **ENG**: *Production of functional bacterial cellulose by a circular biotechnological platform* - **TECSBI.2**
Tipo/Type	PRIN 2022 PNRR Finanziamento dell'Unione Europea – NextGenerationEU – missione 4, componente 2, investimento 1.1 PRIN 2022 PNRR European Union Financing – NextGenerationEU – mission 4, component 2, investment 1.1
Borse/Scholarships	1
Abstract	**ITA:** Negli ultimi decenni i polimeri naturali o biopolimeri, prodotti da fonti naturali (piante, animali, microrganismi) e biodegradabili, hanno guadagnato sempre maggiore popolarità. La cellulosa, il polimero più abbondante sulla terra, è particolarmente interessante per via delle sue eccellenti proprietà fisiche e chimiche, oltre ad essere anche sostenibile, rinnovabile e biodegradabile. La cellulosa è stata a lungo prodotta da fonti vegetali, dove si trova spesso insieme ad altri polimeri come lignina, emicellulosa o pectina. Una interessante alternativa è rappresentata dalla cellulosa batterica (BC). La BC è infatti prodotta in quantità elevate anche da alcune specie batteriche (come Komagataeibacter sucrofermentas), ha la stessa composizione chimica della cellulosa di origine vegetale ma è, tuttavia, caratterizzata da una maggiore purezza e da proprietà fisico-chimiche e meccaniche superiori. Lo scopo di questo progetto di dottorato sarà quello di sviluppare, attraverso una piattaforma biotecnologica, nuovi materiali funzionalizzati a base di cellulosa batterica. Ciò sarà ottenuto attraverso lo sviluppo di una pipeline sostenibile, verde e circolare basata su 1) l'uso di biomasse residuali come fonti di building blocks per la produzione della BC; 2) l'impiego di enzimi per modificare questi building blocks saccaridici in maniera selettiva attraverso processi biocatalitici; 3) l'utilizzo di K. sucrofermentas per ottenere per via fermentativa il biopolimero funzionalizzato. Infine, come proof-of-concept, la BC funzionalizzata sarà utilizzata come supporto per l'immobilizzazione di enzimi. Questo progetto si colloca all'interfaccia tra la chimica verde e sostenibile e la bioeconomia circolare. Inoltre, la sua realizzazione aprirà la strada alla produzione sostenibile di BC funzionalizzata per diverse applicazioni. **ENG:** In the last decades natural polymers or biopolymers, produced from natural sources (plants, animals, microorganisms) and biodegradable, have gained popularity. Cellulose, the most abundant polymer on earth, is attracting attention because of its excellent physical and chemical properties, being also sustainable, renewable, and biodegradable. Cellulose has long been produced from plant sources, where it is often mixed with other polymers as lignin, hemicellulose, or pectin. An appealing alternative is bacterial cellulose (BC). BC is synthesized in high amount by some bacterial species (such as Komagataeibacter sucrofermentas), sharing the same chemical composition to plant-derived cellulose while being characterized by higher purity and superior physico-chemical and mechanical

properties.

The aim of this PhD project is to develop novel BC-based functional materials for various applications by exploiting a full biotechnological platform. This will be achieved through a sustainable, green and circular pipeline based on 1) the use of residual biomasses as sources of BC sugar building blocks; 2) the use of enzymes to selectively modify the BC sugar building blocks; 3) the exploitation of K. sucrofermentas for assembling these building blocks into a functionalized biopolymer. Finally, as a proof-of-concept, the resulting modified BC will be used as support for enzyme immobilization.

This project, as it is conceived, will be laid at the interface between the fields of green and sustainable chemistry and circular bioeconomy. Moreover, the realization of this project will open the way to the sustainable production of functional BC for various applications.

Tutor	Prof. Paola Branduardi

URBEUR- Studi Urbani

URBEUR-Urban Studies

Progetto di ricerca Research project	*"LINUS - LIviNg the UniverSity city: student housing as driver of changes"*
Tipo/Type	PRIN 2022 PNRR Finanziamento dell'Unione Europea – NextGenerationEU – missione 4, componente 2, investimento 1.1 PRIN 2022 PNRR European Union Financing – NextGenerationEU – mission 4, component 2, investment 1.1
Borse/Scholarships	1
Abstract	**ITA:** Specialmente nel Nord Italia, le università sono diventate protagoniste, fungendo da magnete per l'offerta popolazione studentesca fuori sede e investimenti economici, in particolare nel settore immobiliare. Questo processo ha visto una serie di cambiamenti urbani e di narrazioni politiche che accolgono una serie di trasformazioni guidate dall'università, in particolare nel settore immobiliare. Mentre la letteratura "town & Gown" si è concentrata principalmente sul ruolo positivo delle università come fattore di crescita nel paradigma dell'economia della conoscenza, o sulle esternalità negative della crescente presenza degli studenti come particolari forme di gentrificazione, pochissimi studi si concentrano sul rapporto tra città e università e di come questo rapporto influenzi la dinamica degli alloggi per studenti. La ricerca è comparativa: Torino, Milano; Bologna e Padova e prevede un periodo di indagine sul campo in Italia. **ENG:** Especially in Northern Italy, universities have become protagonists, acting as a magnet for the supply of non-resident student populations and economic investments, particularly in the real estate sector. This process has seen a series of urban changes and political narratives that accommodate a number of university-led transformations, particularly in the real estate sector. While the "Town & Gown" literature has mainly focused on the positive role of universities as a growth factor in the knowledge economy paradigm, or on the negative externalities of the growing presence of students as particular forms of gentrification, few studies focus on the relationship between city and university and how this relationship influences the dynamics of student accommodation. The research is comparative: Turin, Milan; Bologna and Padua and includes a period of fieldwork in Italy.
Tutor	Prof. Silvia Mugnano