INAC - Institut nanosciences et cryogénie

Rapport Hcéres

HCERES

High Council for the Evaluation of Research and Higher Education

Research units

HCERES report on research unit:

Institut des Nanosciences et Cryogénie

INAC

Under the supervision of the following institutions and research bodies:

Commissariat à l'Énergie Atomique et aux Énergies Alternatives – CEA

Université Joseph Fourier – Grenoble – UJF

and partly:

Centre National de la Recherche Scientifique – CNRS

Institut Polytechnique de Grenoble – INPG

Evaluation Campaign 2014-2015 (Group A)

HCERES

High Council for the Evaluation of Research and Higher Education

Research units

In the name of HCERES,[1]

Didier HOUSSIN, president

In the name of the experts committee,[2]

Claude WEISBUCH, chairman of the committee

Under the decree N°.2014-1365 dated 14 november 2014,

[1] The president of HCERES "countersigns the evaluation reports set up by the experts committees and signed by their chairman." (Article 8, paragraph 5)

[2] The evaluation reports "are signed by the chairman of the expert committee". (Article 11, paragraph 2)

Evaluation report

This report is the result of the evaluation by the experts committee, the composition of which is specified below.

The assessments contained herein are the expression of an independent and collegial deliberation of the committee.

Unit name:	Institut des Nanosciences et Cryogénie
Unit acronym:	INAC
Label requested:	
Present no.:	
Name of Director (2014-2015):	Mr Yves SAMSON
Name of Project Leader (2016-2020):	Mr Yves SAMSON

Expert committee members

Chair:	Mr Claude WEISBUCH, École Polytechnique and University of California at Santa Barbara
Experts:	Ms Ally AUKAULOO, Université Paris Sud
	Ms Silke BIERMANN, École Polytechnique, Palaiseau
	Mr Malcolm BUCKLE, ENS Cachan
	Mr Jean-Yves DUBOZ, CRHEA – CNRS, Sophia-Antipolis
	Ms Cécile HEBERT, École Polytechnique de Lausanne, Switzerland
	Mr Michel HEHN, Université de Lorraine, Nancy (CoNRS representative)
	Mr Zeger HENS, Ghent University, Belgium
	Ms Muriel HISSLER, Université de Rennes
	Ms Chantal HOUEE-LEVIN, Université Paris-Sud
	Mr Philippe LEBRUN, CERN, Geneva, Switzerland
	Mr Pierre LEVITZ, Université Pierre and Marie Curie, Paris
	Mr Jacques MILTAT, Université Paris-Saclay, Orsay

Mr Christophe MORA, ENS Paris

Mr Paulo Jorge PEIXEIRO de FREITAS, INESC MN, Lisboa, Portugal

Mr Bernard PLAÇAIS, ENS Paris

Mr Philippe POIZOT, IMN, Nantes

Mr Louis RODRIGUEZ, CEA Saclay

Scientific delegate representing the HCERES:

Mr Serge BOUFFARD

Representatives of the unit's supervising institutions and bodies:

Ms Christelle BRETON (représentante de l'École Doctorale n°218 Chimie et Sciences du Vivant)

Mr Benoît CLEMENT (représentant de l'École Doctorale n°47 Physique)

Ms Maria FAURY, CEA/DSM

Mr Niels KELLER, CNRS – INP

Mr Yassine LAKHNECH, Université Joseph Fourier

Mr Jean-Pierre TRAVERS, Université Joseph Fourier

Mr Jérôme VITRE, CNRS – Délégation Régionale

1 • Introduction

History and geographical location of the unit

INAC is an institute mainly devoted to the physical sciences, comprising six laboratories focusing on nanosciences, and on low temperature science and technology. It is located in Grenoble. It originated from the 'Département de Recherche Fondamentale (DRF)' created in 1970 on the CEA Grenoble site. The Institute shifted its name to 'Département de Recherche Fondamentale sur la Matière Condensée (DRFMC)' in 1990. On January 1st, 2008, it adopted its current name, INAC: Institut Nanoscience et Cryogénie. INAC became a joint CEA-UJF research Institute in 2011. INAC laboratories are active members of the University Joseph Fourier (and from mid-2014 of the Université Grenoble Alpes, UGA).

INAC major commitments are to:

- produce frontier science results in basic research over selected fields of nanoscience and condensed matter, and develop innovative cryogenic engineering for large instruments and basic research;
- take care of valorising opportunities for applications emerging from INAC breakthroughs;
- train first class scientists through doctoral and postdoctoral studies. INAC also participates to higher education through teaching in Universities and Schools of Engineering.

Over the reporting period, INAC research activities covered seven axes: nanoelectronics, photonics, spintronics, nanociences for energy, nanosciences at the interface with biology and health technologies, unconventional superconductivity and magnetism, cryogenic engineering. These axes build upon transverse research facilities and expertises, such as advanced characterization tools, clean rooms, theory and numerical simulation.

Mid 2014, INAC staff comprised close to 500 people, including 281 for permanent staff belonging to:

- CEA: 225 (including 165 executive staff [meaning french "cadres"] and 60 non-executive staff);
- CNRS: 30 (including 18 researchers and 12 staff without research duty);
- Grenoble-INP – UJF: 26 (including 24 professors or equivalent positions and 2 technicians).

As well as 116 PhD students (the ratio PhD over scientific staff is approximately 0.56) and 67 post-doctoral researchers.

Over the reporting period (2009 - June 2014), INAC teams, published 1895 papers (excl. proceedings) in international refereed journals, including 296 in journals with the highest impact factors (> 6.5). Its researchers have been awarded major scientific prizes and ended the period with six ongoing ERC contracts; INAC patented 146 innovations; INAC has, since 2011, been inolved in the creation of 4 start-ups, building upon INAC IP (Aryballe, LXRepair, Prestodiag) or joint INAC-Leti IP (Aledia). Over the period, INAC trained an increasing number of PhDs students, 182 having started their PhD over the reporting period, including 116 students present at the end of June 2014 and 39 new PhDs joining in 2013 (an all-time high).

In addition, INAC proactively reinforced its key partnerships with the academic community, including through the participation in five Laboratory of Excellence (Labex) networks: LANEF (nanoscience, energy), ARCANE (chemistry) in Grenoble, GANEX (nitride semiconductors), PRIMES (medical imaging and radiology) and SERENADE (nanosafety). It partnered with the LETI and LITEN laboratories which belong to the CEA technological research division (DRT),through an ambitious coupling programme ("programme phare") launched in 2013, addressing 6 key scientific and technological issues, namely the ultimate nanoelectronic components, organic batteries, ADN-based 2- and 3D organization of matter, advanced in situ characterization for energy, Ge-based laser, metal-free catalysts.

INAC expanded its policy to create, share and operate with the appropriate partners, key research facilities in nanoscience or cryogenic engineering: the French CRG beamlines at ESRF (jointly operated with CNRS partners), the CRGs neutron lines at ILL (jointly operated with FZ Juelich, Germany), the Upstream Technological Facility (PTA, a 700 m² clean room jointly operated with the LTM laboratory), the Minatec nanocharacterization facility (PFNC, jointly operated with CEA-LETI and LITEN), the 400 W, 1.8 K cryogenic test facility.

The institute brings together 6 laboratories/services, each being divided into research teams, namely: Cryogenic Engineering (SBT) [3 teams]; Inorganic and Biological Chemistry (SCIB) [3 teams]; Spin in Electronics (SPINTEC) [2 teams]; Physics of Materials and Microstructures (SP2M) [6 teams]; Structure and Properties of Molecular Architectures (SPRAM) [3 teams]; Statistical Physics, Magnetism and Superconductivity (SPSMS) [3 teams].

These laboratories are joint CEA – UJF research units, SPINTEC being further associated with CNRS and INP, SPRAM with CNRS, and SCIB being a FRE (Formations de Recherche en Évolution) with CNRS.

INAC overall budget amounts to 40,570 k€, as estimated up to mid-2014 and including resources granted to or obtained by INAC (This does not include two important contributions, the industrial contract associated with the cryogenic plant of JT60-SA (designed by the SBT), 6,474 k€ in 2014 – and the invoicing associated with the supply of cryogenic fluids, by SBT, to INAC teams and INAC partners, estimated at 4,023 k€ for 2014).

Over the reporting period, resources granted to INAC teams through competitive calls (ANR, Europe, ESA, CNES, ITER IO…), industrial partnerships or internal grants from CEA, CNRS and UJF increased steadily (> 10% per year from 2009 to 2013). In the european programs (FP6, FP7), annual resources went from 879 k€ in 2009 to 4,203 k€ in 2013 (note that ITER grants for thermometers and flowmeters appears in INAC budget from 2014 on), leading to an average annual increase of 48% over the period. The increase of ANR resources from 2,477 k€ in 2009 to 4,991 k€ in 2013 (average annual growth: 19%) has been achieved in a context of increasing competition as the ANR budget dedicated to competitive calls for research projects has decreased over the last years. This comes after an annual increase of external funding of 15% over the previous reporting period 2005-2010.

Management team

The current director of INAC is Mr Yves SAMSON, assisted by Ms Pascale BAYLE-GUILLEMAUD, deputy-director. The six laboratories are headed by lab directors and deputy directors.

HCERES nomenclature

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Unit workforce

Unit workforce	Number as at 30/06/2014	Number as at 01/01/2016
N1: Permanent professors and similar positions	24	
N2: Permanent researchers from Institutions and similar positions	180	
N3: Other permanent staff (without research duties)	59	
N4: Other professors (Emeritus Professor, on-contract Professor, etc.)	3	
N5: Other researchers (Emeritus Research Director, Postdoctoral students, visitors, etc.)	93	
N6: Other contractual staff (without research duties)	13	
TOTAL N1 to N6	**372**	

Unit workforce	Number as at 30/06/2014	Number as at 01/01/2016
Doctoral students	125	
Theses defended	167	
Postdoctoral students having spent at least 12 months in the unit		
Number of Research Supervisor Qualifications (HDR) taken	22	
Qualified research supervisors (with an HDR) or similar positions	113	

2 • Overall assessment of the unit

Global assessment of the unit

INAC is a major research laboratory in the physical sciences in France, with a broad range of competences in nanosciences and low temperatures. It has a number of unique features: very large and efficient facilities in the fields of characterization (nano Laue X ray diffraction, in-operando set-ups for batteries and fuel-cells, nanoscale chemical and physical analysis including high resolution TEM, high field dynamic nuclear polarization (DNP-NMR)), material growth (numerous MBE and MOCVD crystal growth systems), nano fabrication, physical measurements in extreme conditions, low temperature systems with extreme refrigeration power, etc.

It has a remarkable publication record, with 1895 papers published over the period (excl. proceedings) in international refereed journals, including 296 in journals with the highest impact factors (> 6.5). Its researchers were awarded major scientific prizes and ended the period with six ongoing ERC (European Research Council) contracts.

Its attractiveness is well demonstrated by its high success rate in the highly competitive French and European funding calls, with an average increase in external funding of 10-15% over the past decade. It also attracts high potential PhD students and post-docs on a wide national and european basis.

The training of students is remarkable and the high employment rate testifies of both the attraction of excellent students and the quality of training in technical and other skills.

INAC is strongly committed to valorisation of its research results with 146 patented innovations, and the creation of 4 start-up since 2011, thus testifying to a successful strategy of rapidly implementing and transferring innovations to the market.

Strengths and opportunities in relation to the context

The first strength of INAC is its permanent staff with high technical and scientific skills: this in turn attracts very high quality non-permanent staff, such as PhD students and postdocs. The experts committee notes a large increase in the HDR (Habilitation à Diriger des Recherches) population (22) over the period. The general attractivity of the Grenoble area for students is high in physical sciences, comparable to Paris for some domains and is a major strength. This was eloquently expressed by the foreign students and postdocs in all opportunities. It is also well examplified by the international recruitment of INAC. The creation of UGA (Université Grenoble Alpes) will undoutedbly be a further asset for the determinental role of the region in the scientific advancement on a national level and should also boost the attractivity towards students both on a national and international levels.

The second strength of INAC is the existence and operation of shared facilities such as PTA (“Plateforme Technologique Amont”) and PFNC (“Plateforme de Nano Caractérisation”) with a state of the art equipment, partly run by INAC. These facilities not only allow for advanced analyses and processing, but also for specific developments such as e.g. advanced electron microscopy (HRTEM-STEM). The new HYBRIDEN platform recently set up and devoted to testing of both photovoltaics and batteries is also an opportunity for further developing the energy theme at the lab scale. Beyond these shared facilities, INAC has developed, and seemingly is able to pursue, a policy of ultimate experimental facilities, such as those in low temperatures, the low temperature high field DNP experiment, polarized neutron lines for spin studies, focused X ray scattering beam line, materials synthesis under radioprotection… which allow to undertake studies that cannot be undertaken elsewhere.

The third strength of INAC is its local environment with the European Synchrotron Radiation Facility (ESRF), the Laue-Langevin Institute (neutron source ILL), the Micro and nanotechnologies innovation campus (MINATECH), the CEA Technological Research Division (DRT / LETI and LITEN), Néel Institute and many other academic laboratories notwithstanding private companies working in domains related to physics (Air Liquide is such an example). This leads to numerous collaborations, shared students and postdocs, shared permanent researchers, and shared facilities.

A very meaningful factor is the support by research bodies other than CEA (les “tutelles”), totaling 56 staff members on secondment at INAC from UJF and CNRS. In spite of their difficulties (reduced overall number of new open positions in Grenoble), they increased their commitment at INAC by three staff members over the period.

INAC has an excellent management structure, which operates well to the satisfaction of all stakeholders. In particular, the training of PhD students and PostDocs is deemed excellent.

Weaknesses and threats related to the context

Two main concerns have been expressed by the laboratories/services:

1. funding arises primarily from the successful application to outside calls (mainly ANR and EU). Is it detrimental to, or, even compatible with the definition of INAC's own scientific policy ? In the short term, it might appear as only leading small deviations to INACs directions, but integrated on a long period, these small changes in "derivatives" could lead to a severely altered course. An example is given by the relative abundance of funds for equipment that makes INAC a gifted place to perform research. However, on the long term, the maintenance costs of these equipments could be an added burden on general resources;
2. the shrinkage of permanent manpower could be a major threat to the development of new themes or subjects. Moreover, the change in retirement rules at CEA lead to a delayed retirement of many researchers, hampering the capacity to create new positions; over the period, the 29 CEA recruitments represent 63% of the total recruitments while CEA represents 80% of manpower, and 37% were due to CNRS and UJF which represent 20% of manpower. Both of these could handicap INAC in its exploration of new avenues.

Unless expressedly omitted from presentations or from the written report, the Committee sees a lack in transversality within the fields of Theory/Simulation and Advanced Characterization, all tools that should be a trademark of INAC. The organizational structuring along transveral "axes" (terminology of INAC) (nanoelectronics, photonics, spintronics, nanociences for energy, nanosciences at the interface with biology and health technologies, unconventional superconductivity and magnetism, cryogenic engineering), supposed to operate the transversal synergies between laboratories, seemed through the written documents and presentations to the committee to operate at a relatively low activity level.

The new emphasis on energy related matter is to be noted but it still lacks visibility. A more optimal use of INAC's resources should be deployed in this hot topic to reach the required critical mass. Strengthening the field further might help alleviating financing difficulties by tapping into new sources of funding.

INAC has set up a large number of state-of-the-art equipments and facilities which require large maintenance budget. Decreased supports from the institutions (CEA, CNRS, UGA), if not compensated for by external contracts, may lead to financial difficulties. This can be seen as a significant threat.

There is some ambiguity on the research goals of CEA's and in the present case of INAC's basic research in the frame of CEA mission, possibly leading to research activities developing in directions not perfectly in line, or departing from CEA priorities. More generally, this ambiguity might be seen as a possible weakness.

Recommendations

INAC as all other top ranking institutes in France must be prepared to cope with a situation of diminished external funding and restricted hiring. Beyond the intrinsic political and scientific guidance of the CEA administration, the Committee can only propose some avenues for INAC:

1. to keep a high level of cross breeding of scientific ideas, a good practice would be to encourage / promote researcher thematic mobility e.g. in the form of sabbatical stays and invitations of foreign researchers. It should also be more proactive on ingoing and outgoing personnel fluxes (the latter much more of a challenge);
2. decision on maintaining or not ongoing thematic research must be discussed from both top-down and bottom-up perspectives. Only such practice would lead to viable and accepted compromise with the main actors who are the researchers;
3. the advent of Université Grenoble Alpes is a real opportunity for INAC to propose new collaborative efforts and shared facilities within this operation;
4. concerning the politics of attracting reknown researchers, INAC as all institutes in France must be able to propose internationally competitive packages, while this can lead to local large disparities (salaries, facilities etc…). An alternative may reside in more reliance on joint positions with its academic partners;
5. while the research record is excellent, more emphasis should be put on INAC missions in the frame of CEA objectives. The added Energies Alternatives (EA) to the former CEA acronym should take its whole share in the participation to find new ways to solve energy issues;

6. INAC has to maintain and eventually develop an independent capacity to support new proposals and risky initiatives which are judged highly promising.