

THE EXTREME LIGHT INFRASTRUCTURE

# ROMANIA IS READY FOR ELI

**ANCS**

Autoritatea Națională pentru Cercetare Științifică



ROMANIA  
APPLICATION  
FORM  
FOR HOSTING  
THE EXTREME  
LIGHT INFRA-  
STRUCTURE  
(ELI)

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## GLOSSARY

**CNCAN** - *National Commission for the Control of Nuclear Activities*

**ELI** - *The Extreme Light Infrastructure*

**EU** - *European Union*

**IFA** - *Institute of Atomic Physics*

**IFIN-HH** - *National R&D Institute for Physics and Nuclear Engineering “Horia Hulubei”*

**INFLPR** - *National R&D Institute for Laser, Plasma and Radiation Physics*

**INFM** - *National R&D Institute for Physics of Materials*

**R&D/RDI** - *Research and Development / Research, Development and Innovation*

**RATB** - *Bucharest Autonomous Transport Company*

**SMURD** - *Mobile Emergency Service for Resuscitation and Rescue*



## A. Location of ELI

The ELI site will be Magurele. Romania promotes this location, at 26°00' East and 44°12' North, as it will provide the highest performance and most cost effective option for this major European research infrastructure. The main reasons for selecting this location are listed below:

### ROMANIA FOR ELI

Magurele, the proposed site of ELI, has the largest concentration of research, educational and technological facilities in South-Eastern Europe

and the South-Eastern Europe, with a large concentration of research, educational and technological facilities in all major fields of Physics and related domains: five national R&D institutes (nuclear, atomic and particle physics; laser, plasma and space sciences; physics of materials; seismology; optoelectronics), the Faculty of Physics of the University of Bucharest and two engineering companies (optoelectronics & design of nuclear facilities). With over 1000 researchers and 8 research infrastructures of national interest (out of 19 in the whole country), Magurele has the highest scientific visibility in Romania and is comparable with similar European countries.

**1. Magurele is *par excellence* a pole of Physics.** It is the only place in Romania

**ROMANIA FOR ELI**

1949, September 1<sup>st</sup> – physics research starts at Magurele with the founding of the Institute of Atomic Physics - IFA

**2. Magurele offers ELI important advantages:** *Radioprotection* - the area is already inside a forest ring of 500m radius; *power supply* - the necessary utilities are connected inside the area and have sufficient capacities required by the operation of ELI; *safety* - there is a security system built in accordance with the standards required by the nuclear research facility; *environmental protection* - the environmental management system has already been implemented to the highest standards because of the nuclear research activities carried out at the site; *dedicated space for ELI administration* in the Administrative Building of the Institute of Atomic Physics; *connectivity* – IT high speed connection to GEANT (FO at 10 Gbps); *National Physics Library* - in a new location, with an impressive number of periodicals and books; *Leisure facilities*: park, swimming pool, tennis and football fields.

**3. Magurele can be easily reached** from both inside Romania and abroad (see the map of Bucharest and surrounding area in section D.1):

- **Two international airports**, Henri Coanda - Otopeni and Aurel Vlaicu - Baneasa, within 30 and 20 km distance from Magurele, respectively; scheduled construction by the year 2015 of a **third international airport** at only 15 km from Magurele, of a significantly larger capacity;
- The **Bucharest first ring road** at only 1 km distance, currently being extended to two traffic lanes per direction. With the **second ring road** under construction at 10 km from Magurele, an access in only a few minutes will be ensured to all important highways connecting Bucharest to the most important cities in the country and to Pan-European corridors;
- Magurele benefits from a railroad connection both for persons and freight transportation, being located on the **Bucharest ring railroad**, which is scheduled to be fully upgraded and extended by 2015, ensuring thus connections by rail to all airports and underground network.

**4. Magurele belongs to the Bucharest metropolitan area**, so it has access to all social, educational, cultural, entertainment and religious facilities of the largest city of Romania.



## B. Rationale for hosting ELI in Romania

Romania represents the best option for hosting ELI due to its high level of competence in the field of Physics, a research community of world class reputation, modern R&D facilities and strong political commitment to invest in science.

Building ELI in south-eastern Europe, at Magurele, represents a convergence point of two major axes of EU interest by:

- Strongly contributing to fulfilling one of the most important EU aims - achieving **socio-economic cohesion** across the EU by developing the science and technology capacity in new member states area;
- Strengthening some of the neighbourhood policies' objectives regarding non-EU residents research involvement and

mobility, with the aim of **enlarging the research community inside EU borders**. Moreover, several other aspects are recommending Magurele as the best option to host ELI:

### 1. Scientific potential and tradition relevant to ELI

**ROMANIA FOR ELI**

1956 – IFA hosts the first big physics installations in Eastern Europe outside the USSR – the nuclear reactor and the cyclotron.  
CIFA 1 - the first electronic computer is built.

- *A strong tradition exists in Romania, where Magurele is the pole of scientific research in Physics: Romania was the fourth country*

in the world to build its own laser (October 1962), the first eastern country outside the Soviet Union to operate a nuclear reactor, a cyclotron and a betatron (1956) as well as a factory producing high quality heavy water. More major facilities followed that are in operation today, including: the Tandem Accelerator (1974), the Radioisotope Production Centre (1974), the Nuclear Waste Processing Centre (1974), IRASM – the Multipurpose Gamma Irradiator (2000). In addition, a other facilities of comparable or larger scale are under construction (see section C.5).

#### ROMANIA FOR ELI

1962, October 20 – first Romanian laser built.  
1970 – the first 1 KW laser is built at Magurele.

- The UNESCO study “Scientific profile activities in CEEC” (2002), shows that *Romania is not only highly specialized in Physics but also enjoys an outstanding degree of development.* According to this study, in 1999 Romania had a specialisation index in physics of 2.3, being second to Lithuania (2.6), and above countries such as Poland (1.9), Bulgaria (1.7), Germany (1.2), France (1.1), Czech Republic (1.1) and Hungary (1). In the analysis of the increase of scientific publications over the period 1995-1999 Romania scored 134 in 1999 (reference level is 100 as of 1995), surpassing countries like France, Germany, Poland, Hungary and Czech Republic<sup>1</sup>.
- *Romania has an impressive pool of young scientists*, second only to Poland among the East European countries, with the largest net number of young graduate scientists per year<sup>1</sup>. The many first rank positions in all international science contests is also relevant.

<sup>1</sup> [http://portal.unesco.org/en/ev.php-URL\\_ID=4110&URL\\_DO=DO\\_TOPIC&URL\\_SECTION=201.html](http://portal.unesco.org/en/ev.php-URL_ID=4110&URL_DO=DO_TOPIC&URL_SECTION=201.html)

#### ROMANIA FOR ELI

2007 – the Romanian Government decides to spend over 5.6 billion Euros for Science and Technology up to 2013.

#### 2. Commitment to invest in science

As part of the National Strategy for RDI during 2007-2013, the Government of Romania strongly supports the construction of ELI at Magurele as part of its overall development plans for science and technology. To this end, the latest trends regarding the R&D funding strategies have shown a constant increase in funds, which is supported across the political spectrum (over 5.6 billion Euro from 2007 to 2013). Thus, the ELI team will benefit from the very strong advantage of a constant funding through out its activities.

#### 3. Social and economic impact

- ELI will be a major attractor for industrial R&D, thereby contributing to the technological breakthrough of Europe.
- Brain gain vs. brain drain: ELI will offer young physicists good research careers, will encourage the return of valuable researchers currently working in other parts of the world, and will become an attractor for scientists from abroad.

#### 4. Lower construction costs

This is mainly due to: important indirect financial contributions from the Romanian Government (the land for ELI is free of costs as the area is already public property and the existing infrastructure facilitates its rapid development at no additional costs for the ELI project); costs of both labor and materials are lower than the EU zone average<sup>2</sup>.

<sup>2</sup> For more details see <http://epp.eurostat.ec.europa.eu/portal/>



## C. Quality of the region/country and impact

#### 1. Quality and size of the scientific community relevant to ELI

Romania is the ideal host for ELI because it already has five excellent research centres in Magurele that are related to the field of frontier Physics of ELI, and prestigious faculties of Physics and Engineering in all the main cities of the country. These centres represent the ideal combination between research and specialized university education, thereby guaranteeing a permanent flow of young researchers into the field. The main institutions participating in the ELI project are briefly presented below. Additional information (selected projects, international collaborations, publications, and profiles of other institutions interested in the ELI) are presented in the last chapter.

**The National R&D Institute for Laser, Plasma and Radiation Physics (INFLPR, Magurele).** *R&D personnel:* 337 (222 researchers, 19 PhD supervisors, 134 PhD, 70 PhD students). *National interest facilities:* 2 (Electron Accelerator - betatron, linear accelerator, microtron, Magnetic dense plasma plant). *Departments* relevant to ELI: Lasers; Laser Metrology and Standardization; Quantum Electronics; Plasma Physics & Nuclear Fusion; Low temperature Plasma; Electron Beam & Accelerators. *Subsidiary:* Institute for Space Sciences. *Publications:* ~350/year in ISI journals, out of which ~15% are relevant to ELI. *Foreseen developments driven by ELI:* study and development of high power fs laser systems, high harmonics generation,



laser sources in the X-ray domain, high power laser interaction with matter, laser metrology, technological and medical applications of the ultra-short pulses lasers. *Fields where the institute can contribute to ELI's construction:* Development of TW-PW femtosecond laser systems; Demonstration Centre for High Power Laser Technology and Plasma Engineering. Web site: [www.inflpr.ro](http://www.inflpr.ro).

#### ROMANIA FOR ELI

2008 – the research performed at the five national institutes at Magurele is strongly related to the frontier physics of ELI

**The Horia Hulubei National R&D Institute for Physics and Nuclear Engineering** (IFIN-HH, Magurele). *R&D personnel:* 394 (289 researchers, 29 PhD supervisors, 173 PhD, 51 PhD students). *National interest facilities:* 6 (Tandem accelerator, Multiple-purpose irradiation facility, Radioactive waste treatment and storage plant, National radioactive waste repository, Cyclotron, Reactor – in decommissioning). *Departments relevant to ELI:* Nuclear Physics, Particle Physics, Applied Nuclear Physics, Life and Environment Physics, Radioisotope Research and Production, Radioactive Waste Management, Radioprotection and Nuclear Safety, Nuclear Training Centre. *Publications:* ~300/year in ISI journals, out of which ~30% are relevant to ELI. *Foreseen developments driven by ELI:* Beam Physics (Electron and Proton beams produced by laser, Laser-produced pions, muons, neutrinos), Nuclear Physics and Astrophysics (Neutron-rich nuclei, Developing new detector technology), “Exotic Physics” (Quark-gluon and neutrino oscillations), Medicine (Application to Hadron Therapy), Secondary Sources for Material Science Studies (Improving environment:

transmutation and nuclear waste treatment), Education and Training. *Fields where the institute can contribute to ELI's construction:* control and data acquisition systems (hardware and software), charged particle accelerating systems, radioprotection calculations. Web site: [www.ifn.ro](http://www.ifn.ro).



**The National R&D Institute for Physics of Materials** (INFM, Magurele). *R&D personnel:* 215 (174 researchers, 14 PhD supervisors, 89 PhD, 59 PhD students). *National interest facilities:* 1 (Photoemission spectroscope). *Departments relevant to ELI:* Advanced Materials for Special Applications, Solid State Magnetism, Low Dimensional Systems, Optics and Spectroscopy, Structure and Dynamics of Condensed Matter. *Publications:* ~200/year in ISI journals, out of which ~30% are relevant to ELI. *Foreseen developments driven by ELI:* Laser-produced X-Ray Beam (coherent X-ray source with femtosecond pulses), Attosecond Science (Spectroscopy on dilute samples, Real-time observation of intra-atomic electron dynamics, Control and real-time observation of electron dynamics in molecules and clusters, Real-time observation of electron transfer processes at interfaces, 4-dimensional microscopy of electron dynamics with nanometer-

resolution in space and attosecond resolution in time). *Fields where the institute can contribute to ELI's construction:* end-stations for the X-ray laser beam produced by ELI for spectroscopy of X-ray absorption and of photoelectrons and photoions excited by X-rays, X-ray diffraction and scattering (in particular, small angle and resonant inelastic X-ray scattering).

#### The National R&D Institute for Optoelectronics

(INOE, Magurele). *R&D personnel:* 124 (97 researchers, 1 PhD supervisor, 32 PhD, 33 PhD students). *Departments relevant to ELI:* Lasers and fiber optics communication; Optoelectronics methods for medical applications; Research centre for advanced surface processing and analysis by vacuum technologies; Optoelectronic methods and techniques for cultural heritage restoration/conservation; Remote sensing. *Publications:* ~40/year in ISI journals, out of which ~12 are relevant to ELI. *Foreseen developments driven by ELI:* Time-domain experiments (Spectroscopy on dilute samples), Laser-plasma Interaction (Propagation of intense laser pulses in dense matter), “Exotic Physics” (Exploring the fundamental properties of vacuum), Medicine (Application to Hadron Therapy), Secondary Sources for Material Science Studies (Understanding fundamental aging processes in nuclear power plant material, Improving environment: transmutation and nuclear waste treatment), Education and Training. Web site: [inoe.inoe.ro](http://inoe.inoe.ro).



**University of Bucharest - The Faculty of Physics** (FF-UB, Magurele). *Academic staff:* 135 (49 full Professors). *Studies* on three levels: *Licence* (Physics - 3 years; Technological Physics – 4 years), *MD* (4 semesters) and *PhD* (3 years). The domains covered are: (a) *General* - Physics, Medical Physics and Biophysics; Educational Physics, (b) *Condensed Matter Physics*, (c) *Earth Physics*, Environment Physics and Meteorology, (d) *Theoretical Physics*, (e) *Optics*, Spectroscopy, Plasma and Lasers, (f) *Atomic & Molecular Physics*, Nuclear and Particle Physics, Astrophysics, (g) *Nanosciences and Nanotechnologies*, (h) *Electronic Physics and Metrology*, (i) *Polymer*, (j) *Econophysics*. *Students:* 600 (licence), 190 (MD), 170 (PhD). *ELI relevant publications:* ~30/year. *ELI relevant PhD-MD/Graduation theses (last 5 years):* ~30/70. *Foreseen ELI driven developments:* Four-wave mixing, high harmonic generation; Parametric amplification; Lasers&Masers without population inversion; Cancer therapy, ultra-fast processes in biological systems, human tissues deposition on ceramics/metals; Education&Training; Attosecond Science/Time-domain experiments (inner-shell NLO and coherent control, relativistic atomic and molecular physics, real-time observation of intra-atomic electron dynamics); “Exotic Physics”- e+e- annihilation, evolution of the universe, Extra dimensions; Nuclear fusion; Classical and quark-gluon plasma. Web site: [www.fizica.unibuc.ro](http://www.fizica.unibuc.ro).

**University Politehnica of Bucharest - The Faculty of Applied Sciences** (FSA-UPB, Bucharest). *Academic staff:* 205. *Major fields of study:* Applied Engineering Sciences, Engineering Mathematics and Informatics, Engineering Physics. **Physics Department:** 75 members (25 full professors), out of which 50 work in research fields related

to ELI. *Publications* relevant to ELI (last 5 years): 83 (including communications in international conferences). PhD/Master&Graduation theses relevant to ELI (last 5 years): 6/15. *Foreseen developments driven by ELI: Attosecond Science* (Spectroscopy on dilute samples, Inner-shell nonlinear optics and coherent control, relativistic atomic and molecular physics, Real-time observation of intra-atomic electron dynamics, Control and real-time observation of electron dynamics in molecules and clusters), Beam Physics (Proton beam produced by laser), Laser-plasma Interaction (Propagation of intense laser pulses in dense matter, Electromagnetic solitons, Time-resolved relativistic plasma physics). Education and Training. Web sites: [www.pub.ro/English/Faculties/St\\_Aplicate.htm](http://www.pub.ro/English/Faculties/St_Aplicate.htm), [fsa.pub.ro](http://fsa.pub.ro).

**2. Quality and size of the industries relevant to ELI**

There are two types of industrial sectors relevant for ELI: those which could participate in its construction and those which will participate in its operation. Hosting ELI in any country will involve a number of industrial activities. In the same way, Romania will engage specific sectors



and the list is non exhaustive. For this reason, only a few examples are listed.

**ROMANIA FOR ELI**

Romania is a founding member of JINR - The Joint Institute of Nuclear Research (Dubna, Russia - 1956) and FAIR (Facility for Antiproton and Ion Research - 2006) and a member of CERN - The European Center of Nuclear Research (2008)

- In the first place, several Romanian companies have a long standing experience in developing major infrastructure projects and have acquired a high level of expertise (eg: *accreditation in the construction of nuclear plants, such as Cernavoda*).
- Secondly, there is expertise in the *manufacture of precision mechanical assemblies and software development* (eg. companies such as: *Microsoft, Adobe, Cisco and Oracle* have set up centres of software development in Romania).

For the operational phase the key sectors are:

- Software development.
- Medical sector: one of ELI's foreseen applications will involve introducing new types of cancer treatments, for instance, the use of high energy particles (proton therapy). Future applications in oncology

include novel forms of treatment, which will be available nationwide.

- The companies acting in the waste management sector will certainly be involved related to the treatment of radioactive waste.
- Other sectors, such as optics and electronics, will also play an important role in ELI.

**ROMANIA FOR ELI**

1996, December 2 - Unit 1 at the Cernavoda Nuclear Power Plant becomes operational. Unit 2 is connected to the national grid on September 12, 2007. Each unit produces over 700 MW of electricity

**3. Expected scientific impact**

The starting point in estimating the scientific impact of constructing ELI in Magurele is the local research community, which is internationally competitive in the field of ELI research and applications and can therefore be considered to possess the necessary capacity to assimilate and exploit the new opportunities created by the exawatt-class laser system. The institutions and groups already involved in the ELI science, a representative part of the national research potential (as shown in Section C.1 and Annex 2), will take advantage of placing ELI in Romania, with a beneficial effect for the whole country and surrounding region as they will become part of the strong international ELI community, significantly enhancing thus the scientific visibility of Romania.

The large dimension of the ELI project, the expected breakthroughs in physics and the opening of new research domains will offer extraordinary opportunities for interdisciplinary cooperation in practically all the fields of physics and high advanced technology, from lasers to microelectronics

and from nuclear physics to the physics of materials. From this point of view a direct impact upon the scientific community will be the creation of a strong network of researchers representing the whole of science. They will share experience and expertise and will eventually become a body dealing with the most ambitious results of an avant-garde research. The consequences will be the following:

- opening new areas of advanced research, mainly related to the applications of lasers in general, particularly high-power and ultra short pulses lasers;
- an important increase in the number of researchers, more and more attracted by such a theme and by the size of the entire project.

**ROMANIA FOR ELI**

1984 - the first CO2 laser for neurosurgical applications is built at Magurele. It is followed by lasers built for:  
 1986 - ophthalmology  
 1987 - ENT  
 1990 - orthopedy  
 1991 - gynecology  
 1992 - dentistry

Following the European strategy and initiatives in the R&D field and combining also the specificity of the ELI project, the scientific impact will echo at national level by engaging new lines of research, raising the level of research and upgrading the infrastructure, expanding on new areas by creating possible partnerships and also sharing knowledge and also by including Romania in the wide European network of high end research. On the other hand the impact upon the scientific community can be also regarded from the European perspective, mainly envisaging the elimination of gaps between countries and also the speeding up of reaching long-term convergence for a more sustainable Europe. In this respect Romania and the location pro-

posed offer the best option as it can provide highly specialized researchers, an already existing infrastructure and in addition to all that, the possibility of providing a link between the western and eastern research communities.

The construction of ELI in Romania will also open up for the creation of a number of Ph.D and post-doc positions, contributing to the education and training of highly specialized young researchers at a world-leading facility, who would link science and technology through subsequent career moves. An advanced large-scale facility such as ELI would aid Romanian research in developing unique knowledge and competences, which could be effectively used also as a leverage on the international research scene.

The implementation of ELI will also lead to:

- The strengthening of the research capacity in the region by attracting scientists coming from outside Europe;
- Guiding young researchers towards a sector of advanced science taking into account that they are nowadays more attracted by the alternative of taking other jobs (better paid) or remaining in the research field but moving to other countries.

#### 4. Expected short and long term economic impact

*The expected short term economic impact* includes the following aspects:

- A clear development of the special building sector which can lead to the creation of additional employment, upgrading the level of companies due to the advanced nature of ELI construction, a higher demand for accommodation and facilities for the staff engaged in the research.
- Attracting more companies to supply components and parts specific for the re-

search themes conducted. This effect will occur due to the comparative advantage that these companies can offer based on geo-proximity.

- Creating a link between the private sector and the research community to better address the needs in terms of local production and design for specific assemblies that can be purchased locally.
- A better orientation of the researchers and the carrying out of specific tasks that will lead to a higher specialization. In time this specialization will become less costly as the investment and the process of research have been endogenized into the research process and for a future use there will not be any additional costs.

*The expected long term economic impact*

represents the development of the effects following the short and medium terms activities conducted through ELI and it is presented below.

#### ROMANIA FOR ELI

2009-2012 – Major investments:  
 • IFIN-HH - “Infrastructure Development for Frontier Research in Nuclear Physics and Related Fields” (15 M€)  
 • INFM - “The Euro-Regional Centre for the Study of Advanced Materials, Surfaces and Interfaces” (14 M€)

The ELI project will provide the opportunity for the site in particular and Romania in general to become a pole of competitiveness and to emerge to a higher level of research. Moreover, in line with the Lisbon strategy, the ELI project can become the starting point of decreasing the gaps between eastern and western European countries in terms of technological change, labour productivity and technological efficiency in the research related fields. In addition to that, competitive products can be obtained only in the presence of competition pres-

sure, which will push the actors to upgrade and serve as an incentive to increase their market share. In this situation the benefits will appear for both the producers and the consumers, attracting other companies to operate in the same market resulting in spin-outs and spin-offs.

In conclusion, the key focus of the initiative to host ELI is that from the beginning of the preparatory phase till the fully operational phase it will attract different businesses, develop existing sectors and induce a more competitive environment.

#### ROMANIA FOR ELI

2009-2012 – Major investments:  
 • INFLPR – “The Integrated Centre for Advanced Laser Technologies”, operating a 1 Petawatt laser (20 M€)

#### 5. Synergy within existing and planned scientific initiatives

At the end of the year 2007 the Romanian Government launched a large investment effort in the public research infrastructure – over 200M€ (national and structural funds) for the next three years in research institutes and public universities all over the country. Outstanding among these and estimated to be of a high regional impact (in South-Eastern/Central Europe and the Black Sea Region), the following investment projects can be considered to definitely contribute to a synergic development of the ELI scientific programme.

The largest project (20 M€) belongs to the **National R&D Institute for Laser, Plasma and Radiation Physics**: “*Integrated Centre for Advanced Laser Technologies*”. The project includes a 1 Petawatt laser for the study of hyper intense laser-beam interactions. Comparable in size (15 M€) is the project “*Infrastructure Development*

*for Frontier Research in Nuclear Physics and Related Fields*” of the **National R&D Institute for Physics and Nuclear Engineering**. The project includes five new research centres. Most important for the nuclear physics aspects involved in the ELI project as well as for its future applications in this field is the Laboratory for development and testing of methods related to the international project FAIR/NUSTAR. Of particular relevance for the ELI synergy, in particular concerning the Radioprotection and Environment aspects, are also the Radiocarbon centre for environment and

biosciences and the Centre for Nuclear Spectrometry. In regard to the materials necessary to ELI and the physics of materials, this domain will benefit of the results of the project “*Euro-Regional Centre for the Study of Advanced Materials, Surfaces and Interfaces*” (14 M€) granted to the third largest Institute at Magurele, the **National R&D Institute for Materials Physics**. Research to be developed under other important projects in Bucharest and other institutes and universities in the country (**Petru Poni Institute of Macromolecular Chemistry, Iasi; Babes-Bolyai University, Cluj-Napoca; University of Medicine and Pharmacy, Craiova**) will also add to the synergy of the ELI project.

#### ELI: THE SOCIO-ECONOMIC IMPACT

Developments in the real estate, commercial sectors and tourism  
 Accessing various funding opportunities for Research

## The Extreme Light Infrastructure

Developing partnerships with the industry sector  
Raising the income of the researchers  
Developing the local sectors connected to the research done  
Developing spin-offs and start-ups  
Developing local branches for companies working in the field of laser applications  
Rehabilitation/extension/modernization of municipality's infrastructure  
Development of the educational sector

### ROMANIA FOR ELI

2009, January – INFELPR will operate a 15 Terrawatt laser

The funding instruments managed by ANCS for the period 2007-2013 are very diverse due to the large increase in funds allocated to research and innovation for this period (~5.6 billion Euro). Research projects similar to those funded at European level by the European Research Council are available from the National Programme "Ideas", while the National Programme "Human Resources" is offering funding to PhD students and post-doc researchers, to projects tailored for high-level specialists as well as projects for researchers returning to Romania. Collaboration between research institutions is supported through the Programme "Partnerships", the largest research programme in Romania, while innovative enterprises are targeted by the "Innovation" Programme and by the Operational Programme "Increase of Economic Competitiveness" (structural funds).

### 6. Potential conflicts of interests

No conflicts of interests have been identified.

### 7. Natural environment protection plan

The location selected for the construction of ELI is inside the radioprotection area belonging to IFIN-HH, which was approved and controlled by the National Commission for the Control of Nuclear Activities (CNCAN). Taking into account the fact that nuclear research has been developed for more than 50 years in this area, the measures for protecting the environment are already very strict and have been approved by the environment authorization issued by the Agency for Environment Protection. Moreover, both the International Atomic Energy Agency (IAEA) in Vienna and the CNCAN Romania monitor IFIN-HH's activity. By building ELI, the land designation will remain unchanged, as the entire area has been designated for special research/nuclear research.

In view of the foregoing, the most important measures for environmental protection will be the following:

- Hazardous waste waters will be carried out and treated in the IFIN-HH's WWT plant;
- Hazardous waste, including radioactive waste, is treated inside IFIN-HH, will be subsequently disposed of in controlled and authorized landfills.
- Domestic waste will be collected by the authorized operator for the entire Magurele zone.
- The emissions will be permanently monitored by means of an on-line system, foreseen for the entire area of the City of Bucharest and a measurement plant is will be based in Magurele; a project for modernizing the monitoring system is currently being developed (PHARE funds).



## D. Level of the surrounding civil infrastructures

### 1. General description (airport, roads, telecommunications capacity, etc)

Due to the fact that Magurele is situated in the proximity of Bucharest, being thus part of the soon to be approved Metropolitan Area, the infrastructure of Bucharest can be considered as relevant to the town of Magurele.

#### a. Air transport

Two airports serve the Municipality of Bucharest: Otopeni (Henri Coanda) and Baneasa (Aurel Vlaicu).

- The Otopeni airport is the main air gate of the Capital and handles an annual volume of traffic of approximately 5 million passengers. It is connected by many flights to the main airports of Eu-

rope, North America, Asia and Africa.

- The Baneasa airport is located in Bucharest, on the National Road No. 1 Bucharest-Ploiesti and is mainly used by low-cost internal flights and some to various European countries. A project is currently being developed to connect the two airports by means of Bucharest's subway system by building a new line that will connect them to the existing network. This project is on schedule and is expected to be finalized by 2014.

The connection between Magurele and these two airports can be made either by driving through Bucharest (Otopeni and Baneasa airports are approximately 30 and 20 km away from the centre of Bucharest, respec-

tively) or by using the ring road and the National Road.

By 2015, a third airport, in the southern area of the Bucharest, is to be completed (at Adunatii Copaceni); this future airport will be approximately 15 km far from Magurele and will be reached using the Bucharest ring road.

**b. Railway transports**

Bucharest is the most important railway junction in Romania. There are daily departures from Bucharest to the most important cities in the country via the 8 existing main railways.

From the point of view of the railway transport, Magurele is served by the 902 main railway line; Bucharest – Giurgiu and the freight station Varteju. An important aspect to be mentioned is that the Magurele Platform communicates with the main railway 902 by a secondary railway that starts near the proposed ELI site. This railway can be used to

transport different types of equipment, goods, materials and all of the necessary supplies for the building of the ELI project.

Another relevant project for ELI's infrastructure, which is being done with by the Ministry of Transport, is the creation of a railway ring around Bucharest. The total length of the railway will be 72 km, with 25 stops. Multiple-unit trains will be used, the maximum speed being 80 km/hour and the entire distance will be covered in one hour and ten minutes. Among the 25 stops, the most important for the project will be the ones in Baneasa and Otopeni Airports and the one on the Bucharest- Magurele road. Thus, it will be very easy for persons who land at the Otopeni or Adunatii Copaceni airports to get to Magurele quickly, by following this itinerary.

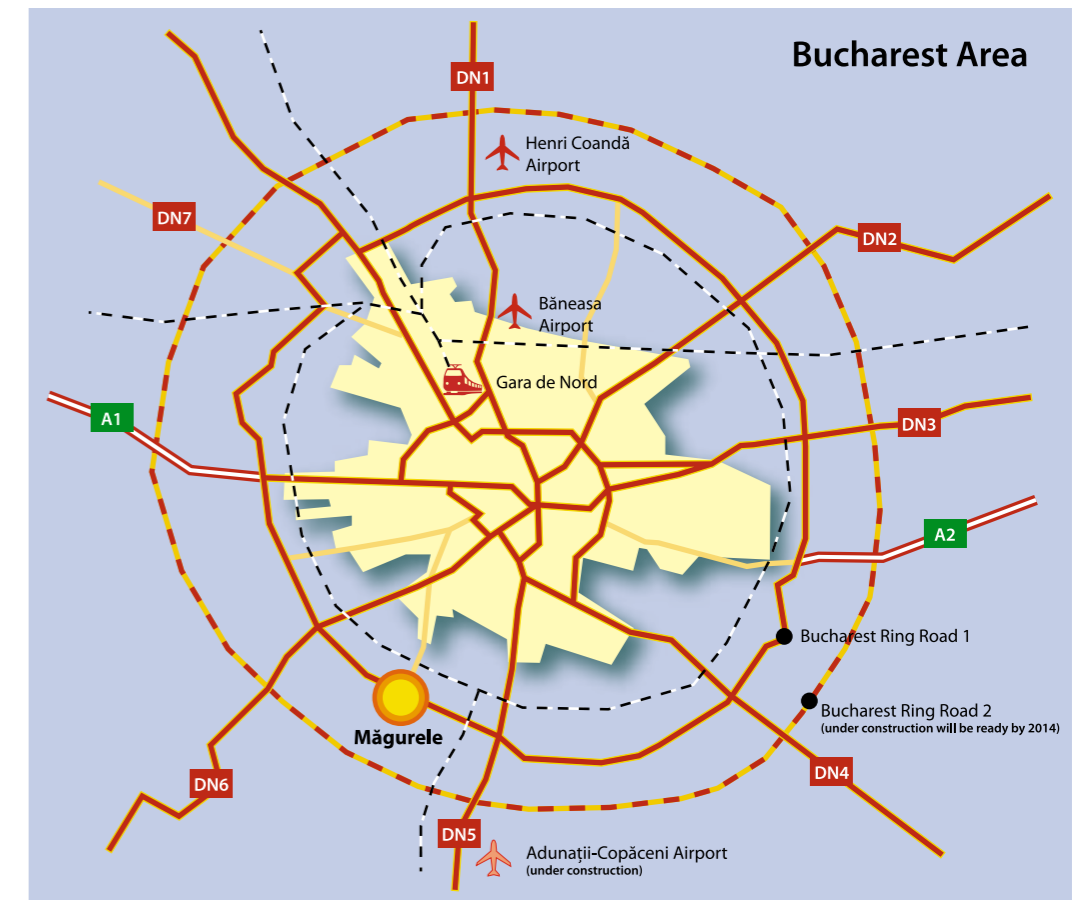
**c. Road transports**

Bucharest is Romania's most important road hub with the principal national and European roads meeting here, as well as



the country's two existing motorways: A1 Bucharest-Pitesti and A2 Bucharest-Cernavoda-Constanta. It is easy to get on to any of the important roads that converge on Bucharest from Magurele, in a very short time, by either crossing Bucharest or by the easy access to its two ring roads (1 km from ring 1 and 10 km from ring 2). Moreover by 2016, according to current estimates, work on the motorways linking the trans-European road networks will be finalized: the Bucharest – Constanța Motorway, Bucharest – Pitești-Sibiu-Deva-Timișoara-Arad-Nădlac Motorway, Bucharest–Brașov-Târgu-Mureș-Cluj-Oradea Motorway, the Iași-Piatra-Neamț-Târgu-Mureș Motorway and the Bucharest–Giurgiu Motorway.

The following map presents the main roads between Bucharest and Magurele and out of Bucharest.



**d. Utilities**

- Internet: The Magurele area is taking advantage of the broadband internet connection offered via optical fiber by RoEduNet (GEANT network).
- Communications: the area is fully covered by all mobile and stationary telephony operators (Romtelecom, Vodafone, Orange, Cosmote, Zapp).
- Drinking water: the site is connected to the Magurele's municipality water mains.
- Waste water: ELI facilities will be connected to the IFIN-HH own waste water treatment plant
- Electricity: the ELI facility will be connected to the electricity distribution network which is currently supplying the IFIN-HH area with medium voltage (20 kV) via a high voltage transformer station (110 kV to 20 kV, installed power 400 MW).
- Gas: the whole Magurele area, including

## The Extreme Light Infrastructure

IFIN-HH premises are connected to the main gas operator for South Romania, namely Distrigaz Sud.

- Waste management: domestic like waste is being collected by authorized operator for Magurele area while the radioactive waste is being treated and sent to Baita Bihor National Radioactive Waste Repository.

### ROMANIA FOR ELI

At the ELI site the land for construction (over 2 ha) is offered at no costs

#### 2. Estimated cost and schedule if any up-grade of existing infrastructures has to be considered due to ELI

The proposed location for hosting ELI does not involve specific needs for upgrading the existing infrastructure, as the developments related to it have already been scheduled within national and local development plans. As it is presented in the different sections of the application, the location provides all necessary infrastructures for building ELI. The fact that the project cost will not be increased with costs for upgrading the existing infrastructure, represents another major advantages of the proposed location.

#### 3. Technical infrastructures (cooling water, high-voltage power supply, etc) and contingency plan

The territory of Magurele city is crossed by the Arges, Ciorogarla and Sabar rivers; the flow of the Arges River insures the construction of a cooling water system for

ELI. The flow is enough even in periods of drought, which leads to the conclusion that a reserve plan is not necessary. To be mentioned however, that due to flood protection and river banking works carried out in the past for these 3 rivers which cross the city Magurele and the difference between the level of these rivers and the level of the land which will be located ELI infrastructure, there is no flooding risk.

As far as the electrical supply is concerned, there is a main network for high voltage (110kV) in the area, as well as IFIN-HH's own transformer station for intermediate high-voltage, with a power of approximately 400 MW. In case of potential accidents at the high voltage main network, a backup energy source is being used within IFIN-HH premises in order to keep online the safety and monitoring systems.

#### 4. Site security plan

Taking into account the nuclear research activities already undertaken and the existence of radioactive sources, the entire ELI area will be surrounded by fences, while the security will be guaranteed by patrols of the Romanian police. The access to the site will be based on a biometric identification system and the access for visitors will be preceded by a notification from one of the institute's management. Video surveillance will be in operation at the entrance as well as at key points of the installation. There is also a fire brigade located inside the IFIN-HH area.



## E. Environment of ELI site

### 1. Geophysical compatibility (seismology, climate conditions, etc)

#### a. Seismology

The Bucharest area is located in the south/south-eastern part of the country and is regarded as presenting a potential seismic hazard. The main reason for this potential risk is due to tectonic activity in the Vrancea region (110 km from Magurele, at the sharp bend of the Southeastern Carpathians) and also to the clay soil that can lead to high accelerations in case of an earthquake. Vrancea region is one of the well-defined seismo-active areas of Europe.

Given this risk, the buildings construction related legislation provides special and very

strict earthquake provisions to be taken into account. While the main institutes in Magurele were built before 1977 (the year when one of the biggest earthquake hit Romania - 7.2 degrees on Richter scale), there was no major damage suffered by these buildings. All new buildings which have been constructed after 1977 were subject to the new regulations and the risk has been even more diminished. It should be mentioned that in the 1977 earthquake, the buildings suffering severe damages or totally collapsing were those either built way before, during the inter-war period (buildings that had been subject to more relaxed norms for seismic hazard) or either to buildings that had undergone unauthorized structural works.

In conclusion, in case of high seismic risk, it has been demonstrated that following the appropriate construction legislation prevents major damages. In Romania there are also other critical buildings such as the Nuclear Plant from Cernavoda, whereto the seismic risk has been carefully assessed and abatement related measures have been taken.

In the case of ELI, in view of the need to guarantee security in the event of a major earthquake, there will be a connection to the automatic earthquake warning system. This system was developed by the National Institute for Earth Physics, which is also located on the Magurele Platform. This system can issue an earthquake warning and, if necessary, initiate an automatic shutdown.

**b. Climate conditions**

Both the Town of Magurele and the Bucharest area are characterized by a typically temperate climate, with influences of mediteranean and extreme continental. The area is characterized by hot, dry summers and cold winters. Due to its position in the Romanian Plain, during winter, there are often cold winds inside the city; sometimes moderated by the urban development. Temperatures during winter often fall below zero. In summer the average temperature is 28° C in July and August, although sometimes the temperature can reach 35-40° C. The average rainfall and level of humidity during the summer is low with occasional thunderstorms. During the spring and autumn seasons, the temperatures vary between 18-22°C, with increased rainfall and milder temperatures. Due to the geographical location of the city and the climatic conditions there is no flooding risk.

**2. Construction rules**

The Romanian legal system for constructions is in line with the existing legal systems in the EU countries and offers a framework with special emphasis on the quality of buildings. There are two categories of laws: (a) the laws defining the framework for construction of any type of building, from planning/design to operational phase of the building and (b), the subsidiary legislation, comprising various norms and standards compulsory for the building design. The Romanian legal system for public procurement is harmonized with the European directives.

The full regulatory framework from planning to construction is presented below:

- Building permit
- Permits incl. Environmental authorization
- Technical description
- Environmental Impact Assesment
- EIA related legislation
- Prefeasibility and Master Plan
- Regulation for budget allowance
- Preparation of the feasibility studies and preliminary/detailed design (incl. geo, topo, hydro surveys) – under yellow / red FIDIC conditions of
- Certificate for urban planning
- Design regulations
- Public Finances Law
- Quality in construction laws
- Design, procurement regulations
- Standards, technical norms
- Quality in construction laws
- Technical documentation for building permit
- Quality in construction laws
- Authorized design checking
- Selecting the contractor and completion of the building
- Procurement and quality in construction
- Documents for authorizing the operational phase of the building, including CNCAN agreement
- Authorization for starting
- Different laws, incl. environmental protection

**3. Impact on nearby existing community**

The construction of ELI will have a major socio-economic impact in the region. The focus will be on the area Bucharest-Ilfov. Going further into details, it can be stated that the impact of such an ambitious project will not only affect the citizens of Magurele, but also the entire population of the County.

The main streams of ELI are related to the long-term perspective of its implementation and its field of research. This project represents a new era for physics as it brings together the most ambitious results achieved with new and greater challenges.

ELI applications involve new breakthroughs in physics. Therefore, the overall results cannot be measured in detail and with the long time framework assumptions will become biased. However, the socio-economic indirect effects can rely on the theories such as new geographic models, OLI paradigm<sup>3</sup>, and models endogenizing R&D.

Magurele represents an important research reference point and due to its proximity to Bucharest, the area is well developed. Yet, considering the potential of this location there is room for even further developments. These developments can be reached with new influxes of investments. The creation of ELI will be a driving force for the investments, which will in turn attract new lines of business.

The existing industries, they are still somewhat lagging behind the European level of development as a consequence of the coun-

<sup>3</sup> The OLI Paradigm provides a framework for analyzing the decision to engage in foreign direct investment (FDI). It is a mix of three different theories that was developed by John Dunning. O = Ownership Advantages L = Location Advantages I = Internalization Advantages

try’s historical and economic background. Thus, the main characteristics of Romanian industry are the following:

- Their development has been based on components and technologies bought from external sources
- The best developed sector is the IT sector
- The other industries connected to ELI functions are not very successful in terms of results, market size of local companies, etc.

Based however on the new growth theory models and the OLI paradigm, the analysis undertaken shows that the Bucharest – Ilfov perimeter will become of increasingly high interest due to the good infrastructure for the researchers specialized on niche areas, and the aim of transforming Magurele into a pole of excellence.

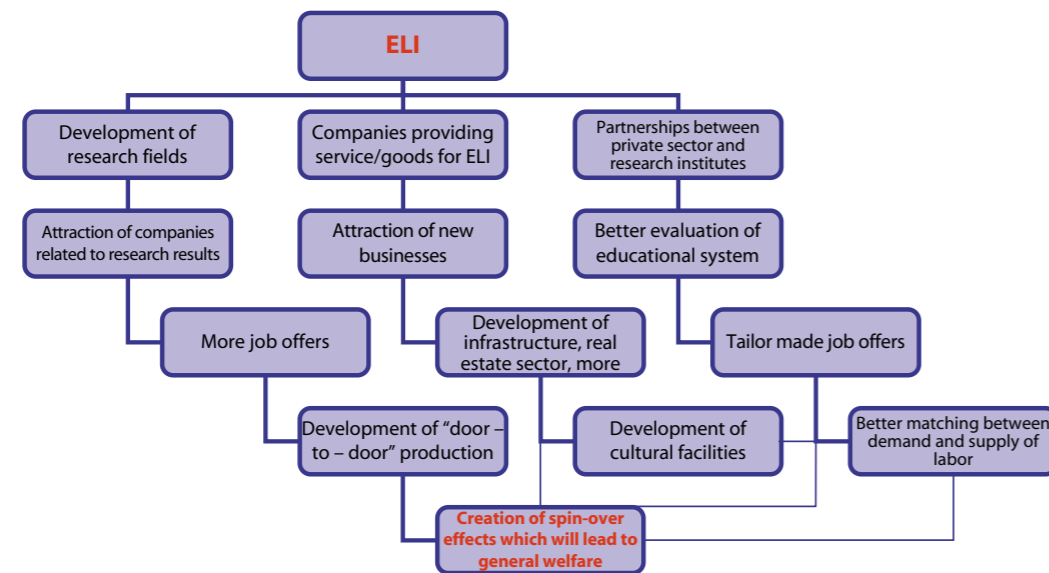
In the long-term, the research field will be strengthened by attracting more young researchers and by hosting researchers of Romanian nationality and encouraging them to work inside the country. In addition to that, judging by the “stepping-on-shoulders” effect, by developing new lines of research, even the parts which will become beneficiaries of the results will upgrade the level of skills of their labour force. Consequently, this location will become attractive for companies that will be interested in placing plants or branches related to ELI fields of research. The interest will be driven by the human capital, in terms of education and practical skills, the possibility for these companies to operate in new markets and new segments, plus the opportunity for new businesses to develop due to ELI’s construction. The new lines of bussiness will be directly connected to ELI or complementary to ELI’s specificity. In this respect the area has a high potential for new infrastructures related to

## The Extreme Light Infrastructure

tourism, commerce, plus strong development for the service sector. The identified fields which will immediately be upgraded are related mainly to companies that will provide services or manufacture goods for ELI; partnerships between the private sector and the public research institutes. As can be seen, there is an entire chain that will develop once ELI will be established. For better explanation the following figure will show the network that can be built around ELI.

### 4. Pollution and radio-protection rules

It is important to note that all the EU directives and regulations relevant to the project are already incorporated into the national legislation. In accordance with national legislation, the central authority, CNCAN, is responsible for: authorizing, reglementing and controlling the elaboration of mandatory instructions, the regulations for nuclear security regarding protection against nuclear radiation for the staff engaged in the activities, for the population and the environment.



## F. Accommodation for permanent and temporary staff

### 1. Housing capacity and location for temporary staff and visitors (hotels, guest houses and renting)

Bucharest provides a wide range of hotels, varying from family business (such as hostels) to well known hotel networks such as Marriott, Intercontinental, Sofitel, Athenee Palace-Hilton, Radisson, Ibis etc. These hotels are located in the centre of the capital, and the potential client has the possibility of to commute easily from different areas of interest (locations of historical interest to banks, shopping centres etc) in a short period of time. In Magurele there is one 2 stars hotel: "Magurele Hotel". The hotel has 64 rooms (double or triple), central heating, cable TV and free parking lots. The restaurant of the hotel has a capacity of 240

persons and provides Romanian as well as international cuisine. Besides the existing accommodation facilities, the Faculty of Physics has four student residences (student hostels) with a capacity of 200 persons each, in double rooms. One of the hostels was recently modernized and is already available for this project, while the other three will be renovated by 2012. All are located in the proximity of the Faculty of Physics, the Institutes in Magurele, and only within 15 minutes walk to the future location of ELI. In addition, IFIN-HH has a hostel for PhD students with 19 studios and a guest house with 5 rooms (3 single and 2 double). Another 2 hostels will be finished by 2010, with 38 single rooms and 10 single rooms, respectively.



Apartments or studios for rent can be found both in Magurele and Bucharest in local newspapers ads, on the internet, or with the assistance of a real estate agency.

## ELI - THE IMPACT ON SCIENCE AND RELATED DOMAINS

Development of existing and new research fields  
Companies providing service/goods for ELI

Partnerships between private sector and research institutes

Attracting companies related to research results  
More job offers

Better evaluation of educational system

Tailor made job offers

Better matching between demand and supply of labor

Attracting new businesses

Development of infrastructure, real estate sector and more

Development of cultural facilities

Development of "door-to-door" production

Creation of spin-over effects which will lead to general welfare

The average time needed to rent an apartment is a day throughout the year, except September and October months when rent applications are higher with the beginning of the academic year, Bucharest and Magurele being both university centres. During these months the time required to rent an apartment increases to a minimum 2-3 days.

### 2. Average and expected cost (to rent or to buy) houses/flats near the site

The prices for land properties in Magurele are the following:

- out of city area – the price is between 10 to 14 euros/square meter
- city area – the price is between 85 to 130 euros/square meter.

The building cost for a house is of approximately 800 euros/square meter.

The prices for a studio, different types of appartments and houses are the following:

- a studio in Magurele costs approximately 60.000 euros (+/-10% according to the area where the studio is located);
- the price for a double room apartment is about 90.000 euros
- the price of a three room apartment is between 100.000 and 110.000 euros
- and the price of a house with four rooms is almost 200.000 euros.

The average monthly rent inside Magurele is about 300 euros/studio, 450 euros/two room apartment and 600 euros/three room apartment.

Once ELI is functional the prices are expected to increase by 20-30%, equivalent to the level of those in Bucharest.

### 3. Welcome plan for newcomers

The welcome plan for newcomers includes the following aspects:

- The accomodation for newcomers will be provided in the student residences until further arrangements can be made.
- Support and assistance for the formalities regarding visa procedures.
- Accessing the programs of EU funds regarding sustainability for researchers' mobility.
- The researchers mobility portal (<http://www.eracareers.ro>) offers useful information for researchers coming to or going out from Romania.

### 4. Transportation

Bucharest has the largest network of public transport in Romania; it is one of the largest in Europe. The network is composed of a subway line plus three terrestrial means of transportation: trams, bus/microbus and

electric buses. Bucharest is built on a circular structure and with 11 arterial roads which converge on the public squares. All of these arterial roads connect the center of the city with the suburbs.

#### a) Road transport

Even though there are a lot of junction points, the subway and terrestrial networks are under separate administration (Metrorex- for the subway, and RATB – for terrestrial transportation) and are using different tickets. This makes the transfer between these two means of transport difficult. Due to these inconveniences, these two networks will merge in the near future under the Metropolitan Authority for Transport and a common system for tickets will be implemented. The RATB network is among the densest in Europe, and is ranked as the fourth in Europe with a delivery value of 1.7 million passengers / day / on 121 bus lines, 30 tram lines, 3 light metro lines and 20 trolleybus lines. As regard connection with Magurele, there are 5 direct links starting from several points of Bucharest. In order to complement the public transportation, IFIN-HH established its own additional five lines. The transportation costs are 0.35 euros per fare or between 8.5 euros per month (single line) and 22 euros per month (whole network). Students and retired persons benefit from a 50% reduction for monthly tickets.

The area is also served by the Bucharest cab companies, the tariffs being set between 0.6 and 1 euro per km (large cab companies). Independent cabs may charge up to 3 euros per km.

#### b) Subway transport

The subway network is under Metrorex administration and is one of the most used

networks for public transport in Romania. The network is composed of 4 lines, the total system's length being 62.2 km with 45 stations, with an average distance between them of 1.5 km. Presently, the subway does not cover the south-west, south and north-east areas of Bucharest. There are plans for expanding the subway network, to link the central part of Bucharest with the south-west area by 2012. There is also a project to connect the central railway station with the southern part of Bucharest (Rahova), the north-east part (Colentina) and Otopeni airport (the Henri Coanda airport). The tariff is varying between 0.6 euros per 2 fares up to 6.4 euros per month. Students and retired persons benefit from a 50% reduction for monthly tickets.

#### c) Railway transport

Magurele will be one of the 25 stops of the ring railroad transport of Bucharest, benefiting thus from a fast and cheap connection to the airports.

### 5. Shopping centres

In Magurele the main shopping area is located in the central part of the city. There are also a few small shops, restaurants, and fast-food outlets.

In Bucharest there are 5 big shopping centers -Bucuresti Mall, Plaza Romania, Militari shopping area, Rahova, and Baneasa- and another 15 will be ready by 2011. In addition, in all parts of Bucharest operate supermarket networks, there are 15 companies operating in this market segment, the most important ones being Carrefour, Cora, Billa and Metro.

### 6. Cost of living and salary scales

The average monthly living costs are 450 euros/family. Regarding the researchers' salaries (mainly referring to the activities

financed by national programmes for research), the maximum levels are established in the legislation and are as follows:

| Category   | Gross salary Euro/month |
|--|-------------------------|
| Scientific researcher I and II; technological development engineer I and II; university professor and associate professor; programme manager; project coordinator                              | 4300                    |
| Scientific researcher III; technological development engineer III; junior researcher; junior technological development engineer; university lecturer; university assistant; workpackage leader | 2900                    |
| Research assistant; PhD student; master's degree candidate   | 1900                    |
| Technician I, II and III; other (support activities)   | 1000                    |

**7. Health care facilities (hospitals, doctors, chemists etc)**

With a population of over 2 million inhabitants, Bucharest has the largest and most complex health care network in Romania, with 52 hospitals, 777 chemists, 681 individual medical units and 617 specialized medical units, in 2006. The high quality of the services that are provided is very well known, thanks to the recent investments in the medical sector in both the public and the private sector. Due to its proximity to Bucharest, Magurele benefits from all the medical services that are available in Bucharest. In Magurele there are 2 chemists, 5 individual medical units, 3 specialized medical units and an ambulance station.

In 2006, in Bucharest there were 10,915 registered doctors, (1,053 family general practitioners), 2,085 dental surgeons and 1,713 chemists. In Ilfov, in 2006, there were 11,359 doctors (1,197 family general practitioners, 2,170 dental surgeons and 1,853 chemists).

**8. Existing or planned international kindergartens and schools**

In 2007 in Bucharest, there were 147 registered nursery schools, 162 primary

schools, 16 special schools, 7 sports schools, 5 art schools and 6 pupils' clubs. In 2007, there were 3 nursery schools and 3 schools were registered in Magurele.

Out of the total number of nursery schools in Bucharest, 34 have a special program exclusively in a foreign language (English, French and German), or they have a program with intensive activities in these languages. There are also schools where the teaching is done exclusively in English, French, German, Italian or Spanish.

**ROMANIA FOR ELI**

Magurele is part of the Bucharest metropolitan zone, enjoying all its facilities: social, educational, cultural, entertainment etc.

**9. High schools and universities**

The network of higher education units in Bucharest is very complex. In 2007 there were 104 high schools, 16 state Universities and 13 private Universities. Magurele is linked to the complex system in Bucharest and, in addition, it has one high school and the Faculty of Physics. Some of the classes at the Faculty of Physics in Magurele are imparted in English or French.

**10. Job opportunities around ELI for partners and family members**

Once ELI is implemented, new jobs will be created due to the complementary investments in this area. As a result, restaurants, supermarkets, leisure facilities and auxiliary jobs will also be created.

According to the information provided by NIS (National Institute of Statistics), the unemployment rate in Bucharest is the lowest in Romania at 1.8% (most of it non-qualified workers).

On the other hand, the existence of multinational enterprises and the dynamic development of the Bucharest area, generates a constant demand for highly skilled persons. Nowadays, there is a constant demand for economists, engineers in various fields (IT, construction, automation etc.), environmental engineers, architects, managers, etc.

**11. Places of worship near the site**

In Romania the right to freely choose a religion is guaranteed by the Constitution. There are 18 religions recognized in the country.

Presently, in Bucharest, there are over 200 places of worship belonging to different religions: Orthodox (Romanian, Bulgarian, Greek and Russian), Catholic, Unitarian, Islam, Judaism, reformed (Calvinist), Sabatarian, Baptist, Lutheran, Anglican, Pentecostal, Adventist etc. In Magurele there are 3 Orthodox churches.

**12. General rules for the National Health Service (cost, access etc)**

Any person who is a permanent resident in Romania and any foreign person with a temporary residence permit, if insured under the national public health system, is

a direct beneficiary of the services. This right is guaranteed by law. In accordance to the different types of activities there are different ways of contributing to the Health Insurance Fund. Thus:

- Employees contribute 5.5% of the total salary income;
- Self employed persons contribute 5.5% of their net income;
- Persons whose income comes from dividends pay 5.5% of their value; if the person is not also an employee.

Insurance rights stop once the person loses the residence permit in Romania. In the case of persons with insurance coverage in the countries with which Romania has international agreements regarding the health system, these will be applicable in accordance with the international agreements.

In order to ensure medical assistance, Bucharest makes available the following:

- Medical units for generalists and other specializations, diagnosis and treatment centres, medical centres, health centres, laboratories.
- public and private sanitary units.

Primary medical assistance is provided in units for general family medicine. Family doctors ensure the access to the health system for their patients. These units also provide medical services for uninsured patients, and, in extreme cases, on payment. The generalist doctor decides whether the patient needs specialized medical assistance and will guide the person towards a specialist doctor.

In case of emergencies, a person can go directly to a specialized unit, which is registered in the emergency services category. Most of the large hospitals in Bucharest provide emergency services. Public medical

## The Extreme Light Infrastructure

and Geometry, Institute of Mathematics, Applied Mathematics, Computer Science. Web page: [www.uvt.ro](http://www.uvt.ro).

**University “Politehnica”** of Timisoara. It is one of the largest technical Universities (over 1,300 teaching staff and more than 15,000 students) with 10 faculties and several independent departments. In the recent years,

the University, through its Regional Centre for Open and Distance Learning, has begun to offer open and distance education in different areas and in different languages, supported by new technologies.

Web page: [www.upt.ro](http://www.upt.ro).



## The Extreme Light Infrastructure

assistance at the pre-hospital stage is ensured by the ambulance service in Bucharest, as well as by teams that form part of the mobile services for emergency cases for resuscitation and rescuing trapped persons (SMURD). These services are part of the structure of the Emergency Institution Bucharest. Bucharest can also provide private medical assistance. This type of assistance in the pre-hospital stage is provided by private ambulance services, based on a contract signed directly with the beneficiary of the service, with the pri-

ivate insurance company or if directly required by the beneficiary, with the consent of the person requiring the service. The costs in the private system are on average from 1500 to 1700 euros/year/person, differing in accordance to the medical services included in the package.

### 13. Local taxes

Direct taxes and local taxes are subject to Fiscal Code, which is the main legal framework regulating these aspects. The actual taxes levels are presented below:

| Description  | %                | Notes   |
|--|------------------|---|
| National level taxes - set at national level                     |                  |   |
| Income tax   | 16 %             | Applicable to gross income realized by both persons and companies.  |
| VAT  | 19 %             | Applicable to goods, services, works  |
| Compulsory health insurance contribution                         | 5.5 %            | To be paid by employee, applicable to gross salary  |
| Compulsory social contribution                                   | 9.5 %            |   |
| Compulsory unemployment tax                                      | 0,5 %            |   |
| Compulsory health insurance contribution                         | 19.5 %           | To be paid by employer, applicable to gross salary  |
| Compulsory social contribution                                   | 5.5 %            |   |
| Compulsory unemployment tax                                      | 1 %              |   |
| Compulsory risks and accidents provision (depending on activity) | 0.6 % up to 1.5% |   |
| Compulsory medical leaves provision                              | 0.85 %           |   |
| Compulsory contribution to National Guarantor Fund for Salaries  | 0.25 %           |   |
| Contribution to Employment Agency                                | 0.75 %           |   |
| Local level taxes – set at municipal level                       |                  |   |
| Taxes for buildings ownership                                    | 1.5 %            | Annual, to be paid by owner companies, applicable to the building value                                   |
| Taxes for buildings ownership                                    | 0.5 %            | Annual, to be paid by owner physical persons, applicable to the minimal building value set in regulations |
| Taxes for land ownership   | 927 up to 1850   | Euros per year and hectar   |
| Taxes for ownership of vehicles                                  | 4.5 up to 55     | Euros per year and every 200 cm3 of engine capacity   |



## G. Financial aspects

### 1. Level of financial commitment (more than 40 %)

According to the ESFRI Roadmap the construction costs of ELI amount to 150 million euro.

The ELI partners have pointed out many times that the construction budget is very likely to be exceeded, but at this moment an updated evaluation of the gross budget is not available.

The detailed ELI budget will be communicated in the second part of the ELI Preparatory Project.

The Romanian Government offers to pay, through the National Authority for Scientific

Research, 70% of the investment costs of ELI. The land foreseen for the construction of ELI (a surface of about 2 ha in the Magurele City) will be offered at no cost by the Romanian State to the future ELI legal entity.

The remaining 30% of the investment costs will be provided by the other ELI partners, calculated on the basis of GDP-shares or on any other basis agreed by the partners.

No EU funds have been committed to the construction of ELI so far.

Romania will investigate the possibility to obtain credits from the European Investment Bank, guaranteed by the Romanian Government.

Romania proposes the following distribution for the operation costs: 30% from Romania (state budget), 30% from the other partners (public funds), and 40% from project funds.

### ROMANIA FOR ELI

70% of the ELI construction costs will be covered by The Romanian Government through the National Authority for Scientific Research.

#### 2. Regional/National funding capacity

The 70% contribution to the construction costs will consist of 100 million euro from national funds (state budget), while the rest will be covered by structural funds. Bridging funds will be provided from the state budget over the 100 million basis, if needed, and the costs will be reimbursed afterwards from structural funds.

In case that the real construction costs will exceed 500 million euro the contribution from the state budget will be increased.

The governmental contribution to the yearly running costs will be ensured from national funds (state budget).

In 2008 the public research funds increased to 850 million euro, which means that the GERD will reach about 0.70% of GDP for this year. By 2010, according to the Governmental commitments, the GERD will reach 1% of GDP.

At the end of the year 2007 the Romanian Government launched a large investment effort in the public research infrastructure, both

from structural and national funds in equal shares. About 29 investment projects with values between 6 million and 24 million euro will be implemented starting with September 2008 in public universities and institutes all over the country. Three such projects will be implemented in Magurele (see section C.5).

#### 3. Expected level of structural funds and management

Except for the 100 million basis ensured from national funds, Romania will cover its contribution to the construction of ELI from structural funds. For a construction budget of 500 million euro, for example, the contribution from structural funds would represent 250 million euro.

During the construction phase the domestic organization that provides the logistic and administrative support for building ELI will be the Institute for Atomic Physics, located in the center of Magurele. The Institute for Atomic Physics is a public institution subordinated to the National Authority for Scientific Research. Romania will offer office space and facilities for ELI partners on the premises of the Institute for Atomic Physics (300 square meters).

#### 4. Level of involvement in the running costs

Romania offers to cover from public funds 30% of the operating costs per year from the first day of operation. 30% will be provided by the other partners on an algorithm agreed by all partners, while the remaining 40% will be covered from project funds.



## H. Legal aspects and management

### 1. Local rules concerning the daily operation of ELI

The operation of ELI will be subject to the usual labour standards.

- The normal daily working schedule is 8 hours, and the maximum duration of working hours cannot exceed 48 hours/week. These regulations also apply to overtime and night shifts.
- Employees have the right to the following holidays: 1<sup>st</sup> and 2<sup>nd</sup> of January, 1<sup>st</sup> and 2<sup>nd</sup> Easter days, 1<sup>st</sup> of May, 1<sup>st</sup> of December (Romania National Day), 1<sup>st</sup> and 2<sup>nd</sup> Christmas days, two days for each of the two annual celebrations proclaimed by the other officially recognized religions.
- All employees have the right to a minimum of 20 working days annual paid vacation.

- In working areas with a level of exposure to radioactive sources, the working schedule is of 6 hours/day

### 2. Description of the organism that will manage ELI

ELI will be established as an European research infrastructure according to the provisions of the future Council Regulation on the Community Legal Framework for European Research Infrastructure, under approval following the consultation procedure.

According to the Work Plan of the European project for the Preparatory Phase (PP), several governance schemes of existing European infrastructures will be analyzed in view of

possible transposition to ELI (Work Package 3). Decisions about the organism that will manage ELI and the governance rules will be established during the negotiations on a government level between the countries that will formally agree to jointly build ELI and the host country.

**ROMANIA FOR ELI**

Building ELI in Romania will mean: establishing the first major advanced research center in south east Europe.

During the construction phase, the role of the domestic organization that provides the logistic and the administrative support in building ELI is crucial. Romania chose for this task the Institute of Atomic Physics (IFA), one of the most prestigious institutions in the country for the management of science and research infrastructures. IFA, located in the centre of Magurele, has coordinated since 1956 the development of physics in Romania, in particular of the Magurele Platform and of all major research infrastructures there. IFA is now a public institution subordinated to the National Authority for Scientific Research. IFA coordinated within the first RDI National Plan (2000-2005) and during the National Programme “Research of Excellence” (2005-2008) the component dedicated to the basic research in natural and socio-economic sciences. Since 2000 IFA coordinates the Romanian participation in the Fusion Programme of the European Atomic Energy Community (EURATOM), being recently reassigned as Research Unit for the next five years (FP7-EURATOM). IFA will undertake all actions required for the construction of ELI in Romania; it will coordinate the national consortium formed by the main institutions that are expected to participate in the ELI project (INFLPR, IFIN-HH, INFM, INOE, FF-UB, and

FSA-UPB) and the cooperation with the decision bodies of the international organism that will manage ELI. IFA will also offer office space and facilities (~300 m<sup>2</sup> – see photo) during the construction phase. Web site: [www.ifa-mg.ro](http://www.ifa-mg.ro).

**3. Visa regulations**

The regime of foreign residents in Romania is subject to the Romanian legal system. Thus, the law draws the difference between residents of EU origin and residents coming from outside EU borders.

The citizens of EU member states are granted the right to move freely inside Romanian borders, they can establish residences, and benefit from all the rights granted to employees as well as of social protection provided by the state in the same way as the Romanian citizens.

**ROMANIA FOR ELI**

Building ELI in Romania will mean: creating an advanced technology pole in Eastern Europe - a catalyst for industry and the private sector.

Legislation sets the rules for entering and exiting the country, the conditions for residence and also the restrictions on freedom of movement in Romania for EU citizens and for members of the family who are not of EU origin. The law sets out the situations for these cases as follows:

- The residence rights of EU citizens working inside the country.
- The residence rights of EU citizens aiming at developing independent activities.
- The residence rights of persons who are providing or are beneficiaries of services.
- The residence rights of employed persons or those who are developing independent activities, or those who have finished their contracts.

For some Non-EU citizens, Romanian law requires an entry visa which could be on short or long term basis, with either one entry or multiple entries in the country. The Ministry of Foreign Affairs is providing the full list at the address:

<http://www.mae.ro/index.php?unde=doc&id=35313&idlnk=4&cat=5>.

For non-EU citizens who want to work in Romania, they will have first to have residence rights.

The residence rights for family members of foreign persons already having the short term or long term residence rights can be granted directly, without further approval from the Immigration Office.

This request for family reinstatement may be made for: husband/wife, children under age, unmarried, resulted in marriage or outside marriage, as well as those adopted by both or only by one of the spouses, and those trusted with both spouses or only one, by a decision of the competent authorities of the State of origin, provided that they are effectively in the care of either of the spouses. Exceptions are minors aged over 12 years, adopted after the applicant has obtained the right to stay in Romania.

The application is approved if the following conditions are fulfilled:

- there is not a state of polygamy;
- the applicant must hold appropriate living space in the area, namely at least 12 m<sup>2</sup> for each family member;
- the applicant must possess means of maintaining the appropriate amount of class right of residence whose owner is.

A separate procedure is being used for researchers, in which case a long-stay visa for conducting scientific research activities is is-

sued. At the EU level the Directive 2005/71/CE was adopted, according to which the researcher from a third country allowed to conduct research and development in another Member State will be allowed to carry out a part of the research and development in Romania, under the following conditions:

- If the researcher is in Romania for a period of up to 3 months, the research may be conducted on the basis of the agreement concluded for the reception in another Member State, provided s/he has sufficient means of maintenance and cannot be considered a threat to public health, order and safety in Romania;
- If the researcher remains in Romania for more than 3 months, a new agreement is necessary to carry out the research and development in Romania.

**ROMANIA FOR ELI**

Building ELI in Romania will mean: narrowing the technological gap between Eastern and Western EU Member States.

The Directive has been adopted in the Romanian legislation through the Emergency Ordinance 194/2002 republished on the regime of foreign citizens in Romania and Order no. 2414/2007 on the approval procedure of the hosting agreement for third-country researchers carrying on research activities in Romania.

Thus, according to legal provisions, foreigners who are to enter Romania for conducting scientific research activities are permitted long-stay visas, or, upon request, visas for a period of 90 days, with one or more entries.

In addition to the elements stated above, a usefull tool for the researchers that will be engaged in ELI development is the researchers' mobility portal <http://www.era-careers.ro>. Here one can find all the necessary informa-

## The Extreme Light Infrastructure

tion in order to have a thorough knowledge regarding the employment conditions and opportunities, and new events regarding the scientific community in Romania. The portal offers a link to the EURAXESS network.

### ROMANIA FOR ELI

Building ELI in Romania will contribute to fulfilling two major EU aims: socio-economic cohesion across EU states and enlarging the research community inside EU borders.



## Other institutions interested in participating in the ELI project

### BUCHAREST

#### **National Institute for Research and Development in Microtechnology (IMT).**

The research activities of this institute are organized within the following laboratories: Nanotechnologies, Microsystems for Biomedical and Environmental applications, Micro and Nanophotonics, RF-MEMS, Computer-aided simulation and design, Microphysical characterization, Reliability. Web page: [www.imt.ro](http://www.imt.ro).

**National Institute for Research and Development in Electrical Engineering (ICPE-CA).** The main activities are: applied and basic research in the electrical engineering field; engineering, samples, tests, mea-

surements, in laboratory, in pilot stations and on field expert's findings; technological development on the processing and practical application field of industrial wastes and on the ecologic rehabilitation; the elaboration of technical and economical norms of national interest concerning the fulfillment of the fundamental demands in the electrical engineering field; building of strategies, technical assistance and consulting in the electrical engineering field; information, documentation, and personal training in the electrical engineering field. Web page: [www.icpe-ca.ro](http://www.icpe-ca.ro).

**OPTOELECTRONICA-2001 S.A.** designs and produces opto-mechanical devices: planar, spherical and aspherical optical components, complex mechanical structures for 3-5



axis, offer services for testing of collimating and focusing systems, optical testing for UV, VIS, IR, measurements of optical parameters, laser testing and calibration.

Web page: [www.optoel.ro](http://www.optoel.ro).

**PRO OPTICA** is a private joint-stock company. The R&D activities developed within PRO OPTICA are focused on optical, optomechanical and electro-optical devices and equipments, optical systems, execution of experimental patterns and prototypes.

Web page: [www.prooptica.ro](http://www.prooptica.ro).

### BRAȘOV

**Transylvania University** of Brasov offers undergraduate, master and doctoral programmes in technical domains: Mechanical Engineering, Technological Engineering, Materials Science and Engineering, Electrical Engineering and Computer Science, Mathematics and Computer Science.

Web page: [www.unitbv.ro](http://www.unitbv.ro).

### CLUJ-NAPOCA

**National Institute for Research and Development of Isotopic and Molecular Technologies (ITIM).** Research laboratories: Mass spectrometry, chromatography and ion physics, Physics of multifunctional nanostructured systems, Molecular and biomolecular physics, Isotope separation and labelled compounds. Research interest: ultrafast spectroscopy with attosecond pulse duration in UV and X-ray spectral domain; investigation of electrons dynamic in atoms, molecules and clusters; research on inter- and intra-molecular carrier transfer processes on surfaces and interfaces; electronic microscopy with high spatial and temporal resolution; electromagnetic field and plasma

models; propagation of intense laser pulses in dense optical medium; electromagnetic solitons. Web page: [www.itim-cj.ro](http://www.itim-cj.ro).

**Babeș-Bolyai University** of Cluj-Napoca provides courses for more than 45,500 students (of which more than 500 are foreign students, more than 3,000 are doctoral students and 4,300 are secondary education teachers), the educational and research activity being carried out by a teaching staff of over 1,700. Between 21 faculties, the following ones are the most important in the field of technical specialities: Faculty of Physics, Faculty of Mathematics and Computer Science, Faculty of Chemistry and Chemical Engineering, Faculty of Environmental Sciences. Web page: [www.ubbcluj.ro](http://www.ubbcluj.ro).

**Technical University** of Cluj-Napoca.

Teaching Staff ~ 600, Students ~ 12,000, long and short term education programmes, postgraduate and PhD studies. Faculties: Material Science and Engineering; Automation and Computer Science; Electronics, Telecommunications and Information Technology; Electrical Engineering; Civil Engineering and Building Services; Machine Building; Mechanical Engineering. The practical results of the research activity are reflected in numerous contracts and projects with domestic and international financing (CNCSIS, ANSTI, and PNCDI, EUREKA, COPERNICUS, COST, PC5 and PC6). Web page: [www.utcluj.ro](http://www.utcluj.ro).

### CRAIOVA

**University of Craiova.** 32,000 students, in various fields embracing 120 specializations. The Teaching Package includes 3 stages of academic studies (BA, MA, and PhD) that are ensured by over 1,000 teaching staff

and high technological equipment. Field of research: lasers and coherent optics, propagation of laser in 3D structures, nonlinear optics, applications in transport phenomena in turbulent plasma, study of materials with special properties, special effect in chiral media, electrical and optical properties in liquid crystals. Web page: [www.ucv.ro](http://www.ucv.ro).

**Research-Development and Testing National Institute for Electrical Engineering (ICMET).** Research, development and manufacturing for power electronics equipment and special electromechanical equipments: High Voltage, High Power and Low Voltage research, development and testing technology; Monitoring and Diagnosis of the electrical power equipment; Measuring of electrical and non-electrical quantities; Power electronics; Electromagnetic Compatibility; Industry applications. Web page: [www.icmet.ro](http://www.icmet.ro).

### IAȘI

**Alexandru Ioan Cuza University** of Iași is the oldest higher education institution in Romania. Since 1860, the university has been carrying on a tradition of excellence and innovation in the fields of education and research. During the academic year 2007-2008 this institution had 34,747 graduate students, 6,560 postgraduate students, 2,377 PhD students, 870 academic staff, 70 Erasmus students, and 206 bilateral agreements. The faculty of physics offers Bachelor degree, Master degree, and Doctoral School in specialties such as Plasma Physics, Spectroscopy, Optics, Theoretical Physics, Non-linearity and self-organization in complex physical systems, Modelling and Simulation, Advanced Materials Physics, Polymer Physics, Biophysics, Medical physics, Nanotech-

nologies, Applied Physics, Methodology of Teaching Physics, Physics and Environment Protection. Web page: [www.uaic.ro](http://www.uaic.ro).

**Gheorghe Asachi Technical University of Iasi.** It has the oldest tradition in engineering education and offers 4-year Bachelor of Science programmes, as well as 1-2 year Master's courses and PhD full-time courses in: Electrical Engineering, Electronics and Telecommunications, Automatic Control and Computer Engineering, Mechanical Engineering, Machine Manufacturing, Material Sciences and Engineering. Web page: [www.tuiasi.ro](http://www.tuiasi.ro).

**National Institute of Research & Development for Technical Physics.** Research activities, small series production and services in different Magnetic Material Science fields. To mention experience in theoretical and numerical studies of condensed matter, development of physical methods for studying magnetic fields, magnetic separation and nondestructive control of materials through electromagnetic methods or development of devices based on magnetic material (new types of pressure, force, torque, movement, etc. sensors and transducers, magnetometric sensors, transducers for turbionar currents, etc.). Web page: [www.phys-iasi.ro](http://www.phys-iasi.ro).

### TIMIȘOARA

**The West University** of Timisoara has 25,004 students in 11 faculties: 19,738 undergraduate students, 4,376 postgraduate level, 890 Ph.D. level, 766 teaching staff. The research activities are conducted in the Research Centres for Intelligent Materials, Theoretical Physics, Physics of Crystalline Materials, Thermal Analysis for Environmental Problems, Mathematical Analysis