Competitiveness Operational Programme (COP)

Extreme Light Infrastructure - Nuclear Physics (ELI-NP) – Phase II

Team management in operating the highest power laser in the world

Antonia TOMA

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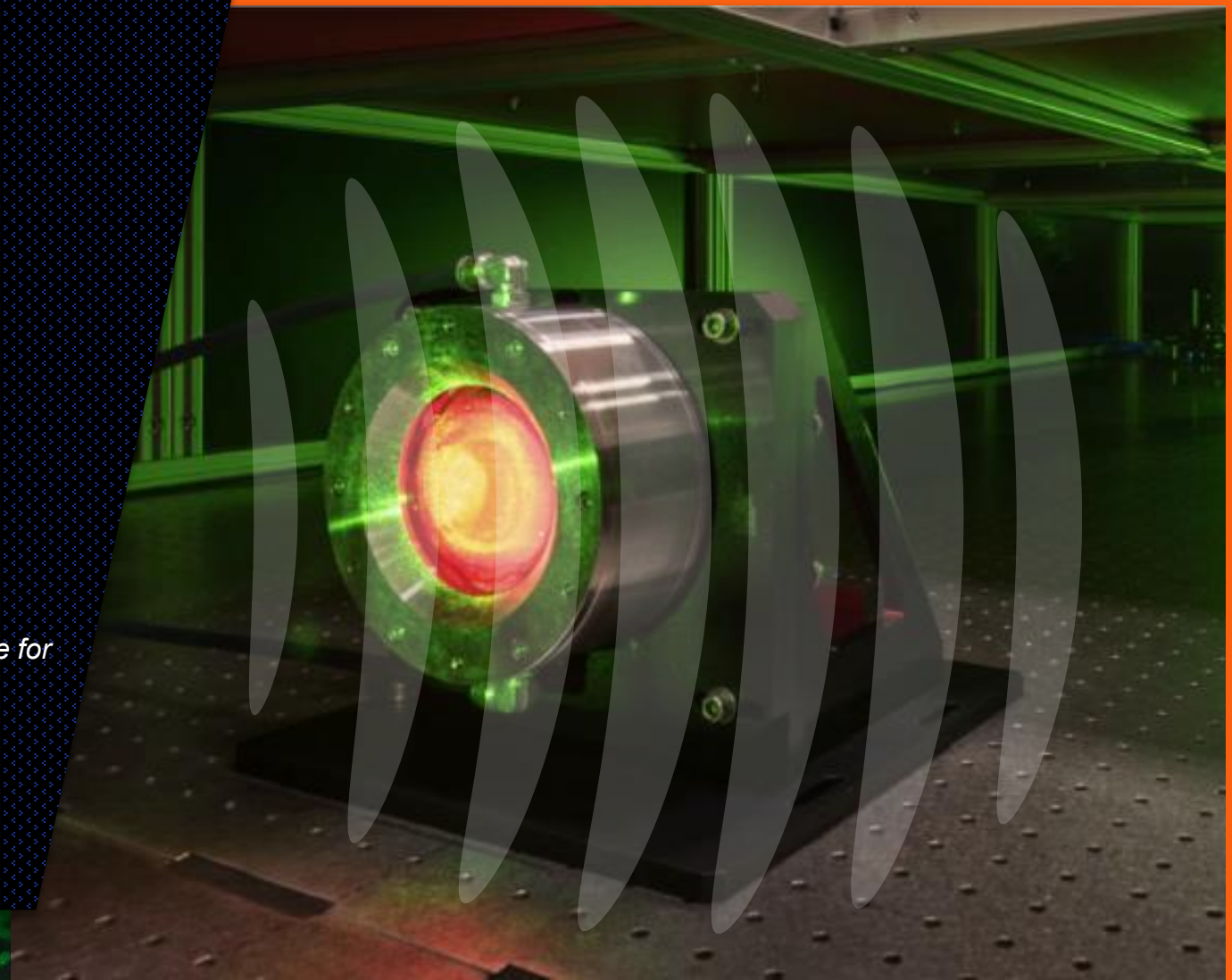


Contents

Human-centric Project Management in Digitalization Era,

https://myipma.ipma.world/events/214/pm-fest-25

21 November 2025, Romania

European Vision: ELI Project

ELI represents a major Research Infrastructure included in the ESFRI (European Strategy Forum on Research Infrastructures), recognized as a strategic project of pan-European importance.

Fundamental Objective:
Creating the first integrated international facility dedicated to research based on ultra-high-intensity and ultra-short-duration lasers (a standalone research infrastructure, open to users worldwide).

The Three ELI Pillars

ELI-ALPS – Szeged, Hungary

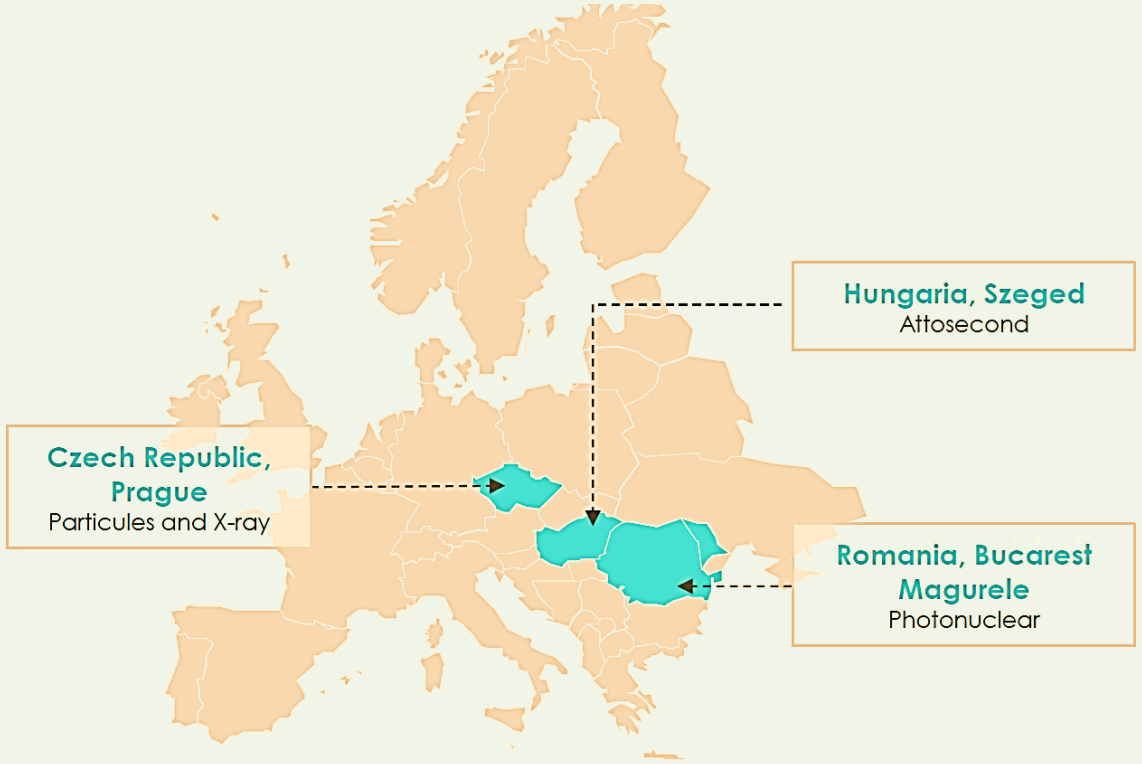
- Dedicated attosecond pulse source
- Studies electron dynamics in matter at the atomic timescale
- Focus on applications – secondary radiation and particle sources

ELI-Beamlines – Dolní Břežany, Czech Republic

- Generation of secondary particle beams (electrons, protons, X-rays) using high-power lasers
- Focused on attosecond physics

ELI-NP – Măgurele, Romania

- Nuclear physics and the generation of the most intense monoenergetic gamma beam system in the world



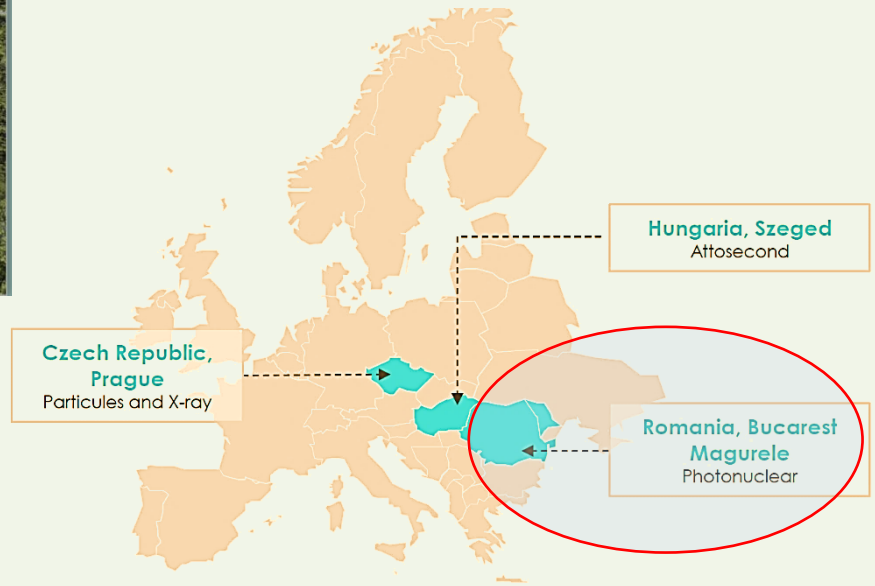
Technological Core of ELI-NP – The Nobel Prize

- The technological core of ELI-NP (on the laser side) is **Chirped Pulse Amplification (CPA)**, an invention of Prof. Gérard Mourou and Dr. Donna Strickland, awarded the **2018 Nobel Prize in Physics**.
- CPA increases the damage threshold of optical components by stretching, amplifying, and then recompressing the laser pulse.
  This ingenious method allows high-energy concentration in a femtosecond-scale pulse, enabling the achievement and operation at **extreme powers in the Petawatt (PW) range**.

Stages of the ELI-NP Project Development

2010–2012: Vision and Strategic Decision

- **Site selection and approval:** Romania was chosen to host one of the three ELI pillars, located on the Măgurele research platform.;
- **European funding:** Major structural funds (ERDF) secured, reinforcing Romania's commitment to advanced scientific research.



EUROPEAN UNION

Structural Instruments 2014-2020

Competitiveness Operational Programme (COP)

Extreme Light Infrastructure - Nuclear Physics (ELI-NP) – Phase II

Stages of the ELI-NP Project Development

2013–2015: Construction and Infrastructure

- **Construction** of unique buildings designed for highly sensitive equipment
- **Extremely strict technical requirements** (seismic protection, high-density concrete shielding, clean room laboratories, vacuum chambers for experiments)

Stages of the ELI-NP Project Development

2016–2018: Installation of Major Equipment

HPLS (High Power Laser System):
Delivery and assembly of the High-Power Laser System (HPLS), aiming for the final 2 × 10 PW configuration

Stages of the ELI-NP Project Development

2019–Present: Integration, Testing, Operationalization

This stage included rigorous testing and staged performance demonstrations of HPLS, in accordance with the technical specifications

ELI-NP becomes a standalone research infrastructure open to users worldwide

The laboratory after the installation and full integration of the High Power Laser System(***HPLS - High Power Laser System***)

Feb 2019

7PW

Mar 2019

10 PW demonstration

THALES

10 PW demonstration

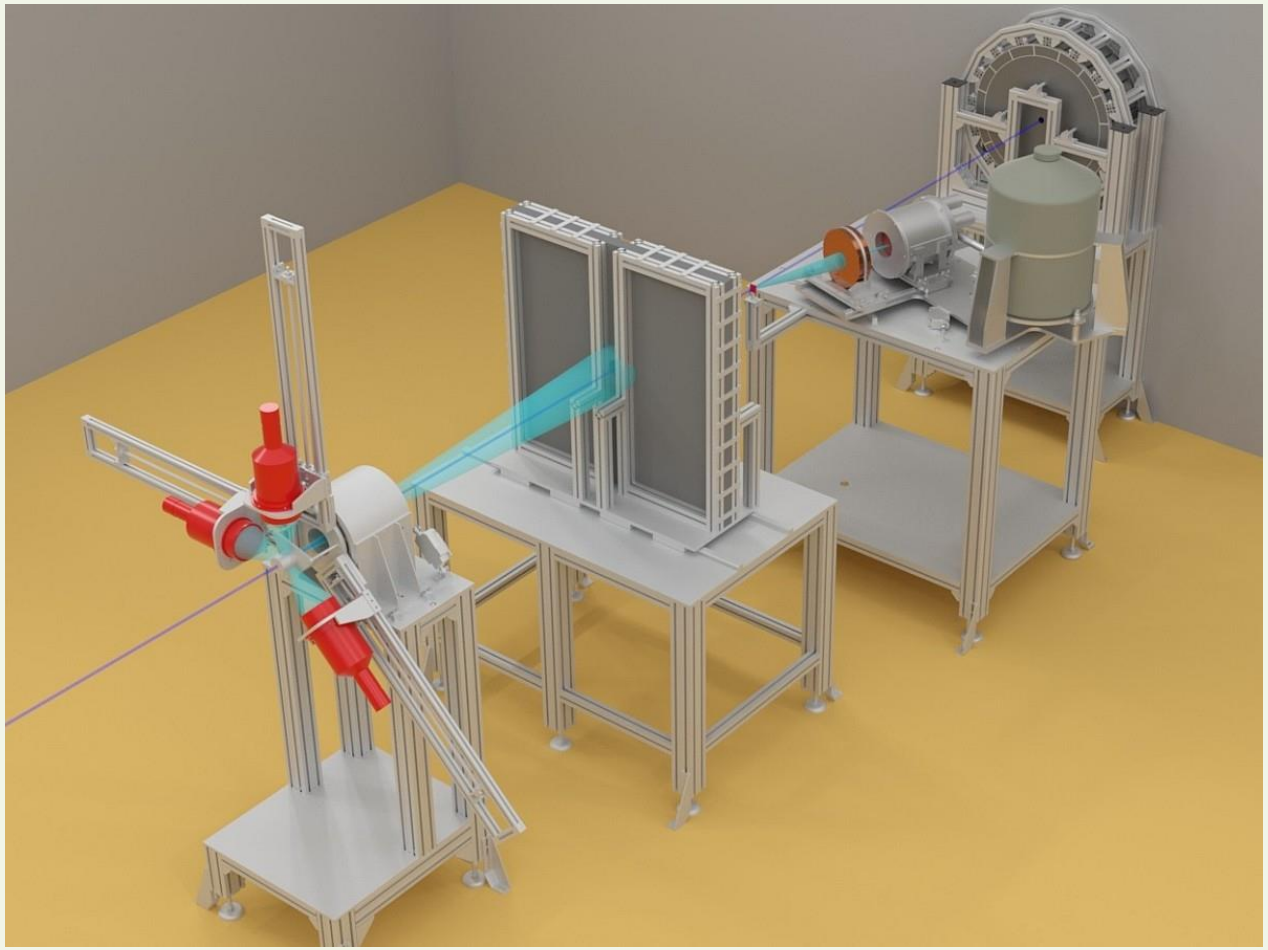
Public demonstration: achieving **3 PW**, an essential milestone on the path to 10 PW

Scientific Mission of ELI-NP

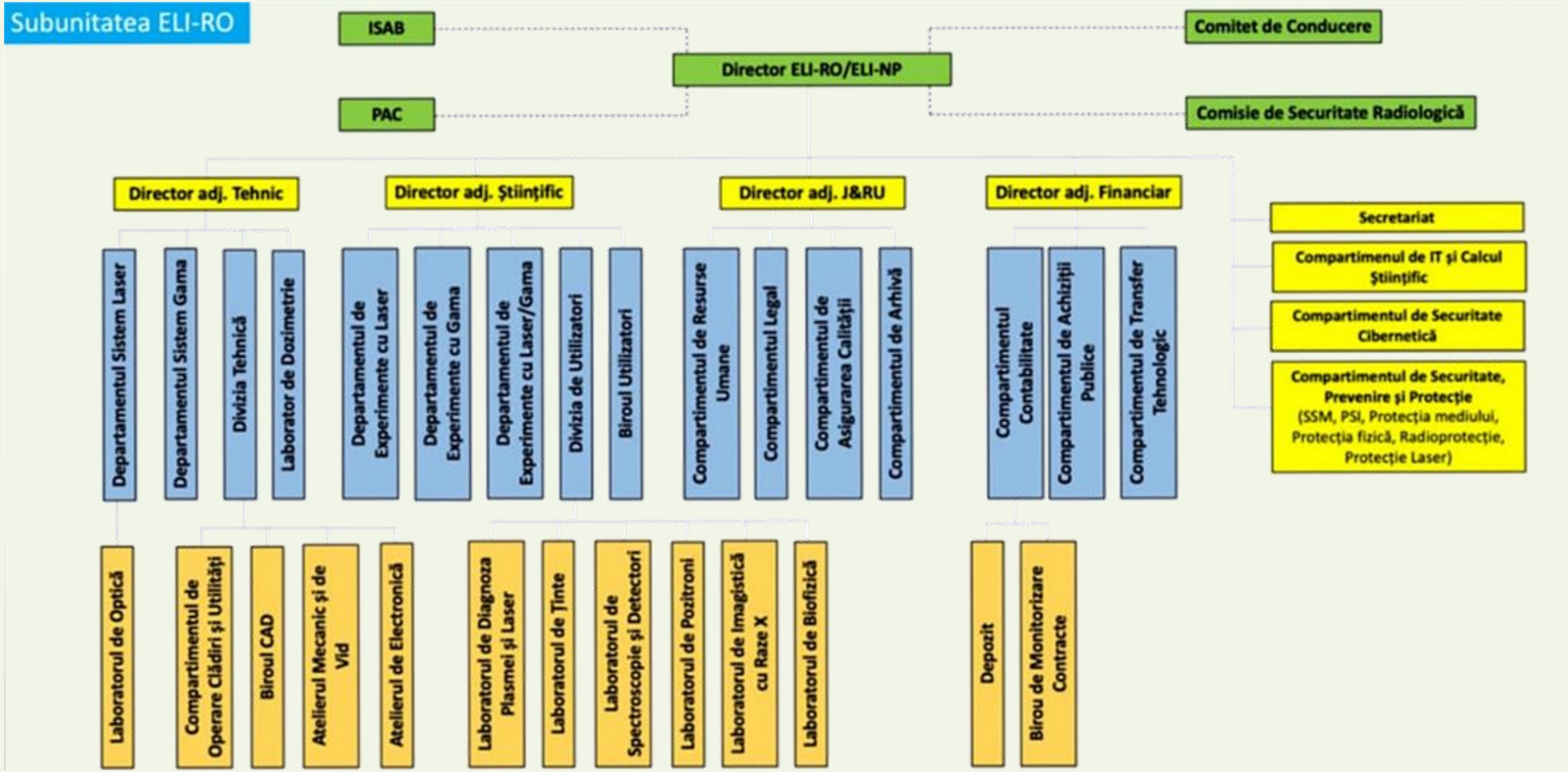
Central Mission: Study of light (laser)–matter interaction at the highest possible intensities.
Using **Two Major Instruments:**

1. **HPLS (High Power Laser System):** two 10-PW arms (Petawatt).

2. **GBS (Gamma Beam System):** high-intensity, monoenergetic, high-quality gamma beams.



Main Organizational Structure and Departments



Research Departments

1 High-Power Laser System (HPLS) Department
- Role: Develops, operates, and optimizes the 10-PW laser
- Purpose: Provides ultrashort, ultraintense laser pulses for fundamental experiments

2 Gamma Beam System (GBS) Department
- Role: Produces high-intensity gamma beams via inverse Compton scattering
- Purpose: Nuclear studies, precision measurements, nuclear security applications

3 Laser Driven Experiments Department
- Role: Designs and fabricates targets for laser–nuclear experiments
- Purpose: Study of new nuclear phenomena induced by high-power lasers

4 Gamma Driven Experiments Department
- Role: Coordinates nuclear physics experiments with laser and gamma beams
- Purpose: Nuclear structure and reaction studies

5 Laser Gamma Experiments Department
- Role: Theoretical support and numerical simulations
- Purpose: Connecting fundamental physics with applied sciences

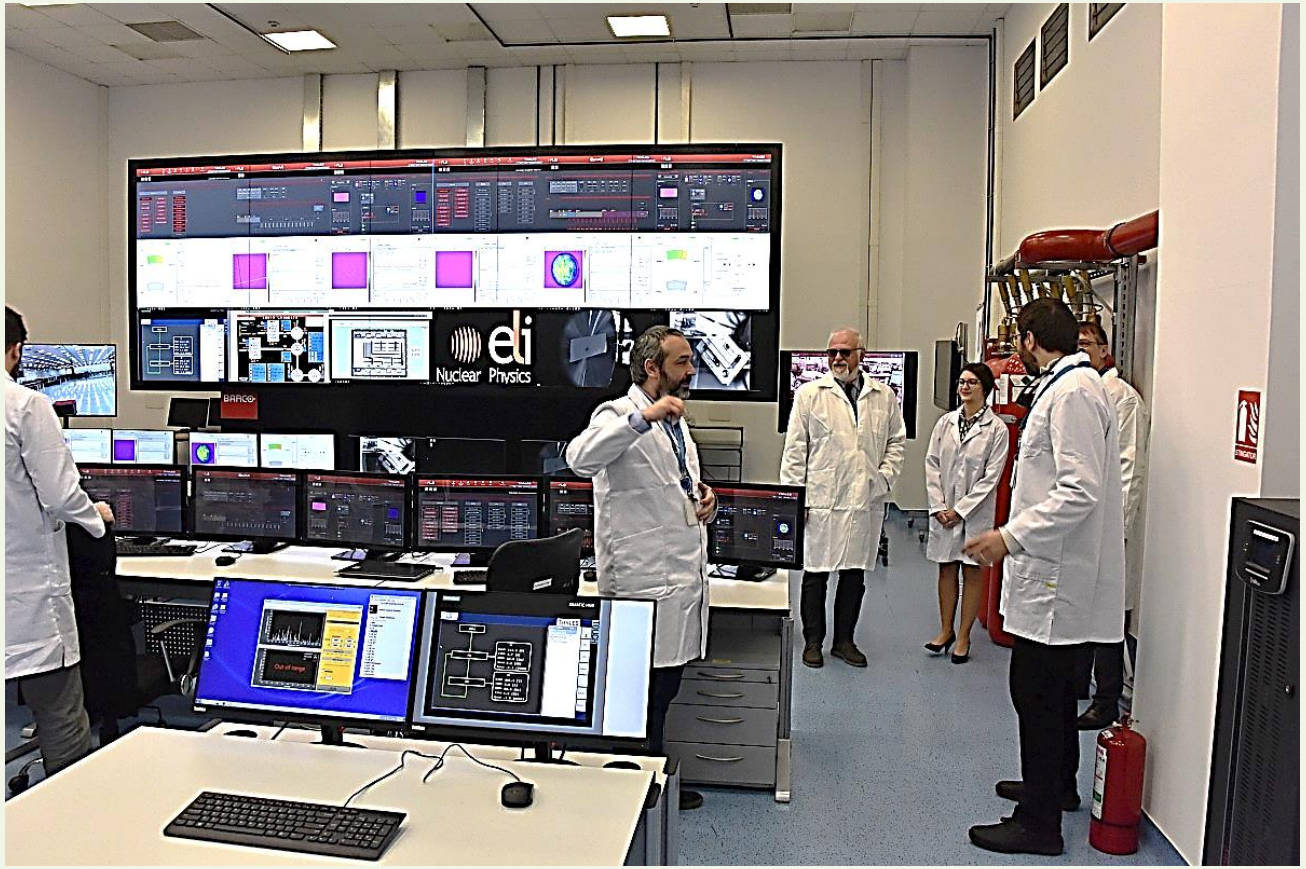
Laser System Department

Location : LSD - Responsible for HPLS (High Power Laser System);

Context: This is the department where our team operates

Mission LSD: ensuring optimal laser availability for user (research) teams

Environment: clean rooms class ISO 7, temperature and humidity control



Team members include: *Antonia TOMA, Bianca-Elena PREOTEASA, Vlad-Toma PLEȘANU, Andrei BULIGA* – YCRO.RO members

LSD Organization

The department consists of three subdivisions:

1) **Operation Team:** delivers a high-quality laser beam for experiments
2) **Scientific Team:** continuously improves system performance and develops procedures
3) **Support/Infrastructure Team:** ensures optimal functioning of technical installations

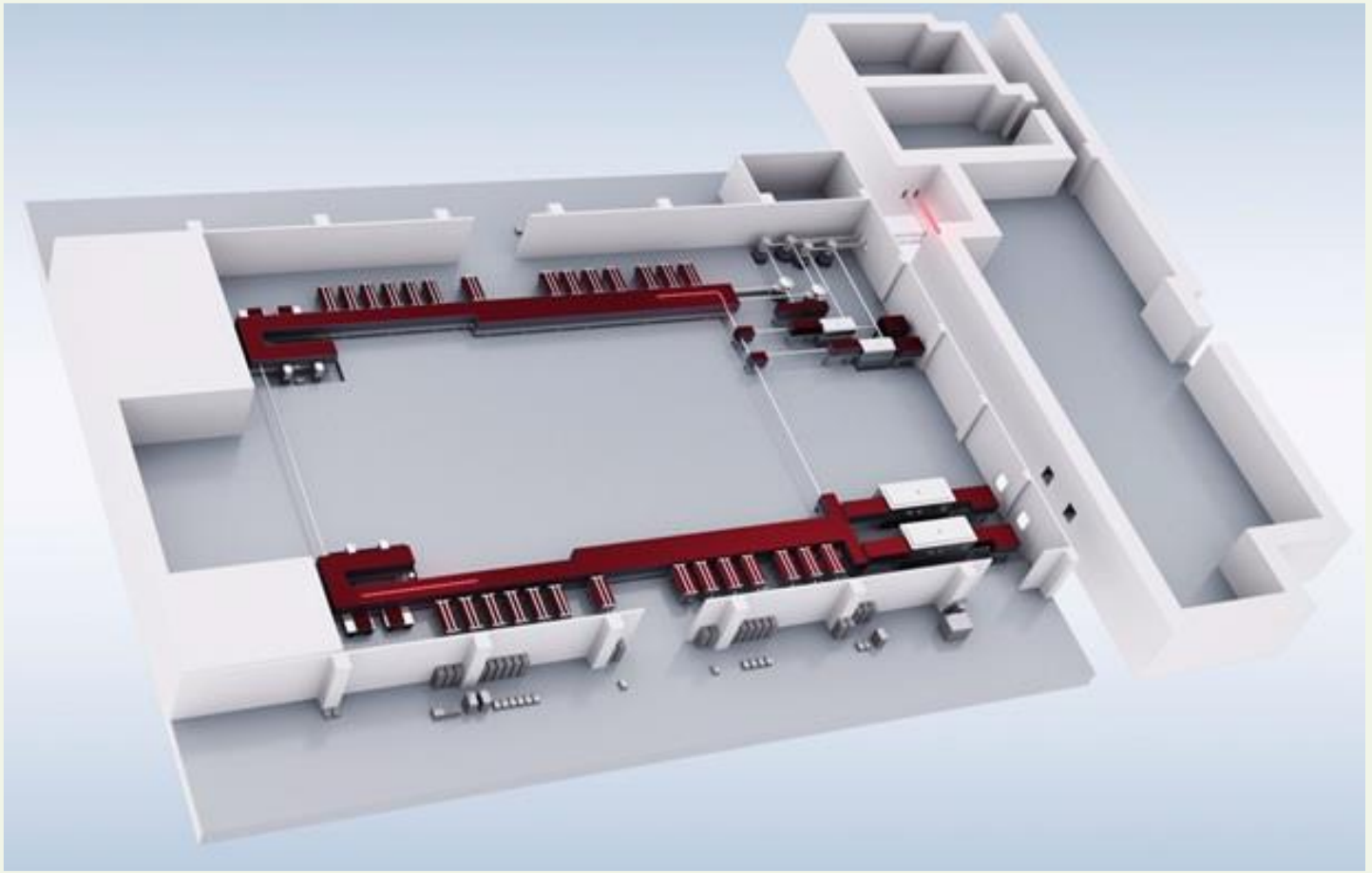
LSD Operation Team: Roles and Responsibilities

1. **Shot Director:**
• Main responsible for laser operation and maintenance
• Interface with experimental teams
2. **Laser Operators:**
• Monitor and report technical parameters
• Participate in operation and maintenance under the Shot Director
3. **Interns:**
• Students in training to become laser operators

HPLS Architecture

HPLS consists of two laser arms, A and B, sharing a common source: the **Front End**. A switching system selects the active Front End.
Each laser beam (A or B) has three power levels with corresponding repetition rates:

- **100 TW / 10 Hz**
- **1 PW / 1 Hz**
- **10 PW / 1 shot per minute**



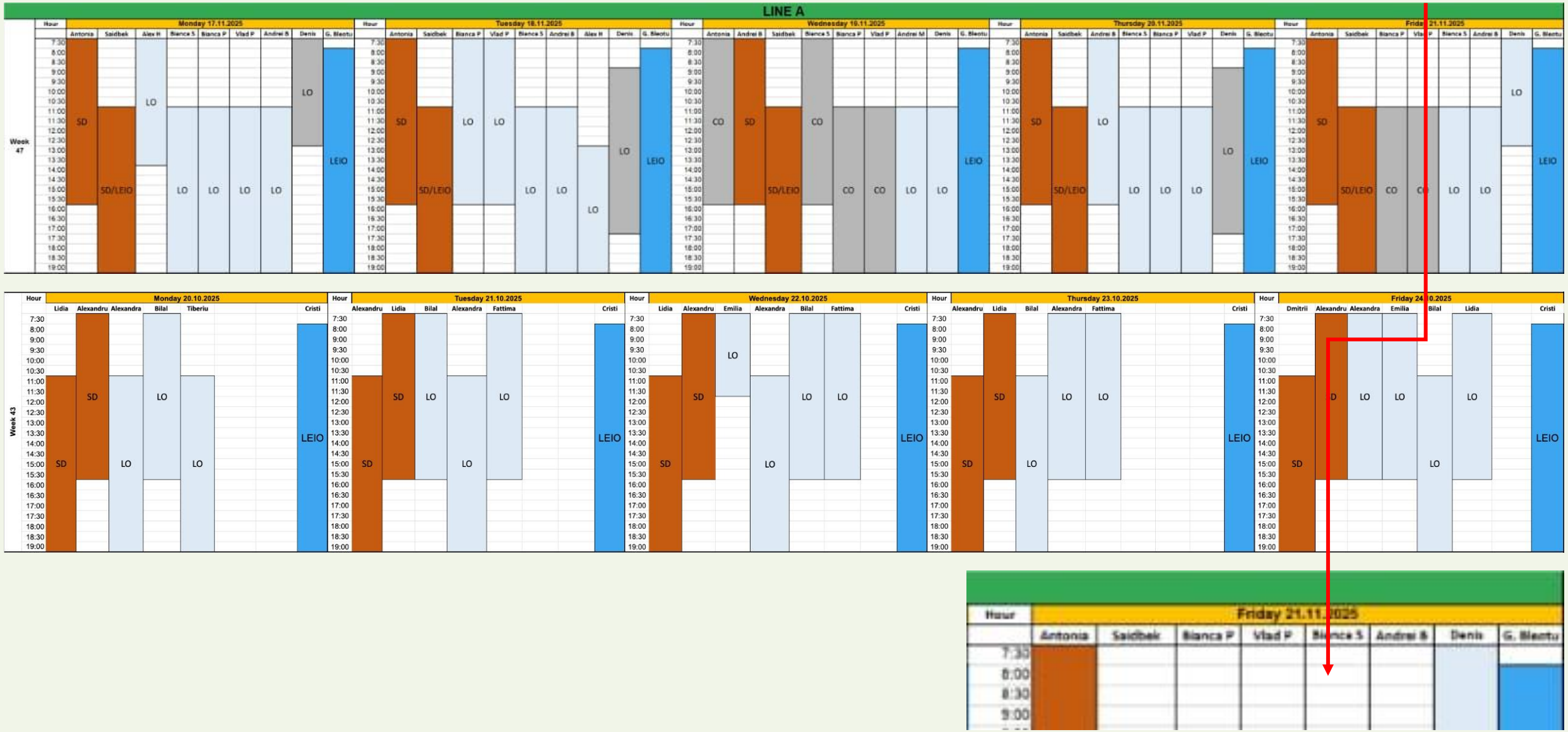
Human resources and operation program

Due to the complex architecture and the demanding work schedule, having a single operating team is not sufficient.

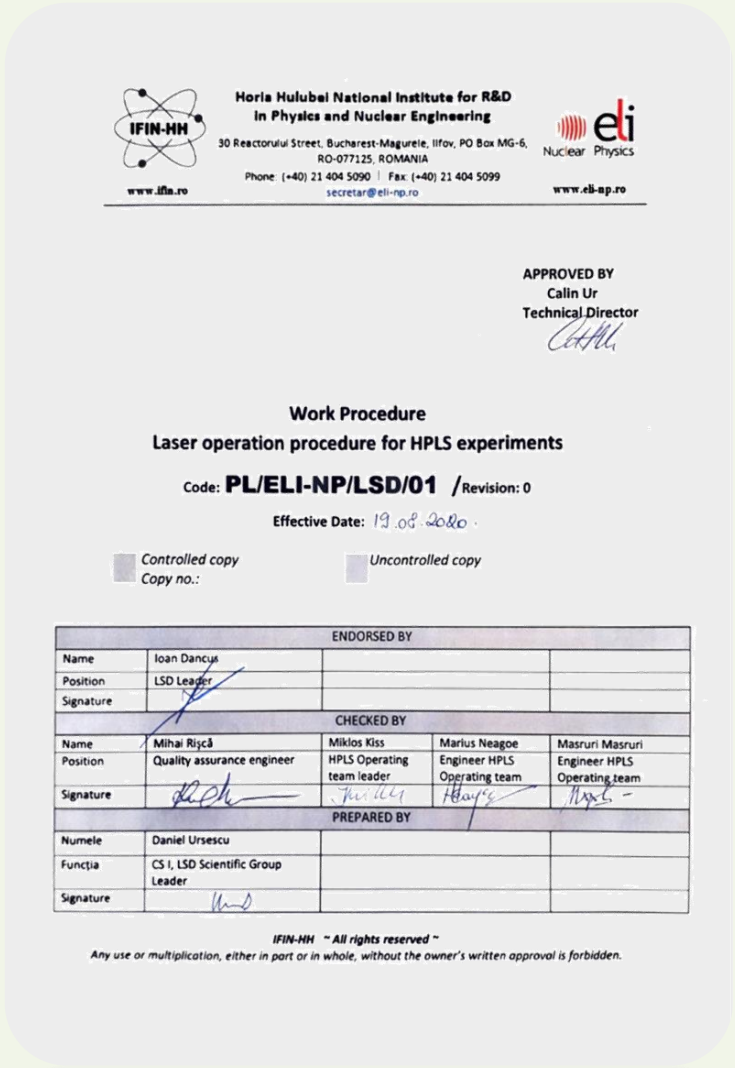
Although we initially worked as a single team, as more people joined the project, we were able to form two integrated teams, allowing us to better cover the full set of requirements needed for operating at maximum capacity.

More than this, we must ensure the laser operates for at least 12 hours a day, and that is why we work in two shifts.

Operation Program



Workflow



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Calin Ur
Technical Director

Work Procedure
Laser operation procedure for HPLS experiments

Code: **PL/ELI-NP/LSD/01** /Revision: 0

Effective Date: 19.08.2020

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Position	Quality assurance engineer	HPLS Operating team leader	Engineer HPLS Operating team	Engineer HPLS Operating team
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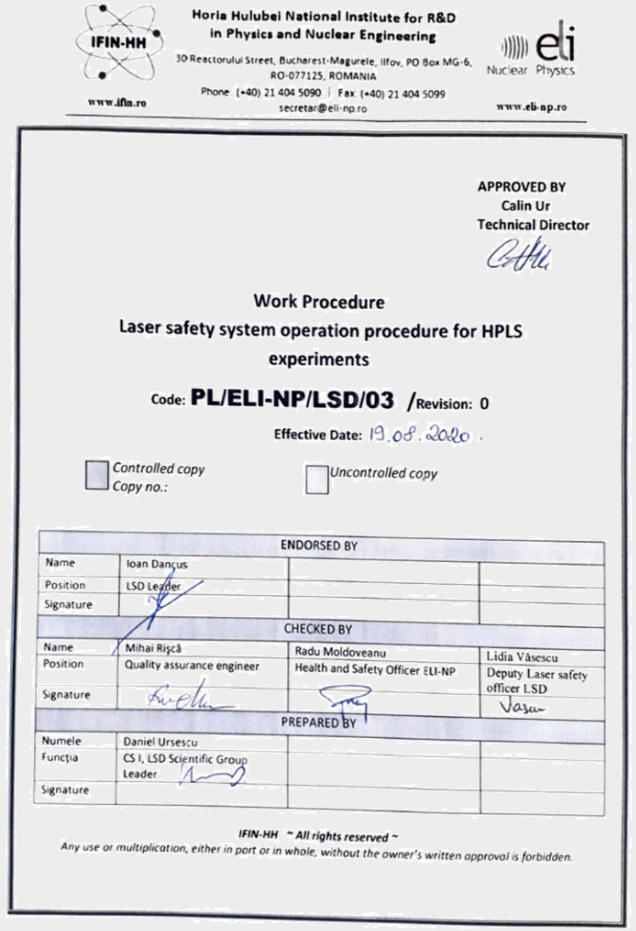
PREPARED BY				
Numele	Daniel Ursescu			
Funcția	CS I, LSD Scientific Group Leader			
Signature				

Activities follow established work procedures.
Procedures define:
- What needs to be done
- By whom
- In what order
- With what resources

They are essential for any organization, regardless of size or field.



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Work Procedure
Laser safety system operation procedure for HPLS experiments

Code: **PL/ELI-NP/LSD/03** /Revision: 0

Effective Date: 19.08.2020

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Funcția	CS I, LSD Scientific Group Leader		
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Preliminary Checks

According to procedure, activity begins with preliminary checks where operators and support staff ensure all safety and operational conditions are met.

After checks, the Shot Director approves (or not) the safe startup.

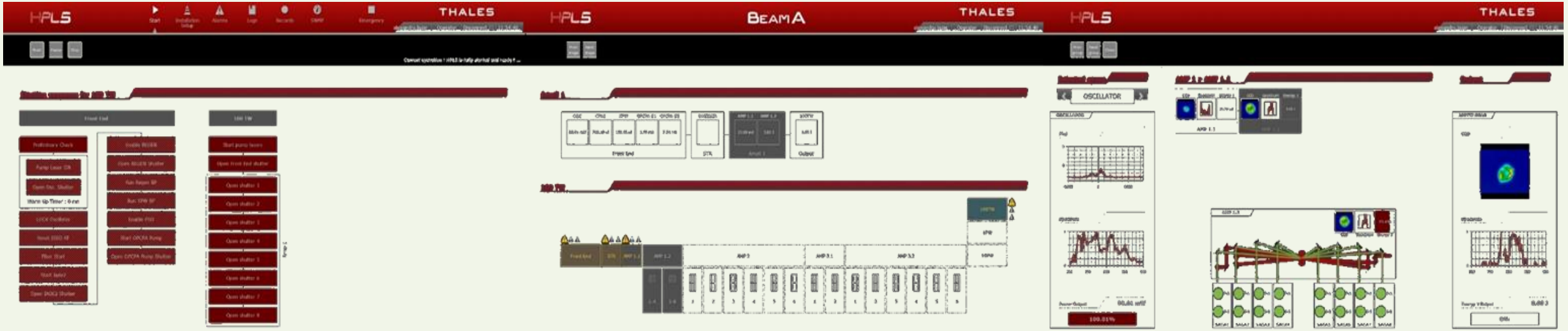
If conditions are not met, the team works to fix issues and resume operation as soon as possible.

PRELIMINARY CHECK RESULTS FOR OPERATION OF LASER SYSTEMS

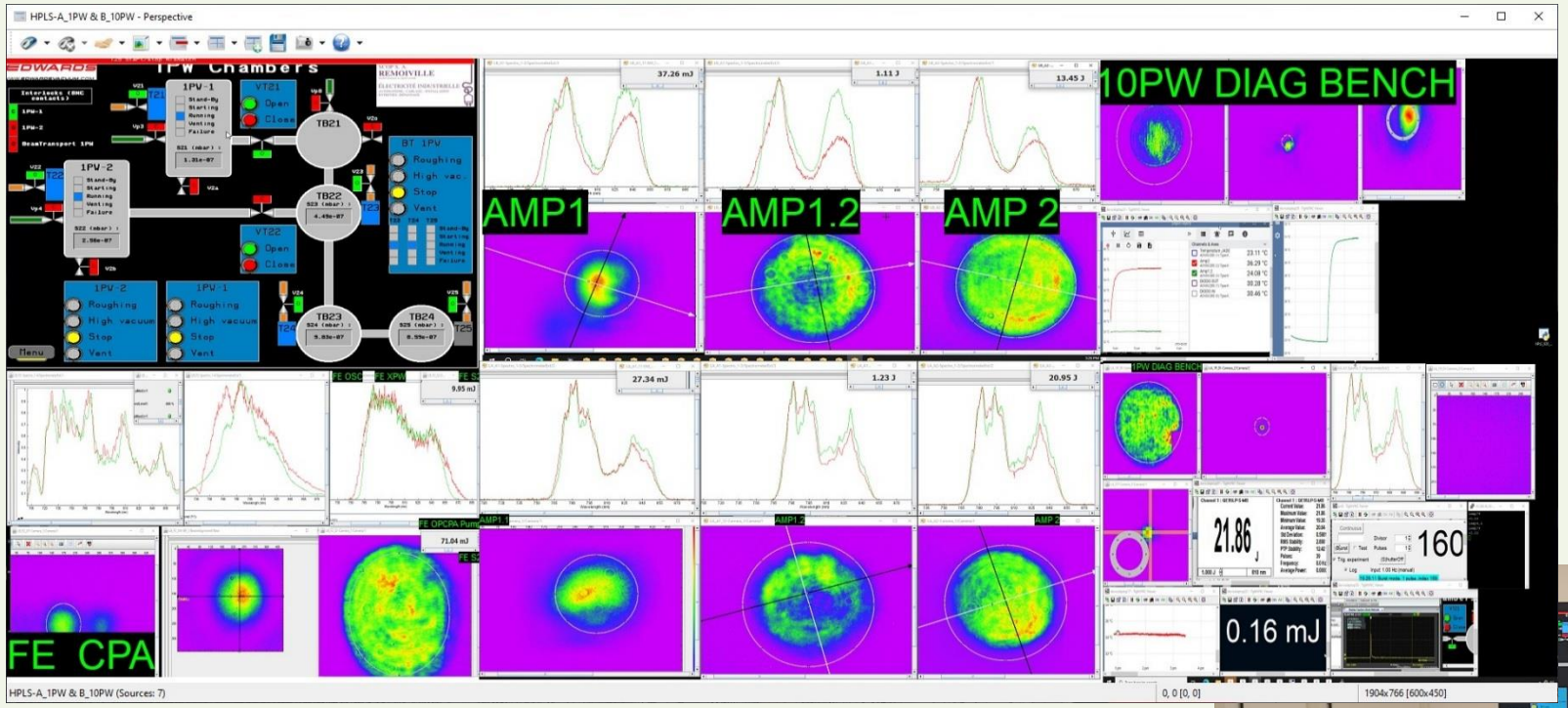
	DATE	Monday, 17 Nov 25
	DATA NETWORK	-
	COMPRESSED AIR, UPS	**OK**
	ENVIRONEMENT	-
	LASER SAFETY OFFICER	**OK**
ARM A	**HPLS ARM**	**ARM B**
FE 2	FRONT END	FE 2
OK	DIAGNOSTIC, SUPERVISION	**OK**
-	100TW OUTPUT	-
OK	1PW OUTPUT	-
-	10PW OUTPUT	**OK**
OK START	**SHOT DIRECTOR Clearance**	**OK START**
N/A	Reason for Not Started	NA

System Startup

After physical startup of equipment, subsystems are started step by step.
This can be done remotely from the control room.
Any subsystem not responding as expected triggers corrective maintenance.



Monitoring and Optimization



The essence of conducting good experiments lies in the operators' attention to detail. The team is divided so that each member is responsible for a part of a subsystem, while the Shot Director oversees the harmonization of the subsystems

Maintenance: Preventive and Corrective

Deilvered at OUTPUT for experiment		Subsystem name (Current Status: Green (OK) / Orange (<90%) / Red (N			
Output	Meaning	**P: Performance**	Meaning	**M: Maintenance**	Meaning
P: Parameters as requested	Power ≥90% requested, ≥8h/day	blank: Nominal	Parameters ≥90%, ≥8h/day	**P:** Preventive maintenance	General preventive maintenace
R: Restricted performance	Power <90% requested, <8h/day	**R**: Restricted perf	Parameters <90%, <8h/day	**R:** Repair corrective maintenace	Corrective maintenace
X: Unavailable output	Beam not available	**X**: Unavailable subsystem	Unusable / out of service	**X:** Part replaced corrective maint.	Corrective maintenace
Y: Environement problem	Restricted due to environement			**I:** Inspection and cleaning	ML1 preventive maintenance
F: FAL only	FAL only requested			**F**: Replacement of [ML1] flash lamps	ML1 preventive maintenance
N: No beam requested	No beam requested			**H**: Replacement of Flash Holder	ML1 preventive maintenance
C: Configuration change	System configuration modification			**O:** Replacement of [ML1] O-rings	ML1 preventive maintenance
M: Measurements	Performance measurement			**W:** Water draining	ML1 preventive maintenance
U: Upgrade	Upgrade activity			**C:** Replacement of chiller filters	ML1 preventive maintenance
				D: Replacement of deionizing cartridge	ML1 preventive maintenance
				J: Replace diodes	ML1 preventive maintenance
				M: Measurements	Performance measurement
				U: Upgrade	Upgrade activity
				D: Development	Ask Costin
				B: Backup	SW / Data / other backup

Preventive maintenance:

- Scheduled, planned activities performed before failures occur
- Extends equipment lifetime
- Includes inspections, tests, cleaning, adjustments, replacing worn parts

Corrective maintenance:

- Performed after a failure occurs
- Restores equipment to operational state
- Includes diagnostics, repair, component replacement

Communication Inside and Outside the Team

Team communication is one of the essential pillars of effective management. It determines how information flows, how decisions are made, how well people collaborate, and ultimately, the quality of the results.

Work schedule planning is done by taking into account:

- The operational requirements for that period (e.g., workload and project deadlines)
- The needs and availability of employees (individual work capacity during busy periods; personal problems or temporary constraints)

The work team is composed of members of similar ages, which provides a natural advantage in communication due to:

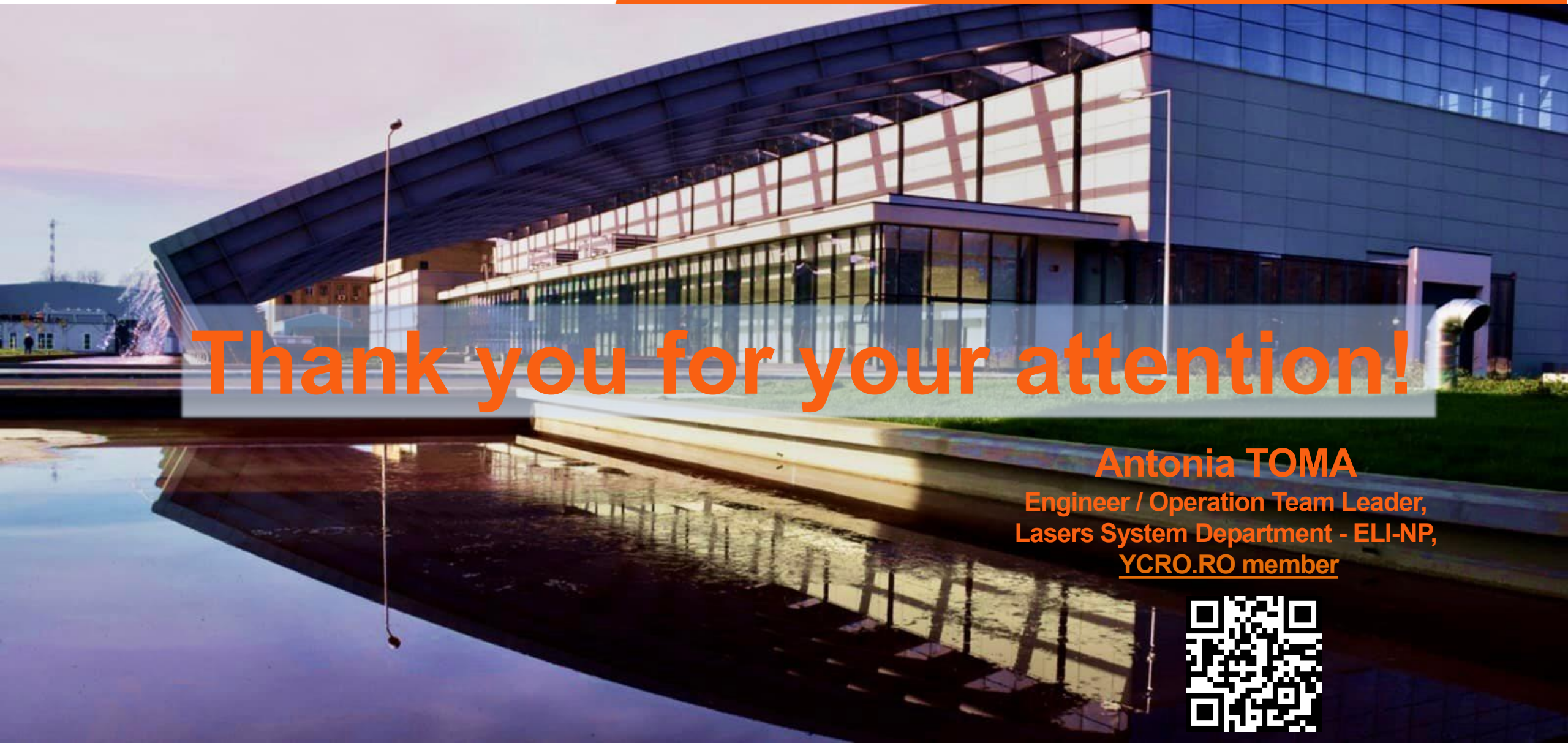
- Communication style
- Approach to changes
- Sense of belonging
- Work rhythm

Importance of the Team Leader

The team leader acts as coordinator and facilitator.
He leads by example, show responsibility, and contribute to the development of team members.
The team leader represents the bridge between management and the team members and ensures that objectives are achieved through proper coordination, communication, and motivation

Closing Remarks

I conclude by emphasizing that effective team management is built day by day through clear processes, constant communication, and a strong focus on results.
A united and well-coordinated team is the foundation of any successful project.



Thank you for your attention!

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