INTERNATIONAL IBERIAN NANOTECHNOLOGY LABORATORY

BACKGROUND

Background Information

Information on Nanotechnology

The concept of nanotechnology and its main implications

In a simple way, nanotechnology is the science and technology that works at an atomic or molecular level and involves working with particles at a nanometer scale. A nanometer is one billionth of a meter, and the nanoscale world has been in the past few years an object of research and utilization due to its enormous influence, value, and significance.

Nanotechnology has the potential to profoundly change our economy and to improve our standard of living, just as the impact the information technology has had in the past two decades. Numerous products featuring unique properties of nanoscale materials are already available to consumers and industry today. Most computer hard drives, for instance, contain giant magneto resistance (GMR) heads that, through nano-thin layers of magnetic materials, allow for a significant increase in storage capacity. Some other current uses that are already in the marketplace include catalysis, which are coatings for easier cleaning or glare-reducing. It is likely that solar cells can be significantly improved with nanotechnology. The pharmaceutical and chemical industries are also being impacted by nanotechnology, both on advanced drug delivery systems and medical diagnostic tools. For instance, a new range of medical treatments is arising for certain diseases such as Alzheimer's and brain tumors.

Today it is clear that nations most actively participating in the international effort to harness nanoscience and nanotechnology will benefit earlier and to a greater extent from their benefits and will be able to play a leading role in the scientific, technical, and economic cooperation with other advanced regions as well as with less-developed nations in Latin America and Asia.

Av. José Mestre Veiga
4715-310 Braga - Portugal
Tel. + 351 253 601 550
Fax + 351 253 601 559
office@inl.int
www.inl.int

INTERNATIONAL IBERIAN
NANOTECHNOLOGY
LABORATORY

Societal impact of nanotechnology

A crucial part of the mission of INL will be to enhance public awareness about nanoscience and technology and to address the ethical, social, and environmental impact of nanotechnology. INL will at all times drive a strong program of public outreach, popularizing nanoscience and strategic nanotechnology, approaching mass media, science and technology museums, foundations, and publishers.

Public outreach, both to increase public knowledge about nanoscience and technology, but also to stimulate the young towards science and technology in general, will be an important task of INL. An outreach office will be established, which will form strong connections with schools, universities, and science museums, and collaborate in their activities. INL researchers will be encouraged to dedicate some of their time to the community, in the form of off-site talks, laboratory visits, and demonstrations. INL will hold “open-days,” during which both scheduled and spontaneous visits to the Laboratory will be held.

A “Ciência Viva” Center dedicated to nanotechnology will be built next to the INL facilities and will develop close connections with the INL administration and researchers for the development of its regular activities. This “hands-on” science museum will be part of the network of close to twenty “Ciência Viva” Centers existing throughout Portugal and coordinated by “Ciência Viva,” the National Agency for the Promotion of Scientific and Technological Culture, from its main node located in Lisbon, The Knowledge Pavilion.

Addressing the ethical, social, and environmental impact of a technology with the disruptive potential of nanotechnology is essential. This will be made through the establishment of protocols with social science and environmental departments of major universities. These agreements will put in contact nanoscience and technology researchers, who will be mostly engineers, chemists, physicists, or biologists, with social scientists and environmental engineers. These teams will be able to have the necessary technical expertise to tackle all the complex issues involved.

Av. José Mestre Veiga
4715-310 Braga - Portugal
Tel. + 351 253 601 550
Fax + 351 253 601 559
office@inl.int
www.inl.int

INTERNATIONAL IBERIAN
NANOTECHNOLOGY
LABORATORY

The International Iberian Nanotechnology Laboratory

In November 2005, at the XXI Portugal-Spain Summit that took place in Évora, the Governments of Spain and Portugal announced the decision to build an International Research Laboratory on Nanotechnology. It was decided that the International Iberian Nanotechnology Laboratory (INL) would be located in Braga, Portugal and would have as its first Director-General Professor José Rivas from the University of Santiago de Compostela, Spain.

The main goal of this Laboratory is to undertake ground-breaking scientific research in specific areas of nanoscience and nanotechnology, such as nanomedicine, and applications from environmental monitoring to food quality control.

INL will closely network with universities, research centers, and businesses to enhance the collaboration within an extended institutional "ecosystem" for the achievement of excellent high-impact research and for identifying key innovative profit-oriented projects.

Taking advantage of its special status as a research organization established under international law, INL has the optimal framework for bringing together researchers from different countries in the world, for being a particularly adequate site of collaboration of different nations for major nanotechnology joint programs, and for establishing strong connections with investors from any part of the world willing to fund spin-off enterprises or other ways of commercializing research results.

Legal Framework

INL is a research organization created under international law. It is an international organization (such as CERN in Geneva, Switzerland, EMBL in Heidelberg, Germany, ESO in Gärching, Germany, and La Silla, Chile, ESRF in Grenoble, France, etc.) created to develop research in nanotechnology.

Av. José Mestre Veiga
4715-310 Braga - Portugal
Tel. + 351 253 601 550
Fax + 351 253 601 559
office@inl.int
www.inl.int

INTERNATIONAL IBERIAN NANOTECHNOLOGY LABORATORY

The INL executive management is headed by a Director-General and a Deputy Director-General who answer to a Council of three representatives of each member state.

The INL international legal framework enables it to have two characteristics that will make the laboratory attractive for top-level scientists:

- Flexibility: being an international organization, INL has an autonomy and independence that allows an efficient management of its tangible an intangible resources;
- It is the first international research organization in the world focused on nanotechnology, and the first such organization in the Iberian Peninsula of any area.

The Council

The INL Council is presently composed by six members, three named by the Portuguese Ministry of Science, Technology, and Higher Education-

- Luis Magalhães- President of the Council of INL, President of the Knowledge Society Agency (UMIC)
- João Sentieiro- President of the Science and Technology Foundation (FCT)
- Carolina Rego Costa- legal advisor to the Minister of Science, Technology, and Higher Education

And other three members named by the Spanish Ministry of Science and Innovation-

- Montserrat Torné- Vice-President of the Council of INL, Director-General of International Cooperation and Institutional Relations
- José Manuel Labastida- Director-General of Research and the National R+D+i Plan
- Fernando Briones- Research Professor of the Agency “Consejo Superior de Investigaciones Cientificas” (CSIC).

Av. José Mestre Veiga
4715-310 Braga - Portugal
Tel. + 351 253 601 550
Fax + 351 253 601 559
office@inl.int
www.inl.int

INTERNATIONAL IBERIAN
NANOTECHNOLOGY
LABORATORY

The Executive Management

The INL executive management is composed of

- a Director-General: Professor José Rivas and
- a Deputy Director-General: Professor Paulo Freitas.

The International Advisory Board

A research laboratory in the forefront of knowledge and technology needs the advice of leading experts in its field. The following experts accepted to serve on the International Advisory Board of the International Iberian Nanotechnology Laboratory:

Roberto G.M. Caciuffo

Laurea (cum laude) in Nuclear Engineering, Torino, Italy
PhD (cum laude) in Solid State Physics, Parma, Italy
Head Actinide Research
European Commission Directorate General Joint Research Centre, Institute for Transuranium Elements,
Postfach 2340, D-76125 Karlsruhe, Germany

Thomas Jovin

B.S. California Institute of Technology, Pasadena, CA, USA
M.D. Johns Hopkins Medical School, Baltimore, MD, USA
Scientific Member, Max Planck Society
Head of Department of Molecular Biology
Max-Plank Institute for Biophysical Chemistry, Am Fassberg 11, 37077 Göttingen, Germany

Emilio Mendez

PhD Massachusetts Institute of Technology, USA
Prize Príncipe de Asturias of Scientific and Technical Research 1998
Since November 1, 2006, Director of the recently created Center for Functional Nanomaterials, one of the five nanocenters funded by the USA Department of Energy at the Brookhaven National Laboratory that started operations by mid-2007

Av. José Mestre Veiga
4715-310 Braga - Portugal
Tel. + 351 253 601 550
Fax + 351 253 601 559
office@inl.int
www.inl.int

INTERNATIONAL IBERIAN NANOTECHNOLOGY LABORATORY

Undergraduate Program Director, Department of Physics and Astronomy, State University of New York at Stony Brook
Nicholls Road, Stony Brook,
NY 11794-3800, USA

Christopher B. Murray

B.Sc. Saint Mary's University, Halifax, Nova Scotia, Canada
PhD Massachusetts Institute of Technology, USA
American Chemical Society's Nobel Laureate Signature Award in 1997
Woodward Fellow by Harvard University Chemistry Department in 2004
Debye Chair Professor, University of Utrecht, the Netherlands in 2004
Manager, Nanoscale Materials and Devices, IBM Corp, T. J. Watson Research Ctr., Yorktown Heights NY 10598, USA, from 1995 to 2006
Richard Perry University Professor at the University of Pennsylvania at Philadelphia, with appointments in chemistry in the School of Arts and Sciences and in materials science in the School of Engineering and Applied Science, since 2006.

Comentário: Is this a Bachelor's of Science? Unless Canada labels it differently, then it should read "B.S."

Aristides A. G. Requicha

Electrical Engineer, Instituto Superior Técnico, Technical University of Lisbon, Portugal
PhD in Electrical Engineering, University of Rochester, USA
Gordon Marshall Professor of Computer Science and Electrical Engineering
Director of the Laboratory for Molecular Robotics, nominated in November 2006 as Editor-in-Chief of the IEEE Transactions on Nanotechnology
Director of the Laboratory for Molecular Robotics (LMR) at the University of Southern California
Computer Science Department, University of Southern California, 941 Bloom Walk, Los Angeles, CA 90089-0781, USA

Mihail C. Roco

PhD, Received the Carl Duisberg Award in Germany, the Burgers Professorship Award in the Netherlands, the Engineer of the Year Award (twice: 1999 and 2004) by the US National Society of Professional Engineers and NSF
Was one of the main architects of the US National Nanotechnology Initiative

Av. José Mestre Veiga
4715-310 Braga - Portugal
Tel. + 351 253 601 550
Fax + 351 253 601 559
office@inl.int
www.inl.int

INTERNATIONAL IBERIAN NANOTECHNOLOGY LABORATORY

Chair of US National Science and Technology Council's subcommittee on Nanoscale Science, Engineering, and Technology
Coordinator of the NSF initiative Grant Opportunities for Academic Liaison with Industry
Senior Advisor for Nanotechnology
National Science Foundation
4201 Wilson Boulevard, Suite 505, Arlington, Virginia 22230, USA

Heinrich Rohrer

Nobel Prize in Physics 1986 for the invention, with Gerd Binnig, of the Scanning Tunneling Microscope while working at the IBM Zürich Research Laboratory
Rebbergstr. 9d, CH 8832 Wollerau, Switzerland

Staff

INL shall have a staff of 200 researchers, including around 25% of tenured positions (the remaining, up to 200, would be associate or visiting researchers and post-doctoral candidates). With an additional 100 PhD students and about 100 technicians, administrative personnel, and other auxiliary personnel, the final head count will be around 400.

Funding of the INL Facilities

The INL facilities are funded by Portugal and Spain in equal parts and count with the co-funding of European Funds for 2007-2013 managed by the two countries and coming from two sources: the Transborder Portugal-Spain Operational Program (POCTEP 2007-2013), which includes a major part of the Spanish contribution, and the Portuguese North Regional Operational Program (PO NORTE).

Milestones

November 19, 2005

Decision of the governments of Portugal and Spain to create the INL: taken at the XXI Portugal-Spain Summit in Évora, Portugal, having in mind the goal of strengthening scientific cooperation with a high international impact between the two countries.

Av. José Mestre Veiga
4715-310 Braga - Portugal
Tel. + 351 253 601 550
Fax + 351 253 601 559
office@inl.int
www.inl.int

INTERNATIONAL IBERIAN NANOTECHNOLOGY LABORATORY

It was decided that INL would be located at Braga, Portugal, its first director-general would be Professor José Rivas of the University of Santiago de Compostela, Spain, and it would be designed to accommodate 200 researchers and 400 people including technicians, administrative staff, PhD students, and Post-doctoral candidates.

A bilateral Technical Commission, formed by the heads of the main agencies of the Ministries of Science of both countries and co-coordinated by Luis Magalhães, President of the Knowledge Society Agency, on the part of Portugal, and by Francisco Marcellan, Secretary-General of Scientific and Technological Policy, on the part of Spain, was charged with preparing a detailed proposal with the definition of the main orientations, including the initial lines of the scientific and technical activities to be developed, the model of organization and functioning of the new laboratory, its funding needs, partnerships to be created, and the modalities and timeline for its installation.

The report prepared by this Technical Commission included, among other aspects, the proposal that the laboratory activities be concentrated in particular areas of nanotechnology, namely nanomedicine, environmental monitoring, food quality and safety control, and a proposal of statutes for the INL and orientations for the internal organization and administration. For legal aspects, the Commission counted on the advice of Jean-Marie Dufour, Professor of the Law School of the University of Genève and President of the Genève International Academic Network and legal counselor of the main international research organizations already established in Europe (CERN founded in Geneva, Switzerland in 1956, ESO founded in Gärching, Germany in 1962, EMBL inaugurated in Heidelberg, Germany in 1978, and the ESRF created in Grenoble, France in 1988. For the administrative and management aspects, the Commission counted on the collaboration of Helmut Krech, Administrative Director of the ESRF.

October 6, 2006

The initiative was selected to be presented at the 1st seminar of good-practices of the Lisbon Strategy entitled “Excellence and Partnerships for an Innovative Europe,” which had participation at the highest level

Av. José Mestre Veiga
4715-310 Braga - Portugal
Tel. + 351 253 601 550
Fax + 351 253 601 559
office@inl.int
www.inl.int

INTERNATIONAL IBERIAN NANOTECHNOLOGY LABORATORY

of the European Commission and the Lisbon Strategy Coordinators of the European Union Member States.

November 17, 2006

Following a selection process of several proposals for a site for INL by the bilateral Technical Commission and its selection of one of the proposals presented by the municipality of Braga, the Minister of Science, Technology and Higher Education signed with the Braga Mayor an agreement of the free transfer of a municipal piece of land of about 47,500 m^2 in a central area of Braga for the INL campus.

November 25, 2006

The convention was signed by the governments of Portugal and Spain, agreeing on the proposed statutes for the INL: at the XXII Portugal-Spain Summit in Badajoz, Spain. The convention had to go through the process of parliamentary approval in both countries in 2007.

On the same day, research funding agencies in Portugal and Spain jointly opened a call of proposals for collaborative research projects involving research teams from both countries in the main scientific areas chosen for the INL.

March 19, 2007

The Installation Commission of the INL was legally created as a non-profit organization with the following associates: the Knowledge Society Agency (UMIC) and the Science and Technology Foundation (FCT) on the part of Portugal, and the Secretariat-General of Scientific and Technological Policy on the part of Spain and having two votes in the general Assembly for parity reasons.

July 27, 2007

The General Assembly of the Installation Commission of the INL deliberated on the proposal of the Administrative Council to order the Basis of Design (BoD) for the constructions in the INL campus and decided to order two competing BoDs to the two bids ranked 1st and 2nd in the evaluation, namely the proposals of M+W Zander (a German company with vast experience in the construction of nanotechnology clean rooms,

Av. José Mestre Veiga
4715-310 Braga - Portugal
Tel. + 351 253 601 550
Fax + 351 253 601 559
office@inl.int
www.inl.int

INTERNATIONAL IBERIAN NANOTECHNOLOGY LABORATORY

including the recently constructed 133.000 m^2 of clean rooms in Taiwan over a period of 12 months) and HDR (a US company with vast experience in nanotechnology laboratories, including six installations, one in the United Kingdom and the others in the US, among which the Birck Nanotechnology Center at the University of Purdue and the Center for Functional Nanomaterials at the Brookhaven National Laboratory).

November 20-21, 2007

Realization in Braga, under the joint organization of UMIC, FCT, Installation Commission of INL, and the Directorate-General of Research Technology and Development and Directorate-General of Information Society and Media of the European Commission, of the High Level Conference on Nanotechnologies, with the participation of the ministers of science of Portugal and Spain, the two European Commissioners and top level scientists, industrialists, and S&T policy experts in nanoscience and nanotechnology. The conference was particularly relevant because it preceded by just two days the important approval of the Joint Technology Initiatives ENIAC and ARTEMIS with a budget of 5.7 million Euros. On the preceding day, November 19, 2007, 9 committees or councils of several EU programs held their meetings at Braga, including the ICT National Director-Generals Forum.

December 3, 2007

The International Advisory Board met in Lisbon to analyze the activities for the installation of INL.

January 18, 2008

Within the XXIII Portugal-Spain Summit in Braga, at a ceremony held in the INL site in the presence of both heads of government and the large delegations of ministers of both countries present at the Summit, and as the parliamentary approval of the treaty between the two countries regarding the statutes of the new international organization and their promulgation by the Heads of State had been finished in 2007, it was signed between Portugal and INL the Headquarters Agreement granting special privileges and immunities to INL and related individuals, which was to be confirmed by the Portuguese Parliament in June 2008.

Av. José Mestre Veiga
4715-310 Braga - Portugal
Tel. + 351 253 601 550
Fax + 351 253 601 559
office@inl.int
www.inl.int

INTERNATIONAL IBERIAN NANOTECHNOLOGY LABORATORY

The ceremony included the public presentation of the INL buildings "maquette" and the signature of a Memorandum of Understanding between the INL and the IBM Corporation regarding the future joint identification of research projects for possible future collaborations.

May 2008

The members representing Portugal and Spain in the Council of the INL were nominated. During its first meeting, May 28, 2009, the Council nominated Professor José Rivas of the University of Santiago de Compostela as Director-General and Professor Paulo Freitas of the Instituto Superior Técnico of the Lisbon technical University as Deputy Director-General. The INL, as a research organization under international law, began operation. In the same meeting the Council authorized the Director-General to contract the Portuguese National Laboratory of Civil Engineering (LNEC) to provide support to the INL in the launching of tenders for the construction and the monitoring of the construction process, to initiate the preparation of proposals regarding the organization and human resources of the INL, and to pursue the construction of cooperation programs with leading institutions in nanotechnology, namely with the MIT – Massachusetts Institute of Technology- and the Max Plank Institute, for collaboration during the installation phase of the INL.

June 27, 2008

In the third meeting of the Council of the INL, held in Madrid, it was approved the proposal of the Director-General to award the first phase of the construction work to a consortium involving the enterprises Mota Engil and CASAIS.

The construction of the INL Campus began.

October 31, 2008

Following the instructions of the Council of the INL in May 2008, a preliminary meeting between the INL and MIT took place at MIT, having the objective of exploring the possibilities of collaboration of the two institutions in relation with the hiring process of Principal Investigators to the INL and the beginning of their research activities.

Av. José Mestre Veiga
4715-310 Braga - Portugal
Tel. + 351 253 601 550
Fax + 351 253 601 559
office@inl.int
www.inl.int

INTERNATIONAL IBERIAN
NANOTECHNOLOGY
LABORATORY

November 22, 2008

The second meeting of the INL-MIT was held in Lisbon to prepare a long-term agreement of collaboration with strategic objectives and short-term concrete joint initiatives.

January 23, 2009

The second meeting of the International Advisory Board in Braga with the presence of the President of the Council, Luis Magalhães, the Director-General, José Rivas, and the Deputy Director-General, Paulo Freitas. The Board analyzed and thoroughly discussed the installation of the INL and was advised on its development. During the lunch break the Board visited the construction site at length. In its report, the International Advisory Board expressed a strong appreciation for the progress accomplished in the preceding year, for the ongoing construction progress, for the hiring of post-doctoral candidates, the awarding of fellowships to PhD students, and for how the collaboration network with several laboratories in Portugal, Spain, and other countries is being created. It also provided recommendations for the future and encouraged the establishment of special institutional partnerships with institutions like MIT – Massachusetts Institute of Technology- in the US and the Max Plan Institute in Germany, as approved by the Council.

January 26, 2009

The third meeting of INL-MIT was held in Lisbon to prepare a long-term agreement of collaboration with strategic objectives and short-term concrete joint initiatives.

March 1, 2009

In its fifth meeting, held in Lisbon, the Council of the INL approved the proposal the Director-General to award the second and final phase of the construction work to a Luso-Spanish consortium of the enterprises of Mota Engil, CASAIS, and AXIMA.

May 30, 2009

Av. José Mestre Veiga
4715-310 Braga - Portugal
Tel. + 351 253 601 550
Fax + 351 253 601 559
office@inl.int
www.inl.int

INTERNATIONAL IBERIAN
NANOTECHNOLOGY
LABORATORY

The INL and MIT sign an agreement for a joint program for the recruitment of Principal Investigators and for collaboration in highly-promising research themes for the scientific results of major international relevance in nanoscience and nanotechnology. This agreement was possible after detailed preparations that occurred since the Council directed the Director-General to establish negotiations approximately one year before. The agreement aims at hiring 10 Principal Investigators for the INL who, in a period of 5 years, will have periodic work as researchers at MIT and at INL in collaboration projects in jointly-selected themes relevant to nanomedicine and the applications of nanoscience to environment monitoring, energy systems, and food quality control. The agreement was signed by the INL Director-general, José Rivas, and the Dean of the School of Engineering at MIT, Subra Suresh. The Deputy Director-General of INL, Paulo Freitas, will be the INL-MIT Program Director at INL, and its counterpart at MIT will be Anantha Chandrakasan, Director of the Microsystems Technology Laboratory at MIT, who will have the support of Carl Thompson, Director of the Materials Processing Center at MIT.

July 17, 2009

Official ceremony of inauguration of the INL by the President of Portugal and the King of Spain, in the presence of the Prime Minister of Portugal, the President of the Government of Spain, the Minister of Science, Technology, and Higher Education of Portugal, and the Minister of Science and Innovation of Spain. The INL administration and support services begin working at the new facilities. It is the beginning of the phase focused in the international projection of the INL, demonstrating the conclusion of the facilities with the objective of assuring the recruitment of top scientists at a global level, the enlargement of the member states involved in the INL to other countries, the conclusion of the research laboratories requiring the support, and the presence of the researchers to be hired, inclusively for the specification of equipment and special lab requirements. The Installation Commission will be terminated, having a three-month period to terminate ongoing contracts.

Since the beginning of 2007, the INL has established agreements with several nanotechnology laboratories and has hired post-doctoral candidates and provided fellowships to recruited PhD students; it

Av. José Mestre Veiga
4715-310 Braga - Portugal
Tel. + 351 253 601 550
Fax + 351 253 601 559
office@inl.int
www.inl.int

INTERNATIONAL IBERIAN NANOTECHNOLOGY LABORATORY

presently has 17 PhD students, 6 specialized clean room technicians, and 14 Post-doctoral candidates, amounting to a total of about 40 people associated with INL in research and specialized technical support activities.

Mission and Vision

Mission

To advance the frontiers of knowledge in nanoscience and nanotechnology, to develop and transform the associated technologies through research and innovation, human capital development, and collaborative work, and to experience the discovery of new knowledge and the creation of societal value and wealth

Vision

To develop a world-leading nanoscience and nanotechnology international community, to attract the best research talent, fostering entrepreneurship in an exciting international context, and to contribute to general socioeconomic strength based on nanotechnology and its related benefits for the member countries

Goals

- To build an internationally competitive research laboratory.
- To provide a challenging work environment, where people contribute to common objectives while responding to individual needs and aspirations.
- To develop a high-performance organizational model based on the management of competencies and respect for the individual.
- To become a world brand capable of attracting the best talent.
- To create a “smart network” organization, where the built-in talent has the distinct ability to mobilize individual members as well as special groups and the entire institution.

The Scientific Program

Av. José Mestre Veiga
4715-310 Braga - Portugal
Tel. + 351 253 601 550
Fax + 351 253 601 559
office@inl.int
www.inl.int

INTERNATIONAL IBERIAN NANOTECHNOLOGY LABORATORY

The scientific program was prepared by professors José Rivas (U. de Santiago de Compostela) and Paulo Freitas (Instituto Superior Técnico and Instituto de Engenharia de Sistemas e Computadores, Microsistemas e Nanotecnologias – INESC MN, Lisbon), taking into account the recommendations of the INL International Advisory Board and input from selected researchers from Portuguese and Spanish laboratories.

Given the need for research in nanotechnology, this scientific program identified four key areas of research:

NANOMEDICINE

The focus of this theme is the study, design, and fabrication of nanoscale structures and devices for the diagnosis, treatment, and prevention of diseases and genetic disorders. Advanced health technologies will be key drivers of the technological development as the world population ages and as the full impact of the genome and proteome research becomes available.

Nanomedical nanostructures will include: in-situ nanodevices for drug delivery; nanoparticles for selected cell destruction (e.g., hyperthermia in cancer treatment), imaging and diagnostics; biochip platforms for bio-molecular recognition applied to genetic disease diagnosis; DNA, protein, and cell-chips; micro and nano-electrodes for neural and cortical implants; neuroelectronics; new biomedical imaging technologies (miniaturized NMR, MRI); and improved MEG and MCG systems.

This theme has a strong societal impact and will stem from interdisciplinary research between existing teams of engineers, biologists, physicists, physicians, chemists, and others. A strong connection to Bioengineering Departments and Medical Schools of major universities as well as to companies operating in the Biotech, Medical, and Pharmaceutical fields will ensure that the research carried out at the INL has an impact both in the education and in the industry.

Finally, this research theme will involve developing point-of-care micro and nanosystems targeted at environmental quality analysis (air, water, and soil), as well as at conventional and nuclear explosives and other bioterrorism detection devices. These are areas of great societal concern

Av. José Mestre Veiga
4715-310 Braga - Portugal
Tel. + 351 253 601 550
Fax + 351 253 601 559
office@inl.int
www.inl.int

INTERNATIONAL IBERIAN NANOTECHNOLOGY LABORATORY

and enormous economical impact. Developments in these areas can be quickly brought into production and into the market.

ENVIRONMENT MONITORING, SECURITY, AND FOOD QUALITY CONTROL

The development of micro- and nanosystems for environment monitoring and security and food quality control incorporates at a first-stage nano-transducer design and fabrication. These transducers will include micro- and nano-electromechanical systems (MEMS and NEMS) and advanced single/few molecule transducers (based on spintronic, photonic, and electronic detection principles). These transducers will include the necessary chemically and biologically sensitive layers for the specific detection of chemical and biochemical signals.

In the food industry, nanotechnology is being used to create better packaging and healthier foods. For example, researchers are working on creating food packages embedded with tiny materials specifically designed to alert consumers that a product is no longer safe to eat. Food scientists are also anticipating nanomaterials whose small size gives the ability to deliver powerful nutrients to human cells where they previously could not reach. In addition, scientists believe nanomaterials can be designed to block certain substances in food, such as harmful cholesterol or food allergens, from reaching certain parts of the body.

Farm applications of nanotechnology are also commanding attention. Nanomaterials are being developed that offer the opportunity to more efficiently and safely administer pesticides, herbicides, and fertilizers by controlling precisely when and where they are released. For example, an environmentally-friendly pesticide is in development that uses nanomaterials to release its pest killing properties only when it is inside the targeted insect. Also, the ability of certain nanomaterials to control dosages could reduce the amount of growth hormones needed to boost livestock production.

There also are nanomaterials in the late stages of development that can detect and neutralize animal pathogens in livestock before they reach consumers.

Av. José Mestre Veiga
4715-310 Braga - Portugal
Tel. + 351 253 601 550
Fax + 351 253 601 559
office@inl.int
www.inl.int

INTERNATIONAL IBERIAN NANOTECHNOLOGY LABORATORY

The application spectrum is wide and the immediate societal impact easily recognizable. Interdisciplinary connections will ensure the impact of the INL research in this area.

NANOELECTRONICS (beyond CMOS)

The focus of this area will be the development of technologies and devices in the "beyond CMOS" area, focusing on the development of electronic devices (semiconductor-, magnetic-, or photonic-based) that incorporate novel materials and unconventional structures, for application in non-commodity products- mostly in the sensor application field.

The combination of electronics, photonics, and nanoscale materials is an emerging area which presents a unique opportunity for the research community to influence the future of technology. Fabrication of 2-D and 3-D photonic crystals do not only allow the manipulation of light, but can also contribute to the design of novel optical fibers, lasers, etc. with new sensing capabilities. These novel devices will include merging various state-of-the-art device and sensor technologies (spintronics, NEMS and MEMS, micro- and nano-fludics, and optical- and semiconductor-based devices) in multifunctional microsystems and lab-on-chip platforms targeted at the above defined strategic themes.

In the first stage, the nanoelectronic devices will support applications in biotechnology and medicine as well as in environmental and food monitoring. In the second stage, it is envisaged that the nanoelectronic modules developed can be commercialized as such for incorporation in other products, thus establishing the basis for start-ups seeded by INL.

NANO-MACHINES AND NANOMANIPULATION

INL will also perform basic "blue-sky" research on nano-machines and micro-robotics as support to the main strategic areas of research. Nano-machines are systems that can have a combination of mechanical, sensorial, electronic, computational, and communication with a size of at most a few tenths of a micron (the width of a human hair). Another example is "smart dust," where systems the size of dust particles can be used for extremely large-scale disseminated monitoring.

Av. José Mestre Veiga
4715-310 Braga - Portugal
Tel. + 351 253 601 550
Fax + 351 253 601 559
office@inl.int
www.inl.int

INTERNATIONAL IBERIAN
NANOTECHNOLOGY
LABORATORY

This area of activity will encompass micro-fabricated NEMS structures (such as nano-actuators, nano-sensors, and nano-fuel cells) targeted at single/few molecule detection and/or manipulation. The area also covers the design, synthesis, and operation of molecular objects (using self assembly, biomimetic chemistry, etc.), and of instruments required to interact with these single molecule structures (such as miniaturized magnetic and optical tweezers).

Externally modified self-assembly will also be a key point towards the fabrication of devices using nanoparticles as building blocks. Of major interest is the design of molecular bio-electronic devices merging the physical principles of electronics and computer engineering with the functional and structural principles of biology.

Recruiting

One of INL's main goals is to reach the highest profile and brightest minds of scientists all over the world, so that they can work at the new facilities and leverage nanoscience and nanotechnology to a higher level. The recruiting process of scientists is, for INL, its most important task as people are its main asset.

As a research institution, INL pays special attention to the recruitment of scientific staff and has already launched several PhD and Postdoctoral recruitment campaigns. As a result, INL presently has close to 40 PhD and Postdoctoral researchers working in several laboratories in Portugal, Spain, and outstanding international research centers in other countries.

During the last two years INL has established strategic partnerships with several research centers around the world. All of these joint ventures involve challenging research projects in the area of nanosciences and nanotechnology. The main purpose of this knowledge network is to create tight links between institutions sharing information, technologies, and resources, as well as to develop outstanding science in order to meet some of the current needs of our society.

Av. José Mestre Veiga
4715-310 Braga - Portugal
Tel. + 351 253 601 550
Fax + 351 253 601 559
office@inl.int
www.inl.int

INTERNATIONAL IBERIAN NANOTECHNOLOGY LABORATORY

The INL has been especially active in the US. In November 2008, INL signed two Memoranda of Understanding with the Center for Functional Nanomaterials – Brookhaven National Laboratory and the University of Texas at San Antonio. In the former institution INL researchers joined the research group Soft and Biological Nanomaterials under the guidance of Dr. Oleg Gang and Dr. Mircea Cotlet. In the latter, a similar collaboration involves the group including Professor José Miguel Yacaman, chairman of the Department of Physics and Astronomy in the College of Sciences, and a highly recognized scientist in the field of electron microscopy.

Regarding Europe and Asia, the INL has established research collaborations with centers and institutions in Denmark (iNano and Technical University of Denmark) and with different institutes of the Max Planck Society in Germany, the University of Glasgow (UK), and the National Institute for Materials Science – NIMS in Japan. The collaborations that INL has already established with European, Asian, and American Research institutions specialized in nanotechnology are:

- Center for Functional Materials - Brookhaven National Laboratory (USA)
- Chemical Engineering Department of the University of Texas at San Antonio (USA)
- Micro and Nanotechnology Center of the Denmark Technical University (Denmark)
- Interdisciplinary Nanoscience Center – iNano – Aarhus University (Denmark)
- Max Planck Institute for Biophysical Chemistry in Göttingen (Germany)
- Max Planck Institute of Colloids and Interfaces in Potsdam (Germany)
- Max Planck Institute of Microstructure Physics in Halle (Germany)
- MIT – Massachusetts Institute of Technology (USA)
- NIMS – National Institute of Materials Science in Tsukuba (Japan)
- University of Glasgow (Scotland, UK)

Av. José Mestre Veiga
4715-310 Braga - Portugal
Tel. + 351 253 601 550
Fax + 351 253 601 559
office@inl.int
www.inl.int

INTERNATIONAL IBERIAN NANOTECHNOLOGY LABORATORY

INL has also attracted a group of 18 PhD students. They are carrying out their research activities in different Spanish and Portuguese Institutions. These students received an INL grant for two years renewable for an extra two years or more. These PhD students provide INL with the possibility to collaborate with selected Portuguese and Spanish research groups in scientific fields related with INL's main areas of research. This initial pool of talent will be a good basis to carry out future research projects in Braga.

The PhD and Postdoctoral communities of the INL participated in the 1st INL Workshop, held in Braga in November 2008. Besides presenting their research results and projects, participants were instructed in entrepreneurship and venture capital activities and learned on how to use virtual worlds such as Second Life and virtual communities for networking and for collaborative work. They also received a cross-cultural course to get an overview about the Portuguese culture, Braga city, and its surroundings.

Finally, INL has negotiated collaboration agreements with specialized research groups of the Centro Nacional de Microelectrónica - Barcelona, the IMDEA Nanociencia in Madrid and the Instituto de Engenharia de Sistemas e Computadores de Lisboa – Microsistemas e Nanotecnologias (INESC-MN) to train 6 technicians in specialized clean room and characterization techniques.

The INL Campus

Location

INL is located in Braga, Portugal. Braga is the third largest city of Portugal, strategically located between the cities of Porto (Portugal) and Vigo (Spain). Both cities have international airports (the one in Porto is just 20 min. by car), making it possible to easily access the laboratory from any part of the world.

Braga is strategically positioned near several universities and it also is a dynamic industrial area.

Av. José Mestre Veiga
4715-310 Braga - Portugal
Tel. + 351 253 601 550
Fax + 351 253 601 559
office@inl.int
www.inl.int

INTERNATIONAL IBERIAN NANOTECHNOLOGY LABORATORY

The INL Campus will occupy about 47,000m^2 of ground with a construction area of about 26,000m^2. This includes laboratories and cabinets with 7,500m^2 and clean rooms with 2,400m^2, an auditorium and other public areas with 4,800m^2, technical areas with 3,500m^2, and administrative areas with a total of 700m^2.

Project Goals

The following primary goals guided the conceptualization of the facility:

- **State-of-the-Art Facility:** The facility should facilitate state-of-the-art science and equipment.
- **Collaboration:** The mission of the INL includes leveraging from multiple disciplines to best tackle problems at the nanoscale. The facility should promote interdisciplinary interaction through the following: the extensive use of glass (visual awareness of colleagues and their research), sharing of common space, and the arrangement of programming components.
- **Flexibility:** The clean room, labs, and offices should all be adaptable, with contiguous space with modular arrangements, regular access to utilities, adequate capacities, and easily interchangeable furnishings. Besides, given the facts that researchers will continuously grow from almost zero to 200 throughout a period of about five years and that nanotechnology is a very dynamic area, which specific developments in this time span cannot be completely foreseen, the clean room, lab, and office spaces will at the beginning be only finished for about half of their final areas, and the finishing of the remaining area will be done later on as researchers are being recruited.
- **Sustainable Design:** The facility should be energy efficient and cost effective to operate. It should also be developed with materials and methods that have a low impact on the environment.
- **Amenities:** The facility should be an attractive workplace, with quality of life amenities (such as a daycare, quality cafeteria, fitness center, and convenient parking) that help recruit and retain the best scientific talent and facilitate their dedication to work.

Av. José Mestre Veiga
4715-310 Braga - Portugal
Tel. + 351 253 601 550
Fax + 351 253 601 559
office@inl.int
www.inl.int

INTERNATIONAL IBERIAN NANOTECHNOLOGY LABORATORY

- **Outreach:** The facility should be an inviting place for the public to discover the science and benefits of nanotechnology. The "Ciência Viva" Center, to be located on the INL campus, will be a primary place for the public to discover nanotechnology and for the interaction among school students and teachers.

How is the INL Campus divided?

The INL campus will consist of 4 buildings:

- The Main Scientific Building (MSB), where all major scientific facilities and offices for researchers, as well as the administration, will be located;
- The Social Support Building (SSB) that will include a small number of residence rooms for temporary visitors, a cafeteria, and other related facilities;
- The Incubator and Start-Ups Building (ISB) that will house new knowledge-based companies;
- The "Ciência Viva" Center and Congress Center Building, the former dedicated to the public dissemination of nanotechnology and science in general and the latter a flexible structure for organizing events related to the activities of both the INL and the "Ciência Viva" Center and also available for external use whenever possible.

Main Scientific Building (MSB)

The Main Scientific Building (MSB) is the "ex-libris" of the campus. Its architecture has been configured to have a high visual impact when seen from the outside, especially the iconic monolith of the clean room block. The remaining buildings have been configured to form meaningful exterior spaces between themselves and the MSB.

The scientific infrastructure of the MSB will comprise central laboratories (providing services for the INL resident research personnel and visiting scientists) and specialized laboratories associated with individual Principal Investigators (PIs) or research groups and research topics.

Av. José Mestre Veiga
4715-310 Braga - Portugal
Tel. + 351 253 601 550
Fax + 351 253 601 559
office@inl.int
www.inl.int

INTERNATIONAL IBERIAN
NANOTECHNOLOGY
LABORATORY

The central facility will be unique in the Iberian Peninsula in what concerns state of the art nanofabrication and characterization facilities. The dedicated laboratories will further strengthen the worldwide competitiveness of the research environment. Besides state of the art instrumentation, the INL will also have new instruments with unique capabilities not available anywhere in the world. Examples of such instruments are nano- and micro-sensor based setups to address individual nanoparticle properties.

Central Micro- and Nano-fabrication Clean Room

The Clean room will be primarily Class 1000 with Class 100 areas for the lithography areas including direct-write e-beam tools capable of 10nm to 20nm feature definition. One of the ebeam tools should allow for Electron Beam Induced Deposition and Etching. The lithography area will also include mask aligners (2) and photoresist tracks for optical and e-beam lithography. A dual beam FIB system will provide sample inspection and nanofabrication capabilities. A soft lithography tool will also be available for mask stamping.

The Clean Room will include standard deposition tools (multi-target PVD for metal deposition [two tools], PECVD for oxide and semiconductor deposition), reactive ion etching (metal and oxide), planarization (CMP tools), thin film characterization tools (thickness monitor, spectral ellipsometer), ion miller, RTA and ovens, and other equipment required for small-scale prototype and device fabrication on wafer sizes not exceeding 4”.

A wet area containing several wet benches (4 to 6) will be installed for wet processing. The central facility will also incorporate a microfluidics unit (mask aligner, thick resist [SU8], disperser, hot plates, PDMS, and electroplating processing equipment).
INL will collaborate with other extant clean room facilities when larger wafer dimensions will be deemed necessary.

Physical Characterization Core

Av. José Mestre Veiga
4715-310 Braga - Portugal
Tel. + 351 253 601 550
Fax + 351 253 601 559
office@inl.int
www.inl.int

INTERNATIONAL IBERIAN NANOTECHNOLOGY LABORATORY

The Characterization Core will allow in-house detailed structural characterization of thin films, interfaces, and nanostructures, including the following techniques/instruments (not exclusive):

HRTEM (with Cs aberration correction) and low energy SEM, combined micro-analytical tools, X-ray, and interface and surface analysis (SIMS, Auger, and XPS). The core will also support Scanning Probe Microscopy (SPM) from standard imaging to advanced applications and development of new techniques. A small number (two, expandable as needed) standard SPMs will be available for regular imaging. An advanced facility, especially intended for biological/biochemical applications, will provide SPM coupled with confocal optical microscopy. Only one similar facility is available in Europe, at the European Molecular Biology Laboratory, EMBL, in Heidelberg.

There will also be one SPM especially intended for the development of new techniques, supported by standard test and measurement equipment.

Biological and Biochemical Characterization Support

The Central Biology and Biochemistry facility will provide support for groups developing biology and biochemistry activities. It will contain equipment for FPLC/HPLC protein purification, spectrophotometry/ nanochop, mass spectrography with gas chromatography, flow cytochemistry and cell sorting, real-time PCR, confocal microscopy and centrifugation (ultra and low-speed), and cell culture.

The facility will also include the necessary supporting infrastructure, such as optical and fluorescence microscopes, –4ºC, –20ºC and –70ºC chambers and freezers, a dark room, a sterile chamber with laminar flow, extraction benches, and a washing and sterilization facility for laboratory material. The possibility of the future installation of secure areas needed for bio-hazard work [not to exceed Bio-Safety Level 2 (BSL2)] shall also be contemplated.

Dedicated Laboratories

The dedicated laboratories will be associated with particular Principal Investigators and topical needs (spintronics, NEMS, photonics, high

Av. José Mestre Veiga
4715-310 Braga - Portugal
Tel. + 351 253 601 550
Fax + 351 253 601 559
office@inl.int
www.inl.int

frequency device characterization, nanomaterial synthesis laboratories, etc.). Funds will be set apart from the beginning to account for these particular infrastructures, and space will be left available for their development when time comes.

Equipment requirements will be discussed with the new PIs as part of the hiring process in order to offer a highly-competitive package that will attract leading scientists, teams, and young researchers in the designated priority areas. Dedicated lab space is to be made available in the clean room and the environmentally-quiet characterization area to facilitate dedicated research that requires these types of environments.

Other Core Laboratories and Laboratory Support

Other common capabilities will support the Nanofabrication Clean room, Principal Investigator laboratories, and the Characterization Cores. These include: a Device Assembly (packaging) Lab, a Dirty Lab (dicing, wire saw, polishing, etc.), and a Nanoparticle (nanotubes, etc.) Fabrication Lab. The latter is likely to be one of the Principal Investigator laboratories.

Administration

The MSB Administration accommodates the INL executive management and must be readily accessible to visitors through a reception area. This area also has direct access to a large conference room with high-level finishing.

Administrative/Financial and Personnel Departments

These are the spaces allocated to the divisions responsible for the proper management of the main administration tasks pertinent to INL. Exceptions will be the goods and services pertinent to the technical management of the equipment and installations particular to a given functional division. These personnel are a resource to all of the functional groups within INL, and therefore need to be centrally located for easy access to the researchers, the central administration, and the Campus Maintenance and Management department.

Technical Maintenance and Management of the Campus

Av. José Mestre Veiga
4715-310 Braga - Portugal
Tel. + 351 253 601 550
Fax + 351 253 601 559
office@inl.int
www.inl.int

These spaces include all the functions related to the running and maintenance of equipment (either scientific or infrastructural) as well as to the general maintenance of the campus. It will also be responsible for the acquisition/outsourcing of related services, consumables, and parts. It will also house all the support workshops. It must be stated that, although responsible for the general maintenance of the campus, the people considered herein, will not include the technical, administrative, and other personnel with functions specific to the remaining campus' buildings. Spaces to house these people are considered in the corresponding areas.

Research Personnel Offices

In the first phase there will be offices for 200 people: 28 Associate Scientists, 24 Principal Investigators (PIs), 48 Post-Docs, 30 technicians, 20 administrative officers, and 50 PhD students.

Associate Scientists are visiting scholars, not paid by INL, who will perform research in-house for periods up to three years. They may, or may not, work in connection with the Principal Investigators. On the other hand, the Principal Investigators will be the main asset of the Laboratory, and a significant part of the research activities will be organized around them. Consequently, they will have their own laboratories, equipped according to the specifications of their research, and at least 2 Post-Docs and a number of PhD students to work under them. Henceforth, the geometry and localization of the offices of the scientific personnel should reflect this hierarchy and organization. The PIs will have single offices, Associate PI's may or may not have single offices depending on their length of stay, Post-Docs will have larger workstations, and PhD students will have smaller workstations (carrels).

Other Support Functions

A main auditorium accommodates approximately 250 people, with larger gatherings possible in other public spaces (such as a main lobby and cafeteria). The remainder of the meeting spaces should be conference space ranging from a large, well-appointed "boardroom" to many small team meeting rooms.

Av. José Mestre Veiga
4715-310 Braga - Portugal
Tel. + 351 253 601 550
Fax + 351 253 601 559
office@inl.int
www.inl.int

INTERNATIONAL IBERIAN NANOTECHNOLOGY LABORATORY

A generous reception area and associated waiting area, of architectural quality appropriate for such a prestigious facility, is to be located contiguous with the lobby and nearby to the administrative areas.

Social Support Building (SSB)

The INL campus needs to be able to house PhD students, associate scientists, visiting researchers, Principal Investigators, and their families. Some of these may spend their entire tenure residing in the SSB; others may only need to stay until they find more permanent residences.

There will be rooms of two types, both with private bathrooms: “standard” and “executive.”

The latter will have higher quality furnishings and better decoration. These rooms are purposefully located separately from the Main Science Building and provide some privacy with views to the small river that flows through the campus and the landscaped area that will surround it.
The building will also be equipped with a small café, capable of providing continental breakfasts, similar to what is provided in local residential hotels, and the capacity to heat up oatmeal, etc.
The SSB will also contain a daycare, a fitness center, offices, other support spaces, and multiple lounges for different types of relaxation.

Incubator and Start-ups Building (ISB)

The Incubator and Start-ups Building will accommodate primarily office space and light labs for incubator and start-up tenants. The ISB will not be used for heavy shops, wet labs, and clean rooms. The use of these MSB facilities will need to be negotiated with the INL. However, the right to use much of the MSB scientific infrastructure and non-technical facilities like the Auditorium and the SSB Cafeteria, is likely to be granted for many tenants. Consequently, the ISB and MSB Lobbies have been located in relatively close proximity for pedestrian traffic between the two buildings.

Av. José Mestre Veiga
4715-310 Braga - Portugal
Tel. + 351 253 601 550
Fax + 351 253 601 559
office@inl.int
www.inl.int

INTERNATIONAL IBERIAN NANOTECHNOLOGY LABORATORY

Tenant space will only be shelled initially. Interior outfitting of each tenant space will be customized to tenant requirements (within building standard guidelines) and occur only as space is needed.

"Ciência Viva" and Conference Center Building

A "Ciência Viva" Center dedicated to nanotechnology will be located in a separate building on the INL campus. The specifications of this center will be supplied by the Portuguese Ministry of Science, Technology, and Higher Education, building on the extensive experience of the Ciência Viva – the National Agency for the Promotion of Scientific and Technological Culture, which is widely recognized for operating for more than 10 years one of the most successful science outreach programs in the world and coordinates close to 20 hands-on science museums located throughout Portugal.

This building will also house a Congress Center to be flexibly used for both the INL and the "Ciência Viva" Center events and to be made available for external use whenever possible.

This building will receive a large flux of visitors who do not necessarily need to interact with the remaining campus buildings. It will be open during weekends and holidays and has been located so visitors do not interfere with other parts of the campus.

A Leap Ahead in the Field of Nanotechnology

The establishment of the INL – International Iberian Nanotechnology Laboratory- was considered in the European Union by the Commission and several of the other Member States as one of the best practice case studies.

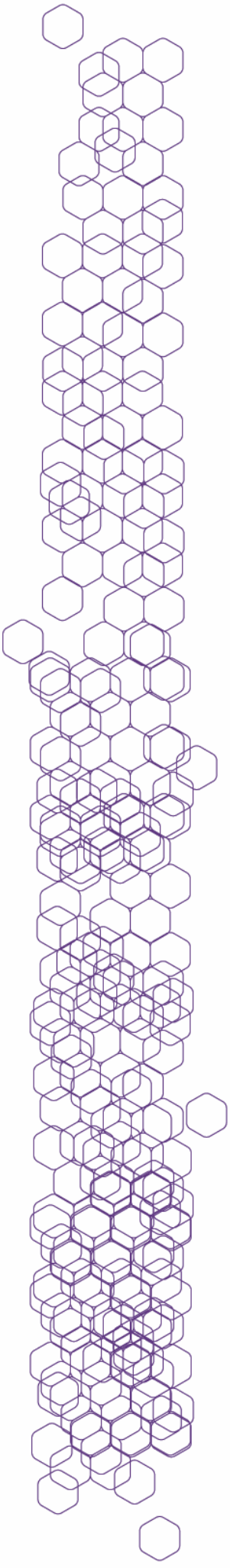
It should be seen and perceived as an example of cooperation between two countries that are fostering and investing in the progress of science and tomorrow's future, assuring world class research excellence in nanoscience. The project was launched in November 2005, specified in 2006 leading to the Convention approving its statutes in November 2006, established as a treaty approved by the parliaments of both countries

Av. José Mestre Veiga
4715-310 Braga - Portugal
Tel. + 351 253 601 550
Fax + 351 253 601 559
office@inl.int
www.inl.int

INTERNATIONAL IBERIAN
NANOTECHNOLOGY
LABORATORY

throughout 2007 while the architectural and engineering design was being developed, had the beginning of construction in July 2008, and is ready in 2009. The development of this project is a clear example of strong commitment and hard work, capable of overcoming some of the most challenging factors that always appear along the development of a project of this type and size.

This project sets a clear example of a new type of research collaboration between European Union Member States while pursuing international cooperation with other regions such as North America, Latin America, and Asia. For that, the recruitment of the talent that will work in the Lab should enhance diversity of nationalities and also different cultures and backgrounders in order to assure top class level research teams from the very beginning and to guarantee an immediate high reputation, enhancing the capability of further attracting top scientists and talented graduate students.



Av. José Mestre Veiga
4715-310 Braga - Portugal
Tel. + 351 253 601 550
Fax + 351 253 601 559
office@inl.int
www.inl.int