From Physics to International Scientific Cooperation: How Does It Work?

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Our goal

To explore the ground and the instruments of international scientific cooperation,

So that:

- You can find your place there,
  - as a scientist, or
    - as a representative of your institution, or even your country
      - or both

- You get the maximum benefit from it for the development of:
  - your research
    - your career

Summary

A few **FIGURES**, to set the scene:

- The example of a French research organization (the CNRS)
- Internationalisation of research
- The place of women, especially in Physics

Why go international ? some **MAJOR RULES**:

- The scientists' point of view
- The point of view of research institutions
- The point of view of governments

Some **EXAMPLES**:

- mine
- that of 3 women scientists

What is the CNRS? (1)

- **Main public player in French research** - under the authority of the Ministry of Research (58% of the French scientific publications)
- **Omnidisciplinary** - covers all areas of knowledge
- **Frontier research** - from novel concepts to forerunner applications
- **Independent** - defines and conducts its own research strategy
- **Nationwide** - has laboratories throughout France (and abroad)
  - **1,100** affiliated laboratories (**77** labs of the INP*)
  - 95% are **joint labs** in partnership with universities, other research organizations or industry (from abroad too)

*** INP: Institute of Physics**

- one of the **10 disciplinary institutes** of the CNRS, ranging from mathematics to social sciences
- physics is also carried out in other institutes' lab at the CNRS and their large research infrastructures, e.g.: IN2P3 (nuclear and particle Physics) and INSU (sciences of the universe, e.g. geophysics, astronomy).

What is the CNRS? (2)

- Total research personnel in all 1100 CNRS labs: **73,500** (7,2% INP)

  Of which **31,500** on direct CNRS payroll:

  - **11,200** researchers (tenured civil servants) (11,4% INP)
  - **13,300** technicians, engineers, administrative staff (tenured civil servants) (9,3% INP)
  - **7,000** short-term positions (PhD students, post-docs, visiting scholars…)

- Largest research organization in Europe
  (7,9% of the European Research Area -ERA scientific publications*)

- 1st ranked in the *Nature Index* and *Scimago Institutions Rankings* (2017)
  (2,9% of the world scientific publications*)

- Budget : 3,4 Md € (9,5% INP)

* excluding SSH publications

How is the internationalisation of scientific research measured?

With

a large majority of publications in **European/international co-authorship**,
an **international origin** of its staff increased by 40% in 10 years,
international recruitment rates exceeding 30% annually,
more than 60,000 **missions abroad** annually managed by the CNRS,

the CNRS is a **relevant observatory** for the internationalization of scientific research.

The key figures of internationalisation

- Increasing share of **international co-publications** (2/3 within the European Research Area, US…)
  - ▲ 52% of the 25,000* CNRS publications (2005)
  - ▲ **60%** of the 52,000* CNRS publications (2018)
  - ▲ **66%** of INP publications are coauthored with an scientist from abroad

    INP publications : 5% of the world's publications in its fields

- Increasing **international mobility** - on direct CNRS payroll:
  - international tenured researchers ratio (90 nationalities)
    - ▲12%, of which 57% from the EU (2006)
    - ▲ **17.5%** , of which **69%** from the EU (2018)
  - international annual researchers' recruitment:
    - ▲25% (2006)
    - ▲ **34%** (2018)
  - international visiting scholars : 1500, representing more than 50% of the total

- Increasing number of **CNRS labs located abroad** in partnership with foreign universities :
  - **40** (3 INP), i.e. 4 times more than 10 years ago (+new: industry may be involved)

* excluding SSH publications

CNRS' Commitment to Professional Equality

Main focuses of the "Acting for Professional Equality at the CNRS" action plan (2014):

- striving for professional equality within the CNRS (recruitment, careers, honors);
- promoting an interdisciplinary "gender" approach in research;
- encouraging scientific and technical careers with young people, especially girls;
- **developing European and international partnerships.**

Ladies, there are places to take!

The Scientist's Point of View

Between **competition** and **cooperation**, the objective of international scientific relations is to cooperate with the best institutions and research teams at the international level in order to:

- strengthen scientific excellence
- share knowledge
- attract talent
- stimulate innovation

- The world's best researchers and research laboratories must obtain the **state-of-the-art instrumentation, skills and knowledge** they need.
  - Some disciplinary fields depend on **access to sites/observation objects outside the national territory.**

Exploration and Attraction
Access to remote study sites and knowledge

=> many cooperations ultimately owe their existence to:

- **incentives** for a loosely targeted cooperation (on the most diffusive level possible)
- **targeted negotiations** …at a high political level

The point of view of Science institutions and policies

1) Since the post-WWII period, the CNRS has been pursuing policies that **promote the global outreach of its researchers and laboratories**:

- participation in the governance of very large international infrastructures
  - sabbatical leaves with virtually no limits on occurrence or duration (secondments)
    - bilateral and multilateral institutional partnerships
      - its own international cooperation instruments

Organization and functioning of international relations at the CNRS are animated and guided by the **duality between the spontaneous (bottom up) and the institutional (top down) levels**.

2) In the age of globalisation, **we can no longer do it alone!**

Neither researchers nor research organisations. E.g. :

- **Global** environmental and societal **challenges**
  - Use, development, sharing or access to **world-class infrastructures**
    - International **attractiveness** (global "Mercato" of researchers and students)
      - International **rankings** (followed by (too) close by decision-makers, governments and...students)

The international action of the CNRS

- always **based on the initiatives of researchers**
- channelled according to the **scientific priorities** defined by research policies
- integrated into the **CNRS corporate scientific strategy**,
- supported through **instruments** dedicated to cooperation
- a **budget** so to fill the geographical gap with partners around the world :
  - ▲incoming and outgoing missions,
  - ▲non-permanent positions to host researchers or expatriate CNRS permanent researchers,
  - ▲organisation of workshops, colloquia, conferences.

  (8 M€)

The international instruments (labels) of the CNRS

A tool-kit that can be adapted to each need

1) Bilateral (or multilateral) cooperation framework agreements with selected partners throughout the world: programmes for the co-financing of joint projects.

Generally similar to the CNRS, depending on the organization of research in the different countries, partner institutions may be *local* (universities) or *national* (research funding agencies or ministries)

2) Cooperation **instruments** that are **increasingly structuring, better funded, and strategic**

2') while *keeping the teams on sites*:

A. For the initiation of cooperation (e. g. 1-2 years)
B. For cooperations that have already produced results (3 years)
C. To carry out joint research in the medium/long term (4-8 years)
D. To set up scientific networks (disciplinary communities; multilateral; interdisciplinary) (4-8 years)

2''') Or by *moving teams to a joint laboratory* for high-risk joint research (5 years renewable).

These **quality labels** give visibility to the projects, attracting **multiple complementary funding** from embassies and other international, European or national financial backers.

The point of view of Governments

Good laws and frameworks for cooperation

The need of **cooperation** and of having **competitors** is the same for the *scientific world* and for the *industrial and commercial world*.

National and European policies provided **incentives**, in the long term and in a coherent way to back the very high propensity of scientists to **intellectual exchange and mobility** which accelerate a movement of "brain diffusion".

- Examples of legal frameworks with the greatest impact at the CNRS:
  - **derogatory** eligibility of **foreign researchers** for **civil servant positions** in France, enacted by law in the early 1980s,
  - **European** policies for the **mobility** of young students (ERASMUS) and young researchers (Marie Sklodowska Curie Scheme).

- The Member States of the European Union have since many years supported the vision of a **European Research Area** - based on the **free movement of researchers** - similar to the former EEC: "The European Charter & Code for Researchers » https://euraxess.ec.europa.eu/jobs/charter

The Diplomats' point of view

- Diplomats need the scientific research to do their job:
  - obtain information that is difficult to access,
  - develop or restore dialogue, particularly after geopolitical conflicts,
  - organize fields of influence (arenae),
  - shed light on global challenges with a scientific and technological dimension (global warming, biodiversity, pandemics, food security, nuclear proliferation, information technologies, etc.),
  - to base (ex ante, or ex post) political decisions on global issues (migration, peace, terrorism, etc.).

- The need for cooperation between the world's diplomatic networks and research actors seems all the more important today because:
  1. many international conflicts and dynamics are so complex that scientific data seem increasingly important to get a clear picture (e.g. Arab Spring; occurrence of natural disasters linked to global warming)
  2. Budgetary restrictions weaken the resources dedicated to scientific cooperation, including the scientists posted to the Embassies.

Nowadays, it is a common practice to attribute the qualities of « Ambassadors » to all those who know how to dialogue across borders: artists, writers, scientists,....
But far from being real diplomats by profession, they just serve what is called « Soft Power ».

For scientists who play a role in Soft Power, the term « Scientific Diplomacy » is used.

The Diplomats' point of view

Soft Power and Scientific Diplomacy

- What are we talking about?
  Diplomacy = : representing the interests of a government abroad; administering international affairs; directing and conducting negotiations between states.
  Science =: Accurate, universal and verifiable knowledge, expressed through laws.

- Risks of misunderstandings: Between the universality of research methods and results and the particular interests of nations (and sometimes researchers…!), the combination of these two concepts can theoretically produce many different interpretations and certainly misunderstandings.

- To delimit the field and give to Scientific Diplomacy tangible qualities, a three-fold definition:
  A. Science for diplomacy, i.e. using scientific cooperation to achieve national foreign policy objectives
  B. Diplomacy for science, i.e. facilitating international scientific cooperation
  C. Science in diplomacy, i.e. to inform national foreign policy objectives through scientific advice.

Some reading:
In English: "New frontiers in science diplomacy" (Royal Society, AAAS) https://royalsociety.org/~/media/Royal_Society_Content/policy/publications/2010/4294969468.pdf
In French: "Une diplomatie scientifique pour la France" (French Ministry of Foreign Affairs) https://www.diplomatie.gouv.fr/IMG/pdf/Rapport_Complet_DiplomatieScientifique_2013_cle8a68fb.pdf

So how can you get involved internationally?

Physics is a very wide disciplinary field that can be incorporated into a large number of strategic/institutional issues:

- International cooperation in fundamental/academic research
- Interdisciplinary research (e.g. environmental and societal challenges)
- Innovations (technologies, business advantages, etc.)
- Best / Large international research infrastructures (CERN, ESRF, SOLEIL, LIGO-VIRGO, JINR, SKA…)

Bottom-up

Participate in conferences, cultivate networking, cooptation for women and mutual aid, cooperate in an informal way on your own funds
then make yourself visible to the scientific institutions to stimulate their « top-down action »: solicit funding through bilateral/multilateral cooperation instruments

Top down

Lend yourself for coordination actions, actions for the scientific collective and progressive structuring of scientific communities, on behalf of the institutions and their scientific policies, sit on international steering committees, represent the institutions in international negotiations…

Science diplomacy

Lend yourself to scientific diplomacy action : established International Committees, Embassies, …

Laura G.

50 years-old, University Professor in France, 1 child

« The starting point is to struggle for performing excellent research at an international level.
International cooperation has not saved me once, but several times throughout my career.
First as a doctoral student, thanks to the first ERASMUS grants, I was able to complete my PhD thesis in Italy and France and obtain a double degree.
As my home country offered a less favourable environment for a career in my field of research, I could easily obtain a permanent position in France where I was already known and used to work.
As a junior researcher in a group, in an unfavourable and isolated environment, I was promoted and supported by the CNRS in exchange for the coordination of an international scientific network involving Italy where I could keep many scientific contacts.
A fruitful bilateral Franco-Italian cooperation within this network was then labelled as an international joint laboratory, which will be extended to the US where one of my students has created a research group.
This has given even more international visibility to my research. »

Myself

Graduated in Physics, at the Università Statale of Milan (Italy)
European Marie Curie individual grant holder, French government fellow (Ministry of foreign affairs), fellowship for further training abroad from the University of Milan
German husband
PhD in physics and short post-doctoral fellowship in Paris (France)
One child during the doctorate, a second child at the end of the Post-Doc
Research abandoned but tenured at the CNRS
20 years of career in the Administration of the CNRS

Physics has led me to:
- relations with industry, patents, technology transfer, start-up creation
- international relations accessible (within Science : no matter I wasn't yet French) :
  - as CNRS representative for more than thirty countries, ranging from Italy, Switzerland, Austria, Greece, Turkey, Israel, to the the countries of the former Soviet area
  - as Secretary General of the European and International Policy Council, reporting to the President of the CNRS.

2018 IN FIGURES

RESOURCES

A BUDGET EXCEEDING
€ 3 BILLION

More than **1,000** research units

Nearly **130** service units

More than **31,500** STAFF MEMBERS including more than **40% women**

More than **11,000** researchers

More than **13,000** engineers and technicians

More than **7,000** contractual employees

Nearly **300** researchers recruited

More than **300** engineers and technicians recruited

RESEARCH

THE CNRS RANKS **2nd**
In the *Nature Index* and *Scimago Institutions Rankings*
(natureindex.com; Scopus / Scimago 2017)

More than **52,000** SCIENTIFIC PUBLICATIONS

of which **60%** are co-signed with at least ONE FOREIGN LABORATORY
(Scopus / Elsevier)

COMMUNICATIONS

More than **3** MILLION PAGE VIEWS on CNRSlejournal.fr and news.cnrs.fr

More than **300** PRESS RELEASES ISSUED

Nearly **500K** FOLLOWERS ON THE SOCIAL NETWORKS (Facebook, Twitter, Instagram, LinkedIn, YouTube)

INTERNATIONAL

Nearly **40** INTERNATIONAL JOINT UNITS

More than **200** PROJECTS FINANCED

Nearly **500** EUROPEAN RESEARCH COUNCIL (ERC) LAUREATES

INNOVATION AND PARTNERSHIPS

More than **150** CNRS / INDUSTRY JOINT RESEARCH STRUCTURES

More than **20** FRAMEWORK AGREEMENTS with major groups

Some **100** STARTUPS CREATED EACH YEAR

6th LARGEST PATENT FILER IN FRANCE
(INPI)

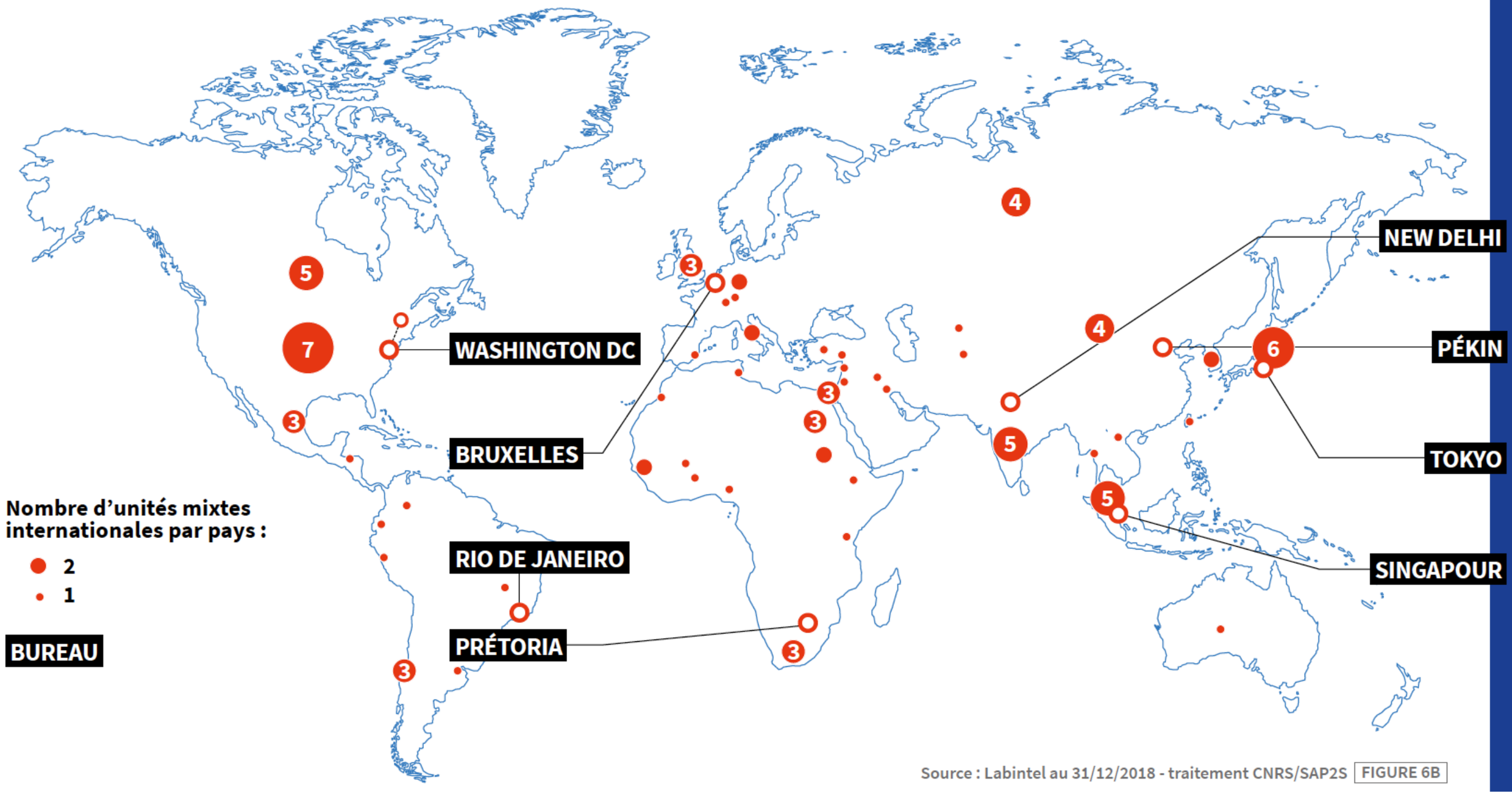
Source: CNRS / DSFIM / DRH / DERCI / DIRE / DASTR / FIST SA

Stationary figures :

25 labs worldwide with the French Ministry of Foreign Affairs (SSH, mainly about major Archeological sites)

8 CNRS offices abroad (location changes over time)

Implantation à l'étranger des laboratoires liés au CNRS en 2018

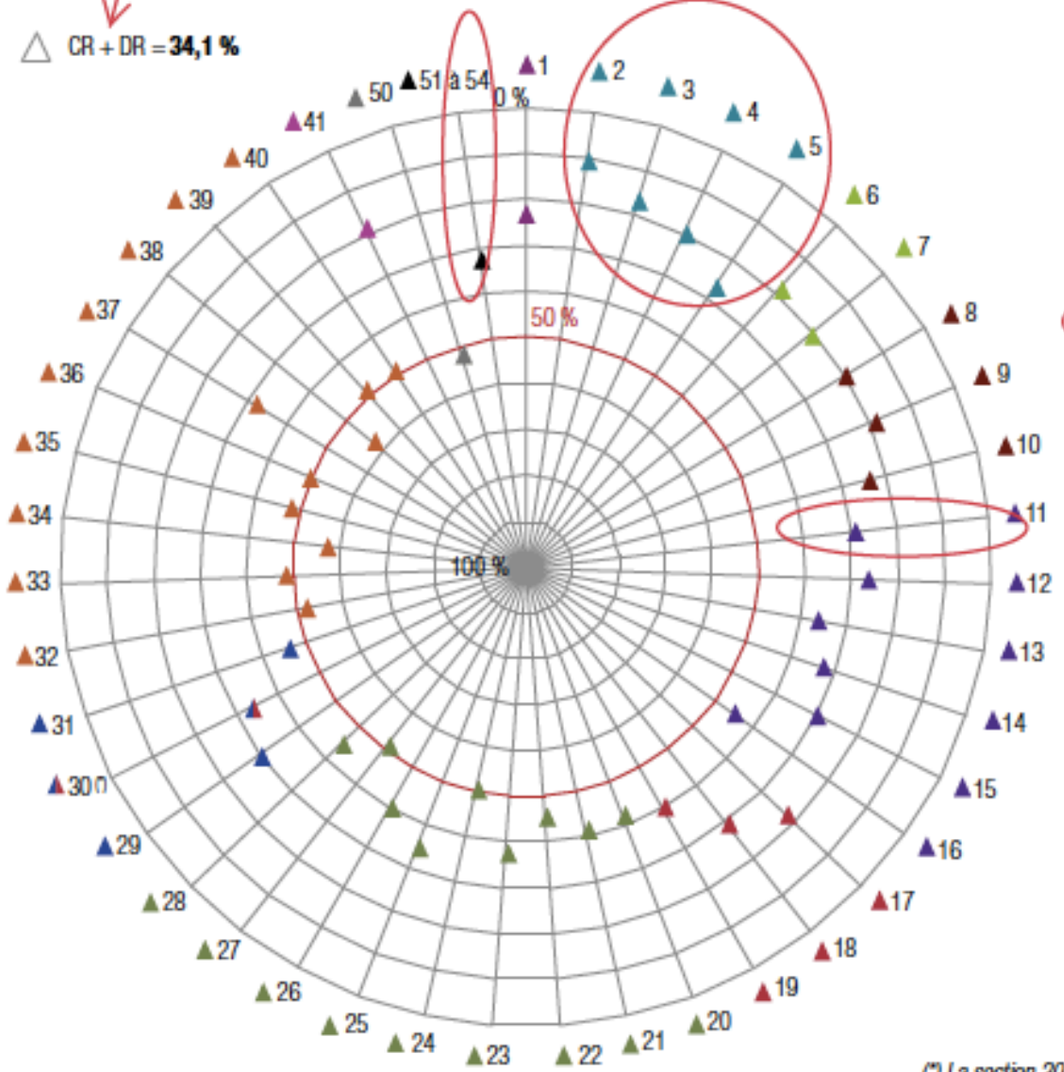


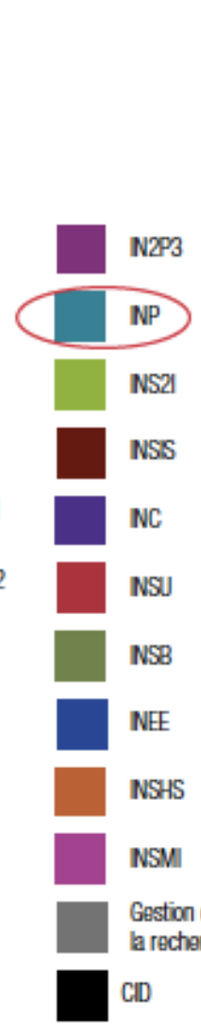
Source : Labintel au 31/12/2018 - traitement CNRS/SAP2S FIGURE 6B

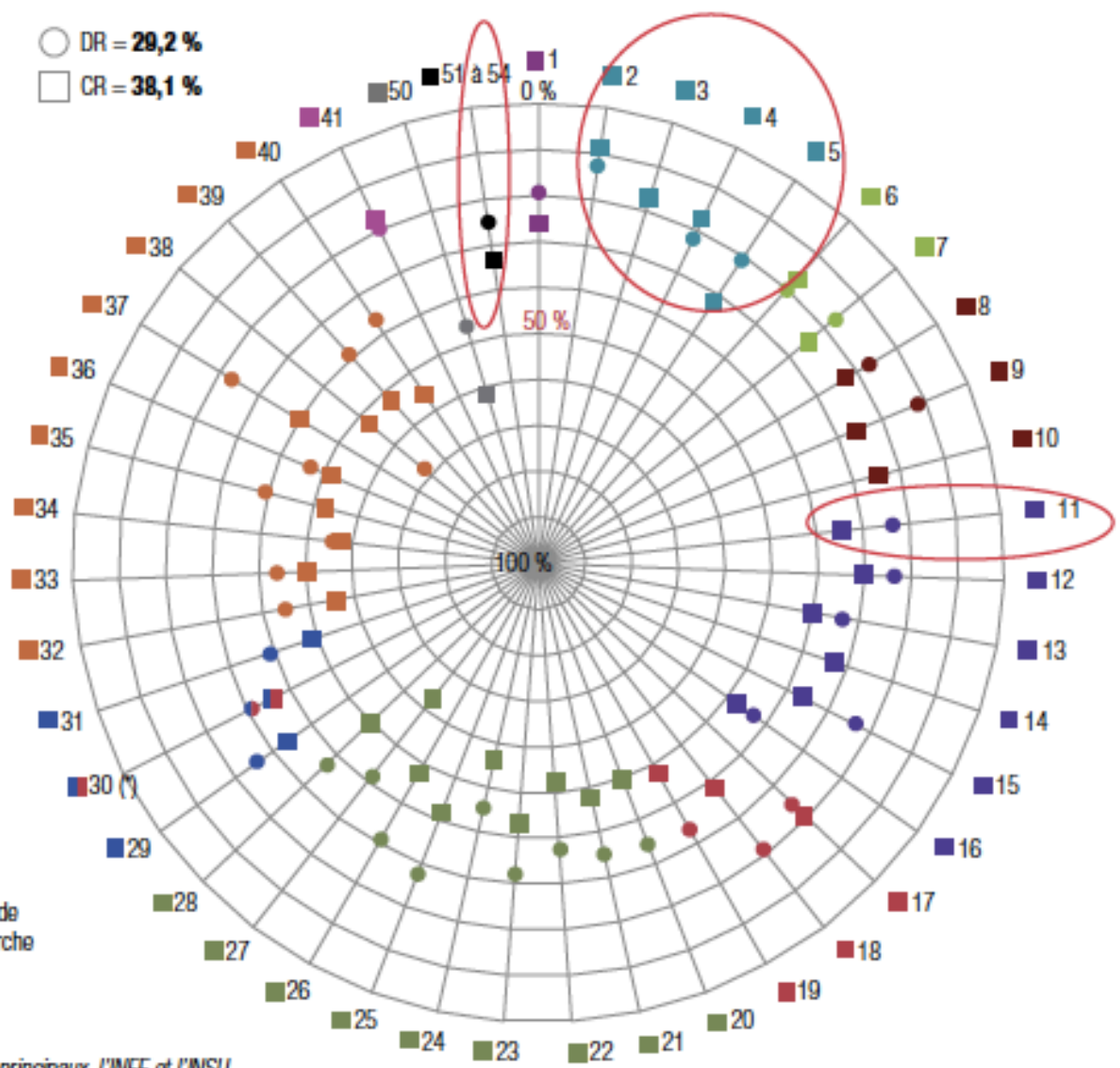
Institute of Physics (INP)
02 Physical theories: methods, models and applications
03 Condensed matter physics: structures and electronic properties
04 Atoms and Molecules, Optics and Lasers, Hot Plasma Physics
05 Condensed matter physics: structure and dynamics
11 Supra and Macromolecular Materials and Systems: elaboration, properties and functions (Main Institute : Chemistry (INC))
54: Experimental methods, concepts and instrumentation in materials science and life science engineering (Interdisciplinary)
(- Instrumentation and experimental approaches for imaging, manipulation and understanding of individual biological objects, their assemblages and interactions, the influence of external and internal stimuli and stress.
- Biophotonics
- Nano and microfluidic for live sciences. Nano and microsensors, nano and microsystems for live sciences, metrology in vivo and in natura.
- Functional and stimuli responsive interfaces for live sciences.
- Biomimetism and reconstituted biological systems. Single molecules and molecular assemblies. Dynamics of biological assemblies. Bioinspired artificial systems.
- Mechanics, rheology and dynamics at different scales in live sciences.
- Physical and chemical tools for synthetic biology.
- Multiscale and multimodal approaches, from the molecules to the whole organisms in their environments: biologging, telemetry for the study of ecosystems from a physical and biological point of view.
- Neurosciences: instrumental approaches and developments)

On CNRS Payroll
DR: Senior Researcher
CR: Researcher

Institute of Physics (INP)
02 Physical theories: methods, models and applications
03 Condensed matter physics: structures and electronic properties
04 Atoms and Molecules, Optics and Lasers, Hot Plasma Physics
05 Condensed matter physics: structure and dynamics
11 Supra and Macromolecular Materials and Systems: elaboration, properties and functions (Main Institute : Chemistry (INC))
54 Experimental methods, concepts and instrumentation in materials science and life science engineering (Interdisciplinary)







(*) La section 30 comporte 2 instituts principaux, l'INEE et l'INSU.

Fig. 11 – Proportion de femmes permanentes selon la section d'évaluation, tous corps confondus

Fig. 12 – Proportion de femmes permanentes selon la section d'évaluation et le corps

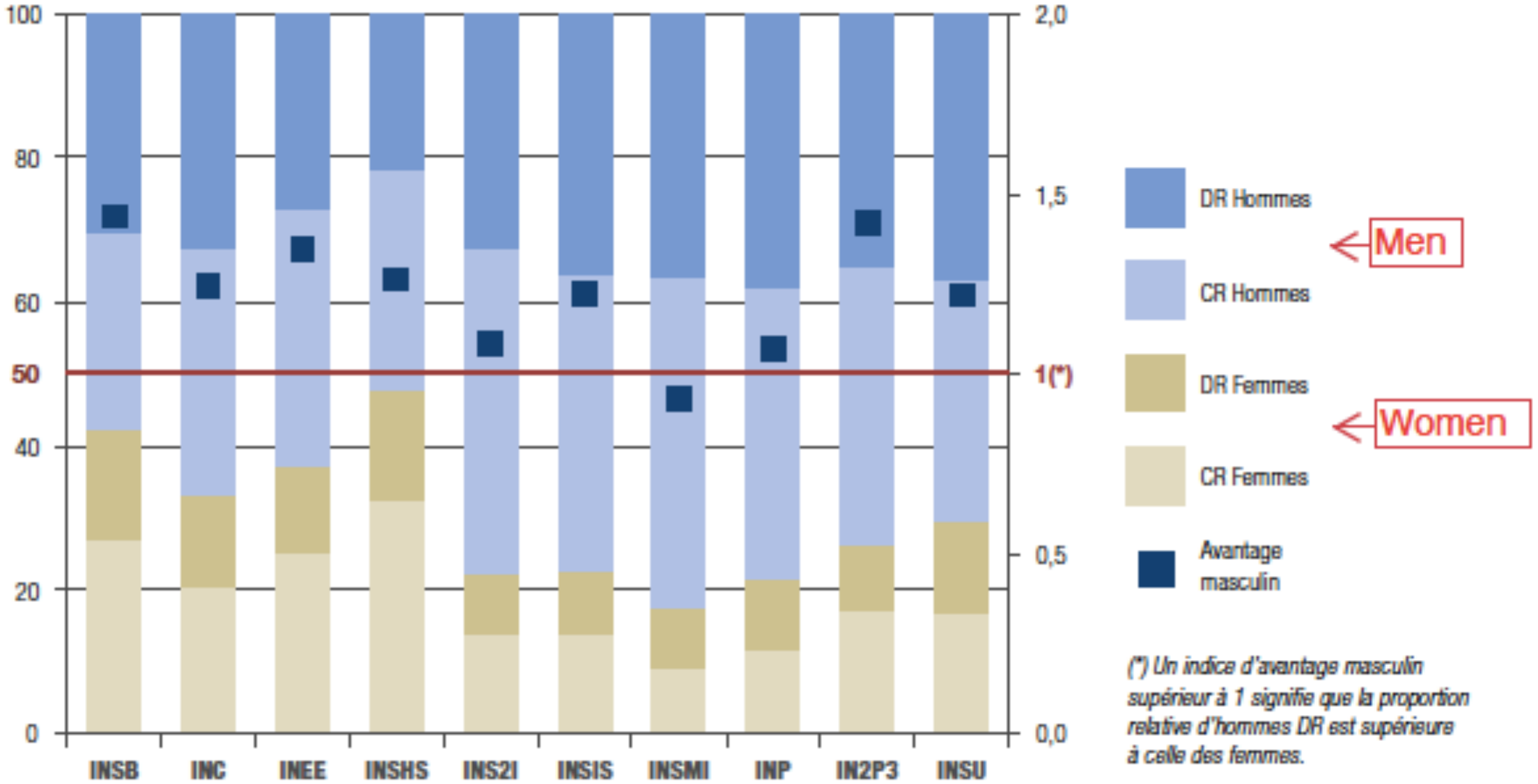


Fig. 18 – Proportion de femmes et d'hommes par corps et avantage masculin par institut