



Nanosciences Foundation
—
Activity Report 2009



NANOSCIENCES FOUNDATION

Activity report 2009

Introduction	3
Part one: The main characteristics of the Foundation	5
Introduction	5
Some key events	5
The administrative management of the Foundation	6
The governance of the Foundation	7
Part Two: The scientific activities of the Foundation	9
Supporting high quality research within the RTRA	9
A brief review of the campaigns in 2007 and 2008	10
The campaign of 2009	11
Research personnel employed by the Foundation	16
Activities of the Foundation in "Training and Scientific Animation"	18
Part Three : The Finances of the Foundation	21
The budget of the Foundation	21
Funding future calls for projects of the Foundation	22
Fund raising efforts made by the Foundation	23
Part Four: The impact of the Foundation on the activities of the laboratories in the RTRA	27
Academic indicators	27
The recruitment of excellent scientific personnel	27
The support of the technological platforms of the RTRA	28
The unifying role of the Foundation	28
New research themes induced by the Foundation	29
The evaluation of the Foundation's activity by its Scientific Council	30
The changes planned for the 2010 campaign	31
Part 5: The scientific reports of the Working Groups of the Nanosciences Foundation	33
Part 6 : The Network of Technological Platforms of the RTRA "Nanosciences aux limites de la nanoélectronique"	53
Appendix 1: The Laboratories of the RTRA	59
Appendix 2: The Foundation Board	61
Appendix 3: The Steering Committee	63
Appendix 4: The Scientific Committee	65
Appendix 5: List of the Chairs of Excellence of the Nanosciences Foundation	67
Appendix 6: List of the Post-Doc fellows of the Nanosciences Foundation	71
Appendix 7: List of the Ph. D. students of the Nanosciences Foundation	73
Appendix 8 : "Les Parrains de la Fondation"	75
Appendix 9: The scientific production of the funded projects	77

NANOSCIENCES FOUNDATION

Activity report 2009

Introduction

The year 2009 is pivotal for the Nanosciences Foundation since it is mid-way through the period 2007 to 2011, during which we can use the financial resources that have initially been attributed by the government and that are completed each year by the founding members. The year 2011 will, nevertheless, not be the final budgetary year since the financial situation of the Foundation allows us to already foresee a sixth year of full operations, for reasons discussed in this report.

One can further observe that 2009 is the year in which the Foundation has reached its cruising speed. After a quick start the first year, with the first call for project applications just weeks after a governing structure was put into place, the Foundation has continued to grow in 2008 with the hiring of a secretary general, the development of an administrative framework that specifies and regulates the relationship with its network of laboratories and their guardianship (Support agreements Foundation – parent body of laboratory, hosting agreements for the employees of the Foundation, etc.) as well as the setting up of the necessary accounting and budgeting tools. Simultaneously, a second call for projects was launched, following a much less tight calendar than in 2007.

The year 2009 is characterized by a significant strengthening of cooperation and coordination within the Foundation. In response to the 2009 call for projects, the Thematic Working Groups (TWG) that animate the RTRA community have been intensely involved in preparing proposals, organizing meetings in which the various project leaders were able to interact with their colleagues and develop their proposal involving new partners and/or modifying the scientific program. Further, the TWG have also mobilized to identify research priorities to be proposed for the recruitment of Chairs of Excellence (COE) in 2010 and they held several workshops to explore possible new orientations. The Nanosciences Foundation is a unique structure in which the founding institutions CEA, CNRS, Grenoble INP and UJF have joined to develop the scientific coordination in the field of the nanosciences in Grenoble, and 2009 has permitted a strengthening of this aspect.

Finally, a special effort has been provided by the Foundation in 2009 to develop its local communication: a new bilingual Web site updated each week, the publishing of a widely distributed quarterly newsletter, monthly seminars, creation of a doctoral thesis award, etc.

During the last three years, in the process of structuring itself and strengthening its capacity to act locally by influencing the research orientations of Grenoble labs in the field of the nanosciences, the Foundation may have somewhat neglected to develop its profile nationally and internationally. The new guidelines it has chosen for its activities in 2010 should enable it to address this important issue.

Roland HERINO

Director of the Foundation

Part one:

The main characteristics of the Foundation

Introduction

The Foundation "Nanosciences at the limits of Nanoelectronics" (in short "the Foundation") brings together the four major players in this field at the Grenoble site: CEA, CNRS, UJF and Grenoble INP. The Thematic Network for Advanced Research (RTRA: Réseau Thématique de Recherches Avancées) associated with it comprises 32 laboratories representing 880 researchers and research engineers (See Annex 1 for the list of laboratories in the RTRA). The project brings together all partners involved in fundamental and technological research in nanosciences and nanotechnologies in Grenoble, setting nevertheless a limit by not addressing purely technological objectives.

For the period from 2007 to 2011, the Foundation has received a grant of 17.5 M€ from the government; the four founding members have pledged to contribute each year 1.7 M€ (500 k€ from CEA, CNRS and Université Joseph Fourier (UJF), 200 k€ from Grenoble INP). This amounts to a total endowment of 26 M€. Taking into account the rule that 10% are not consumable, this enables the Foundation to spend an average 4.68 M€ per annum for its actions and its management, not counting new, additional resources.

The size of this budget is by far inferior to the resources available to the individual founding members, a fact that may seem to place considerable limitations on the degree of inflection that can be exerted by the Foundation on the scientific orientations followed by the laboratories. Nevertheless, the strategy that has been adopted allows the fostering of a true and lasting collaboration among the four founding members and their laboratories. In addition, the significant role played by the Foundation in structuring and reinforcing the technological platforms, as well as in the recruitment of PhD students, postdocs, and COE could not be assumed as efficiently by any individual member.

Some key events

The Foundation was established by decree on February 19, 2007, the Board of Administration ("the Board") held its first meeting March 23, 2007, and the Steering Committee May 9, 2007. This responsiveness has helped launch the first call for proposals as early as June 2007, and the choice of projects selected for funding was effective September 17, 2007.

The implementation of selected projects did not advance as rapidly, due to the necessity of elaborating the four-party conventions among the founding members. This required a series of time consuming meetings between the different administrations involved, each with its own variable time of response. Although several projects could start working between the end of 2007 and April 2008, most of the conventions for the projects validated in 2007 were only signed at the end of 2008.

The year 2008 was marked by the second call for proposals issued in January. The Board validated the selected projects on June 24, 2008. Owing to the previously gathered experience, implementation of the projects was faster and the proportion of projects that

have actually started in 2008 is more important. Projects from 2008 that could be implemented only in 2009 are mainly those whose beginning was conditioned by the recruitment of a suitable PhD student or the arrival of the holder of a COE.

The third call for proposals, concerning the year 2009, was issued already in mid-December 2008, with a deadline fixed at the beginning of April. This extended period, compared to previous years, allowed the TWG of the Foundation to intervene in the elaboration of proposals in a concerted and well-organized manner. More details about the role of the TWG will be given later in this report. The Board validated the selected projects at its meeting on June 24, 2009.

The administrative management of the Foundation

The administrative team

The team consists of the managing director and three collaborators: Karine Argento, the secretary general hired November 19, 2007; Maud Dayez, an assistant secretary in charge of administrative support and human resources of the Foundation recruited in November 2008 (position created in December 2007, but vacant in July 2008); and Stéphanie Monfront, in charge of development and communication, recruited in January 2009, initially with a 6 months limited contract (CDD), now a permanent contract (CDI).

Since January 1, 2009, the managing director of the Foundation is Roland Hérino, professor at UJF, made available to the Foundation by ministerial order.

The premises which house the administrative staff of the Foundation at 23 rue des Martyrs, Grenoble, are leased from Grenoble INP under an agreement signed on September 1, 2007. The offices, covering an area of 76 m², are properly equipped with furniture and computers since January 2008.

Bank accounts and accounting tools

A current account and a securities account were opened in May 2007 with BNP Paribas. More recently, in January 2009, it was decided to also open a current account and a securities account with CIC Lyonnaise de Banque in view of diversifying the investments of the Foundation.

In financial accounting, the secretary general is assisted by the accounting firm Adquo, chosen in July 2007 for the bookkeeping and accounting needs of the Foundation, the preparation of annual accounts, the setting up of procedures for payments by money transfers and their execution, the setting up of cost accounting and establishing the spreadsheets for project monitoring that were developed specifically for the Foundation.

Human resources management

Since May 2007, the management of pay slips, contributions to social security, establishment of standard labor contracts and assistance with social legislation is also entrusted to Adquo.

The Foundation employs mostly foreigners, and in this context it issues the hosting agreements for the recruited scientists and delivers or updates their residence permits in direct contact with the Préfecture. A detailed welcoming booklet was edited in English to facilitate the period of installation and agreements have been signed with Alliance Française

to offer courses in French upon arrival. Since November 2008, a personalized service is offered to the newcomers (assistance in the search for housing, help with administrative formalities and with moving in) through the agency EPERGOS Mobilité.

Relations with the founding members

The multi-annual agreements, approved by the Board on April 7, 2008, were signed by the four founding members between April 2008 and January 2009.

Each successful project is subject to the signing of an agreement between the Foundation and one or several founding members, in their role as parent bodies of the laboratories involved in the project. Model agreements have been drafted according to the nature of the projects, which have been validated by the parent bodies and are thus systematically applied since December 2008. Similarly, a model hosting agreement for employees of the Foundation working in one of the RTRA laboratories has been established.

A procedure for monitoring the projects supported by the Foundation has been developed: a spreadsheet facilitates controlling the progress of the projects over time, interim reports are required for annual updates and at the close of a project it is planned, in addition to a written report, to organize an oral presentation before the Steering Committee.

The governance of the Foundation

The Board of the Foundation consists of 15 members and the representative of the government (who is the "Recteur de l'Académie de Grenoble"). Eight members are representatives of the founding institutions (two per institution), five other members are nominated because of their scientific expertise and two are the elected representatives of the researchers within the RTRA (see detailed list of Board members in Annex 2). The Board has met three times in 2009, June 24, October 2 and December 8.

The Executive Committee of the Foundation, composed of the president, two vice-presidents and the treasurer, met nine times during the year 2009. The president convenes the Executive Committee and, with his agreement, the managing director prepares the agenda and attends the meetings. Since September 2009, the secretary general is also invited to attend the meetings.

The scientific life of the Foundation relies on ten TWG that bring together the entire community of researchers in the RTRA. Eight of the TWG cover the eight themes of excellence that define the RTRA. Two additional ones, entitled "Training and Scientific Animation" and "Technological Platforms" focus on all matters within the network that are related to their respective area of interest. The TWG hold meetings, seminars and workshops to conduct a reflection on the evolution of the thematic orientations of the Foundation.

The heads of the ten TWG compose the Steering Committee (see a list of the members and their substitutes in Annex 3). The main tasks of the Steering Committee are the organization and conduct of the Foundation's calls for projects, the selection and the ranking of proposals received in this context (given the expert advice of outside specialists assigned to the RTRA), the selection of candidates for post-doctoral and PhD scholarships. The Steering Committee also defines and implements any new initiative to help the Foundation achieve its goals. It has met ten times in 2009.

The Foundation has a Scientific Council composed of 12 members chosen by the Board who are internationally recognized specialists in the areas covered by the themes of the RTRA, and are otherwise not involved in the activity of any of the network laboratories (see the list in Annex 4). The role of the Scientific Council is to analyze the functioning of the Foundation and to issue recommendations for improvement of its strategy. The Scientific Council met in Grenoble on November 19 – 20, 2009.

Part Two:

The scientific activities of the Foundation

Supporting high quality research within the RTRA

At the time of launching its first campaign in 2007, the Foundation has defined the different types of support it would lend to the RTRA to fulfill its mission. It was decided to operate on the basis of annual calls for projects. Acceptable proposals would have to fall under one or more of the eight priority themes of the RTRA, but there would be no further targeting of particular themes. The following paragraphs describe the main types of support that were retained.

Projects concerning technological platforms

An important asset of the RTRA is the sum of its technological and instrumental platforms, open to researchers, postdocs and students of all laboratories in the network. Pooling the platforms among the founding institutions (CEA, CNRS, Grenoble INP and UJF) offers very high capacity for conducting advanced research projects. The Foundation contributes to the development of this pool, on the one hand by means of its TWG "Technological Platforms", which brings together the heads of all the facilities, thereby promoting cooperation and coordination among them and, on the other hand, by investing in new equipment for the platforms and subsidizing their operating expenses. Each call for proposals since 2007 thus includes a section dedicated to the platforms. Applications for this type of support must first have been presented and discussed within this TWG.

Chairs of Excellence

The aim is to attract high-level scientists to Grenoble to become involved in outstanding research projects that contribute to the development of interactions between the network laboratories. Besides the personal salary, the Foundation offers them a budget for the recruitment of graduate students and/or post-docs and for additional equipment or for operating expenses. Two types of COE are available, full time or part time, each with a commitment for three years. This period is sufficient for the visiting scientists to become well integrated into the network, which can eventually lead them to postulate for a tenured position offered by one of the founding members, in order to establish themselves permanently in Grenoble.

RTRA Projects

This type of support provides funding for particularly innovative projects that enhance the interactions between several network laboratories. The funding will be granted primarily to recruit doctoral and/or post-doctoral students who become involved in the project, although some support may be devoted to the purchase of equipment or to operating expenses.

Projects for "Jeunes entrants": Recently hired, young scientists

The goal is to provide specific support to young researchers who have just been recruited in Grenoble by one of the founding institutions of the Foundation. Financial support is dedicated to the purchase of equipment and/or the recruitment of a graduate student or a post-doc. The type of support "Jeunes entrants", retained in 2007 and 2008, was abolished in 2009, with the underlying reasoning that newly recruited researchers should rather get an incentive to seek collaborative partnerships, such as within an RTRA project.

Graduate scholarships: “Au fil de l’eau”

The purpose of this support, which is attributed outside the annual campaign for projects, is to attract outstanding undergraduates trained abroad to pursue their graduate studies in one of the network laboratories. The host laboratories present PhD candidates who, for some administrative reason, are not eligible for one of the French government scholarships. The selection is made by the Steering Committee. This program takes advantage of the flexibility of the Foundation, enabling it to start an employment contract for doctoral training at any time during the year (“au fil de l’eau”).

In addition, the Foundation has awarded an annual financial support for activities concerning training programs or scientific events in the field of nanoscience. Since 2009, a specific theme "Training and Scientific Animation" is added to the call for proposals.

A brief review of the campaigns in 2007 and 2008

- ***The 2007 campaign***

The first campaign for projects was launched by the Foundation in 2007, the year of its inception. The short time span between the publication of the call for proposals (June 2007), the deadline (July 1) and the selection of projects (September 2007) imposed a tight schedule. The projects were analyzed by an Expert Committee consisting of 61 external referees (including many foreign experts) and the members of the Steering Committee.

The call had an overall response of 72 proposals, out of which 28 projects were selected (not counting PhD thesis projects "au fil de l’eau").

Successful projects are as follows:

- recruitment and/or support for 8 COE (including 2 full-time) representing a financial commitment of 2286.5 k€ over 3 years
- support of five “Jeunes Entrants” (representing a financial commitment of 773 k€ for 3 years)
- support of five RTRA projects, for a financial commitment of 1091 k€, 3 years
- support of technological platforms amounting to 1775 k€
- support for workshops, summerschools and scientific events: 8k€.

To this list should be added the commitment to recruit seven doctoral students according to the procedure “au fil de l’eau”.

At the start of the RTRA, the strategy was to concentrate a major effort on the technological platforms. This choice, made in a spirit of cooperation, was considered on the one hand to improve significantly and rapidly the technological support available to researchers in the network and, on the other hand, to favor coordination between different platforms so that the offer available at the Grenoble site in the field of nanotechnology would become more transparent to the entire RTRA community and more operational to serve its members.

Most of the projects selected in 2007 did actually not start before 2008, for the reasons outlined above, so that the amount spent in 2007 (467 k€) was significantly lower than the

consumable part for that year. Since it is possible to defer the unused portion to 2012, we can already announce a sixth year of operation for the Foundation.

- ***The 2008 campaign***

In 2008, the campaign followed a less tight schedule than in 2007: call for proposals in January, deadline for submissions March 3, selection by the Steering Committee in May, after receiving the referee reports, and approval by the Board June 24. Each project was refereed by two out of the 50 experts (nearly 50% of whom from outside of France). Of the 47 proposals received, the following projects were selected and approved by the Board:

- support for the technological platforms, with a commitment of 2327 k€ over 3 years
- RTRA projects for a commitment of 951 k€
- recruitment and / or financial support of four COE (including one full-time) commitment of 1085 k€ over 3 years
- support for three “Jeunes Entrants” for a total of 475 k€
- support for workshops, training and scientific events of 40 k€.

In addition, as part of the 2008 operations, six PhD students were recruited according to the procedure “au fil de l’eau”, for doctoral contracts lasting 36 months.

As in 2007, the action highlighting the strategy of the Foundation was again the strong support for the technological platforms, with a commitment of 2327 k€ over 3 years.

The campaign of 2009

A new procedure for preparing proposals

The call for proposals 2009 has been circulated among the members of the network December 19, 2008. The new campaign presents a marked change from earlier ones, partly in response to the recommendations of the first Scientific Council of the Foundation held in late June 2008, which suggested that the Foundation should support larger projects along well-defined strategic orientations.

The call has been centered on three types of actions: the COE, the RTRA projects, and the support to the platforms. Support for “Jeunes entrants” has only been maintained to the extent that young, newly appointed researchers were involved as partners in a unifying project. This was to encourage them to integrate themselves into important projects involving several RTRA partners. The wording of the call clearly announced that priority would be given to projects accompanying the recruitment of a COE, further to projects that develop sustainable collaborations between multiple RTRA partners, excellence of the project remaining the primary criterion for selection.

The deadline for submission of proposals has been set for April 1, 2009. The extended time span of over three months was granted to allow reflection on the choice of the strategic orientations and promote the development of collaborative projects. Thus, the eight TWG of the RTRA have organized several meetings during the months of January and February 2009 with the aim of preparing a concerted response to the call for projects. During this process, several of the original proposals were modified, supplemented and/or extended to other partners, and some have been abandoned. In March, the TWG met again to interview the project leaders and validate the proposals to be submitted to the Foundation, this validation

being a necessary condition for eligibility. Inviting researchers to participate in the work of several TWG, making sure that the various group meetings did not overlap, has fostered the multidisciplinary aspect.

In 2009, support for actions within the theme "Training and Scientific Animation" has been the subject of a separate call for proposals. The Executive Committee of the corresponding TWG has defined eligibility criteria in order to structure the applications, avoiding fragmentation and ensure the transparency of the Foundation's actions in this field. A selection process of the projects has been established, consisting of the presentation before the Executive Committee of the TWG and subsequent review by the Steering Committee.

The submitted proposals

In the end, 28 proposals (excluding "Training and Scientific Animation") have been validated by the TWG and then submitted to the Foundation. They are broken down as follows:

- 10 COE projects, for a total funding request of 4.256 M€
- 14 RTRA projects, for a total funding request of 3.882 M€
- 4 requests of platform support, for a total of 1.26 M€

Twenty-two laboratories of the RTRA are involved in at least one proposal, either as principal investigator or as partner. Counting multiple entries, 68 laboratories are listed in the 24 proposals concerning COE and RTRA projects, which means that on average, there are 2.8 partners per proposal. The table below shows the involvement of each laboratory in the submitted proposals.

Coordinator or partner of	Laboratory Acronym
more than 3 proposals	Néel Institute (17), INAC (12), LETI (6)
3 proposals	SPECTRO, LMGP LTM, IMEP
2 proposals	DCM, IAB, LEPMI, LNCMI, GIN, SIMAP, SPINTEC
1 proposal	LJK, TIMA, TIMC, CERMAV, LPMMC, IBS, LIG

Unlike previous years, the call for proposals did not provide recommendations regarding the amount per project that could be requested. The table below shows the distribution of applications received, which shows that most of the proposals requested funding in the range 200 - 400 k€.

interval (k€)	0-100	100-200	200-300	300-400	400-500	500-600	600-700
Number of projects	1	4	5	6	3	3	2

Regarding "Training and Scientific Animation", ten applications for support were received, of which five for thematic schools, the others for seminars, workshops or conferences. The requests represented a total of 85 k€.

The selected projects

1. Support to Technological Platforms

The selection was conducted in two stages: first oral presentations of all the proposals by their platform managers before the Steering Committee, accompanied by an overview of platform activities at a meeting open to all users (May 14), then two weeks later, the selection and ranking of proposals by the Steering Committee.

The table below summarizes the main characteristics of selected projects and the amounts of funding attributed by the Steering Committee. The Board then validated these decisions.

One may notice that the overall support to the platforms has been significantly reduced compared to previous years, since it amounts to 0.74 M€, down from 1.775 M€ in 2007 and 2.327 M€ in 2008. Thus, in 2009, support for platforms represents 23% of the total amount allocated to projects, while it was approximately 50% in previous years. As previously announced by the Foundation, this decrease in support had to be anticipated since the strategy has been to make greater efforts for the development of technological platforms in the first two years so that the investments could immediately benefit the entire community of the RTRA.

Platform	Project Acronym	Nature of support requested	Funding requested	Proposal Steering Comm.
NanoFab	Nanofonction	Equipping a facility for surface functionalization (silanization)	140 k€ , of which: 120 k€ equipment, 20 k€ operation 2009	120 k€
PTA CIME	LPCV-Deposition, operation	High temperature LPCVD equipment for the deposition of thin layers of semiconductor materials and dielectrics, operation of the PTA platform	550 k€ , of which: 250 k€ equipment, 300 k€ operation	470 k€ , of which: 220 k€ 250 k€
NanoBio	MALDIToFToF	Mass spectrometry equipment for Nanobio platform: purchase of a Maldi-ToF in support of synthesis plateau, to meet the needs for routine analysis of organic molecules of high molecular weight	170 k€	150 k€
IBS	Cryo-electron-tomo	Acquisition of an energy filter for a transmission electron microscope for cryotomography in biology	400 k€	0
		Total	1 260 k€	740 k€

In 2009, two thirds of platform support granted by the Foundation is dedicated to the purchase of equipment of very wide utility, and requested by a large proportion of users of the platform network. One third of the support is to subsidize operating expenses.

PTA-CIME: the attributed sum of 250 k€ is nearly 50% of the total operating expenses of of the PTA-CIME cleanrooms and keeps the hourly rate at a level acceptable to users. Due to permanent increase in the number of users of this platform (see the summary section on the platforms) a larger share of self-financing can be anticipated.

2. Chairs of Excellence and RTRA projects

The 24 proposals of this type have first been submitted to the expertise of specialists outside of the RTRA: 54 referees, including 23 from outside of France, have participated in this assessment, given that each proposal was submitted to three different referees, and that each of them had to analyze 1 or 2 projects. This stage of external evaluation took place from April 15 to May 25.

The analysis of the referee reports and the ranking of the projects by the Steering Committee were carried out on June 5, in the presence of two independent outside observers, Jean-Yves Marzin, Director of the Photonics and Nanostructures Laboratory, member of the Board and Jean-Philippe Bourgoïn, head of the CEA Nanoscience Program, member of the Scientific Council of the Foundation. The outside observers were invited to this meeting of the Steering Committee in order to respond to a reservation made by the Scientific Council in its 2008 report about possible difficulties the Steering Committee, being entirely composed of scientists belonging to the Grenoble RTRA, could encounter in making tough and/or difficult decisions in the selection of the projects. The two observers have written a report documenting the proper conduct of the deliberations of the Steering Committee, also giving some advice for the future.

In the end, six projects were selected for funding, representing a total financial commitment of 1.69 M€. These are broken down into three COE, all part-time, for a commitment of 0.93 M€ over 3 years, and 3 RTRA projects, for a total of 0.76 M€ (see table below). This outcome indicates a very severe selection, given the careful preliminary elaboration of proposals within the TWG of the Foundation. The preliminary work had already resulted in a reduced number of proposals (24 received in 2009, compared to 47 in 2008 and 72 in 2007), all well focused on priorities discussed at TWG meetings and in good agreement with the Foundation's strategy. Half of the finally selected projects associate four, the remaining ones three partner laboratories.

The bulk of the funds allocated to the six projects (77.5%) is spent on salaries: remuneration of COE, post-doc and PhD positions figuring in the proposals (the COE are not the biggest weight, as they are all part-time). This aspect clearly reveals the current policy of the Foundation, which is to focus on the recruitment of research personnel to the extent that the financing of equipment can be obtained by other means. The policy is to make use of the Foundation's flexibility in the recruitment, a flexibility that individual founding members do not always have. It may also be noted that the average funding per project is 280 k€, which is significantly higher than the 230 k€ attributed on the average in 2007 and 2008.

SELECTED PROJECTS in 2009			
Theme	Project Title	Partner Labs	Funding (k €)
Chaires of Excellence (COE)			
Nanocharacterization	John Kirtley, Stanford University, USA <i>Nanocharacterization of Superconducting Nanostructures</i>	Néel Institute SIMAP, INAC	350
Nanophotonics	Yong Zhang , NREL Golden, USA <i>II-VI Photovoltaics: New concepts solar cells with II-VI semiconductor nanostructures</i>	Néel Institute LETI, LTM	300
Nano modeling	Normand Mousseau, Université de Montréal , Canada <i>MUSCADE: Multi-scale Design of Nano-materials with simulations on hybrid architectures</i>	INAC, SIMAP Institut Néel LIG, LETI	280
RTRA Projects			
Nanomaterials	<i>PERCEVAL: Phase transformation and small scale effect: study of materials for phase change random access memories (PC RAM)</i>	LETI, INAC LMGP, LTM	280
Nanomagnetism	<i>MIDWEST: Magnetic Microscopies for the detailed study of the interaction between magnetic Domain Walls and Spin-Polarized currents</i>	Néel Institute INAC, SPINTEC	250
Quantum Nanoelectronics	<i>TRANSPIN: Coherent transport of a single electron spin</i>	Néel Institute IMEP, TIMA	230

With regard to the COE, it may be noted that it is difficult to obtain full time applications over three years from senior scientists. This is easily understandable since most of these scientists are tenured professors in their country, with responsibilities from which they cannot be relieved during long periods of time. Thus, it was decided that the next call for applications will offer the possibility of full-time professorships with shorter contracts, from 9 to 12 months, which would enable scientists on sabbaticals to apply.

3. PhD Contracts

Parallel to the projects supported as a result of the 2009 campaign, the Foundation has selected nine students who were recruited throughout the year in the procedure "au fil de l'eau". These enrollments are in addition to those provided in the research projects. Annex 7 shows the list of doctoral students employed by the Foundation, specifying for each of them the framework and the key dates of their contract.

4. Support for "Training and Scientific Animation"

As mentioned above, this type of support, which had previously been also rather "au fil de l'eau", has been in 2009 the object of a specific call for proposals. The change has enabled the Foundation to better define its strategy, clarifying in particular the criteria for eligibility of proposals, and to better keep track of its actions in this area. The selection was organized

in two stages, first a hearing of the project leaders who presented their applications to the Executive Committee of the TWG concerned in the presence of the director of the Foundation, and second the meeting of the Steering Committee that selected the proposals and set the level of funding. Selected projects were then submitted to the Board. The table below summarizes the funding attributed in 2009.

One may notice the considerable support granted to ESONN, a flagship of the RTRA Nanosciences community, which attracts to Grenoble a considerable number of young researchers: 56 attendees in 2009, coming from 23 countries, mostly European, but also from Brazil, India, USA.

Activities in "Training and Scientific Animation" supported in 2009				
Theme	Event	Location	Dates	Funding (k€)
SUMMER SCHOOLS				
Nanosciences	ESONN'09	Grenoble	Aug 23 - Sept 12	25
Nanocharacterization	HERCULES No 10 (special session)	Grenoble	May 18-22	5
Living organisms	Nanomaterials, Miniaturization Science and Biology	Grenoble	June 8-12	5
Quantum Nanoelectronics	MIGAS 09 "SOI"	Autrans	June 20-26	2
SEMINARS, WORKSHOPS and CONFERENCES				
Nanomaterials, Quantum Nanoelectronics	4th Symposium GDR Nanowires, nanotubes, semiconductors	Autrans	June 30-July 3	2
Quantum Nanoelectronics	Seminars on Quantum Nanoelectronics	Grenoble	weekly	6,5
Nanomaterials, Quantum Nanoelectronics	2 nd France-China Workshop "Quantum Information and Spintronics with Semiconductors"	Grenoble	October 11-16	2
Nanomaterials, Quantum Nanoelectronics	2 nd Grenoble -UT Austin Workshop on Nanoscience	Autrans	October 14 -16	2
Nanomagnétism	Séminar Daniel Dautreppe	Biviers	November 16 -21	2

Research personnel employed by the Foundation

Until 2009, the Board had made the choice that the Foundation itself should be the employer of any research personnel recruited as part of its action, whether such personnel were the COE, the post-docs, or the PhD students in the projects. The researchers were then

incorporated in the laboratories, where their activity was subject to the local regulations. At December 31, 2009, the total scientific staff of the Foundation amounts to 45 people plus 2 holders of COE who came for part-time visits not extending to the end of year, to which must be added the 3 people with administrative functions in the Foundation.

The administrative tasks to be fulfilled by the Foundation are thus significant, in particular the management of the employment contracts and all related aspects, along with the assistance of the researchers upon arrival, since most of them come from abroad.

Chairs of Excellence

12 COE (3 of them full-time) were created as a result of the campaigns in 2007 and 2008, to which have to be added 3 new chairs created in 2009 but occupied only in 2010. A summary of the award holders, providing details of nationality, beginning and duration of visit, research topic and home institution is found in Annex 5.

Among the scientists selected for a COE, are six U.S. citizens (Brown University, CalTech, Stanford University, Yale University, NREL), one Russian (from University of Alabama, USA), two Brazilians, one Ukrainian, one Australian, three Europeans (Belgium, Spain, Czech Republic) and one Canadian.

All the holders of COE are internationally renowned scientists. We distinguish the three full-time chairs, which involve researchers who consider remaining permanently in Grenoble, from the part-time chairs, who help to develop lasting relationships with foreign laboratories, either concerning new orientations or to reinforce certain existing themes. Several of these scientists have already given seminars open to the wider Grenoble scientific community (notably in the framework of the Foundation's own monthly seminar, launched in November 2008). It is expected that they will also participate in the doctoral training by providing courses or cycles of graduate seminars.

Post-Doctoral Fellows

On December 31, 2009, the Foundation was the employer of 8 post-docs involved in projects selected in 2007, 2008 and 2009. The complete list is given in Annex 6, specifying the project on which they were recruited, their research topic and host laboratory.

PhD Students

On December 31, 2009, the Foundation had 33 salaried PhD students, recruited either as an accompaniment of COE (5 students) and of projects (6 students), or "au fil de l'eau" (for 22 of them). There are six Chinese, nine Indian, two Korean, three Brazilian, two Vietnamese, one Mexican, one Argentine, one Iranian, one Canadian, one Russian, one Ukrainian; the others are from the European Union (Czech, Romanian, Polish, German and French). A summary given in Annex 7 specifies the names of the students, their nationality, their thesis topic and their laboratory affiliation.

Furthermore, it has been decided that from January 2010, the PhD students of the Foundation will be employed directly by the administration of the laboratory in which they do their thesis work. In turn, the Foundation will remit a grant equivalent to the payroll of the corresponding parent organism. This choice will allow a gradual reduction of the Foundation's administrative workload in the domain of human resources.

Activities of the Foundation in "Training and Scientific Animation"

The foremost activity of the Foundation in the domain of research training is the financial support of doctoral theses, allowing attracting to Grenoble high quality PhD students from all continents. The Foundation is therefore committed to the Graduate Schools (GS) which enlist these students, primarily the GS of Physics and the GS of Chemistry and Life Sciences (the director of the Foundation is an invited member of their scientific councils) but also other GS, federated as EEATS (Electronics, electrical engineering, automatic control, signal processing) and I-MEP2 (Material Engineering, Mechanics, Environment, Energetics, Industrial Processes, Production). The Foundation acts as intermediary, to organize the involvement of the COE in the courses offered by the GS. In particular, in 2009, the Foundation has strengthened its relations with the GS by organizing a meeting with their directors and the director of the Doctoral College (the college federating all the GS) to discuss possible measures designed to optimize the involvement of the Foundation in the teaching.

The Foundation provides support to ESONN (European School on Nanosciences and Nanotechnologies), which hosts each year for three weeks young researchers from all over Europe and also from abroad (U.S., India, Brazil, etc.). The practical part of this summer school offers hands-on tutorials on experiments going on in the RTRA network of laboratories, promoting the contact of these young foreign researchers with Grenoble scientists belonging to the Nanosciences Foundation. It thus contributes significantly to the international visibility of Grenoble in the field of nanosciences.

Concerning local scientific events, the "Seminars of the Foundation" were launched in November 2008. This is a monthly seminar alternately hosting a renowned scientist presently visiting Grenoble and the holder of a COE. In addition, the Foundation supports a weekly seminar on the theme "Quantum Nanoelectronics".

In 2009, the "Thesis Prize of the Nanosciences Foundation" was inaugurated to reward the best thesis of the preceding year, defended in one of the RTRA laboratories. The first winner, Francis Varchon, prepared his thesis entitled "Electronic and structural properties of graphene on silicon carbide" at the Néel Institute and defended it Dec. 8, 2008. The attribution of this prize will be renewed in 2010 and subsequent years.

The Foundation also provides support to major international conferences held in Grenoble, such as Elec Mol (over 300 participants during five days), and a few other events aimed at local, regional or national audiences.

To avoid the risk of dispersion of resources, to pursue a policy of transparency and maintain a strategy of readability and efficiency, the Foundation has implemented a new procedure for selecting the projects among the applications that it receives. As described in more detail earlier, in the paragraph devoted to the 2009 call for proposals, the new procedure is applied by the Executive Committee of the TWG "Training and Scientific Animation".

Scientific discussions and exchange of information within the RTRA are conducted under the leadership of the director by the eight TWG that coordinate the network's eight areas of excellence. This role of the TWG has been significantly strengthened since 2009. About twenty meetings are now organized each year in the course of the preparation of responses to calls for projects. Thematic workshops involving several areas of excellence are also organized with the aim of strengthening the multidisciplinary activities in the network. Three major workshops of this kind, all of them well attended (between 50 and 75 people), were

organized by the Foundation during 2009: "Self-assembly", January 19, "Contribution of computational simulation to nanosciences", March 23, and "Super resolution optical microscopy", June 19.

Part three :

The Finances of the Foundation

The budget of the Foundation.

Resources.

The annual budget of the Foundation, which consists of the consumable part of the capital installed by the Ministry of Research in 2007 and the annual contribution of the founding members, amounts to 4680 k€, to which must be added income from investments and possible donations.

The annual contributions of the founding members were received on the dates indicated in the table below.

Member	Annual contribution	Date of Payment
CEA	500 k€	07/08/2009
CNRS	500 k€	09/03/2009
Grenoble INP	200 k€	10/02/2009
UJF	500 k€	06/05/2009

Expenditures and commitments

As noted earlier, for most projects supported by the Foundation, financial commitments are spread over several years, usually over 3 calendar years. Only the support for technological platforms, training and local scientific events is generally paid in its entirety in the same year it is awarded.

One component of the expenditures of the Foundation in 2009 is therefore resulting from the financial commitments to projects decided in 2007 and 2008, a second component from support granted in 2009 to platforms, training and local scientific events. A smaller fraction results from those projects selected in 2009 that were able to start the same year.

To these items one needs to add the operating expenditures of the Foundation, including the salaries of the administrative personnel, the costs of organizing scientific events and workshops and, for 2009, the remuneration of a consultant in fundraising, chosen to implement a fundraising campaign (see below for details of this action and its outcome).

The following table provides a breakdown of expenditures in 2009 between the main items. Regarding the projects (COE, RTRA, "Jeune entrant") the parts made up of "salaries" and "equipment" are listed separately. Further listed are the salaries of PhD students recruited "au fil de l'eau", that is to say independently of the call for proposals. This option characterizes the responsiveness and flexibility of the Foundation.

Amounts in k€	Total expenditures	Foundation Management	PhD Salaries ("fil de l'eau")	Project support: salaries (COE, PhD, post-doc)	Project support: equipment	Technological Platforms	Training and Scientific Animation
2009	4803	443	620	1041,3	928,7	1710	60

It is remarkable that within the sums directly funding research (projects + PhD "au fil de l'eau", not platforms) the fraction dedicated to wages is 64%. This percentage reflects the Foundation's strategy, namely to focus on the recruitment of research staff, for which it has a specific flexibility.

The projects approved by the Board as a result of the 2009 campaign (i.e.: excepting PhD scholarships "au fil de l'eau") represent a total financial commitment of 2481.5 k€. The impact will be felt primarily in 2010 and the following two budgetary years, since projects that could not start before the last quarter of 2009 or early 2010 are precisely the 3-year ones. The projects selected in 2007 and 2008, and the salaries from PhD contracts "au fil de l'eau" also have an impact on 2010 and beyond. The table below summarizes all budgetary commitments of the Foundation for the coming years:

Commitments in €	PhD Salaries, ("fil de l'eau")	Project Salaries (COE, PhD, post-doc)	Projects Support, Equipt	Platform Support	Training Scientific Animation	Total funds committed
2010	805,3	1929,1	810,7	500	33	4078,1
2011	549,4	1530,2	430,2	0	0	2509,8
2012	216,6	375,9	125	0	0	717,5
Total	1571,3	3835,2	1365,9	500	33	7305,4

The total sums are known but the breakdown into amounts per year is for the time being only an estimate, because the dates of recruitment are not yet known for all the positions to be filled. In addition, the management expenses of the Foundation (which include costs associated with scientific events organized under its immediate responsibility) can be estimated to not exceed 500 k€.

Funding future calls for projects of the Foundation

To estimate the possibilities for future funding, we compare the financial commitments of the Foundation with the expected resources for each of the coming years. As discussed below, it is still premature to expect significant resources due to private sponsorship, so that we have entered in the following provisions only the consumable part of the Foundation's initial capital, the balances of unspent capital from previous years that are not consumable before 2012, and the income from financial investments. Income from this latter source that has arisen in 2007 and 2008 was affected to 2010. A portion arisen in 2009 (449 k€) was

spent the same year, and the unspent balance was assigned to 2011. Note that the income from financial investments has no calendar restrictions as to when it can be used.

Calendar year	2010	2011	2012	Total
Financial commitments	4 078	2510	717	7305
Consumable capital	4 680	4 680	0	9360
Unspent consumable capital 2007+2008			4 833	4833
Unspent financial products	1048	375		1423
Uncommitted funds, available	1650	2545	4116	8311

According to this balance sheet, the Foundation will be able to launch at least two further campaigns for projects, of approximately 2.5 M€ each, the same level as in 2009. Whether a third campaign is possible depends on renewed support the founding members will decide to attribute to the Foundation starting from 2012, keeping in mind that their present commitments sum up to 1.7 M€ annually, but end in 2011.

Fund raising efforts made by the Foundation

The objective of the French government, when it created the Foundations for Scientific Cooperation that are associated to the RTRA, was to develop ways that allow these networks to collect funds from businesses and individuals, namely that the Foundations could pursue their action on the basis of private sponsoring, once the initial support consisting of public funds would end.

It was thus understood since the time of its inception that the Nanosciences Foundation would at some point engage in a measure of fundraising. However, it could not reasonably start such a measure without first being able to demonstrate its role and its impact on the scientific community, that is to say, the Foundation first had to start working in order to enable it to present examples of its actions. It was just a year and a half after its creation, early in 2009, that the Nanosciences Foundation began to engage in this process. A first decision was to hire a collaborator in charge of the various aspects of fundraising, also responsible for the development of communication, the two aspects being closely linked. That person, Stephanie Monfront, was initially focused on the communication of the Foundation, which had hitherto not been extensively developed because of lack of time. She profoundly restructured the website of the Foundation, created an English version, and simultaneously made contact with various actors in the economic landscape of the Grenoble region (Chamber of Commerce and Industry, Agence d'Études et de Promotion de l'Isère, Pôles de Compétitivité, etc..) in order to publicize the existence of the Foundation and open up channels of promotion for it. She has also been intensely involved in the establishment of a committee of moral support for the Foundation, which brings together leading figures, including a Nobel Prize, two members of the French Academy of Sciences, and the directors or presidents of major research institutions (see the list in Annexe 8)

Organizing a fundraising campaign requires both specific skills and experience, which led the Foundation to seek help from a consulting firm specializing in this domain. After contacting several companies, the firm *Iain More Associates* was chosen because of its prior experience with other scientific foundations and also because it has a local correspondent in Grenoble.

The strategy has been to proceed in three phases, the first two leading to a feasibility assessment, the third phase being the fundraising campaign itself.

Phase 1 ran from April to September 2009. Its objective was to analyze the strengths and weaknesses of the Foundation as a potential fundraiser, to define the specific fundraising projects and the financial goals, and prepare a list of arguments to support the campaign effort. Several working sessions with the consultant were held in April-May to begin drafting the case statement, i.e.: the rationale for supporting the Nanoscience Foundation, and to prepare the stage of internal consultations, which took place in May-June. It consisted of interviews between Ms Levallois, our consultant from *Iain More Associates*, and personalities directly linked to the Foundation, such as representatives of the founding members, heads of research units, a member of the Scientific Council and one holder of a COE. In total, 11 individuals were interviewed, their vision of the Foundation and their feedback helped to finalize the case statement, which was then validated by the Executive Committee of the Foundation in September 2009.

Phase 2, called the external phase, ran from October 2009 through January 2010. Its objective was to test the case statement by presenting it to a number of potential donors, relatively close to the Foundation, either by their activity or by their interests. This period has also been devoted to set up a list of companies that might be approached during the last phase of the campaign. A meeting was organized to familiarize all directors of RTRA laboratories with the conduct of the fundraising campaign and with the case statement, explaining its rationale. The directors were also requested to provide to the Foundation any industrial contacts due to their scientific relations and / or existing contracts. These informations have helped to compile a list of about 50 companies, but with only a dozen for which the name of a contact person was provided.

Phase 2 has been organized with the help of a Strategy Committee, established in October 2009, bringing together five RTRA lab directors, a professor from UJF representing a sixth lab, the Foundation staff and the consultant. This committee reviewed the list of companies and selected the business leaders to meet for the conduct of the external phase. Selection criteria were: existing links with the Foundation, closeness to its thematic interests, and financial potential. Requests for appointments have been sent by mail by the director of the Foundation, supplemented by reminders via e-mail and phone. Finally, out of 16 requests, only 8 interviews have actually taken place (3 officials have clearly refused to grant an interview, five requests have remained unanswered despite reminders). Ms. Levallois was able to meet the CEO or Managing Directors of the following companies: Aplinov, Tronics, CIC Lyonnaise de banques, ST Microelectronics, Crocus Technologies, Kalray Innovation, Air Liquide TM, GEG.

The result of these consultations, which have been the subject of detailed written accounts prepared by *Iain More Associates*, is not encouraging. Although the missions of the Foundation are well understood, although the case statement is deemed clear, concise and perfectly describing the Grenoble context, none of the companies surveyed are willing to finance the Foundation.

The main conclusion of *Iain More Associates* after this phase of external consultations states that "the Foundation has not to date the potential to embark on a fundraising campaign for 6 M€, even if this finding does not imply outright abandonment of the approach." It is clear that private sponsorship for scientific research is not part of the French culture (except for medical research), the principal supplier of funds having always been the state. The present

study confirms this situation and has prompted the Foundation to postpone its engagement in a much wider fundraising campaign, as was planned with the third phase.

This additional time will be used to further develop the Foundation's communication skills by personalizing its interactions with the private sector, and to better define its long term role in the context of the Grenoble ecosystem. Significant restructuring of the Grenoble research landscape is underway, spurred by the calls for projects emanating from the so called "Emprunt National" (National Loan). A repositioning of the Foundation may be necessary when the new structures are in place. Until then, 2011 or 2012, the Foundation has the means to pursue its action with undiminished momentum and to widen its role in supporting the development of the nanosciences in Grenoble, thus possibly also giving it new arguments for investing again in a fundraising campaign.

Part Four:

The impact of the Foundation on the activities of the laboratories in the RTRA

Academic indicators

There is no doubt that the impact of the Foundation on the activities of the network laboratories is important, but it is still difficult to accurately measure this impact by indicators. The Foundation supports basic research projects, most of which have actually begun in 2008, but it would be inappropriate to attribute all publications of the network laboratories with the "nano" label (or all patent filings in that area) to the action of the Foundation.

To distinguish the scientific output that emanates directly from projects supported by the Foundation is easier, since the various project coordinators, as well as the employees of the Foundation are required to regularly send us a list of their publications. In appendix 9, one finds the complete list, broken down by project.

The recruitment of excellent scientific personnel

A clear and quantifiable aspect of the impact of the Foundation to date is linked to the numerous new recruitments that it has made possible, strengthening the teams involved in the funded projects. Through the action of the Foundation over a period of less than three years, more than 50 new investigators are now working in Grenoble, actively involved in basic research in the field of the nanosciences. The vast majority of them come from outside of France and all were recruited following a rigorous and highly selective procedure, taking into account not only the excellence of their scientific or educational record but also the originality of their research project and its relevance to the priorities of the Foundation.

It should be stressed that the recruitment of so many researchers in this short time span, all centered on the field of the nanosciences, would have been impossible to realize by any of the founding institutions. For example, the number of research grants for doctoral students at individual institutions is limited and must be shared with many other scientific fields. The application process follows a rigid time schedule and until 2009 only students from the European Union were eligible for these grants. The Foundation is not subject to such constraints; its flexibility and responsiveness enable it to attract to Grenoble excellent PhD students from around the world. This inflow of foreign students is also measurable in the graduate schools (GS), particularly in the GS of Physics, where the percentage of foreign students has increased significantly since the creation of the Foundation and nationalities previously represented little or not at all have made a strong appearance (Chinese, Koreans, Indians).

The highlight of the Foundation's impact on the Grenoble scientific community is the recruitment of the COE. Although the parent bodies of the various laboratories in the RTRA also have the potential to host high-level foreign researchers on visitor contracts, the number of such contracts assigned to nanoscience is still low. Most importantly, the Foundation has the capacity to implement longer visits, which is extremely difficult otherwise. Thus, the COE represent a very important tool, unique to the Foundation, that has a strong impact on the scientific life of the RTRA.

For example, the recruitment of Mairbeck Chshiev from the University of Alabama (USA) has initiated at Grenoble a new research activity focused on the theory and the modeling of spin transfer in electronic devices. Thus, a new competence has reinforced the expertise of Grenoble in the field of spintronics, which now extends from the general theory to the development of devices. Another example is the arrival of Donald Martin, professor at the Sydney University of Technology (Australia), which led to the development of a new research group around this world-renowned specialist on biomimetic membranes. His research project aims to take advantage of the ion selectivity of natural cell membranes to develop new sources of energy of electrochemical origin. A final example is the COE awarded to Michael Roukes, professor at the California Institute of Technology, under a project focusing on the development of NEMS, which combines the technological expertise of LETI in the fabrication of MEMS with the experience of the CalTech team in the understanding and development of these new nano-devices. The interactions with CalTech will expand to other local partners, as new contacts were established with the Néel Institute and the Albert Bonniot Institute. Last but not least, the Foundation is attentive to strengthen the interactions of the holders of COE with the entire RTRA, particularly by associating them to events that allow them to meet a wider community of researchers, also by inviting them to present seminars and get involved as teachers in the GS.

The support of the technological platforms of the RTRA

The RTRA benefits from a range of technological platforms that offer advanced equipment in all areas related to nanotechnology, both for nano manufacturing, nano characterization, nano chemistry and nanobiology, as also for computer simulation and modeling. The platforms are largely accessible to the entire scientific community of the network.

The TWG "Technological Platforms", initiated by the Foundation, unites the heads of the various technical platforms and meets several times a year with the aim of coordinating the evolution of the equipment and improve access to the facilities for the entire RTRA community. The TWG discusses each project of new equipment to be proposed for funding by the Foundation, ensuring that it does not represent a duplication of resources already present on the site and matches the needs of a broad community.

A good example of the influence of this TWG is the consensus obtained for the acquisition of a "Dual Beam Focus Ion Beam", which was selected as a result of the 2008 campaign and entirely funded by the Foundation. Another example is the rapprochement of the two platforms PTA (Advanced Technology Platform) and CIME Nanotech (Interuniversity Center for Micro Electronics), which now fully share their equipment and their operating expenses.

Information regarding the available platforms and their procedures is easily accessible on the website of the Foundation. The number of users continues to grow, and about 80% of projects supported by the Foundation use one or more platforms.

The unifying role of the Foundation

An important qualitative impact is the unifying role played by the Foundation. The collaborative research projects promoted by the Foundation help bridge the gap between teams from different institutes and create new relationships that will last beyond the project funded.

A first indicator of this unifying role is the number of partners involved in projects supported by the Foundation. Below is a summary of the data on the last three campaigns, from which follows that 75% of all projects funded include 3 or 4 different teams. In many projects, the partnerships allow to associate teams more focused on the fundamental aspects to others more involved in technological aspects. We also see that partners often come from different scientific disciplines, physics and biology, chemistry and microelectronics, etc. Thus, through the Foundation's calls for projects, new interdisciplinary links grow between RTRA laboratories.

Partners per project	Number of projects	Campaign 2007	Campaign 2008	Campaign 2009
4	3	0	1	2
3	12	8	3	1
2	3	1	2	0
1	2	1	1	0
Total of supported projects	20	10	7	3

It may be interesting to cite some examples. The project "DispoGraph", centered on graphene and its use for new devices, has brought together the various Grenoble teams involved in this research. Thus, the establishment of a monthly Journal Club enables all the partners to exchange recent results obtained in their groups and analyze together the other publications that appear on the subject. The "DispoGraph" project highlights Grenoble as a major international player on the subject of graphene by combining the teams involved in different aspects, such as model calculations, material growth, characterization, study of electronic and transport properties, technology or devices. Another example of a new partnership is the collaboration between physicists from the Néel Institute and biologists from GIN (Grenoble Institute of Neuroscience) in the project "NeuroFETs" which focuses on the detection of electrical activity of single neurons using nanoelectronic devices. The multidisciplinary approach is also a strong feature of the project "PolySUPRA" which combines chemists from DCM (Department of Molecular Chemistry), physicists from INAC and technologists from LETI in the study of metallic, supramolecular polymers for applications in microelectronics.

New research themes induced by the Foundation

The Foundation has helped launch new themes in the RTRA. One example is the innovative project "Cellulose Hybrid" launched by the CERMAV in the field of the physical chemistry of natural block copolymers. Self-assembly of these compounds in specific solvents leads to the formation of nanostructures that have a wide variety of morphologies. Understanding and controlling these phenomena allows envisaging new applications for flexible electronics and intelligent surfaces, and the partnership of the LTM in the project will allow to immediately implement any applications as they arise.

In another area, the already mentioned recruitment of Mairbeck Chshiev on a COE has resulted in the creation of a new activity on computer modeling of nano devices in spintronics. Similarly, the project "Scanning-gate nanoelectronics" that is associated with the

COE Vincent Bayot has given rise to a new research orientation at the Néel Institute, using near-field microscopy at low temperature under high magnetic field to study coherent quantum transport in the quantum Hall effect. In the Life Sciences, the Foundation has enabled researchers at the IBS and the LEGI to join their efforts in developing new devices that will control the assembly of lipid bilayers and eventually detect the activity of a single protein.

The evaluation of the Foundation's activity by its Scientific Council

The Scientific Council of the Foundation comprises 12 members selected by the Board for their expertise and reputation in the field of the nanosciences. Their combined specialties allow covering all the themes of the RTRA. The members of the Scientific Council are fully independent; their role is to analyze the work of the Foundation and to advise it in its strategy.

The Scientific Council met in Grenoble on November 19 and 20, 2009; it was the second meeting, the first dating back to June 2008. The agenda of the first day started with an overview of the actions of the Foundation by its Director. Then the heads of the following TWG presented the results of their activity: Platforms, Nanophotonics, Life Sciences, Training and Scientific Animation. In the evening, the "Thesis Prize of the Foundation" was awarded for the first time, preceded by a presentation of the laureate. This was followed by presentations of those researchers from the RTRA who were distinguished by ERC awards in 2009. A cocktail reception for all participants closed the day. The second day consisted of presentations on RTRA and COE projects funded by the Foundation. Finally, after the Council met for its deliberations, the Chairman made an oral presentation of its main conclusions.

In general, the Council unanimously believes that the Foundation has done a very good job within its possibilities. It emphasized the successful recruitment of outstanding scientists and the choice of projects that are not only of good quality but also appropriately selected to enhance collaborations between different RTRA teams. The opinion of the Scientific Council on the actions of the Foundation towards the technological platforms is very positive; its comments underline the important role played by the Foundation in coordinating and supporting the platforms.

Some reservations concern the selection of projects which, according to the Scientific Council, focuses too much on existing activities rather than taking into account the "competence gaps" in the network, that is to say, a strategy of "more of me" that the Council recommends changing by selecting more projects that are markedly distinct. It estimates that the Foundation has to make scientific choices, and improve its visibility, particularly if it hopes to attract funds from sponsors. The Council proposes to focus on the COE, on topics that are not yet represented in the network, and to appeal to the founding members to increase the funding that accompanies the COE.

Finally, the Council expressed its doubts about the procedure "au fil de l'eau" by which doctoral students are recruited all along the calendar year, stating that this type of process is perhaps not sufficiently competitive to guarantee the quality of the candidates.

The changes planned for the 2010 campaign

After analyzing the report of the Scientific Council, the Steering Committee has proposed to modify the 2010 call for projects in order to take into account the recommendations addressed to the Foundation. The proposed changes were presented to the Board and validated in December 2009.

It was decided to launch a distinct call for projects corresponding to each type of funding that the Foundation has to offer. In 2010, this will result in a call for projects for the "Technological Platforms" and another one for "Training and Scientific Animation". The terms remain unchanged since the action of the Foundation was appreciated in these areas.

Furthermore, it was decided that research funding will be granted exclusively to COE projects; proposals not associated with the recruitment of a COE will no longer be eligible. The Foundation will draw up a list of priority areas on which it wishes to recruit preferably the holders of these chairs. The elaboration of the list will start with exploratory discussions within the TWG and it will then be finalized by the Steering Committee to be proposed to the founding members and the Scientific Council. This call for proposals, emanating directly from the Foundation, will be circulated world-wide: advertisement in international science journals, dispatch to renowned foreign research centers and to the scientific services of French embassies, as well as transmission through all the usual channels (directors of laboratories and research institutes, heads of GDR, etc.). The call will specify that applicants must get in touch with the Foundation to develop their project in accordance with the priority areas selected. It was also decided to allow more time between the launching of the call for proposals, scheduled for mid-March 2010, and the application deadline, set for September 1, 2010, to allow time for candidates to build their project and, if possible, come to Grenoble to refine it.

Finally, the procedure for recruitment of doctoral students "au fil de l'eau" is canceled. It will be replaced by the Foundation's own "PhD Program", launched again world-wide, in order to attract candidates by another channel than through the individual RTRA laboratories. The number of PhD scholarships will be determined by the budget (6 are planned in the 2010 campaign). There will be two annual calls for applications (April and October), a pre-selection on the basis of referee reports will be performed by the Steering Committee, and selected applicants will be invited to a hearing after which they may be recruited. This new procedure is considerably more transparent, more competitive, and the selection in two stages, including the hearing before a jury involving also the directors of the GS, makes it more severe than before.

The Scientific Reports of the “Thematic Working Groups” (TWG) of the Nanosciences Foundation

The Nanosciences Foundation aims to promote excellence in basic research in Nanosciences in the RTRA. The research developed in the network's laboratories has several objectives:

- to understand the properties of matter at the nanometer scale,
- to fabricate objects of a few nanometers,
- to model their properties
- to discover new phenomena and develop new materials with unique properties.

The activity of the RTRA is distributed into eight major areas of excellence:

- quantum nanoelectronics
- nanomagnetism and spin electronics
- nanophotonics
- molecular electronics
- nanomaterials, nanoassembly and nanostructuring
- nanocharacterization and metrology
- life sciences at the frontiers of nanoelectronics
- theory and nanomodelling.

There are of course numerous overlaps between these different themes, and the research projects supported by the Foundation are often related to several of them, although it is the current practice to assign each project to a major theme.

Each of these broad areas is represented in the Steering Committee of the Foundation by two scientists (one member and one deputy member). These persons are also the heads of the corresponding TWG, where researchers from different RTRA laboratories meet who are specialists in the area.

Scientific reports from all TWG can be found in the following paragraphs, which highlight the main features and advances of the research done with the help of the Foundation.

1. QUANTUM NANO-ELECTRONICS

Maud VINET and Olivier BUISSON

Brief topical overview

Following the prediction of Moore's law and the assessment of the ITRS, micro-electronics continually decreases its typical dimensions, preserving at the same time the basic MOS operation. However when all the typical lengths (gate length, channel thickness, width of the transistor) tend to be of the order of 10nm, quantum effects begin to control the electrical characteristics of the device: quantum confinement in the channel, tunnel current between source and drain, quantum transport.

Rather than considering them as “spoilsports”, we can take advantage of these effects to design new devices or new basic circuits. This is what *Quantum nano-electronics* aims to do. The specific strength of the RTRA lies in the fact that Grenoble has unique advanced technological platforms for the fabrication of ultimate high quality nanostructures (quantum boxes, nanowires, Josephson and tunneling junctions) together with means of characterization, modeling and numerical simulation that lead to a deeper understanding of what physically dominates the electronics properties of the devices.

Several laboratories such as LPMMC, LETI, IMEP-LAHC, INAC, Institut Néel ... are directly involved in research on quantum nano-electronics. The work they perform together enables to investigate a number of topics such as:

- Experimental and theoretical study of new devices for integrated silicon based electronics (memories and transistors). Two paths are under study: either taking advantage of transport properties of alternative materials such as germanium or graphene or using tunneling effect to design low slope switches with low leakage current (Tunneling Field Effect Transistor). Thin film specific electrostatic coupling can also be used to design new efficient and compact memories such as, for instance, ZRAM (Zero-capacitance- Random Access Memory).
- Experimental and theoretical study of electronics properties of nanowires, with the aim to either use them as ultimate transistors or introduce new functionalities within integrated circuits (mass, chemical, or biological sensors, nano-electro-mechanical or thermo-electrical device).
- Experimental and theoretical study of electron quantum degrees of freedom to enable their control, manipulation and measurement. First topic is the study of Single Electron Transistors. In addition to the charge, electron spin or phase can be used to design quantum bits *i.e.* a quantum two-levels system. Thanks to the design of Josephson junction based circuits experimental realization of quantum bits has recently been demonstrated.
- Experimental and theoretical study of current fluctuations, non-local effects in hybrid structures (normal metal in contact with superconductor or ferro-magnetic materials) to observe Andreev reflection or electronic cooling...

Activity report

In the framework of the previous calls for proposals, four COE have been created which deal with the above mentioned topics. In addition, a weekly seminar on quantum nano-electronics is organized, thanks to the Foundation support. This seminar is quite well attended with an average of more than 30 attendees.

Leonid Glazman, COE - Since the beginning of the project mid-08 , Leonid Glazman made several visits (typically 2 weeks): 2008, Jul 6-20 and Dec 7-19, 2009; Mar 8-20, Jul 24-31, Nov 24 - Dec 1. An longer visit of 3 consecutive months (also) took place from April to June 2010. A 2-year post doctoral position has been added to this project: V. Golovach has been recruited and started his work in October 2009.

The project is focused on the theoretical study of Coulomb blockade in coupled quantum dots, of the dynamic spectral function of 1D non-homogeneous systems and nano-electro-mechanical effects in suspended carbon nanotubes.

Below is the list of most subjects discussed between local scientists and Leonid Glazman during his visits

1. Excitations spectrum of quantum Josephson junctions chain, with F. Hekking (LPMMC)
2. Aharonov-Bohm effect in a resonant tunneling nanomechanical device, with M. Houzet (INAC)
3. Quantum Hall effect in bilayer graphene, Corbino geometry, with L. Levy
4. non-equilibrium Kondo tunneling, with M. Lavagna
5. Relaxation in 1D Bose liquid; pumping vs. stirring of 1D Bose liquid with A. Minguzzi: (joint with Hekking)
6. resonant tunneling in a Coulomb blockade device, with M. Sanquer: (joint with Houzet)

7. spin-orbit effects in SNS devices, with S. De Franceschi
8. Aharonov-Bohm effect in resonant tunneling nanomechanical device, with F. Pistolesi (joint with M. Houzet)

Item 5 evolved into a broader question of dynamic responses of mesoscopic trapped atomic systems, and an article is being finished (Dynamic response of 1D bosons in a trap; authors: Vitaly Golovach, Anna Minguzzi, and Leonid Glazman). Item 1 got further development with symmetry analysis of the excitations spectrum and possible semi classical evaluation of eigenmodes. Items 2 and 8 resulted in (i) the derivation of the Hamiltonian describing Aharonov-Bohm effect on electrons crossing a vibrating nanotube in the resonant transport regime, (ii) the discussion on the conductance behaviour in the elastic regime (vanishing voltage and temperature) where the resonance line not only narrows, but also gets suppressed in case of asymmetric coupling of the nanotube to the leads at finite magnetic field, in weak coupling regime, and (iii) the project to study the transport when the nanotube's vibrations are coupled to electrons both electrostatically and via Aharonov-Bohm effect, within sequential tunnelling theory. The developed research program involves now a Université Joseph Fourier postdoc, G. Rastelli.

Leonid Glazman has given an ILL theory seminar on the *Nonlinear Luttinger liquid* on Mar 13, 2009. He has organized 4 seminars with invited speakers:

- Vitaly Golovach (U. Munich) on Dec. 11, 2008. Title : *Interaction effects on transport through an electronic Mach-Zehnder interferometer.*
- Fabian Hässler (ETH Zurich) on Dec. 12, 2008. Title: *Wave-Packet Formalism of Full Counting Statistics.*
- Mattias. Lunde (U. Genève) on Dec. 15, 2008. Title : *Electron-electron interaction effect in quantum point contacts*
- Dmitry Gangardt (U. Of Birmingham), on Mar. 9, 2009. Title : *Mobile impurities in 1D quantum liquids: Bloch oscillations and dissipation*

A series of lectures at Master level is scheduled for Spring 2010 when Leonid Glazman will stay for an extended period of time in Grenoble.

Mickael Roukes, COE - The aim of this COE is to develop new Nano Electro Mechanical Systems within the Grenoble RTRA. Michael Roukes came 6 times from Pasadena (Caltech) to Grenoble between April 2008 and April 2009, corresponding to a total of 54 days in Grenoble. During his visits, several meetings have been organized with several scientists from Institut Néel (Joël Chevrier, Serge Huant, Hermann Sellier) to establish a collaborative research focused on the use of the AFM tips developed by Caltech in Scanning Gate Microscopy experiments and measurements of very low forces at very low temperature or in liquid environment. In the coming year, the group of Michael Roukes in Caltech will fabricate specific tips for joint experiments with the Institut Néel.

Other discussions also took place with the Grenoble Institute of Neurosciences (GIN) (group of Pr. François Berger). Several meetings have been organized, among them a conference dedicated to the potential use of NEMS for biomedical applications. In the near future, the GIN should provide the Caltech group with several samples of cancer cells to develop cellular forces measurements using new tools based on NEMS.

The presence of M. Roukes in Grenoble has allowed accelerating the research developed in the frame of the LETI-CALTECH alliance to develop new applications of NEMS. Many new results have been obtained that will lead to several publications already being prepared. New projects are also being discussed. The meetings in Grenoble have also made easier the discussions about patents that will be submitted soon.

In terms of communication M. Roukes has contributed to the organization of a Workshop on NEMS: "Nanomechanics for NEMS - Scientific and technological issues", Grenoble, 2009, June 26-27; he also gave a seminar in the frame of the monthly Seminar of the Nanosciences Foundation entitled "Complexity and Nanosystems: from "Craft" – to Technology – to New Frontiers". A program of courses focused on the issue of low noise measurements has been prepared that M. Roukes will give at the UJF Doctoral School of Physics in late 2009 or early 2010.

Philip Wong, COE - Philip's Wong project is focused on silicon nanowires. He came 2 weeks in 2008 and one of his PhD students (Lan Wei) came 2 months to perform measurements of parasitic capacitance on narrow FDSOI transistors. These measurements were useful to calibrate the model. A Workshop on Nanowires has been organized in Grenoble (July 2008) during the stay of Philip Wong. Finally Jae Woo Lee was hired as a PhD student (in co-direction with Seoul University). He will work on transport characterization in nanowires (gate dielectric defects influence – surface roughness, charged defects) and the theoretical study of what can bring a core-shell structure in term of electrical performance.

Alex Zaslavsky, COE - This project has begun in June 2009 and is focused on the Tunneling Field Effect transistor. One PhD student has been hired to characterize and model SiGe, Ge and Si TFETs. Several publications have already been submitted, and Alex Zaslavsky has contributed to the scientific animation in Grenoble by giving several seminars and conferences.

Following the 2009 call for proposals, several meetings of the TWG were organized. The number of attendees (more than 20 on average) shows the dynamism of the teams and their willingness to collaborate. Among the projects presented, TRANSPIN was accepted. The goal of this ambitious project is to realize coherent transport of a single electron spin in a scalable condensed matter system. Presently, one can achieve extremely high control of an electron spin using semiconductor quantum dots, the elementary brick for spin based quantum computing. In order to manipulate and control spins individually on a large scale, one has to be able to coherently transport a single electron spin individually from one quantum dot to another relatively distant quantum dot. The present approach relies on our ability to control and detect quantum objects in nanostructures at GHz frequencies. This project proposes a collaborative effort between a Solid State quantum computer groups and RF- nano electronic groups to tackle all the foreseeable problems. It gives the opportunity to bring together the expertise developed over the years in Grenoble labs to study quantum properties of nanostructures aiming at quantum information processing. Such an approach will open new possibilities to the field of Quantum Information and is an essential step towards coherent control of a large number of Q-Bits.

2. NANOMAGNETISM AND SPIN ELECTRONICS

Ursula EBELS and Joël CIBERT

The relevant activities are developed mainly within Neel Institute, INAC and SPINTEC. A board, active since 2006, has been created to coordinate the scientific projects, the teaching activity, and more generally the stimulation of the research activity related to spintronics and nanomagnetism. Naturally this board also assumed the charge of coordinating the TWG for this theme, in the organizational frame of the Foundation. The research developed in Grenoble in this area covers the whole chain from the fundamental understanding of the physical phenomena to the fabrication of devices and test structures. The involved community is already in very strong interaction and most of the projects are run jointly by 3 or more laboratories.

Since the launching of the Foundation in 2007, we attracted M. Chshiev to Grenoble, a brilliant assistant professor of the University of Alabama, on a full time COE. The goal was to introduce theoretical research activities in the field of nanomagnetism and spintronics among the RTRA's laboratories and institutions based in Grenoble. The general idea of this project was to combine our experience in free electron, tight binding and ab-initio methods in order to reveal the nature of spin dependent transport phenomena in magnetic nanostructures (magnetic tunnel junctions or multilayers involving innovative magnetic materials). Today, two years after his arrival in Grenoble, we can say that his presence has given a fresh impetus to the research in the field of spintronics. His action was not limited to the perimeter of the laboratory host SPINTEC, but from the beginning he established collaborations with other laboratories of CEA and CNRS. His team which includes now one Post Doc and one Ph.D. student got an important impact on the national spintronics community. Two consortia contacted him to participate in national ANR projects. The first one, named "CRYSTO" for CRYstallised SrTiO₃ barrier for ultra low RA magnetic tunnel junctions, is already funded and has started in December 2009. During this period thanks to the support of the Nanosciences Foundation, his work led directly to one book chapter and to many scientific publications including a paper in Nature Physics. Meanwhile, M. Chshiev gave 8 invited presentations in international conferences.

The first research project funded by the Nanoscience Foundation, named POMME, started in July 2008, just one year after the partners of POMME provided the first experimental demonstration that the magnetic coercivity of ultra-thin metal films (FePt and FePd) can be controlled by electric charging. POMME was proposed to the RTRA in order to further develop this topic. In the experiment on FePt, the electric field was applied through the double layer of an electrolyte in which the sample was immersed. The main focus during this first phase of the project POMME, starting July 2008, has been to develop solid state barriers with large surface areas, allowing an electric field (E) in excess of typically 2×10^8 V/m to be applied. The other parts of the project are focused on the development of the experimental tools required for the planned studies and the preparation of model systems in which E-activation effects could be demonstrated. A reflectometry experiment under E has also been performed on ID10b at the ESRF.

The part time COE J. Fernandez-Rossier has been funded to develop a research program named "Downsizing nanospintronics: single atom control". The periodic presence of J. Fernandez-Rossier in Grenoble has strongly helped to develop theoretical models to account for the results of optical spectroscopy obtained on the spin dynamics of a single manganese atom inserted into a quantum dot. This is achieved in particular through the work of Cao Chonglong, a Ph.D. student jointly supervised by J. Fernandez-Rossier and L. Besombes, also financed entirely by the Foundation. Within the PhD project of Chonglong Cao, the study of the system of one quantum dot doped with a single magnetic Mn atom will provide a heuristic non-equilibrium model for the Mn spin dynamics driven by laser pumping. A microscopic description of relaxation for resonant pumping and for microwave coherent control experiments is now under progress.

The project IMAGE has started in early 2009. The first stage of this project was the purchase of a cryostat + coil to simultaneously perform magneto-optical (MCD, Kerr) and magneto-transport measurements on the magnetic semiconductor GeMn. After a few months, the cryostat (OXFORD) and the spectrometer and detector have just been received. The next step will be the setup of the experiments and first experimental results are expected during the next year. Another project in Nanomagnetism MIDWEST has been elected in the frame of the 2009 Call for Proposals. The aim is to study the propagation of domain walls using spin-polarized currents by developing a platform of magnetic imaging.

Several Ph D students have been selected by the Foundation to work on spintronics. Within the Ph.D. project of Ales Hrabec, it was proposed to use ferrimagnetic GdCo close to its compensation point as a model system for the study of spin-transfer torque (STT). The first dynamic tests on this material have revealed very high domain wall velocities induced by nanosecond pulsed magnetic fields. For pulses of 145 mT a domain velocity above 500 m/s is reached.

The goal of the thesis of Medeiros Soares is the controlled growth of ferromagnetic thin films as FePt or CoPt, with anisotropy perpendicular to the surface, deposited on an antiferromagnetic substrate, in order to understand and control the magnetic interactions at the interface. Several experiments have already been done and a large amount of data remains to be analyzed. For example, Mr. Soares used the instrument SUV-BM32 at ESRF to follow the growth of the FeMn/FePt/Pt (100) system. Next will be the construction of the high-field (magnetic) and low temperatures MOKE, and then characterization of samples already made by Medeiros Soares. Moreover, several MOKE experiments are planned at MPI Halle. New tests of the growth of phase L10 of MnPt on Ag substrates will be performed.

Agnihotri Sandeep started his Ph.D. in March 2008. His work is related to the study of spin-dependent transport in heterostructures made from II-VI semiconductors. The first year was devoted to the development of nanofabrication processes to format samples. Nanopillars networks have been made with diameters ranging from 50 to 1000 nm. This study has requested a long optimization of the wet etching process. Photoluminescence studies were then performed. The observed narrow peaks attributed to excitons helped to highlight the confinement in quantum dots. The study is now moving towards electric transport measurements in order to highlight tunnel transport. Several publications are in progress. This set of results obtained after only one year is quite impressive. It shows the vitality of the student and the right path on which he is located, and very positive output of this work is expected.

The other projects funded by the Foundation started too recently to already lead to exploitable results. However, considering the scientific production of the first funded projects, it can be concluded that by supporting collaborative activities and structures, the Nanosciences Foundation significantly helped to increase the dynamism and synergy of the Grenoble community of nanomagnetism and spintronics.

Members of the TWG have organized the school of the “Séminaire Dautreppe” series, entitled “Nanomagnétisme et Electronique de spin”, held 16-20 novembre 2009 in Saint-Hugues de Biviers, France.

3. NANOPHOTONICS

Jean-Michel GERARD and Jean-Emmanuel BROQUIN

Within the RTRA network, fundamental research in nanophotonics is mainly carried out by four laboratories: the Néel Institute (CNRS), the Institute for Nanosciences and Cryogeny (CEA/INAC), the Spectrométrie Physique laboratory (UJF-CNRS) and the Microelectronics, Electromagnetism and Photonics laboratory (IMEP, INPG-CNRS). Generally speaking, these laboratories actively collaborate together (as an example, all INAC and Néel research activities on compound semiconductor nanostructures are jointly conducted within the Nanophysics and Semiconductor CEA-CNRS team) as well as with other application-oriented Grenoble laboratories such as the Optronics Department of CEA LETI, or the LAOG.

In 2009, the meetings of the TWG on Nanophotonics have allowed identifying several fields for which an improved coordination of the nanophotonics community was desirable:

- Nanostructures for photovoltaics (INAC, Néel, Léti).
a collaborative research project named "II-VI Photovoltaics" based on a Chair of Excellence (Dr. Y. Zhang, from the National Renewable Energy Laboratory) has been set up, and submitted for funding to the Foundation in the frame of the 2009 Call for Proposals. This project is one of the three Chair of Excellence projects which have been selected for support.
- Nanosources for biophotonics (Néel, INAC, Léti, Spectro);
for this topic, the coordination resulted in a joint project "Silica Labels" which has also been submitted to the Foundation call in 2009. Unfortunately, it could not be supported in spite of its quality and of its federative features as well (better mutual knowledge and new collaborations).
- Plasmonics (Néel, Léti, INAC);
in this area, only weak links existed until recently between the different teams. Although no joint project has been presented for the 2009 Foundation call, new collaborations aiming in particular at coupling semiconductor and metallic nanostructures are emerging.

From a scientific point of view, the nanophotonics community in Grenoble has obtained numerous high-level results in 2009, as illustrated by the following non-exhaustive selection of highlights :

- Observation of the strong coupling regime between bulk excitons and whispering gallery modes in ZnO nanowires (M. Richard et al, in the frame of the young incoming researcher project RICOPHIN, associated with the Ph.D. grant attributed to J.S. Hwang)
- Fabrication of CdSe quantum dots embedded in ZnSe nanowires, and observation of single photon emission at a temperature as high as 220 K, the highest ever reported for a non-blinking semiconductor source of single photons (A Tribu et al, Nano Lett 8, 4326, dec 2008; Ph.D. grant attributed to M Elouneq-Jamroz).
- Development of a high efficiency single-mode single photon source (SPS) made of a single QD in a photonic wire. A record single photon collection efficiency (72% for a NA=0.75 collection optics) has been obtained for a photonic wire with tapered tip and integrated composite bottom mirror. This efficiency is much higher than the best reported values for microcavity SPS exploiting the Purcell effect (~40%) and is obtained over a large spectral band (here >70 nm). In photonic wires, the single mode behaviour results indeed from a very strong inhibition ($\sim 1/10$ at least) of the QD spontaneous emission into non-guided modes. This broadband spontaneous emission control is also very attractive to build tunable SPS, efficient sources of entangled photon pairs, or SPS exploiting spectrally broad emitters such as colour-centres in diamond. (J. Claudon et al, 2007 young incoming researcher project "Strongchip", submitted to Nature Photonics).
- Theoretical study of the emission spectrum of a single QD in a OD optical microcavity, in the presence of excitonic dephasing (A. Auffèves et al, Phys Rev A, 2009). This study demonstrates that the emission of a spectrally detuned QD can be very efficiently funnelled into the cavity mode in the presence of dephasing. This opens a route toward novel optoelectronic devices EXPLOITING decoherence, such as wavelength stabilized SPS. This research axis has been strongly reinforced in 2009 by the start of the COE of M Franca Santos (EPOCA 2008project).

- Demonstration of the writing and erasure of a single spin memory, made of a single Mn atom in a II-VI quantum dot (C Le Gall et al, Phys. Rev. Lett. 2009, Chair of excellence J. Fernandez-Rossier).
- High Q ($\sim 10^7$) silica microtoroids have been fabricated using the laser induced melting of a silica microdisks, detached from their Si pedestal, and positioned on a surface in close vicinity with a mesa structure containing QDs. This is a key step toward the demonstration of low threshold lasing (and possibly single QD vacuum Rabi splitting) for such a hybrid system. (JB Jager, J Claudon et al, STRONGCHIP project).
- The lateral evanescent coupling of two 1D photonic crystal cavities integrated in silicon on insulator waveguides has been studied by near-field optical microscopy. For a distance between waveguides smaller than $\lambda/10$, strong field localization in the gap is observed. This study shows that it is possible to merge the two concepts of “slot waveguides” and high-Q photonic crystal cavities to get efficient resonators confining a resonant mode in the air (K. Foubert et al, Appl. Phys. Lett. 94, 251111, 2009).

We must also mention that 2 famous scientific awards have been attributed to researchers of the RTRA : the Quantum Devices Award (launched in 2000 by the Japanese corporation Fujitsu) to Jean-Michel GERARD, and the "Prix Herbrand de l'Académie des Sciences" to Lucien BESOMBES.

These examples highlight the dynamism of the nanophotonics community in Grenoble, as well as the very significant benefits it has already gained from the support of the Nanoscience Foundation. Furthermore, it is worth noticing that this community is nowadays also widely involved in the new PTA nanofabrication platform, which is obviously a strategic tool for advanced research in nanophotonics.

4. MOLECULAR ELECTRONICS

Vincent BOUCHIAT and Eric SAINT AMAN

Molecular electronics, whose aim is to use molecules as active components in electronic devices, is a rapidly emerging field at the crossroads of nanosciences and nanotechnology. Prototypes of devices involving molecular entities (including but not limited to organic ones) and mimicking electronic functions such as transistors, diodes, wires, switches, memories have been demonstrated in the last decade. From the size of the active entities and the diversity of the physical and chemical properties that can be taken advantage of (such as bistability, specific recognition, optical, mechanical, redox properties), molecular electronics will play a major role in the near future for the acquisition and processing of information. Beyond the implementation of new functionalities, it is highly probable that alternative solutions to resume the miniaturization and increase the integration density of transistor devices will emerge from these researches.

One original aspect of this field is to link many subfields of nanosciences from basic mesoscopic physics (fundamentals principles of low dimensional systems, quantum coherence), to nanofabrication (advanced lithography processes), nanoelectronics (novel architectures, new features enabling information coding and storage) and even biology (DNA based lithography ,bio-inspired approaches).

The techniques usually involved follow “bottom-up” methods that are complementary to those currently used in the microelectronic industry which are usually based on nanofabrication of bulk material by lithography, etching and deposition stages (the so-called top-down approach).

Bottom-up techniques that guide most of molecular electronics follow three steps :

- i) the design and synthesis by chemical routes of molecules with well characterized electronic and optical properties
- ii) their integration by self-assembly techniques within solid state architectures by optimizing the hybrid metal/molecule interface.
- iii) the measurement of electronic properties within the resulting device under well controlled physical conditions (under applied electric , magnetic fields, light irradiation, etc...).

Considering a molecule having a specific chemical structure, it is now possible to establish a reproducible and reliable link between the energy levels of the molecular orbitals as predicted by quantum mechanical calculations and the characteristics of the electronic transport in a junction including this molecule.

Key issues

The main issues that are currently addressed are:

- What is the relationship between structure and function of a given molecule and its electron transport properties? The goal is to describe the link between the physico-chemical properties of a molecular structure and its use in an electronic device performing a specific function (diode, transistor, memory...)
- How to efficiently manipulate molecular objects in order to build reliable solid-state devices with good yield? The grafting techniques, the control of quality and nature of the substrate are key features controlling the physics of this interface control, determining the application of the resulting hybrid device.
- How to cope with energy consumption problems associated with high density of devices including aging and degradation due to heat dissipation ?
- -How to go from the nano-scale level to the macro-scale one, providing upscaling methods enabling the transfer of an isolated unique device to the integrated circuits.
- -How to connect the nanoscale/Molecular level (for example a single molecule device) to the macroscopic world?

Disruptive innovation

In order to realize the selective assembly and the alignment of specific molecules on solid substrates in a controlled way, it is necessary to play with specific physico-chemical or -biochemical interactions. Interdisciplinarity thus appears as the key approach to efficiently contribute to the advancement of this new field of research. Its frontiers are largely beyond those of nano-electronics since, for examples, mesoscopic physics (theory and experimental works in electronic system of low dimensionality), nano-fabrication (ultimate lithography, nano-electronics), as well as numerous domains of chemistry (organic synthesis, supramolecular chemistry, functionalization of surfaces, electrochemistry...) must be involved.

Position of the Nanosciences Foundation within this field

Grenoble has a strong expertise in the main aspects of molecular electronics, from fundamental research up to industrial activities. Many inter-laboratories projects have emerged in the past years, supported by the local, regional and national funding agencies including RTRA. Among them, it is worth noting the Chemtronics project which aim to manage the research in molecular electronics at the CEA, linking 120 researchers (80 of them are working at the Grenoble center) from both basic (INAC) and applied (LETI) laboratories.

The following topics are addressed in the various laboratories of the network:

- Design, synthesis and characterization of specific molecular assemblies having redox and photochemical properties.
- Study of molecular machines and motors
- Functionalization of surfaces and metal-molecule coupling.
- Bottom-up approach for the conception of molecular wires or assemblies for photo-electronics.
- Functionalized nano-particles and Carbon Nanotubes
- Conductive polymers
- Molecular memories and molecular magnetism
- Theoretical calculations on molecular junctions using *ab initio* methods.
- Molecular junctions (fabrication, integration, and electrical measurements)
- Self organization and self assembling of carbon nano-tube based transistor
- Molecular switches and memories, organic transistors
- Integration of carbon nanotubes for logical gates or interconnexions.

It has to be noted that due to the strong interdisciplinary approach of molecular electronics, many projects that belong to this field are in fact presented in the RTRA call for proposals under others fields such as quantum nanoelectronics or nanomaterials.

A good example in this context is the project POLYSUPRA which has been funded by the Foundation, starting in 2009 jointly in the CEA and UJF laboratories. The objectives of the POLYSUPRA project are to develop original dynamic metallopolymer materials containing Cyclam-metal complexes, to explore and provide an insight into the behaviour – namely the spatial structural changes – of these supramolecular materials from the bulk to the surfaces and to integrate these molecular architectures in solid state optoelectronic devices (electrochromic devices, molecular memories and transistors) using 3 complementary approaches (grafting of the solid substrates, elaboration of multilayered plates by dip-coating protocols or use of mesoporous structured host silica films). The originality of this project lies in both the highly modular architectures of the newly-designed self-assembled materials and in the state-of-the-art techniques of physical analyses. In practice, the interdisciplinary POLYSUPRA project brings together chemists, soft-matter physicists and electronic engineers so as to function in a real-time feedback-loop between the conception and synthesis of supramolecular objects, their resulting behaviour as materials and their integration in electronic devices.

Another very active topic is the Molecular Spintronics which aim at building (a) new organic electronics sensitive to spin by taking advantage of the very promising quantum properties of molecular magnets. Several teams at CNRS and at CEA are working in that field. Wolfgang Wernsdorfer who is leading the molecular spintronics team at Institut Néel has been the laureate of the European Research Council Senior Call which started in 2008.

Actions of the Foundation for Research dissemination

For such an emerging field, a great effort of information dissemination is necessary in order to promote new partnerships and collaborations. An important action of the Foundation over the past years has been to provide a continuous financial support of a series of conference on molecular electronics.

These international Meetings on Molecular electronics (“ELECTMOL” conferences) have been held in 2004, 2005, 2006 and 2008 at Minatec with an increasing audience, establishing Grenoble as a major center and reference in the field. The last edition in December 2008 has gathered 325 participants (55 speakers including 20 invited keynote lecturers and 199 Poster

contributors) in a 5-day meeting. The next edition is scheduled to be held in December 2010, and it will be partially supported by the Nanosciences Foundation.

5. NANOMATERIALS, NANOASSEMBLY AND NANOSTRUCTURATION

Thierry BARON and François MARTIN

The introduction of new materials and the development of technology for nanobonding and nanopatterning at the frontier between nanosciences and nanoelectronics is a driving force for innovation and development of new types of applications. Grenoble is a very favorable scientific place for bringing to a successful conclusion such projects through the collaboration of scientists with complementary expertise in the field of physics, chemistry and biology. Many laboratories are involved in this transverse topic (Institut Néel, CEA-INAC, LTM CEA-Leti, , LMGP, SIMAP, CERMAV, DCM, SPECTRO ...). The application of nanomaterials in the nanoelectronics, energetic domains as well as in biology and medicine seems to be a promising way to follow. (Then) The research in this field aims to control specific properties obtained at nanometer scale, like physical, chemical, optical and electrical or magnetic properties. An important challenge is the reproducibility and self assembly of the nano-objects in order to attempt the fabrication of functional nanodevices.

In the area of nanomaterials, 3 federative projects involving many laboratories and collaborations within the Grenoble area have already started, and 2 new projects are just beginning. One of them deals with promising extrapolations of the existing concepts of electronic memories, like molecular memories and phase change materials at the nanoscale, aiming to find ruptures (?) for ultimate integration of memories. The more significant highlights illustrating the progress in the 3 started projects are detailed below: they address new materials and elaboration methods to grow in a controlled way materials able to open promising ways in new applications for electronic but also possibly for health applications.

Graphene:

Graphene exhibits outstanding fundamental properties and high potential for the development of future nanoelectronics as well. The DISPOGRAPH project which is dedicated to graphene has two main objectives: to control the material and its characterization to design devices based on its exceptional properties and, in the course of this process, gather the Grenoble scientific community. This indeed requires skills in advanced characterizations (STM, Hall measurements), the development of generic steps like patterning, contacts, gate technology to make MOS structures and finally to make electrical measurement and theoretical and simulation work. New devices could be designed that take advantage of the exceptional properties of graphene, such as ballistic conduction or quantum coherence that may persist up to room temperature.

The groups of Institut Néel, LCMI and LMGP focus on the graphene-on-SiC system where the controlled annealing of a SiC substrate leads to the formation of a graphene monolayer or towards graphitic multilayers. One peculiarity of this system is that the SiC surfaces are polar: they end either on a Si or on a C plane. The morphology and the electronic properties of the graphene layers depend on the termination. Recent results on the graphene/SiC interface have been obtained by Institut Néel and STMI on the C terminated surface, both from STM and from ab initio calculations.

They demonstrate that the interaction of the first C layer on the C face is weak so that this first C layer already exhibits the electronic properties of graphene. This was not the case on the Si face where the interaction with the substrate distorted the first C layer. Graphene like properties were only recovered from the second C layer. The results have been published

in a special issue of *Physica Status Solidi Rapid Research Letter* dedicated to carbon electronics. To advance still faster in this exciting research topic, closer links have been created between the laboratories involved in the DISPOGRAPH project by the organisation of a 'Journal Club graphene'. This initiative aims to favour a stronger international position for Grenoble.

Nanowires:

Another way to address nano-objects for future nanodevices deals with the crystal growth of original Nanowires (column IV elements). This topic is investigated in the RTRA to create a new class of materials with unexplored electronic properties to be compared with the so called "standard Si channel". This approach will help to understand the physical properties and transport phenomena in Si wires. The next step is the monitoring of wire properties through engineering of the band diagram via crystallographic modification by strain application on pure silicon or alloying with germanium and tin. The transport in nanowires could be modified by electrostatic effects provided by grafted molecules at the surface. The RTRA has partly supported the funding of a dedicated tool for the elaboration of these 1D nanostructures. A method based on dielectrophoresis forces has been developed for positioning the nanowires.

Investigation of Si NWs electronic properties through time-resolved low temperature Photoluminescence (PL) is performed. The passivation of non radiative defects is obtained by a thermal oxidation of the NW surface. The typical recombination line of free carriers has been identified and demonstrates that intrinsic Auger recombination governs the recombination dynamic of the dense e-h plasma generated inside the NW. In a few tens of nanoseconds after the pulsed excitation, the density of the initial electronic system rapidly decreases down to reach that of a stable electron-hole liquid phase. The comparison of the PL intensity decay time of Au-SiNWs with high crystalline quality and purity allows concluding that their electronic properties are highly comparable to those of bulk silicon crystal. This work was published recently in *Nanoletters* (O. Demichel et al, *Nanolett* **9**, (2009) 2575-2578), and gives hints to heal the defects in the NWs. It is an important clue for the control of conductance in NWs which is very sensitive to its electrostatic surrounding.

It opens up a way towards label free detection of biomolecules for point-of-care. Indeed, electrical detection of biomolecules could be obtained via electrostatic coupling with NW used as a channel in field effect devices. In this context, the capability of the molecule grafting like DNA on Si NWs has been demonstrated by a fluorescence technique.

Self assembly:

Self-assembling of nanomaterials is a choice topic within the RTRA network. The Foundation has supported an original way to self-organize the materials at the nanometer scale combining (i) the specific properties of copolymer diblocks with (ii) cellulose green chemistry. The "Cellulose hybrid" project has initiated collaboration between several expertises available in Grenoble. The objective is to control the organization of matter in the sub 15 nm regime (size and period), objective which is more than challenging for both (i) lithography and (ii) copolymer di-block technology purely based on synthetic chemistry.

In these hybrid materials, the organization scheme is governed by two antagonistic phenomena: the mutual repulsion of different blocks tends to form nanodomains with size as large as possible to minimize the system free energy, while the minimization of the system entropy imposes the formation of nanodomains with a minimum size. Rod-coil block copolymers thin films associating a natural and a synthetic block are a promising route to fabricate well-organized objects with dimensions in the 10 nm nanometer range and lower.

This association is expected to increase critical parameters (“named incompatibility”) favoring the formation of smaller domains. Indeed, they are already able to self-assemble in a selective solvent into several structures (sphere, cylinder, lamella...). The project aims to study the self-organization of these new diblocks including a “green” block issued from the biomass with a synthetic one and to transfer the pattern on the underlying substrate to fabricate dots, holes and pillars in high density ($\sim 10^{12}/\text{cm}^2$).

After first process investigations, an hexagonal close-packed cylinder (HCP) array has been obtained for the first time, exhibiting a lattice period, p , of 11.66 nm. In parallel, a hard mask strategy is already used to pattern transfer obtained with purely synthetic diblock copolymer.

The use of this new class of diblocks copolymer in nanotechnology has led to a patent deposition. This result illustrates well the capability of this project to gather the chemists from the polymer community with the nanophysics and devices community through the RTRA.

6. NANOCARACTERIZATION AND METROLOGY

Hubert RENEVIER and Joël CHEVRIER

The TWG of this cross-theme is animated by a committee of 5 renowned experts who belong to the main Grenoble institutes. The TWG helps the community to identify the needs for new instrumental and methodological developments that will improve the sensitivity and scale down the spatial resolution of our instruments to measure physical and structural properties at the nanometer scale.

A broad range of scientific and instrumental activities depends on «Nano- Characterisation - Nanometrology», the most relevant are:

- **Electron (aberration corrected) and x-ray microscopies.** These include diffraction, coherent diffraction, spectroscopy, tomography, holography, ... The knowledge of the crystallographic structure and composition at the atomic, nanometric and mesoscopic scales of materials, buried interfaces and individual object is essential for understanding their properties and designing functional devices. Advances in instrumentation and software (including ab-initio calculations) have led to unprecedented power, both in terms of spatial resolution and sensitivity to composition and physical properties.
- **Surface/subsurface spectroscopy, surface imaging, surface crystallography.** Atomic Force Microscopy, Scanning Tunneling Microscopy, Scanning Gate Microscopy, PhotoEmission Electron Microscopy, Angle Resolved Photoelectron Spectroscopy, Medium Energy Ion Scattering, grazing incidence x-ray ..., for obtaining information on electronic/magnetic and structural properties at the surface and/or subsurface.
- **Coupled techniques.** For instance the coupling of Raman scattering, Atomic Force Microscopy or x-ray spectroscopy with x-ray diffraction.
- **Growth, in operando and in situ studies.** For instance, *in situ* x-rays studies, in real time, of nucleation and growth thin film, nanostructures, etc.; *in situ* studies as a function of temperature, external field, stress, gas (electric or magnetic field, stress, electric current, ...).
- **Advanced instrumentation.** For instance, manipulation and study of micro- nano-sized object (optical tweezers, ...)
- **Instrumentation at very low temperature and / or high magnetic field.** For instance improving the sensitivity of Nuclear Magnetic Resonance.

- **Micro Electro-Mechanical Systems, Nano Electro Mechanical Systems.**

The field Nanocaracterization-Nanometrology enjoys an exceptional scientific environment which is best characterized by the presence of large instruments (ESRF for x-rays, Laboratoire des Champs Magnétiques Intenses for high magnetic field, ...) and the Leti, by a unique expertise in the field of instrumentation at low temperatures in particular at Institut Néel (CNRS) and Institut des Nanosciences et Cryogénie (CEA), by the presence of 9 platforms gathering state-of-the-art instruments (or equipment) and excellent facilities for technology manufacturing (« Plateforme Technologique Avancée » located at MINATEC or NanoFab at Institut Néel).

One should also mention a strong expertise in surface imaging, including near field spectroscopy, Transmission Electron Microscopy, crystallography. The French Collaborative Research Group at the ESRF, run by CNRS and CEA, has setup dedicated beam lines and developed world leading methods and instruments for studying the growth and the structural properties of nanostructures. Several activities in the field of nanocaracterization - nanometrology benefit of a dedicated Focus Ion Beam bought by the foundation in 2008.

Since the year 2007, 5 projects (among them 3 COE) in the field of Nanocaracterization - Nanometrology have been funded by the Foundation. Four (out of 10) were selected in 2007, none (out of 5) in 2008 and one (out of 3) in 2009. In 2009, the TWG has strengthened its role in organizing several meetings, prior to the submission deadline, to help the community to identify the best projects to be submitted to the call.

Several instrumental developments in the field of Nanocaracterisation – Nanometrology have been strongly supported by the Foundation.

Surface/subsurface spectroscopy. Scanning gate nanoelectronics (IN, IMEP). The funding of one COE for Pr. Vincent Bayot (Louvain la Neuve) has fostered the development of the Scanning Gate Nanoelectronics here in Grenoble and established a collaboration between the groups of Vincent Bayot and Serge Huant (Institut Néel). Scanning Gate Microscopy is an electric variant of non-contact atomic force microscopy where the electrically polarized tip locally perturbs electron transport through an open buried (i.e. not accessible to STM) electronic system. Vincent Bayot is a specialist of thermodynamics and quantum transport in two dimensional electron systems and semiconductor nanostructures made of GaAs/AlGaAs or InGaAs/InAlAs heterostructures or of Silicon-on-insulator (SOI). The **Scanning Gate Nanoelectronics** project is focused on Imaging and controlling coherent and ballistic transport in semiconductor devices and on coherent and spin-dependent transport at very low-temperature. A first study using scanning gate microscopy of quantum rings has shown the effects of an external magnetic field and of charged defects. The Foundation allowed the recruitment of a PhD student, co-directed by Dr. H. Sellier and Prof. V. Bayot.

Scanning Gate Microscopy of a quantum ring. Conductance images (Local Density Of State) for a magnetic field strength $B = 0.102, 0.134$ and 0.166 T, respectively. Quasi-classical orbits inside the ring are found. M.G. Pala, S. Baltazar, F. Martins, B. Hackens, H. Sellier, T. Ouisse, V. Bayot, S Huant. Nanotechnology, 2009.

Instrumentation at very low temperature. DC-to-THZ cryogenic platform for new generation of nano-detectors. A “Jeune entrant” project: A. Monfardini, (IN, IMEP, SPINTEC). The foundation has supported the development of an innovative dilution cryostat well adapted for optical and RF electrical input/output signals and designed to reach a base temperature of 20mK. The funding also supports the development of high-Q superconducting resonators (for hydrodynamic and materials studies) and Kinetic Inductance Detectors (KIDS) for large field-of-view astronomical imaging (Lumped Element

KIDS). The project has funded a post doctoral position for L. Svenson who joined the team July 1, 2008.

Growth, *in operando* and *in situ* studies. UHV-CVD measuring station for *in situ* x-ray investigation of growing semiconductor nanowires. A “Jeune entrant” project: T. Schüllli (IN, INAC). X-rays are a unique tool that can probe the structural properties during the growth of nanostructures and the evolution of surfaces nondestructively, independent on the gas-pressure and the sample temperature. The foundation has supported the extension of the existing UHV-MBE system, located on beamline BM32 at the ESRF, to Chemical Vapour Deposition compatibility. This will offer a promising tool of a unique flexibility for sample growth. The refurbishment of the experimental hutch is now complete. The gaz distribution set-up is ongoing, it should be ready beginning of 2010. Then, the first experiment will start with the study of the nucleation and (the) growth conditions of Si nanowires on patterned Si substrates, as well as their organization. The internal crystallographic structure, the organization and the morphology of the Si nanowires will be studied during the growth. A post doctoral fellow is about to be hired by the Foundation to work on the UHV-CVD project.

Electron (aberration corrected) and x-ray microscopies. X ray investigations on nanoparticles. The part-time COE Professor V. Holy is an internationally renowned specialist of X-ray diffuse scattering applied to the study of nanostructures. He is working with the Grenoble network groups that are using X-ray beamlines at ESRF. As an example of research and fruitful collaboration with Professor Holy is the modeling of the diffuse scattering generated by the presence of nano-gas cavities in a crystalline matrix. These cavities can be created by implantation of small gaseous species (hydrogen and/or Helium atoms) subsequently annealed. The measurement of diffuse scattering around the Bragg peaks and the modeling has allowed the determination of the strain field around these cavities and the determination of the gas pressure in these cavities. In the frame of this collaboration a PhD student of the University of Prague, V. Vales, supervised by V. Holy, is being supported for two months a year by the INAC/SP2M/NRS laboratory. Pr V. Holy is also collaborating with the network in order to understand and to model the details of the resonant diffuse scattering of GeSi Quantum Dots grown on Si(100) substrates.

Instrumentation at very low temperature. Nanocharacterization of Superconducting Nanostructures. COE John R. Kirtley (IN, SIMAP, INAC), one of the world’s leading experts on Josephson junction devices and superconductivity, will join this project for the next three years. It is aimed at the study of the physical properties of high quality superconducting films and their integration into quantum nano-devices. Epitaxial superconducting films will be grown by Molecular Beam Epitaxy and characterized at the nanoscale at room temperature as well as at very low temperature. The growth of epitaxial trilayer Semiconductor/Insulator/Superconductor films by MBE will provide the best possible material to build low noise Josephson junctions. The epitaxial trilayers will be patterned into phase Q-bits. Novel nano-SQUID microscopy techniques will be employed to image the high quality circuits. This project will bolster research not only on fundamentals of superconductivity and quantum computing, but will also generate developments for applications like high Q resonators and solid state nano-refrigerators. In addition, the novel nanoSQUID will be a powerful tool for measuring magnetism at the nanoscale. John Kirtley will play an active role in many aspects of this project, joining together with Grenoble scientists working on material science, nanoprobes and nano-electronic circuits, bringing success to this project.

7. LIFE SCIENCES AT THE LIMITS OF NANOELECTRONICS

Pierre LABBE and Franz BRUCKERT

This theme involves 16 institutes or laboratories in Grenoble, on the three research campi:

- **Minatec-Polygône:** LETI (DTBS), INAC (SCIB, SPRAM), iRTSV (Biopuces, PCV, HTS, angionesis), LTM, G2ELab, LMGP, the Néel Institute, the Structural Biology Institute (IBS)
- **Medical sciences :** the Albert Bonniot Institute (IAB, oncology), the Grenoble Institute of Neurosciences (GIN), TIMC-IMAG
- **The University campus** at Saint-Martin d'Hères : LSP, DCM, CERMAV, LEPMI, LEGI

These labs co-organize different platforms: Nanobio (nanochemistry and nanophysics applied to the life sciences) on the University campus, NanoFab, PTA, CIME and IBISA at Minattec-Polygône. Some of these labs already collaborated on pluridisciplinary projects, but the projects supported by the Nanosciences Foundation lead to new collaborations.

In Grenoble, several aspects of Nanobiosciences or related to Nanobiosciences are well developed:

- structure-function relationship of macromolecules (proteins at the IBS, polysaccharides at the CERMAV), molecular assembly of molecules (DCM, INAC)
- application of nanotechnologies to life sciences and for medical applications : biosensors and microarrays (enzymatic, DNA, protein and cells), control of the cell microenvironment and morphology (adherence patterning), medical imaging (nanoparticles, fluorescence instrumentation).
- the theoretical synergy between physics (the Néel Institute, LSP) and mathematics (TIMC-IMAG) and biology or medicine, especially in the analysis of protein structure and interactions, biomechanics and signal and image processing.

Over the period 2007-09, about 30 projects have been proposed to the Nanosciences Foundation by the above-mentioned institutes or laboratories, consisting of COE, RTRA or "Jeune entrant-" projects, technological platform support or PhD student grants. Aside scientific excellence, key criteria for support by the Foundation were the practical involvement of microelectronics or photonics, and the relevance of the questions addressed by the project for the life sciences.

COE Donald Martin: "Biomimetic Artificial Membrane Systems for Generating Electrochemical Energy" (MekaNo project). The aim of the project is to design new energy sources for implantable microelectronics devices (e.g. pacemakers), using a biomimetic approach to exploit the chemical energy available in the blood. This project is based on the expertise of D. Martin in membrane biology and ion channels selectivity and is complementary to existing Grenoble teams working in the fields of electrophysiology and electrochemistry. During the first year, the research activities have been directed at establishing the new laboratory within TIMC and establishing the collegiality of the research team. In addition to establishing the project within TIMC, the MekaNo team has carried out the specific research activities of (a) purifying membrane channels and transporters, (b) first experiments using tethered planar lipid membranes, (c) installing equipment for patch-clamp electrophysiology, (d) constructing polyelectrolyte membranes, and (e) construction of diffusion apparatus specific for project MekaNo.

Tetiana Aksenova: Implantable computer-brain interface. The aim of the project is to develop human-computer interfaces using brain electric signals. This could have important applications for the rehabilitation of paralyzed patients. Mrs Aksenova is an expert in the development of online algorithms for signal analysis and her presence reinforces the teams involved in computer science applied to medicine.

RTRA and “Jeune entrant” - projects

NeuroFETs: The project is focused on the coupling of neurons with functionalized surfaces and their stimulation/recording with silicon nano Field Effect Transistors. Its objectives are connected with major neurosciences issues, the control of axonal differentiation by adhesive clues and the in-vitro preparation of functional of neuron networks. In this work, a real synergy is created by the complementary expertises in neurosciences and nanofabrication. During the first year, a complex pattern of adherence has been designed to constrain the centrosome position by adjusting the geometry of the cell body adhesion. A model has been developed that proposes a mechanism based on the elastic nature of the neurites and on the need of adherence to maintain the internal tension. This result is being published in Nature. In a second step, nanotransistors dedicated to measurements or to the induction of the neuronal activity at the subcellular level are manufactured in the NanoFab platform. Their development is an important part of the research of Libertad Abad, post-doc funded by the Foundation Nanoscience.

Dendritic potentials imaging by second harmonic generation. The aim of the project is to get a better understanding of the computational function of dendrites, using new molecular markers of neuronal electric activity and innovative imaging techniques. This project illustrates the synergy between nanophysics and nanochemistry in the field of neurosciences. During the first year, important goals have already been achieved. The development of dyes and delivery strategies is quite advanced, neuron culture and work on slices has been started. After receiving the ordered new equipment, the installation of the perfusion chamber, the new patch-clamp amplifier and the new objective will allow testing the new dyes for their 2-photon efficiency on real neurons, select the best dyes and most appropriate neuron types and study the voltage-dependence of the 2PEF and SHG signal. Putting in place the new scan-head will speed up measurements, allowing to follow small graded signals in real time.

Nanodroplet chip for a controlled assembly of lipid layers and electrical detection of single-protein activity is a 2008 project. It consists in the controlled formation of biomimetic membranes to reconstitute the insertion of transmembrane protein in the lipid bilayer and to investigate their transport activity. Digital microfluidics is used to create and manipulate nanodrops containing complex mixtures or proteins, detergents, ions and possible drugs. This project is illustrative of new collaborations initiated between Grenoble labs thanks to the Nanosciences Foundation research proposal initiatives.

Contribution of 3D micro-environnement to cell adhesion, “Jeune entrant “- project (Martial Balland). Mechanical forces play important roles at the cellular level, by coupling with chemical signaling pathways. In this project, the adhesive forces developed at the cell/cell interface and their coupling to those developed at the interface with the extracellular matrix will be quantitatively investigated. Microfabrication technology is combined with surface functionalization techniques to reconstitute the cell microenvironment and monitor mechanical forces in well defined geometries, suitable to theoretical analysis.

Support to technological platforms

Because of its importance for the nanoscience community as a whole, the Nanoscience Foundation has strongly supported the development of the **Nanobio facilities** in Grenoble through the acquisition of scientific equipment intended for wet samples: quartz microbalance, AFM scanner, transient spectroscopy, dual AFM-fluorescence microscopy, mass spectrometry analysis.

PhD grants “au fil de l’eau” (3)

WANG Xu: "New nanometric bio-sensors from carbon nanotubes". Carbon nanotubes provide large surface to volume ratio which is interesting for electric or electrochemical biosensors. The DCM institute makes use of its expertise in chemistry to functionalized carbon nanotubes with probes allowing efficient electric coupling.

BOMBERA Radoslaw: Development of biochips dedicated to blood cell characterization. Surface plasmon resonance is a very sensitive technique for label-free detection in microarrays. The INAC/SPRAM laboratory is developing this technique for Lab-on-Chip applications in the field of immunology.

JAIN Purvi: Antibody phage display in materials sciences : new nano-probes and linkers for nano-objects. The SPECTRO laboratory makes use of the diversity of the immune repertoire and the genetic selection techniques provided by the phage display techniques to search for new antibody proteins able to recognize specific materials. This will open new ways in the assembly of nanoparticles and nanoobjects, which could be useful for microelectronics applications.

Future development of the theme “life science at the limits of nanoelectronics”

From the output of the previous project campaigns, it is clear that the synergy between nanofabrication and the life sciences is stimulated by the action of the Nanosciences Foundation, especially in the field of neurosciences and biosensor development. The complementary expertise of Grenoble labs in this field should catch the attention of technological companies, and possibly their financial support, in the hope of a sustainable development of the activities of the Nanosciences Foundation.

8. THEORY AND NANOSIMULATION

Didier MAYOU and Gilles LE CARVAL

Theory and numerical simulation gather about 50 permanent theoreticians in physics, mathematics and chemistry. One of the characteristics of the community is the strong coupling between theory and experiment, a tradition in Grenoble, which is found in almost all laboratories involved in the RTRA. One might also note that about half of the permanent theoreticians is heavily involved in numerical simulation. The Grenoble theoretical community is involved in many networks at national and European level (Phantoms, ETSF, psi-k ...)

The scientific activities are related to physical, chemical and structural materials, interfaces, nanostructures. An important activity focuses on transport phenomena, from the atomistic to the mesoscopic level, going up to the simulation of elementary circuits. The contribution of applied mathematics is currently being increased in particular through topics like nano-optics, or micro-magnetism.

The support of the Foundation

Several foreign theoreticians have been selected to occupy COE of the Foundation. The list given below shows the diversity of these actions in the framework of the RTRA priorities. Some of these chairs are also found in other RTRA themes since theory is naturally connected with the experimental topics.

- Mairbek Chshiev, already mentioned in the nanomagnetism is a theoretician of electronic transport and spintronics. He is specialized, in particular, in the calculation of electron

transport in devices based on the giant magnetoresistance (GMR) and tunnel magnetoresistance (TMR) and in the quantum statistical theory of spin polarized electron transport.

- Leonid Glazman is Professor at Yale University, in the department of Theory of Condensed Matter Physics. He is a recognized expert in the physics of mesoscopic systems including ballistic transport, interactions in systems of low dimensionality, mesoscopic fluctuations in the Coulomb blockade regime and the Kondo effect in nanoelectronics. This chair is also strongly coupled with the Quantum Nanoelectronics group.
- J. Fernandez-Rossier is Professor at the University of Alicante. He is a theoretician of spintronics, semiconductor and magnetic spectroscopy of coherent states. The goal during his stay is to control the quantum state of a single magnetic atom inserted inside a quantum dot and submitted to the influence of an external electric circuit and a laser beam. He has close interaction with several experimental teams in the RTRA.
- P. Wong is a Professor of Electrical Engineering at Stanford University. He is a specialist in the development strategy of nanosciences and nanotechnology in the frame of the "roadmap" of electronic components. His work focuses on the development of simulation tools able to predict the quantum transport in components of which the gate length would be only 10nm and to take into account the effects of roughness and of localized Coulomb interactions.
- L. Fonseca is a researcher in Brazil in the center W. Von Braun. He develops new atomistic simulation routines of materials and interfaces used in ultra-miniaturized electronic devices. His project focuses more specifically on the topics of high-K materials used for the grids and on the simulation of quantum transport.

Two "Jeune entrant"- projects are also supported:

- Natalio Mingo, who was selected for being supported in the frame of the 2007 campaign, is involved in the modeling problems of thermoelectric materials and heat conduction. His work is based on numerical approaches and on the formalism of out of equilibrium Green functions that allows a detailed description of these effects at the nanoscale.
- Stéphane Labbé also received support from the 2007 campaign. He is interested in transitions between atomistic and mesoscopic scales. These transitions which are of strong interest for (the) physicists have not been mathematically studied despite their importance, e.g. in the transition between atomistic models of magnetic materials and micro magnetism.

RTRA project:

The Nanostar project involves 16 theoreticians working in the fields of quantum transport, optics and spectroscopy. This project has received support for two Ph.D. students, one for focusing on spectroscopy and the other on quantum transport. In both of these thesis subjects, methodological developments play an important role and the students can take advantage of the many skills grouped within the community of the theoreticians of the RTRA. The Nanostar project has also received funding for numerical computation which is invested in the computing platform CEMENT (€ 125k) supported by the RTRA.

In 2009, a new important project has been elected for being supported, entitled MUSCADE for Multi-scale Design of Nano-materials with simulations on hybrid architectures. It is a COE project that brings together Professor Normand Mousseau from the University of Montréal and a comprehensive team of experts in theoretical modeling and simulation in Grenoble, in order to share their expertise and to pool computational resources based on new hybrid computers thanks to the platform Ciment. Through the study of three prototype systems motivated by the experimental community, multiscale simulations are expected to advance

our fundamental understanding of the key issues governing the formation and stability of semiconducting quantum dots, silicon nanowires and graphene sheets. This will allow guiding the way to “dream” structures pursued by experimental groups which are also involved in this project.

Scientific animation

The Working Group on Theory held a one day workshop (March 23, 2009) devoted to nanosimulation in Grenoble. The conference was open to the entire scientific community and has allowed showing to a quite broad attendance what are the scientific issues, achievements and prospects for computational nanosciences, especially on the Grenoble site.

The contributions were:

- the input of mathematics: asymptotic developments and applications to wave propagation problems of convergence in the description of micro-magnetism ...
- the input of chemistry: molecular quantum chemistry applied to studies of systems at the nanoscale
- the contribution of quantum engineering, its successes and limitations (a large part was devoted to the problem of electronic transport)
- electronic transport from ab-initio to mesoscopic physics
- Description of spintronics phenomena by parameterized or ab-initio methods
- Modeling of electronic transport in semiconductor nanodevices

This meeting has demonstrated the broad skills of the numerical simulation in nanosciences in Grenoble, with a particularly strong impact on the electronic transport.

Conclusion.

The Grenoble community involved in theoretical physics and nanosimulation has a broad spectrum, and shows strong dynamics and efficient coupling with experiment. Regarding numerical simulation, the methodological developments play an important role from the physical approximations (models) to the development of codes, including algorithmic developments. In the future, these broad skills in numerical simulation at the university level could move closer to many other activities more related to the industrial development on the site of Grenoble.

Part 6 :

The Network of Technological Platforms of the RTRA “Nanosciences aux limites de la nanoélectronique”

Created in 2007 under the auspice of the Nanosciences Foundation, the network of the platforms is now fully operational. With the strong support of the Foundation (1/3 of its budget is dedicated to the platforms), this network contributes efficiently to the development of nanotechnologies in physics, chemistry and biology in the Grenoble area. These platforms, open to the whole community of researchers, post-docs and students involved in nanosciences, offer last generation equipments for nanofabrication, nanocharacterization and numerical simulation. More than 80% of the projects supported by the Foundation have used the platform facilities and many other National and European projects have also benefitted from them.

1. Coordination within the network

The network is coordinated by a small Working Group gathering the heads of each platform plus the member of the Steering Committee in charge of the platforms. The main objectives of this committee are to maintain the coherence between the projects submitted to the Foundation, to avoid redundancy and to meet the needs of the community. This provides also a unique opportunity to build cooperative projects between the platforms as demonstrated by the project of Focused Ion Beam equipment funded by the Foundation in 2008 and shared by all platforms.

2. The network

The network is composed of four kinds of platform: nanofabrication, nanocharacterization, synthesis and characterization for chemistry and biology, numerical simulation.

Platform for Nanofabrication.

This platform is distributed over 3 clean rooms, each one having a well identified specificity in terms of equipments and materials which can be treated.

1- The Plateforme Technologique Amont (PTA) operated by CEA, CNRS and Grenoble University on the MINATEC campus, provides to the community, equipments of the last generation for electronic lithography and etching (ion beams, reactive plasma) of inorganic nanostructures made of semiconductors, metals and insulators materials.

2- The Centre Interuniversitaire de MicroElectronique-Microtechnologie (CIME-NanoTech) operated by Grenoble University proposes equipments which are fully dedicated to the fabrication of microdevices and microsystems on Silicon.

3- The NanoFabrication (NanoFab) operated by CNRS and Grenoble University offers a panel of equipments for the fabrication of nanodevices based on superconductors and magnetic materials.

This platform covers 1000 m² dispatched over three clean rooms located in close proximity. These clean rooms offer top level equipment for optical and electron beam lithography, metals and oxides deposition, reactive ion etching, chemical cleaning and etching and characterization and metrology. These platforms are specially equipped to treat samples of various sizes (from millimetre up to 4 inches). Special procedures have been implemented to avoid cross contamination as different types of materials (semiconductors, metals and polymers) can be processed. This flexibility is particularly important to provide a full access

to the members of the network. The Foundation contributes to the cost of the clean room facilities for an annual amount corresponding to about one half of the total operating costs. For the equipments, 1.1 M€ have been invested in 3 years by the Foundation. The impact of the nanofabrication platform is illustrated by the very large number of projects in the nanosciences area funded or not funded by the Foundation in 2007 and 2008 which have used the equipments of the platform.

The attendance of the nanofabrication platform increases regularly because a lot of project relies now on technologies. Typically more than 18.000 hrs, dispatched on the three sites have been used in 2009 by the community of nanosciences. The main increase (about 30%) is due to the starting of the PTA in 2007 which is now strongly linked to the CIME NanoTech . In 2009, more than 30 projects are using the platforms (see the list below). We can estimate from the information given by each platform that more than 50 papers relying on devices made on the nanofabrication platforms have been published in the period 2007 -2009 .

Projects using the Platform :

- Research projects supported by the Foundation:
 - POMME (spintronics)
 - NEP IV (nanoelectronics))
 - StrongChip (photonics)
 - NeuroFet (biotech)
 - Nanobiodrop (biotech)
 - THz cryogenic platform (nanoelectronic)
 - DispoGraph (nanoelectronics)

- Examples of Research projects supported by the National Initiative in Nanosciences (P_Nano) from a total of 30.
 - DYNAWall (spintronics)
 - GEMO (spintronics)
 - X-P graphene (nanoelectronics)
 - SuperNems (nanosystems)
 - MolNanoSpin (spintronics)
 - DeltaDiam (nanomaterials)
 - COSNI (nanophotonics)
 - QUANJO (nanoelectronics)
 - ANTARES (nanomaterials)
 - SYNODIS (nanoimprint)
 - HYPERSCAN (nanoelectronics)
 - NANoSIL (photovoltaics)
 - PREANS (nanoelectronics).

Platform for Nano Characterization

This platform gathers top level equipments for probing nanostructures and nanodevices from atomic up to macro scale with beams of electrons, ions and X-rays. These facilities are available on the three following sites:

- 1- The "PlateForme de Nano Caractérisation" (PFNC) located on the MINATEC campus is specialized in crystallography and chemical measurements of inorganic nanostructures by high Resolution Transmission Electron Microscopy and Ion beam analysis.
- 2- The French Cooperative Research Group (CRG) at ESRF operates equipments for the structural and chemicals analysis of nanostructures by hard X-rays diffraction and diffusion.
- 3- The CMTC of Grenoble INP offers laboratory equipments for X-ray characterization and electron microscopy analysis of nanomaterials.

The platform is open to a large part of the RTRA while there are no uniform access rules because some top level equipments can only be operated by trained experts or because the agreement of Program Committee is required (ESRF). The platform has received 1.74 M€ from the Foundation for equipments among which a Focused Ion Beam of 1.3 M€ which is operational since the end of the year 2009. This installation has been officially celebrated on May 2010, 11th, a day during which the Nanosciences Foundation has organized a workshop on the use of the FIB which has gathered many attendees from the different laboratories of the network. The CMTC has received a new X ray diffractometer funded after the 2007 Call for Proposals. This diffractometer which has extended capabilities for grazing incidence diffraction and for imaging strains in nanostructures and devices is now operational.

Projects using the Platform :

- Research projects supported by the Foundation.
 - a. Dispograph (carbon nanoelectronics)
 - b. In situ growth of nanowires NEP IV (nanomaterials)
 - c. Nanocharacterization of Superconducting Nanostructures (John Kirtley Chair)
 - d. A large part of the projects done on the nanofabrication platform are using the nanocharacterization tools.
- Research projects supported by the National Research Agency
 - a. DVD-AME (electrodes for fuel cells)
 - b. CHAMEAU (nanostructured electrodes for FC)
 - c. SOLAMON (plasmonic photovoltaics cells).
 - d. VERNANOMAG (nanomaterials for spintronics)
 - e. CRISTAL (interconnections for nanoelectronics)
 - f. CARTDOP(nanoelectronics)
 - g. GeMo (spintronics in DMS) .

Platforms for Nano Chemistry and Biology

The objectives of these platforms are to provide to the community the tools for the synthesis of molecules and their characterization as well as equipments for analysis of organic/inorganic heterostructures and interfaces.

- The "Plateforme NanoBio-Chimie" located on the campus of Grenoble-University offers equipments and tools for the synthesis of molecules, the grafting on surfaces and their characterization (mass spectroscopy, AFM, IR spectroscopy,.....) and imagery.

- The electron microscopy platform of the Institut de Biologie Structurale (IBS) has developed the tools to study fragile materials such as living cells , proteins ,... grafted on inorganic nanostructures.

This platform initiated in 2006 is dedicated to the conception and synthesis of bio molecules and to surface grafting. The platform is now well equipped for the analytical characterization of final products, functionalized surfaces and molecular interactions. This platform is largely open to the community and the number of users increases regularly. The Foundation has already invested 700 K€ to buy new equipment for quantitative mass spectrometry analysis of molecules and for the characterization of functionalized surfaces by atomic force microscopy. A new platform is dedicated for imagery of biological samples by advanced optical techniques (bi photon microscopy, fluorescence correlation , ...) and for the measurements of rheological properties at micro and nano scale. A bio AFM has been funded by the Foundation in 2008. In 2008, 40 contributions in international journals using the equipment of the Nano Bio Chemistry platform have been published.

Projects using the Platform :

- Research projects supported by the Foundation.
 - MekaNo (bio energy)
 - MOLSWIT (molecular electronics)
 - Development of nm scaled affinity biosensors (biotechnology)
 - MECCA (biomechanics)
- Research projects supported by the National Research Agency
 - E-DETACPEM (electrochemistry)
 - PolyComsa (self assembled polymers)
 - Molecule for Spin electronics (molecular spintronics)
 - Catalytic synthesis of C from CO₂.

Platform for Simulation.

The platform "Calcul Intensif, Modélisation, Expérimentation Numérique et Technologique" (CIMENT) provides access to medium size frames for computer simulations of the physical and chemical properties of nano structures.

This platform called CIMENT is operated by Grenoble University. It is dedicated to the High Performance Computing and is used by several members of the RTRA for simulation of the physical, mechanical and chemical properties of nanostructures. The contribution of the Foundation to this platform is done in the form of research projects rather than direct funding of equipments. These project are for one part devoted to the development of new algorithm for ab initio calculations and for the other part to the simulation of the electronic properties of the nanostructures used in photonics, nanoelectronics and spintronics. Nanosciences contributes only to a small part of the activity of CIMENT (20% for numerical Physics, 60% for Climate and Environment, 20% for chemistry and biology) but it is clear that the Foundation has been the motor to start strong collaborations in Nanosimulation between the different teams.

Projects using the Platform :

- Research projects supported by the Foundation.
 - NanoStar (electronic properties of nanomaterials)
 - MUSCADE
- Research projects supported by the National Research Agency
 - DUCTIL

- Strudyliis
- FILEMON (nanooptic and nanomaterials)
- GRAPHIC (graphene on SiC)
- ACCENT

3. Funding of the Platforms by the Foundation

The support of the Foundation to the technological platforms is attributed both for buying equipment (either totally, or partially in case of multi-financing partners) and for covering part of the running costs related to the scientific projects of the RTRA. The proposals from the platforms are analyzed by the Steering Committee following an annual call.

The tables below show the sharing between the different platforms of the support attributed by the Foundation.

Equipment (k€)	<i>Total</i>	<i>Nano fabrication</i>	<i>Nano-chemistry biology</i>	<i>Nano characterization</i>	<i>Nano simulation</i>
2007	1.443	665	203	440	135
2008	2.027	420	307	1.300*	120
2009	470	180	170	0	120

* FIB equipment shared by the Nanofabrication and Nanocharacterization platforms

Running costs (k€)	<i>Total</i>	<i>Nano fabrication</i>	<i>Nano-chemistry biology</i>	<i>Nano characterization</i>	<i>Nano simulation</i>
2007	332	300	32	0	0
2008	320	300	20	0	0
2009	270	270	0	0	0

Main equipments bought in 2007.

1. metallic deposition : 340 K€
2. UV photolithography: 125 K€
3. ellipsometer: 100 K€
4. AFM scanner: 47 K€
5. quartz microbalance : 160 K€
6. EELS spectrometer: 60 K€
7. CVD reactor: 250 K€

Main equipments bought in 2008.

1. Focused Ion Beam : 1300 K€
2. Optical microscope: 70 K€
3. Laser lithography: 250 K€
4. Bio AFM : 287 K€

Main equipments bought in 2009.

1. Surface treatment (Silane): 120 K€
2. TOF mass spectrometer: 170 K€
3. CVD oxide reactor: 120 K€

4. Evaluation of the Platforms

The evaluation of the platforms is performed by the Steering Committee on the basis of an evaluation sheet provided by each platform and of a public presentation by their directors reporting on how the financial support of the Foundation was used (operating and equipment) and on the scientific highlights of the projects which are using the resources of the platform. The salient points that emerge from this internal assessment are the following:

- the funds provided by the Foundation are strictly used for the equipment requested in accordance with the original budgets.
- the coordination between the platforms has been enhanced
- the number of users has been significantly increased: this can be explained both by the increasing number of research projects which need extensive use of the technical platforms and by a better dissemination of the information about the facilities and their availability.
- all the scientific topics developed in the RTRA were impacted by the development of the platforms resulting from the financial support of the Foundation

Conclusion

After 3 years of existence, the network of platforms offers to the community of nanosciences and nanotechnologies a large panel of top level equipments operated by very highly skilled research and technical staff. The initial choice of the Foundation to support financially a limited number of selected platforms has been essential, first in the creation and then in the operation of the network. A true coherency exists now between the platforms which are prompted to build collaborative projects. Gaps in technologies have been filled up essentially in nanofabrication tools and processes, with a substantial support of the Foundation in a restricted number of equipments.

Finally, the positive effect of networking has been the spreading out of the "culture" of technology in the community. This is shown by the increasing number of projects (research projects, Ph.D. thesis, Chairs of Excellence) which relies on micro and nanodevices built and characterized on the platforms of the network. So it seems important, for the short and long term future, that the Foundation maintains a high level of involvement in the technological platforms.

Appendix 1 :

The Laboratories of the RTRA "Nanosciences aux limites de la nanoélectronique"

NAME	DIRECTOR	HEAD INSTITUTIONS	IDENTIFICATION
Centre de Recherche sur les Macromolécules Végétales CERMAV	Redouane BORSALI	CNRS/ UJF	UPR 5301
Département de Chimie Moléculaire DCM	Pascal DUMY	CNRS/UJF	UMR5250
Grenoble Electrical Engineering Laboratory G2ELab	James ROUDET	CNRS/INPG/UJF	UMR5269
Grenoble Institut des Neurosciences GIN	Claude FEUERSTEIN	UJF/INSERM/CEA /alpha	U836-UJF-CEA-CHU
Institut Albert Bonniot IAB	Christian BRAMBILLA	UJF/INSERM / alpha	U823
Institut Nanosciences et Cryogénie (INAC)	Engin MOLVA	CEA	
INAC – Service de Chimie Inorganique et Biologique	Pascale MALDIVI	CEA/UJF	UMR-E 3
INAC – Service de Physique des Matériaux et Microstructures SP2M	Jean-Michel GERARD	CEA/UJF	UMR E - 9002
INAC – Service de Physique Statistique, Magnétisme et Supraconductivité SPSMS	Jean-Pascal BRISON	CEA/UJF	UMR-E 9001
INAC - Structure et Propriétés d'Architectures Moléculaires SPram	Jean-Pierre TRAVERS	CEA/CNRS/UJF	UMR 5819
INAC - Spintronique et Technologie des Composants SPINTEC	Alain SCHUHL	CEA/CNRS/UJF	URA 2512
Institut de Biologie Structurale IBS	Eva PEBAY-PEYROULA	CEA/CNRS/UJF	UMR5075
Institut Fourier	Michel BRION	CNRS/ UJF	UMR 5582
Institut de Microélectronique, Electromagnétisme et Photonique IMEP	Gérard GHUIBAUDO	CNRS/INPG/UJF	UMR 5130
Institut Néel	Alain FONTAINE	CNRS/UJF	UPR2940
Laboratoire de Chimie et Biologie des Métaux LCBM	Marc FONTECAVE	CEA/UJF	IFR27
Laboratoire National des Champs Magnétiques Intenses LNCMI	Geert RIKKEN	CNRS/UJF	UPR 5021
Laboratoire des Ecoulements Géophysiques et Industriels LEGI	Alain CARTELLIER	CNRS/INPG/UJF	UMR 5519
Laboratoire de Biologie structurale des interactions virus cellule hôte	Stephen CUSACK	CNRS/EMBL/UJF	UMR 5233
Laboratoire d'Astrophysique de l'Observatoire de Grenoble LAOG	Jean Louis MONIN	CNRS/UJF	UMR 5571
Laboratoire d'Electro et Physico-chimie des Matériaux et Interfaces LEPMI	Eric VIEIL	CNRS/INPG/UJF	UMR 5631
Laboratoire d'Electronique et de Technologie de l'Information LETI	Laurent MALIER	CEA	
Laboratoire d'Informatique de Grenoble LIG	Brigitte PLATEAU	CNRS/ INPG / UJF	UMR 5217
Laboratoire d'Innovations pour les Technologies des Energies nouvelles et les Nanomatériaux LITEN	Didier MARSACQ	CEA	
Laboratoire Jean Kuntzmann LJK	Georges-Henri COTTET	CNRS/ INPG / UJF /UPMF	UMR 5224.
Laboratoire des Matériaux et du Génie Physique LMGP	Bernard CHENEVIER	CNRS/INPG	UMR 5628
Laboratoire de Physique et Modélisation des Milieux Condensés LPMMC	Bart VAN TIGGELEN	CNRS/UJF	UMR 5493
Laboratoire de Spectrométrie Physique LSP	Thierry DOMBRE	CNRS/UJF	UMR 5588
Laboratoire des Technologies de la Microélectronique LTM	Olivier JOUBERT	CNRS/INPG/UJF	UMR 5129
Science et Ingénierie des Matériaux et Procédés SIMAP	Michel PONS	CNRS/UJF/INPG	UMR 5266
Techniques de l'Imagerie, de la Modélisation et de la Cognition TIMC	Jacques DEMONGEOT	CNRS / UJF / INPG	UMR 5525
Technique de l'Informatique, de la Microélectronique pour l'Architecture des ordinateurs TIMA	Dominique BORRIONE	CNRS / UJF / INPG	UMR5159

Appendix 2 :

The Foundation Board

Representatives of the Founding Institutions

CEA:

- Jean-Paul DURAUD, Deputy Director of the Direction des Sciences de la Matière, CEA
- Simon DELEONIBUS, Director of the Laboratoire Nanodispositifs Electroniques, CEA-LETI
- Engin MOLVA, Director of INAC, CEA

CNRS:

- Alain FONTAINE, Director of the Institut Néel, CNRS
- Claude AMRA, Deputy Scientific Director, Department ST2I , CNRS
- Pascale BUKHARI, Deputy Director CNRS Rhône Alpes

Grenoble-INP:

- Paul JACQUET, Président of the Groupe INP Grenoble
- Roland MADAR, Research Director at the Laboratoire des Matériaux et du Génie Physique, Groupe INP Grenoble
- Pierre BENECH, Director of PHELMA

UJF Grenoble:

- Thierry DOMBRE, Director of the Laboratoire de Spectrométrie Physique, Université Joseph Fourier
- Ahmad BSIESY, Director of the CIME Nanotech
- Alain SCHUHL, Director of the Laboratoire SPINTEC

Qualified personalities

- André-Jacques AUBERTON-HERVE, CEO of SOITEC (Bernin, Isère, France)
- Elisabeth CHARLAIX, Professor, Laboratoire de Physique de la Matière Condensée et Nanostructures, Université Claude Bernard Lyon 1
- Gabriel M. CREAN, Professor, Department of Microelectronic Engineering of the University College (Cork, Ireland)
- Michel DUCASSY, department manager at CIC Lyonnaise de Banque

Representatives of the partners

- François SILLION, Director of INRIA

Two representatives of the network researchers

- Marc SANQUER, Institut Nanosciences et Cryogénie, CEA Grenoble
- Jean-Claude MOUTET, Professor at Département de Chimie Moléculaire

The Commissioner of the Government

- Jean SARRAZIN, Recteur de l'Académie de Grenoble

Invited representative of the Ministry of Higher Education and Research

- Robert PLANA, Direction Générale de la Recherche et de l'Innovation

The Executive Office of the Board

- President: Jean-Paul DURAUD
- First vice-president: Alain FONTAINE
- Second vice-president: Roland MADAR
- Treasurer: Alain SCHUHL

Appendix 3 :

Steering Committee

1. member, 2. Deputy member

Nanomagnetism :

1. Ursula EBELS, Researcher, CEA
2. Joël CIBERT, Research Director, CNRS

Nanocharacterization :

1. Hubert RENEVIER, Professor, Groupe Grenoble INP
2. Joël CHEVRIER, Professor, UJF

Education and Scientific Animation :

1. Hervé COURTOIS, Professor, UJF
2. Panagiota MORFOULI, Professor, Groupe Grenoble INP

Nanosimulation :

1. Didier MAYOU, Research Director , CNRS
2. Gilles LECARVAL, Researcher, CEA

Nanoelectronics:

1. Maud VINET, Researcher, CEA
2. Olivier BUISSON, Researcher, CNRS

Nanomaterials :

1. Thierry BARON, Researcher, CNRS
2. François MARTIN, Researcher , CEA

Technological Platforms :

1. Noël MAGNEA, Researcher, CEA
2. Cécile GOURGON, Researcher, CNRS

Nanophotonics :

1. Jean Michel GERARD, Research Director, CEA
2. Jean-Emmanuel BROQUIN, Professor, Groupe Grenoble INP

Molecular Electronics:

1. Vincent BOUCHIAT, Researcher, CNRS
2. Eric SAINT AMAN, Professor, UJF

Life Sciences :

1. Pierre LABBE, Professor, UJF
2. Franz BRUCKERT, Professor, Groupe Grenoble INP

Appendix 4 :

The Scientific Committee

- **Benoît DEVEAUD-PLEDRAN**, Head of the Laboratoire d'Optoélectronique Quantique, Ecole Polytechnique Fédérale de Lausanne, Suisse
President of the Scientific Committee
- **François AMALRIC**, Director of the Institut de Pharmacologie et de Biologie Structurale, University Paul Sabatier , Toulouse, France
- **Giorgio BACCARANI**, Professor, University of Bologna, Italy
- **Paul F. BARBARA**, Director of the Center for Nano and Molecular Science and Technology, University of Texas in Austin, USA
- **Jean-Philippe BOURGOIN**, Director of the Nanoscience Program at the CEA, Saclay, France
- **Alain CAPPY**, Director of the Institut d'Electronique, de Microélectronique et de Nanotechnologie (IEMN), Lille, France
- **Marc DRILLON**, Director of the Institut de Physique et Chimie des Matériaux de Strasbourg, France
- **Philippe FAUCHET**, Professor, Director of the Center for Future Health, University of Rochester, USA
- **Jagadeesh MOODERA**, Senior Research Scientist and Group Leader at the Francis Bitter Magnet Laboratory, MIT, Cambridge, USA
- **Klaus KERN**, Scientific Director of the Nanoscale Science Department, Max-Planck-Institute for Solid State Research, Stuttgart, Germany
- **Benoît PERTHAME**, Professor, Université Pierre et Marie Curie, Paris, France
- **Clivia SOTOMAYOR TORRES**, Professor, Catalan Institute of Nanotechnology, Barcelone, Spain

Appendix 5 :

List of the Chairs of Excellence of the Nanosciences Foundation

Name Nationality Stay lasting	Major topic.	Description	From	Starting on
2007CALL FOR PROPOSALS				
Full time				
Mairbek Chshiev Russian 3 years	Nano-magnetism	Modelisation of magnetic nanostructures The research of Mairbek Chshiev is focused on the theory of spin-dependent electronic transport phenomena in nanostructures with giant and tunnel magnetoresistance as well as on electronic band structure of materials for spin electronics.	University of Alabama (USA)	2008, May
Donald Martin Australian 3 years	Life sciences at the limits of nano-electronics	Biomimetic artificial membrane. Donald Martin is one of the leaders of the Nanobiotechnology program at the University of Technology Sydney. He has launched the OzNano2Life program, in partnership with the European project Nano2life. His research focuses on ion channels in cell membranes.	University of Technology de Sydney Australia	2009, January
Part time				
L. Glazman American 3m/year x3	Quantum Nano-electronics	Quantum coherent phenomena L. Glazman, Professor at Yale University, is a renowned expert in the physics of mesoscopic systems with major contributions to the theory of electron transport and correlations in systems of reduced dimensionality, such as quantum dots and quantum wires.	Yale University USA	2008, July
Vincent Bayot Belgium 2,5 m/year x5	Nano-characterization	Scanning-gate nanoelectronics V. Bayot is a specialist of low-dimensional electronic systems and mesoscopic physics. More recently, he has concentrated on the study of mesoscopic and quantum transport by scanned gate microscopy.	Université Catholique of Louvain, Belgium	2008, April

Philip Wong American 1m/year x3	Quantum Nano- electronics	Transport in core/shell devices P. Wong is interested in exploring new materials, novel fabrication techniques, and novel device concepts for future nanoelectronics systems. His research covers a broad range of topics including carbon nanotubes, semiconductor nanowires, self-assembly, exploratory logic devices, and novel memory devices.	Stanford University USA	2008, June
J. Fernandez-Rossier Spanish 1,5 m/year x3	Nano- magnetism	Downsizing nanospintronics J. Fernandez-Rossier works in the broad research field of condensed matter theory. He is particularly interested in the magnetic properties of systems of reduced dimensionality and in the manipulation of these properties by means of electrical fields and currents as well as laser excitation.	University of Alicante Spain	2008, September
Vaclav Holy Czech Republic 1 m/year x4	Nano- characterisation	X ray investigations on nanoparticles Vaclav Holy is a well known specialist of X-ray diffraction by nanostructures. His expertise is particularly focused on the quantum objects prepared in situ on the beam lines and on the nano-defects induced in silicon by the technological processes.	University of Masarik Czech Republic	2008, July
Michael Roukes 3 m/year x 4 American	Quantum Nano- electronics	VLSI of NEMS M. Roukes, Professor at CalTech, is the founding director of the Kavli Nanosciences Institute. His research interests are focused on developing and using of nanodevices in the exploration of single-quantum and single-molecule phenomena.	Californian Institute of Technology USA	2008, May
2008 CALL FOR PROPOSALS				
Full time				
Tetiana Aksenova Russian 3 years	Life sciences at the frontiers of nanoelectronics	Implantable computer –brain interface T. Aksenova is a leading expert in the field of machine learning and real time signal processing. She invented several innovative approaches for signal processing, classification and modeling that will be used for Brain Computer Interface design.	Institut d'Analyse Appliquée des Systèmes Ukraine	2008, November

Part time				
A. Zaslavsky 3m/year x3 American	Quantum Nano- electronics	Tunneling-based nano-FETs A. Zaslavsky conducts research on devices that could supplement the current silicon transistor-based microelectronics technology.	Brown University USA	2009, June
Marcelo Franca Santos Brazilian 3m/year x3	Nano- photonics	EPOCA: Emission Properties Of a semiconducting Cavity coupled to an Artificial atom. M. Franca Santos is a theoretician specialized in quantum optics and cavity QED.	University of Belo Horizonte Brazil	2009, July
L.eonardo Fonseca Brazilian 6m/year x 3	Nano- modeling	Nanometric Devices calculated ab initio Leonardo Fonseca is an expert in theory and modeling of nanostructures.	W. Von Braun Center Brazil	2009, 2 nd Semester
2009 CALL FOR PROPOSALS				
Part time				
John Kirtley American 3m/year x 3	Nano- characterization	Nanocharacterization of Superconducting Nanostructures J. Kirtley, one of the world's leading experts on Josephson junction devices and superconductivity. For the past years, he has developed the technique of scanning SQUID microscopy and used the resulting novel instruments for fundamental studies.	Stanford University, USA	2010, 1 st semester
Yong Zhang American 2m/year x 3	Nano-photonics	New concepts solar cells with II-VI semiconductor nanostructures Y. Zhang is an expert in both optical spectroscopy and electronic structure computation, and is involved in optoelectronic applications of materials (e.g., solar cell, solid state lighting, thermoelectrics).	National Renewable Energy Laboratory, Golden USA	2009, November
Normand Mousseau Canadian 2m/year x 3	Nano- modeling	MUSCADE: Multi-scale Design of Nano-materials with simulations on hybrid architectures N. Mousseau is an expert in theoretical and numerical studies of the structural and dynamical properties of complex materials.	University of Montreal, Canada	2010, 1 st semester

Appendix 6 :

List of the Post-Doc fellows of the Nanosciences Foundation

*List drawn up on 2010, April 22nd
(in grey, Post-Docs recruited in 2010)*

Name <i>Project</i>	Nationality	Stay	Topics	Laboratory
WEGE Hartmut <i>"New incoming" Project Douady</i>	German	2008, March - 2009, September	Dendritic potentials imaging by second harmonic generation	Spectro
LIGUORI Lavinia <i>Chair of Excellence Donald Martin</i>	Italian	2008, July - 2010, June	Biomimetic artificial membrane systems for generating electrochemical energy	TIMC
SWENSON Loren <i>"New incoming" Project Monfardini</i>	American	2008, July - 2010, June	A DC-to-THz cryogenic platform for new generations of nano- detectors	Institut Néel
DOBRYNIN Alexey <i>POMME Project</i>	Russian	2008, July - 2010, June	Properties of magnetic metals under electric field	Institut Néel
ABAD MUNOZ Libertad <i>NeuroFET Project</i>	Spanish	2008, November - 2010, May	Coupling of neurons with silicon nano Field Effect Transistors	Néel/CRETA
AISSOU Karim <i>Cellulose hybrid Project</i>	French	2009, February - 2010, August	Cellulose Hybrid Block Copolymers	CERMAV
KALITSOV Alan <i>Chair of Excellence Mairbek Chshiev</i>	Russian	2009, April – 2010, April	Modeling of spin-dependent electronic transport in nanostructures	SPINTEC
GOLOVACH Vitaly <i>Chair of Excellence Leonid Glazman</i>	Ukrainian	2010, October - 2012, September	Quantum coherent nanoscale devices	INAC
WANG Shidong <i>"New incoming" Project Mingo</i>	Chinese	2009, May - 2010, November	Computational modeling of novel nanostructured thermoelectric materials	LITEN
MACHADO CHARRY Eduardo MUSCADE Project	Colombian	2009, December – 2011, september	Multi-scale Design of Nano- materials with simulations on hybrid architectures	INAC
BERNARD MANTEL Anne POMME Project	French	2010, January – 2010, september	Preparation and study of models revealing magnetism activation effects under a given electric field	Institut Néel
CONSONNI Vincent <i>II VI Photovoltaic Project</i>	French	2010, february – 2011, january	Core/shell nanostructures from ZnO nanowires	LETI
MASSEBOEUF Aurélien <i>MIDWEST PROJECT</i>	French	2010, march – 2011, october	Study of current-induced domain wall motion	INAC
RENARD Vincent <i>Dispograph Project</i>	French	2010, march – 2011, september	Study of graphene and its application to new devices	Institut Néel
CANTELLI Valentina <i>"New incoming" Project Schulli</i>	Italian	2010, april – 2011, September	UHV-CVD measuring station for in-situ x-ray investigation of growing semiconductor nanowires	INAC

Appendix 7 :

List of the Ph. D. students of the Nanosciences Foundation

List drawn up on 2009, December 31st

Name Project	Nationality	Thesis started on	Thesis	Laboratory
QUAGLIO Thomas "fil de l'eau"	French	2007, October	Local spectroscopy of nanostructured superconductors out of equilibrium	Institut Néel
WANG Xu "fil de l'eau"	Chinese	2007, October	New nanometric bio-sensors from carbon nanotubes	DCM
DATTA Subhadeep "fil de l'eau"	Indian	2007, October	Molecular spintronics using single-molecule magnets	Institut Néel
HWANG Jun-Seok "fil de l'eau"	South Korean	2007, November	Transport and optics of single nanowires	Institut Néel
KUSTOV Michael "fil de l'eau"	Russian	2007, December	Micromanipulation of nanoparticles using the diamagnetic levitation approach	G2ELAB
AGNIHOTRI Sandeep "fil de l'eau"	Indian	2008, March	Spin-based electronics in II-VI semiconductors : Spin-dependent tunnel current in heterostructures	Institut Néel/ INAC
MEDEIROS SOARES Marcio "fil de l'eau"	Brazilian	2008, May	Growth, structure and magnetism in perpendicular coupled systems.	Institut Néel
HRABEC Ales "fil de l'eau"	Czech	2008, September	Spin-torque-induced domain wall displacement in a compensated ferrimagnetic alloy	Institut Néel
LIU Peng Chair of Excellence Vincent BAYOT	Chinese	2008, September	Nanoelectronics by scanning probe microscopy	Institut Néel
NATARAJAN Bharathi Nanostar Project	Indian	2008, September	Development of New Functionals and Algorithms for Time Dependent Density Functional Theory	INAC
MALIK Nitin Singh "New incoming" project Julien CLAUDON	Indian	2008, September	Study of strong atom-light interaction on chip	SP2M-INAC
CAO Chonglong Chair of Excellence Fernandez-Rossier	Chinese	2008, September	Optical and electronic properties of quantum dots with a single Mn impurity	Institut Néel
DEB Arpan Khrisna "fil de l'eau"	Indian	2008, October	Multiscale study of the charge effect on diffusion in silicon	SP2M-INAC
BOMBERA Radoslaw "fil de l'eau"	Polish	2008, October	Development of biochips dedicated to blood cell characterization	INAC CREAB
GROZA Irina "fil de l'eau"	Romanian	2008, October	Spin-torque effects in magnetic nanoparticles	SP2M-INAC
CHAKRABORTY Akash "fil de l'eau"	Indian	2008, October	Non magnetic impurity induced ferromagnetism and effects of nanoscale inhomogeneities	Institut Néel
CHEN Xiaojun "fil de l'eau"	Chinese	2008, October	Selective growth of nitride nanowires for photonics applications	SP2M-INAC
YELISYEVYEV Andrey Chair of Excellence Tetiana AKSENOVA	Ukrainian	2009, January	Brain-Computer Interface using electro-corticogram (ECoG) from the cortical surface	CEA/LETI/DTB S/LE2S
LEE Jae Woo	South	2009,	Transport in core-shell nanowires	IMEP LAHC

<i>Chair of Excellence Philip WONG</i>	Korean	February		
YANG Hongxin <i>"fil de l'eau"</i>	Chinese	2009, March	Electronic structure and spin-polarized currents in magnetic epitaxial tunnel junctions.	SPINTEC
ELOUNEG JAMROZ <i>"fil de l'eau"</i>	Canadian	2009, March	Development of quantum dots in II-VI semiconductors nanowires for photonic applications	Institut Néel
GUIMARAES Vinicius <i>"fil de l'eau"</i>	Brazilian	2009, June	Preparation and characterization of yttrium aluminoborate nanopowders for the development of a new generation of phosphors for lighting	Institut Néel
WAN Jing <i>Chair of Excellence Alexander ZASLAVSKY</i>	Chinese	2009, June	Quantum and tunneling nanodevices integrated in the "semiconductor-on-insulator" platform	IMEP/LETI
FAIZY Omid <i>Projet Nanostar</i>	Iranian	2009, July	Quantum transport in nanostructures	Institut Néel
JAIN Purvi <i>"fil de l'eau"</i>	Indian	2009, September	Antibody phage display in materials sciences : new nano-probes and linkers for nano-objects	SPECTRO
NGUYEN Van Dai <i>"fil de l'eau"</i>	Viet-nameese	2009, October	Injection of electrical current and the dynamics of magnetic walls propagation	INAC/SP2M
MANDAL Kalpana <i>"New incoming" project Martial Balland</i>	Indian	2009, October	Contribution of the physical properties of the environment to cell/cell interactions.	SPECTRO
ARES Natalia <i>"fil de l'eau"</i>	Argentinian	2009, October	Electronic transport and spin dynamics in coupled SiGe self-assembled quantum dots	CEA/INAC/SPS MS/LaTEQS
SALAZAR Romero <i>Chair of Excellence Yong ZHANG</i>	Mexican	2009, October	New concepts solar cells with II-IV semiconductor nanostructures	LETI
VO VAN Chi <i>"fil de l'eau"</i>	Viet-nameese	2009, October	Graphene epitaxy on metals for a new generation of self-organized, highly ordered, tunable magnetic nanosystems	Institut Néel
VALENTE Daniel <i>Projet EPOCA</i>	Brazilian	2009, December	Emission properties of a semi-conducting Cavity coupled to an Artificial Atom	Institut Néel
NAMBIAR Siddarth <i>"fil de l'eau"</i>	Indian	2009, November	Plasmons assisted Si electro-optical devices	CEA/LETI/DOP T
GANZHORN Marc <i>"fil de l'eau"</i>	German	2010, January	Molecular spintronics using single molecule magnets: magnetic force measurements using carbon nanotube based mechanical resonators.	Institut Néel

Appendix 8 :

"Les Parrains de la Fondation"

- **Alim-Louis Benabid** : member of the Academy of Sciences, Professor Emeritus of Biophysics at the University Joseph Fourier of Grenoble, Scientific Counselor at the Direction des Recherches Technologiques of the CEA.
- **Michel Briel** : Scientific Counselor at the CEA/LETI and Founder of the Consulting Company APLINOV.
- **Jean-Lou Chameau**, President of the Californian Institute of Technology.
- **Albert Fert** : 2007 Nobel Prize in Physics, Professor at the University Paris-Sud (Paris XI).
- **Axel Kahn**, geneticist, President of the University Paris Descartes (Paris V).
- **Etienne Klein** : Physicist and Doctor in Philosophy of Sciences, Research Director at the CEA Saclay, Director of the Laboratoire de Recherche sur les Sciences de la Matière.
- **Joël Monnier** : Founder of the start-up Kalray and former Vice-President and Director of R&D in STMicroelectronics.
- **Eva Pebay-Péroula**, Member of the Academy of Sciences, Director of the Institut de Biologie Structurale, Professor at the University Joseph Fourier of Grenoble, President of the ANR (Agence nationale de la recherche).
- **Francesco Sette** : General Director of the European Synchrotron Radiation Facility.
- **Jean Therme** : Director of the CEA Grenoble.

The scientific production of the funded projects

Call for proposals 2007

Modelisation of magnetic nanostructures / Chaire d'excellence Mairbeck Chshiev

Post doctorant : Alan KALITSOV

BOOK CHAPTER

- *"Introduction to spin transfer torque"*,

C. Baraduc, M. Chshiev, U. Ebels, in *Nanomagnetism and Spintronics - Fabrication, Materials, Characterization and Applications* , Eds: F. Nasirpour, A. Nogaret, World Scientific Publishing, Singapore, 2009, pp. 173-192

PUBLICATIONS

- *"A two-band model of spin polarized transport in Fe|Cr|MgO|Fe magnetic tunnel junctions"*, A. Vedyayev, N. Ryzhanova, N. Strelkov, M. Chshiev and B. Dieny, *J. Appl. Phys.* 107 (2010)

- *"Bias-voltage dependence of perpendicular spin-transfer torque in asymmetric MgO-based magnetic tunnel junctions"*,

S.-C. Oh, S.-Y. Park, A. Manchon, M. Chshiev, J.-H. Han, H.-W. Lee, J.-E. Lee, K.-T. Nam, Y. Jo, Y.-C. Kong, B. Dieny & K.-J. Lee, *Nature Physics* 5, 898 (2009); advance online publication, 25 October 2009 | doi:10.1038/nphys1427

- *"Stable hydroxyl network on diamond (001) via first-principles and MD investigation"*,

H. X. Yang, L. F. Xu, C. Z. Gu, Z. Fang, S. B. Zhang, M. Chshiev, *Surf. Sci.* 603, 3035 (2009)

- *"Origin of low Gilbert damping in half metals"*,

C. Liu, C. K. A. Mewes, M. Chshiev, T. Mewes, and W. H. Butler, *Appl. Phys. Lett.* 95, 022509 (2009)

- *"Spin-transfer torque in magnetic tunnel junctions"*,

A. Kalitsov, M. Chshiev, I. Theodonis, N. Kioussis, and W. H. Butler, *Phys. Rev. B* 79, 174416 (2009)

- *"Voltage Dependence of Spin Transfer Torque in Magnetic Tunnel Junctions"*,

M. Chshiev, I. Theodonis, A. Kalitsov, N. Kioussis, , and W. H. Butler, *IEEE Trans. Magn.*, *IEEE Trans. Magn.* 44, 2543 (2008)

- *"Description of current-driven torques in magnetic tunnel junctions"*,

A. Manchon, N. Ryzhanova, A. Vedyayev, M. Chshiev and B. Dieny, *J. Phys.: Cond. Matter*, 20, 145208 (2008)

COMMUNICATIONS

Invited:

- *"Spin transfer torques in magnetic tunnel junctions "*, *Gordon Research Conferences "Magnetic nanostructures"*, Bates College, Lewiston, ME, USA, August 8-13, 2010

- *"Non-collinear spin transport in layered structures and bulk materials for spintronics"*, *MINATEC Upstream Research, MINATEC Crossroads'10*, Grenoble, France, June 23-24, 2010

- *"Quantum theory of spin transfer torques in a view of memory applications"*, *International Symposium on Integrated Functionalities (ISIF 2010)*, San Juan, PR, USA, June 13-16 2010

- *"Finite element modeling of charge and spincurrents in CPP GMR structures"*, N. Strelkov, A. Vedyayev, L. Buda-Prejbeanu, M. Chshiev and B. Dieny, 2009 Intermag Conference, Sacramento, CA, USA, May 4-8, 2009, EA-06

- *"Voltage dependence properties of ballistic spin currents and spin transfer torques in magnetic tunnel junctions"*, 2009 APS March Meeting, Pittsburgh, PA, March 16-20, X29.0006
- *"Description of spintronic phenomena with tight-binding and ab-initio simulation tools"*, Workshop de la Fondation Nanosciences "Les apports de la simulation numérique en nanosciences", Grenoble, France, March 23, 2009
- *"Nature of voltage dependence of spin transfer torque in magnetic tunnel junctions"*, 2008 Intermag Conference, Madrid, Spain, May 4-8, 2008, CC-02
- *"Design of new spintronic materials"* (with W. H. Butler), International School M-SNOW 2008, Nancy, France, November 23-25, 2008
- *"Voltage dependence of spin transfer torques in magnetic tunnel junctions"*, MINT Workshop "Materials for Spin Transfer Torque MRAM", Tuscaloosa, AL, October 15, 2008
- *"Modelling Spintronic Phenomena"*, MINATEC Crossroads'08, Grenoble, France, June 24, 2008

Invited seminars

- *"Recent advances in theory of spintronic phenomena"*, séminaire de la Fondation Nanosciences, Grenoble, France, February 26, 2009
- *"Spin dependent transport properties and electronic structure of materials for spintronics"*, University of Maryland Eastern Shore, Princess Anne, MD, USA, October 30, 2007
- *"Spin torque in magnetic tunnel junctions and electronic structure of materials for spintronics"*, CNRS/Thales, June 13, 2007
- *"Spin torque in magnetic tunnel junctions and electronic structure of materials for spintronics"*, IPCMS/GEMME, Strasbourg (France), July 27, 2007
- *"Spin-dependent transport in structures with giant and tunnel magnetoresistance"*, California State University, Northridge, CA, USA, January 2005
- *"Transport polarisé en spin dans une jonction tunnel à double barrière"*, Séminaire de L'Institut Louis Neel, Avril, 2002
- *"Spin-Polarized Transport in Double Barrier Junctions assisted by quantum well states"*, Colloquium, Thales CSF – Université Paris-Sud, January, 2001

Orales presentations and posters

- *"Bias-voltage dependence of perpendicular spin-transfer torque in asymmetric MgO-based magnetic tunnel junctions"*,
S.-C. Oh, S.-Y. Park, A. Manchon, M. Chshiev, J.-H. Han, H.-W. Lee, J.-E. Lee, K.-T. Nam, Y. Jo, Y.-C. Kong, B. Dieny & K.-J. Lee, 2010 APS March Meeting, March 15–19, 2010; Portland, OR, USA, L37.00010;
- *"Effect of oxidation on interlayer exchange coupling in Fe|MgO|Fe tunnel junctions"*,
H. Yang, M. Chshiev, A. Kalitsov, A. Schuhl and W.H. Butler, 2010 APS March Meeting, March 15–19, 2010; Portland, OR, USA, S1.00121;
- *"Voltage induced control and magnetoresistance of magnetically frustrated systems"*,
A. Kalitsov, M. Chshiev, B. Canals and C. Lacroix, 2010 APS March Meeting, March 15–19, 2010; Portland, OR, USA, Y34.00011;
- *"Voltage induced control and magnetoresistance of magnetically frustrated systems"*,
A. Kalitsov, M. Chshiev, B. Canals and C. Lacroix, 11th Joint MMM/Intermag Conference, Washington, DC, Jan. 18-22, FV-16
- *"Spin polarized transport in Fe|Cr|(Fe)|MgO|Fe magnetic tunnel junctions using a two-band model"*,
A. Vedyayev, N. Ryzhanova, N. Strelkov, M. Chshiev and B. Dieny, 11th Joint MMM/Intermag Conference, Washington, DC, Jan. 18-22, FB-07
- *"Effect of oxidation conditions on interlayer exchange coupling in Fe|MgO|Fe tunnel junctions from first-principles and tightbinding approaches"*,

H. Yang, M. Chshiev, A. Kalitsov, A. Schuhl and W.H. Butler, 11th Joint MMM/Intermag Conference, Washington, DC, Jan. 18-22, FB-08

- *"Mechanism of magnetotransport properties modulation via interfacial electronic structure in single crystal Fe-MgO-Fe tunnel junctions"*,

C. Tiusan, H. Yang, M. Chshiev, F. Greullet, C. Bellouard, Y. Lu, F. Montaigne and M. Hehn, 11th Joint MMM/Intermag Conference, Washington, DC, Jan. 18-22, EV-07

- *"Modeling and measurement of transport properties in Current Confined Path GMR structures"*,

S. Amara, C. Baraduc, N. Strelkov, A. Vedyayev, L. Buda-Prejbeanu, M. Chshiev, Y. Liu, M. Li, K. Zhang and B. Diény, 11th Joint MMM/Intermag Conference, Washington, DC, Jan. 18-22, AC-11

- *"Calculation of intrinsic damping in half metals"*, C. Liu, C. Mewes, M. Chshiev, T. Mewes, W. H. Butler, 2009 APS March Meeting, Pittsburgh, PA, March 16-20, T32.0005

- *"Nonequilibrium properties of spin transfer torque and tunnel magnetoresistance in magnetic tunnel junctions"*,

M. Chshiev; A. Kalitsov, I. Theodonis; N. Kioussis, W. H. Butler, 53rd MMM Conference, Austin, TX, Nov. 10-14, EB-01

- *"Calculation of intrinsic damping in half metals"*,

C. Liu, C. Mewes, M. Chshiev, T. Mewes, W. H. Butler, 53rd MMM Conference, Austin, TX, Nov. 10-14, GF-04

Biomimetic Artificial Membrane Systems for Generating Electrochemical Energy

Chaire d'excellence Donald Martin

Post doctorant : Lavinia LIGUORI

PUBLICATIONS

- *"Terminating polyelectrolyte in multilayer films influences growth and morphology of adhering cells"*

Ting JHY, Haas M, Valenzuela S, Martin DK, IET Nanobiotechnology (2010) (sous presse, accepté le 30/3/10)

- *"Crystallization of the membrane protein hVDAC1 produced in cell-free system"*

Aurélien Deniaud¹, **Lavinia Liguori**, Iulia Blesneac, Jean-Luc Lenormand, Eva Pebay-Peyroula (2010). *In Press on BBAMEM journal*.

- *"Characterization of the cell-penetrating properties of the Epstein-Barr virus ZEBRA trans-activator."*

Romy Rothe, **Lavinia Liguori**, Bruno Marques, Didier Grunwald, Emmanuel Drouet and Jean-Luc Lenormand (April 2010). *In press Journal of Biological Chemistry*.

- *"A simple method for the reconstitution of membrane proteins into giant unilamellar vesicles."*

Armelle Varnier, Frédérique Kermarrec, Iulia Blesneac, Christophe Moreau, **Lavinia Liguori**, Jean Luc Lenormand, and Nathalie Picollet-D'hahan (2010). *J Membr Biol*. 233: 85-92.

- *"Single-step Production of Functional OEP24 proteoliposomes."*

Lavinia Liguori, Iulia Blesneac, Dominique Madern, Michel Vivaudou and Jean-Luc Lenormand (2010). *Protein Expr Purif*. 69: 106-111

COMMUNICATIONS / SEMINAIRES and CONFERENCES

- *"Characterisation of diffusion in a free thin polyelectrolyte membrane"*

Alcaraz JP, Liguori L, Stidder B, Cinquin P, Martin DK (2010), NanoBio Europe2010, Juin 15-17, Munster, Allemagne

- *"Towards a biological battery to power implantable devices"*

Stidder, B, Alcaraz JP, Liguori L, Cinquin P, Martin DK (2010). NanoBio Europe2010, Juin 15-17, Munster, Allemagne

- *"Production of proteoliposomes with a cell-free expression system to develop new nanotechnology devices"*

Liguori L, Alcaraz JP, Stidder B, Cinquin P, Martin DK (2010), NanoBioEurope2010, Juin 15-17, Munster, Allemagne

- *"MekaNo – Biomimetic Artificial Membrane Systems for Generating Electrochemical Energy"*, D. Martin, P. Cinquin, S. Cosnier, C. Gondran, J-L. Lenormand, L. Liguori, J-P. Alcaraz. Inauguration of RTRA, Grenoble, 19 September 2008

- *"Providing Permeability to Microcapsules with Incorporated Ion Channels"*, D. Martin, P. Cinquin, S. Cosnier, C. Gondran, J-L. Lenormand, L. Liguori, J-P. Alcaraz, Laboratoire de Spectrometrie Physique, UJF, Grenoble, 9 March 2009

- *"Providing Permeability to Microcapsules with Incorporated Ion Channels"*, D. Martin, P. Cinquin, S. Cosnier, C. Gondran, J-L. Lenormand, L. Liguori, J-P. Alcaraz, CEA, Grenoble, 10 March 2009 et Spectro UJF Grenoble 9 mars 2009

- *"Possibilities of Power using Biological Transport Proteins Built into Artificial Biomimetic Membranes – MekaNo"*.

D. Martin, P. Cinquin, J-P. Alcaraz, L. Liguori, B. Stidder, J-L. Lenormand, S. Cosnier, C. Gondran, TIMC-GMCAO, Grenoble, 2 June 2009

- *"Possibilities of Power using Biological Transport Proteins Built into Artificial Biomimetic Membranes"*.

D.K. Martin, L. Liguori, B. Stidder, J-P. Alcaraz, P. Cinquin, J-L. Lenormand, Journées Nationales en Nanosciences et Nanotechnologies (ANR - J3N), Toulouse, 21-23 Octobre, 2009 et TIMC GMCAO Grenoble le 2 juin 2009

INVITED CONFERENCES

- *"Biomimetic membrane systems with incorporated biological transport proteins provide stable platforms for novel biosensors."*

Martin DK, Alcaraz JP, Liguori L, Stidder B, Cinquin P, Cornell BA, Valenzuela SM (2010), NanoAgri 2010, Juin 20-25, Brésil

- *"Le point sur les membranes biologiques"*.

J-P. Alcaraz, TIMC-GMCAO, 19 May 2009

- *"Engineering Human Bak Proteoliposomes: a New Approach for the Treatment of Glioblastoma"*.

L. Liguori, Lenormand JL. EHRlich II, 2nd World Conference on Magic Bullets", October 3-5, 2008, Nürnberg, Germany.

- *"Optimized bacterial cell-free expression system for membrane proteins and proteoliposomes production"*

L. Liguori, Lenormand JL. CHI (Cambridge healthtech institute) protein expression Europe. 20-21 October 2008 Lisbona, Portugal.

BREVET

Cinquin P, Martin DK (2007). *"Biomimetic artificial membrane device"*, PCT/EP2008/058253, WO/2009/003936

Coherent quantum phenomena./ Chaire d'excellence Leonid GLAZMAN

Post doctorant : Vitaly GOLOVACH

COMMUNICATIONS / SEMINARS

- *"Electronic noise and relaxation in nanostructures "*, April 1-2, 2010 in Grenoble
- ILL theory seminar in Mar 2009, seminar at ENS Lyon in Mar 2009, talk during "Theoretical Physics days" in Grenoble (run by A. Minguzzi) in Nov 2009.

PUBLICATIONS

- *"Dynamic response of 1D bosons in a trap"*
V. Golovach, A. Minguzzi, L. Glazman, Phys. Rev. A 80, 043611 (2009), [also selected for Nov. 2009 issue of Virtual Journal of Atomic Quantum Fluids]
- *"The fate of 1D spin-charge separation away from Fermi point"*
T. Schmidt, A. Imambekov, L. Glazman, arXiv:0912.0326,
- *"Correlated Electrons in One-Dimensional Nanostructures"*
V. Deshpande, M. Bockrath, L. Glazman, A. Yacoby, (review) Nature Insights article (accepted, 2010)

Scanning gate nanoelectronics / Chaire d'excellence Vincent BAYOT

Doctorant : Peng LIU

PUBLICATION

- *"Scanning gate microscopy of quantum rings: effects of an external magnetic field and of charged defects"*

M.G. Pala, S. Baltazar, F. Martins, B. Hackens, H. Sellier, T. Ouisse, V. Bayot, S. Huant, Nanotechnology 20, 264021 (2009)

CONFERENCES

- *"Imaging the electron LDOS inside buried quantum rings"*
ICPS-29 (2008), International conference on the physics of semiconductors
- *"Imaging electron transport close to filling factor $\nu=2$ in a quantum ring"*
EP2DS (2009), Electronic properties of two dimensional systems
- *"Scanning gate microscopy on quantum rings : influence of the magnetic field and of charged defects"*, EP2DS (2009)

COMMUNICATION / INVITED CONTRIBUTIONS

- Imaging confined semiconductor systems, "9th International Balkan Workshop on Applied Physics », July 7-9, 2008, CONSTANTA, ROMANIA, B. Hackens (orateur)
- XXXIX « Jaszowiec » International School & Conference on the Physics of semiconductors, Poland, June 2010, S. Huant (orateur), titre non encore défini.
- "Imaging Electron Transport By Scanning Gate Microscopy"

P. Liu 1, H. Sellier 1, S. Huant 1, X. Wallart 2, L. Desplanque 2, B. Hackens 3, F. Martins 2 and V. Bayot, Le Forum 2010 des Microscopies à Sondes Locales, Mittelwihr, France, 15—19, March, 2010

Transport in core/shell nanowires / Chaire d'excellence Philip WONG

Doctorant : Jae Woo LEE

POSTER

- *"Charge Transport Characteristics in Time Domain"*

JW LEE, X.MESCOT, M.MOUI, G. KIM and G.GHIBAUDO, MIGAS summer school, 20th-26th June 2009, Autrans-Grenoble, France

PUBLICATIONS

- *"Maskless optical microscope lithography system"*

Eung Seok Park, Doyoung Jang, Jaewoo Lee, Yun Jeong Kim, Junhong Na, Hyunjin Ji, Jae Wan Choi, and Gyu-Tae Kim, Review of Scientific Instruments, **80**, 126101 (2009)

- *"Analysis of charge sensitivity and low frequency noise limitation in silicon nanowire sensors"*

Jae Woo Lee, Doyoung Jang, Gyu Tae Kim, Mireille Mouis, and Gérard Ghibaudo, Journal of Applied Physics, 107, 044501 (2010)

PUBLICATIONS

- *"Optical probing of spin fluctuations of a single paramagnetic Mn atom in a semiconductor quantum dot"*.

L. Besombes, Y. Léger, J. Bernos, H. Boukari, H. Mariette, J.P. Poizat, T. Clement, J. Fernandez-Rossier, R. Aguado, Phys. Rev. B 78, 125324 (2008)

- *"Optical Spin Orientation of a Single Manganese Atom in a Semiconductor Quantum Dot Using Quasiresonant Photoexcitation"*

C. Le Gall, L. Besombes, H. Boukari, R. Kolodka, J. Cibert, and H. Mariette, Phys. Rev. Lett. 102, 127402 (2009)

- *"Modelling optical spin pumping of a single Mn atom in a CdTe quantum dot"*

C. Chonglong, L. Besombes, J. Fernandez-Rossier, Proceeding of the conference OECS 11 (Journal of Physics), Madrid, septembre 2009.

- *"Optical spin orientation of a single manganese atom in a quantum dot"*

L. Besombes, C. Le Gall, H. Boukari, R. Kolodka, J. Cibert, D. Ferrand, H. Mariette Solid State Comm., special issue on Fundamental Phenomena and Application of Quantum Dots, 149, 1472 (2009)

- *"Optical initialization, readout and dynamics of a single Mn spin in a quantum dot"*

R. Kolodka, C. Le Gall, C. Chonglong, H. Boukari, H. Mariette, J. Fernandez-Rossier, L. Besombes, in preparation for Phys. Rev. B

X ray investigations on nanoparticles/ Chaire d'excellence Vaclav HOLY

PUBLICATION

- *"In situ x-ray scattering study on the evolution of Ge island morphology and relaxation for low growth rate : advanced transition to superdomes."*

Ml. Richard, T. Schulli, G. Renaud, E. Wintersberger, G. Chen, G. Bauer, V. Holy, Physical Review B 80(4) 04 53 13 (2009)

Very Large Scale Integration of NEMS/ Chaire d'excellence Michael ROUKES

CONFERENCES

- OMNT – NEMS (juin 2008), *"Nanomechanics for NEMS – Scientific and technological issues "*
- CHU – GIN (mars 2009) *"NEMS for biological applications"*
- RTRA (mars 2009) : Complexity and Nanosystems: from « Craft » to Technology
- Workshop Alliance for NEMS VLSI (juin 2009)

PUBLICATIONS

- *"Piezoelectric nanoelectromechanical resonators based on aluminum nitride thin films "*

R. B. Karabalin, M. H. Matheny, X. L. Feng, E. Defaÿ, G. Le Rhun, C. Marcoux, S. Hentz, P. Andreucci, and M. L. Roukes, Appl. Phys. Lett. 95, 103111 (2009)

- *"In-plane nanoelectromechanical resonators based on silicon nanowire piezoresistive detection",*

E. Mile, G. Jourdan, I. Bargatin, S. Labarthe, C. Marcoux, P. Andreucci, S. Hentz, C. Kharrat, E. Colinet, and L. Duraffourg, Nanotechnology 21 (2010) 165504

Patent

- brevet sur des moyens de transduction pour les NEMS à base de matériaux métalliques (déposé mais non publié) – P. Andreucci/P. Brianceau/S. Hentz/L. Duraffourg/C. Marcoux/S. Minoret + E. Myers/M. Roukes

- brevet sur des couches de fonctionnalisation chimique localisée sur des NEMS pour des applications de détection de gaz (déposé mais non publié) – G. Delapierre/Y. Hou + E. Myers/H. McCaig/M. Roukes
- 2 brevets sur des architectures de spectrométrie de masse à base de NEMS (en cours de dépôt) – L. Duraffourg/P. Andreucci + A. Naik/M. Roukes
- brevet sur une architecture de détection/analyse multigaz (en cours de dépôt) – P. Puget + E. Myers/M. Roukes
- brevet sur technique d'intégration hybride de NEMS – T. Ernst/P. Andreucci/E. Colinet / L. Duraffourg + M. Roukes

Cellulose Hybrid block copolymers / Projet RTRA

Post doctorant : Karim AISSOU

COMMUNICATION

- *"Chemistry and Self-Assembly Properties"*

I. Otsuka, K. Fuchise, A. Narumi, S. Halila, S. Fort, T. Kakuchi, R. Borsali, Methods in Polymer and Materials Science EUPOC 2009 "Hybrid Oligosaccharide-Poly(N-isopropylacrylamide) Block Copolymer Systems: 31 May - 4 June, 2009, Gargnano, Lake Garda, Italy

Patent

- *"Auto-organisation de films minces d'amylose(4',4-bipyridine)-bloc-polystyrène pour des applications dans la microélectronique et les nanotechnologies"*

K. Aissou, S. Halila, S. Fort, R. Borsali, T. Baron: French patent submitted by CNRS institute (2009).

PUBLICATION

- *"Thermo-responsive vesicular morphologies obtained by self-assemblies of hybrid oligosaccharide-block-poly(N-isopropylacrylamide) copolymer systems"*

Otsuka, K. Fuchise, S. Halila, S. Fort, K. Aissou, I. Pignot-Paintrand, Y. Chen, A. Narumi, T. Kakuchi and R. Borsali, LANGMUIR, 2010, 26 (4), pp 2325–2332.

NEP-IV (New Electronic Properties with Group Four Nanowires) / projet RTRA

PUBLICATIONS

- *"The morphology of silicon nanowires grown in the presence of trimethylaluminium"*,

F Oehler, P Gentile, T Baron, M Den Hertog, J Rouvière and P Ferret, Nanotechnology 20 (2009) 245602,

- *"Recombination Dynamics of Spatially Confined Electron-Hole System in Luminescent Gold Catalyzed Silicon Nanowires"*,

O. Demichel, V. Calvo, N. Pauc, A. Besson, P. Noé', F. Oehler, P. Gentile, and N. Magnea, Nanoletters 2009 Vol. 9, No. 7 2575-2578,

- *"Photoluminescence of confined electron-hole plasma in core-shell silicon/silicon oxide nanowires"*

O. Demichel, F. Oehler, P. Noé, V. Calvo, N. Pauc, P. Gentile, T. Baron, D. Peyrade, and N. Magnea, Appl. Phys.Lett. 93, 213104 (2008),

- *"Three-Dimensional Real-Space Simulation of Surface Roughness in Silicon Nanowire FETs"*

C. Buran, M.G. Pala, M. Bescond, et al. ,IEEE-Transactions on Electron Devices 56, 2186 (2009),

- *"Phonon- and surface-roughness-limited mobility of gate-all-around 3C-SiC and Si nanowire FETs"*

K. Rogdakis, S. Poli, E. Bano, K. Zekentes, and M.G. Pala, Nanotechnology 20, 295202 (2009),

- *"Self-connected horizontal silicon nanowire field effect transistor. "*

B. Salem ,F. Dhalluin, H. Abed, T. Baron, P. Gentile, N. Pauc and P. Ferret, Solid State Communications, 149, p 799 (2009)

COMMUNICATION / CONFERENCES:

- *"Electrical characterization of silicon nanowires FET"*,
B. Salem, H. Abed, F. Dhalluin, M. Panabière, T. Baron, P. Noé, F. Oehler, N. Pauc, P. Gentile, ECS Vienne (Autriche) 2009,
- *"Backscattering coefficient in gate-all-around 3C-SiC nanowire FETs"*,
K. Rogdakis, S. Poli, E. Bano, K. Zekentes, and M.G. Pala, IEEE-NANO 2009, Jul 26-30, Genoa (Italy).

NANOSTAR / Projet RTRA

Doctorants : Bharathi NATARAJAN, Omid FAIZY NAMARAVAR

POSTER

- *"Behaviour of Conical Intersections within Noncollinear"*
"Spin-Flip Time-Dependent Density-Functional Theory: Oxirane as Test Case Conical Intersections and Photochemistry"
Bhaarathi Natarajan, Miquel Huix-Rotllant, Andrei Ipatov, C. Muhavini Wawire, Thierry Deutsch, and Mark E. Casida, DFT09 International Conference(2009), Lyon, August 31 – September 4

Neuro FETs /Projet RTRA

Post doctorant : Libertad ABAD MUNOZ

COMMUNICATIONS

- *"Achieving in vitro axonal polarization by using micropatterns"*,
S. Roth, J. Brocard, S. Gory- Fauré, C.Villard, APS March meeting, mars 2009, Pittsburg, USA
- *"Neurones sur motifs d'adhésion : vers un contrôle de la polarisation axonale"*,
Sophie Roth, Jacques Brocard, Ghislain Bugnicourt, Sylvie Gory-Fauré, et Catherine Villard. Conférence de la Société Française de Physique, Juillet 2009, Palaiseau.

A DC – to THZ cryogenic platform for new generation of nano-detectors / Projet JeuneEntrant

A.Monfardini

Post doctorant : Loren Swenson

PUBLICATIONS

- *"In situ measurement of the permittivity of helium using microwave NbN resonators"*
G. J. Grabovskij, L. J. Swenson, O. Buisson, C. Hoffmann, A. Monfardini, and J.-C. Villégier, Applied Physics Letters 93, 134102 (2008)
- *"Kinetic inductance detectors development for MM-wave astronomy"*
A. Monfardini, L. J. Swenson, A. Benoit, A. Bideau, G. Bres, P. Camus, G. Garde, C. Homann, J. Minet, H. Rodenas and the NIKA collaboration, EAS Publications Series, Vol. ?, 2009
- *"A Fast, Ultra-Sensitive and Scalable Detection Platform Based on Superconducting Resonators for Fundamental Condensed-Matter and Astronomical Measurements"*
L. J. Swenson, J. Minet, G. J. Grabovskij, O. Buisson, F. Lecocq, C. Hoffmann, P. Camus, J.C. Villégier, S. Doyle, P. Mauskopf, M. Roesch, M. Calvo, C. Giordano, S.J.C. Yates, A.M. Baryshev, Y. J.J.A. Baselmans, A. Benoit, A. Monfardini, in Proc. 13th Int. Workshop on Low Temperature Detectors (LTD-13), AIP Conf. Proc. 1185, 84 (2009).
- *"Readout for large arrays of Microwave Kinetic Inductance Detectors using a Fast Fourier Transform Spectrometer"*
S. J. C. Yates, J. J. A. Baselmans, A. M. Baryshev, Y. J. Y. Lankwarden, L. Swenson, A. Monfardini, B. Klein and R. Güsten, LTD 13, Proceedings of the 13th International Workshop on Low Temperature

Detectors, Edited by B.Cabrera, A.Miller, and B.Young in Proc. 13th Int. Workshop on Low Temperature Detectors (LTD-13), AIP Conf. Proc. 1185, 249 (2009).

- "Optimisation of lumped-element kinetic-inductance detectors for use in ground based large arrays,"

S. Doyle, P. Mauskopf, J. Zhang, S. Withington, D. Goldie, L. J. Swenson, A.Monfardini and D. Glowacka, in Proc. 13th Int. Workshop on Low Temperature Detectors (LTD-13), AIP Conf. Proc. 1185, 156 (2009).

- *Kinetic inductance detectors development for mm-wave astronomy,"*

A. Monfardini, L. J. Swenson, A. Benoit, A. Bideau, G. Bres, P. Camus, G. Garde, C.Hoffmann, J. Minet, H. Rodenas and the NIKA collaboration, "Astrophysics Detector Workshop 2008, P. Kern (ed), EAS Publications Series, 37 (2009) 95-9.

- "In situ measurement of the permittivity of helium using microwave NbN resonators,"

Grabovskij, G. J.; Swenson, L. J.; Buisson, O.; Hoffmann, C.; Monfardini, A.; Villégier, J.-C., Applied Physics Letters, Volume 93, Issue 13, 134102 (2008).

COMMUNICATIONS

- "A Fast, Ultra-Sensitive and Scalable Detection Platform Based on Superconducting Resonators for Fundamental Condensed-Matter and Astronomical Measurements"

L. J. Swenson and J. Minet and G. J. Grabovskij and O.Buisson and F. Lecocq and C. Hoffmann and P. Camus and J.-C.Villegier and S. Doyle and P. Mauskopf and M. Roesch and M. Calvo and C.Giordano and S. J. C. Yates and A. M. Baryshev and J. J. A.Baselmans and A. Benoit and A. Monfardini editor = Betty Young and Blas Cabrera and Aaron Miller, 13th International Workshop on low temperature detectors (2009), Stanford (USA)

- "Readout for large arrays of Microwave Kinetic Inductance Detectors using a Fast Fourier Transform Spectrometer "

S. J. C. Yates and J. J. A. Baselmans and A. M. Baryshev and Y. J.Y. Lankwarden and L. Swenson and A. Monfardini and B. Klein and R.Gusten, 13th International Workshop on low temperature detectors (2009), Stanford (USA)

Dentritic potentials imaging by second harmonic generation / Projet Jeune Entrant Julien Douady
Post doctorant : Hartmut WEGE

PUBLICATION

- "Neutral push-pull chromophores for nonlinear optical imaging of cell membranes"

Cyril Barsu, Rouba Cheaib, Stéphane Chambert, Yves Queneau, Olivier Maury, Davy Cottet, Hartmut Wege, Julien Douady, Yann Bretonnière and Chantal Andraud, *Org. Biomol. Chem.*, 2010, 8, 142-150

POSTER

- "Second harmonic generation microscopy : a way to study neuronal potentials"

"TOPIM – European Society for Molecular Imaging" Davy Cottet, Hartmut Wege, Julien Douady, Jean-Claude Vial, Jonathan Coles, Mireille Albrieux, Patrick Mouche), Yann Bretonnière, Chantal Andraud, Catherine Villard. "TOPIM – European Society for Molecular Imaging", Ecole Thématique "Dual and Innovative Imaging Modalities", Les Houches – 26-30 janv. 2009

Computational modelling of novel nanostructured thermoelectric materials /

Projet Jeune Entrant N. Mingo
Post doctorant : Shidong WANG

COMMUNICATION / CONFERENCES:

- Invited talk, *First-principles thermal transport calculations*, at Minatec Crossroads, Grenoble, 2008.

- Invited talk, *Quantum Mechanical Description of Phonon Transport Through Atomically Defined Systems*, MRS meeting, San Francisco, 2007.
- Invited talk, *Lattice thermal transport through atomically defined systems in a quantum mechanical description*. APS March meeting, Denver, 2007.
- *The "Nanoparticle in Alloy" Approach to Efficient Thermoelectrics: Silicides in SiGe*, N. Mingo et al, MRS, San Francisco, 2009.
- *Tailoring Interface Roughness and Superlattice Period Length in Novel Electron Filtering Thermoelectric Materials*. Shidong Wang and Natalio Mingo, MRS, San Francisco, 2009.
- *Predicting the Very Low Thermal Conductivity of Carbon Nanotubes Junctions Using Atomistic Green's Functions*. Chalopin Yann, Volz Sebastian and Natalio Mingo. MRS, San Francisco, 2009.
- *The impact of isotopes on the thermal conductivity of boron nitride nanotubes*, (poster) D. A. Stewart, I. Savic, N. Mingo, 6th Japan-US Joint Seminar on Nanoscale Transport Phenomena, Boston, MA, July 15th, 2008.
- *Thermal conduction mechanisms in isotope-disordered boron nitride and carbon nanotubes*, I. Savic, N. Mingo, D. Stewart, APS meeting, 2009.
- *"A first principles perspective on thermal transport in nanostructures with defects"*, D. A. Stewart, I. Savic, N. Mingo, APS March Meeting, New Orleans, March 12th, 2008.
- *Disorder and geometry effects in thermal transport across an interface in semiconductor nanowires* I. Savic, N. Mingo, MRS Meeting, San Francisco, 2008

COMMUNICATION / WORKSHOPS

- Invited talk, CECAM workshop on structural, electronic and transport properties of quantum wires, Lyon, 2008.

PATENTS

- *"Silicide nanoparticle in silicon germanium matrix nanocomposites for silicon compatible thermoelectric energy conversion"*, N. Kobayashi, N. Mingo, M. Plissonnier, and A. Shakouri, international patent filed, PCT/2008/001020, 11 July 2008.
- *"Magnesium based nanocomposite materials for thermoelectric energy conversion"*, Natalio Mingo, Marc Plissonnier, Shidong Wang, PCT/FR2009000392 provisional number, Date : 2/04/2009.
- *"Micro-structure pour générateur thermoélectrique à effet Seebeck et procédé de fabrication d'une telle micro-structure"*, N. Mingo, T. Caroff, M. Plissonnier, V. Remondiere, S. Wang, N° E.N. :09 53930, Date: June 12, 2009.

PUBLICATIONS

- *"Cooling electrons one by one."*
S. De Franceschi, N. Mingo, Nature Nanotechnology 2, 538 (2007).
- *"Intrinsic lattice thermal conductivity of semiconductors from first principles."*
D. A. Broido, M. Malorny, G. Birner, Natalio Mingo, D. A. Stewart, Appl. Phys. Lett. 91, 231922 (2007).
- *"Thermal conduction mechanisms in boron nitride nanotubes: few-shell or all-shell?"*
I. Savic, D. A. Stewart, and N. Mingo, Physical Review B, 78 235434 (2008).
- *"Phonon transport in isotope-disordered carbon and boron-nitride nanotubes: is localization observable?"*
I. Savic, N. Mingo, and D. A. Stewart, Phys. Rev. Lett. 101, 165502 (2008).
- *"Phonon transmission through defects in carbon nanotubes from first principles."*
N. Mingo, D. A. Stewart, D. A. Broido, and D. Srivastava, Phys. Rev. B 77, 033418 (2008).
- *"Phonon thermal transport in bulk and nanostructured materials from first principles.."*

D. A. Broido, N. Mingo, and D. A. Stewart, IMECE 2008-67049 (2008).

- *"Carbon Nanotube MicroArchitecture for Enhanced Thermal Conduction at Ultra-Low Mass Fraction in Composite Materials"*.

M. Bozlar, D. He, J. Bai, Y. Chalopin, N. Mingo, and S. Volz, *Adv. Mat.*, 22, 1654 (2009).

- *"Improved thermoelectric properties of $Mg_2Si_xGe_ySn_{1-x-y}$ nanoparticle in alloy materials."*

S. Wang and N. Mingo, *Appl. Phys. Lett.* 94, 203109 (2009).

- *"Lattice thermal conductivity of single-walled carbon nanotubes: Beyond the relaxation time approximation and phonon-phonon scattering selection rules"*

L. Lindsay, D.A. Broido, and Natalio Mingo, *Phys. Rev. B* 80, 125407 (2009).

- *"Reducing the thermal conductivity of carbon nanotubes below the random isotope limit."*

Gabriel Stoltz, Natalio Mingo, Francesco Mauri, *Phys. Rev. B* 80, 113408 (2009).

- *"Mesoscopic Size Effects on the Thermal Conductance of Silicon Nanowire."*

J. S. Heron, T. Fournier, N. Mingo, and O. Bourgeois, *Nano Letters* 9, 1861 (2009).

- *"Interface heat transfer between crossing carbon nanotubes, and the thermal conductivity of nanotube pellets."*

Y. Chalopin, S. Volz, and N. Mingo, *Journal of Applied Physics*, 105, 084301 (2009).

- *"Turning carbon nanotubes from exceptional heat conductors into insulators."*

R. S. Prasher, X.J. Hu, Y. Chalopin, N. Mingo, K. Lofgreen, S. Volz, L. F. Cleri, and P. Keblinski, *Phys. Rev. Lett.*, 102, 105901 (2009).

- *"The nanoparticle in alloy approach to efficient thermoelectrics: silicides in SiGe."*

N. Mingo, D. Hauser, N. P. Kobayashi, M. Plissonnier, and A. Shakouri, *Nano Letters* 9, 711 (2009).

- *"Effects of interface roughness and superlattice period length on thermoelectric electron filtering."*

S. Wang and N. Mingo, *Phys. Rev. B*, 79, 115316 (2009).

- *"First-Principles Calculation of the Magnitude of the Isotope Effect on Boron Nitride Nanotube Thermal Conductivity."*

D. A. Stewart, I. Savic, and N. Mingo, *Nano Letters*, 9, 81 (2009).

- *"Marked effects of alloying on the thermal conductivity of nanoporous materials"*.

C. Bera, N. Mingo, and S. Volz, *Phys. Rev. Lett.*, 104, 115502 (2010).

- *Precise control of thermal conductivity at the nanoscale via individual phonon barriers.*

G. Pernot, M. Stoffel, I. Savic, A. Jacquot, J. Schumann, G. Savelli, A. Rastelli, O.G. Schmidt, J. M. Rampnoux, S. Dilhaire, M. Plissonnier, S. Wang, and N. Mingo, *Nature Materials*, accepted (2010).

- *"Cluster" isotope effects on phonon conduction: the case of graphene."*

N. Mingo, K. Esfarjani, D. A. Broido, and D. A. Stewart, *Phys. Rev. B*, 81, 045408 (2010)

- *Two-Dimensional Phonon Transport in Supported Graphene.*

J. H. Seol, I. Jo, A. L. Moore, L. Lindsay, Z. H. Aitken, M. T. Pettes, X. Li, Z. Yao, R. Huang, D. Broido, N. Mingo, R. S. Ruoff, and L. Shi, *Science*, 328, 213 (2010).

BOOK CHAPTER

N. Mingo, to appear within the series "Topics in Applied Physics", Springer (2009), *Phonon transport through nano-contacts by Green's function methods*.

UHV – CVD growth and measuring equipment– Projet JE Tobias Shulli
Post doctorant : Valentina CANTELLI

PUBLICATION

- *"Substrate-enhanced supercooling in AuSi eutectic droplets"*

T.U. Schüllli, R. Daudin, G. Renaud, A. Vaysset, O. Geaymond & A. Pasturel, *Nature*, le 22 avril 2010

Call for proposals 2008

Implantable computer-brain interface / Chaire d'excellence Tetiana AKSENOVA

Doctorant : Andrey YELISYEYEV

CONFERENCES

- *"Filtrage spatial robuste à partir d'un sous-ensemble optimal d'électrodes en BCI EEG"*
Barachant A., Aksenova T., Bonnet S, Proceedings of 22e Colloque GRETSI, Dijon, France, Septembre 2009
- *"RPNN: Structural modeling robust to outliers in input and output variables, Proceedings of International Conference on Intelligent Information and Engineering Systems"*
Shaposhnyk V., Villa A.E.P., Aksenova T., INFOS 2009, Krynica, Poland, Septembre 2009
- *"Filtering of Multichannel Recordings of Neuronal Activity during Deep Brain Stimulation"*
Aksenova TI, Nowicki DV, Benabid AL. Frontiers in Neuroinformatics. Septembre 2009

COMMUNICATION / SEMINAIRE

- *"Brain computer interface : from laboratory to real life applications"*
Tetiana AKSENOVA, Séminaire de la Fondation nanosciences, le 26/11/2009, Grenoble

PUBLICATION

- *"Filtering out of Artifacts of Deep Brain Stimulation Using Nonlinear Oscillatory Model"*
Aksenova, T.I., Novicki D.V., Benabid A.-L., Neural Computation, 21, 2648–2666, (2009)

Tunneling-based nano-FETs / Chaire d'excellence Alexander Zaslavsky

Doctorant : Jing WAN

PUBLICATIONS

- *"Tunneling field-effect transistor with epitaxial junction in thin germanium-on-insulator,"*
D. Kazazis, P. Jannaty, A. Zaslavsky, C. Le Royer, C. Tabone, L. Clavelier, and S. Cristoloveanu, Appl. Phys. Lett. 94, 263508 (2009).
- *"GeOI as a platform for ultimate devices,"*
W. Van Den Daele, S. Cristoloveanu, E. Augendre, C. Le Royer, J.-F. Damlencourt, D. Kazazis, and A. Zaslavsky, chapter in: S. Luryi, J. M. Xu, and A. Zaslavsky, eds, Future Trends in Microelectronics: From Nanophotonics to Sensors to Energy, New York: Wiley, 2010.

EPOCA Emission Properties Of a semiconducting Cavity coupled to an Artificial atom / Chaire

d'excellence Marcelo Franca Santos

Doctorant : Daniel VALENTE

PUBLICATION

- *"Pure emitter dephasing: A resource for advanced solid-state single-photon sources"*
A.Auffèves, JM.Gérard and JP.Poizat, Phys. Rev. A 79, 053838 (2009)

POLYSUPRA / Projet RTRA

PUBLICATION

- *"Soluble Heterometallic Coordination Polymers Based on a Bis-terpyridine-Functionalized Dioxocyclam Ligand"*

Production Scientifique des Doctorants "au fil de l'eau"

Mikhail KUSTOV

POSTERS

- *"Diamagnetic levitation applied to the μ -manipulation of μ - and nanoobjects and biological cells"*

Christian Pigot, Paul Kauffmann, Hichem Chetouani, Mikhail Kustov, *Minatec Crossroads 2008*, Grenoble, FRANCE, June 23-27, 2008

- *"Quantitative imaging and straightforward calculation of magnetic fields of micropatterned permanent magnet films for magnetic MEMS"*

Mikhail Kustov, Rostislav Grechishkin, Frederic Dumas-Bouchiat, and Nora M. Dempsey, *JCGE (Conférence des Jeunes Chercheurs en Génie Electrique)*, Lyon, France, December 16-17, 2008

- *"Modeling a "flying carpet" stable in both the positive and negative z-directions" **

Mikhail Kustov, Paul Kauffmann, Orphee Cugat, Gilbert Reyne, *Compumag 2009*, Florianopolis, Brésil, November 22-26, 2009

- *"Measurement of the 3 components of a magnetic field using a single component Scanning Hall Probe Microscope"*

Mikhail Kustov, Nora M. Dempsey, Piotr Laczkowski, Danny Hykel, Dominique Givord, Orphée Cugat, Rostislav Grechishkin and Klaus Hasselbach, *EMSA 2010 (8th European Conference on Magnetic Sensors and Actuators)*, Bodrum, Turquie, July 4-7, 2010, (accepted)

COMMUNICATIONS

- *"Comparative magneto-optic and scanning Hall probe microscopy of magnetic field distributions in patterned Nd-Fe-B films"*

Mikhail Kustov, Rostislav Grechishkin, Frederic Dumas-Bouchiat, Daniel O'Brien, Klaus Hasselbach, Piotr Laczkowski, Danny Hykel, Sergey Soshin, Dominique Givord, and Nora M. Dempsey *EUROMAT 2009 (European Congress and Exhibition on Advanced Materials and Processes)*, Glasgow, UK September 7-10, 2009

PUBLICATIONS

- *"Thermomagnetically patterned micromagnets"*

F. Dumas-Bouchiat, L. F. Zanini, M. Kustov, N. M. Dempsey, R. Grechishkin, K. Hasselbach, J. C. Orlianges, C. Champeaux, A. Catherinot, D. Givord, *Appl. Phys. Letters*, 96, 102511 (2010)

- *"Contactless dielectrophoretic handling of diamagnetic levitating water droplets in air"*

P. Kauffmann, P. Pham, A. Masse, M. Kustov, T. Honegger, D. Peyrade, V. Haguët, G. Reyne, *IEEE Trans. on Magn.*, 2010 (accepted)

Irina GROZA

POSTERS

- *"Transport measurements with nanometric magnetic clusters"*

Irina Groza, Robert Morel, Ariel Brenac, Damien Le Roy and Lucien Notin, Réunion Thématique du GDR Nanoalliages-Nanoalliages&Magnétisme, 19-20 janvier 2009, Lyon

- *"Correlations in core-shell clusters"*

Irina Groza, Robert Morel, Ariel Brenac, Damien Le Roy and Lucien Notin, European School on Magnetism, September 1-10th 2009, Timisoara, Romania

- *"Corrélations magnétiques dans les agrégats Co-CoO"*

Irina Groza, Robert Morel, Ariel Brenac, Cyrille Beigné et Lucien Notin, Colloque Louis Néel 2010, du 31 mars - 2 avril, Albé (2010)

Akash CHAKRABORTY

COMMUNICATION

- *"Magnetic Spin Excitations in Diluted Ferromagnetic Systems"*

Akash Chakraborty, Georges Bouzerar, workshop "New trends in the theory of strongly correlated electron systems", 8-9 Avril, 2010

PUBLICATION

- *"Dynamical properties of a three-dimensional diluted Heisenberg model"*

Akash Chakraborty, Georges Bouzerar, Physical Review B, 81, 172406 (2010)

Xiaojun CHEN

COMMUNICATIONS

- The 4th Nanowire Growth Workshop, Oct. 26-27, 2009, Paris :Poster contribution
- The 3rd international symposium on the Growth of Nitride Materials July-4th-7th, 2010, Montpellier :Oral presentation contribution

PUBLICATIONS

- *"Pyramid/wire shape of GaN Nanostructures induced by Ga-/N-polarity"*

X.J. Chen, G. Perillat-Merceroz, C. Durand, J. Eymery (Submitted to Appl. Phys. Lett.)

- *"Selective area growth of GaN hexagonal nanoprisms on patterned c-sapphire substrates"*

X.J. Chen, J.S. Hwang, G. Perillat-Merceroz, D. S. Landis, D. Le Si Dang, J. Eymery, C. Durand (Submitted to J. of Appl. Phys.)

Miryam ELOUNEG JAMROZ

POSTER

- *"CdSe Quantum Dots Insertion in ZnSe Nanowires: MBE Growth and Microstructural Analysis"*

Miryam Elouneg-Jamroz, Y. Genuist, E. Bellet-Amalric, C. Bougerol, Samir Bounouar, J.P. Poizat, R. André, Martien den Hertog, K. Kheng and S. Tatarenko, GDR Nanofils 2009, Autrans (France)

PUBLICATION

- *"Epitaxial growth of ZnSe and ZnSe/CdSe Nanowires on ZnSe"*

E. Bellet-Amalric, M. Elouneg-Jamroz, C. Bougerol, M. Den Hertog, Y. Genuist, S. Bounouar, J.P. Poizat, K. Kheng, R. André, S. Tatarenko, Physica Status Solidi 2010 (sous presse)

Chi VO VAN

COMMUNICATION

- *"Ultrathin epitaxial cobalt films on graphene: perpendicular magnetic anisotropy"*

C.Vo-Van, Z.Kassir-Bodon, H.Yang, J.Coraux, J.Vogel, S.Pizzini, P.Bayle-Guillemaud, M.Chshiev, L.Ranno, V.Santonacci, P.David, V.Salvador, O.Fruchart., XIII Colloque Louis Néel, Albé (2010)

nano SCIENCES
FONDATION



Nanosciences Foundation
23 rue des Martyrs, F-38000 Grenoble
accueil@fondation-nanosciences.fr
Tél. : +33 (0)4 56 52 96 28 – Fax : +33 (0)4 56 52 96 98
www.fondation-nanosciences.fr