The Extreme Light Infrastructure European Project

The Extreme Light Infrastructure
Preparatory Phase

Nov. 1st, 2007 - Oct. 31st, 2010

www.eli-laser.eu

S. Saltiel

Presentation at XV International School on Quantum Electronics
15-19 September 2008, Bourgas, Bulgaria

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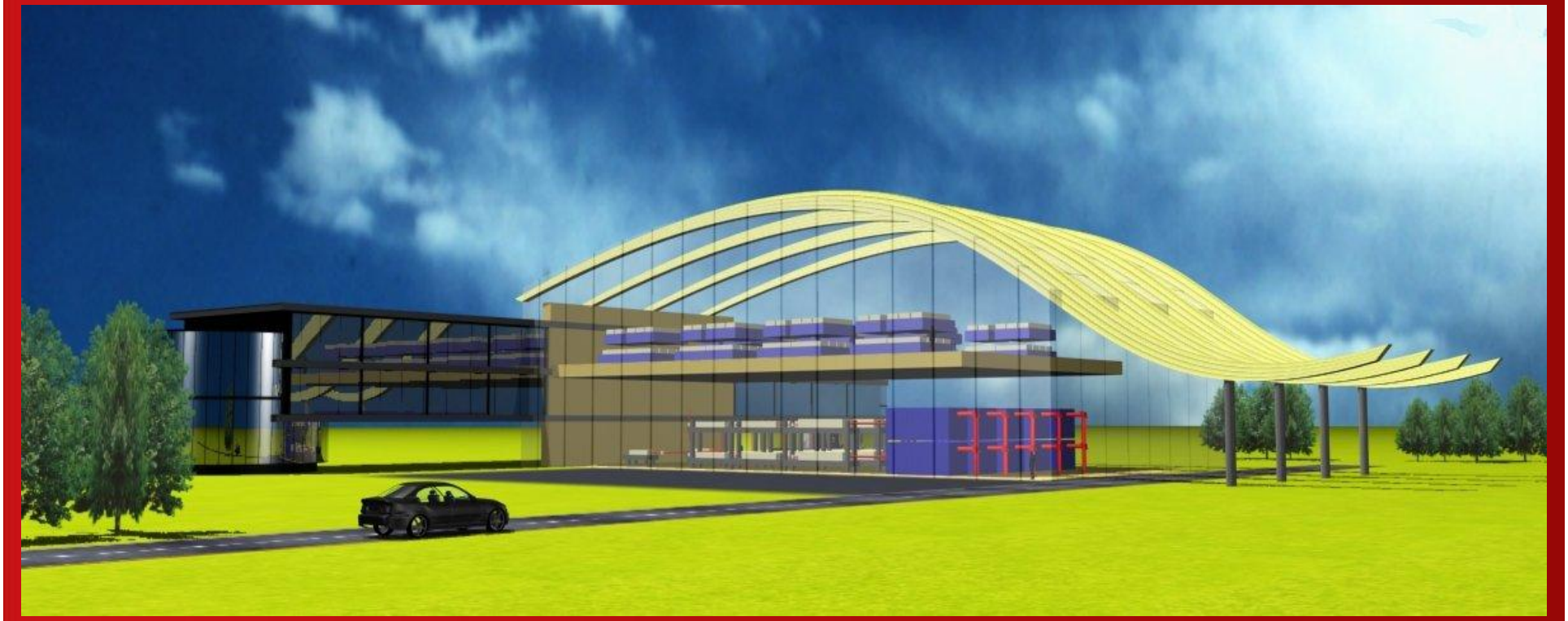
THE GOAL ….



Artistic view of ELI building

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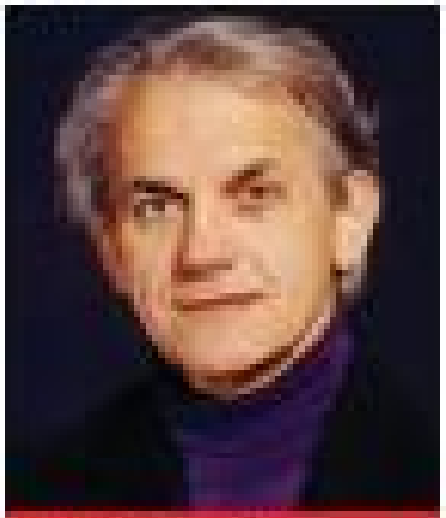

"We're going to change the index of refraction of the vacuum, and produce new particles."
— Gérard Mourou

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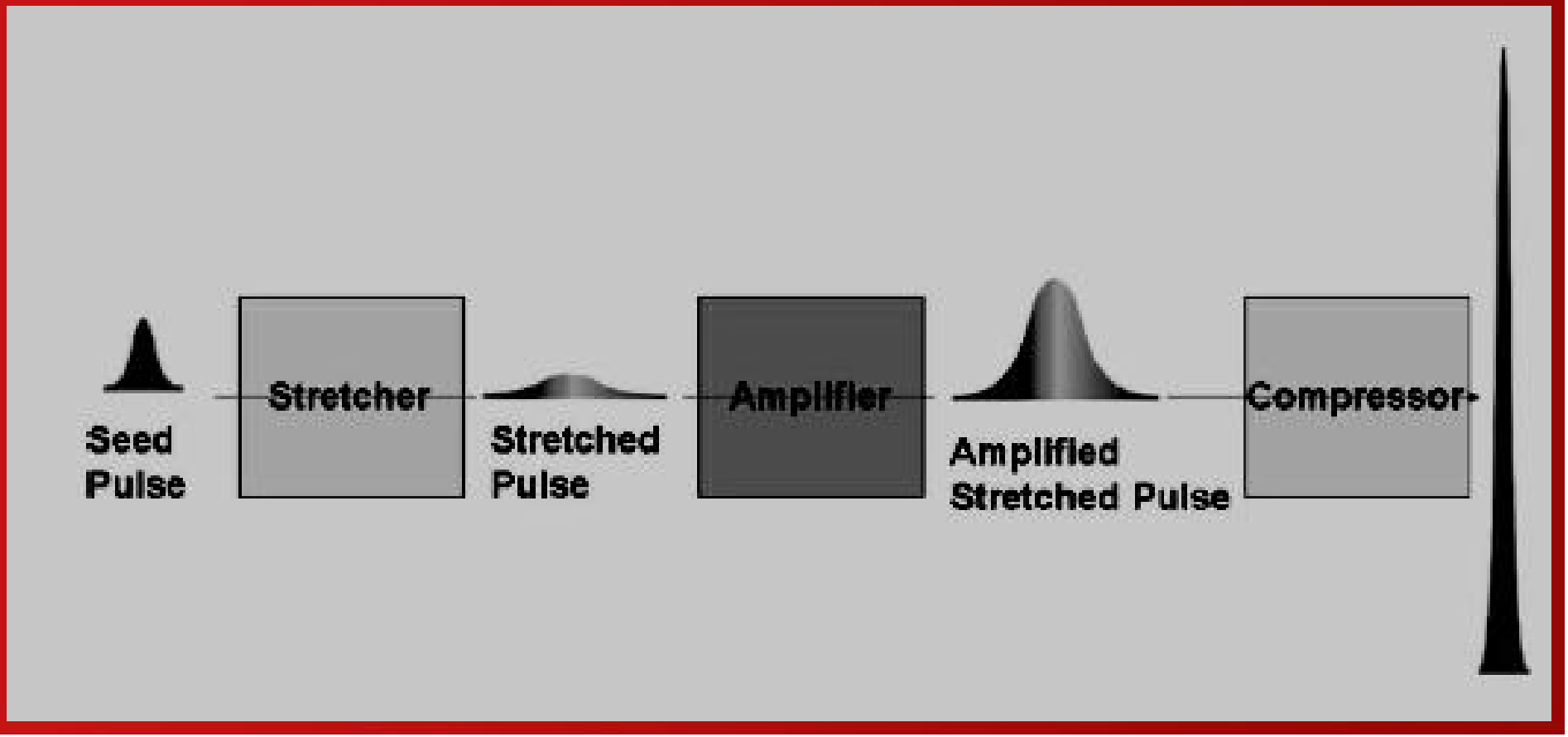
The name of Gerard MOUROU, the coordinator of ELI, is connected with the discovery of chirp-pulse amplification

CPA



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Target - EXAWATT laser:

Initially will be designed a single beam laser to deliver 20 PW in 10/20 fs pulse duration at not less than one shot per minute.

By pushing everything to the limits on a single beam: 70 PW at 1 hertz (10^{25}W/cm²) is possible

When combining 10 beams (phase locked) , 200 to 700 PW is achievable leading to 10^{26} W/cm²

200 PW = 200 x 10^{15} W =

= 0.2 x 10^{18} W = 0.2 EXAWATT (EW)

This will be 100 - 1000 times more powerful laser than any other laser worldwide

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ELI team: 13 countries, 15 beneficiaries

Bulgaria,
Czech Republic,
France,
Germany,
Greece,
Hungary
Italy (*2),
Lithuania,
Poland
Portugal,
Romania,
Spain (*2)
United Kingdom

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General goals of the Preparatory Phase

Work out every issues required to ensure the financing of ELI by the national Funding Agencies.

✓ **Precise the user community (size, field of research, countries);**

✓ **Precise the expectation of future users;**

➡ **Completion of the Technical description;**

➡ **General and detailed costs of ELI (construction, operation, decommission);**

➡ **Financial plan - how much will cost ?**

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ELI Preparatory Phase is much more…

- ✓ Find the future ELI location,
- ✓ Define the legal structure and solve the foreseen legal aspects,
- ✓ Prepare the ELI governance,
- ✓ Consider the impact to the European R&D fabric.
- ✓ Solve the safety issues,
- ✓ Advertise ELI at the European and international level

List of Preparatory Phase Work Packages foreseen under this proposal

WP	Descriptive Title	Short Description and specific objectives of the task	Leading Participant
WP 1	Management	Overall management of the ELI Preparatory Phase to warrant that the Funding Agencies will take the final decision to building ELI. Ensure that every milestone and decision are met on time, check that the budget is used according to the objective and take the necessary correcting measures.	CNRS
Support Actions			
WP 2	Legal issues	Study the different legal forms of ELI according to the possible host countries. Set the final legal scheme of ELI.	FORTH -IESL
WP 3	Governance	Analyze several governance schemes of existing European infrastructures considering possible transposition to ELI. Set the governance rules of ELI.	U. Sal
WP 4A	Strategy on EU large scale facilities	Study the influence of ELI on the actual fabric of large-scale facilities, including lasers, FELs and accelerators.	RISSP O
WP 4B	Site choice	Establish a project for the implementation of ELI in the countries willing to host the infrastructure. Site selection by the funding Agencies.	S.U.
WP 5	Finance	Consider the different funding schemes according to the possible host countries. Implement the final financial plan.	CNRS
WP 6	Safety and radio protection	Analyze every safety issues related to the use of high-power lasers, radio-protection and any other hazards. Set a safety and radio-protection book for users and ELI personnel.	STFC
Technical			
WP 7A	Lasers	Achieve the final benchmarking and take the last decisions so as to completely define the lasers, the metrology systems and optics. Individual items and total cost estimation.	IoP
WP 7B	Secondary sources	Finalize the secondary sources (particle and x-ray) that will be delivered to users. This includes the design of the beamlines as well as the metrology.	IST
WP 7C	Infrastructures	Set the detailed description of the ELI building based on the results from the safety WP as well as the laser/secondary source WP. Precise description of every target area.	MPQ
Coordination Actions			
WP 8	Transnational networking	Follow and organize the trans-national networking within ELI community to ensure a highly efficient Preparatory phase.	INFN
WP 9	International networking/communication	Promote ELI at the international level by organizing schools, workshops and conferences. Follow the participation of ELI participants to events not organized by the ELI-PP. Promote ELI outside Europe.	IST

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Objectives

Long-term societal impacts

Fundamental studies of new alternatives to ion beam-based cancer therapy.

Dynamical studies of neutron-matter interactions to understand nuclear reactor aging.

4D x-ray imaging of ultra-fast molecular processes to make new inroads in drug design.

Understanding the effects of radiation dose fluxes on biological samples.

Education

Centre of excellence.

Training of students from undergraduate to graduate levels.

Attracting top-level researchers.

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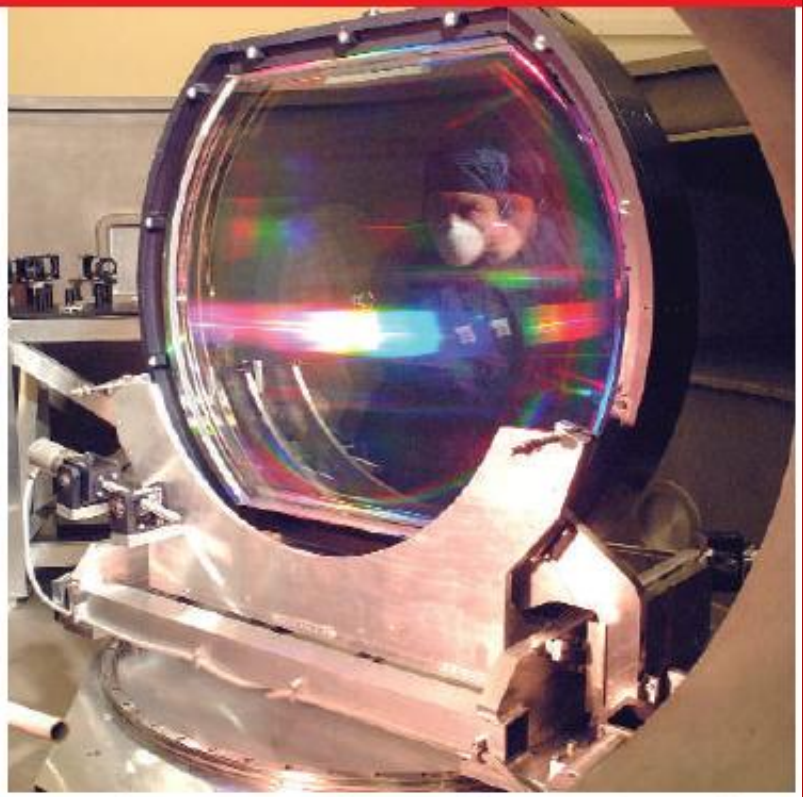
Industrial spin-offs

Innovative research and developments in optics and laser technology. New particle accelerating concepts. Long-term collaboration with SMEs and large companies.



A researcher examines one of the two diffraction gratings used by petawatt lasers to achieve their extreme power.

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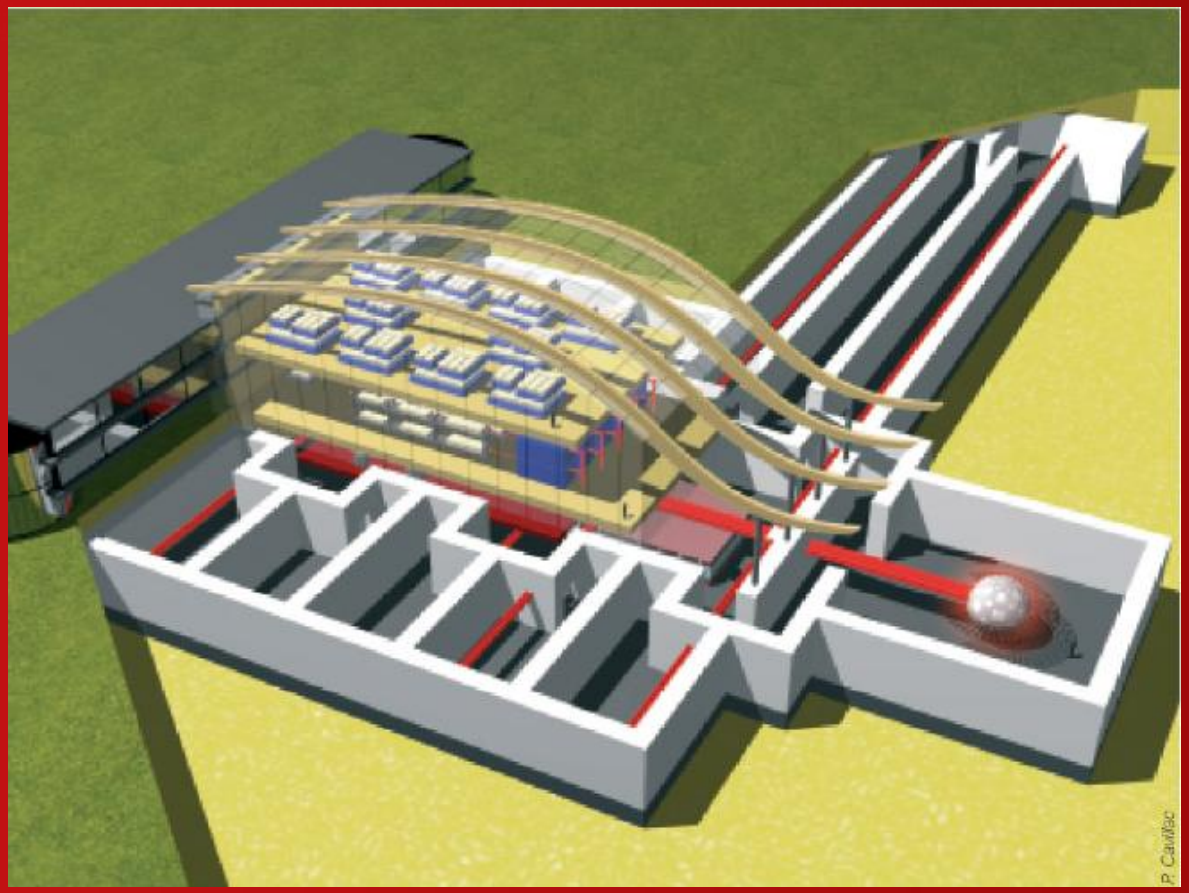

The users will apply for beam time, similar as now in Laser Lab Europe Infrastructure

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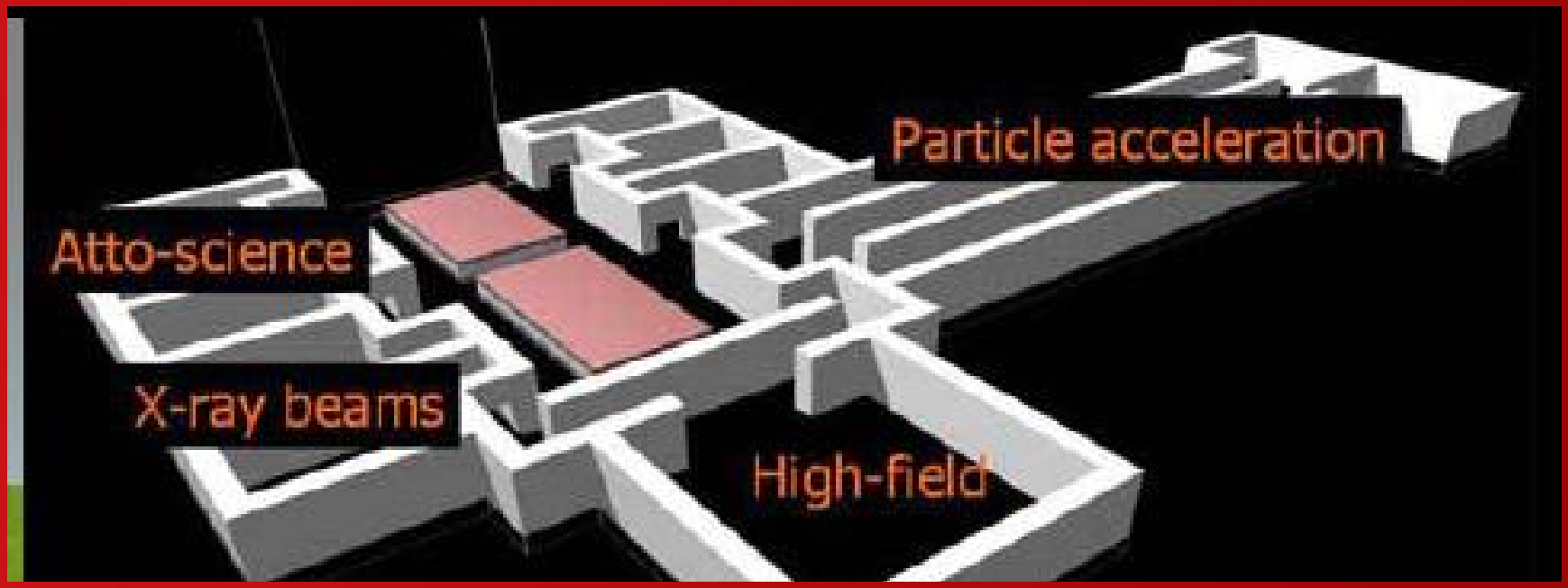

Scientists working in many fields in physics, biology, chemistry will be able to perform experiments

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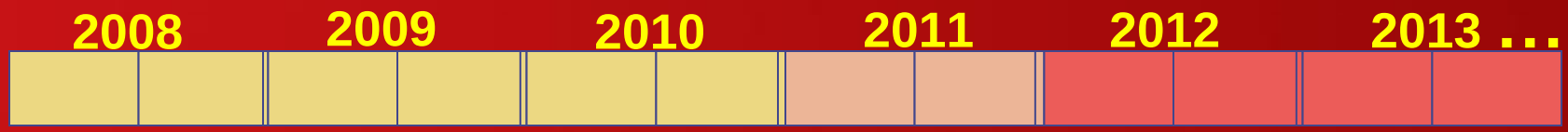
At-a-glance planning



Preparatory phase **finalization** **construction**

Communication, users involvement

First technical specification

First radio-protection specification

Gross budget

Site choice

Detailed technical specification

Final radio-protection specification

Final budget

Financial plan

Approbation for construction

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The objective of the Extreme Light Infrastructure European project (ELI) consists in providing the worldwide scientific community with a unique laser based facility allowing the investigation of the unexplored domain of laser-matter interaction at $10^{25}W/cm^2$ and beyond.

ELI will provide ultra intense and ultra short sources of particles (electrons, protons, ..), attosecond pulses, coherent and high energetic X rays opening the path to exotic physics (pair creation, etc…)

ELI will allow preliminary qualification of major societal applications, such as ion acceleration for cancer therapy, nuclear waste treatment…

The first step toward the realization of ELI is done by the the construction of a single laser beamline (ILE) able to deliver 25 PW/ 15 fs pulses at 1/shot per minute and was funded through a French National program (CPER). The ILE system constitutes in the first beamline of the whole ELI laser system described on fig 1 in which 9 other beams, coherently combined together, will allow to reach > 0.2 Exawatt.

A separate Kilohertz amplification will provide high repetition rate 100 TW sub 10 femtosecond pulses available for attosecond experiments.

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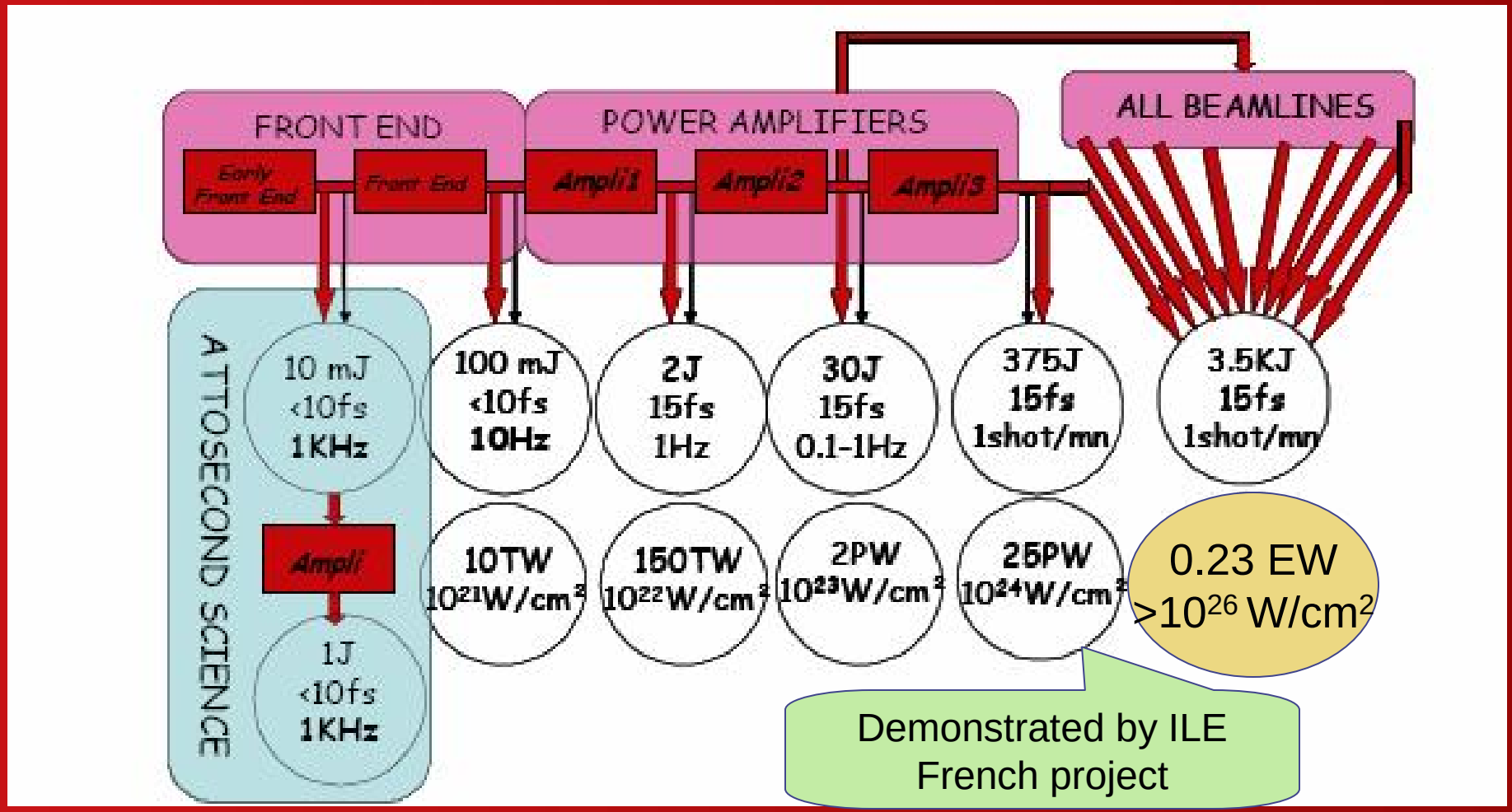
The expected performance of the ELI laser



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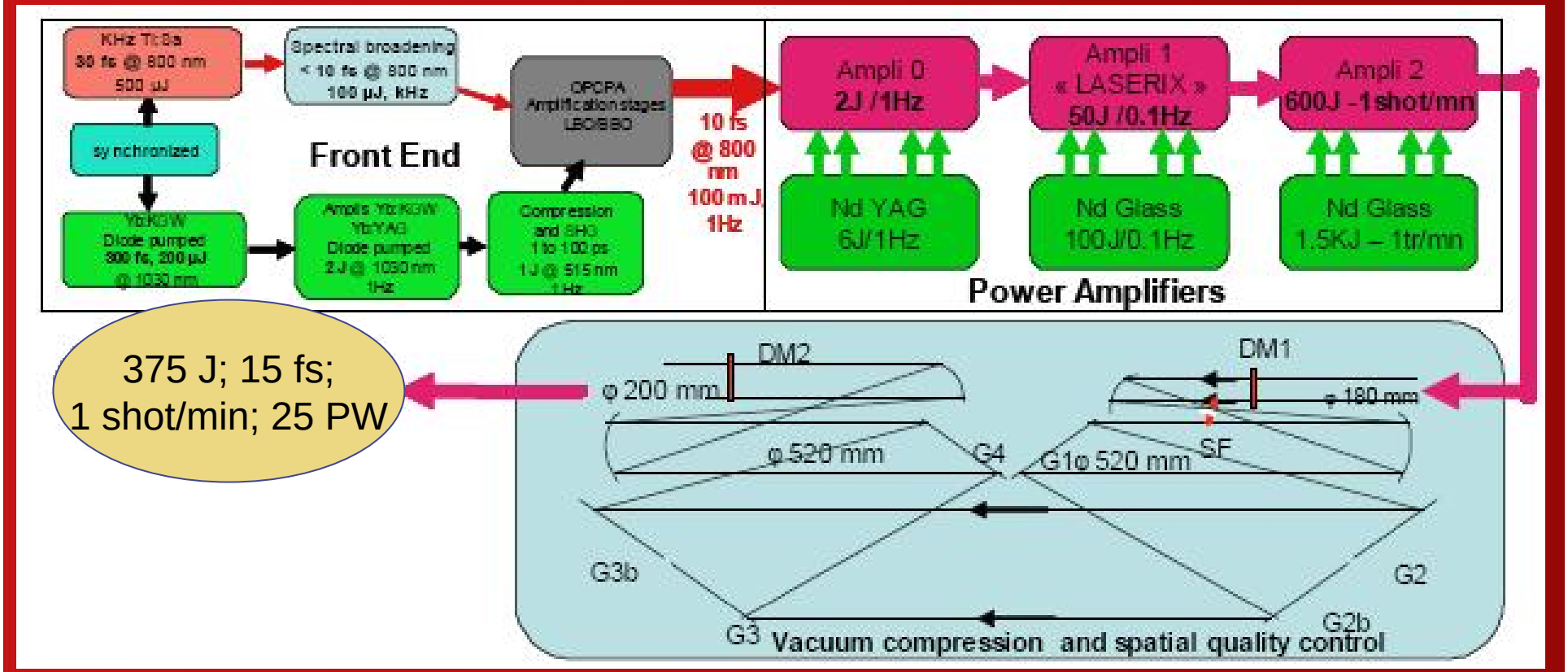
Single beam OPCPA system in ILE - Palaiseau Cedex, France



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Bulgarian team is responsible for organizing site choice procedure included in WP4. The candidates are 4. France, Hungary, Czech Republic and Romania

Scientific contribution in WP7A and WP7B

We expertise in improving temporal contrast parameters of femtosecond pulses with nonlinear optical methods in crystals. This topic was developed for the last 5 years in collaboration with group in LOA-ENSTA and the results demonstrated this technique *) will be employed in ELI.

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*) patented

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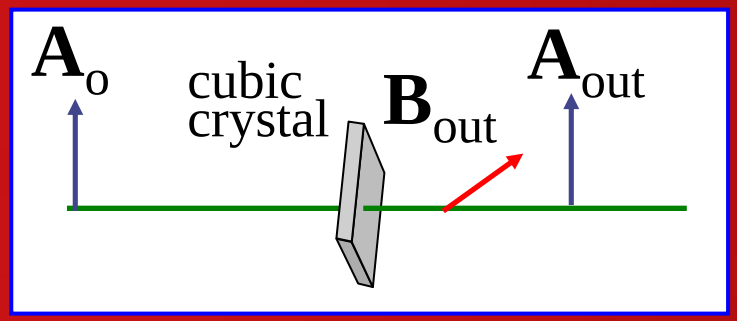
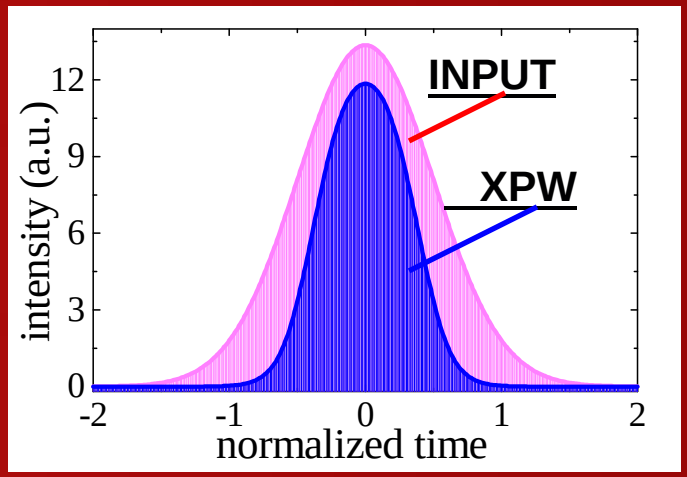
Cross-polarized wave generation – WP7A





+ output at the same wavelength

+ improvements for both temporal and spatial shapes

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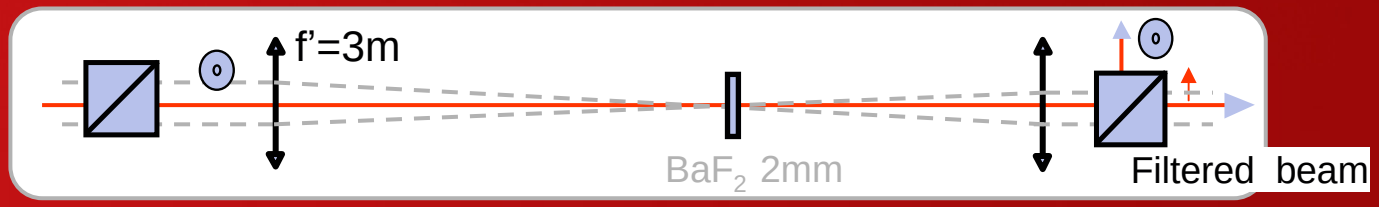

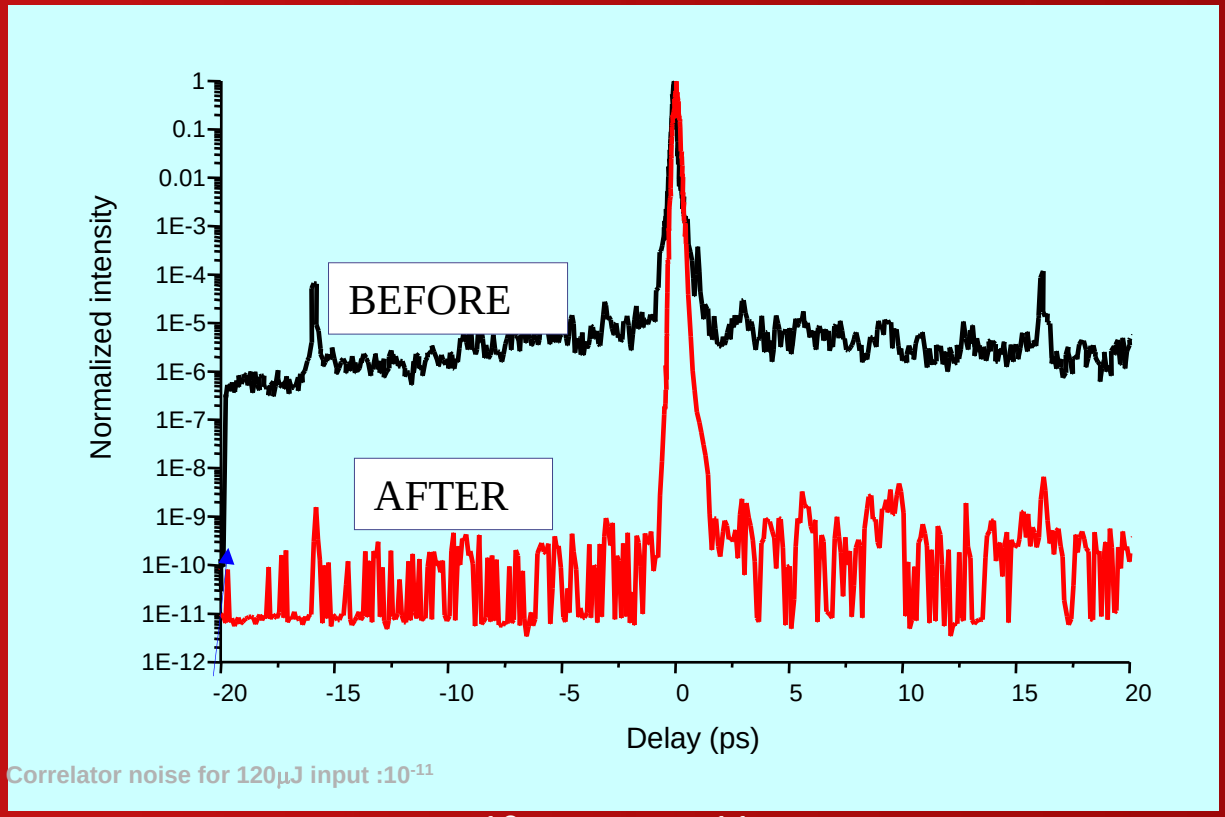

Contrast achieved 10^{-10} … 10^{-11} with efficiency > 20%

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ATTOSCIENCE - WP7B

Sofia University team has a long time experience on modeling of femto-attosecond pulse generation, amplification and interaction with matter.

During the ELI preparatory phase the research on femto- and attosecond quantum dynamics of atoms, molecules, and condensed phases (incl. nanostructures) will be directed to solve specific related to ELI problems.

Relativistic and ultrarelativistic electron dynamics, and radiation in the field of high-power femto- (atto-) second pulses will be studied as well.

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Bulgarian team is quite enthusiastic to continue working in this multinational team as ELI and to contribute to the success of its preparatory phase.

The Ministry of Education and Science and FUND "Scientific research" expressed their support in a letter of commitment . Co-financing of the project by FSR is expected in response to submitted project.

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REPUBLIC OF BULGARIA

MINISTRY OF EDUCATION AND SCIENCE

DEPUTY MINISTER

Letter of Commitment

to execute the Preparatory Phase of the Extreme Light Infrastructure (ELI)

The Bulgarian National Science Fund (NSFB) expresses its support for the ELI project amongst the 35 ESFRI nominated research infrastructures. The NSF accepts to join the ELI consortium under the proposal submitted for **EC FP7** call **INFRA-2007-2.2.1.5** under the title ***"Extreme Light Infrastructure"***. Further to the decisions of the Board of the National Science Fund of Bulgaria from April 19th 2007, I authorize the Sofia University "Saint Kliment Ohridski" (Physics Department) and its chair Prof. Solomon Saltiel to join in ELI, and being a contact point as well.

I understand that along with the studying of national scientific funding bodies we will advise the ELI consortium on how to secure funding for the sustainability of the project. This will be with a view to develop a consortium agreement to facilitate this funding. I also consider that participation in the proposal for the preparatory phase **does not mean a formal commitment to contribute to the costs** of ELI.

Yours sincerely,

Vanya Dobreva

President of the Board
National Science Fund of Bulgaria
Ministry of Education and Science

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Letter of Understanding concerning the Extreme Light Infrastructure Project

PREAMBLE

Whereas the future participants in the preparatory phase of the Extreme Light Infrastructure, hereinafter referred to as the "Parties", have intended to develop a competitive proposal for a combination of collaborative project and co-ordination and support action in response to the call ***FP7-INFRASTRUCTURES-2007-1 / INFRA-2007-2.2.1.x / INFRA-2007-2.2.1.21***, published on the 22nd of December, 2006, under the Seventh Framework Programme of the European Community for Research, Technological Development and Demonstration activities for the period 2007 to 2013, in the field of "Construction of new infrastructures – Preparatory Phase" and to implement the preparatory phase of the Extreme Light Infrastructure, hereinafter referred to as the "Project" after acceptance by the European Commission;

Whereas for the purpose of the proposal negotiation, the Parties shall provide each other with all necessary relevant information;

The signatory Party of this letter of understanding agrees upon the following:

DEFINITIONS

Words beginning with a capital letter shall have the meaning defined herein or in the Rules for participation Regulation (EC) No 1906/2006 of the European Parliament and the Council of December, 18 2006 laying down the rules for participation of understandings, research centres and universities in actions under the seventh Framework Programme for the dissemination of research results (2007-2013) or in the Grant Agreement including its annexes.

NEGOTIATION OF CONSORTIUM AGREEMENT

After acceptance of the Project proposal by the European Commission and in accordance with the rules established by the European Commission, the Parties shall make their best efforts to negotiate a consortium agreement that will stipulate the consortium commitments and the governance of the Project. To this end, the Parties commit to delivering the needed information, contributing to Project finalisation according to European Commission recommendations, attending meetings, allocating resources, respecting planning and deadlines, etc.

After acceptance of the proposal by the Commission, all arrangements reached within this letter of understanding shall be replaced by the provisions of the consortium agreement.

If the negotiations fail to lead to a consortium agreement, the obligations of confidentiality herein stated shall remain into force for a period of five (5) years after the date of the signature of this letter of understanding.

CONFIDENTIALITY

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The Parties undertake to treat all information, whether of financial, commercial, scientific or technical nature, that they have received directly or indirectly in the context of the negotiation of the Project proposal and that of the consortium agreement, as strictly confidential.

The Parties undertake not to disclose the received information in any form to third parties for any purpose unless and until expressly authorized in writing to do so by the disclosing Party.

The Parties agree that the received information shall be used solely for the purpose for which it was submitted.

GENERAL PROVISIONS

This letter of understanding shall come into force on the date of its signature and shall remain into force until the signature of the consortium agreement.

This letter of understanding and its effects shall be governed by the laws of Belgium.

Belgian Courts shall have exclusive jurisdiction for all disputes which cannot be solved amicably, arising out of or in connection with this letter of understanding.

I hereby do agree to start negotiation under the above-mentioned conditions.

PARTICIPANT

Authorized to sign on behalf of: Rector of Sofia University, Prof. B. Bioltchev

By (signature):

Name (block letters): Prof. G. Bakalov,

Position: Vice Rector

Date: 30.07.2007.

SOFIA UNIVERSITY
ST. KLIMENT OHRIDSKI
15, Tzar Osvoboditel Blvd

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It is very important that

Ministry of Education and Science and FUND "Scientific research" and other Bulgarian institutions make strong both direct and IN KIND support of the ELI-PP. The amount of actual support will be used:

a) in the negotiation stage for the share of Bulgaria for the actual construction of ELI and

b) for the defining the beam time for ELI users from Bulgaria

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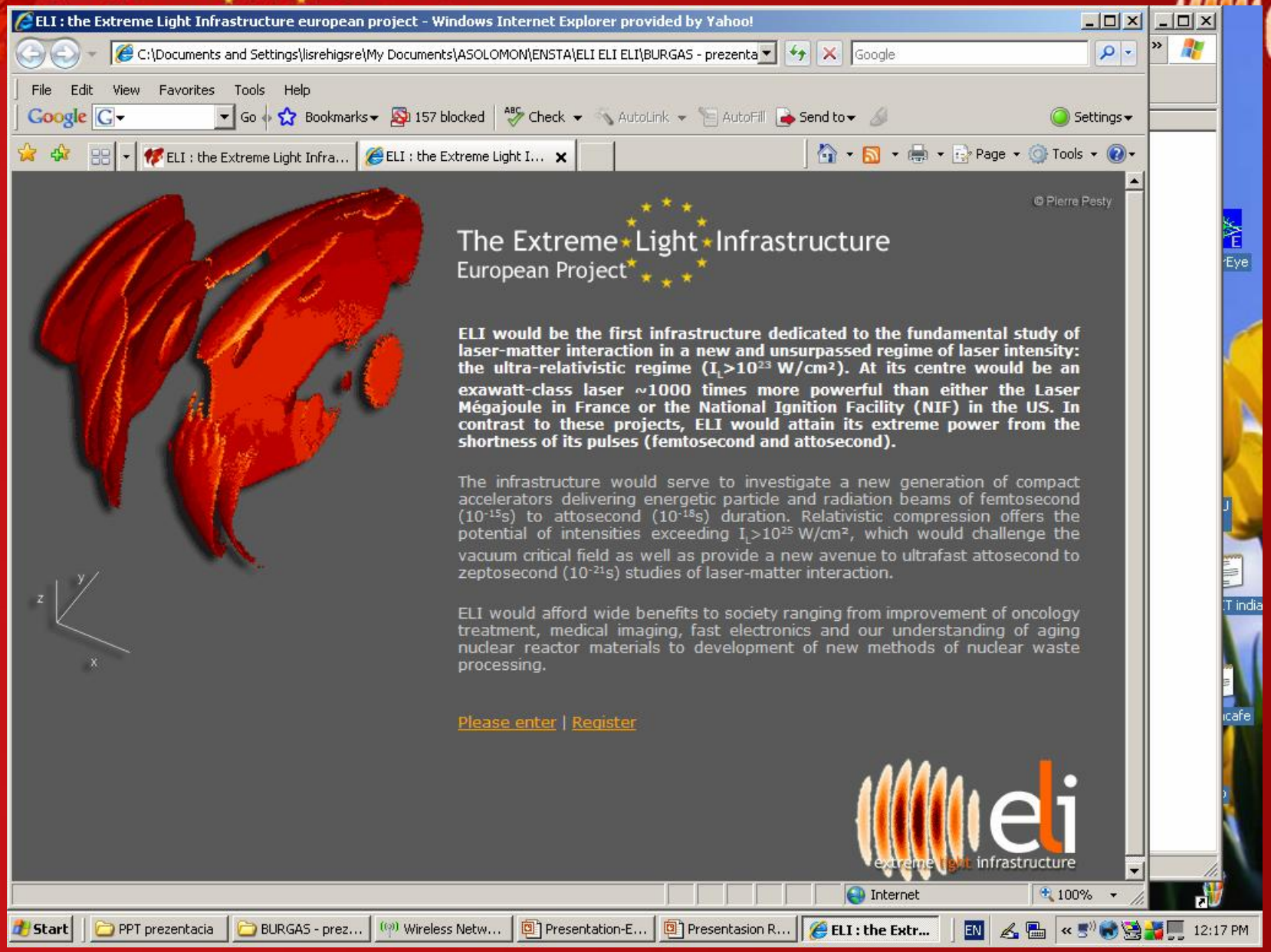
Everybody is encouraged to became a registered member of ELI by visiting address:

www.eli-laser.eu

All registered members have full access to the information for ELI and its preparatory phase



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THANK YOU FOR YOUR ATTENTION