

## CALL FOR EXPRESSION OF INTEREST:

# Université Côte d'Azur (UCA<sup>JEDI</sup>) welcomes postdoctoral fellows in the framework of the Marie S.-Curie Actions programme

Université Côte d'Azur, the National Centre for Scientific Research (CNRS), Cote d'Azur Observatory (OCA) and Centre Hospitalier Universitaire of Nice (CHU Nice) are looking for talented and ambitious postdocs who want to apply for Marie Skłodowska-Curie Postdoctoral Fellowships (funded by the European Commission, under the Horizon Europe programme). Hereafter you will find information about the offers of UCA<sup>JEDI</sup> research units willing to host fellows.

### What are Marie S.-Curie Postdoctoral Fellowships

Marie Skłodowska-Curie Postdoctoral Fellowships aim to support the career development and training of researchers in all scientific disciplines through international and intersectoral mobility. The fellows carry out their own research project in collaboration with a host institution, which is indicated at the time of their application. Researchers of all ages, nationalities and scientific disciplines can apply. Postdoctoral Fellowships provide an extremely enriching experience that enhance the career perspectives by developing new scientific competences and gaining international and collaborative research experience.



The European Commission will launch the call for projects in May 2021 and the deadline for submission of applications is September 15th 2021. The selected projects may start between April 2021 and September 2022, for a duration of 12-24 months.

### Université Côte d'Azur (UCA<sup>JEDI</sup>) as host institution

[Université Côte d'Azur](https://www.univ-cotedazur.fr)<sup>JEDI</sup> includes 17 major academic establishments around the historic university core to create one of France's top 10 research-intensive universities. Université Côte d'Azur offers an attractive research environment, among the most competitive in France.

In the framework of the Marie S.-Curie Actions, postdoctoral students will be hosted by one of the following establishments, depending on the research focus:

- **Université Côte d'Azur:** a world-class multidisciplinary research intensive university, who obtained the prestigious "Initiative of Excellence" label in 2016, which illustrates the quality of its research and ensures its visibility and attractiveness. The research carried out aims to meet major challenges in science and society and it covers a wide spectrum of objectives, approaches and methodologies.
- **National Centre for Scientific Research (CNRS):** one of the most important research institutions in the world. To meet the major present and future challenges, its scientists are exploring living things, matter, the universe and the functioning of human societies. The CNRS of Côte d'Azur covers a wide spectrum of disciplines, present in the Alpes-Maritimes and Var.
- **Cote d'Azur Observatory (OCA):** a national public institution of higher education and administrative research and carries by its statutes the missions of scientific research, observation services and dissemination of knowledge of an Observatory of Sciences of the Universe (OSU). The OCA brings together and manages research activities in Earth and Universe sciences in the Riviera region.

[www.univ-cotedazur.fr/cem](http://www.univ-cotedazur.fr/cem)

- **Centre Hospitalier Universitaire of Nice (CHU Nice):** a public establishment and the leading health actor in the Alpes-Maritimes. The CHU performs 3 essential functions: Care (diagnosis, prevention, education); Education (medical and paramedical training) and Research-innovation (contribution to the progress of medical and pharmaceutical sciences).

## The Call for expression of interest

Researchers interested in applying to the Call for expression of interest of UCA<sup>JEDI</sup> may be of any nationality but they should meet the eligibility criteria of the Marie S.-Curie programme, which are the following:

- Must be **postdoctoral researchers** at the date of the call deadline (September 15, 2021), i.e. in a possession of a doctoral degree, defined as a successfully defended doctoral thesis, even if the doctoral degree has yet to be awarded.
- Must comply with the following **mobility rule**: they must not have resided or carried out their main activity (work, studies, etc.) in France for more than 12 months in the 36 months immediately before the call deadline.
- At the call deadline (September 15<sup>th</sup>, 2021), supported researchers must have a **maximum of 8 years full-time equivalent experience in research**, measured from the date that the researcher was in a possession of a doctoral degree and certified by appropriate documents. Years of experience outside research and career breaks (e.g. due to parental leave), will not be taken into account.

### APPLY TO THE CALL FOR EXPRESSION OF INTEREST

If you meet the eligibility criteria described above and are interested to respond to our call for expression of interest you have two choices:

- 1
  - Look into our university's host offers (please find hereafter the list of projects) and find the research topic that best suits your career interests.
  - Send us your CV<sup>1</sup> and a Cover letter tailored to the research topic you chose from our offer.

OR

- 2
  - If you do not find a topic that corresponds to your interests, propose a personal innovative and transdisciplinary postdoc research project that can be deployed over 12-24 months. It would be better if you will have already [identified a research unit](#).
  - Send us your CV<sup>1</sup>, a Cover letter **and** a description of the research topic you propose (objectives, approach, methodology, impact..)

**Send us your application in English at [cellule-europe-mutualisee@univ-cotedazur.fr](mailto:cellule-europe-mutualisee@univ-cotedazur.fr)**

**Application deadline: May 31, 2021. The sooner the better!**

Accepted applicants will be contacted at the latest mid-June and they can immediately start working on the proposal together with their supervisor. The [Joint European Research Office](#) of UCA<sup>JEDI</sup> will provide full support in the application process.

We thank you in advance for your interest.



<sup>1</sup> Your CV should also include information on publications, granted patents, invited presentations to international conferences, organization of conferences in your field of research, examples of participation in industrial innovation, prizes and awards, funding received so far, supervising and mentoring activities.

## List of postdoctoral projects

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# SOCIAL SCIENCES AND HUMANITIES

## Spatialialization and capacity in short-term memory (12 month)

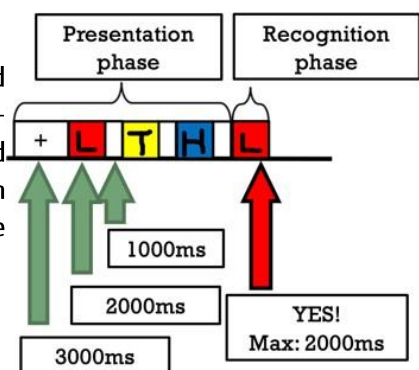
**Research unit:** BCL (Bases, Corpus, Language) / Mixed research unit Université Côte d'Azur and National Centre for Scientific Research (CNRS)

### Project summary:

Spatialization is a process by which spatial information can supplement the cognitive system to process information. Spatialization is used explicitly by mnemonists in world memory championships, who extensively employ the method of loci invented 2500 years ago (Yates, 1966), but on the unconscious side of cognitive processes, spatialization also occurs widely. In numerical cognition (Dehaene et al., 1993), numerous studies have confirmed that numbers are processed spatially along a horizontal mental number line. Research in human development seem to suggest that spatialization starts very early in life. For instance, seven-month-old babies show preference for increasing numeral sequences presented from left to right (de Hevia et al., 2014). In animal cognition, spatialization has also been a fascinating topic after the discovery that newborn domestic chicks naturally show a leftward bias (Rugani et al., 2015, 2010). Although these findings are in line with the idea that spatialization seems to possess an innate dimension, its direction also appears to be culturally determined. We showed (Guida et al., 2018), for instance, that spatialization of a series of items to-be-recalled immediately depends on the direction of reading/writing, after Shaki et al. (2009) had found a similar result in long-term memory.

Whether spatialization is a by-product of reading and writing proficiency in older individuals remains an open question. We for instance found no spatialization in illiterate subjects (Guida et al. 2018) and spatialization could thus be very malleable. For instance, Guida, Mosinski, Cipora, Mathy, and Noël (2020) showed that the direction of spatialization can be reversed by adults asked to mentally organize the memoranda from right to left. These diverse issues leave us with a vast field of inquiry for studying the relationship between working memory capacity, memorization of verbal information and spatialization.

Fig.1. Go No-Go task used to detect spatialization of a to-be-remembered sequence. Spatialization is measured by the difference between right-hand and left-hand reaction times (RTs). This RT difference is expected to decrease in favor of the right hand as a function of the ordinal position of the tested items in the original sequence. The expected negative slope corresponds to a left-to-right direction in Westerners.

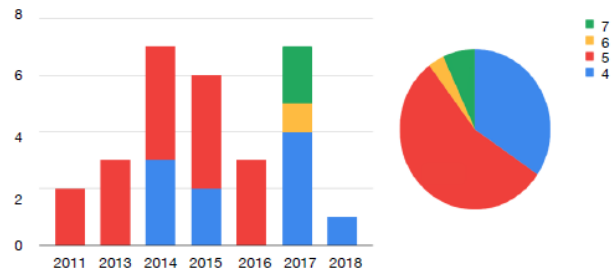


### Hypotheses and objectives

1. **Psychometric approach: Measure of capacity.** Based on the review by Guida and Campitelli (2019), we compared the studies according to the length of the memoranda (see Fig. 2). It is clear that past designs have been chosen to use list lengths that are superior or equal to working memory capacity (i.e., 4; see Cowan, 2001) and inferior to short-term memory capacity (i.e., 7; see Miller, 1956), without the reasons for this choice being explicit in the papers. It is not clear whether researchers targeted infra-span lists but we presume the idea was to fit capacity, and indeed memory performance at these span tasks is generally high. Our hypothesis is that spatialization predominantly occurs when span tasks fit capacity. Because

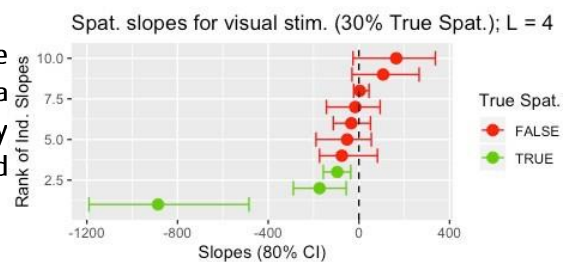
capacity can be computed in these tasks by the formula  $k = \text{MAX}(L(pH-pFA))^2$ , an initial series of experiments will determine how list lengths can be optimized individually in children and adults to increase power in terms of the largest spatialization effect. By taking the MAXimal value of  $k$  across list length, we can estimate working memory capacity. For instance, if capacity  $k$  is 3 for  $L=3$ , but only  $k = 4(.75-.25) = 2$  for  $L = 4$ , then  $\text{MAX}(k) = 3$ . This is the foundation of the present project.

Fig.2. Distribution of the length of the to be remembered sequences in published studies between 2011 and 2018.



2. Bootstrapping approach: Detection of true spatializers. After we obtain custom-made measures of individual spatializations by computing  $k$ , our goal is to determine the reliability of the spatialization effect at the individual level. To do so, we will apply a bootstrapping method developed by Cipora et al. (<https://psyarxiv.com/bwyr3/>). Fig. 3 shows pre-test results with 10 participants. Individual spatialization slopes are marked in green when confidence intervals are outside zero.

Fig.3. Result of a bootstrapping analysis to detect the true spatializers among 10 participants. In this pretest using a limited number of trials with sequences of Length = 4, only three participants showed a reliable negative slope expected in Westerners.



## Supervision:

The supervisor, Fabien Mathy's current research is focused on working memory capacity and its development, chunking and compression processes, and structure of span tasks. The collaborator Alessandro Guida specializes in working memory and spatialization. Selected articles of the two collaborators that specifically relates to the present topic can be found in Section III of this pre-proposal. The two collaborators (A. Guida and F. Mathy) have more than 500 citations each in Google Scholar and this grant would amplify their potential. Fabien Mathy is experienced in managing grants after being PI of two previous ANR grants. In 2019, [Alessandro Guida](https://perso.univ-rennes2.fr/alessandro.guida) (<https://perso.univ-rennes2.fr/alessandro.guida>) and I ([Fabien Mathy](http://fabien.mathy.free.fr), PI, <http://fabien.mathy.free.fr>) organized **The Mind's Spatialization in Humans and Non-humans Workshop** at Université Côte d'Azur.

Sample of publications of the supervisor and collaborator:

*Chekaï, M., Gauvrit, N., Guida, A., & Mathy, F. (2018). Compression in working memory and its relationship with fluid intelligence. Cognitive Science, 42, 904-922.*

*Guida, A., Mosinski, F., Cipora, K., Mathy, F. & Noël, Y. (2020). Spatialization in working memory: Can individuals reverse the cultural direction of their thoughts? Annals of the New York Academy of Science. In press.*

*Guida, A., Fartoukh, M., & Mathy, F. (2020). The development of working memory spatialization revealed by using the cave paradigm in a two-alternative spatial choice. Annals of the New York Academy of Science. In press.*

<sup>2</sup>  $k$ , capacity;  $L$ , ListLength;  $pH$ , proportion of Hits;  $pFA$ , proportion of False Alarms. Hits are defined as correct detection and false alarms are incorrect responses when a lure is presented.

Guida, A., Megreya, A. M., Lavielle-Guida, M., Noël, Y., Mathy, F., van Dijck, J. P., & Abrahamse, E. (2018). Spatialization in working memory is related to literacy and reading direction: Culture "literarily" directs our thoughts. *Cognition*, 175, 96-100.

Mathy, F., Fartoukh, M., Gauvrit, N., & Guida, A. (2016). Developmental Abilities to Form Chunks in Immediate Memory and its Non-Relationship to Span Development. *Frontiers in Psychology: Cognition*, 7, #201.

Mathy, F., Fartoukh, M., Friedman, O., Gauvrit, N., & Guida, A. (2020). Children's Working Memory Develops at Similar Rates for Sequences Differing in Compressibility. *L'Année psychologique, Special issue on working memory*. 120, 175-202.

## Philosophy of Inheritance - PHILHERIT project (24 months)

**Research unit:** [CRHI \(History of Ideas Research Center\)](#)/ Université Côte d'Azur

### Project summary:

#### *Project context*

As demonstrated by Anthony B. Atkinson for the United Kingdom (Atkinson 2013), Joseph Stiglitz for the United States (Stiglitz 2019), Thomas Piketty for France (Piketty 2011 and 2013) and for other European countries (Alvaredo, Garbini & Piketty 2017), inherited wealth has been making a comeback in developed countries since the 1970s. After decreasing in the first half of the twentieth century, the share of inherited wealth in the total resources of households has now reached a level comparable to the level it held in the nineteenth century. Far from benefiting everyone, this comeback is a strong factor of discrimination because it is highly concentrated.

#### *Aim of the project*

This "inheritance comeback" has been encouraged by inheritance taxes that have been reduced or even completely abolished in some countries, and yet it generates unfair inequalities. In light of a preliminary and minimal definition of justice which is to "render to each his own" (*suum cuique tribuere*), current low-tax or non-tax inheritance systems are unfair: individually, these systems benefit heirs not by virtue of their personal merit, but by the accident of their birth; collectively, the surge in inherited wealth reinforces the transfer of inequalities between generations, by concentrating opportunities among certain social groups, thereby generating economic and social segregation. Yet, this "inheritance comeback" is not collectively perceived as unfair today. As several recent studies have shown, inheritance inequalities are better tolerated than other types of economic inequality (Forsé et al. 2018) and the inheritance tax is one of the most unpopular taxes (Hammar et al. 2008; Prabakar 2012; Grégoire-Marchand 2018). Is the commonly held opinion that justice is on the side of inheritance and injustice on the side of taxation totally unfounded? Could we not consider, based on the same preliminary definition of justice, that it is fair for individuals to freely dispose of the goods they have acquired during their lifetime, and even dispose of them after their death? Would it not be unfair for children to be dispossessed of property to which they are attached because these belong "to the family" and represent the physical embodiment of the family heritage? The inheritance institution presents a *normative dilemma*: does "to render to each his own" mean that only personal merit should be rewarded by limiting inherited resources as much as possible, or, on the contrary, should these resources be established as truly being "own's own", that one can freely dispose of, even beyond one's death, as a material consolidation of the family heritage? The PHILHERIT project intends to **explore the relationship between inheritance and justice, and to overcome the normative dilemma of inheritance.**

#### *General methodology of the project*

To achieve this goal, the PHILHERIT project proposes to use a philosophical approach to study the institution of inheritance. While the question of inheritance is of increasing importance in economics, it remains surprisingly absent in philosophy, even though it covers the cardinal philosophical concepts of property, family, death, social justice, tax justice, equal opportunity, and utility. More surprisingly still, with the notable exception of left libertarians (Steiner 1994; Vallentyne 2001; Van Parijs 1991 and 1995; Otsuka 2000), the inheritance institution remains largely unchallenged, even among the proponents of theories of justice. **This research project aims to break this silence in contemporary social and political philosophy.**



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## Supervision:

[Mélanie PLOUVIEZ](#), Associate Professor of Philosophy, Université Côte d'Azur



# BIOLOGY

## Roles of stress-induced phase separation in RNA regulation and evolutionary adaptation (24 month)

**Research unit:** [iBV \(Institut de Biologie Valrose\)](#)/ Mixed research unit Université Côte d'Azur, National Centre for Scientific Research (CNRS) and INSERM

### Project summary:

Organismal development and fitness depend on the precise control of gene expression. Recent research has started to shed light on a poorly understood, yet universal phenomenon of post-transcriptional control of gene expression in response to environmental stress: phase transitions of RNA supramolecular condensates (granules) containing translationally repressed RNAs and RNA-binding proteins. Despite its universal occurrence across eukaryotic taxa, the fundamental biological relevance of RNA phase separation remains to be fully explored.

Preliminary work by the teams of Arnaud Hubstenberger (IBV) and Christian Braendle (IBV) shows that RNA phase separation in the *C. elegans* germline displays extensive environmental and evolutionary variability, suggesting that phase separation is of likely evolutionary ecological relevance. In this collaborative project, we therefore propose (1) to test if observed plasticity in the induction, composition and structure of RNA granules is involved in tuning RNA expression in response to ecologically relevant temperature variation; (2) to test if natural genetic variation in *C. elegans* RNA phase separation and its thermal sensitivity reflects evolutionary variation consistent with adaptation to divergent ecological niches; (3) to genetically map and molecularly characterize natural genetic variation in RNA phase separation taking advantage of existing differences between wild isolates; (4) to test if and how plasticity in RNA phase separation in response to thermal stress improves organismal fitness.

RNA phase separation seems to be a central biological mechanism regulating RNA expression to maintain cellular integrity when facing adverse environments. This project is among the first to test this hypothesis in a metazoan organism.

The objective of the proposed project is to focus on natural variation in stress-induced granule formation and to quantify organismal fitness consequences associated with variation in granule formation. The postdoctoral research associate will use *C. elegans* genetics and mutant analysis, high-throughput phenotyping, molecular biology, advanced microscopy and bioinformatic approaches.

Candidates should have a strong interest in multidisciplinary research at the interface of developmental genetics, cell biology and evolutionary biology.

### Supervision:

Supervision will be jointly provided by Christian Braendle and Arnaud Hubstenberger. The two partner teams have complementary expertise in *C. elegans* RNA phase separation, RNA expression control, and transcriptomics (Team Hubstenberger) as well as genetics, evolutionary biology, and ecology (Team Braendle).

## Extracellular Vesicles in the zebrafish Left-Right Organizer (24 months)

**Research unit:** [iBV \(Institut de Biologie Valrose\)](#)/ Mixed research unit Université Côte d'Azur, National Centre for Scientific Research (CNRS) and INSERM

### Project summary:

After having long been dismissed as mere biological debris, Extracellular Vesicles (EVs) have emerged in recent years as important carriers of biological information in development and disease. While knowledge on mechanisms of EV biogenesis and cargoes transported by these membrane-bound carriers is steadily increasing, our understanding of the physiological functions of these enigmatic extracellular organelles is still in its infancy. The team of Maximilian Fürthauer at the Institut de Biologie Valrose (CNRS UMR7277, INSERM U1091, Université Côte d'Azur) is searching for a highly motivated postdoctoral researcher to study EV function *in vivo* in the context of the establishment of zebrafish LR asymmetry.

EVs arise through two modes of biogenesis: Microvesicles form by plasma membrane budding, while exosomes are released as multivesicular endosomes fuse with the plasma membrane and secrete their intraluminal vesicles into the extracellular space. The ESCRT complex is an evolutionarily conserved membrane remodelling machinery that is implicated in both modes of EV biogenesis, highlighting its particular interest for EV biology. Previous work from the Fürthauer lab has allowed to uncover novel developmental functions of the ESCRT machinery in fish and flies (Matusek et al. 2014, Maminska et al. 2016, Matusek et al. 2019). These studies have notably revealed for the first time that ESCRT-dependent EVs (ESCRT-EVs) ensure the secretion and long-range transport of Hedgehog, a signalling molecule that is of major importance for both normal embryonic development and tumour formation (Matusek et al. 2014, Juan & Fürthauer 2018, Matusek et al. 2019).

The difficulty to visualize EVs within the generally opaque tissues of vertebrate organisms has long hindered their functional analysis *in vivo*. In this context, the transparent embryos of the zebrafish have recently emerged as a unique model system for vertebrate EV biology. Of particular interest, the Fürthauer lab has obtained evidence that EVs are present in the zebrafish Left-Right Organizer (LRO) and required for the establishment of LR asymmetry.

The establishment of LR asymmetry is an essential but poorly understood aspect of animal development. The pathophysiological relevance of LR asymmetry is underscored by the fact that cardiac laterality defects are a major symptom of human Congenital Heart Disease. In numerous vertebrates including fish and humans, LR asymmetry requires motile cilia that are present in a morphological structure that acts as a global LR Organizer (LRO) governing cardiac, visceral and brain asymmetry. Within the LRO, the beating of motile cilia LRO creates a directional fluid flow that is essential for LR asymmetry. Both Experimental work in mice and theoretical considerations have led to the suggestion that the Left-Right Organizer flow may transport EVs that carry symmetry-breaking signalling molecules.

Our recent work has allowed to identify the unconventional non-muscle myosin Myosin1D (Myo1D) as an essential regulator of the ciliary fluid flow in the zebrafish LRO (Juan et al. 2018). In an interdisciplinary collaboration with Xavier Descombes (INRIA Sophia Antipolis), we have moreover generated tools for the quantitative analysis and modelling of flow-mediated transport processes in the fish LRO. Through a combination of genetic, cell biological, quantitative live imaging and mathematical modelling approaches, we presently aim to study the biogenesis, transport and function of EVs in the zebrafish LRO.

Altogether, our takes advantage of the unique opportunities of the zebrafish model system to foster our knowledge EV biology and thereby provide novel insights into the fundamental mechanisms that govern the establishment of LR asymmetry that is required for the proper function of different organs within the body.

Candidates should have a strong drive to implement quantitative approaches at the interface between cellular and developmental biology. Experience in the use of zebrafish or extracellular vesicle biology is not required but will be considered a plus.

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## Supervision:

Maximilian Fürthauer, Institute de Biologie de Valrose, Université Côte d'Azur

## Evolution of animal nervous systems (24 months)

**Research unit:** [LBDV \(Laboratoire de Biologie du Développement de Villefranche-sur-Mer\)](#), Institut de la Mer de Villefranche (IMEV)

### Project summary:

The function of a nervous system is to collect, process and respond to sensory inputs from the environment and the body. Animal nervous systems present a great morphological diversity and due to this diversity, the origin and evolutionary history of these organs remain a matter of fierce debate<sup>1,2</sup>. One of the major points of controversy concerns the origin of condensed, centralized nervous systems, which can be found in various, distantly related animal phyla. This type of nervous system has been proposed to have emerged either only once, in the last common ancestor of bilaterians, or several times, independently in different bilaterian lineages<sup>1-3</sup>. To solve this conundrum, the consensus in the community is to characterize the nervous systems of a wide variety of different animals<sup>1,2</sup>. Yet, the nervous systems of some key lineages still remain largely unstudied.

One animal group that has so far been neglected in comparative analyses of animal nervous systems is that of the echinoderms, chiefly due to the pentaradial symmetry of their adult bodies<sup>3,4</sup>. Our recent work, however, suggests that echinoderms are instrumental for providing insights into the origin and evolution of bilaterian nervous systems<sup>5,6</sup>. Echinoderms together with hemichordates form the ambulacrarians, which are classically considered as close relatives of the chordates (vertebrates, tunicates and cephalochordates). In extant chordates, adult nervous systems are centralized, meaning that they are composed of a central, integrative nervous system (CNS) and a peripheral nervous system (PNS) that connects the CNS with the peripheral structures of the body<sup>7</sup>. It is thus reasonable to postulate that the last common ancestor of chordates already had a centralized nervous system. In ambulacrarians, in turn, the situation is different. They are characterized by several nerve cords and a diffuse basiepidermal nerve plexus<sup>6,8,9</sup>, of which homologies with the CNS and PNS of chordates remain fiercely debated in the case of hemichordates<sup>8,9</sup> and elusive in the case of echinoderms. It is thus currently impossible to draw any solid conclusions on the ancestral state of ambulacrarian nervous systems.

The proposed project aims at addressing this shortcoming by providing a careful molecular description of the developing adult nervous system of two echinoderms, the sea urchin *Paracentrotus lividus*<sup>6,10,11</sup> and the crinoid *Antedon mediterranea*<sup>12</sup>. The data obtained from these animals will subsequently be compared to those acquired in a chordate, the amphioxus *Branchiostoma lanceolatum*<sup>13,14</sup>. The proposed work includes three tasks:

- Task 1 will consist of immunohistochemistry and *in situ* hybridization surveys on *P. lividus*, *A. mediterranea* and *B. lanceolatum* larvae and juveniles to establish matchable molecular references of the developing adult nervous systems for each one of these three species.
- Task 2 will be based on high-throughput bulk and single-cell transcriptome analyses to be carried out on the three species to characterize similarities and differences in molecular timing and developmental trajectories of adult nervous system development.
- Task 3 will make use of pharmacological treatments and inducible, stage-specific loss of function analyses to define the developmental signaling systems required for the formation of the *P. lividus*, *A. mediterranea* and *B. lanceolatum* nervous systems, with a particular attention on intercellular signaling pathways, such as Wnt, retinoic acid, BMP and Hh signaling.

Taken together, this work will create a wealth of new data on the development of the adult nervous system of a sea urchin, a crinoid and an amphioxus. Comparisons of the results obtained in the sea urchin and the crinoid will reveal the anatomical and molecular nature of the ancestral echinoderm nervous system. Comparisons with the situation in amphioxus will further establish homologies between

echinoderm neural structures and those of amphioxus, which will thereby provide novel information for addressing the questions of the origin and evolution of centralized nervous systems in bilaterians.

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## Supervision:

Jenifer Croce and Michael Schubert, [Evolution of Intercellular Signaling in Development \(EvoInSiDe\)](#)

# HEALTH

## Role of sensory nerves in the immunosuppressive tumor immune microenvironment of aggressive cutaneous squamous cell carcinoma (24 month)

**Research unit:** [IPMC \(Institute of Molecular and Cellular Pharmacology\)](#)/ Mixed research unit Université Côte d'Azur, National Centre for Scientific Research (CNRS) and INSERM

### Project summary:

We are seeking a highly motivated post-doctoral fellow with strong expertise in immunology, mouse models, bioinformatic and multiparametric analyses and with strong motivation to develop innovative technical approaches at the interface between immunology, dermatology and neurobiology.

The project will be supervised by Dr V. Braud heading a research group with Dr F. Anjuère at the Institute of Molecular and Cellular Pharmacology (IPMC) (<https://www.ipmc.cnrs.fr/cgi-bin/ipmcx.cgi>) at the Université Côte d'Azur. Recent work conducted by the team has provided evidence that immune suppression associates with aggressive cutaneous squamous cell carcinoma (cSCC). Through gene expression profiling, imaging mass cytometry and phenotypic and functional analyses, they have characterized immune cells infiltrating cSCC, identified mechanisms that drive tumor growth and propose immune cell reprogramming (Khou, 2020, Luci, 2021, Elaldi, 2021, Goncalves-Maia, 2020). They also used mathematical modeling and numerical methods to predict tumor outcome (Atsou, 2020). In this context, they visualized the presence of sensory nerves interacting with components of the tumor immune microenvironment. They now seek to understand the role of nerve fibers as regulator of cancer progression, to identify and quantify interactions of immune cells with nerves and to identify the cellular and molecular mechanisms promoting tumor growth. The candidate will develop this project in interaction with the team and in collaboration with neurobiologists at the institute.

### References:

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**Supervision:** The project will be supervised by Dr Véronique Braud heading a research group with Dr Fabienne Anjuère at the Institute of Molecular and Cellular Pharmacology.



## Integrative spatial characterization of tumor immune microenvironment associated with progression of oral cavity squamous cell carcinoma: impact of myeloid cells and nerves in immune evasion (24 month)

**Research unit:** [IPMC \(Institute of Molecular and Cellular Pharmacology\)](#)/Mixed research unit Université Côte d'Azur, National Centre for Scientific Research (CNRS) and INSERM

### Project summary:

We are seeking for a motivated, skilled post-doctoral candidate to study the tumor immune microenvironment associated with progression of oral cavity squamous cell carcinoma (OCSCC) and to elucidate the impact of interactions between immunosuppressive myeloid cells and nerves.

The project objective is to provide an extensive in situ characterization of OCSCC immune infiltrate and its interaction with other components of the Tumor Micro-Environment and to elucidate immune mechanisms triggering tumor growth. The project will focus on the impact of immunosuppressive myeloid cells and tumor-associated nerves in immune evasion in OCSCC. The project will be conducted using human OCSCC cohorts, in vivo OCSCC mouse models and in vitro cellular assays (Spénlé, 2020; Khou, 2020; Luci, 2021; Paris, 2021). The candidate will use integrative high-dimensional technological approaches including Imaging Mass Cytometry (IMC) and multiparametric flow cytometry technologies combined with bio-informatic analyses (Elaldi, 2021). Implications of our findings for human cancer will be determined by analyzing samples from human patients. This collaborative project will provide training in an interdisciplinary context at the crossroads of immunology, neurobiology and human tumor pathology.

The Institute of Molecular and Cellular Pharmacology (IPMC) is a Research Center equipped with state of the art core facilities and a dynamic scientific environment including immunologists, molecular biologists and neurobiologists. The team is headed by F. Anjuère and V. Braud. F. Anjuère is an expert in mucosal immunology and has led numerous studies aimed at developing mucosal vaccines against infectious diseases and cancer. Clinical collaborators at the head and neck oncology team of the Centre Antoine Lacassagne (CAL) and University Head and Neck Institute (IUFC) are actively involved in clinical studies.

The successful post-doctoral candidate should have a strong background in immunology and experience in multiparametric tissue imaging and unsupervised high-dimensional data analyses and mice studies. Excellent written and spoken English communication skills, strong self-motivation, the ability to work both independently and collaboratively is expected.

### References:

Spénlé C, Loustau T, ... Anjuère F, Van Oberghen-Schilling E and G Orend. TNC orchestrates an immune suppressive TME in OSCC. *Cancer Imm. Res.* 2020.

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**Supervision:** The project will be supervised by Dr Fabienne Anjuère.

# SPACE SCIENCES

Formation of protoplanets, mid-infrared interferometric observations of the inner region of protoplanetary disks (24 month)

**Research unit:** [JL LAGRANGE laboratory](#) / Mixed research unit Université Côte d'Azur, National Centre for Scientific Research (CNRS) and Côte d'Azur Observatory (OCA)

## Project summary:

Protoplanetary disks are the birth place of planetary systems. They are created during star formation and they rapidly evolve in a few million years. As shown from radio-interferometry observations such as with ALMA and, from visible and near-infrared high angular resolution imaging as the ones performed by the SPHERE/VLT instrument, the protoplanetary disks present various structures : inner cavities, gaps, emitting clumps, spiral features. The recently installed VLTI/MATISSE mid-infrared instrument is the perfect tool to study the inner disk geometry by performing mapping of the smaller scales (1-10 au) where telluric planets are expected to form.

The intermediate scales in disks in the range 10-30 au remain poorly explored due the lack of angular resolution of single dish instruments observing at the same wavelengths than MATISSE. In this context, the new mid-infrared instrument Large Binocular Telescope INTERFEROMETER of University of Arizona allows to significantly improve the disk exploration at intermediates scales (10-30 au), and thus bridges the gap between MATISSE and mid-infrared classical imaging observations. We propose to perform VLTI and LBTI coordinated observations on a selection of protoplanetary disks. This collaboration between the MATISSE european Consortium and the LBTI team of University of Arizona open new perspectives for the 2 teams. It requires one post-doc researcher on the European side for performing joint LBTI/MATISSE observation programs and contributing to their interpretation. A two year fellowship support will allow to build, together with our team resources, a database of 10 observed and modelled protoplanetary disks

## Supervision:

The project will be supervised by Bruno Lopez and Alexis Matter.

## Asteroid mass determination with Bayesian technics (24 month)

**Research unit:** [GEOAZUR laboratory](#) / Mixed research unit Université Côte d'Azur, National Centre for Scientific Research (CNRS) and Côte d'Azur Observatory (OCA)

### Project summary:

#### Context

The macro porosity of asteroids and their internal structures are directly linked to their origin, heat alteration and also to the past collisional evolution of the asteroid belt. The knowledge of masses of main-belt asteroids combined with diameters measurements collected by the MP3C database developed at the Observatoire de la Côte d'Azur is then an important input for constraining models of evolution for the main belt planetesimals.

Furthermore, since 2003, our team develops the INPOP planetary ephemerides, providing very accurate planetary, Moon and asteroid orbits ([www.imcce.fr/inpop](http://www.imcce.fr/inpop)). INPOP ephemerides are used by space agencies (CNES, ESA) for the navigation and scientific analysis of spacemissions such as Gaia, Bepi-Colombo and Juice, and by scientists for testing general relativity, constraining mass distribution in the solar system, solar physics, and paleoclimatology (ERC AstroGéo).

#### Methods

Several methods of mass determinations are used but only 50 masses are known up to now with a good accuracy, mainly deduced from binary system (asteroid with satellites). In 2020, our team demonstrates that it is possible to determine with an accuracy better than 30%, 100 masses in using our planetary ephemerides INPOP (Fienga et al. 2020). For this result we used *a priori* knowledge of the asteroid spectra and run Monte Carlo simulations associated with least squares inversion. However, there is clearly more to explore in this field as we think that free-derivative inversion methods as the one developed in seismology for the past 20-years are very promising for our problem. We will benefit from the proximity with our colleagues in seismology in Géoazur to dig out this approach.

About 250,000 asteroids are indeed in the main belt region, perturbing highly the orbit of the planet Mars for which we have a very good localization (below the meter levels) thanks to Mars orbiters. Because of these very numerous sources of perturbations, the inversion problem is very complex and Bayesian approaches such as the Metropolis algorithms or highly paralalled neighborhood algorithms can be explored.

#### Expected results

We expect to obtain at least 300 asteroid masses with an accuracy better than 15%. This new mass characterization will be also applied for Kuiper Belt objects. Thanks to this work, a new description of the mass distribution into the Main Belt and the Kuiper belt will be obtained, introducing new constraints for the scenario of formation and evolution of the planetesimals in our solar system.

These determinations will also take part of a more global work dealing with the improvement of the INPOP planetary ephemerides, for preparing the arrival of the data from the ESA Mercury orbiter Bepi-Colombo and their use for testing general relativity and for providing more accurate constraints for paleoclimatology datations.

## Relevant references:

A. Di Ruscio, A. Fienga, D. Durante, L. Iess, J. Laskar, and M. Gastineau. Analysis of Cassini radio tracking data for the construction of INPOP19a: A new estimate of the Kuiper belt mass. , 640:A7, August 2020.

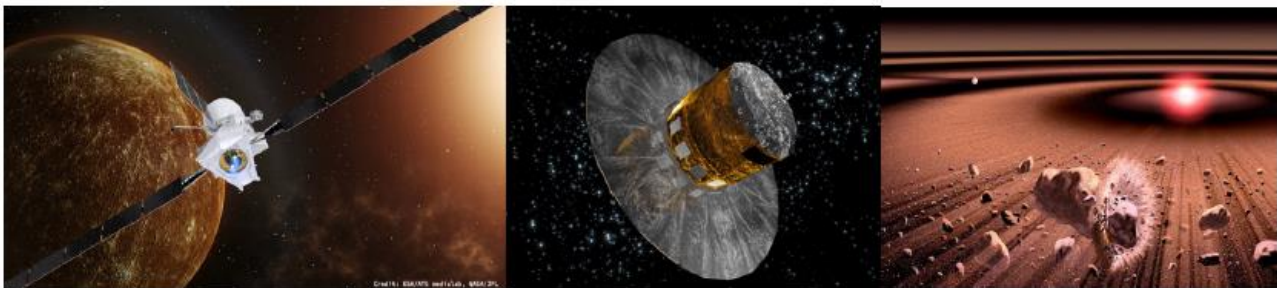
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J. Laskar. INPOP19a planetary ephemerides. Notes Scientifiques et Techniques de l'Institut de Mecanique Celeste, 109, December 2019.

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## Supervision:

The project will be supervised by A. Fienga, Géoazur, Côte d'Azur Observatory in collaboration with M. Delbo (Lagrange laboratory).



# DIGITAL SCIENCES

## Cognitive Cloud: Artificial Intelligence-enabled cloud networking (24 month)

**Research unit:** [I3S \(Laboratoire d'Informatique, Signaux et Systèmes de Sophia Antipolis\)](#) / Mixed research unit Université Côte d'Azur, National Centre for Scientific Research (CNRS) and INRIA

### Project summary:

#### *Description:*

At this year 2021, cloud IP traffic has become the most part of Internet traffic. A traffic that complexifies with an increasing devices diversity and traffic dynamicity. The combination of Machine Learning (ML) and Artificial Intelligence (AI) with Network Softwarization (SDN/NFV) has been proposed in the so-called Knowledge Defined Networking (KDN) to give rise to a "Cognitive Cloud." This "Cognitive Cloud" will allow automatically adapting to the growing complexity and variability of Internet traffic by (i) (re-)learning Cloud network control policies from data monitoring; and, (ii) applying these control policies onto a (re-)configurable Cloud network. For example, thanks to the flexibility provided by Network Softwarization (SDN/NFV), an application could be (re-)deployed in the Cloud or on the Edge (closer to the user) seamlessly (i.e. without degrading the user experience) to optimize the resources usage. This decision would be based on the past and current network status.

Thus, this postdoc is placed at the crossroad of two domains:

1. **Artificial Intelligence (AI):** Deep Learning Artificial Neural Network (ANN) will be used to learn the optimal control policies from network data.
2. **Cloud Computing and Networking Softwarisation:** SDN, virtualization and Cloud orchestration tools will be used to implement the above-mentioned control policies onto private test-beds and/or public cloud platforms.

First, the postdoc researcher will work on the development of the AI algorithms and its deployment on test-beds and/or public cloud platforms. Hence, machine learning knowledge is necessary. Second, the postdoc will work on the development and maintenance of the Cloud test-beds (based on private or public infrastructure) where the AI algorithms will be deployed. Then, a strong background on system, networking and Cloud technologies is recommended.

#### *Pre-requisites:*

#### Desired level of studies:

- PhD degree on Information and Communication Technologies (disciplines such as Computer Science, Telecommunications or Data Science)

#### IT skills:

- Python 3.5 language, Python frameworks (like PyCharm, Jupiter Notebook, Spyder, Conda)
- Deep Learning Libraries (like TensorFlow, Keras)
- Networks and system (Unix, typically)
- VM/Containers technologies, cloud orchestration (OpenStack, Kubernetes, Ansible, Docker, LXD/LXC)
- Network programmability: SDN controllers (e.g. OpenDaylight), OpenFlow protocol, Mininet emulator
- OOP (like Java)

#### Theory:

- Machine learning and data science (namely neural network theory)
- Classical optimization theory (convex optimization, combinatorial optimization)
- Computer network control plane (algorithms and protocols)

#### *Work context:*

The thesis will take place in the I3S laboratory, a joint public research laboratory resulting from the collaboration of the CNRS, Univ. Cote d'Azur and INRIA. The I3S laboratory is one of the most important research laboratories in information and communication sciences in the French Riviera and was one of the first to settle in the science and technology park of Sophia Antipolis. It brings together just under 300 people.

The postdoc will work with experts in optimization, machine learning and telecommunications networks from the I3S and INRIA.

#### References:

*Cisco Global Cloud Index (GCI): Forecast and Methodology, 2016–2021, White paper, Feb. 2018*

*Cisco Annual Internet Report (2018–2023) White paper, Oct. 2020*

*A. Mestres, A. Rodriguez-Natal, J. Carner, et al. Knowledge-defined networking. ACM SIGCOMM Computer Communication Review, 2017, vol. 47, no 3, p. 2-10.*

*D. Kreutz, et al. "Software-defined networking: A comprehensive survey." Proc. of the IEEE, vol. 103.1, pp. 14-76, 2015.*

#### **Supervision:**

This project will be supervised by Ramon APARICIO PARDO (<http://www.i3s.unice.fr/~raparicio/>)

# ECONOMIC SCIENCES

## Industrial Dynamics of Artificial Intelligence: Looking at Job Offers and Skills in Europe (24 month)

**Research unit:** [GREDEG laboratory](#) / Mixed research unit Université Côte d'Azur, National Centre for Scientific Research (CNRS)

### Project summary:

Artificial Intelligence (AI) is probably one of the most documented technologies in the new digital paradigms so far. As every new digital technologies, it is mostly considered a disruptive technology, involving transformation of innovation and production activities (Alcacer et al., JIBS 2016; Aghion et al., NBER 2017), management and organization of firms (Varian, NBER 2018), job creation but also polarization effects (Autor and Dorn, AER 2013), changing skills requirements and firms recruitment patterns (Nedelkoska and Quintini, OECD 2017), and profound impact on labour markets (Acemoglu and Restrepo, 2017 NBER).

To the best of our knowledge, none of these contributions investigated why AI is intrinsically considered a disruptive technology, as yet very few is known about its own industrial dynamics: which companies and sectors are in the field of AI, which AI skills are recruited in the job market and why, whether AI is concentrated in metropolitan areas or more distributed across space.

The project aims to fill this gap in a European context, using a Schumpeterian Mark 1 / Mark 2 framework. This framework is here primarily dedicated to address a novel question: does Artificial Intelligence (AI) – taken as an industry of its own, transversal to existing industries – fit with Schumpeter Mark 1 or alternatively Schumpeter Mark 2 industrial dynamics?

Questioning the Mark 1 or Mark 2 AI industrial dynamics at a granular level (skills level) has not been investigated in the literature so far, and is the core of the current project, at a time where relevant research in the field of AI is highly US centric and the European situation not well documented. This research is further motivated by the non-availability of statistical-friendly data on AI: there is no existing database characterizing AI firms in Europe, the sectors in which they operate, the types of new hires they are recruiting, or their location – all dimensions that are key in the characterization of AI industrial dynamics. The project is thus grounded on the development of an original database, collecting information on job offers and skills posted on a top AI recruitment platform, and providing an entry point to characterize AI industrial dynamics (see Cimiterra, Krafft and Nesta, ICC 2021, for recent works of the project team).

### *Job description*

We are encouraging applications of candidates with proven research experience in the field of industrial dynamics and news digital paradigms (especially Artificial Intelligence), as well as specialization in relevant empirical, econometric and/or modelling tools.

### Supervision:

This project will be supervised by Jackie Kraft from the GREDEG laboratory. GREDEG is located in Nice-Sophia Antipolis and it develops theoretical and applied research in economics, law and management, in the field of innovation.