The CNRS in The United States
December 2021
The CNRS (French National Centre for Scientific Research) is part of the worldwide fundamental and applied research landscape, and its activities across the scientific spectrum make it the largest research organization in Europe. International projects and partnerships are essential for cutting-edge, competitive research. These are top priorities for the CNRS. The indicators tracking the international development and activity of the Centre are many and varied, and each one points to the strong international recognition of the establishment. Every year, almost 30% of its newly recruited researchers come from abroad, alongside almost 5,000 students, post-doctorates, researchers, and professors brought into its laboratories. Moreover, out of 43,000 publications every year, more than half are co-signed with at least one international partner.

Every CNRS assignment and project is designed to increase the Centre’s international outreach and cement its position as a leader in research and innovation. The DERCI, the office dedicated to the CNRS international cooperation strategy, is the natural spearhead for these efforts. It is both very close to the Presidency of the CNRS in Paris, and also to strategic research hubs around the world, with offices representing the Centre in ten countries: in Beijing, Brussels, Melbourne, New Delhi, Pretoria, Rio de Janeiro, Singapore, Tokyo, Washington, and Ottawa.

The DERCI also draws on a network of scientific advisers and attachés in French embassies and consulates around the world and works with the relevant ministries in this field: in particular, the MESRI (Ministry of Higher Education, Research and Innovation) and the MEAE (the Ministry for Europe and Foreign Affairs).
Foreword

They help the CNRS in developing its strategies for international and European cooperation, from implementation to oversight, and act as a coordinator for the actions associated with them. Thanks to their presence in the field, the regional offices are a core pillar of the CNRS international policy and strategies. They provide expertise, advice and play a supporting role for the CNRS scientific partners.

The opening of its two new offices in Melbourne (2021) and Ottawa (2022) marks a new step forward for the CNRS as it increases its cooperation with its international partners. In both of these cases, the projects associated with these two new offices offer an illustration of how far the CNRS is ready to go in the most strategic scientific fields of today, from quantum and climate science to energy transition, environmental protection and remediation as well as artificial intelligence, to name but a few areas.

This booklet offers a perspective on the partnerships and cooperation developed by our researchers with their partners in Oceania. It showcases the flagship projects supported by the CNRS, in partnership with their partner institutions overseas, and with other members of the French research ecosystem. The CNRS office in Washington plays a role in these projects, offering support, assistance, fund-raising, new project initiatives and, above all, representing the CNRS towards its local partners and ensuring that their assignments and projects are a success.
CNRS at the forefront of cooperation with the United States

It was in 1947, just after the Second World War, that the CNRS scientific office in New York was created by the CNRS with the Atomic Energy Commission (CEA). It followed the emigration to the United States during the war of a dozen French scientists, including Louis RAPKINE, head of the Scientific Office of the French Exiles. In 1946, L. RAPKINE had obtained two major grants from the Rockefeller Foundation to the CNRS for the equipment of laboratories and the organization of international conferences (Sources: Matériaux pour l'histoire de nos temps, n° 60 October-December 2000). In 1984, the CNRS office left New York to settle in the heart of the French Embassy in Washington, DC.

As the bridgehead of the CNRS in North America, the Washington Office helps to promote and value the expertise of the CNRS, and that of French research in the United States, Canada and Mexico at the same time.

In addition, since February 2020, it has been hosting a project manager from INRAE (National Research Institute for Agriculture, Food and the Environment) in Washington.

In accordance with its multidisciplinary character, the CNRS does not display any thematic specificity but brings its support to all research fields.

Research plays a major role in the United States. In 2019, the cumulative public/private R&D budget amounts to $656 billion with a federal share of $139 billion. To this end all U.S. scientific agencies have seen their budgets increase. Such an increase allows the United States to remain a leader in scientific research and innovation.

Faced with this challenge, the CNRS helps to provide the staff of its research units with the resources and expertise needed for collaboration, among other things through the structuring tools for international collaboration developed by the organization. First and foremost, the International Research Laboratories (IRL).

1Sources: Matériaux pour l'histoire de nos temps, n° 60 October-December 2000.
To date, the CNRS manages nearly 80 IRL with its partners around the world, including 6 in the United States, 4 in Canada and 2 in Mexico. The IRL partners in the United States are University of Pennsylvania (in partnership with the Solvay group), University of California Berkeley, University of California San Diego, George Washington University, Georgia Institute of Technology and University of Arizona with which the CNRS has recently started a strategic dialogue.

In the United States, collaboration has also been structured through 22 International Research Projects (IRP) and 24 International Research Networks (IRN).

In addition, there are many individual collaborations between researchers and the CNRS produces more than a quarter of its international co-publications with the United States. In 2019, there are nearly 6,000 missions of CNRS agents in the United States and the CNRS has welcomed 89 researchers, 90 doctoral students and 41 post-doctoral Americans.

Finally, the CNRS works with several American partners around very large research infrastructures and supports specific programs. For example, over the past two years, 430 projects focusing more specifically on earth systems science, climate change, sustainable development and energy transition have been submitted as part of the "Make Our Planet Great Again" (MOPGA) campaign.

These figures indicate the important place the United States occupies in our international scientific relations. The publication of this booklet aims to ensure a good visibility of ongoing cooperations.

The CNRS Office in Washington also regularly publishes two newsletters: "Le Fil de Marianne", aimed at French researchers in the United States, and "AdN", dedicated to scientific and technical information in the geographical area covered by the Office. I therefore invite CNRS researchers on a mission in the United States, Canada or Mexico to identify themselves to the Office if they have not already done so, in order to develop and promote their collaborations.

As a manual of the CNRS bilateral collaboration in the United States, may this booklet help and inspire new collaborations and new projects!

Paris, December 15, 2021
General context

The CNRS in a few words

The National Center for Scientific Research (CNRS), a Public Scientific and Technological Establishment (EPST), is placed under the supervision of the Ministry of Higher Education, Research and Innovation (MESRI).

Its governance is ensured by Antoine Petit, Chairman and CEO of CNRS, assisted by a Deputy Director General for Science, Alain Schuhl, by Christophe Coudroy Deputy Director General for Resources, and by Jean-Luc Moullet, Deputy Director General for Innovation.

As a large research organization, the CNRS conducts a policy of European and international collaboration in all scientific fields, in partnership with countries all over the world.

The CNRS covers all the major disciplinary fields thanks to its ten institutes.

- **Institute of Biological Sciences (INSB):** All biology research aimed at deciphering the complexity of the living from atoms to biomolecules, from cells to the whole organism and to populations.

- **Institute of Chemistry (INC):** All research concerning the development of new compounds, the understanding of chemical reactivity, ever finer elucidation and the prediction of the relationship between the structure of compounds at the atomic level and their properties.

- **Institute of Ecology and Environment (INEE):** All research in the fields of ecology and the environment including biodiversity and human-environment relationship.

- **Institute for Humanities and Social Sciences (INSHS):** All research on man, both as a producer of languages or knowledge and as an economic, social or political actor.

- **Institute for Information Sciences and Technologies (INS2I):** All research in the fields of computer sciences and digital technology.

- **Institute of Engineering and Systems Sciences (INSIS):** Ensures the basic engineering-technology research continuum by favoring the "system" approach from the core disciplines of the institute.

- **National Institute for Mathematical Sciences and their Interactions (INSMI):** All research in the various branches of mathematics.

- **Institute of Physics (INP):** All research in physics with two main motivations: the desire to understand the world and the desire to respond to the current challenges of our society.

- **National Institute of Nuclear and Particle Physics (IN2P3):** All research in the field of nuclear physics and particle physics, carried out in connection with large equipment.

- **National Institute of Sciences of the Universe (INSU):** All national and international research in astronomy, earth, ocean, atmosphere and space sciences.
The CNRS in a few figures

With nearly 32,000 researchers, engineers and technicians, the CNRS is organized into 10 institutes which orchestrate scientific policy and 18 delegations which represent it in the regions. It has a budget of around 3.5 billion euros in 2021.

Of the 1071 laboratories, more than 97% are in partnership with universities, Grandes Ecoles and other research organizations and are spread throughout the country.

Talent developer

Each year, many French and foreign scientists join the ranks of the CNRS. With 22 Nobel Prize winners and 12 Fields Medal winners, the CNRS has a long tradition of excellence. Each year, the CNRS awards a gold medal, considered the highest French scientific distinction.

Knowledge producer

With more than 16,000 researchers, the CNRS is present in all fields of knowledge.

The CNRS is one of the major producers of knowledge. According to the 2020 “Nature Index” ranking, the CNRS occupies the 4th place in the international ranking of scientific institutions with 4,561 referenced articles.

According to the 2020 SIR (Scimago Institutions Rankings), the CNRS is the second largest research institution in the world in terms of number of scientific publications. Now overtaken by the Chinese Academy of Sciences, the CNRS remains in front of Harvard University (United States). This ranking assesses more than 5,100 universities and research organizations around the world and is based on the indexing of global scientific publications in the Scopus database.

Driving force for innovation

Researchers and engineers have participated in the creation of more than 1,200 innovative companies since 1999. At the head of a portfolio of 5,800 patent families, the CNRS ranks sixth in the list of leading patent applicants published in 2020 by the INPI (or 401 applications). It is involved in the 14 Technology Transfer Acceleration Companies (SATT).

From around fifty in 2009, the number of joint research structures (public/private) between the CNRS and at least one industrial partner has increased to 150 in 2020 (including 21 laboratories in joint venture with a company), 4 are located abroad (one in the United States with Solvay).

The CNRS has signed framework agreements with 20 major CAC 40 companies.
Large equipment designer

Telescopes, particle accelerators, computers and large databases are essential tools for today's research. The CNRS is involved in the design and construction of these very large infrastructures which are useful for all disciplines. More than 100 million euros are spent each year by the CNRS for its participation in major scientific instruments outside France.

Research pilot

The CNRS participates in the emergence of major university sites, foreshadowing future world-class multidisciplinary research universities. It is a founding member of the five National Alliances for Research.

International player (2020 figures)

Almost 60% of CNRS co-publications are international. The CNRS contributes to the influence of French research in the world through 80 IRL (International Research Laboratories) in 17 countries, a network of (8) permanent offices in Brussels, New Delhi, Beijing, Pretoria, Rio de Janeiro, Singapore and its subsidiary CNRS@CREATE, Tokyo, Washington and its branch in Ottawa and conventions signed with more than 60 countries.

The CNRS also leads 180 International Research Projects (IRP) in 42 countries, 100 International Research Network (IRN) with at least two countries involved and 500 International Emerging Action (IEA) and joint research projects in 59 countries until 2019 and 1 International Research Center (IRC) in the United States.

Thanks to its international roots, the CNRS is involved in a large number of major discoveries alongside its foreign partners. It takes part in global scientific and technological challenges, within the framework of globalized research that develops on the basis of the free circulation of researchers and ideas.

Antoine Petit, Chairman and CEO of CNRS (National Centre for Scientist Research) with Forrest Maltzman, Provost of George Washington University (GW), at the signing of the agreement to create the international Research Laboratory "EpiDaPo". April 25, 2018
CNRS foreign offices in 2021

Two new offices are opening in Melbourne (end of 2021) and Ottawa (January 2022)
The CNRS cooperation with the United-States
With a population of 324.8 million, an area of 9,833 km², 50 states (and one district), the United States is the largest country in North America and the scientific leading partner in Europe.

**Indicators**

**United-States co-publications with France and CNRS cumulated over 2 years**

<table>
<thead>
<tr>
<th></th>
<th>2018-19</th>
<th>2019-20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total USA publications</td>
<td>1446040</td>
<td>1539849</td>
</tr>
<tr>
<td>Importance of publications in the world</td>
<td>27.3%</td>
<td>26.5%</td>
</tr>
<tr>
<td>USA-France Copublications</td>
<td>38319</td>
<td>40883</td>
</tr>
<tr>
<td>including copublications USA-CNRS</td>
<td>15486</td>
<td>16043</td>
</tr>
</tbody>
</table>

Source: Incites dataset-Web of Science

In addition to the increasingly important part of the CNRS in France-United States co-publications, the internationalization of US scientific production should be noted. The rate of international co-publications by the United States rose from 24.5% to 35.5% between 2010 and 2020.

At the same time, the rate of CNRS international co-publications increased from 50.5% to 63.6% over the same period.

<table>
<thead>
<tr>
<th></th>
<th>2010²</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Int. Copublications rates in USA</td>
<td>24.5%</td>
<td>35.5%</td>
</tr>
<tr>
<td>Int. copublications rates in France</td>
<td>46.2%</td>
<td>61.5%</td>
</tr>
<tr>
<td>Int. copublications rates at CNRS</td>
<td>50.5%</td>
<td>63.6%</td>
</tr>
</tbody>
</table>

Source: Incites dataset-Web of Science
American public research is carried out in universities and in federal laboratories.

University research activities are mainly carried out in about 100 of the country’s 4,000 institutions, 45 of which are among the top 100 in the 2019 ranking of Shanghai Jiao Tong University.

More than 64% of R&D is financed by the private sector.

Biology and medical sciences concentrate 47.2% of American publications

CNRS-United States copublications themes 2019-2020 (Source : InCites-Wos)
Top 25 American universities involved in CNRS - USA co-publications 2018-2020
(Source : Incites-Wos)

<table>
<thead>
<tr>
<th>Rank</th>
<th>Institutions</th>
<th>Copublications</th>
<th>Category Normalized Citation Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Harvard University</td>
<td>1886</td>
<td>4.00</td>
</tr>
<tr>
<td>2</td>
<td>California Institute of Technology</td>
<td>1780</td>
<td>3.61</td>
</tr>
<tr>
<td>3</td>
<td>Massachusetts Institute of Technology (MIT)</td>
<td>1753</td>
<td>3.27</td>
</tr>
<tr>
<td>4</td>
<td>University of California Berkeley</td>
<td>1741</td>
<td>3.65</td>
</tr>
<tr>
<td>5</td>
<td>University of Chicago</td>
<td>1582</td>
<td>3.70</td>
</tr>
<tr>
<td>6</td>
<td>Stanford University</td>
<td>1396</td>
<td>3.87</td>
</tr>
<tr>
<td>7</td>
<td>University of Michigan</td>
<td>1386</td>
<td>3.50</td>
</tr>
<tr>
<td>8</td>
<td>Ohio State University</td>
<td>1326</td>
<td>2.99</td>
</tr>
<tr>
<td>9</td>
<td>University of California San Diego</td>
<td>1304</td>
<td>3.61</td>
</tr>
<tr>
<td>10</td>
<td>University of Maryland College Park</td>
<td>1275</td>
<td>3.40</td>
</tr>
<tr>
<td>11</td>
<td>Princeton University</td>
<td>1236</td>
<td>3.24</td>
</tr>
<tr>
<td>11</td>
<td>University of Colorado Boulder</td>
<td>1194</td>
<td>2.74</td>
</tr>
<tr>
<td>13</td>
<td>University of California Los Angeles</td>
<td>1166</td>
<td>2.87</td>
</tr>
<tr>
<td>14</td>
<td>Columbia University</td>
<td>1158</td>
<td>3.66</td>
</tr>
<tr>
<td>15</td>
<td>Johns Hopkins University</td>
<td>1122</td>
<td>3.83</td>
</tr>
<tr>
<td>16</td>
<td>Lawrence Berkeley National Laboratory</td>
<td>1103</td>
<td>3.86</td>
</tr>
<tr>
<td>17</td>
<td>University of Texas Austin</td>
<td>1093</td>
<td>2.82</td>
</tr>
<tr>
<td>18</td>
<td>University of Arizona</td>
<td>1086</td>
<td>3.27</td>
</tr>
<tr>
<td>19</td>
<td>University of Wisconsin Madison</td>
<td>1079</td>
<td>2.75</td>
</tr>
<tr>
<td>20</td>
<td>University of Washington</td>
<td>1056</td>
<td>5.46</td>
</tr>
<tr>
<td>21</td>
<td>Cornell University</td>
<td>1003</td>
<td>4.39</td>
</tr>
<tr>
<td>22</td>
<td>NASA Goddard Space Flight Center</td>
<td>983</td>
<td>3.65</td>
</tr>
<tr>
<td>23</td>
<td>Yale University</td>
<td>977</td>
<td>3.07</td>
</tr>
<tr>
<td>24</td>
<td>Boston University</td>
<td>938</td>
<td>3.12</td>
</tr>
<tr>
<td>25</td>
<td>University of Illinois Urbana-Champaign</td>
<td>920</td>
<td>4.38</td>
</tr>
</tbody>
</table>
US citizen staff present in the CNRS units on 01/01/2019
Breakdown by CNRS Institute

<table>
<thead>
<tr>
<th></th>
<th>Researchers CNRS - USA</th>
<th>PhD USA</th>
<th>P-Docs USA</th>
</tr>
</thead>
<tbody>
<tr>
<td>INC</td>
<td>6</td>
<td>7</td>
<td>5</td>
</tr>
<tr>
<td>INEE</td>
<td>5</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>INP</td>
<td>7</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td>IN2P3</td>
<td>4</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>INSB</td>
<td>24</td>
<td>10</td>
<td>11</td>
</tr>
<tr>
<td>INSHS</td>
<td>18</td>
<td>36</td>
<td>4</td>
</tr>
<tr>
<td>INS2I</td>
<td>4</td>
<td>8</td>
<td>3</td>
</tr>
<tr>
<td>INSIS</td>
<td>6</td>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td>INSMI</td>
<td>5</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>INSU</td>
<td>10</td>
<td>7</td>
<td>5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>89</strong></td>
<td><strong>90</strong></td>
<td><strong>41</strong></td>
</tr>
</tbody>
</table>

Share of foreign staff at CNRS

- Researchers: 4.6%
- PhD: 0.8%
- P-Docs: 2.4%

(source: Labintel)
Main actors in American research, excluding universities

Research agencies and organizations

The National Science Foundation (NSF) is both the only resource agency (exclusively "extra-mural") and the only multidisciplinary agency. Created by the American Congress in 1950, it offers funding to more than 2000 American universities and companies, i.e. more than 11,000 projects with an average selection rate of 28%.

Its contribution represents about 20% of the federal government’s contribution to university institutions in basic research. It plays a role in the financing of major equipment (in particular cyber-infrastructure, for which it is investing several hundred million euros) and new structures of excellence such as science and technology centers (CTS) or Nanoscale Science and Engineering Centres (NSEC). NSF is particularly active in promoting science and mathematics education. It is active at the primary and secondary levels as well as at the university level.

The National Institutes of Health (NIH), part of the U.S. Department of Health and Human Services (DoHHS), is the primary source of funding for medical research and the largest single federal budget item for non-defense R&D. The NIH is the largest single source of funding for medical research.

In fact, more than $30 billion - $37 billion in 2019 - is invested annually, 80% of which is used to fund approximately 325,000 researchers and 50,000 scholarships through 3,000 universities, medical schools and other research centers. The NIH operates in intramural mode in NIH laboratories (located mainly in the suburbs of Washington, DC) and also as an agency of means by largely subsidizing university research (about 80% of its budget). Relatively independent from each other, the institute’s actions are coordinated by a director’s office.

The National Aeronautics and Space Administration (NASA) is an independent agency: NASA’s research and development activities cover both space exploration and space research, development, and transfer.

The Department of Energy (DOE) with its National Laboratories, its Technology Centers (Fermi National Accelerator, Stanford Linear Accelerator, etc.) and their very large facilities, are among the main players in research in the United States, particularly in the physical sciences, energy and large computing resources.

They are involved both in the military (for the nuclear field) and in the civilian sector, sometimes well beyond energy-related fields (research on the genome, climate, carbon sequestration, etc.).
The Department of Defense (DOD), in particular DARPA, the U.S. Department of Defense agency responsible for developing emerging technologies for military use. It is a key element in the American landscape.

The DoD is mainly involved in development, but the share devoted to basic research remains significant.

The National Oceanic and Atmospheric Administration (NOAA), under the Department of Commerce (DoC), is responsible for describing and predicting changes in the environment.

Responsible for the conservation of coastal and marine resources or meteorological observation means, it is an important player in federal programs related to climate change.

The National Institute of Standards and Technology (NIST), under the Department of Commerce (DoC): heir to the Bureau of Standards, NIST plays a major role at the interface between academia and industry.

By developing the technologies needed for standards development, it helps improve industrial productivity and facilitates trade. Facilitating trade and industrial development is a key component of its mission.

The Advanced Technology Program (ATP) is a government-university-industry model. In addition, it is a leading research and infrastructure center in areas such as nanotechnology, where several recent Nobel laureates have been awarded.

The Environmental Protection Agency (EPA) is an independent agency responsible for environmental protection.

The Department of Agriculture (USDA), the Department of Transportation (DoT) and the Department of the Interior (DoI) are also involved, but to a lesser extent, in R&D efforts in the United States.
Other institutions

For questions of science and technology, two organizations have acquired an essential place.

The National Academy of Sciences (NAS), composed of the National Research Council (NRC), the National Academy of Engineering (NAE) and the Institute of Medicine (IOM), was established in 1863 as a scientific reference for the federal government with the goal of advancing science and technology.

The American Association for the Advancement of Science (AAAS), an independent professional association, has been in existence since 1848. It publishes analyses of R&D policy, various newsletters, books, reports and journals, including the million-copy magazine "Science".

It is an authority on the American R&D landscape and organizes science-related events that attract far more than just its members.

In the academic world, university associations have naturally taken an important place. They enable the various players to group together by area of interest and to speak with a single voice.

The Association of American Universities brings together the 62 most prestigious research universities. Although they compete with each other, they meet on common themes (organization of fundraising campaigns, educational choices, etc.).

The American Council of Education (ACE) brings together the presidents of 2000 institutions representing 80% of students.

The Association of Public and Land Universities (APLU). It is the oldest of the higher education associations, which brings together 186 public research universities for 3.5 million students.
CNRS missions in the United States

The analysis of CNRS missions abroad is an indicator of CNRS activity with other countries. It also has the advantage of revealing SHS activity that is not as well integrated in the bibliometric studies.

Table 3: Breakdown of CNRS missions in the United States by CNRS institute in 2018

<table>
<thead>
<tr>
<th>Institute</th>
<th>Number of missions</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>IN2P3</td>
<td>351</td>
<td>6.06%</td>
</tr>
<tr>
<td>INC</td>
<td>538</td>
<td>9.29%</td>
</tr>
<tr>
<td>INEE</td>
<td>145</td>
<td>2.50%</td>
</tr>
<tr>
<td>INP</td>
<td>852</td>
<td>14.71%</td>
</tr>
<tr>
<td>INS2I</td>
<td>382</td>
<td>6.60%</td>
</tr>
<tr>
<td>INSB</td>
<td>718</td>
<td>12.40%</td>
</tr>
<tr>
<td>INSHS</td>
<td>580</td>
<td>10.02%</td>
</tr>
<tr>
<td>INSIS</td>
<td>611</td>
<td>10.55%</td>
</tr>
<tr>
<td>INSMI</td>
<td>195</td>
<td>3.37%</td>
</tr>
<tr>
<td>INSU</td>
<td>1338</td>
<td>23.10%</td>
</tr>
<tr>
<td>Res. Com.</td>
<td>81</td>
<td>1.40%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>5791</strong></td>
<td><strong>100.00%</strong></td>
</tr>
</tbody>
</table>

Source: BFC: Traitement: CNRS-Sap2s

© Xavier FAIN / IPEV/LGGE / CNRS Photothèque
CNRS partnership actions with the United-States

The CNRS actively participates alongside the United States in major international programs such as:

The Europe-Japan-North America ALMA (Atacama Large Millimiter Array) project located at an altitude of 5,000 m in Chatnanjor near San Pedro de Atacama in northern Chile.

There

- the Integrated Ocean Drilling Program (IODP), an international ocean drilling program through the European Consortium for Ocean Drilling Research (ECORD IODP),

- the Large Synoptic Survey Telescope (LSST), an 8.4-meter wide field telescope project whose objective is to perform a complete survey of the sky in 6 colors. It will take images of each point of the sky. The CNRS participates in the R&D of this project, initiated by the United States, and in particular the NSF. The LSST company, in charge of the construction of the telescope is based in Tucson and works in close collaboration with the Steward Observatory Mirror Lab, the Rubin Observatory of Chile and other astronomical observatories.

- the Canada France Hawaii Telescope This telescope allows astronomical observations in the visible and near infrared range. Operational since 1979, it is located at the summit of Mauna Kea at 4200m altitude, the best site in the northern hemisphere. 15% of the observation time is attributed to the University of Hawaii, 42.5% to the CNRS and 42.5% to the NRC. Equipped with several instruments developed by user communities, it is recognized for the exceptional quality of wide-field imaging, as well as for the worldwide development of stellar spectro-polarimetry.

- the DUNE project (Deep Underground Neutrino Experiment) is an international project with the LBNF (Long Baseline Neutrino Facility) infrastructure, scheduled to start up by 2026 at Fermilab, near Chicago. When it starts up, this neutrino beam will be the most intense in the world.
The CNRS and its collaboration tools with the United States
DERCI

The mission of the European Directorate for Research and International Cooperation (DERCI) is to implement and enhance the European and international collaboration policy that CNRS is pursuing through its 10 thematic institutes. It pursues a policy of collaboration in all scientific fields, in partnership with industrialized countries around the world.

In 2019, the CNRS achieved 60% of publications with at least one foreign laboratory. The CNRS has about 1,800 foreign researchers (35% of the researchers recruited in 2016 are foreign), more than 11,000 foreign PhD students and 2,350 foreign post-doctoral fellows in its units. The CNRS manages 80 nearly IRL (international research laboratories) abroad and 170 joint research structures in public / private partnership in France (2020).

The DERCI's mission is to structure and support international affairs. The first scientific contacts are most often established at the initiative of researchers, either individually or as part of a team policy or the UMR (Unité Mixte de Recherche). In addition to these direct exchanges that researchers can build up, the CNRS wishes nevertheless to give rise to structuring actions, bilateral or multilateral, using specific tools, adapted to the degree of maturity of the collaboration projects: bilateral conventions, IEA, IRN, IRP, IRL, IRC.

In addition to its own tools, the CNRS encourages its researchers to participate in all the programs offered, particularly by the MEAE (Ministry of Europe and Foreign Affairs), notably through the programs of the French Embassy in the United States which aim at increasing transatlantic student mobility allowing American doctoral students to carry out research stays in France (Chateaubriand grants) and also to support joint research projects through the allocation of funds: Thomas Jefferson Funds and bilateral funds (France-Austin, France-Berkeley, France-Chicago, France-Stanford, France-MIT).

The CNRS also promotes the participation of its teams in the European Horizon program. The activities carried out in the United States by the CNRS, in particular with the IRL, thus contribute to the influence of its action, and more broadly to that of French research abroad. They also strengthen the attractiveness of the CNRS in terms of hosting and recruiting scientists from around the world at the highest level, while increasing its visibility beyond French borders.

To fulfill its missions, the DERCI has central services in Paris as well as 8 offices and 1 CNRS branch office abroad, some of which cover an area including several countries. It also relies on the network of attachés and scientific advisers of the French diplomatic representations abroad.

© Nicolas BAKER/IRAP/NASA/CNRS Photothèque Scientifiques en mission à bord d'un Boeing 747 SOFIA
www.cnrs.fr/derci
The CNRS and its tools

8 CNRS offices abroad

- Washington DC: United-States, Canada, Mexico
- Ottawa Branch
- Rio de Janeiro: South America
- Pretoria: Southern Africa
- Beijing, China
- Tokyo, Japan, Korea, Taiwan
- New Delhi: South Asia
- Singapore: Southeast Asia, Oceania
- Brussels, European Union branch
- Paris: Head office
- Ottawa: Branch
The CNRS and its tools

CNRS offices abroad and 1 branch office

- United States, Canada, Mexico
- South America
- Brazil, Rio de Janeiro
- Southern Africa, Pretoria
- South Asia, New Delhi
- Southeast Asia, Oceania, Singapore
- Japan, Korea, Taiwan, Tokyo
- European Union, Brussels
- Head office, Paris
- Branch office, Ottawa
II- CNRS international cooperation tools

Another asset of the CNRS in the implementation of its actions at the international level, is the collaborative tools at its disposal. The formalization of cooperation is indeed at the heart of the CNRS's objectives, in particular in order to transform the existing links between researchers into a real cooperation project that is the subject of conventions or memorandums of understanding between the different parties.

The CNRS distinguishes two types of collaborative tools at the international level:

Pre-structuring tools

- **International Emerging Action (IEA)**

and

Structuring tools

- **An International Research Center (IRC)** is intended to strengthen and perpetuate strategic partnerships around structures without walls bringing together all various cooperations. The follow-up of the IRC is ensured by a regular high-level strategic dialogue between the two partner institutions in order to set cooperation objectives.

- **The International Research Laboratories (IRL)** are true joint laboratories to which the CNRS confers the same status as its UMR in France. The Joint Units of French Research Institutes Abroad (UMIFRE) cooperate with host institutions and French social science research organizations. They are joint laboratories under the co-supervision of the MAE (Ministry of Foreign Affairs).

- **The International Research Project (IRP)** establishes collaboration around a common project most often between one or more French teams and a main partner abroad.

- **The International Research Network (IRN)** connects two - or more - research networks.
Establishment of the International Research Laboratories (IRL), and the International Research Project (IRP) - synthesis February 2020
The CNRS and its tools

CNRS activities with the country

Structured cooperation
6 International Research Laboratories (IRL)
22 International Research Project (IRP)
24 International Research Network (IRN)

International Research Laboratories (IRL)

An international cooperation tool shared by the CNRS, aimed at structuring highly-localised international research collaboration.

This type of collaboration is the most elaborated form of a bilateral research project. Because of the scientific resources to be mobilized and the budgets to be raised, the setting up is an operation requiring several months of work.

Like all CNRS laboratories, the IRLs are subject to evaluation (every 5 years).
What is an International Research Laboratory?
The IRL correspond to international research facilities where research activities are conducted jointly around shared scientific axes.

They structure in an identified location the significant presence of a limited number of French and foreign research institutions (only one foreign partner country). They include establishments bringing together scientists attached to different units and international units - mixed research units with foreign partners (IRL) and service and research units (USR) located abroad - set up when a backing to a dedicated operational research structure is required.

International Research Laboratories have a duration of five years.

Who are International Research Laboratories intended for?
International Research Laboratories bring together personnel conducting research at the CNRS or in partner institutions.

How are International Research Laboratories established?
The IRL are proposed by the scientific institutes of the CNRS according to their own modalities on the basis of structured international collaborations involving a high degree of internationalization of the participating teams, and a strong localization of the research activities in a common location.

They are evaluated by peer review within the Institutes as well as by the relevant section of the National Committee for Scientific Research, when necessary. The location of activities (prospect of long-term scientific stays or assignments depending on specific cases) is an essential criterion of evaluation.

Consideration is also given to the scientific value of the project, the potential interest of the collaboration and its expected impact, the quality of the team and institutional partnership, the balance between institutional partners in contributing resources, the participation of young researchers, collaboration history, ethics, and financial justification.

The decisions relating to the creation or renewal of International Research Laboratories are made by the CNRS Executive Board.

4. What are the outlines of the institutional formalisation of International Research Laboratories?
International Research Laboratories are developed over a year, during which a cooperation agreement is negotiated between the various French and international supervisory bodies involved.

5. How are International Research Laboratories financed?
In addition to the resources pooled by the institutions involved and directly provided by participating laboratories, International Research Laboratories receive, over their duration, funding earmarked by the CNRS for a total amount comprised between €75,000-€100,000. Managed by the CNRS laboratory overseeing the International Research Laboratory, these funds are allocated in annual instalments depending on the initial project, scientific assessments, and the annual financial reports issued by its director and members.

Should a dedicated unit be created, the funds are allocated to this structure, and supplemented by specific resources (functioning, equipment, investment), and the assignment of personnel.
International Research Project (IRP)

An international cooperation tool shared by the CNRS, dedicated to strengthening research partnerships.

1. What is an International Research Project?

International Research Projects are collaborative research schemes between one or more CNRS laboratories and one or two laboratories from foreign countries.

They strengthen previously-established collaboration through short- and medium-term scientific exchange.

They are aimed at organising working meetings or seminars, developing joint research activity including field research, and supervising students. The French and foreign teams concerned must have already shown their capacity to collaborate (for example through one or more joint publications). These projects have a duration of five years.

2. Who are International Research Projects intended for?

International Research Projects are intended for staff conducting research in a CNRS or partner unit.

3. How to propose an International Research Project?

Applications should be submitted to the CNRS scientific Institute in charge of the applicant’s unit.

It is recommended that candidates contact the international relations correspondents within their Institute as early as possible, in order to find out about the specific procedures for submitting a project. For interdisciplinary projects, the various Institutes concerned may be informed.

4. How are International Research Projects evaluated?

Proposals for International Research Projects are evaluated by peer reviews within the CNRS scientific Institutes based on the following criteria: scientific value of the project, interest of the international collaboration, scientific quality and complementarity of teams, balanced distribution of scientific activity between partners, participation of young researchers, ethics, financial justification, and past relations between the partners.

5. What are the outlines of the institutional formalisation of International Research Projects?

Once selected, International Research Projects are the subject of institutional letters of commitment from the French and foreign institutions willing to support them, for example by granting additional funds in accordance with the internal evaluation and selection procedures specific to each institution.
6. How are International Research Projects financed?

In addition to the resources directly provided by the participating laboratories, International Research Programmes receive funds specifically earmarked by the CNRS for international mobility between teams and for organising meetings and field assignments, for a total amount comprised between €50,000 and €75,000 over the duration of the project.

Managed by the CNRS laboratory overseeing the International Research Project (lead laboratory), the CNRS funds are allocated by annual instalments on the basis of the initial project, scientific assessments, and annual financial reports issued by the lead laboratory and its partners.

The team "Small GTPases" - October 2015 - IRP CYLIA
Missing from the photo : Ilham Ladid
International Research Network (IRN)

An international cooperation tool shared by the CNRS, dedicated to structuring international research networks.

1. What is an International Research Network?

The purpose of an International Research Network is to structure an international scientific community around a common theme or research infrastructure. It promotes the organisation of international workshops and seminars, as well as thematic schools organised by the network partners in France and abroad.

It brings together, for a duration of five years, researchers from one or more French laboratories, including at least one from the CNRS, as well as from several international partner laboratories.

2. Who are International Research Networks intended for?

International Research Networks are intended for personnel conducting research in a CNRS unit, as well as their scientific partners in France and abroad.

3. How to propose an International Research Network?

Applications should be submitted to the CNRS scientific Institute in charge of the applicant’s unit.

It is recommended that candidates contact the international relations correspondents within their institute as early as possible, in order to find out about the specific procedures for submitting a project. For interdisciplinary projects, the various Institutes concerned can be informed.
4. How are International Research Networks evaluated?

Proposals for International Research Networks are evaluated by peer reviews within the CNRS scientific Institutes based on the following criteria: scientific value of the project, interest of the international collaboration, scientific quality and complementarity of teams, past relations, balance of participation in scientific activity, participation of young researchers, ethics, and financial justification.

Special attention will be given to the identification of targeted objectives relating to the expected impact beyond the scientific activity itself (for example, preparation of a joint response to calls for proposals, promotion of joint programming, insertion into multilateral networks, organisation of the activity around a research infrastructure).

5. What are the outlines of the institutional formalisation of International Research Networks?

Once selected, International Research Networks are the subject of institutional letters of commitment from the French and foreign institutions willing to support them, in particular by granting additional funds in accordance with the internal evaluation and selection procedures specific to each institution.

6. How are International Research Networks financed?

In addition to the resources directly provided by the participating teams, International Research Networks receive funds specifically earmarked by the CNRS for international mobility between the laboratories involved, and for setting up international workshops and seminars, working meetings, and thematic schools organised by the partners, for a total amount comprised between €50,000-€75,000 over the duration of the project.

Managed by the CNRS laboratory overseeing the International Research Network (lead laboratory), the CNRS funds are allocated by annual instalments depending on the initial project, scientific assessments, and annual financial reports issued by the lead laboratory and members of the International Research Network.
International Emerging Action (IEA)

An international cooperation tool shared by the CNRS, dedicated to exploring new subjects and partnerships on the international stage.

1. What is an International Emerging Action?

International Emerging Actions are PI-to-PI projects whose purpose is to explore new fields of research and international partnerships through: short-term mobility of scientists, the organisation of working meetings, and the initiation of early-stage joint research works for shared scientific projects.

These actions have a duration of two years.

2. Who are International Emerging Actions intended for?

International Emerging Actions are intended for personnel conducting research in a CNRS or partner unit.

3. How to propose an International Emerging Action?

Project leaders are invited to submit their application during the annual call for proposals launched by the CNRS’s European Research and International Cooperation Department (DERCI), and to submit their application on the CNRS CoopIntEer platform between the months of June and September.

In line with the CNRS’s scientific policy, the terms of the call for proposals can specify particular subject-related or geographic priorities depending on the Institute, applicable to the units of these Institutes.

A letter of support from the foreign partner is expected as part of the application process, indicating possible co-financing for the implementation of the project.
4. How are International Emerging Actions evaluated?

Proposals for International Emerging Actions are evaluated by peer review within the CNRS scientific Institutes based on the following criteria: scientific value of the project, interest of the international collaboration, scientific quality and complementarity of teams, participation of young researchers, ethics, and financial justification.

No pre-requisites in terms of previous exchanges or publications are required.

5. How are International Emerging Actions financed?

As a complement to the resources provided directly by participating teams, International Emerging Actions receive funds earmarked by the CNRS for international mobility between the laboratories involved, for organising working meetings, and implementing field assignments between partners, for a total amount comprised between €10,000-€14,000 over the duration of the project.

Managed by the CNRS laboratory in charge of the International Emerging Action, funding is allocated by annual instalments depending on the initial project and annual financial reports issued by the CNRS laboratory and its partners.

Panorama of the faulted edge of Death Valley, USA. @Michel FAURE/CNRS Photothèque
Tools for cooperation between the CNRS and the United States
An International Research Center (IRC)?

An IRC aims at strengthening and perpetuating strategic partnerships with institutions presenting a significant volume of cooperation with the CNRS institutes, involving different institutes and various themes.

The follow-up of the IRC is ensured by a regular high-level strategic dialogue between the two partner institutions in order to set cooperation objectives.

An international research center is managed by bilateral institutions to foster synergies.

Presentation

The University of Arizona is particularly well known as a world leader in the environmental sciences (1st in the United States for environmental research, 1st in the Shanghai ranking for water resources research).

On November 17, 2020, a strategic dialogue involving University of Arizona President Robert C. ROBBINS and CNRS CEO Antoine PETIT established that the already rich and numerous collaborations between the two institutions could be strengthened, particularly in the environmental, astrophysical and information sciences.

April 14, 2021 saw the signing of the first ever International Research Center (IRC) entitled France Arizona Institute for Global Grand Challenges which aims at tackling major environmental science challenges.
Keywords

- Environmental sciences
- Astrophysics
- Information sciences.

Joint call for theses

The first joint PhP program call was launched in 2021. After a bipartite evaluation, the CNRS and the University of Arizona converged on 6 projects in line with the global scientific challenges of this cooperation. Five CNRS institutes are involved: INEE, INP, INSB, INSHS, INSU.

Main events:

- Joint PhP program call: December 2021
- High-level strategic dialogue: March 2022
- Scientific workshop: March 2022
Presentation

The University of Pennsylvania (UPenn), the CNRS and the SOLVAY group have created a partnership within the International Research Laboratory COMPASS whose aim is to develop innovative materials and solutions based on fundamental concepts of physical chemistry and detailed understanding at the molecular level.

The laboratory’s objective is to gather 8 permanent researchers. At the moment, the laboratory functions with a staff of 2 CNRS researchers, 4 Solvay research engineers and one Solvay technician. 3 UPenn professors are also part of the collaboration.

The lab hosts on average 2 PhD students and 4 post-doctoral researchers.

Keywords

- Surface treatments
- Biofilms
- Soft material
- Formulations
- Encapsulation

Scientific agenda

The research we have developed in recent years has enabled us to identify 3 key areas creating a strong link between fundamental research and innovation, based on the skills gathered in our laboratory, in our immediate environment and in the groups with which we already collaborate.

These scientific axes have been identified because of their strong potential for innovation, and because of the new fields of fundamental research they open up.

They form the backbone of the research projects we have developed over the last few years.
Start date: January 2009

Adresses
Solvay USA Inc
350 Georges Patterson Blvd, Bristol
19007, PA, USA

UPENN - Laboratory for Research on the Structure of Matter
3231 Walnut Street, Philadelphia, 19104, PA, USA

City involved: Bristol & Philadelphia

The theme of the lab revolves around the concept “From physical understanding to design of devices” and the main themes of interest are:

- Biofilms and surfaces
- Surface engineering
- Encapsulation

To sum up, our way of working is to select the laboratory's subjects for their scientific and industrial relevance. At the moment we are developing more precisely the following projects:

- Bactericidal formulations
- Anti-adhesive formulations of bacteria
- Early detection of biofilms
- New formulations for encapsulation
Presentation

Created in 2001 and directed by Guy Bertrand, the CNRS/UC IRL in Chemical Sciences was originally located at the University of California at Riverside (UCR). It joined the University of California at San Diego (UCSD) in July 2012.

Under the co-supervision of the National Institute of Chemistry (INC) of the CNRS and UC San Diego, the laboratory mainly conducts research on the stabilization of highly reactive molecules, such as carbenes, nitrenes, phosphinidenes, etc...

The IRL joint venture is managed by Guy Bertrand from San Diego, and the laboratory receives funding from a wide range of sources including the National Science Foundation (NSF), the Department of Energy (DoE) and the Solvay group.
Scientific agenda

Research today tends to focus on the transformation of these chemical entities into powerful tools for organic synthesis, catalysis and materials.

Institutions and laboratories involved

Discussions are in progress with the Ecole Normale Supérieure of Lyon to create a double label PhD.
Presentation

From the discovery of DNA to the first sequencing of the epigenome of human cells, life sciences regularly transform the nature of their technical and scientific project, and through it the boundaries that separate them from other sciences.

Epidapo (Epigenetics, Data, Politics) is a International Research Laboraty of the CNRS with GW Department of Genetics and Precision Medicine. Epidapo has moved from UCLA to George Washington University. The research carried out by our interdisciplinary team is at the intersection of Genetics, Environment, Big Data and Society.

Through its interdisciplinary approach to the challenges associated with the "genomic" and "post-genomic" approaches of life, Epidapo aims to not only make the representatives of different academic communities (life sciences, environmental sciences, human and social sciences, bioinformatics, etc.) work together, but also to contribute to the public debate and participate in informed decision-making, particularly in the field of public health policies.

Keywords

- Epigenetics
- Genetics, Big Data, Undiagnosed Diseases
- Science and Technologies Studies
- Gender & Sexual orientation
- Scientific misconduct
Scientific Agenda

Epidapo’s researchers study the genomic/post-genomic transition from various perspectives:

(i) the variety of factors at the origin of the post-genomic "revolution";

(ii) the nature and consequences of the data produced by computational biology;

(iii) the impact of (epi)genomics on personalized medicine, and the transformation of the "diagnosis" of diseases;

(iv) the development of new therapies by the pharmaceutical industries or the evolution of health policies;

(v) the public controversies associated with the progress of genetic engineering and their ethical and regulatory consequences.

Epidapo’s research activities are developed at the intersection of cross-cutting themes such as interdisciplinarity & (epi)genetics, data and (epi)genomic, gender and politics, nutrition and aging.

Identification of structural variants (inversion)
Presentation

The International Research Laboratory (IRL) 2958 GT-CNRS is an international joint laboratory, founded in 2006 by the National Center for Scientific Research (CNRS) and the American University Georgia Tech based in Atlanta.

This unit has its main site on the Georgia Tech-Lorraine (GTL) campus in Metz.

The IRL 2958 develops its activities in three main research areas with high-tech industrial applications in the aeronautics, automotive, biomedical and energy sectors.

Keywords

- Smart materials
- Nonlinear dynamics
- THz spectroscopy
- Acoustic spectroscopy
- Non-destructive testing
- III-N semiconductor nanostructures
- Information system
- Robotics - Design and integration of systems

Themes

- Non-linear optics
- Signals and information systems
- Environmental solid state semiconductor sensors
- Micro LED, UV LED
- Photovoltaic
- Flexible optoelectronics
- Non-destructive testing (THz and acoustics)
- Cryptography
- Additive manufacturing
- Vision and artificial intelligence

Georgia Tech Lorraine
Start date: **January 2006**

Head FR since 2018

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2 Rue Marconi 57070 Metz

**Georgia Institute of Technologie**
North Ave NW, Atlanta, GA 30332

Cities involved: **Metz and Atlanta**

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**Founders**

- Georgia Institute of Technology
- Centre Nationale de la Recherche Scientifique (CNRS)
- Georgia Tech Lorraine (GTL)

**Partners laboratories**

- LMOPS Laboratoire Matériaux optiques, photonique et systèmes
- LEM3 (Laboratoire de Microstructures et de Mécanique des Matériaux)
- FEMTO (Franche-Comté Electronique Mécanique Thermique et Optique)

**Partners (scientific collaborations)**

- Arts et Métiers ParisTech
- Université de Franche-Comté
- Université de Lorraine
- Centrale Supélec

**American partners**

- Missouri S&T
- Northwestern University
- Massachussetts Institute of Technology (MIT)
- University of Sherbrooke

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Georgia Tech professor David Citrin is shown with images produced by a terahertz imaging technique. Researchers studied a 17th century painting using a terahertz reflectometry technique to analyze individual paint layers. John Toon, Georgia Tech
IRL - Interdisciplinary and Global Environmental Studies (iGLOBES)

Exploring the interface between social and environmental sciences

INSHS (INEE)

Presentation

The IRL iGLOBES – Interdisciplinary Global Environmental Studies – is an international and interdisciplinary research center located at the University of Arizona (UArizona), associated with the Biosphere 2 Institute within the Research Vice-Presidency of the University.

iGLOBES aims at establishing a hub of collaborative interactions between the French scientific community and UArizona to foster interdisciplinary research on global environmental challenges. The IRL is thus focused on strengthening international cooperation between French and American researchers, in social and environmental sciences.

The questions raised by the conflict, cooperation and adaptation of populations around natural resources in extreme environments are at the heart of the IRL program. iGLOBES research strongly emphasizes the arid and cross-border context that characterizes Southeastern Arizona.
iGLOBES acts to facilitate and expand collaborations that have long been established between the French scientific community and multiple departments and centers at the University of Arizona, including the Udall Center for Studies in Public Policy, the Arizona Institute for Resilient Environment and Societies, the Arizona Data Science Institute, the Schools of Geography & Development, Information, Natural Resources and the Environment, Government and Public Policy and the Departments of Ecology and Evolutionary Biology, Environmental Sciences, Mathematics, Materials Science and Engineering, Hydrology and Atmospheric Sciences, and Astronomy.

Building on the graduate programs of Paris Sciences & Lettres (PSL) University, the IRL iGLOBES is pursuing new collaborative opportunities with Biosphere 2, the Arizona Desert Laboratory, the Arizona Initiative in Ecosystem Genomics and the Program in Applied Mathematics.
Scientific Agenda

Current projects at iGLOBES involve sociologists, geographers, anthropologists, archaeologists, ecologists and planetary scientists, and span four main themes:

• Cooperation, conflict, and policy for water resources in the arid Americas.
• The governance of natural resources and sparsely populated areas in the Americas.
• Ecological and societal adaptation and collapse in response to extreme climate events.
• Anthropologic and ethnographic analysis of the relationship between societies, nature and life.

Photo - Biosphère 2
iGLOBES also supports research carried by the “Pima County Human-Environment Observatory”, which is a member of the French Human-Environment Observatory Network funded under the “Laboratory of Excellence DRIIHM”.

The Pima County Observatory promotes innovative research on the multiple interactions between stakeholders and decisional levels in public policy regarding major environmental transformations occurring in the Sonoran desert environment.

In 2020, on-going externally funded research programs include the GUYINT project (Agence Nationale de la Recherche), focused on the governance of sparsely populated areas in the Guiana Shield; and the Dimensions of Biodiversity project (National Science Foundation), which explores the multi-scale evolutionary mechanisms by which biodiversity responds to environmental changes.

New bridges to UArizona astronomy and space sciences have recently been established, at the interface with social sciences and anthropology.

This makes iGLOBES a major international partner of the Research Center on the Origin and Conditions of Appearance of Life coordinated by PSL University in Paris.
Presentation

The International Research Laboratory, Centre Pierre Binétruy, is a research center of the CNRS and the University of California at Berkeley. The scientific area of this IRL is astroparticle and cosmological physics and their interface with fundamental physics in particular in the light of on-going and forthcoming observational efforts.

The goal of the Center is to support some of the most successful existing collaborations between research groups from France and Berkeley, and to assist them in their transformation into leading, next generation efforts capable of addressing some of the most exciting, scientific challenges faced by the cosmology and astroparticle physics in the coming decade.

The Center also aims at encouraging, supporting, and motivating new initiatives and ideas.

It will organize meetings and workshops, and animate scientific life at various levels and will provide support, help, and guidance for visiting researchers from France.

Simons Array - one of the highest observatories on the Earth, observing fluctuations of the cosmic microwave background from the Atacama Desert in Chile (~5100 meters over the sea level) in the search of insights about the origin of the Universe. Simons Array and Simons Observatory are two of the key projects of the Centre Pierre Binétruy.

Key words

- Cosmological physics: primordial Universe, dark matter, dark energy,
- Astroparticle physics: neutrinos, relativistic particles,
- Gravitational waves.
Start date: **January 2020**

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Berkeley, CA 94720-5800

**City involved:** Berkeley

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**Scientific agenda**

Main scientific objectives of the IRL are defined around four main themes. These are:

- understanding the nature of the cosmological components, including dark energy - responsible for the observed acceleration of the expansion of the Universe, dark matter - dominant matter like component necessary to explain the present-day structures in the Universe; and relativistic particles including neutrinos;
- understanding the mechanism, known as inflation, responsible for the generation of the primordial inhomogeneities which gave rise to currently observed structure in the Universe;
- understanding the gravity in cosmological and astrophysical contexts and fundamental physics as driven by gravitational wave observations;
- promoting multi-disciplinarity to accelerate progress in addressing the three themes listed above.

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**The IRL strives to:**

- support original, cutting-edge science and leading projects in the areas of cosmological and astroparticle physics with special emphasis on those aspects and those projects that can benefit from France – Berkeley synergies;
- increase the presence, visibility and impact of France-based scientists at Berkeley;
- provide new educational and research opportunities for France-based doctoral students and postdoctoral researchers and develop active exchange programs for Berkeley- and France-based junior researchers in the form of internships, PhD co-supervisions, and postdoctoral exchanges.

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Speech by his Excellency Philippe Etienne, Ambassador of France in the US at UC Berkeley's Auditorium  
Photo credit: Thomas Lee/Berkeley Engineering
Historically, the collaborations have been established between several PIs in Montpellier and Stanford since 2005. At that time, C. Jonquet, former PhD student and now Assistant Professor at LIRMM, spent 3 years as a postdoctoral fellow in Pr. Musen’s lab working on semantic web and ontologies and kept the informatics collaboration since then.

In 2007, Prof. P. Fraisse, roboticist at LIRMM, spent several months at Stanford in the team of Prof. O. Khatib to work on biomechanical modeling. Here too, the collaboration continues as well.

More recently, from 2015, Prof. O. Khatib and Dr. V. Creuze started a collaboration in the field of underwater robotics within the framework of the "Corsair" project coordinated by the underwater archeology department of the ministry of culture.

Finally, for the 2017/2018 academic year, one Stanford Pr. Okamura’s PhD student stayed several months at LIRMM working on medical robotics with Prof. P. Poignet and Dr N. Zemiti.

The LIRMM-Stanford partnership in the last ten years has then been developed along three main streams: (i) Underwater robotics, (ii) Medical robotics and (iii) Semantic Web.
Key words

- Underwater robotics,
- Surgical robotics,
- Semantic web.

Extended to more generally:

- Data science,
- Artificial Intelligence,
- Robotics.

Scientific agenda

Existing collaborations cover different fields of research from computer sciences to robotics and have already accomplished great scientific outcomes.

The LIRMM-Stanford partnership for the next coming years will then be built atop of existing collaborations along the three main streams presented hereafter: (i) Underwater robotics, (ii) Medical robotics, (iii) Semantic Web. In the mean time, we expect the formal partnership to enlarge the spectrum of collaborations covering e.g. human-robot interactions, biomedical applications, data science, AI, etc. in order to be of benefit to the largest possible scientific community of Montpellier and Standord.

Furthermore, collaborations are easily aligned with the University of Montpellier’s "MUSE strategic regional scientific directions” including health, environment and agronomy.

Basic and applied research areas addressed. All the actors concerned have extremely strong theoretical and applied expertise which gives all its meaning to the research carried out.

The main results of the project will be promoted through publications in international journals or communications during international conferences. If necessary, they will be the subject of a declaration of invention to our regulatory institutions.
Presentation

The International Research Project (IRP) between the Centre National de la Recherche Scientifique and the University of Illinois at Urbana-Champaign was launched at the end of 2012. Its primary objective is to develop methods for high-performance molecular simulation with the aim of understanding the function of complex biological assemblies, transcending the frontiers of traditional disciplines by uniting mathematicians, physicists, theoretical chemists and biologists on both sides of the Atlantic.

In Nancy, the partner is a theoretical chemistry and biophysics group incepted in 2003. Its expertise lies in describing the structure and the dynamic properties of the biological membrane and elucidating the mechanisms of the cell machinery. To attain this goal, its members leverage numerical simulations over size and timescales commensurate with the biological process at hand.

Over the years, the team has gleaned milestone results in such diverse research areas as membrane transport, interaction with the biological membrane, membrane protein structure and function, as well as self-organized molecular systems. They also develop original approaches in the field of free-energy calculations to tackle rare events in biology.

In France, the major contributors are located at the Université de Lorraine, the École des Ponts ParisTech, the Institut de Biologie Structurale and the Laboratoire de Biologie Physico-Chimique.

In the United States, the contributors belong to the NIH Resource for Macromolecular Modeling and Bioinformatics.

Atomic detail of the bacterial photosynthesis machinery / Rhodobacter sphaeroides revealed by a computational microscope
Start date: 2013-2025

Head FR
CHRIS CHIPOT - christophe.chipot@univ-lorraine.fr

Head US
EMAD TAJKHORSHID - emad@life.illinois.edu

Number of laboratories: 8

Events: Mainly conferences and workshops

Website: http://www.lia-uiuc.cnrs.fr

Key words
- Modeling
- Numerical Simulations
- Biological Assemblies

Themes

1. The adaptive biasing force algorithm.
   (a) Extended adaptive biasing force.
   (b) Helmholtz projection and adaptive biasing force.
4. Molecular mechanism of processive 3' to 5' RNA translocation in the RNA exosome complex.
5. The p7 viroporin of the Hepatitis C virus.
6. Conformational transitions in the ADP3-/ATP4- carrier.
7. Organization of annexins at the surface of membranes.

Institutions and laboratories involved
- Université de Lorraine, UMR 7565, Nancy
- Laboratoire de Biochimie Théorique, UPR 9080 et UMR 7099, Paris
- École des Ponts ParisTech, Champs-sur-Marne
- Institut de Biologie Structurale, Grenoble
- Laboratoire d'Ingénierie des Systèmes Macromoléculaires, UMR 7255, Marseille
- Beckman Institute for Advanced Science and Technology, University of Illinois at Urbana-Champaign, Urbana
- University of Chicago
- Weill Cornell Medicine
IRP - LCC-CPR

Laboratory of Coordination Chemistry for Controlled Radical Polymerization

Presentation

The objectives of the LCC-CPR IRP are centered on the contribution of coordination chemistry to the performance of controlled radical polymerization, which has revolutionized polymer science in the last 20 years by allowing the development of previously inconceivable macromolecular architectures.

This is possible by combining the radical mechanism, which is tolerant of a large number of reactive functions, with extremely long-lived growing chains. This allows the average molar mass and molar mass distributions of the polymers to be controlled and makes it possible for dormant chains to be reactivated to prepare macromolecules that contain blocks of different natures.

These materials display new properties that make them suitable for applications in such different areas as drug delivery, microelectronics or solar energy conversion. Of the various techniques to control radical polymerization, the two that have proven most flexible and that focus the attention of this IRP are “atom transfer radical polymerization” (ATRP) and “reversible addition-fragmentation chain-transfer” (RAFT) polymerization.

The IRP is also interested in a third controlling method that relies on the reversible formation of a bond between the radical chain and a metal complex, called “organometallic-mediated radical polymerization” (OMRP), because of its greater promise for the control of less reactive monomers. Coordination chemistry plays a key role in the ATRP and OMRP techniques.

Key words

- Coordination Chemistry
- Organometallic Chemistry
- Controlled Radical Polymerization
- Atom Transfer Radical Polymerization
Scientific agenda

The research activities of the IRP are developed along three directions:

- Fundamental understanding of the role of metals in the radical termination catalysis, a side-process that negatively impacts controlled growth and must therefore be minimized in order to improve the properties of the materials obtained by ATRP.

- Optimization of the polymerization of less reactive monomers, in order to push the limits of application of this technique and develop additional intelligent materials for new applications.

- Reversible switch between different polymerization methods (notably ATRP and RAFT) in order to further broaden the scope of monomers than can be combined with the same macromolecular structure.

Institutions and laboratories involved

- Laboratoire de Chimie de Coordination (LCC), UPR 8241 CNRS, Toulouse
- Interactions Moléculaires et Réactivité Chimiques et Photochimiques (IMRCP), UMR 5623 CNRS-Université Toulouse III Paul Sabatier, Toulouse
- Chemistry Department, Carnegie Mellon University (CMU), Pittsburgh, PA
- Chemistry Department, Duquesne University (DU), Pittsburgh, PA

Events

- Kick-off meeting in Washington DC from 20 to August 24, 2017
- Visit of Simon Harrisson to CMU from August 25-27, 2017
- First annual meeting in Toulouse on June 1st, 2018
An International Research Project was launched on May 30, 2019 at the Metropolitan Museum of Art, New York (The Met). The project entitled “Art and Cultural Heritage: Natural Organic Polymers by Mass Spectrometry” (ARCHE) establishes the collaboration between the CNRS, the University of Bordeaux, Bordeaux INP and the Met. The opportunity to understand scientifically the material dimension of the museum collection, especially for conservation and preservation of artworks, and to recall the relationship between history and natural products.

Coordinated by Caroline Tokarski (Institute of Chemistry and Biology of Membranes and Nanoobjects - CBMN, CNRS/University of Bordeaux/Bordeaux INP) and Julie Arslanoglu (Department of Scientific Research, Metropolitan Museum of Art in New York).

Their previous collaborations resulted in the introduction of “proteomics” and “enzyme immuno-absorption assay” (ELISA) respectively in the field of cultural heritage, allowing thus a precise identification of proteins and their biological species, as well as their targeted localization in a sample.

Key words
- Proteomics
- High resolution mass spectrometry
- Artworks and museum objects
- Molecular networks
- Art preservation and conservation

Scientific agenda
The scientific program proposes the development of techniques for the structural study of organic macromolecules (proteins, lipids, polysaccharides) used to create cultural heritage and their molecular networks, as well as for the elucidation of their degradation mechanisms, a program linked to art conservation and preservation of works of art. The project also incorporates new imaging techniques based on immunological detection and high resolution mass spectrometry for the precise localization of organic material and its altered areas.
**Number of laboratories:** 2

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<tr>
<th>The Institute of Chemistry and Biology of Membranes and Nanoobjets (CBMN UMR5248 - CNRS / Université de Bordeaux / Bordeaux INP);</th>
<th>Mass Spectrometry team-Proteome Platform; The Department of Scientific Research (DSR) (The MET)</th>
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**Organized events**


Summer School Advanced Mass Spectrometry applied to Cultural Heritage 2019, 2021

MaSC 2021, Bordeaux

Gordon Conferences 2020 postponed to 2022

IRP ARCHE signature ceremony: H. Jacquet (VP Strategy & Development of UBx), M. Hollein (Director of Metropolitan Museum of Art), C. Tokarski (Professor at UBx), J. Arslanoglu (researcher at the Scientific research Departement, Metropolitan Museum of Art), J. Maddaluno (Director of the CNRS chemistry Institute)
The creation of the IRP iNOVE aims to establish a permanent and high-visibility international relationship between three CNRS-AMU joint laboratories (CEREGE, IMBE, and LEMIRE-BIAM) and the Civil & Environmental Department at Duke University (North Carolina, US) for Research, Training, and Education. This creation corresponds to the evolution of a collaboration that began more than 20 years ago and which deals with environmental issues of major interest to our society.

The goal of iNOVE is to extend the international leadership beyond what partners have already built around the environmental risks associated with nanotechnologies (CEINTcenter in the US and iCEINTconsortium in France) towards the development of innovations for a sustainable environment.

There is no doubt that human activities (industry, agriculture, energy, etc.) will impact the different compartments of our environment (water, soil, atmosphere and biota).

The sustainable preservation of resources but also of human and environmental health, will remain a major scientific issues that will be covered during the course of iNOVE.

**Key words**

- multi-contamination
- environmental pollutions and their impacts
- nano-, biotechnologies
- water reuse
- extraction of critical metals
- environmental databases
**Main events**

**US researchers invited in France:**
Christine Ogilvie (Duke), Zachary Hendren (RTI), Mark Wiesner (Duke), Jaleesia Amos (Duke)

**French researchers invited in the US:**
Jeanne Perrin, Mélanie Auffan, Jérôme Rose, Danielle Slomberg, JY Bottero

**Joint meetings:**
- Final Alignment and Integration of the NanoFASE Database with the US NanoInformatics Knowledge Commons (NIKC) Database Structure
- EU-U.S. NanoEHS Communities of Research (CoRs) Workshop

**Institutions and laboratories involved**

CNRS, Aix-Marseille Université (AMU), Avignon Université, Collège de France, Commissariat à l’énergie atomique et aux énergies alternatives (CEA), Institut de recherche pour le développement (IRD), Institut national de la recherche agronomique (INRA), Duke University
Presentation

The IRP «ACTIMOVE» aims at addressing conflicts between environment and health, and is based on a unique interdisciplinary approach that brings together medical doctors, physiologists and ecologists.

This innovative project is organized around three main axes, involving observation, experimentation, and implementation of new strategies of prevention of sedentary behaviors in free-living conditions. The feasibility of the latter will be tested thanks to a unique socio-ecological approach.

The research will be conducted over a period of 4 years in Senegal within the framework of the Tessekéré Observatoire Hommes-Milieux International (OHMI - Labex DRIIHM: http://www.driihm.fr/), in France and in the State of Colorado in the USA.

Scientific agenda

The objectives of this IRP are to understand the overall transition of physical activity and its impact on health, as well as to develop and implement strategies of prevention of sedentary behaviors in everyday life and of associated chronic diseases.

The specific aims are:

(i) To characterize adaptations of developing populations in the epidemiological transition towards a western lifestyle and industrialized society,

(ii) To test new strategies to reduce sedentary behaviors,

(iii) To test the feasibility of these strategies in the real world and at work by using a socio-ecological model.
The IRP includes three complementary and synergistic work modules (WM).

**WM 1: TRANSITION OF PHYSICAL ACTIVITY**

Since 2015, Audrey Bergouignan and her team have joined the Tessékéré in Senegal to work on the sedentarization of the Peuhls population.

Using a comparative approach, the evolution of the level of physical activity and its effect on various health markers are evaluated. The studied populations are Peuhls living in settlements in Northern Senegal who go in transhumance, Peuhls living in villages built around wells, and Peuhls who have moved to Dakar.

The study combines accelerometry techniques, marking techniques with stable isotopes in order to determine the physical activity profile, the total energy expenditure and its components.

Relationship between changes in physical activity and energy consumption is examined.
WM 2: FRAGMENTATION OF TIME SPENT IN A SEDENTARY LIFESTYLE AND METABOLIC HEALTH

A clinical study (4 weeks) will be dedicated to better defining:
1) the effects of fragmentation of time spent in a sedentary lifestyle on metabolic health and
2) the underlying mechanisms; a proposal for direct application will also be made.

The following factors on overweight adults will be evaluated:

- Physical activity profile: time spent sitting, energy expenditure and its components
- Maximum aerobic capacity (VO2max)
- Biomarkers profiles of cardiometabolic health (triglycerides, cholesterol, CRP, HDL, LDL) and of inflammation (IL1a, IL6, IL10, TNFa)
- Daily use of total and exogenous lipids and carbohydrates
- Distribution of dietary lipids between oxidation and incorporation in intermediate lipid fractions of the muscle
- Mitochondrial function measured on fresh muscle tissue
- Sensitivity to insulin of the whole organism, the liver and the skeletal muscle
- Appetite and eating behavior
WM 3: FRAGMENTATION OF TIME SPENT IN A SEDENTARY LIFESTYLE ON THE WORLD OF LABOR

In this study efficiency of long-term interventions (several months), aiming at reducing the time spent sitting in the workplace, will be tested, with the objective to identify feasible and efficient approaches to reduce time spent sitting by adults in order to improve health.

The following parameters/indicators will be monitored:

• Daily time spent in a sedentary lifestyle and physical activity profile
• Body mass and composition
• Biomarkers of inflammation and cardiometabolic diseases
• Energetic metabolism (total energy expenditure)
• Lipid metabolism (oxidation of dietary lipids)

In addition, Interventions that promote a) standing up position instead of the sitting working position with height adjustable workstations and b) short daily sessions of physical activity will be considered and compared.

Institutions and laboratories involved

France
• Institut Pluridisciplinaire Hubert Curien UMR 7178,
• Département d’Ecologie, Physiologie et Ethologie, Université de Strasbourg

USA
• University of Colorado, School of Medicine, Division of Endocrinology
• University of Colorado, Anschutz Health and Wellness Center
**IRP - NANOELEC**

Nanoelectronics, from new phenomena to low power electronics

**INP**

**Presentation**

The central goal of this IRP is to develop new understanding and control of charge and spin in nano-scale structures, and the development of novel nanoelectronics devices to drastically reduce power consumption and demonstrate new computing architecture.

**Themes and research projects**


They benefited from 4 scholarships: 1 Chateaubriand fellowship program (French Embassy in the USA), 1 Fulbright Scholarship, 1 Scholarship Jean d'Alembert, 1 ITN Scholarship.

Spintronic device based on domain wall motion in magnetic wires
Start date: **2015-2022**

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**Number of laboratories:** 4

**Websites**
http://www.c2n.universite-paris-saclay.fr/fr/recherche/nos-laboratoires-communs/ia-nanoelec/
http://face-foundation.org/partner-university-fund/news/NanoelectronicsInternationalAssociatedLaboratoryLaunch.html

**Key words**

- Spintronics
- Nanoelectronics
- Bio-inspired circuits

**Institutions and laboratories involved**

C2N (université Paris Sud/Paris-Saclay/CNRS)

Institut Jean Lamour (Université de Lorraine/CNRS)

University California of San Diego

New York University

**Main events**

Exchange with students, professors/researchers; workshops, Franco-American research projects, double degree ....

IRP Kickoff meeting at UCSD in September 2015 with the presence of the French Consul

Signig ceremony in presence of Thomas J.Carey, Dean of the faculty of Arts and Science at NYU
Presentation

The collaboration between the Craig Roy's Lab, *Department of Microbial Pathogenesis*, (Yale University) and Cherfils, Laboratory of Biology and Applied Pharmacology (LBPA), under supervision of CNRS and the Ecole Normale Supérieure Paris-Saclay was setup to analyze the cellular, biochemical and structural mechanisms whereby effectors from pathogenic bacteria hijack trafficking pathways during infections.

It brings together the expertise of LBPA in protein biochemistry and structure and of the Roy lab in cell biology and microbiology of intracellular pathogens.

The LBPA investigates the structural and biochemical basis of molecular reactions that govern the functions of regulatory small GTPases and how these reactions can be inhibited by small molecules.

The Roy lab aims to understand the molecular and cellular events that enable microbial pathogens to evade host defense mechanisms, in particular bacterial effector proteins that subvert eukaryotic cell functions to regulate phagosome maturation and modulate host immunity.

Structure of a legionella effector that hijacks a small GTPase of the host by addition of a post-translational modification. From Campanacci V., Mukherjee S., Roy C.R. and Cherfils J., EMBO J. 2013.

Key words

Structural biology, microbiology, host-pathogen interaction
Start date: **2014-2021**

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**Head US**  
**Prof. Craig R. Roy** - craig.roy@yale.edu

**Number of laboratories:** 2

**Website**  

**Scientific agenda**

The goal of this IRP is to understand the molecular mechanisms whereby intracellular microbial pathogens subvert membrane trafficking pathways to evade host defense.

Legionella pneumophilla, Coxiella burnetii and Rickettsia prowazekii are used as model pathogens with divergent intracellular lifestyles.

Previous and future research combines in vivo infection and cellular studies in the Roy laboratory with structural studies and reconstitution of protein activities in artificial membranes in the Cherfils laboratory.

These studies should provide important advances in our understanding of the molecular basis of host-pathogen interaction.

The Arf/Sec7 complex is stabilized by the interfacial inhibitor Brefeldin A (red), illustrating a conceptual advance in inhibiting proteins by stitching them together ineffectively. (Image courtesy of J. Cherfils)

**Institutions and laboratories involved**

- CNRS and Ecole normale supérieure
- Paris-Saclay, Laboratoire de Biologie et Pharmacologie Appliquée (UMR 8113), Cachan, France
- Yale University School of Medicine
- Department of Microbial Pathogenesis, New Haven, Connecticut, USA
The IRP "Myosin-Cancer" aims at finding unconventional myosin inhibitors which have an important role in the survival, invasion or migration of tumor cells.

Rich from their collaboration started 20 years ago, the French and American laboratories coordinate their efforts and concentrate them to study three molecular motors which are potential targets against tumour cells.

Key words

- Myosin
- Molecular Motor
- Therapeutical target
- Inhibitor
- Cancer
Star date: **2019-2023**

Number of laboratories: **2**

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Curie Institute, Paris 75248, France

**Scientific agenda**

- Joined Video Meeting – every week to coordinate work on myosin VI studies
- Lab meeting and zoom call every week to coordinate efforts on myosin VI
- Visit to the USA in July 2020 canceled due to coronavirus for Anne Houdusse and Julien Robert-Paganin
- Lee Sweeney planned in March canceled in 2020 post-poned due to Covid-19

**Main events**

- Lee Sweeney visits to France in January 2019, April 2019, November 2019, January 2020
- NIH grant obtained for the support of the Myo18a project

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Anne Houdusse  
Credit: Curie Institute
Presentation

The ultimate/long-term goal of Pr Coruzzi, Dr Krouk and Dr Ruffel systems biology approach is to model and predictively manipulate regulatory networks affecting nitrogen uptake and assimilation in plants.

This might help to decrease energy consumption, reduce ground water contamination by NO3- and improve seed yield, with implications for human health and biofuels. As N is a key rate limiting element in plant growth.

Understanding the factors that limit N-use efficiency will have particular relevance.

Steps that potentially limit N-use efficiency include:
   i) uptake of inorganic-N (including NO3-) from the soil,
   ii) NO3- reduction to ammonia,
   iii) assimilation of inorganic-N onto organic-N (Glutamate (Glu)/Glutamine (Gln))
   iv) being the N-donors for all biosynthetic reactions involving nitrogen including chlorophyll, DNA and amino acid synthesis.

All these steps are known to be at least transcriptionally coordinated by NO3- and alternative N. It is noteworthy that manipulating these steps by biotechnology processes already led to significant improvements of N use by plants.

Thus, understanding how molecular networks coordinate N use is key for i) basic research and, ii) for long term industrial applications.

One key aspect of the control of plant N nutrition is the potential to coordinate several steps of the nutrition at once. To do so, the use of Transcription Factor (TF) as molecular hubs is an exciting perspective.

However, the only known TF able to improve some aspect of N/Carbon nutrition is Dof1.
Scientific agenda

The IRP aims to infer a causal genetic network, effectively the circuit diagram underlying N-assimilation and its transcriptional control by nitrogen signals, to uncover mechanisms that optimize N-use efficiency.

An algorithm to understand the cooperation of Transcription Factors (TF) has been developed.

The project will be articulated around 2 main aims:

The first aim will use and develop the algorithm in order to detect TF cooperation controlling Nitrate assimilation involved genes.

The second aim will experimentally test the hypothesis generated by the algorithm. If successful this approach will advance basic knowledge i) on TF network structure through machine learning algorithm and ii) on plant mineral nutrition and gene coordination.

Institutions and laboratories involved

- Center for Genomics and system biology, department of biology, NYU (Pr Gloria Coruzzi lab),
- BPMP, (Biochimie et physiologie moléculaire des plantes) under supervision CNRS/ Université de Montpellier/Institut national de recherche pour l'agriculture,
- Institut national de recherche pour l'agriculture, l'alimentation et l'environnement (INRAE) et Institut Agro.

Number of laboratories: 2

Start date: 2017-2025

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Head USA
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Main events
Think Tanks, Jacques Monod Conference

Website
https://sites.google.com/site/iplantsystemsbiol/

New York University Center for Genomics and Systems Biology
IRP - PredEvo
Predicting evolution
INSB

Presentation

Understanding the complexity of the microbial world needs a close collaboration between biologists and computer scientists, which is the aim of this IRP.

The project aims to study the evolution of bacterial phenotypic variability at population and single cell levels using an experimental evolution platform, where researchers combine bacterial and numerical organisms to measure and model this variability in a robust manner.

This evolutionary platform will be used to measure and control many bacterial characteristics, and will become an integral part of other systems biology and synthetic biology approaches.

Researchers are studying how genome evolution and phenotypic variability interact to influence evolutionary dynamics.

This question remains difficult to grasp due to the lack of integrated tools to systematically measure the phenotypic variability of a given individual.

This IRP combines the longest ongoing experience of bacterial evolution with the Aevol model of numerical organisms to measure the phenotypic variability associated with antibiotic resistance and tolerance (the latter phenomenon being called persistence).

For bacteria: the experiments will be carried out at the population level using conventional microbiological and molecular approaches and at the single cell level using microscopy and microfluidics. Numerical organisms, variability phenotypic and stochasticity of gene expression will be included in the models.

This IRP project will thus integrate experimental data and computational models to understand the evolution of bacterial physiology and evolutionary dynamics both at a fundamental level and to ask concrete questions related to current concerns of our society.
Start date: **2015-2023**

**Number of laboratories: 3**

**Head FR**
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**Head USA**
**Pr RICHARD E. LENSKI**
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**Website:**

Grenoble French team: [http://www-timc.imag.fr/rubrique555.html](http://www-timc.imag.fr/rubrique555.html)

Michigan American team: [http://myxo.css.msu.edu/](http://myxo.css.msu.edu/)

Lyon French team: [https://team.inria.fr/beagle/](https://team.inria.fr/beagle/)

**Keywords**

- Experimental evolution
- Microbiology
- Genetics, genome analyses
- Physiology
- Bacteria
- Digital genetics

**Scientific agenda**

Experimental evolution of bacterial and digital organisms: from phenotypes to genotypes, including the evolution of genomes and regulatory and metabolic networks.

**Institutions and laboratories involved**

4 Laboratoires Techniques de l’Ingénierie Médicale et de la Complexité - Informatique, Mathématiques et Applications, Grenoble (TIMC-IMAG), UMR5525 CNRS - Université Grenoble Alpes, Campus Santé, Domaine de la Merci, 38700 La Tronche.

Microbiology and Molecular Genetics, Michigan State University, Biomedical Physical Sciences Building, 567 Wilson Road, East Lansing, MI 48824, USA.

Laboratoire d’Informatique en Images et Systèmes d’Information, UMR 5405, CNRS, INSA-Lyon, Université Claude Bernard Lyon 1, Université Lumiére Lyon 2, Ecole Centrale de Lyon, Equipe-Projet Commune Beagle, INRIA, INSA-Lyon, Université Claude Bernard Lyon 1.
IRP - RiGoK

Rigor and the Growth of Knowledge

Presentation

This IRP (International Research project) “RiGoK” (Rigor and the Growth of Knowledge) is based upon an interdisciplinary team gathering philosophers, mathematicians, logicians and historians from France and the USA. It relies on a long-standing cooperation, which has been increasingly developing over the last ten years, and needed stronger institutional support.

The first objective of this IRP is to give a new dimension to this collaboration by creating a top-level international skills cluster, with a special focus on doctoral training. It aims at reinforcing the development of a philosophy of mathematics anchored in the between the Anglo-Saxon ("analytic") and the French ("epistemological") traditions.

The researchers propose to focus their work on a renewed study of the question of rigor in mathematics approached from both a historical and philosophical point of view. The challenge is to highlight the diversity of practices associated with a standard that mathematicians too often believe has only one meaning and only one way of performing.

Scientific agenda

- The reinforcement of our joint program in history and philosophy of mathematics (Philmath Intersem), which until now has only been held in France, for lack of additional institutional support;
- A series of joint publications, including a collection of essays presenting our original approach to the philosophy of mathematics;
- The building of a network for young researchers working in the field in Europe and in the USA.

Keywords

- History and philosophy of mathematics
- Rigor
- Proofs
- Intuition
Main events

Annual Franco-american seminar (one month): *Philmath Intersem*

Institutions and laboratories involved

- Laboratoire SPHERE (Sciences, Philosophie, Histoire), UMR 7219 (CNRS/Université Paris)
- Laboratoire Archives Henri Poincaré, Philosophie et recherches sur les sciences et la technologie – UMR 7117 (CNRS/Université de Lorraine/Université de Strasbourg)
- Laboratoire Philosophies et rationalités (EA 3297), Université Clermont Auvergne
- Institut d’histoire et de philosophie des sciences et des techniques, UMR 8590 (CNRS/Université Panthéon-Sorbonne)
- Department of Philosophy, University of Notre-Dame, Indiana
- Department of Philosophy, University of California, Los Angeles, California
- Department of Philosophy, University of Michigan, Ann Arbor, Michigan
- Department of Mathematics and Computer Science, Drake University, Des Moines, Iowa
- Department of Philosophy, Kansas State University, Manhattan, Kansas
Modern Approaches to Knowledge Compilation

Presentation

The MAKC IRP is focused on the knowledge compilation (KC) paradigm for problem solving. Knowledge compilation is a research area which aims to preprocess information to improve the time required to solve highly-demanding computational tasks (formally, problems located in the NP or beyond NP complexity classes). The key insight underlying knowledge compilation is to translate a given representation of knowledge into a target representation that has good algorithmic properties, therefore facilitating the process of reasoning with knowledge to solve certain problems. Boolean and arithmetic circuits are the typical targets of this compilation process.

The MAKC IRP aims to conceive and evaluate knowledge compilation tools of various kinds (mainly preprocessors, compilers and reasoners) and apply them to solve problems from a large spectrum of areas, including product configuration, formal verification, probabilistic inference, machine learning, and databases.

Scientific agenda

- Designing and evaluating knowledge compilation tools
- Applying knowledge compilation tools to a spectrum of AI applications
- Collecting benchmarks
- Disseminating results
Keywords

- Artificial Intelligence
- Knowledge compilation.

Institutions and laboratories involved

- Automated Reasoning Group of the University of California at Los Angeles (UCLA)
- Centre de Recherche en Informatique de Lens (CRIL UMR 8188 CNRS - Artois University)
IRP - Radioboost

Boosting radiotherapy with ultrasmall nanoparticles

Presentation

Radioboost project is a collaborative project between scientists and clinicians at the University of Lyon, Dana-Farber Cancer Institute, Massachusetts General Hospital and Tufts University.

The goal of the project is to propose new ambitious and innovative research at the interface between nanotechnology, radiation therapy, computational modeling and immunotherapy.

The project is based on the long collaboration between researchers at the Dana-Farber Cancer Institute and the University of Lyon for the development of AGuIX nanoparticles that are now in clinic in France for radiosensitization of brain metastases (Phase 1b, Nanorad; Phase 2, NanoRad 2 and phase 2, Nanostereo) and cervix cancer (Phase 1b, NanoCol).

The collaboration with Dr Ross Berbeco from the Dana-Farber Cancer Institute, Brigham and Women’s Hospital and Harvard Medical School has played a major role in the development of the AGuIX nanoparticles from in vitro experiments to preclinical proof of concept.

Key words

Nanoparticles, radiotherapy, MRI, active targeting, cancer.
Number of laboratories: 8

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Start date: 2020-2025

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Scientific agenda

A clinical trial is planned for 2021 with Dana Farber Cancer Institute and Harvard Medical School on lung and pancreatic cancer.

During Radioboost project, proofs of concepts will be performed on drug delivery, administration via the airways and active targeting.

Bismuth based nanoparticles will be particularly studied in order to perform clinical translation. These particles are protected by a common patent.

Main events

Nanohybrid congress, annual congress around hybrid nanoparticles.

Annual visits to Boston and Lyon.
IRP - DASEIN

Defects And Strain Engineering In materials for New and improved properties

Presentation

This IRP between the Materials Department of the University of California, Santa Barbara (UCSB) and the Institut Matériaux Microélectronique Nanosciences de Provence (CNRS/Aix-Marseille Université (AMU)) aims to set up a center of excellence dedicated to the influence of deformations and their gradients on the properties of functional materials. It relies on complementary skills that exist in Marseille (in situ strain mapping in 3D at ultimate resolution using advanced X-ray synchrotron techniques) and Santa Barbara (dedicated mechanical testing and control over the couplings between strain, magnetization, and temperature in intermetallics).

This project is a new step that builds upon a strong existing collaboration and it will bring closer together two major collaborative research projects at UC Santa Barbara and AMU: MRSEC (NSF DMR 072256) and AMUtech. This partnership will plant the seeds for a broader collaboration between the two centers. Exchange between scientists, postdocs and PhD students will be strongly encouraged through regular tele- and face-to-face meetings and seminars, workshops and a summer school.

First in situ Coherent X-ray Diffraction experiment during tensile testing of a Au nanowire. The nanowire was transferred and glued on a MEMS (Micro Electro-Mechanical System), which was placed at the center of ID01-ESRF goniometer. During the mechanical testing experiment we have been able to perform coherent X-ray diffraction and follow the strain in the wire as well as lattice rotation.

Key words

- Strain engineering
- Mechanics
- Physical properties
- X-ray diffraction

Representative engineering tensile stress-strain curves for different Au NW coated with two thicknesses of Al2O3. Representative SEM images of fractured NWs for (b) uncoated, (c) 3 nm coated, and (d) 10 nm coated Au NWs. Insets show higher magnification of fractured ends.


Main events

- Two workshops (2021 and 2023) in South of France and in Santa Barbara.
- One summer school (2022) in South of France.
IRP - CoopCelModel

Modeling of the cooperation between T lymphocytes and macrophages in the tumor microenvironment

INSB

Presentation

Despite significant advances, cancer immunotherapy fails to systematically elicit tumor regression.

The group of N. Bercovici showed that myeloid cells can cooperate positively with T cells during tumor regression. This is in constrast to the prevailing view that these interactions are deleterious in nature for an effective anti-tumor immune response. The possibility of "reprogramming" macrophages to promote their cooperation with T lymphocytes in tumors is a very promising alternative.

The cooperation between T lymphocytes and myeloid cells involves complex cellular and molecular interactions that vary in time and space. To integrate these variables, the IRP CoopCelModel (N. Bercovici, FR, A. Boissonnas, FR and G. Altan-Bonnet, USA) proposes to apply a computational modeling of experimental data thanks to the coordinated expertise of the groups on anti-tumor T cell responses (N. Bercovici, FR) and Macrophages ontogeny (A. Boissonnas, FR) in the onco-immunology field with the expertise in computational modeling (G. Altan-Bonnet, USA) to built a model of cooperation and test this model in mice and on human biopsies.

Original in its combination of experimental approaches and computational modeling, this project should bring solid basis for the design of efficient cancer therapies promoting the cooperation of innate and adaptive immunity.

Key words

- T lymphocyte
- Myeloid cell
- Tumor microenvironment
- Synergy
**Start date:** 2020-2024

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- **Center for Cancer Research National Cancer Institute (NCI)** Building 37, Room 4134 MD 20892 Bethesda, MD 20892, Etats-Unis
- **Site Pitié-Salpêtrière**, 91 Boulevard de l'Hôpital, 75013 Paris, France

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**Number of laboratories:** 3

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The "cancer and immune response" team led by Emmanuel Donnadieu at the Institut Cochin © Institut Cochin

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**Scientific agenda**

1. To determine the cellular components and molecular pathways involved in TIL (Tumor Infiltrating Lymphocytes) and TAM (Tumor Associated Macrophages) cooperation during tumor rejection.
2. To characterize the potential of TAM subsets (ResMac (Resident Macrophages), MoDMac (Monocyte Derived Macrophages) and monocytes to cooperate with TIL for tumor rejection.
3. To model the TIL and TAM killing cooperation using mathematical model.
4. To challenge in mice in vivo and on human tumor biopsies ex vivo the therapeutic modulations predicted to promote a TIL and TAM anti-tumor activity.

**Institutions and laboratories involved**

- UMR8104 Institut Cochin (CNRS/INSERM/Université de Paris)
- ERL8255 Centre d’immunologie et des maladies infectieuses (CIMI) - (CNRS/INSERM/Sorbonne Université)
- Center for Cancer Research National Cancer Institute (NCI)

**Main events**

Regular video conferences (every quarter) are planned with the three teams. Ongoing experiments, results and issues will be discussed altogether, with a face-to-face meeting in Paris or in the US organized once a year. The project will also cover missions of the staff between Paris and the NIH to perform some of the experiments.
IRP - OdoWell

Neural mechanisms underlying odor impairment by early life adversity

INSB

Presentation

A major risk factor of depression in adults is childhood abuse or trauma. Indeed, neglect early in life causes developmental brain disorders that have a long-term effect on the emotional state, more pronounced in women.

There is a mouse model that mimics this pathology: the model of early life adversity induced by maternal separation.

This International Research Project (IRP) “Neural mechanisms underlying odor impairment by early life adversity” aims at investigating the neural bases underlying impairments in olfactory perception after early life adversity-induced depression in male and female mice.

A special attention will be given to the olfactory tubercle. In addition, we will study the effects of olfactory training on the perception of odors and mood as well as the neural mechanisms of the potential improvements.

The ultimate goal is to better understand the neural underpinnings of this debilitating disorder and guide future treatments.

The two partners have a very good expertise in their specific field, olfactory mechanisms for the team of N. Mandairon and psychiatric pathologies for the team of K. Bath. This complementarity is essential to the success of this project.

Key words

- Neurosciences
- Brain
- Olfaction
- Emotion
- Stress
- Odors
- Neural mechanisms
Scientific agenda

The expected results of the project are mainly scientific: we hope to make a significant advance in our understanding of the neural alterations induced by early stress.

This can be measured by communications (seminars, conferences, congresses) and publications in scientific journals.

The benefits of the project will also attract the interest of scientists from different fields (olfaction, neuroscience) and institutions, and will allow young researchers (doctoral students, post-docs) involved in the project to work in a context of international collaboration.

Methodological aspects. (A) Automatic assessment of olfactory attraction in mice using one-hole board apparatus. (B) Immediate early gene mapping after olfactory stimulation. Cell labeling is automatically matched in common anatomical space for cell imagery and 3D representation.
Environmental changes caused by humans is the leading driver of the current biodiversity crisis. The present project is an integrative and collaborative international research project (IRP) entitled FUNELAKES (Functional Ecology of Lake Ecosystems) that aims to understand the patterns, drivers and functional consequences of community reassembly in lakes ecosystems.

FUNELAKES will be based on the use of a set of complementary approaches across spatial scales, including global data syntheses, lake ecosystem monitoring, and ex-situ experiments in mesocosms and microcosms.

FUNELAKES is composed of members from the CNRS (Toulouse, France: Laboratoire Evolution et Diversité Biologique et Laboratoire Ecologie Fonctionnelle et Environnement) and the University of Washington (Seattle, United States: School of Aquatic and Fishery Sciences).

**Key words**

- Ecology, Ecosystem Functioning, Conservation Biology, Aquatic Ecosystems, Freshwater Fish
Start date: **2020-2023**

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**Credit IRP FUNELAKES**

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**Scientific agenda**

This project will provide novel fundamental knowledge on ecological processes that could improve the management of freshwater biodiversity and ecosystems.

The two groups will share their expertise on freshwater biodiversity and ecosystems, analyze together field data collected in lakes located in France and USA and perform joined experiments in microcosms and mesocosms, providing a unique and integrative nature to the project.

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**Institutions and laboratories involved**

- Laboratoire Évolution et Diversité Biologique (EDB, UMR 5174) sous tutelle CNRS, Université Toulouse III - Paul Sabatier et IRD.
- Laboratoire Écologie Fonctionnelle et Environnement (UMR 5245) sous tutelle CNRS, Université Toulouse III - Paul Sabatier et Toulouse INP.
- School of Aquatic and Fishery Sciences (SAFS), Washington University, Seattle.
IRP - ELINE

ELectrified INterfaces for better Energy

Presentation

The project aims at supporting ongoing experimental and computational collaborations in the understanding and improvement of electrified interfaces, which are at the heart of current developments in chemistry for Energy: batteries, fuel cells, electrocatalysis and photocatalysis are at the heart of the transition from a petroleum-based economy to a green and sustainable economy.

Electrified interfaces accumulate difficulties: (i) the conductors are computationally demanding (ii) the liquid has a high concentration of ions (from atomic ions to polymeric ions) (iii) the surface is electrified.

To meet these challenges, the development of a set of novel approaches is at the heart of the work of the IRP consortium "ELINE" which combines the complementary expertise of theoretical chemistry teams in Lyon and Los Angeles.

This IRP is based on two pre-existing cooperations. On the one hand, the interactions between Bruce Dunn and Stéphane Parola, Frédéric Chaput, Frédéric Lerouge in materials preparation and synthesis, on the other hand the interactions of Philippe Sautet with Stephan Steinmann, Tangui Le Bahers and Carine Michel.

The IRP "ELINE" appears to be a way to strengthen these cooperations by facilitating research stays of a few weeks to a few months.

Key words

• Energy
• Electrified interfaces
• Materials
• Catalysis
• Modeling
### Scientific agenda

The project is divided into three areas:

1. Improvement of modeling methods to better describe the electrified interfaces. The developed methods will be disseminated via free programs.

2. Validation of the simulation methods on model systems.

3. Towards oxides and complex systems. This part will open the door to applications in the medium term, thanks to the network of privileged contacts of the Chemistry Laboratory with French industrialists. The most promising results will be protected by patenting.

### Institutions & laboratories involved

- CNRS, Laboratoire de Chimie, UMR 5182
- UCLA, Department of Chemical and Biomolecular Engineering
- UCLA, Department of Chemistry and Biochemistry

### Main events

One meeting per year is planned with all partners.
Presentation

Glioblastoma is the most common and the most aggressive high-grade brain tumor. Despite significant advances, the median survival rate for patients has shown no notable improvement (12–18 months) in the last decades. The presence of the blood-brain barrier makes approaches such as chemotherapy and immunotherapy challenging.

To overcome this limitation, Paul Dayton’s lab (University of North Carolina, USA) and Anthony Novell’s group (BioMaps, FR) proposes the use of focused ultrasound in conjunction with sono-sensitive agents to disrupt the blood-brain barrier and promote localized delivery of systemically administered therapeutic agents into brain tumors.

Material and unique skills are combined in the IRP SONATA to allow the development and the validation of breakthrough strategies including new formulations of drug-loaded sono-sensitive agents (droplets) and multimodal imaging strategies to optimize the brain cancer therapy.

The potential of our original agents has been recently demonstrated for both enhancing cellular drug uptake and safe blood-brain barrier opening at low acoustic pressure. The clinical translation of this non-invasive and targeted therapy would allow an improvement of survival rates and quality of life.
Key words

- Ultrasound therapy, Medical imaging, Brain, Cancer, Nanodroplets.

Scientific agenda

1. Formulation and validation of drug-loaded sono-sensitive agents for brain cancer therapy
   - Encapsulation of the drug into droplets for therapeutic application.
   - In vitro evaluation of drug delivery on cell lines.
   - Validation on a preclinical model for cancer therapy.

2. Sono-sensitive agents for multimodal imaging: MRI, PET, Ultrasound
   - Detection of droplet activation using Magnetic Resonance Imaging (MRI) in vivo.
   - Determination of the biodistribution of radiolabeled droplets using positron emission tomography (µPET).
   - Adjustment of the ultrasound dose using passive cavitation detection for optimal and safe drug delivery.

Main events

Exchanges with students and researchers between Chapel Hill and Orsay, regular video meetings.
IRP - NUTRIMMUNE

Nutrient Network regulation of anti-tumor T cell immunotherapy

Presentation

The NUTRIMMUNE IRP is a project based on a collaboration between two laboratories located for one in France, in the Institute of Molecular Genetics of Montpellier (IGMM) UMR5535 CNRS and for the other in Bethesda, in the United States, at the Pediatric Oncology Branch (POB) of the National Cancer Institute (NCI), National Institutes of Health (NIH).

The objective of Nutrimmune IRP project is to evaluate CART effector function under conditions where nutrient availability, nutrient transporter levels and nutrient utilization pathways are modulated as a function of the costimulatory domain expressed in the CAR construct.

The IRP will significantly be increasing exchanges between students and scientists and formalizing these interactions and create an optimal environment to carry out collaborative projects from the NIH and the IGMM/CNRS.

Key words

• Anti-tumor immunotherapy
• Hematologic malignancies
• Metabolism
• T cells
• Chimeric antigen receptor (CAR)
Start date: 2021-2025

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Center for Cancer Research; National Cancer Institute
Building 10-CRC, Room 1-3940
Bethesda, MD 20814

Scientific agenda

The goal of the project is to improve anti-tumor therapies based on the use of CAR-T cells, focusing on the modulation of nutrient transporters and nutrient utilization.

The team wishes to determine the factors, particularly metabolic, involved in the success or failure of anti-tumor immunotherapies. This project is therefore at the interface between basic and applied research.

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Institutions & laboratories involved

UMR5535 CNRS –UM Institut de Génétique Moléculaire de Montpellier

Pediatric Oncology Branch
Center for Cancer research, National Cancer Institute
National Health Institute

Main events

Symposium every 2 years alternatively in Montpellier (FR) and Washington, DC (USA)
Presentation

The “transition to digital” in the entertainment industry appears to observers as a major upheaval and, at the same time, a ubiquitous and ongoing process which poses a challenge to academic analysis and professional practice alike.

This project investigates how the uses of technologies by entertainment professionals translate into the emergence of new areas of specialties and changes in career paths and work organization; how new channels for content distribution and circulation come to prevail, audiences get re-delineated, business models re-imagined, and creative content redefined in the process. What is at stake with this project is therefore nothing less than shedding new light on the making of “popular culture” as it is drastically changing.

More specifically, the worlds of production, distribution, and talent representation are the focus of this study. Our empirical fields of study include and compare the French and American film, television, and music industries while placing the analysis of their transformation and changing relations in the larger European and global context. To do so, this project brings together an interdisciplinary team of expert scholars and leading professionals of the studied industries.

Scientific agenda

Our network organizes at least two events per year over the duration of the IRN program, combining scholarly workshops and public events aimed at a wider audience.
Start date: 2019-2023  
Number of laboratories: 4

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Key words

Entertainment industry, Digital transformation, Film/television, Cultural intermediaries

Main events

- December 4, 2019, TREND symposium, CRESPPA, Paris
- Events postponed as a result of the global health crisis
- March 16, 2020, (De)Mobilizing with digital media, international symposium, CRESPPA, Paris (in the process of being rescheduled)
- April 4, 2020: TREND panel, SCMS Annual Meeting (Society for Cinema and Media Studies), Denver (=> April 2021)
- October 2020, Transforming Hollywood, international conference, UCLA, Los Angeles (currently being rescheduled)

Institutions & laboratories involved

- CRESPPA (Centre de recherches sociologiques et politiques de Paris) UMR 7217
- CNRS/Université Paris 8 Vincennes Saint-Denis/Université Paris Nanterre
- Orfalea Center, 21st Century Global Dynamics, University of California Santa Barbara
- Département of Film, Television, Digital Media; University of California, Los Angeles School of Cinematic Arts, University of Southern California

"Streaming banner": © Adobe Stock, Proxima Studio
IRN - Graphene and co: 

From 1D nanostructures to 2D materials and their heterostructures: Basics and application

INP

Presentation

The goal of the IRN « Graphene and co » is to initiate, sustain and organize the research activities on graphene and other 2D materials and nanotubes in the partners’ laboratories on priority topics.

Themes and research projects

• Growth, Structural characterisation and growth models
• Chemistry, toxicity and biological studies
• Photonics and spinvalleytronics
• Nanomecanics, nanofluidics, and membranes
• Emerging Properties of 2D materials and their heterostructures
• From material to functional devices: applications

Key words

• Condensed Matter Physics
• Two- dimensional Systems
• Graphene

Institutions and laboratories involved

France: associated with the CNRS research network IRN graphene & Co, 87 research teams in France

USA: Georgia Institute of Technology – School of Physics

International: 7 research teams (Canada, USA, Germany, Spain, Switzerland, Belgium, Greece).
Start date: 2018-2021

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Head USA
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Number of laboratories: 7

Website: http://www.graphene-and-co.org/

Main events

Organisation of the yearly workshop of the IRN in Aussois, mid-October 2017


Sponsorship to the Raman Spectroscopy school, June 2017

International conference NT17 in Belo Horizonte, June 2017

First european conference on the chemistry of 2D materials, Chem2DMat, August 2017, Strasbourg

IRN - QUADMARTS

QUAntitative Detection of Molecular And Radical Trace Species

INP

Presentation

Modelling gaseous environments with large networks of chemical reactions is a major challenge in various scientific fields such as combustion, environmental science or astrophysics. Models are designed to help us understand how molecules, radicals and particles are formed and to quantify their abundances. They are based on extensive theoretical and experimental research that provide quantitative information on the rates of the physical and chemical processes involved.

The aim of this multidisciplinary network is to gather together world-leading groups from various scientific fields to exchange their complementary knowledge and approaches in order to push forward the limits of detection of molecular and radical trace species in the gas phase as well as to address the important and highly challenging problem of the determination of the quantum state in which collisional or photochemical products are formed.

Key words

- Astrophysics
- Environment
- Molecular Physics
- Physical Chemistry
Start date: 2018-2022

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Head USA
MITCHIO OKUMURA - mo@caltech.edu

Number of laboratories: 11

Main events - Kick off meeting

Scientific agenda

In the last years, experimental devices as well as theoretical tools have been developed to quantitatively address the issue of product branching ratios of gas phase chemical reactions or photodissociation processes under a large variety of physical conditions in the different scientific communities cited above.

From an experimental point of view, quantitative information can be obtained by several approaches, including photoionization or electron spectroscopy combined with mass spectrometry, optical spectroscopy and microwave spectroscopy.

Institut de Physique de Rennes (IPR)
© Jean-Claude MOSCHETTI/CNRS Photothèque

Institutions and laboratories involved

- FR : IPR (Université de Rennes 1), PC2A (Université de Lille), ISMO (Université de Paris-Sud Orsay) SOLEIL, LRGP (Université de Lorraine), LiPHY (Université de Grenoble Alpes)

- USA : Caltech, MIT, Sandia National Laboratories, Missouri University, PURDUE University
IRN - PhilInBioMed
Institute for Philosophy in Biology and Medicine

**Presentation**

The Institute for Philosophy In Biology and Medicine (PhilInBioMed) is a network of interdisciplinary institutes in Australia, Austria, France, the UK and the USA.

PhilInBioMed aims at advancing philosophy in the biological and medical sciences, i.e. the co-production of knowledge by the direct interactions of philosophers, biologists, and medical doctors.

The mission of PhilInBioMed is to promote short- and long-term stays of philosophers in biology and medicine labs, as well as short- and long-term stays of biologists and MDs in philosophy labs.

PhilInBioMed wants to foster interdisciplinary initiatives that use the conceptual tools of philosophy to solve scientific problems.

**Scientific agenda**

The ultimate goal is a collaborative publication of the joint work in scientific journals, in order to impact scientific research.

**Key words**

- Repair, regeneration and development
- Cancer and the concept of disease
- Biological individuality in immunology and other biomedical sciences
- Aging
- Big data in biological and medical sciences

**Main events**

Organization of annual meetings and seminars for network members.
Hosting of international interdisciplinary workshops open to all.

Promotion of short- and long-term stays at the participating institutes for permanent researchers and professors as well as doctoral and post-doctoral students.

Publication of interdisciplinary articles in scientific journals, co-authored by philosophers, scientists and medical doctors.
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<tr>
<th>Start date: 2020-2024</th>
<th>JANE MAIENSchein</th>
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</table>

**Institutions & laboratories involved**

- ImmunoConcept - Immunologie conceptuelle, expérimentale et translationnelle (CNRS / Université de Bordeaux), France
- IHPST - Institut d'Histoire et de Philosophie des Sciences et des Techniques (CNRS / Université Paris 1 Panthéon-Sorbonne), France
- The History and Philosophy of Science Project at Marine Biological Laboratory, Etats-Unis
- Center for Biology of Society (Arizona State University), Etats-Unis
- Department of Philosophy (University of Utah), Etats-Unis
- Department of Philosophy (University of Cincinnati), Etats-Unis
- Department of History and Philosophy of Science (University of Pittsburgh), Etats-Unis
- Egenis (University of Exeter), Royaume-Uni
- Department of History and Philosophy of Science (University of Cambridge), Royaume-Uni
- Konrad Lorenz Institute for Evolution and Cognition Research (KLI), Autriche
- Theory and Method in Biosciences group (University of Sydney), Australie

Second meeting of PhilInBioMed in october 2019, Bordeaux, France
IRN - SILENE
A model genus in plant evolution and ecology

INEE

Presentation

The Silene genus (around 870 species) has long been a widely used model for investigating numerous aspects of evolution and ecology, such as speciation, genome evolution, sex-chromosome evolution, ecological specialization, reproductive strategies, co-evolution between plant and pathogenic fungi, and plant-pollinator interactions.

However, the full potential of the system is unavailable because of the lack of a full genome sequence and a lack of coordination among research groups producing genomic resources, including transcriptome data, linkage maps, and partial genome sequences from various taxa within the genus.

The CNRS IRN “Silene” will facilitate communication and collaboration among eleven teams working on Silene, including teams belonging to three French labs associated with INEE CNRS institute.

There are already one-on-one collaborations among teams but this IRN has the ambition to unite researchers on the scale of the whole community in order to generate new collaborations, launch coordinated projects at the genus level (e.g., whole genome sequencing), and share resources (DNA, seeds, sequences...).

Scientific agenda

The life of the network will rely on two main actions:

• An annual meeting where updated results will be communicated.
• Student exchanges among partners through mobility grants

Key words

• Speciation
• Host-pathogen co-evolution
• Mating systems
• Phylogenomics and genome evolution
Institutions and laboratories involved

- Evolution, Ecologie et Paléontologie (EVO-ECO-PALEO) UMR8198, CNRS/Université de Lille, FR
- Écologie, systématique et évolution (ESE) UMR8079/ Orsay, FR
- UMR5558 Biométrie et Biologie Evolutive (LBBE), Lyon, FR

- Department of Biology, Indiana University, Bloomington, USA
- Department of Biology, Amherst College, Amherst, USA
- Department of Biology, Colorado State University, Fort Collins, USA

Main events

Even though the philosophy of the network is to benefit from complementary expertise and thus avoid compartmentalized groups, its scientific objectives can be described in several axes or actions that will also be reflected in the different sessions of the annual meetings.

Collaborations between partners (with publications in solid lines and current collaborations without publication in dotted lines) and complementary expertise of the partners of the “Silene” IRN
IRN - Interstellar Institute

INSU

Presentation

The Interstellar Institute is an IRN of the CNRS with 27 staff members working in 19 institutes located in Europe, North America and Australia.

The mission of the Interstellar Institute is to produce new scientific breakthroughs and to lead the study of complex physics of diffuse baryonic matter in and around galaxies.

The scientific scope is to study the interstellar medium in details to understand how stars, galaxies and planets form, and more generally how complexity emerges in the Universe.

Key words

- Astrophysics
- Interstellar medium
- Star formation
- Galaxy evolution
- Observation
- Theory
- Numerical simulations
- Data science

Scientific agenda

An essential aspect of the Interstellar Institute is to gather a group of people that would last long enough to establish common languages in several sub-groups, long enough for new collaborations and new vantage points to emerge.

This can only be done with enough time. To reach that level of interaction and mutual understanding, the Interstellar Institute runs a yearly 4-week intensive working session combining its core members with a similar number of visiting scientists to foster new ideas and new collaborations.

These sessions happen in Paris, the world’s most active centre for interstellar physics. Interstellar Institute members collaborate throughout the year on projects developed at the intensive sessions.
Start date: **2020-2024**

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**Website**  
https://interstellarinstitute.org

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**Main events**

Yearly 4-week meeting. The next one is “The Grand Cascade”, July 5-30, 2021.  
https://interstellarinstitute.org/cascade

**Institutions & laboratories involved**

- AIM (Astrophysique, instrumentation, modélisation), CEA (Commissariat à l’énergie atomique et aux énergies alternatives), CNRS, Université Paris-Saclay  
- IRAP (Institut de Recherche en Astrophysique et Planétologie)/CNRS, Université de Toulouse  
- Space Telescope Science Institute  
- Johns Hopkins University  
- University of Wisconsin  
- Rutgers University  
- Harvard University  
- University of North Carolina Chapel Hill  
- University of Massachusetts  
- Institute for Advances Studies, Princeton Caltech  
- University of British Columbia  
- Dominion Radio Astrophysical Observatory  
- University of Toronto  
- Macquarie University  
- Australian National University  
- University of Vienna  
- Max Planck Institute for Astronomy  
- Scuola Normale Superiore di Pisa

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Credits: Marc-Antoine Milville-Deschênes (CNRS, AIM)  
Joshua Peek (STScI, Johns Hopkins University)
IRN - USERS
Urban Science and Engineering for (quantitative) Sustainability and Resilience

INP

Presentation

In this IRN project “USERS” Urban Science and Engineering for (quantitative) Sustainability and Resilience, we propose to capitalize on the results of the on-going IRN M2UN work on a gradual bottom-up approach amenable to bridge time and length scales. More specifically, we plan to fill the difficult gap ranging from few tenth nm to 0.5 micrometer and from few tenth ns to the microsecond. This space and time window is often encountered in many hierarchical materials as a critical transition zone.

The aim of this program is combining statistical physical-chemistry (that concerns small time and length scales) with larger length scales approaches that are common in engineering. This is one of the largest and most ambitious challenges in the field of Science and Engineering as it precisely blurred the frontier between these two traditional parts of mankind technical knowledge. It consists in passing to the next scale above in time or length, the relevant parameters established at a given scale. The goal of multiscale models is to enable translation of system characteristics on one length or time scale to another.

City leaders are challenged to focus greater attention and resources on mitigating the negative effects of indispensable products like concrete, while at the same time supporting smart city infrastructure growth. USERS will lead at doing just that: its mission is to unite experts in scientific research, municipal leadership, sustainability experts, and industry to meet the concrete GHG mitigation challenge.

Key words

- Sciences of Porous Materials
- Poromechanics
- Multiscale simulation techniques,
- Multiscale Mechanics experiment (elasticity, plasticity, fracture)
- Tomography (Nano, Micro), Urban planning
- Urban growth
- Urban resilience and climatic risks
Scientific agenda

The essence of IRN USERS is to establish a sustainable international community around urban physics and building materials in the context of urban resilience including population growth and the risks associated with climate change.

By definition, it is an interdisciplinary project on the border between Engineering and Science with the ambition to bring out knowledge combining concepts from physics, chemistry and mechanics in a so-called “bottom-up” approach from the nanometer to the macroscopic scale. Moreover covering the elementary processes of transport on the nanosecond scale to those of aging on the year or even the century scale.

Institutions and laboratories involved

- CNRS, Aix-Marseille Université, Université de Bordeaux, Sorbonne Université, Université de Montpellier
- Department of Physics, Georgetown U., Washington DC, USA
Presentation

Whole genome duplication (WGD), resulting from polyploidy, is a central mechanism of biological diversification, contributing recurrently to the formation of new species and providing new opportunities of adaptation, expansion and domestication of species. The aim of the IRN POLYDIV is to extend and formalize previous interactions (e.g. successive French-American LIAs) among scientists from 7 countries (FR, USA, UK, BE, SE, CH, CZ) and 8 internationally recognized partner teams with complementary expertise on various aspects of polyploidy, in the fields of ecology, genetics, cytogenetics, (epi) genomics, modelling and bioinformatics.

Comparative approaches are performed across a broad set of appropriate models to determine how general are the particular biological responses to WGD and the ecological and adaptive consequences of polyploidy in a rapidly changing environment, for both ecological and agronomical contexts.

The project will enable us to analyze the short- and long-term consequences of polyploidy, by addressing the following questions: (I) How do newly formed polyploid species manage to increase their fertility? (II) What are the evolutionary dynamics of duplicated genes and genomes over various evolutionary timeframes? (III) What are the processes driving diploidization in polyploids? (IV) What is the effect of polyploidy on the evolution of reproductive systems? (V) What are the ecological consequences of polyploidy in terms of tolerance to environmental constraints, adaptation to novel ecological niches and their impact on the evolution of new functions?

Key words

- Biodiversity
- Plant Genomics
- Evolutionary Biology
- Ecology
- Agronomy

Sampling the neopolyploid Spartina anglica in Hythe (UK) saltmarshes
**Scientific agenda**

Collaborations, reciprocal visits, organization of international meetings and summer schools are planned.

**Main events**

Monthly scientific meetings with PhD student seminars from each partner team. Workshops and international congress. International field trips, propections and population sampling.

Poliploidy provided the raw material for evolutionary novelties and plant domestication

**Institutions and laboratories involved**

- UMR6553 ECOBIO (Ecosystems Biodiversity and Evolution), Université de Rennes 1, FR
  - https://ecobio.univ-rennes1.fr/
- UMR IGEPP (Institut de Génétique, Environnement et Protection des Plantes), INRAE, Le Rheu, FR
  - https://www6.rennes.inrae.fr/igepp
- Department of Ecology, Evolution and Organismal Biology, Iowa State University, Ames, USA
  - https://www.eeob.iastate.edu/faculty/wendel/
IRN - PoLS
Physics of Living Systems

Presentation

The goal of the IRN Physics of Living Systems (PoLS) is the establishment of a trans-national community-based network of graduate students and graduate student educators, working at the interface between Biology and Physics.

This structure, which relies on an existing network originally created by the US National Science Fundation (NSF), allows researchers at participating institutions to meet their peers and collectively help define the research agenda for this field, via funding for short-term visits to participating institutions, workshops and colloquia.

The research is especially focused on three areas: superresolution and single molecules microscopies, cellular mechanics, and theoretical biophysics.

The network also enables the exploration of various means of educating these students in biology while also ensuring that they develop and maintain a firm grounding in physics.

Key words

Biophysics, biomechanics, microscopies, modelling
Themes

Cellular mechanics and dynamics, Advanced microscopies and single molecules, Theoretical biophysics

Institutions & laboratories involved

- Centre de biochimie structurale (CBS) : UMR5048 / U1054 (CNRS/Inserm/Université de Montpellier)
- Dynamique des interactions membranaires normales et pathologiques (DIMNP) UMR 5235 (CNRS/Université de Montpellier)
- Centre d’immunologie de Marseille Luminy (CIML) UMR7280 / U1104 (CNRS/Inserm/AIX-Marseille Université)
- Unité physico-chimie Curie (PCC) UMR168 (CNRS/Sorbonne Université/Institut Curie)
- Laboratoire Charles Coulomb (L2C) UMR5221 (CNRS/Université de Montpellier)
- Biologie Computationnelle et Quantitative (CQB) UMR7238 (CNRS/Sorbonne Université)
- University of Illinois at Urbana-Champaign
- Georgia Institute University
- Princeton University

Main events

iPOLS 2020 Virtual Meeting June 8-11 2020
International Physics of Living Systems meeting 2021, Montpellier, France, December 12-16th 2021
15 IRN & 1 IRP of which the United States are not the main country

**INSHS**

**IRN RADEX (2019-2022)** - Violences politiques: les processus et discours de radicalisation  
*Responsable FR*: Nadia Marzouki  
*Domaines et mots-clefs*: radicalisation, contre-radicalisation, les programmes CVE (Countering Violent Extremism), et PVE (Preventing Violent Extremism), religion, violence politique, stratégies de recrutement, politiques et législations de lutte contre le terrorisme, sécurité internationale, droit international  
*Partenaire américain*: Northwestern University  
*Autres pays*: Canada, Danemark, Italie, Liban, Suisse

**IRN Genre-monde (2019-2022)** - Traductions politiques et culturelles du genre  
*Responsable FR*: Marta Segarra  
*Domaines et mots-clefs*: Études de genre et de sexualité, études culturelles, philosophie, sociologie, sciences politiques, études littéraires et artistiques, anthropologie, histoire, histoire de l’art  
*Partenaires américains*: Cornell University, Duke University  
*Autres pays*: Espagne, Finlande, Maroc, Royaume-Uni

**IRN Humanités médicales (2019-2022)**  
*Responsable FR*: Alain Schaffner  
*Domaines et mots-clefs*: bioéthique, philosophie morale, histoire, phénoménologie, psychanalyse, littérature et arts (théâtre, cinéma), narratologie, anthropologie de la santé, sociologie de la médecine et des organisations  
*Partenaire américain*: Columbia University  
*Autres pays*: Canada, Royaume-Uni, Suisse, Portugal

**IRN MIRACLE (2019-2023)** - Mobilité internationale de recherches autour des connexions et des limites de l’ex-voto  
*Responsable FR*: Caroline Perrée  
*Domaines et mots-clefs*: histoire, histoire de l’art, religion, anthropologie, anthropologie de l’image, archéologie; ex-voto, religions monothéistes et polythéistes, pratiques dévotionnelles, syncrétismes, matérialité des croyances, histoire des objets: mobilité et détournement  
*Partenaire américain*: Bard Graduate Center  
*Autres pays*: Allemagne, Argentine, Brésil, Espagne
IRN GHC (2015-2023) - Global History Collaborative  
Responsable FR : Marc Elie  
Domaines et mots-clefs : histoire globale, histoire transnationale, histoire croisée, histoire connectée  
Partenaire américain : Princeton University  
Autres pays : Allemagne, Japon

IRN TranSocGen (2021-2025) - Transnational Transdisciplinary Network on Society and Genetics  
Responsable FR : Luc Berlivet  
Domaines et mots-clefs : épistémologie, enjeux sociaux, génétique, génomique  
Partenaire américain : University of California at Los Angeles  
Autres pays : Brésil, Mexique, Royaume-Uni, Israël, Singapour

IRN RITMO 2 (2015-2024) - De la répétition à l’innovation en Mésoamérique : Approches interdisciplinaires de la transmission et du changement dans les sociétés passées et présentes  
Responsable FR : Valentina Vapnarski  
Domaines et mots-clefs : sociétés passées et présentes, Mésoamérique ; anthropologie-ethnologie, archéologie, linguistique, histoire, iconographie, épigraphie ; répétition, transmission, innovation  
Partenaires américains : University of California at Berkeley, University of Texas at Austin  
Autres pays : Brésil, Mexique, Royaume-Uni

IRN CYCLADES (2019-2023) - Corpora and computational linguistics for digital humanities  
Responsable FR : Thierry Poibeau  
Domaines et mots-clefs : traitement automatique des langues, humanités numériques  
Partenaire américain : Stanford University  
Autres pays : Allemagne, Italie, Japon, Mexique, Pays-Bas

IRN SSSQ (2020-2024) - Society for the Social Study of Quantification  
Responsable FR : Emmanuel Didier  
Domaines et mots-clefs : sociologie, histoire, sciences politiques, anthropologie, statistique, science de l’information  
Partenaires américains : Northwestern University, University of California at Los Angeles  
Autres pays : Afrique du Sud, Royaume-Uni

IRN ALL (2020-2024) - Afroasiatic Languages and Linguistics: Bridging the Red Sea Rift  
Responsable FR : Sabrina Bendjaballah  
Dates d’exercice : 2020-2024  
Domaine et mot-clef : linguistique  
Partenaire américain : Penn State University  
Autres pays : Italie, Pays-Bas, Royaume-Uni
INP

**IRN PAN (2019-2023)** - Prévisibilité, adaptation et navigation  
*Responsable FR : Aleksandra Walczak*  
*Domaines et mots-clefs : biophysique*  
*Partenaire américain : University of Chicago*  
*Autres pays : Allemagne, Italie, Pays-Bas*

**IRN MCTDH (2020-2024)** - Quantum Dynamics with the Multi-Configuration Time-Dependent Hartree method  
*Responsable FR : Fabien Gatti*  
*Domaines et mots-clefs : dynamique quantique, physique atomique et moléculaire théorique, chimie théorique*  
*Partenaire américain : University of Colorado*  
*Autres pays : Allemagne, Autriche, Chine, Israël, Royaume-Uni*

**IRN QFS (2020-2024)** - Quantum fields and strings  
*Responsable FR : Boris Pioline*  
*Dates d’exercice : 2020-2024*  
*Domaines et mots-clefs : Interactions fondamentales ; théorie des champs quantiques ; théorie des cordes ; supergravité ; gravité quantique ; physique mathématique*  
*Partenaires américains : Stony Brook University, University of California at Los Angeles, State university of New York*  
*Autres pays : Allemagne, Corée, Inde, Italie, Pays-Bas, Royaume-Uni*

INSIS

*Responsable FR : Jack Legrand*  
*Domaines et mots-clefs : Biologie, Bioénergie, Génie des Procédés*  
*Partenaire américain : University of California at San Diego, University of California at Los Angeles*  
*Autres pays : Australie, Japon*

INEE

**IRN ZOOMATHIA (2014-2021)** - La transmission culturelle des savoirs zoologiques (Antiquité-Moyen Âge)  
*Responsable FR : Arnaud Zucker*  
*Dates d’exercice : 2014-2021*  
*Domaines et mots-clefs : archéologie, épistémologie, histoire, iconographie, littérature antique et médiéval, ontologies et bases de données informatisées, philologie, zoologie*  
*Partenaire américain : Cornell University*  
*Autres pays : Allemagne, Belgique, Italie, Royaume-Uni*  
*NB : Cofinancement avec l’INSHS*
IRP CANECEV (2017-2025) Roles of cancer in ecology and evolution
Partenaires français : CNRS, IRD, Université de Montpellier
Coordinateur français : Frédéric THOMAS
Partenaire américain : Moffitt Cancer Center (à partir de 2021)
Autres pays : Australie (Deakin University, University of Tasmania)

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### Technical sheet of active structures in 2021

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Thanks

The CNRS North America office thanks all the directors and managers laboratories presented in this collection.