

**« International » 2018 call for projects
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« INTERNATIONAL » 2018 CALL FOR PROJECTS

PROJECTS PRESENTATION

June 2020

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INTRODUCTION

The A*Midex Foundation, Initiative of excellence for the Aix-Marseille site, launches its second “International” call for projects, with the **objective of encouraging and supporting the development of international collaborations** - beyond the Mediterranean area - **with favoured partners in the fields of training, research and innovation**

The objectives of the current call for proposals are to:

- Support long-term and ambitious international research partnerships
- Reinforce the international visibility of the Aix-Marseille site and exploit the expertise available in terms of doctoral training and research
- Help research teams located on the Aix Marseille site to progress in the international reference classifications and improve their visibility in reference international publications

They are implemented through the following **three targeted actions**:

1. Support for international research, development & innovation projects with a strong strategic potential - **14 selected projects**
2. Development of internationally recognised summer schools - **2 selected projects**
3. Support for international visibility of the Humanities through support for access to language services - **1 selected project**

For more information: read the [framework text call](#)

17 projects were selected under the International 2018 call for projects for a total budget of **2,617,798€**. They were subject to an independent scientific evaluation, by two international experts per project, and were labelled by the A*Midex Steering Committee meeting on 18 March 2019. The projects started between 1 July 2019 and 1 February 2020, and have a duration of 2 years, extended to 3 years for projects wishing to organise themselves to submit a European project application in the final year.

ACTION 1. INTERNATIONAL RESEARCH, DEVELOPMENT AND INNOVATION PROJECTS WITH HIGH STRATEGIC POTENTIAL

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**A*MIDEX INTERNATIONAL PROJECT | “MITOMUTCHAGAS”
COLLABORATIVE PROJECT COORDINATED BY CHRISTOPHE
CHEVILLARD, BETWEEN AIX-MARSEILLE AND THE
UNIVERSITY OF SAO PAULO**



MITOMUTCHAGAS project led by Dr. Christophe CHEVILLARD, was labelled by the A*Midex Foundation within the framework of the "International 2018" call, started its activities in July 2019. This project strengthens Aix-Marseille's cooperation with the University of Sao Paulo for the study of Chagas disease.

The project *"Additive effect of pathogenic mutations in mitochondrial proteins and inflammatory cytokines in mitochondrial dysfunction and innate immunity: relevance for Chagas disease cardiomyopathy"* (MITOMUTCHAGAS) addresses the challenge of heart failure as a major global public health problem. In particular, it focuses on **dilated cardiomyopathies associated with Chagas disease (CCC)**, a

serious heart disease that affects millions of people worldwide, particularly in Latin America. It will explore mitochondrial function in patients with and without a genetic defect in the dihydroorotate dehydrogenase gene using 1) cell lines modified by CRISPR/CAS9 technology to make them carriers of the genetic defect under investigation, and 2) blood and heart cells from patients living in endemic areas.

The project will be implemented at the [Theories and Approaches to Genomic Complexity Laboratory](#) (TACG) of Aix-Marseille University and INSERM in partnership with the Clinical Immunology and Allergy Laboratory of the **University of São Paulo (Brazil)** headed by Professor Edécio Cunha-Neto.

MITOMUTCHAGAS started up on 1 July 2019 for a period of 24 months. Over this period, the project will be supported by the A*Midex Foundation with a grant of 190,000 euros, and will have a total funding of 220,000 euros with the partner's contribution.

Contact: [Christophe Chevillard](#)

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**A*MIDEX INTERNATIONAL PROJECT | "AQUA-IGNIS"
COLLABORATIVE PROJECT, COORDINATED BY MORTEZA
DJAMALI, WITH IRAN AND ITALY**



The **AQUA-IGNIS** project, coordinated by **Dr. Morteza Djamali** and scientifically co-led by **Prof. Nicolas Faucherre**, was labelled by the **A*Midex Foundation** as part of the "International 2018"

call, and started its activities in **October 2019**. This project strengthens Aix-Marseille's cooperation with the **University of Chiraz** in Iran, the **Iranian National Institute for Oceanography and Atmospheric Sciences** and the **University of Bologna** in Italy.

The project entitled "*The First City of the Last Empire: Geoarchaeology of the Sasanian Circular City of Gur (Iran)*" (**AQUA-IGNIS**) aims to reconstruct **the genesis of the circular city of Firouzabad (Iran) and its surroundings in late antiquity**. It will provide a unique opportunity to understand how and in what context an urban centre is created and how its creation has impacted its environment. Firuzabad was the first urban administrative centre established during the last Persian empire, the Sassanid Empire (224-651 AD). The site is included in the list of Sassanian monuments of the Iranian province of Fars inscribed on the World Heritage List since 4 July 2018. Archaeologists and historians have many questions concerning the construction of the circular city (2 km in diameter) of Gur, built ex nihilo in the year 224 or earlier in the middle of the irrigated plain of Firouzabad, surrounded by the Zagros mountains, by King Ardashir, the first Sassanid king. These questions concern in particular **environmental factors and impacts** : the factors that may have caused the abrupt transition from the Parthians to the Sassanids, the environment and hydraulic factors that may have determined the choice of this location for the first capital of the Sassanid Empire, the impact of its urbanization on its environment and the factors of its rapid abandonment a few generations later. A **multidisciplinary geo-archaeology and a paleo-environmental methodology** are envisaged in conjunction with the methods of **built archaeology** and **topography** to answer these questions, involving three partner universities in France, Iran and Italy and an Iranian National Institute. With this project, the site of Aix-Marseille contributes to the conservation of a **World Heritage Site (UNESCO)**.

The project is implemented at the [Mediterranean Institute of Biodiversity and Marine and Continental Ecology \(IMBE\)](#) in Aix-Marseille (UMR AMU-CNRS-IRD-AU), in conjunction with teams from the **Laboratoire d'Archéologie Médiévale et Moderne en Méditerranée (LA3M)** in Aix-Marseille (UMR AMU-CNRS), in partnership with the **University of Chiraz** in Iran, the **University of Bologna** in Italy, and the **Iranian National Institute for Oceanography and Atmospheric Sciences** (Iran).

AQUA-IGNIS started on **October 1, 2019** for a period of **24 months**. Over this period, the project will be supported by the **A*Midex Foundation** with a grant of **81,800 euros**.

Contact : [Morteza Djamali](#) and [Nicolas Faucherre](#)

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A*MIDEX INTERNATIONAL PROJECT | "TAUFU"
COLLABORATIVE PROJECT, COORDINATED BY OLIVIER
LEROY, WITH CHINA AND CERN, THE EUROPEAN
ORGANIZATION FOR NUCLEAR RESEARCH



Crédits photo : Coll. LHCb CERN

TAUFU project approved by the A*Midex Foundation as part of the "International 2018" call, began its activities in november 2019. It builds on the broad international LHCb network around CERN, and implements a strong collaboration with Tsinghua University in Beijing (China).

The project entitled "*Tsinghua and AMU Test of Lepton Flavor Universality*" (TAUFU) is led by Dr. Olivier Leroy and the LHCb team at the Marseille Centre de Physique des Particules (CPPM). The LHCb experiment is installed at the Large Hadron Collider (LHC) at CERN in Geneva. The aim of the experiment is to highlight New Physics by performing precision measurements in the decay of beautiful and charmed hadrons. The LHCb collaboration involves 1335 members from 81 laboratories and universities in 19 countries. The Large Hadron Collider (LHC) at CERN has, since its commissioning in 2009, produced an impressive amount of scientific results, including the discovery of the Higgs boson. It allows not only direct research of new physics at the energy frontier, but also **indirect research at the frontier of intensity**. The latter are essential because they allow probing energy scales far beyond those available in the accelerator's centre of mass. This research is precisely the work carried out by the LHCb collaboration, in which the CPPM group has played a leading role since 1998. Among them, the anomalies observed in the $b \rightarrow c \ell \nu$ ($\ell = \tau, \mu$) charged current are causing great excitement in the community. Indeed, the experimental measurements deviate from theoretical predictions by around 3 standard deviations. If confirmed, this will be the **first observation of Lepton Flavor Universality Violation**. The TAUFU project intends to analyse data recorded by the LHCb experiment, with the aim of testing one of the fundamental aspects of the Standard Model of Particle Physics: the universality of lepton couplings.

At the international level, it intends to set up a **long-term collaboration with the prestigious Tsinghua University in Beijing (China) in order to play a major role in highlighting processes beyond the Standard Model**. The Franco-Chinese Laboratory of Particle Physics (Laboratoire Associé International)

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now exists for more than 10 years and several fruitful partnerships have emerged between the Chinese groups and the Physics group of the CPPM. However, no collaboration existed yet with the CPPM LHCb group. In 2018, 4 new Chinese groups joined the LHCb collaboration. There is thus a real opportunity to develop a fruitful and long-term partnership, not only with Tsinghua University, but also with the other Chinese groups that have recently become members of the LHCb collaboration.

The project is implemented at the [Centre de Physique des Particules de Marseille](#) (UMR AMU-CNRS). It officially started on 1 November 2019 for a period of 24 months. Over this period, the project will be supported by the A*Midex Foundation with a grant of 164,140 euros.

Contact: [Olivier Leroy](#)

A*MIDEX INTERNATIONAL PROJECT | “TONGA” COLLABORATIVE PROJECT, COORDINATED BY SOPHIE BONNET, WITH A LARGE NETWORK OF INTERNATIONAL PARTNERS



The TONGA project led by Sophie Bonnet (DR IRD, Aix-Marseille) and co-led by Cécile Guieu (DR CNRS), approved by the A*Midex Foundation as part of the "International 2018" call, started its activities in November 2019. This large oceanography project brings together more than 90 scientists from 14 French research units based in metropolitan France or New Caledonia and 6 foreign universities located in the United States, Australia, the United Arab Emirates, Germany, the United Kingdom and Israel.

The TONGA project "**shallow hydroThermal sOurces of trace elemeNts: potential impacts on biological productivity and the bioloGicAl carbon pump**" aims to study the impact of shallow submarine volcanoes on biological activity in the surface ocean. These volcanoes emit hydrothermal fluids that are rich in trace elements, nutrients or toxins, and most certainly have a major impact on surface biological communities and the ocean's ability to sequester CO₂.

The project began in November 2019 with **an oceanographic expedition aboard the Oceanographic Vessel L'Atalante**. The scientific team's challenge was to locate shallow active volcanoes and study them in detail in order to elucidate the role of emitted hydrothermal fluids in fertilizing the surface ocean with iron, an essential micronutrient for life. This mechanism could explain the plankton blooms observed during the austral summer over a region stretching from Australia to the Tonga Arc. To do this, the team is drawing on **specialists in fields ranging from trace element chemistry and biology, geochemistry of hydrothermal springs and physical oceanography**. The use of a range of complementary tools (multibeam echosounder, satellite imagery, automated sensors, in situ profiling robots, molecular biology, modelling) has enabled the real-time acquisition of physical, chemical and biological parameters from the atmosphere to marine sediments, necessary to answer the scientific questions of the project. The data are now being processed and analysed, and more data continue to arrive thanks to the drifting profiling floats deployed in the Pacific. An oceanographic instrument recovery campaign is planned for 2020 in the Pacific.

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The robots deployed during the campaign also serve as support for the "[Adopt a float](#)" educational project involving primary, middle and high school students. The activity of the scientists was filmed on a daily basis during the expedition and will be the subject of a documentary.

TONGA officially started as an A*Midex project on 1 November 2019 for a duration of 24 months. The project is implemented at the [Mediterranean Institute of Oceanography](#) (MIO) in Aix-Marseille (UMR AMU-CNRS). Over this period, the project will be supported by A*Midex with a grant of 159,600 euros and also benefits from co-financing (ANR, INSU, IRD, French Oceanographic Fleet).

The progress of the project can be followed on the [project website](#) at and on [Twitter](#)

Contact of the coordinators :

- [Sophie Bonnet](#) (Mediterranean Institute of Oceanography, M.I.O)
- [Cécile Guieu](#) (Laboratoire d'Océanographie de Villefranche, L.O.V)

A*MIDEX INTERNATIONAL PROJECT | "3D-INHOAC" COLLABORATIVE PROJECT, COORDINATED BY SANDRINE RAKOTONARIVO, WITH THE UNITED STATES OF AMERICA



3D-InHoAc project, led by Dr. Sandrine Rakotonarivo, Assistant professeur (Maître de conférence) at Aix-Marseille Université, was approved by the A*Midex Foundation as part of the "International 2018" call. It began its activities in november 2019. This project will strengthen Aix-Marseille's cooperation with two american institutions in the field of acoustics.

The project entitled "*Innovative 3D holography acoustic devices for complex structures characterization (3D-InHoAc)*" aims to develop **novel acoustic methods for fault location or characterization of complex structures based on innovative holographic acoustic devices**. More broadly, the project intends to foster the exchange of ideas between different laboratories, scientific communities and disciplines (passive and vibro-acoustics, ultrasound, antenna processing, numerical

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computation) and different skills (experimental, technological, numerical and theoretical skills). It offers the opportunity, through its international consortium, to bring together **two fields of application, non-destructive testing and structural integrity monitoring, and Underwater Acoustics**. Non-destructive testing and structural integrity monitoring are essential to ensure the integrity of civil engineering infrastructures, composite structures encountered in aeronautics or nuclear power plant components. Underwater acoustics aims at using acoustic waves to probe the ocean or the seabed and allows to detect, locate and characterize an intruder in the water or on the seabed. These two communities thus share **identical scientific problems: to provide precise information on the state of the inspected structure and its environment, by acoustic or ultrasonic means, in order to ensure the safety of people**.

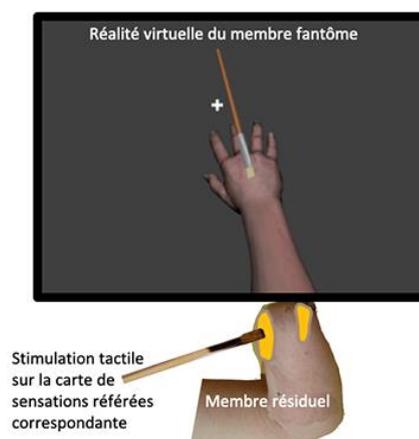
This tripartite collaborative project will reinforce the existing collaboration between the **Marine Physical Laboratory at the University of California San Diego (USA), the United States Naval Research Laboratory in Washington (USA), and the Laboratoire de Mécanique et d'Acoustique (LMA)** in Aix-Marseille (France). The collaboration was initiated in 2011 between the two American partners and extended in 2013 to Sandrine Rakotonarivo's team in Aix-Marseille. Since 2016, exchanges have increased and have been extended to CEA Cadarache in France. The three partners bring complementary expertise as well as exceptional equipment to this collaboration. Both American partners benefit from funding from the US Office of Naval Research (ONR) for their activities as part of the project. This project will also be an opportunity to promote the LMA's notable infrastructure (e.g. its anechoic chamber) internationally, thus strengthening its attractiveness.

The project is being implemented at the [Laboratoire de Mécanique et d'Acoustique](#) d'Aix-Marseille (UMR CNRS-AMU-ECM). **It officially started on 1 November 2019 for a duration of 24 months. Over this period, the project will be supported by the A*Midex Foundation with a grant of 196,313 euros.**

Contact: [Sandrine Rakotonarivo](#)

A*MIDEX INTERNATIONAL PROJECT | "PHANTOMTRAINING" COLLABORATIVE PROJECT, COORDINATED BY JOZINA DE GRAAF, WITH SWITZERLAND

credits photos: Dr. Michel Absaloud



The PhantomTraining project labelled by the A*Midex Foundation under the "International 2018" call, started its activities in November 2019. The project is led by Dr. Jozina De Graaf, Maître de conférences of Aix-Marseille Université, and brings together a team from Aix-Marseille and the Centre Hospitalier Universitaire Vaudois (CHUV), Switzerland's leading hospital.

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The project entitled "**Neuroplasticity studied by multisensory and motor training of the phantom upper limb after amputation**" (**PhantomTraining**) is an ambitious Franco-Swiss project in terms of generating new scientific knowledge in the field of health and clinical applications. The main scientific ambition of the project is to acquire an in-depth knowledge of the **mechanisms of neuroplasticity after limb amputation**. The project will focus on two phantom phenomena in particular: **phantom limb mobility** and **referred sensations**, both of which are of particular interest for studying the reorganization of the central and peripheral nervous system after major body changes such as limb amputation. The innovative approach of this project is based on the quantification of the link between the phenomenology of the phantom limb (motor, multisensory and subjective aspects) and the cortical representations of the amputated limb. The comparison of subjective, behavioural and neurophysiological measures of phantom limb experience before and after mobility training will provide a unique data set to improve our understanding of brain-body interactions determined by plasticity. This research will also have important implications for the use of bi-directional prostheses, a growing field worldwide but so far limited to an experimental level mainly due to the lack of fundamental knowledge on neuroplasticity. With this project, Aix-Marseille is deepening its commitment to the field of neuroprosthesis and rehabilitation of amputees, an area that is heavily invested by leading research groups and companies in the United States, the United Kingdom and Italy, which will pave the way for future major international collaborations.

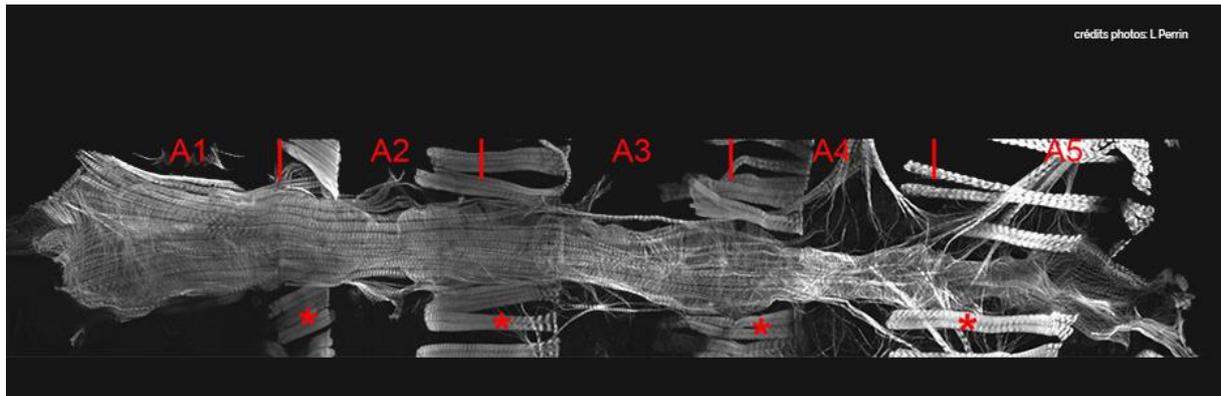
The project is being implemented at [the Institut des Sciences du Mouvement - Etienne-Jules Marey \(ISM\)](#) in Aix-Marseille (UMR AMU-CNRS), in conjunction with scientific teams from the Institut Régional de Réadaptation (IRR) in Nancy, university hospital for Physical Medicine and Rehabilitation (MPR) in Lorraine, France, and with the [MySpace laboratory](#) of the Centre Hospitalier Universitaire Vaudois (CHUV) in Switzerland, which provides important technological infrastructures and unique expertise (virtual reality, multisensory stimulation, physiological recordings, neuropsychology and neuroimaging).

PhantomTraining officially started on 1 November 2019 for a duration of 24 months. Over this period, the project will be supported by the A*Midex Foundation with a grant of 129,000 euros. Ms. De Graaf previously benefited from support from the Région Sud-PACA (France), the CNRS (France), and from an ANR (France) project, to start this project, especially to start the collaboration with the IRR.

Contact: [Jozina De Graaf](#)

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**A*MIDEX INTERNATIONAL PROJECT | "ARCHI-OLD-HEART"
COLLABORATIVE PROJECT, COORDINATED BY LAURENT
PERRIN, WITH THE UNITED STATES**



Picture: *Drosophila* heart (marking of actin polymerized by phalloidine coupled with a fluorophore)

Archi-Old-Heart project, led by Dr. Laurent Perrin, and scientifically co-led by Dr. Christine Brun, was approved by the A*Midex Foundation as part of the "International 2018" call and began its activities in november 2019. This project involves scientific teams from Aix-Marseille and the Sanford Burnham Prebys (SBP) Medical Discovery Institute (San Diego, USA).

The project entitled "**A Systems genetic approach of cardiac aging in *Drosophila*: Elucidating the genetic architecture of cardiac senescence in a model organism**" (**Archi-Old-Heart**) focuses on the **genetic mechanisms of cardiac aging**, as a major determinant of life expectancy in an aging population, while cardiac diseases and disorders increase with age. The genetic basis of the interindividual variation in cardiac senescence remains largely unknown. The Archi-Old-Heart project will therefore attempt to elucidate complex interactions between aging, the environment and genetic factors, a major challenge in vertebrate models, by studying in particular the dorsophilus, a species of insect widely used in the laboratory. The teams of Dr. Christine Brun and Dr. Laurent Perrin will capitalize on their expertise in *Drosophila* genetics, biostatistics and bioinformatics, and on their collaboration with their international partner in the project, the Sanford Burnham Prebys (SBP) Medical Discovery Institute (San Diego, USA), to analyze the natural variations associated with cardiac senescence. Professor Rolf Bodmer's team at SBP is at the forefront of using *Drosophila* as a model for the analysis of cardiac function and aging. The project is expected to open new avenues for the functional dissection of complex age-related cardiovascular disorders in humans.

The Archi-Old-Heart project is being implemented at the [Theories and Approaches to Genomic Complexity \(TAGC\)](#) laboratory in Aix-Marseille (UMR AMU-INSERM) in collaboration with the **Sanford Burnham Prebys (SBP) Medical Discovery Institute (San Diego, USA)**. It officially started on November 1, 2019 for a duration of 24 months. Over this period, the project will be supported by the A*Midex Foundation with a grant of 194,500 euros.

Contact : [Laurent Perrin](#) et [Christine Brun](#)

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**A*MIDEX INTERNATIONAL PROJECT | "MARS"
COLLABORATIVE PROJECT ABOUT MALARIA, COORDINATED
BY JORDI LANDIER, WITH SENEGAL AND MALI**



MARS project was approved by the A*Midex Foundation as part of the "International 2018" call. It began its activities in november 2019. It will develop joint activities within the joint international unit (UMI) "Environment, Health and Society" (France, Burkina Faso, Senegal, Mali).

Pic: landscape during a mission in Senegal. Credits : Jordi Landier.

The project entitled "**Malaria Asymptomatic Reservoir in the Sahel : generating the evidence-base for elimination interventions**" (**MARS**) aims to address an important international health challenge: malaria, which along with HIV/AIDS and tuberculosis, is one of the three infectious diseases with the highest burden of morbidity and mortality in the world. Its elimination by 2030 is one of **the Sustainable Development Goals (SDGs) adopted by the UN**. The fight against this infection by the Plasmodium parasite, itself transmitted by mosquitoes, requires an integrated approach based on vector control and improved access to healthcare. The considerable progress made in the years 2000 to 2015 by some sub-Saharan countries is slowing down. To continue progress towards elimination, new interventions are needed to complement existing strategies. Malaria transmission is fuelled in particular by untreated clinical cases and chronic asymptomatic carriers. These individuals are rarely identified or treated since they do not present with a malaria crisis and can therefore be infected over long periods of time. They thus play a major role in countries where malaria is highly seasonal: during seasons when there are not enough mosquitoes to ensure transmission, they are the ones who harbour the Plasmodium parasite until favourable conditions return. Similarly, their movements can help spread the parasites to new areas.

The MARS project thus aims **to increase knowledge of the seasonal dynamics of the reservoir of asymptomatic carriers, through their detection with very high sensitivity methods, combined with the genetic analysis of parasite populations**. The circulation of parasites will be related to human movements; and a longitudinal sub-study will be carried out on the dynamics of infection in carriers. The knowledge thus acquired will enable the **development of effective strategies, based on solid scientific foundations, to intervene on this reservoir in order to limit morbidity and mortality and accelerate the reduction of transmission in order to achieve malaria elimination**.

The MARS project is being implemented at the [Sciences Economiques et Sociales de la Santé et Traitement de l'Information Médicale \(SESSTIM\)](#) laboratory in Aix-Marseille (UMR AMU-IRD-INSERM), in collaboration with the [Vecteurs - Infections Tropicales et Méditerranéenne \(VITROME, UMR AMU-IRD-SSA\)](#) laboratory. The international partners are **the Malaria Research and Training Centre (MRTC)**

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of the **University of Sciences, Technologies and Techniques of Bamako (USTTB)** in Mali, and the Parasitology Department of the **University Cheikh Anta Diop de Dakar (UCAD)** in Senegal. These two universities are strategic partners of Aix-Marseille Université internationally, with a strong collaboration in health research developed within the joint international unit "Environment Health and Society" (France, Burkina Faso, Senegal, Mali). This scientific partnership also has strong impact in terms of public health, since the partners are major interlocutors of national and sub-regional health authorities. The work they have carried out in Senegal and Mali is the basis for the generalisation of seasonal chemoprevention, one of the most effective current strategies for protecting young children from malaria. The principal investigators of the project are Dr Jordi Landier (UMR SESSTIM), Dr Cheikh Sokhna (UMR VITROME) and Dr Issaka Sagara (MRTC).

The MARS project officially started on 1 November 2019 for a duration of 24 months. Over this period, the project will be supported by the A*Midex Foundation with a grant of 200,000 euros.

Contact : [Jordi Landier](#)

A*MIDEX INTERNATIONAL PROJECT | "CALOR-I" COLLABORATIVE PROJECT, COORDINATED BY CHRISTELLE REYNARD-CARETTE, WITH THE USA



Photo : view from the MITR.

CALOR-I project, led by Dr. Christelle Reynard-Carette, was approved by the A*Midex Foundation as part of the "International 2018" call and began its activities in January 2020. This project will strengthen the collaboration between Aix-Marseille, the Massachusetts Institute of Technology (USA), and the French Alternative Energies and Atomic Energy Commission (CEA).

The project entitled "**Compact-CALORimeter Irradiations inside the MIT research reactor**" (CALOR-I) is in line with a general ambition to **improve the performance and safety of current and future generations of nuclear power plants**. The development and qualification of appropriate materials/fuels for nuclear power plants contributes to the optimisation and demonstration of the

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operational safety of existing nuclear reactors (plant life extension and management, safety enhancement, waste and resource management, economic improvement), as well as to the support of future generations of nuclear reactor design (improved use of uranium resources and reduction of long-lived radioactive waste). The CALOR-I project concerns the study of an innovative compact differential calorimeter, recently patented by Aix-Marseille Université and the CEA, dedicated to the measurement of absorbed dose rate in Material Testing Reactors such as the Jules Horowitz reactor under construction at the CEA in Cadarache (South of France, scheduled to start up in 2025). The main objectives are to study a **prototype of this sensor under irradiation conditions in the MIT reactor (MITR)** and to map its fluid loop located in the core. These important measurements for the future conversion of its fuel, from highly enriched to low enriched, have never been carried out in the MITR. At present, the absorbed dose rate in the MITR is estimated by numerical simulation coupled with temperature measurements. The CALOR-I project adopts a methodology combining 3D numerical work and experimental work in laboratory and then real conditions.

The project is being implemented at the [Institut des Matériaux, Microélectronique, Nanosciences de Provence \(IM2NP\)](#) - UMR AMU-CNRS-UTLN, in conjunction with scientific teams from the CEA in Cadarache in the framework of the **joint LIMMEX laboratory** (AMU-CEA-CNRS, Laboratoire d'Instrumentation et de Mesures en Milieux Extrêmes), and with the **Nuclear Reactor Laboratory of the MIT in the United States**, which is providing important infrastructures for the project. The collaboration between Aix-Marseille University and the NRL at MIT began in 2016 and has since enabled mobility in training (MOBIL-APP project of the A*Midex Academy of Excellence), joint actions in research (co-organisation of a workshop at the ANIMMA conference, joint work and development, thesis juries, trainees). CALOR-I will strengthen this collaboration and extend it to other projects.

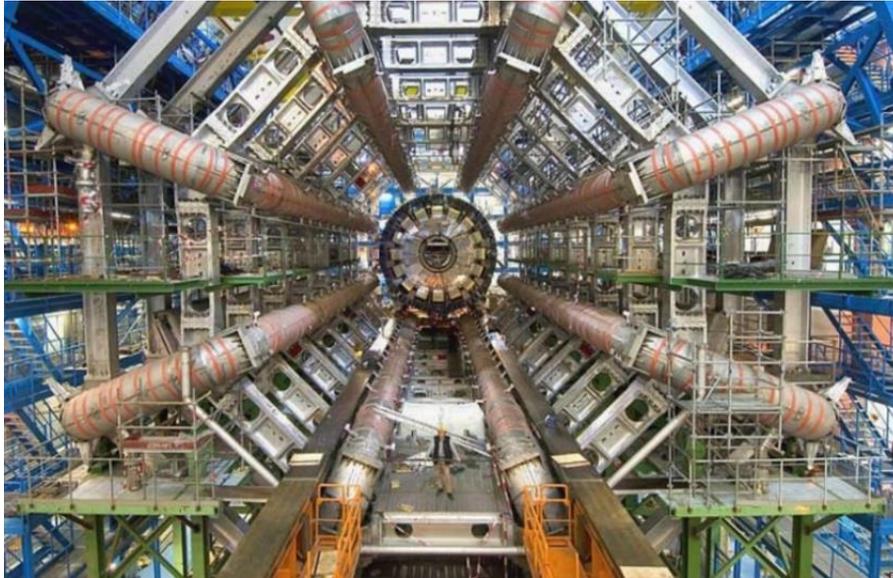
CALOR-I officially started on 1 January 2020 for a duration of 24 months. Over this period, the project will be supported by the A*Midex Foundation with a grant of 198,420 euros.

Contact: [Christelle Reynard-Carette](#)

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A*MIDEX INTERNATIONAL PROJECT | “AIDAQ”
COLLABORATIVE PROJECT COORDINATED BY GEORGES AAD
WITH GERMANY

Photo : ATLAS ; Photo credits : CERN.



AIDAQ project was approved by the A*Midex Foundation as part of the "International 2018" call. It began its activities in January 2020. The project involves a team from Aix-Marseille and the Technical University of Dresden, a German university of excellence.

"Artificial Intelligence on FPGAs: A breakthrough for data acquisition in High Energy Physics experiments and beyond" (AIDAQ) aims to overcome the major challenge of **intelligent processing of very large volumes of data on the fly**. The increasing power of **programmable logic circuits (FPGAs, for Field Programmable Gate Array)** opens up an innovative field combining the potential of artificial intelligence algorithms with large $O(100\text{ TB/s})$ data processing capabilities. In particular, this project should open an innovative path in **particle physics**, with a strong potential for extension to general applications.

Artificial intelligence algorithms and machine learning techniques are today one of the most promising areas of research and industry. The use of artificial intelligence in particle physics is not new, but these algorithms are only used in the later stages of the data analysis chain because of their relatively high computing power requirements. With the next generation of high-end FPGAs, which includes a large increase in available processing and memory units, it becomes possible to implement complex AI algorithms within these FPGAs.

At CERN (the European Organization for Nuclear Research), the world's largest particle physics centre, the upgrade of the Large Hadron Collider (LHC) and the ATLAS detector (photo) is a cornerstone of European strategies in high-energy physics and a major step forward for fundamental physics. The evolution of the readout electronics of the [ATLAS](#) Liquid Argon Calorimeter (LAR) is essential and requires state-of-the-art FPGAs to instantaneously process the huge volume of data with sophisticated algorithms needed to maintain the accuracy required for physics analysis. The ATLAS group at the Marseille Particle Physics Center is responsible for the development of these readout cards.

The modernisation of the LHC and the ATLAS experiment is a crucial part of the European strategy for particle physics. These upgrades are financed by a large consortium of countries (including European countries, USA, Russia, Japan and China) and are supported by the global particle physics community.

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French institutions are financing a significant part of the ATLAS modernisation programme, and in particular the LAr calorimeter. The [Centre de Physique des Particules de Marseille](#) (CPPM) and the Technical University of Dresden (Germany) have leading roles in the consortium. These leading international roles are an opportunity for the CPPM and Dresden groups to propose new solutions for data processing and to ensure the recognition of these solutions by international collaborators.

The project is implemented at the [Centre de Physique des Particules de Marseille](#) (CPPM) -UMR AMU-CNRS, with the Technical University of Dresden (Germany). A close interaction has been initiated with industrials, in this context with NexVision and INTEL/ALTERA to explore and then develop industrial applications of this research program.

AIDAQ officially started on January 1, 2020 for a duration of 24 months. Over this period, the project will be supported by the A*Midex Foundation with a grant of 194,500 euros, notably allowing the recruitment of a post-doctoral student for 2 years.

Contact : [Georges Aad](#)

**A*MIDEX INTERNATIONAL PROJECT | “PATHWAY”
COLLABORATIVE PROJECT ABOUT ALPINE TRANSHUMANCE,
COORDINATED BY FLORENCE MOCCI WITH THE UNIVERSITY
OF YORK (UNITED KINGDOM)**

Photo : Transhumance on the Plateau de Faravel (2200 m, Parc national des Ecrins, Freissinières, Hautes-Alpes).

Photo credits: K. Walsh, University of York, 2013



The PATHWAY project, led by Florence Mocci, CNRS Research Engineer (Camille Jullian Centre), and scientifically co-led by Pierre Magniez, Senior Lecturer at Aix-Marseille University (LAMPEA), was awarded by the A*Midex Foundation as part of the "International 2018" call and started its activities in January 2020. This project is associated with the project of the same name directed by Kevin Walsh at the University of York (Department of Archeology), funded by *The Arts and Humanities Research Council*

(AHRC). The project involves teams from Aix-Marseille and other French laboratories in Chambéry and Toulouse, as well as the Universities of York and Southampton in the United Kingdom.

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The project entitled "*Protohistoric to Medieval pastoralism in the Western Alps: The origins and development of long-distance transhumance (PATHWAY)*" focuses on **long-distance transhumance**, its emergence and development **from the Iron Age to the Middle Ages**. Transhumance, the seasonal movement of herds along migration routes in the Mediterranean and the Alps, was inscribed on the [Representative List of the Intangible Cultural Heritage of Humanity](#) in December 2019. The historical approach of the project should make it possible to characterize the composition and structure of domestic herds and to understand their seasonal movements in the Western Alps (France, Italy and Switzerland). PATHWAY will use archaeozoological studies and specific analyses of the teeth and bones of caprines and bovines from archaeological sites (strontium and oxygen isotopic analyses) to determine the origin and mobility of the herds. The study of animal bones collected in significant quantities during recent archaeological excavations in the French Alps and lower Provence will make it possible to understand the role of urban centres in the Alpine pastoral economy and to express the production/consumption patterns of protohistoric and historical societies. Moreover, the coring of alpine lakes will have to specify the impact of pastoralism on high altitude landscapes, in terms of erosion, changes in vegetation...

PATHWAY brings together a complementary consortium of specialized teams from the Aix-Marseille research site, the [Centre Camille Jullian \(CCJ\)](#) for its expertise in human-environment relations, the Alpine arc and agro-pastoral practices, the [Laboratoire Méditerranéen de Préhistoire Europe Afrique \(LAMPEA\)](#) and the [Laboratoire d'archéologie médiévale et moderne en Méditerranée \(LA3M\)](#) which will conduct the archaeozoological studies. Two other French laboratories are contributing to the project: [EDYTEM](#) in Savoie, for coring alpine lakes, and [TRACES](#) in Toulouse, for its expertise in medieval agricultural practices.

PATHWAY is also the result of a long tradition of scientific cooperation between the Centre Camille Jullian (Aix-Marseille) and the [Department of Archaeology at the University of York](#) in the United Kingdom on common issues related to the history of settlement dynamics and landscapes in medium and high mountain territories and the Mediterranean basin. The University of York provides expertise in landscape archaeology and, the [University of Southampton](#), in bioarchaeology. This project thus reinforces an already strong scientific collaboration, which has led to a Convention for International Research Cooperation in 2019.

The project is coordinated by the CCJ (UMR 7299 Aix-Marseille Université-CNRS-Ministry of Culture), in conjunction with its partners. **PATHWAY officially started on 1 January 2020 for a duration of 24 months**. Over this period, the project will be supported by the A*Midex Foundation with a grant of 182,023 euros, and will benefit from international co-financing from the University of York (AHRC) in the amount of 927,000 euros.

Contact : [Florence Mocci](#) and [Pierre Magniez](#)

More information : [project website](#)

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A*MIDEX INTERNATIONAL PROJECT | “JUNE”
 COLLABORATIVE PROJECT IN EVOLUTIONARY
 DEVELOPMENTAL BIOLOGY, COORDINATED BY CAROLE
 BORCHIELLINI WITH THE UNITED STATES OF AMERICA (USA)

Photo : *Oscarella lobularis* sponge. Photo credits : Christian Marschal (IMBE)



The JUNE project, led by Carole Borchiellini, Senior Lecturer at Aix-Marseille Université, was awarded by the A*Midex Foundation as part of the "International 2018" call for projects. It started its activities in January 2020. The project involves teams from Aix-Marseille, the European Molecular Biology Laboratory (EMBL) and the University of Florida in the United States.

The project entitled "**Cell JUNction Evolution**" (JUNE) operates in the field of **evolutionary developmental biology**, whose general objective is to understand the origin of the morphological complexity of organisms, both plants and animals, through the comparative study of the genes that regulate their development. The JUNE project focuses on understanding **the origin and evolution of epithelium in animals**. Epithelia are tissues made up of joined cells that form a barrier between the inside of the body and the outside. Epithelia therefore play a key role in maintaining body integrity and controlling homeostasis in animals. As a result, even the slightest deregulation can lead to significant disturbances. It is therefore crucial to understand when and how this fundamental cellular organization emerged during evolution.

More specifically, JUNE will focus on the two oldest animal lines, ctenophores and sponges, which are marine organisms. The project aims to characterize the proteins involved in the establishment and maintenance of their epithelia in order to establish their level of conservation at the animal scale, and to identify the fundamental molecular mechanisms conserved during evolution.

The synergy of four internationally recognized laboratories in different and complementary fields will be able to answer these exciting evolutionary issues through the implementation of complementary approaches in comparative transcriptomics, proteomics and immunomarking. The project involves two laboratories on the Aix-Marseille site : the [Mediterranean Institute of marine and terrestrial Biodiversity and Ecology](#) (Aix-Marseille Université - CNRS) for its expertise on sponges in particular, and the [Developmental Biology Institute of Marseille](#) (Aix-Marseille University - CNRS) for its expertise on epithelia ; associated with the [European Molecular Biology Laboratory - EMBL](#)- (Europe) and in particular its Developmental Biology Unit in Heidelberg (Germany) for its expertise in evolutionary

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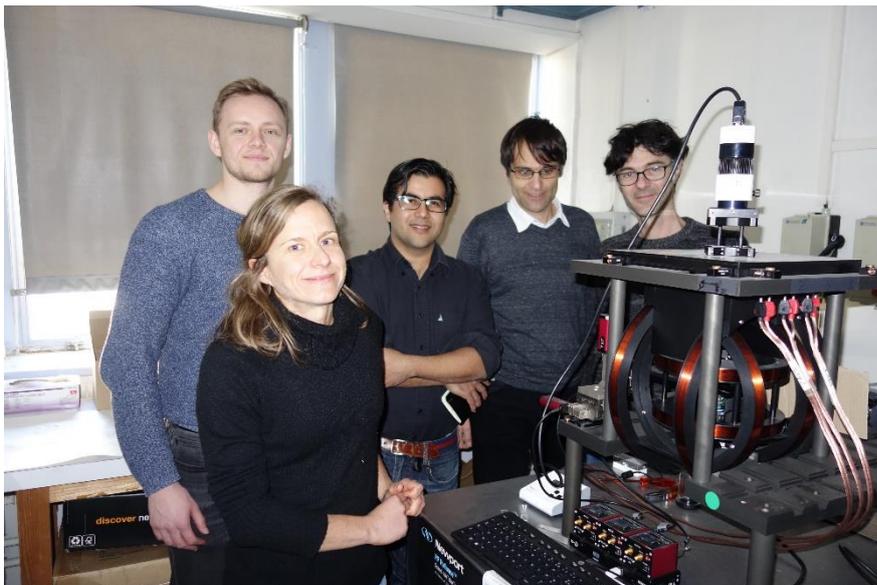
developmental biology, and the [Whitney Laboratory for Marine Bioscience](#) of the University of Florida (USA) for its expertise on ctenophores.

The project is coordinated by the Mediterranean Institute of marine and terrestrial Biodiversity and Ecology (UMR Aix-Marseille Université-CNRS), in conjunction with its partners. **JUNE officially started on 1 January 2020 for a duration of 24 months.** Over this period, the project will be supported by the A*Midex Foundation with a grant of 200,000 euros.

Contact: [Carole Borchiellini](#)

A*MIDEX INTERNATIONAL PROJECT | “MATHER” EUROPEAN COLLABORATIVE PROJECT ON MICROORGANISMS, WITH GERMANY AND SPAIN

Picture : International kick-off meeting of MaTher. Photo credits : Véronique Lamare (BIAM)



MaTher project, led by Damien Faivre, research fellow at the CEA (BIAM), has been approved by the A*Midex Foundation as part of the "International 2018" call, and started its activities in February 2020. The project involves a team from Aix-Marseille and from the University of Göttingen in Germany and the Institute of Bioengineering of Catalonia (IBEC) in Spain.

The project "***Magnetotactic bacteria and magnetosomes-based theranostic systems (MaTher)***" is concerned with magnetotactic microorganisms forming magnetic nanoparticles and moving along the lines of the Earth's magnetic field.

Microorganisms in general, such as bacteria and algae, have developed effective systems to detect external stimuli in their complex environment and to respond accordingly to changes by moving using organs called *flagella* or *pili*. These microorganisms can thus be described as "microswimmers". For the past ten years or so, research has been looking into the development of artificial bacterial flagella, in particular for **biomedical applications, especially for the treatment of diseases (using these microswimmers to transport molecules for treatment)**. Microorganisms are also used either directly or as inspiration for the design of medical robots.

These developments now face scientific and technical barriers, and **new approaches must be developed to make the conception of these devices simpler and make them more robust.** Purely

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synthetic approaches cannot achieve the level of efficiency that natural systems have in terms of detection, which is leading to hybrid developments. In particular, the MaTher project proposes to **develop the potential of so-called "magnetotactic" bacteria** as biohybrid cargo systems. These bacteria synthesize magnetic nanoparticles (called "magnetosomes") that can be used to direct cell movement, or as a contrast agent for medical imaging.

Few research groups in the world today are working on magnetotactic bacteria and micro-swimmers for biomedical applications. The Aix-Marseille site (including CEA Cadarache) has a unique opportunity, with Dr. Faivre's research team and the MaTher project, to develop this research. An important financial and institutional effort has also been developed in Germany recently through a priority programme of the German Research Foundation (DFG).

MaTher associates Dr. Faivre's team with complementary teams in Germany and Spain. The aim is to establish a strong scientific collaboration between the Aix-Marseille team and the research group of Prof. Dr. Stefan Klumpp (theoretical biophysics) at the [University of Göttingen](#), a collaboration initiated by Dr. Faivre with joint research grants during his time in Germany. The [Institute of Bioengineering of Catalonia \(IBEC\)](#), a Spanish centre of excellence, and in particular the *Smart nano-bio-devices group* of Prof. Samuel Sánchez, is also a partner in the project and brings its expertise in synthetic and hybrid devices.

The project is coordinated by the [Institut de Biosciences et de Biotechnologies d'Aix-Marseille](#) - BIAM (UMR 7265 Aix-Marseille Université-CNRS-CEA), in conjunction with its partners. **MaTher officially started on 1 February 2020 for a duration of 24 months.** Over this period, the project will be supported by the A*Midex Foundation with a **196,600 euros** grants, to fund the experiments and the recruitment of a post-doctoral student for two years.

Contact: [Damien Faivre](#)

More information: [project web page](#) on the BIAM website, and [news](#) on the project kick-off meeting.