EUROfusion

Enabling Research Project CfP-FSD-AWP26-ENR-01

Conceptual design for a European High Power Laser Fusion Research Facility (HiPER+RF)

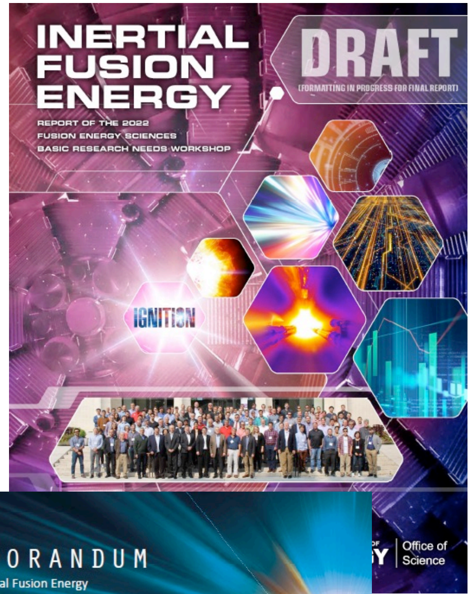
Period 2026-2027
12 countries
30 research groups
146 researchers
825 Person months (69 PPY)

HiPER+
EUROPEAN LASER FUSION ENERGY

- History
- Organisation of the project
- Groups and funding
- Management of the project
- HiPER+ and the rest of the world
- Concluding remarks

Large impact of NIF results

NIF results provided a validation of the Inertial Fusion concept, achieving ignition beyond breakeven, and opening the pathway to gain.



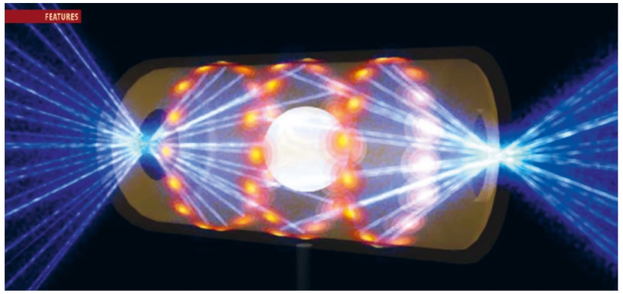
For the first time in the U.S., they think on the possibility of developing national projects on Inertial Fusion Energy (IFE) as a future source of energy

- **Basic Research Needs** report: a foundational guide for DOE to establish a national IFE program in the USA

Germany has suddenly changed its attitude towards IFE

- **Memorandum** on laser IFE for the federal ministry of education and research of Germany (May 2023) and more recently statement of allocation of 1 B€ to fusion research

A big shift from defense-driven research to energy-oriented research



BREAKTHROUGH AT THE NIF PAVES THE WAY TO INERTIAL FUSION ENERGY

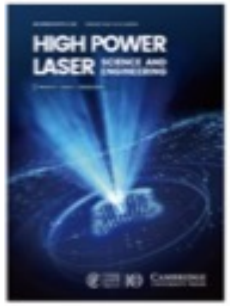
S. Atzeni[1], D. Batani[2], C. N. Danson[3,4], L. A. Gizzi[5], S. Le Pape[6], J-L. Miquel[7], M. Perlado[8], R.H.H. Scott[9], M. Tatarakis[10,11], V. Tikhonchuk[2,12], and L. Volpe[13,14] – DOI: https://doi.org/10.1051/epn/2022106

In August 2021, at the National Ignition Facility of the Lawrence Livermore National Laboratory in the USA, a 1.35 MJ fusion yield was obtained. It is a demonstration of the validity of the Inertial Confinement Fusion approach to achieve energy-efficient thermonuclear fusion in the laboratory. It is a historical milestone that the scientific community has achieved after decades of efforts.

HiPER+ Project

Letter to launch an HiPER+ project has been so-far signed by more than 100 European scientists

https://www.clpu.es/Laser_Fusion_HiPER



High Power Laser

An evaluation of sustainability and societal impact of high-power laser and fusion technologies: a case for a new European research infrastructure

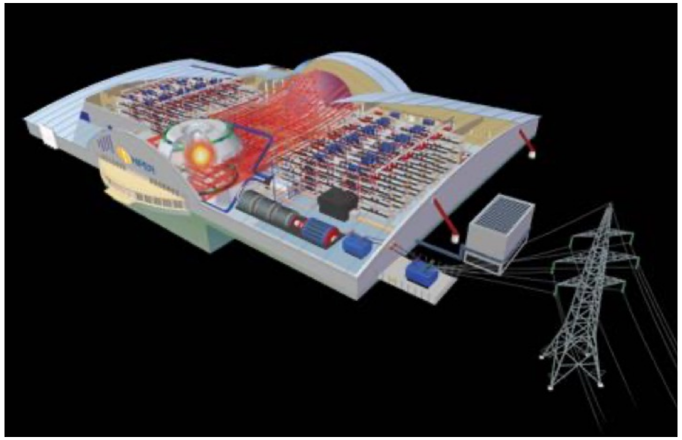
Part of: HPL Perspectives

Published online by Cambridge University Press: 21 September 2021

S. Atzeni, D. Batani, C. N. Danson, L. A. Gizzi, M. Perlado, M. Tatarakis, V. Tikhonchuk and L. Volpe Show author de

On what we build: The EU IFE community

2005-2014 European Project “HIPER” (High Power Laser Energy Research Facility)



HiPER

HiPER, conceived as a large-scale laser system designed to demonstrate significant energy production form ICF, was listed on the ESFRI large scale facility roadmap and awarded preparatory phase funding (~2 M€) by the EU with additional funding from STFC, UK, and the Ministry of Education, Czech Republic, and work in kind form many other partners

The project was based on the assumption that NIF would ignite during the National ignition Campaign (2009-2012)

www.hiper-laser.org

On what we build: The EU IFE community

COST Action MP1208 «Developing the Physics and the Scientific Community for Inertial Fusion at the time of NIF ignition» 2013-2017

Laserlab Europe supports 3 ICF-related groups:
Expert group in ICF/IFE
Expert group in micro-structured materials
Expert group in laser-generated EMP

EUROFusion within Enabling Research projects. One-two projects per year related to IFE at the level of $\sim 300\ k€$ per year per project (2017-2025)

Strengths:

- Role of EU of scientists with ground-breaking contributions to ICF and important work on shock ignition done in the last 10 years within EUROFusion projects;
- Important, and often pioneering contributions in laser-plasma physics and applications;
- Effective international collaboration in direct drive fusion (e.g. University of Rochester)

Weakness: No experience in driving implosions due to the lack of a dedicated facility
• Direct-drive implosions were done in the 70's and 80's both at the LULI and Vulcan laser facilities but soon these facilities became non-competitive.

We can make the jump by federating the groups around an IFE test facility in Europe with strong international collaboration

EUROPEAN COMMISSION
DIRECTORATE-GENERAL FOR RESEARCH & INNOVATION

Directorate C - Clean Planet
The Director

Brussels,
rtd.c.4.dir(2022)2594050

April 2022

Dear Prof. Batani, Prof. Tikhonchuk,

Thank you for your recent letters to Commissioner Mariya Gabriel and Director-General Jean-Eric Paquet, which bear the proposal for a coordinated international project on Inertial Fusion Energy (IFE) in Europe.

At the European Commission, we are well aware of the recent experimental results at the US National Ignition Facility, and of the excitement those results have prompted in the IFE community worldwide. To a certain extent, the Euratom Research and Training Programme already funds IFE research through the Enabling Research Projects of the EUROfusion consortium. The Euratom Programme, however, is strongly focused on the development of the magnetic fusion concept along the European Fusion Roadmap, and it is therefore not the right instrument to fund IFE activities at the scale envisaged in your proposal.

The European Strategy Forum on Research Infrastructures (ESFRI) appears to be a better suited framework to discuss the idea of a European IFE facility, as the HiPER project, which your proposal builds upon, was included in the 2006 ESFRI Roadmap. I recall that at least three EU Member States or Associated Countries are needed to support an ESFRI proposal. No less importantly, proposal evaluation is based on strict criteria which require that a sound scientific and business case is made upon submission. General information on ESFRI can be found in the dedicated website (https://www.esfri.eu) and further information can be requested through the functional mailbox info@str-esfri.eu.

Wishing you every success with the development of your project, I remain at your disposal for further clarification or information.

Yours faithfully,

e-signed

Rosalinde van der Vlies

HIGH POWER LASER
SCIENCE AND ENGINEERING

High Power Laser Science and Engineering, (2023)
doi:10.1017/hpl.2023.80

REVIEW SPECIAL ISSUE ON ICF

Future for inertial-fusion energy in Europe: a roadmap

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HIPER+ initiative

The call is the result of a new sensibility towards ICF but also of our lobbying activities with EURATOM, ESFRI, EUROFUSION

Identification of the main gaps:

- Absence of implosion facility
- Technological missing steps in lasers, targets, materials

The absence of an implosion facility which is:

- dedicated to direct drive
- European
- open and civilian

is also identified as a major gap in other ongoing proposal at the European level (e.g. the preparation of the SRIA document for the future PPP launched by EURATOM)

For this reason, the call for Enabling Research Project was centred about preparing the conceptual design for a future European laser facility.

It is a big jump for inertial fusion in Europe: from studying some physical aspects of ICF as “keep in touch” activities to paving the way to a future research program and a future facility on IFE in Europe.

This also determines the character of the project: from blue sky research to a programmatic approach.

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Usually, the activity in previous ER projects was centred to continuing ongoing research (possibly in collaboration). Here the MAIN focus will be the reparation of conceptual design of a future facility, and each group will need to work in this direction…

Challenge 1: Lasers

- Today's laser efficiency (electricity to laser energy) is < 1%
- NIF, LMJ, SG-III can fire typically 1 shot/day
- They use 350 nm light (near UV, 3ω of Nd:glass lasers)

In order to think about a reactor, we need:

- Develop more efficient laser (≥ 10%)
- Develop high repetition frequency laser (10 Hz)
- Think about the possibility of using 2ω light (532 nm) to reduce damage to optics
- Develop broadband lasers (to quench parametric instabilities)

Possible by using diode pump lasers (efficiency up to 20% but not yet demonstrated with high energy systems)

Today, laser systems like L4n at ELI-beamlines already offer higher repetition rate (≈ 1 shot /min) and larger broadband…

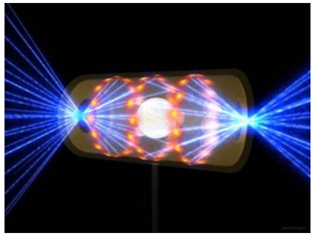
Challenge 2: Targets

- Today's cryogenic target costs ≈ 10000 \$.
- They require many days of preparation and characterization
- They need $\approx$ hour to be inserted in the chamber and properly aligned

In order to think about a reactor, we need:

- Develop cheap technology (< 1\$/target)
- Develop capability of mass production of targets
- Develop techniques for target injection and alignment at ≈ 1 Hz
- Design of the target insertion and tracking system

All this does NOT seem possible with indirect drive !!



Challenge 3: Materials

- Problems of tritium breeding and handling system
- Problems of activation of materials. Identification of adequate materials for chamber construction and protection.
- Security and safety issues.
- Facing the problem of huge EMP
- Development of remote handling techniques
- Cooling system and energy recovery system. Systems for material control, replacement and refurbishing

Many of these issues are common to MCF too (synergies possible)

- History
- Organisation of the project
- Groups and funding
- Management of the project
- HiPER+ and the rest of the world
- Concluding remarks

Conceptual design for a European High Power Laser Fusion Research Facility (HiPER+RF)

Abstract

The HiPER+RF project proposes the conceptual design of a next-generation European laser fusion research facility for Direct Drive (DD) inertial confinement fusion (ICF). While Europe leads in magnetic confinement fusion, it lacks a civilian-accessible laser-driven program, leaving a strategic gap with the US and China. Recent ignition breakthroughs at the US National Ignition Facility (NIF) confirm the credibility of ICF and highlight the urgency for Europe to invest in DD as a complementary path to Inertial Fusion Energy (IFE). The facility will be designed to achieve ignition, scale to high gain (Q ≥ 100), and operate at Hz repetition rates under reactor-relevant conditions. It will integrate diode-pumped solid-state lasers, scalable target fabrication and injection, radiation-hardened diagnostics, and materials capable of withstanding extreme thermal and neutron loads.

The project builds on the HiPER project (2008–2013), Enabling Research on DD and shock ignition (2017–2025), the HiPER+ Roadmap (HPLSE, 2023), and the LaserFusion Erasmus+ project (2024–present). It will unite European civilian IFE community and foster collaboration with industrial partners and start-ups (Thales, Amplitude, Marvel, GenF, Focused Energy, …) and with leading European laser facilities (LULI, PHELIX, PALS, ELI, XFEL). It will address bottlenecks in hydrodynamic stability, laser–plasma interaction, target physics, diagnostics, and materials through advanced simulations and tailored experiments, supplemented by large-scale campaigns at NIF, Omega, and LMJ when required. Seven coordinated work packages cover implosion design, experimental validation, efficient laser drivers, targets and materials, diagnostics, system integration, and community building. The expected output is one general conceptual design, including validated DD target designs, a roadmap for high-repetition lasers with >10% wall-plug efficiency, conceptual designs for reliable target production and reactor-scale diagnostics, and a complete facility layout with safety and licensing specifications.

Beyond technical progress, HiPER+RF will reinforce the European IFE ecosystem through workshops, schools, and industry–academia forums, while preparing long-term EU and national support for ESFRI integration. It will also train the next generation of fusion scientists and engineers. The project offers both a pathway to ignition and high-gain DD fusion and a strategic investment in Europe's energy autonomy, technological leadership, and the green transition.

Organisation of project (WP)

WP1: Project Management, Coordination, and Facility Conceptual Design

WP2: Tailored Experiments

WP3: Laser Technology

WP4: Targets, Materials, and engineering aspects

WP5: Laser-Plasma and Nuclear Fusion Diagnostics

WP6: Physics

WP7: Community Building and European Research Landscape Development

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WP1: Project Management, Coordination, and Facility Conceptual Design

This work package coordinates and supervises all project activities to ensure delivery of the final conceptual design. Responsibilities include progress monitoring, resource reallocation, communication across all levels, and organization of technical, administrative, and general meetings to guarantee efficient and timely execution. WP1 constitutes the central management hub of the project, integrating oversight with the strategic development of the HiPER+RF facility's conceptual design.

Task 1.1: Integrate all technical outputs from WPs 2-7 into a coherent facility design, including the laser hall, chamber layout, and diagnostics, the required subsystems and the overall architecture

Task 1.2: Conduct trade-off analyses on various design options, among others chamber geometries and beamline layouts, to ensure a modular and upgradable design.

Task 1.3: Create 3D CAD models of the facility and perform simulations for thermal loads, shielding, and mechanical stress of critical components. Explore AI-driven control schemes for autonomous operation.

Task 1.4: Define and assess engineering constraints, including laser beam path, vacuum compatibility, and tritium handling. Deliver technical specifications for all utility systems, such as cooling loops and remote handling systems.

Task 1.5: Nuclear analysis for safety in the conceptual design of the facility. Define licensing requirements according to nuclear safety regulations.

Task 1.6: Conduct integrated design iterations with feedback from other WPs, including safety and logistics evaluations to support the pre-licensing phase.

WP2: Tailored Experiments

The primary objective of the project is to deliver the full conceptual design of a European IFE infrastructure, and this requires performing some dedicated experimental activities. These efforts will sustain and advance the consortium capabilities to supply tailored solutions for the conceptual design, building upon the achievements previously supported by ENR programs on DD. Major European laser laboratories within the consortium (LULI, PHELIX, PALS, and ELI-NP) will provide dedicated beam time, while collaborations with XFEL, ELI Beamlines, and ELI-ALPS will further enhance experimental capacity, also through dedicated access routes. This work package focuses on experimental validation, providing critical support to theoretical models and guiding design choices for the proposed facility.

Task 2.1: Validate theoretical models and mitigation strategies for laser parametric instabilities (LPI) and for ablator dynamics and hydro instabilities through experiments at key European laser facilities (e.g., LULI, PALS, PHELIX, ELI) and non-European ones (e.g., NIF, Omega).

Task 2.2: Coordinate with facility directors to secure beam time and ensure logistical feasibility.

Task 2.3: Execute and coordinate experimental campaigns across multiple EU facilities, ensuring cross-calibrated diagnostics and shared data.

Task 2.4: Develop a campaign strategy covering different energy regimes (single-beam, intermediate, high-energy) and establish pre-shot and post-shot data analysis pipelines.

Task 2.5: Develop a coordinated data archiving and sharing strategy to promote open science and collaborative model refinement.

Task 2.6: Initiate bilateral experimental campaigns with international partners and publish open-access reports to harmonize protocols.

WP3: Laser Technology

The HiPER+RF project addresses key challenges in inertial confinement fusion (ICF) facility design by: (i) increasing laser wall-plug efficiency to 7–15%,
(ii) demonstrating high-repetition-rate operation with ≥1 shot/min and potential multi-Hz capability,
(iii) mitigating laser–plasma instabilities through broadband pulses, longer wavelengths (e.g. the 2^{nd} harmonic of Nd lasers), and advanced beam smoothing.

This work package develops the high-efficiency, high-repetition-rate laser drivers essential for a fusion power plant.

Task 3.1: Develop a roadmap for Diode-Pumped Solid-State Laser (DPSSL) technology, including risk and cost analysis and scaling.

Task 3.2: Conceptual development of prototype laser subsystems, primarily amplifier modules and adaptive optics, in close collaboration with industry.

Task 3.3: Propose laser architectures for both single-shot and multi-Hz operation, evaluating different technologies and cooling methods.

Task 3.4: Define and model laser front-end stability and control, amplification noise, and thermal effects to ensure system resilience.

Task 3.5: Design scalable power conditioning and heat extraction systems.

Task 3.6: Partner with European photonics SMEs and research labs to co-design key components, fostering a European supply chain for fusion-class DPSSLs.

WP4: Targets, Materials, and engineering aspects

This activity defines the engineering specifications of the interaction chamber for ignition experiments, addressing licensing, target manufacturing, diagnostics, and debris management. It also evaluates reactor wall and blanket materials, and optical components under irradiation, while developing models, innovative designs, and industrial pathways to ensure safe, reliable, and cost-effective operation. The assessment of different concepts of blanket and vacuum vessels for the Fusion Power Plant in IFE will be performed, including the evaluation of tritium breeding solutions. In this WP we'll collaborate with companies and institutions working on targetry in Europe and able of providing foams, 3D printed structures, diamond shells, and other types of targets (e.g. UPNANO, Nanoscribe, Istituto Italiano di Tecnologia, Fraunhofer Institute, ...)

This work package concentrates on the engineering and materials science aspects of the fusion chamber and target systems.

Task 4.1: Address the manufacturing, metrology, and injection of cryogenic DD targets. Define material specifications for the chamber walls and optics that can withstand harsh, repetitive neutron loads.

Task 4.2: Develop protocols for tritium handling and initiate pre-regulatory dialogue with tritium handling authorities. Study compatibility with chamber debris management systems, laser-generated Electromagnetic Pulses (EMPs) and propose preliminary specifications for breeding blankets.

Task 4.3: Assess high-volume target production methods, such as 3D printing and droplet injection, and propose automation protocols for quality assurance.

Task 4.4: Investigate target survivability during high-repetition-rate shots and define the interface for the target injector with the chamber timing systems.

Task 4.5: Conduct material testing for novel ablator materials and foam shells.

WP5: Laser-Plasma and Nuclear Fusion Diagnostics

This activity delivers the conceptual design of diagnostics for an ignition facility operating at high repetition rates in harsh environments. It develops methods to monitor target positioning, implosion dynamics, and ignition using optical, X-ray, particle-beam, and nuclear techniques. Existing systems at NIF and Omega will be reviewed in light of recent advances, with emphasis on direct-drive geometry to support ignition studies for the European scientific community.

This work package designs the advanced diagnostic systems required to monitor and control the fusion process under reactor-relevant conditions.

Task 5.1: Define diagnostic systems for laser plasma interaction, implosion performance, and reactor-scale operation, assessing them for radiation hardness, real-time readout, and EMP resilience.

Task 5.2: Benchmark diagnostic systems against those at existing facilities such as NIF and Omega and simulate their performance in the harsh environment.

Task 5.3: Map out diagnostics for key metrics like hot spot formation, neutron yield, and implosion symmetry.

Task 5.4: Test and validate radiation transport codes (Monte Carlo) and shielding standards.

Task 5.5: Develop protocols for radiation-induced drift correction and noise filtering, designing scalable readout electronics for high shot rates.

Task 5.6: Propose an industrial demonstrator program for sensor integration and prototyping under harsh conditions.

WP6: Physics

This work package establishes a comprehensive framework for the current state of laser fusion physics, with emphasis on direct-drive shock ignition (WP6.1–WP6.6), while also assessing alternative direct-drive schemes (WP6.7). This is of high importance to define, at the end of the project, updated solutions for the conceptual design following the most promising schemes and implementations.

This work package focuses on the theoretical and computational physics of direct-drive implosions, a central component of the project's strategy.

Task 6.1: Advance theoretical models for instabilities, imprint effect, alpha particle transport, and burn propagation, leading to validated target designs capable of a gain greater than 2 (Q>2).

Task 6.2: Validate new hydrodynamic models against experimental results.

Task 6.3: Model complex laser plasma interactions using integrated fluid-kinetic solvers and benchmark these tools against data from NIF and Omega.

Task 6.4: Perform detailed benchmarking of new 3D radiation hydrodynamics tools against historical data from major international facilities.

Task 6.5: Analyze the interplay between drive asymmetries and Rayleigh-Taylor growth. Train AI-based surrogate models to guide future design iterations.

Task 6.6: Define a new European standard for implosion performance metrics and collaborate internationally to refine capsule geometries.

Task 6.7: Explore and describe alternative approaches to direct drive, such as **fast ignition** and **magnetized ignition**, to broaden the project's scope and implosion facility design to allow also their implementation

WP7: Community Building and European Research Landscape Development

The HiPER+RF consortium will strengthen collaboration across the laser and nuclear fusion research community through strategic communication, training, and stakeholder engagement. Activities include dissemination of results, governance discussions, talent development via schools and workshops, and fostering broader cooperation within the European fusion landscape. The ultimate goal is to prepare the scientific and political foundations required for inclusion of HiPER+RF in the European Strategic Forum on Research Infrastructures (ESFRI) roadmap.

This work package focuses on building long-term community support and infrastructure beyond the conceptual design phase.

Task 7.1: Foster a coherent European IFE community through workshops, summer schools, and engagement with industry and policymakers.

Task 7.2: Maintain ongoing stakeholder engagement and track input from academia, industry, and government.

Task 7.3: Produce an ESFRI-compliant white paper to secure future support.

Task 7.4: Coordinate cross-border engagement through MOUs and joint PhD programs, aligning with broader European fusion strategies.

Task 7.5: Liaise with industrial consortia and policy platforms to prepare for ESFRI pre-application dossiers and the establishment of a formal legal entity.

Task 7.6: Propose a governance model for the future facility and develop talent retention strategies to prevent brain drain.

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Strategic collaborations

The consortium participants collectively cover the necessary expertise across the relevant scientific and technological domains and maintain strong collaborative links with key national and international partners. ...

This being said, we will also welcome external contributions and indeed partnerships will be strengthened with European world-leading laser technology companies (Thales, Amplitude, ...), European IFE start-ups (Marvel, GenF, Focused Energy, ...), and with colleagues in the US and in the UK. Also, since the project aims at reinforcing the IFE community in Europe, we will strengthen collaboration with major European facilities (Phelix, LULI, PALS, ELI, ...), which indeed are already part of our project through the presence of several researchers or even facility directors. This is a prerequisite for an ambitious future research program, based on conducting tailored experiments in such facilities allowing to refine the target design. We also anticipate a close collaboration with the HZDR Helmholtz-Zentrum Dresden-Rossendorf, the European XFEL, and, in particular, with the three ELI pillars (which recently launched a call for programmatic experiments in the field of IFE). This call highlights the need for programmatic research in the field but also testifies the high interest in IFE all over European research facilities and scientific community.

Ultimately, full-scale experiments will be pursued at NIF and Omega in the US and at LMJ in France

Conclusive remarks

The **HiPER+RF proposal** charts a clear pathway toward a next-generation European facility capable of demonstrating fusion ignition via Direct Drive (DD) and paves the way to the future European IFE reactor, through a truly multidisciplinary scope —plasma physics, laser engineering, materials science, and community development …

… The proposed facility will thus serve as a European hub for frontier science while advancing a roadmap to scalable energy production.

In parallel, the project will play a key role in educating and training a new generation of fusion experts. across computational physics, optics, cryogenics, diagnostics, and regulatory science. This creates fertile ground for careers in academia and industry, while broadening Europe's fusion strategy beyond tokamaks. Such diversification strengthens the prospects for long-term energy sovereignty and aligns with the Green Deal, REPowerEU, and other decarbonization initiatives.

The facility will also act as a **steppingstone** toward a DEMO-class DD reactor. By starting with a research-scale installation, the project minimizes risks while maximizing returns in experimental data, community building, and validation of critical technologies. Its modular design ensures adaptability to rapid technological change and evolving stakeholder needs.

A **phased roadmap** will guide the transition from conceptual design to engineering development, prototyping, subsystem testing, and construction. Milestones will include metrics for technology readiness, procurement, and risk management. An exploitation plan will identify commercial spinoffs, industrial applications, training programs, and intellectual property strategies, ensuring alignment with ESFRI priorities and access to national and European co-funding.
Historically, inertial confinement fusion has been driven by military programs, particularly in the United States. Europe now has the opportunity to redefine this trajectory by establishing an open, civilian facility for DD ignition and high-repetition experiments. The HiPER+RF initiative positions the EU at the forefront of peaceful fusion development, committed to transparency, collaboration, and scientific excellence.

Future Vision and Long-Term Impact

The proposed facility could be realized by 2035 evolving into a fully operational research hub for high-gain, high-rep-rate inertial fusion, capable of producing scientific-grade neutron yields at multi-Hz rates. .... The long-term vision is to build the first civilian fusion testbed that can inform the development of a commercial-scale DD reactor within three decades.

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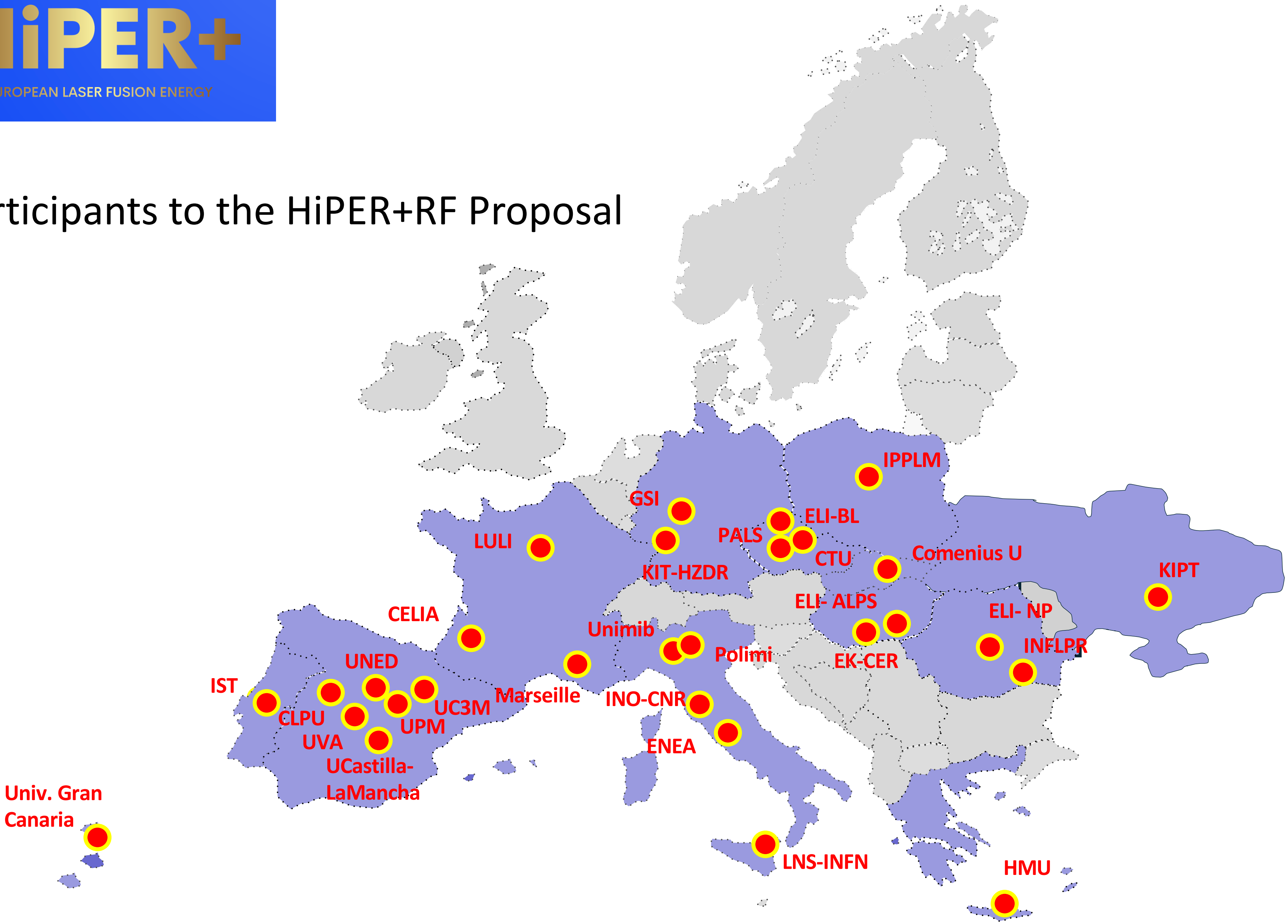
HiPER+

EUROPEAN LASER FUSION ENERGY

Participants to the HiPER+RF Proposal



Criteria for funding

Minimum of 2 PM per researcher per year

PI involvement 6 PM per year

Balance among countries: researchers from some countries cost less, so it was possible to assign more PM

The total budget of the project could not exceed 2.360 M€

Open position must not exceed 10% of total PM. This has been compensated by adding some PM "in kind"

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Participation and funding

Country	*Lab*	*#Researchers*	*PM*	*PM in kind*	*Open position*	*Funding (k€)*
Italy	INO-CNR	7	27	8	11	98.3
	ENEA	18	36	54	0	130.6
	INFN	8	26	10	0	94.8
	Bicocca	2	11	0	0	40.0
	Polimi	4	19	0	0	69,1
France	CELIA	8	44	9	0	162.5
	LULI	5	16	6	0	77.7
	U.Marseille	3	10	3	0	48.6
Spain	IFN-UPM	4	12	10	0	41.9
	ETSI-UPM	3	16	5	0	55.7
	UC3M	1	4	0	0	14.0
	UCLM	3	8	8	0	27.9
	UGC	3	12	0	0	41.9
	U.Valladolid	2	8	0	0	27.9
	UNED	2	9	0	0	31.4
	CLPU	1	5	0	0	17.4
Germany	GSI	5	21	0	0	107.8
	KIT-HZDR	2	4	0	16	20.0
Slovakia	CU	3	13	0	0	26.7
Poland	IPPLM	14	54	21	12	130.3
Czechia	PALS	2	14	0	0	32.0
	CTU	5	25	0	0	57.0
	ELI-BL	3	14	0	12	44.9
Hungary	EK-CER	2	8	0	0	20.0
	ELI-ALPS	5	14	0	12	21.2
Romania	INFLPR	7	28	0	0	83.3
	ELI-NP	9	38	0	12	113.1
Greece	HMU	5	42	0	0	118.1
Ukraine	KIPT	5	43	0	0	33.8
Portugal	IST	11	45	0	0	133.6

The funding does not include the open positions

Participation and funding

In principle EUROFusion pays for the work done (i.e. the salaries). However, since in most countries, salary of researchers are already paid, this money can be used for ANYTHING related to the project

In some countries, the EUROFusion funds are instead directly used to pay the salaries. However, even in this case the institutions must commit to provide the participating researchers with the funds needed to take part in the activities of the consortium (workshops, common experiments, etc)

Open positions for Post Doc (all finishing on December 2027)

Italy	INO-CNR	11	PM
Germany	KIT-HZDR	16	PM
Poland	IPPLM	12	PM
Czechia	CTU/ ELI-BL	12	PM
Hungary	ELI-ALPS	12	PM
Romania	ELI-NP	12	PM

Recruitment of these researchers should involve the members of the core group

These researchers are also intended to work on the preparation of the conceptual design and the final report to be delivered at the end of the project

The institutions which have an “open positions” must clarify with the beneficiary whether they need to advance the money or they an be supported at the beginning of the project (not directly by EUROFusion...)

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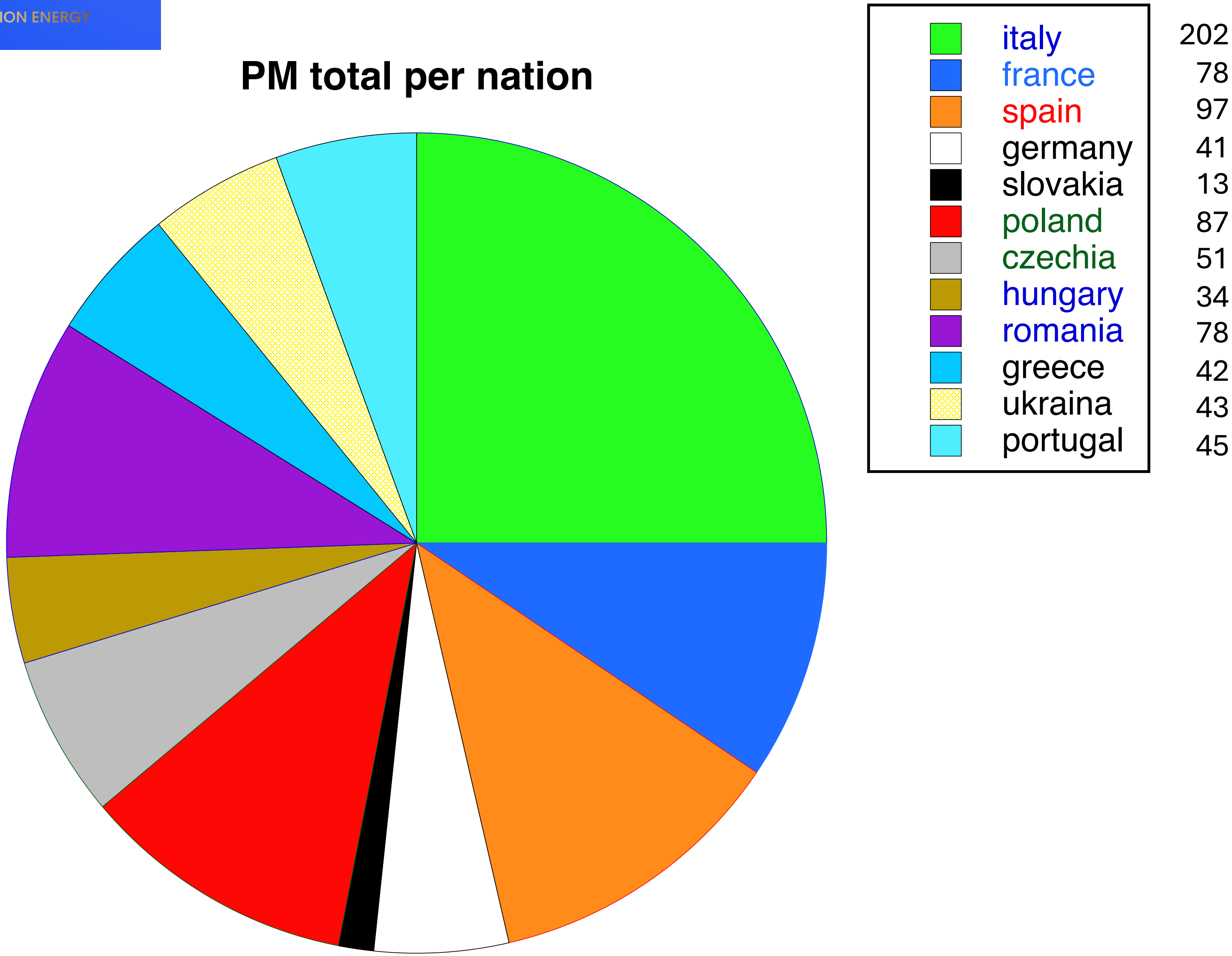
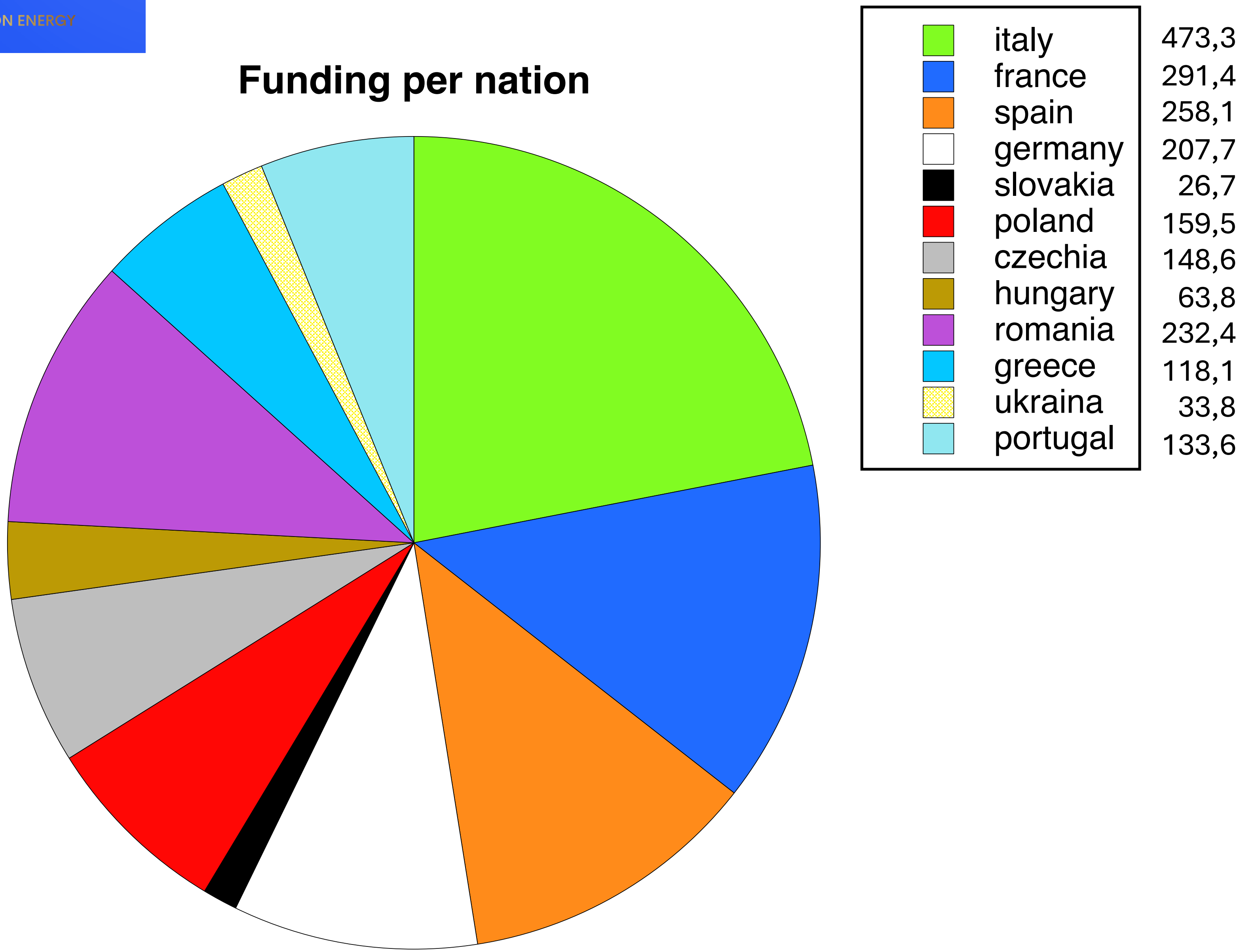
EUROPEAN LASER FUSION ENERGY

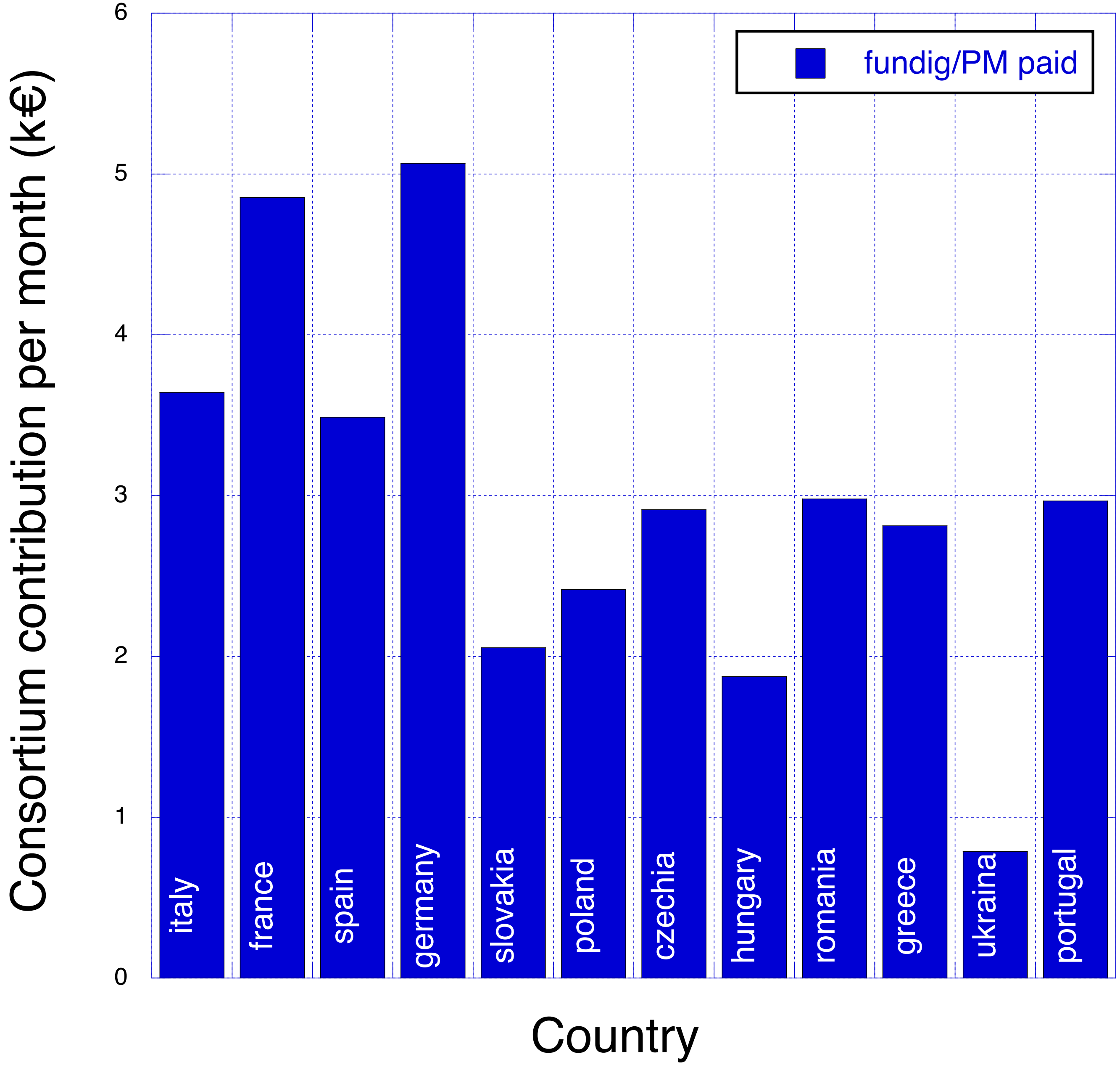
PM total per nation



HiPER+
EUROPEAN LASER FUSION ENERGY

Funding per nation





Consortium contribution per month (k€)
Country
fundig/PM paid
0
1
2
3
4
5
6
italy
france
spain
germany
slovakia
poland
czechia
hungary
romania
greece
ukraina
portugal

- History
- Organisation of the project
- Groups and funding
- Management of the project
- HiPER+ and the rest of the world
- Concluding remarks

Managing the project

Executive committee. Members: Dimitri, Luca and Michael (scientists that wrote the proposal) for fast bureaucratic decisions where no scientific nor strategic “choices” are involved.

Core group. Members: Dimitri, Luca, Michael, Leo, Vincent, Fabrizio, Manolo, Sebastien, and Vladimir.

Management committee including at least one or two representatives per country and of the main groups.
The committee is not expected to meet often but its role will eb fundamental especially in order to prepare the future beyond the current project.
We need to begin to lobby with our governments (a task which can be done by members of the managing committee) to get support for the “next steps”

WP coordination *(preliminary)*

WP1: Project Management, Coordination, and Facility Conceptual Design
(Dimitri Batani, Michael Tatarakis, Luca Volpe)

WP2: Tailored Experiments
(Sebastien LePape, Gabriele Cristoforetti, Paul Neumeyer)

WP3: Laser Technology
(Leonida Gizzi, Vincent Bagnoud)

WP4: Targets, Materials, and engineering aspects
(Manolo Perlado, Fabrizio Consoli)

WP5: Laser-Plasma and Nuclear Fusion Diagnostics
(Marta Fajardo, Massimiliano Sciscio, Thomas Cowan)

WP6: Physics
(Vladimir Tikhonchuk, Sebastien LePape, Michael Tatarakis)

WP7: Community Building and European Research Landscape Development
(Daniele Margarone, Pablo Cirrone, Michael Tatarakis, Sakura Pascarelli)

Managing the project

The WP coordinators are the person who commit to writing the chapters of the conceptual design (which will reflect the structure of the WPs of the project).

For each group:

Local responsible. Each research group has a local responsible who must act as contact point between the group and the management of the project

Local WP responsible. Each group which takes part in more than one WP must choose a local WP responsible who should collaborate with the WP coordinator in preparing the contribution to the conceptual design

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Attention and interaction with what is going on around us

- Interaction with fusion start-ups
- Interaction with laser companies (Thales, Amplitude, ...)
- PPP go4Fusion SRIA
- Proposal XFEL INFUSE (but also recent German call)
- Call for programmatic research in the field of fusion from ELI-ERIC
- Proposal COST 2025 HiPER+n (P.Cirrone)
- More to come .... (act as an “incubator” of proposals...)

The Interaction with fusion start-ups is important but “delicate”, opportunities but also risks…

While today IFE is a credible approach to Fusion Energy, the challenges are still very big, both technologically and scientifically.

Even with ∞ money, the needed time cannot be indefinitely compressed.

Now it is necessary to maintain the scientific enthusiasm and optimism but keep scientific credibility

Also, start-ups at the crossway between Europe and US..??

Expression of Interest: ELI Mission-Based Access Program in Inertial Fusion Energy (IFE)

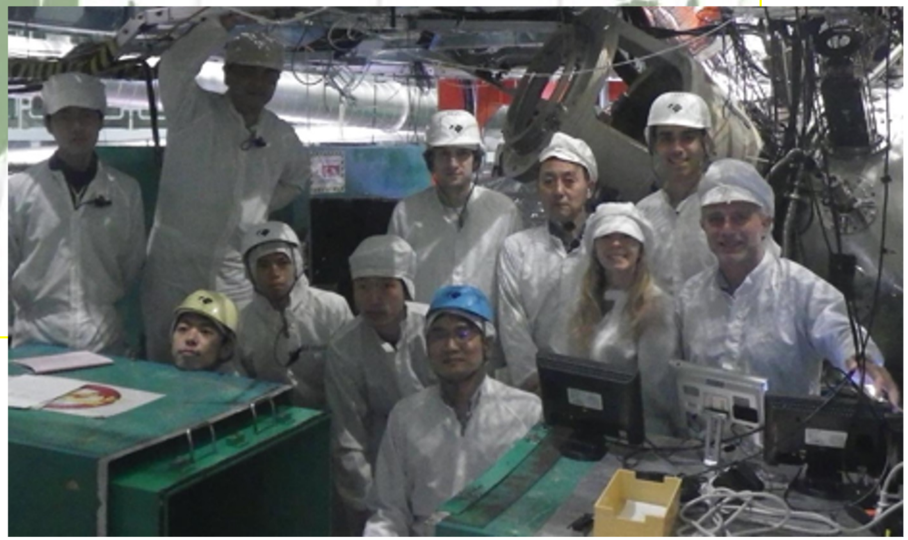
Developing knowledge in the field of IFE requires PROGRAMMATIC research !

International collaborations

Connections with our colleagues in US, Japan, etc.

Make agreements (MoU) with facilities in and outside Europe

Strengthen relations with UK (Robbie Scott)



Experiment at the laser Gekko, Osaka

Publicity

- We should take care of the “publicity” of our project (social media)
- We need a standard form of the acknowledgements to be put in papers which does not simply recognize Eurofusion but explicitly mention our project and inertial Fusion)
- We should put our articles on the EUROFUSION PinBoard.
- We should have an adequate representation of HiPER+ in all scientific conferences in our field (and ask our members to put the HiPER+ logo in their presentations)
- There is a HiPER+ web site (currently managed at IPPLM). This must be updated with contributions from all participants
- Interactions with EPS PDD and BPIF in particular

HiPER+
EUROPEAN LASER FUSION ENERGY

Acknowledgement

This work has been carried out in the framework of the EUROfusion Enabling Research Project: CfP-FSD-AWP26-ENR-01 "Conceptual design for a European High Power Laser Fusion Research Facility" (HiPER+RF), funded by the European Union via the Euratom Research and Training Programme (Grant Agreement No 101052200 — EUROfusion). Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Commission. Neither the European Union nor the European Commission can be held responsible for them.

Other items

- Support to PhD
- Missions (through IMS, approved by PI) budget 70 k€ per year
- Publications (Eurofusion pinboard, publication costs)
- Schools (LaserFusion in particular)
- Find ways to involve more countries / groups in the project both within Eurofusion (e.g. Belgium, …) or outside (e.g. Serbia, Georgia, …)
- Strengthen relations with UK (Uplift)

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Next steps

- Organize HiPER+ meetings in relevant conference (coming ones: DDFIW in Frascati, EPS Plasma Physics in Edinburgh)
- Close coordination with major European large-scale laser facilities (MoU) to prepare future work, including experimental campaigns and political advocacy for IFE in Europe
- At end 2026 we will revise the task specification 2027 based on 2026 outcome. Resources can be re-allocated and even some groups could be excluded…
- End 2026: Organization of an industry–academia forum involving European decision-makers

Future steps

We need to use the ENR HiPER+RF project (2026-2027) to pose the basis of the future, i.e. begin to think and prepare the next step.

At the moment the possibilities seems to be:
1) Apply to enter the ESFRI Roadmap and develop a technical design,
2) Establish a Work Package “Inertial Fusion” within EURATOM.

Something different might appear during these two years (maybe by the interaction with national projects, start-ups, projects within PPP, etc.)

Conclusion

This project represents a *unique opportunity* for developing IFE research in Europe and proposing the construction of an international, civilian, implosion facility dedicated to direct drive. Our community should not miss this opportunity!!

The management of the HiPER+RF project will operate to assure that the work of each group is coherent with the final goal of preparing the conceptual design of such facility