CNRS-Momentum 2018

CALL FOR PROPOSALS

CNRS launches a call for proposals that aims at enabling independent and talented young scientists to create and lead an original project within a CNRS affiliated laboratory.

In 2019, the CNRS-Momentum program will support projects within the following emerging and transverse themes (that are described in detail on page 3-4):

1. Modeling the living
2. Understanding complex networks
3. Decrypting brain algorithms
4. Applying data science to the Earth and the Universe
5. Boosting sciences for sport
6. Assessing the effects of low doses
7. Studying phenomena at physical interfaces
8. Meeting the challenges of machine learning
9. Designing systems inspired by nature
10. Showing the invisible
11. Rethinking the urban ecosystem
12. Revisiting the carbon cycle
13. Exploring collective intelligence

The CNRS-Momentum funding is allocated for a period of 3 years, from January 1st, 2019. It includes:

1. Three-year salary for non-tenured successful applicants;
2. Two-year salary for a postdoctoral researcher/engineer or one-year salary for a technician;
3. Travel, equipment and operating costs up to a maximum of € 60,000 a year.

Eligibility:

The call is open to young researchers, CNRS tenured or without permanent position, having defended their PhD (or equivalent doctoral degree) after 12/31/2010[*]), whatever their nationality.

[*] Also eligible are candidates who have defended their PhD during a period prior to 31/12/2010 at most equal to the actual period of career interruption due to maternity, adoption, paternity, parental leave, long-term sick leave

Laureates of a similar funding are not eligible (e.g. ATIP program, ANR, ERC, Chaire d'excellence).

Selection of laureates:

The selection criteria are the relevance of the project to the chosen theme, the originality and risky nature of the proposal, the quality of the applicant, the relevance of methodology and budget.

The selection of projects will be carried out by the CNRS Executive Board, under the chairmanship of its President Antoine Petit. It will be done in two stages: short listing in September 2018 and interviews in October 2018. The list of laureates will be established in November 2018.

How to apply:

The application form must be completed on-line here.

The model of scientific project must be downloaded and the project must be joined at the end of the application form (the document must not exceed 8 pages, must be saved in PDF format and named Momentum2018_Project_LASTNAME_Firstame).

Deadline for submission of projects: May 23, 2018 at noon (Paris time)

For any further information, please contact cnrs-momentum@cnrs-dir.fr.

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or national service, on presentation of supporting documents. Example: A candidate who took 6 months of parental leave in 2011 is eligible if he obtained his doctorate after 30/06/2010.

Themes

1. Modeling the living

Novel experimental methods in life sciences call for modelling to obtain quantitative insights which cannot be provided by experimental studies alone. As an example, predicting properties of biomolecules (proteins, DNA…) and/or biological processes, can be achieved through a theoretical approach in direct relation with experimental data. A special attention will be deserved to candidates having already experienced interdisciplinary works with mathematics, physics, computer science, biology, ecology or medicine, and developing rigorous analysis.

Keywords: organization of molecular assemblies, living tissues, evolutionary biology, mechanisms of disease progression and therapy, multi-scale analysis

2. Understanding complex networks

Complex networks are composed of heterogeneous entities, among which local and/or distant interactions create multiple levels of collective structures and organizations. Within such complex systems, among the numerous and difficult challenges one can mention understanding how new behaviors emerge from the interconnections rather than the individual component activities, effects of transitions from one steady state to another, etc. Complex networks include a large range of systems from biomolecules and living cells to social and eco systems as well as large-scale distributed systems such as power grids and internet for example. The investigation of these complex networks requires the dynamic study of communication and interactions between their elementary components as well as specific methodologies going through a specific work on the components or subsystems, including adapted technological developments.

Keywords: large-scale distributed systems, interactions and connectivity, dynamics modeling and control, auto-organization, plasticity

3. Decrypting brain algorithms

The human brain is an outstanding system of information processing. Understanding how the brain actually works, how it can perform such accurate processing and computation with biological components are great challenges. This requires joint pluridisciplinary efforts mixing modelling, simulation and original experimentations. Addressing this challenge will have strong impact in both neurosciences and computer sciences. The objective is to develop research projects uniting both domains through a pluridisciplinary approach aiming at making a paradigmatic shift and cracking the neural code, ultimately.

Keywords: neural code, brain information processing, brain modelling, brain signal processing and control, neuromorphic computing

4. Applying data sciences to the earth and the Universe

Information sciences have nurtured modern research through innovative tools in mathematical modeling, simulations, big data, machine learning, high performance computing, robotics, image and data processing. In some instances, the direct consequence is the emergence of new fields and the transformation of scientific approaches. Astronomy is one of the fields where the impact is potentially huge: instruments are getting extremely productive with the capability to obtain complex information on billions of objects across the universe in quite limited time. Sciences of the earth system fed on the rising number of heterogeneous observations, from space and in situ observations, often interpreted in combination with high performance computation and modelling. The joint and strong involvement of Earth and Universe sciences, in conjunction with data science, mathematical modeling and image processing, will bring out innovative tools for data manipulation and visualization, data interpretation and event prediction.

Keywords: astronomy, astro-informatics, earth system, distributed and high-performance computing, image processing, mathematical modeling, machine learning, data mining

5. Boosting sciences for sport

Sports is at the heart of numerous societal issues: well-being, social interactions, technological innovations. Improving performances of the sportsmen and sportswomen, protecting them against accidents and trauma, developing new technologies (e.g. around material, arbitration or parasports), or improve fight against doping (e.g. through detection of illegal products), these are new challenges to be addressed whose impact lies both on professionals and amateurs. This call therefore concerns transdisciplinary approaches that advance knowledge about sport and sport practices.

Keywords: Biomechanics, material, modelling, detection

6. Assessing the effects of low doses

An important risk for human health or environment is that of low dose of chemicals, drugs, radioactivity, sound, light, endocrine disrupters… These "diluted" risks are difficult to assess, our human societies have to face increasing legal actions and claims. Basic research provides new ways of understanding these low dose effects by developing innovative methods of evaluation, modeling, new decision-making tools, legal-ethics, social and cost-benefit analyses and mechanisms of action. The development of analytical and imaging techniques capable of probing ultra-low concentration of chemical or biological products and their distribution in complex systems are central to this theme. Particular attention will also be paid to the bioconversion of toxic substances.

Keywords: low doses, traces, drugs, chemicals, radioelements

7. Studying phenomena at physical interfaces

Interfaces between solids, liquids or gases are the place of specific chemical, physical or biological processes often driven by the discontinuity between media and the properties of the surfaces themselves. Surfaces can be stabilized, decorated, or functionalized to introduce tailored structural or dynamical properties. Interfaces can stabilize molecules, group of molecules, or nano-objects controlling or allowing exchanges, establishing compatibility/discontinuities and possibly transfers between media. This includes, for example, subject related to nanoscience, biological membranes, signal interaction between the extra and the intracellular compartments, sensors, enzymatic activity, but also catalysis, corrosion and durability of materials, atmospheric and environmental sciences.

Keywords: Surfaces, interfaces, transport, reactivity

8. Meeting the challenges of machine learning

Machine learning is at the heart of the recent advances in artificial intelligence, but theoretical understanding of some of the most successful methods to date, i.e., deep learning, is still lagging behind. One focus of this subject is on the theoretical foundations of this fast-growing research area, using approaches from mathematics, computer science or statistical physics, with a privileged interest for robustness and explainability issues. In parallel, novel techniques of artificial intelligence drive knowledge acquisition and innovative developments in almost all fields of science, in particular in domains with large volumes of data, such as chemistry, physics, material sciences, or healthcare, to mention a few. Projects addressing fore-front applications of machine learning in these domains are also encouraged to apply.

Keywords: Explainable Artificial Intelligence, Generalization properties and stability, omics data, quantum chemistry, novel materials

9. Designing systems inspired by nature

Natural systems and their unique properties are a powerful reservoir of abundant inventiveness that deserves to be described, analysed and understood. They represent a source of inspiration for developing cutting-edge approaches in order to tailor new molecules, materials or composites with enhanced or unique properties, to settle new processes, to design and manufacture new autonomous devices or reactive systems, robotic systems, to envision new information processing architectures or calculation paradigms. . ., with performance levels that conventional approaches could not cover.

The final goal is to insure the transfer of natural concepts from biology/ecology/anthropology to applications, with the objective of designing tomorrow conceptual approaches and developing technological realizations. These new concepts and realizations intrinsically associate biology, chemistry, ecology, neurosciences, anthropology, physics, nanosciences and nanotechnologies, mathematics, computer sciences in pluri- or inter-disciplinary context.

Keywords: bio-inspiration, mimicry, neuromorphic architectures, complex systems

10. Showing the invisible

Recent imaging techniques have benefitted from the introduction of reinterpreted concepts, i.e. near-field optics, hyperspectral imaging, non-linear optics or radar tomography. Observations in domains as high-resolution microscopy, observation of the Earth or the Universe, or biology, become more quantified and richer in parameter space by employing measurement techniques from different disciplines. In addition, artificial intelligence brings in new techniques which outperform human capacities and draws on measured data to make new predictions.

Multi-parameter measurements allow to extract data which are not visible at first sight, in particular a variety of geometric properties. Projects may be situated in different scientific domains, reaching from the study of the universe to microscopy in a broader sense, with a special focus on the exploration of novel and original measurement techniques which can exalt existing methods by using numerical tools.

Keywords: multi-parameter measurements, hyperspectral imaging, advanced microscopy

11. Rethinking the urban ecosystem

Urban ecosystems are composed of four subsystems: green (all living matter and soils), grey (built areas), blue (coastal areas, rivers, standing water, and subsurface hydrosystems. . .) and red (technological environment and sensors, information, models, decision-making systems). The first three are equally important and interdependent, the fourth is an abstract representation that shows the interactions and dynamics of the first three. Thus, the city develops through socio-geo-ecological dynamics and ecological processes, strongly linked between them. To have a global vision of the city's complexity, its development, the quality of life of its inhabitants (including water and air qualities, noise pollution and access to infrastructure), we need to strengthen interdisciplinary and intersectoral research approaches, in particular through modelling and reasoning-based on integrated information systems. There is also a need to strengthen the role of biodiversity in the provision of ecosystem services (e.g. energy and communication networks) and the associated biodiversity. Their forms and habitats must be considered as a complete ecosystem integrating the various expressions of the environment, the diversity of its characteristics and services, an optimized access to the various resources, as well as the tools and actors for mitigation and remediation. The objective is to develop a new approach to urban ecology to project the city of the future in the face of climate change and global change.

Keywords: urban ecosystems, methodology, dynamics, adaptation, global change, integrated solutions, new policies, circular economy, information systems, modelling, connected objects, mobility

12. Revisiting the carbon cycle

More than 35 billion tons of CO2 are released into the atmosphere each year. The CO2, a highly stable molecule, accumulates in the oceans and terrestrial biosphere. The problem of this call concerns what happens to the CO2 and what can be done with it: Should it be buried forever, how? What are the political, social and geostrategic costs and consequences? Can it be transformed into intermediate chemicals,... or even fuels? The challenge of separating, capturing and converting CO2 with a low carbon footprint is immense. Concerning its natural cycle, different bottlenecks must be addressed to better understand the marine biological pump which involves photosynthesis, biogeochemical cycles, the transfer of this particulate carbon and its degradation in the intermediate and deep ocean up to its storage or sequestration in sediments. Making photosynthesis more efficient is a major challenge, as assessing and modelling the duration of this sequestration before carbon returns to the atmosphere.

Keywords: Carbon, cycles, CO2 recovery, carbon sequestration, catalysis, photosynthesis, climate, capture and sequestration, climate change, biogeochemical cycles

13. Exploring collective intelligence

Simple or elaborate interactions between individuals in a population generate self-organized phenomena and produce collective responses beyond the capabilities of each individual. This collective or distributed intelligence is illustrated in the animal world by the construction of habitats with complex architecture or by the movements of fish or birds, in humans by collective behaviour and achievements. An important challenge is to develop predictive theories and models to account for coherent collective activities of various levels of complexity, by autonomous agents (individual or formed by groups of agents themselves) pursuing individual objectives in an environment of which they have only partial knowledge. These agents can be humans as well as other living beings, artificial agents, even hybrids (living artificial). This involves developing research at the interface between the social sciences, life sciences and information sciences, particularly concerning the definition of collective goals, self-organization, profiling or specialization of agents, modelling of behavioural processes and collective decision-making, task allocation and coordination. This area also concerns crowdsourcing management and related legal and ethical issues.

Keywords: distributed intelligence, interactions, self-organization, complex systems, crowdsourcing, collective behaviours