Phase de présélection



Acronym of the project	PSL★	
Titre du projet en français	PSL★ Rendons possible le nécessaire	
Project title in English	PSL★ On the move	
Project manager	Nicolas Sennequier Contacts: +33 (0)689322251, <u>nicolas.sennequier@obspm.fr</u>	
Institution leading the project (Project leader)	Fondation de Coopération Scientifique Paris Sciences et Lettres	
Capital grant requested	1 208 000 000 euros including LABEX demands and based on a 3.4% interests rate	

Structure of the IDEX partnership

Etablissements d'enseignement supérieur et de recherche	Organismes de recherche	Autres
Collège de France	CNRS*	FCS PSL
Ecole Normale Supérieure Ulm (ENS)	INSERM*	Institut Curie
Ecole Nationale Supérieure de Chimie de Paris (ENSCP ParisTech)	INRIA*	Institut Louis Bachelier (ILB)
Ecole Supérieure de Physique et de Chimie Industrielles (ESPCI ParisTech)		
Observatoire de Paris		
Université Paris-Dauphine (UPD)		
Ecole Nationale Supérieure des Arts Décoratifs (ENSAD)		
Ecole Nationale Supérieure des Beaux-Arts (ENSBA)		
Conservatoire National Supérieur de Musique et de Danse de Paris (CNSMDP)		
Conservatoire National Supérieur d'Art Dramatique (CNSAD)		

*: CNRS, INSERM and INRIA have officially expressed their support to PSL \star

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Key words

, source

• Research University, Cutting-edge, Transformation, Creation, Innovation, Empowerment, Reactivity, Transdisciplinarity, Collegiate, Assessment

• For update on the project, see www.parissciencesetlettres.org

1. AMBITION AND STRATEGY OF THE PROJECT

The PSL★ proposal is presented by twelve of the most prestigious French institutions of higher education and research, including the five charter members of the Pôle de Recherche et d'Enseignement Supérieur (PRES) Paris Sciences et Lettres (PSL), namely the Collège de France, Ecole Normale Supérieure (ENS), Ecole Nationale Supérieure de Chimie de Paris (ENSCP ParisTech), Ecole Supérieure de Physique et de Chimie Industrielle (ESPCI ParisTech) and Observatoire de Paris, along with the Institut Curie, Université Paris-Dauphine (UPD), Institut Louis-Bachelier (ILB), and four schools of creative arts, the Ecole Nationale Supérieure des Arts Décoratifs (ENSAD), the Ecole Nationale Supérieure des Beaux Arts (ENSBA), the Conservatoire National Supérieur d'Art Dramatique (CNSAD) and the Conservatoire National Supérieur de Musique et de Danse de Paris (CNSMDP).

The target of PSL \star is to create a highly visible Research University, which is capable of rapidly becoming one of the top 20 Universities in the World. To achieve this ambitious target, PSL \star will focus on four key goals:

- 1) To upgrade PSL★ performances in research through ground-breaking projects and a constant enrichment and assessment of topics, methods and processes.
- 2) To empower and promote French assets in research and education and to turn them into resources for innovation.
- 3) To change the way scientific and intellectual elites are trained by stressing the utmost importance of orienting students' mindsets towards innovation and creation.
- 4) To ensure that education and research are in profound synergy with socio-economic needs, and develop links with the business world in all domains, thus turning PSL★ into a motor for economic growth.

PSL★ aims to reach these objectives within the timeframe of the IDEX project and will define precise targets on a yearly and a 4-year horizon. The size of the partnership and above all the clearly defined perimeter of excellence make PSL★ comparable to leading global universities. Its flexible collegiate structure and the efficient decision chain already at work within each partner institution guarantee its reactivity and will enable it to evolve rapidly in the face of new challenges. Its autonomous governance structure is largely open to representatives of the corporate world. A high standard of management with a strategic board, a shared scientific policy and a progressive pooling of resources will ensure the long-term sustainability of the project.

PSL★: A COMPREHENSIVE RESEARCH UNIVERSITY

PSL★ complies with the most stringent international definition of a Research University: high quality research, high ratio of graduate students, leading role for innovation. Together, the institutions of the PRES PSL form a consistent group which demonstrates excellence in all the main academic disciplinary fields. They are perfectly complemented by the Institut Curie (medical and clinical research), Paris-Dauphine University (social sciences, economics, business and management) and ENSAD, ENSBA, CNSMDP and CNSAD (creative and performing art).

 $\mathsf{PSL}\star$ will be unique in France, thanks to the combination of:

- Cutting-edge research in all academic fields (formal, natural, cognitive and social sciences and humanities), with special emphasis on research at the interfaces between disciplines, and the articulation with creative and performing arts.
- Highly competitive processes in order to ensure the selection of the students with the highest potential for research and innovation from a wide variety of academic backgrounds.
- Outstanding performance in education characterized by one of the highest worldwide percentage

of graduate students (over 80%, including 31% in PhD) and the awards and positions obtained by former alumni.

- A unique research and education environment, offering optimal conditions for innovation and creation.
- A clear and unified territorial strategy with a highly visible Parisian campus located in the historical centre of scientific and cultural life and radiating outwards towards the *Grand Paris* (South and West).
- Strong relations with the main socio-economic and cultural actors in Paris, in France and throughout the world.

All the institutions involved in the project PSL \star share a set of common values and notably a specific and distinctive approach to education through research and an emphasis on graduate studies. This common orientation is both a key asset for PSL \star and a guarantee of dynamism since it implies that these institutions and scholars are engaged in a process of constant renewal, of transformation and challenge at all levels. In this, as in many other aspects, PSL \star will be a pioneer in France, a *laboratory* for innovation in research and formation. The size, selectivity and flexibility of PSL \star will ensure the necessary reactivity to thrive at the forefront of global competition.

A CLEARLY DEFINED PERIMETER OF EXCELLENCE

Within PSL*, the perimeter of excellence includes laboratories and programmes which satisfy a strict

Distinguished scholars active on PSL★ campus

- 2 Nobel Prize laureates
- 4 Fields medals laureates
- 4 CNRS gold medals laureates
- More than 30 ERC
- More than 40 fellows of French and foreign academies

set of criteria in order to guarantee their scientific quality. Laboratories rated A+ by the AERES and demonstrating a high publication ratio as well as international distinctions are immediately eligible to the Excellence perimeter. Laboratories rated A with strong research performances are included only if they have both a transformative potential and close relations to a specific research project. Similarly, only training programs with the highest ratings are included within the IDEX perimeter.

Even under such stringent conditions, the excellence of PSL★ in research and education is such that more than 90%

of researchers and students of PSL and Institut Curie will be included in the perimeter, along with 29 % of UPD.

Together, the partners reach a critical mass in all academic disciplinary fields. $PSL \star$ is characterised by a diversity of identities, statutes and finalities, united around a community of values and practices. They are convinced that this is an optimal context for mutual improvement and are sure that the IDEX will rapidly tighten ties and connections between partners, thus insuring a strong synergetic and transforming effect.

The partners' potential in research and education is demonstrated by the 16 Labex and 9 Equipex projects presented by PSL \star institutions (9 Labex are directly carried by PSL institutions and 7 others by RTRA or other national initiatives of whom institutions of PSL \star are charter members). These Labex and Equipex projects cover all academic fields and fuel the ambition of PSL \star to become a world class Research University. They will have a beneficial effect on all partners which are associated in one way or another to PSL \star initiatives, due to the long-standing practice of research dissemination in France (alongside its own Labex, research groups of PSL \star are present in more than 60 Labex carried by other institutions).

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TOWARDS A COLLEGIATE RESEARCH UNIVERSITY

 $PSL \star$ includes several "grandes écoles" and "grands établissements", a university, schools of creative and performing arts and private foundations for research. The institutions of $PSL \star$ are the result of centuries of French exception and excellence, but they are aware that this is not enough for them be recognised on the international scene. $PSL \star$ project is therefore a unique opportunity to capitalise on their strengths and create a coherent structure, which will enable them to gain international visibility.

The chosen structure, the Collegiate Research University, is ideally suited to the objectives. Each of $PSL \star$ institutions will retain its identity and increase its reputation within the IDEX. Their strong identity will thus be an asset in a common venture. The institutions will remain self-governing and autonomous; each with its own property and income, but their synergies will enable them to establish a series of shared research and educative programmes, to pool essential infrastructures and equipment and to project a strong corporate identity out to the world.

Focus on international rankings

- In international rankings, PSL can capitalise on indisputable assets such as international distinctions, alumni performances, staffstudent and undergraduate/graduate ratios and especially an outstanding publication per researcher ratio and unique score in terms of qualitative evaluation.
- This potential for immediate international visibility is specific to PSL since all PSL charter members, have a very high ratio of publications per researcher (Thomson Reuters base). Such homogeneity in quotation rate throughout a PRES is a key condition for a good positioning in international rankings (along with the percentage of graduate students. As a result, and according to our estimation, PSL★ will appear within the first 20 academic institutions on a worldwide level. One has to observe that in these rankings, the total number of students is not relevant. CalTech is thus currently rated number two in the world (THE), despite having only 2 300 students and the average number of students of the first ten institutions is around 15 000.

As a short term objective, measurable within the first four years of the IDEX program, PSL★ members will pool their facilities and equipments, and develop common structures such as new research and education resources (for example the Mesoscopic Biology Institute, the Environment Institute and the planning of a Chemistry Centre, a European thinktank in Economy and Finance). Simultaneously they will promote the use of PSL★, alongside their own individual names. Over a period of 10 years, PSL★ will progressively evolve towards a Collegiate Research University with a number of common projects, whose implementation will be guaranteed by an appropriate institutional structure.

ON THE MOVE

Research

The teams and laboratories of PSL \star already compete with the best institutions in the world. PSL \star is reference institution in major academic disciplinary fields including mathematics, astronomy, archaeology, cognitive sciences or finance. It is also a strongly dynamic group of institutions as demonstrated by the fact that PSL is the PRES with the highest percentage of Labex and Equipex projects per number of researchers in France.

However, research ambition in the framework of the IDEX goes well beyond the Labex projects and aims to reinforce a dynamic research environment. The objective is to increase team dynamics, accelerate dissemination and favour renewal of the research axis by ensuring synergies, reactivity and creating the necessary interfaces and incentive mechanisms for innovative actions (*i.e.* internal call for tenders, scientific committees, and regular international assessments). In this sense, PSL \star is a trigger for creativity and excellence.

Within specific disciplinary fields, PSL★ will reinforce and empower disciplinary research (such as Computer Science and Mathematics, Biology and Physics projects) and increase dynamism in fields such as Humanities and Earth Sciences. The launch of three major interdisciplinary programmes – 1) Environment, Energy and Universe, 2) Life Sciences/Hard Sciences Interfaces & Health; 3) Rationalities and Human Behaviour – will allow knowledge and skills to be pooled around transversal

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topics. It will transform the existing disciplinary fields by enabling methodological transfers between them. These three programmes are expected to establish themselves as key international hubs in the emerging picture of global higher education. Each programme will be supported by a number of research projects, including not only Labex and Equipex but also ANR, ERC and other initiatives already active on campus.

 $PSL \star$ will thus create a comprehensive network of excellence, which will structure research practices throughout the different institutions.

Key research projects

- 16 Labex and 7 Equipex affiliated to PSL★ institutions
- 1 IRT Finance and Croissance Durable
- 2 new disciplinary Institutes: Institut des Hautes Etudes en Informatique Mathématiques, and Paris Institute for Chemical Engineering
- 3 transversal programmes: Environment, Life Sciences/Hard Sciences, and Rationalities and Human Behaviour

Education

The PSL \star educational model is based on the systematic practice of training through research and an emphasis on developing a critical approach to knowledge. It is highly selective but encourages equal opportunities and is open to students from other institutions. As soon as they enter the institutions of PSL, students receive their training in laboratories, libraries and research facilities and are strongly encouraged to become not only experts, but innovators. The unique ratio of researchers per students allows individual tutoring and a flexibility of curricula within disciplinary fields as well as at their interfaces. This pedagogical approach is shared by all PSL \star institutions: from mathematics to management and from the first year of undergraduate studies to the doctorate. It enables PSL \star to train researchers, scholars, managers, engineers, designers and artists, who share a commitment to innovation and are capable of creating new knowledge at the highest level.

The key ambition of PSL \star in education is to take full advantage of these unique characteristics to develop a coordinated educational strategy not only for research and innovation, but also for management and public administration. It will ensure a training of elites based on education through research; it will reward innovation, and allow the acquisition of excellent general skills. PSL \star will thus implement a new type of training for French elites, better adapted to the demands of contemporary societies, which require not only highly skilled experts, but also flexible and innovative minds, a key condition for the future economic growth of the country.

This general ambition will be extended to all disciplinary fields and all levels of training thanks to four key projects:

- The PSL★ Graduate Programme will offer common services for graduate students, including a writing centre, career services, and special courses in foreign languages, academic writing, management and finance, and facilitating campus life (lodging, health, leisure) and work spaces.
- A thorough and demanding Undergraduate cycle, with a focus on general intellectual skills and creativity, based on a principle of major/minor. It will offer the adequate basis for a training geared to innovation at the graduate level.
- Developing Executive Education through research not only for the academic world but also for managers and executives with an emphasis on promoting the interaction between the business world, academic research, high level executives and students.
- An original project of research programme for creative artists will develop interactions between creation and science.

A coherent territorial strategy

The location of the founding institutions of PSL at the heart of Paris is a key asset for the project which will strengthen both its inner coherence and its international visibility. The territorial strategy of PSL \star aims to reinforce a common identity by developing a clearly defined urban campus, closely related to other sites in Southern (Boulevard Jourdan, Montrouge and Meudon) and Western Paris (Porte Dauphine and La Défense). This strategy will enable PSL IDEX to promote a close relationship with both the traditional cultural and intellectual heart of Paris and the modern financial and entrepreneurial centres.

At the heart of the Quartier Latin, PSL \star partners have the ambitious project to create an academic and research campus deeply anchored within the urban fabric. The urban strategy will clearly identify the campus territory, with visible paths of circulation, meeting places and characteristic elements of urban design. It will focus in particular on improving student life and highlight the importance of the research community. Furthermore it will show the influence of academic entities on the surrounding economic and cultural neighbourhood and create a feeling of shared identity. All institutions of PSL \star will have a branch at the heart of the Campus.

The Campus will develop strong ties with 1) the Southern Paris branches (boulevard Jourdan devoted to social sciences, computer science and their interface; Meudon which hosts an important centre for astrophysics and unique observatory facilities; Montrouge, a residential students campus); 2) the Western Paris locations: $PSL \star$ key partner, UPD Economics and business school, with a link with Paris La Défense, financial and entrepreneurial centre.

Beyond the current surface occupied by $PSL \star$ institutions on its core campus, $PSL \star$ will initiate a broad reflection on the organization of research locations. It will campaign for larger research surfaces for the ENSCP and the Institut Curie (with the prospect of moving into the AgroParisTech building) and implement strategic projects in order to create common ventures (as the Institut of Environment in the restructuration of the Jourdan Campus). PSL \star will be the ideal structure to develop a reflection on a real estate strategy adapted to research and education projects.

An intense link with business world and society

 $PSL \star$ institutions already have many connections with both the business world and civil society (research grants, start-ups, joint programmes, cultural events, education). Indeed, for $PSL \star$ institutions, the interaction with society taken as a whole, including its economic, social and cultural aspects, is of strategic importance. Not only because it is today necessary for higher education and research institutions to pay attention to society and its needs, but also because the intellectual, scientific and educational values created by academic entities must contribute to the well-being of society and to economic growth.

Currently, PSL is at the origin of a start-up company quarterly and UPD has set-up several laboratories in cooperation with major private companies. In the framework of the IDEX programme, PSL \star partners will develop a large-scale coordinated strategy and will have an aggressive attitude in the domains of industrial property production and management, and value creation through ventures.

 $PSL \star$ will aim to match its scientific potential with innovation within 10 years, in order to reach worldclass level. It will integrate its technology transfer value chain, from upstream public-and-private collaborative projects to start-up creation (IP licensing, by building on the Fondation Pierre-Gilles de Gennes model). It will replicate successful ventures to new fields and expand FPGG's experience to existing fields by marketing industry-academia contract research towards the business world. The objectives are to stabilise the number of patents in a range of 80 to 100 per year; to reach the objective of 8 start-ups and social ventures created within PSL \star per year; and to increase the value of research private contracts to 3% for the consolidated research perimeter.

PSL★ partners will also strengthen their relations with society and contribute to a better understanding and perception of social needs. This will notably enable an appropriate training of managers and

decision-makers and foster the necessary ethical assessment of scientific progress.

The connection between PSL \star partners and their economical, societal and cultural environment will be a decisive component of the programme. Thus, in the framework of PSL \star , the ambition goes far beyond what institutions already do in terms of innovation and creation of economic value, formation, diffusion and dissemination of knowledge, social opening and fund-raising.

International strategy

All institutions of PSL \star already have a strong international presence thanks to 1) numerous relations between research teams on specific topics; 2) exchange programmes for students; and 3) numerous invited fellowships and professorships. This international network finds its expression in agreements and memorandum of understanding with the most prestigious universities such as Harvard, Oxford, Cambridge, and many more.

Aware of the fact that overall quality is the best asset of an international strategy and that grass-root initiatives constantly fuel international relations, $PSL \star$ considers international relations as an area where the IDEX can have a major impact and will develop a coherent and truly ambitious international strategy. To achieve this objective, $PSL \star$ can capitalise on dynamic international activities, a clear capacity of attraction and numerous research and educative agreements with institutions worldwide.

PSL \star will thus start by creating an Office for International Relations which will coordinate the existing projects and develop major common initiatives. It will enhance ongoing partnerships, extend the educative offer in English, launch specific actions and provide international fellowships to outstanding students and post-doctoral researchers. It will set up a top-level international support services platform and open permanent joint-offices in collaboration with partner universities abroad. To ensure deeper PSL \star integration to the "European Research Area", it will foster systematic application of European recommendations on higher education and research.

Secondly, PSL★ will establish a Centre for Advanced Research, dedicated to the organisation of intensive workshops, working on a yearly basis with scholars and fellows in residence for a semester on a specific topic.

CONCLUSION: PSL ★: FROM ACADEMIC INSTITUTIONS TO A WORLD-CLASS RESEARCH UNIVERSITY

Unlike most institutions of higher education, all the members of PSL \star were created to meet the specific research and educational challenges of their times from 1530 (Collège de France) to 1968 (UPD). They aim to pursue this tradition and move from a national to a global scale. Indeed, PSL \star partners benefit from unique conditions (optimal size, selectivity of students, long heritage of excellence), which allow them to implement a research and educational strategy that has secured widely recognised results. PSL \star institutions have always been incubators both in terms of research and Education but this project offers them the possibility to optimize their potential.

PSL* thus proposes a change of scale; with projects covering all disciplinary fields, all research approaches and all levels of education. This change of scale will also foster the knowledge transfers, the creation of companies and industrial partnerships. PSL* thus embodies a transforming process, with ambitions adapted to the requirements of the 21^{st} century, for minds able to innovate and participate actively in a world in which economic growth will depend first and foremost on the quality of research. In order to implement this ambition, PSL* can rely on its existing excellence and on its commitment to openness and transformation. The "Investissement d'Avenir" is a tremendous opportunity for PSL* partners to empower centuries of French talent and become a recognized world class Research University in constant improvement.

2. STRUCTURE AND CHARACTERIZATION OF THE INITIATIVE OF EXCELLENCE

 $PSL \star$ is larger than the PSL PRES. It is a common venture involving the five institutions of the FCS PSL along with the Institut Curie, the UPD, the ILB and four schools of creative arts (ENSAD, ENSBA, CNSMDP and CNSAD). It is a project based on shared values (formation through research and commitment to graduate studies), clearly identified complementarities, pooled resources and a commitment to a common future.

The PSL Foundation, given its legal existence approved by the government, will be the bearer of the $PSL \star$ programt, and will delegate its governance to a specifically dedicated executive committee which will act independently from the Foundation PSL and will ensure and secure the reviewing of projects and the traceability of funds.

The statutes of the PSL foundation give PSL \star a clearly defined juridical status. The inclusion of additional partners has been carefully thought out and unanimously approved by all members of PSL \star . It ensures that the program fulfils all the requirements of a world-class Research University. PSL \star will thus rapidly acquire international visibility and guarantee an optimal return on investment.

2.1 PRESENTATION OF THE PROJECT LEADER (INCLUDING THE LEGAL STATUS)

PARIS SCIENCES & LETTRES, CORE OF THE PARTNERSHIP

Created on July 8th 2010, Paris Sciences et Lettres (PSL) is a Foundation of Scientific Cooperation, which includes five institutions that have been contributing to the advancement of knowledge for centuries: the Ecole Normale Supérieure (ENS), the Collège de France, the Observatoire de Paris, the École supérieure de Physique et de Chimie industrielles (ESPCI ParisTech) and the École Nationale Supérieure de Chimie de Paris (Chimie ParisTech). The chairman of PSL board is Claude Cohen-Tannoudji, Nobel Prize winner in Physics in 1997.

Since 2008, these five partners have started collaborating on their educative offer, elaborating shared research projects and pooling their documentary and knowledge dissemination services and tools, so as to promote their scientific and cultural heritage. They form a coherent territorial entity, propose a continuum of high level training and research in all academic disciplines, from classical humanities to the most innovative sciences and regroup outstanding students and scholars. They are value-driven towards "training for research" and "innovative research".

2.2 APPLICATION TO THE ACTIONS OF THE PROGRAMME « INVESTISSEMENTS D'AVENIR »

The perimeter of excellence is structured by the sixteen Labex and seven Equipex projects affiliated in an exclusive fashion to $PSL \star$: 11 Labex are directly carried by PSL institutions and 5 others by RTRA or other national initiatives of which institutions of $PSL \star$ are charter members.

	Call for tender	Acronym	name of the coordinator	consortium
1	Equipex	PHOBIOL	Antoine Triller, ENS	ENS, Collège de France, CNRS, INSERM
2	Equipex	PARIS-EN- RESONANCE : RMN 800 MHz WB	Geoffroy Bodenhausen, ENS	ENS, Institut Curie CNRS, Institut Pasteur, IBPC Université Paris V, UPMC
3	Equipex	PLANAQUA	J-F Le Galliard, ENS	ENS, CNRS, UPMC, Université Paris XI, MNHN

9 EQUIPEX are included in the perimeter of excellence, directly carried by PSL★ Institutions

PSL*

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	Call for tender	Acronym	name of the coordinator	consortium
4	Equipex	IPGGM	Patrick Tabeling, ESPCI	ENS, ENSCP, FPGG/ ESPCI, Institut Curie, CNRS
5	Equipex	ULTRABRAIN	Arnaud Tourin, ESPCI	ESPCI, CNRS
6	Equipex	GEOPAST	Katherine Gruel, ENS	ENS, Institut de France, CNRS
7	Equipex	D-FIH	Pierre-Cyrille Hautcœur, IC	ILB, EEP, GIS Quetelet, Pôle de compétitivité Finance innovation
8	Equipex	IMAGEX	Jacques Camonis, IC	Institut Curie
9	Equipex	ICGex	Olivier Delattre, IC	Institut Curie

11 LABEX are included in the perimeter of excellence, directly carried by PSL \star Institutions

	Call for tender	Acronym	name of the coordinator	consortium
1	Labex	WIFI	Mathias Fink, ESPCI	PSL (ESPCI), CNRS, Inserm Universités Paris VI, VII
2	Labex	METACEN	Philippe Marcus, ENSCP	ENSCP, CNRS, CEA, Université Paris Est Créteil
3	Labex	ENS-ICFP	Werner Krauth, ENS	ENS, Collège de France, Observatoire de Paris, CNRS
4	Labex	MemoLife	Antoine Triller, ENS	ENS, Collège de France, ESPCI, CNRS, INSERM
5	Labex	ChemVivo	Ludovic Jullien, ENS	ENS, ENSCP, Collège de France, ESPCI, Institut Curie, IBPC, CNRS, UPMC
6	Labex	IPGGM	Patrick Tabeling, ESPCI	ENS, ENSCP, ESPCI, Institut Curie, CNRS, UPMC
7	Labex	TransferS	Michel Espagne, ENS	ENS, Collège de France, Université Paris IV, Université Paris X
8	Labex	AASG	Daniel Egret, Observatoire de Paris	Observatoire de Paris, CNRS
9	Labex	Risques	Université Paris- Dauphine	Université Paris- Dauphine, Fondation partenariale Paris-Dauphine
10	Labex	IEC	Christian Lorenzi, ENS	ENS, CNRS, INSERM, EHESS, Université Paris V
11	Labex	TRANSIC	Daniel Louvard	Institut Curie

5 PSL★ LABEX Projects (national bearers or RTRA)

	Call for tender	Acronym	name of the coordinator	consortium
1	Labex	ESEP	CNRS (Pierre Drossart)	Observatoire de Paris, CNRS, UPMC, Université Paris VII, Université Versailles Saint Quentin Polytechnique, Université Paris XI, Université d'Orléans
2	Labex	FIRST-TF	SYRTE (Noël Dimarcq), et LNE-SYRTE (Philip Tuckey)	Observatoire de Paris, LNE, CNRS, UPMC
3	Labex	SMP	FSMP	ENS, Fondation de Sciences Mathématiques de Paris Centre (FSMPC), UPMC, Paris 7, CNRS



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4	Labex	L-IPSL	INSU-CNRS	INSU-CNRS, IPSL
5	Labex	OSE	Ecole d'économie de Paris (EEP)	Membres fondateurs de l'EEP dont l'ENS

1 IRT Project carried directly by PSL★ Institutions

Call for tender	Acronym	name of the coordinator	consortium
IRT	Finance et croissance durable	Université Paris Dauphine	Université Paris-Dauphine, ILB

1 Bioinformatic Project carried directly by PSL ★ Institutions

Call for tender	Acronym	name of the coordinator	consortium
Bioinformatique	DYALOG	Denis Thieffry	ENS / IBENS, CNRS, INSERM

2.3 EXCELLENCE PERIMETER, ENVIRONMENT, PROSPECTS AND ADDED VALUE

In the framework of the IDEX call for tenders, PSL has defined its excellence perimeter using selective criteria:

- · Laboratories and programmes rated A+ by the AERES
- Laboratories and programmes rated A by the AERES but contributing to the transversal topics identified by the IDEX programme and having the potential to reach the A+ grade.

This results in a comprehensive and homogeneous perimeter, covering a very large part of the total scope of the institutions.

Contribution of each partner to the perimeter of excellence:

Collège de France	Research - UMR CNRS 7421 – Inserm U1050 Centre Interdisciplinaire de Recherche en Biologie - UMR CNRS 7152 Laboratoire de Physiologie de la Perception et de l'Action - UMR CNRS 7574 Chimie de la Matière Condensée de Paris - UMR CNRS 7130 Laboratoire d'Anthropologie Sociale - UMR CNRS 7192 Proche-Orient, Caucase, Iran : Continuités et Diversités - UMS CNRS 2409 Centre de documentation des Instituts d'Orient Education - 52 chairs in Mathematics, Physics, Life Sciences and Human/Social sciences
Ecole Normale Supérieure – Rue d'Ulm	Research - UMR 8553 Département de mathématiques et applications - UMR 8548 Laboratoire d'Informatique de l'ENS - UMR 8549 Laboratoire de physique théorique de l'ENS - UMR 8551 Laboratoire Pierre Aigrain - UMR 8552 Laboratoire Kastler Brossel - FR 684 Département de Physique de l'ENS - UMR 8550 Laboratoire de physique statistique - UMR 8511 Laboratoire de physique statistique - UMR 8510 Laboratoire de physique statistique - UMR 8112 Laboratoire d'Études du Rayonnement et de la Matière en Astrophysique - Participation à FR 2702 Sciences chimiques de la mesure et de l'analyse de Paris centre - UMR 8197 Institut de biologie de l'ENS - UMR 7203 Laboratoire des Biomolécules* - UMR 8640 Laboratoire Pasteur - UMR 854 Laboratoire de Neurosciences Cognitives - UMR 8554 Laboratoire de Sciences Cognitives et psycholinguistique - UMR 8538 Laboratoire de géologie - UMR 8538 Laboratoire de géologie - UMR 8538 Laboratoire de Recherche en Ecologie expérimentale et prédictive - UMR 7625 Ecologie et Evolution* <

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	 UMR 7618 Biogéochimie et Ecologie des milieux continentaux*
	 Participation à FR 636 l'Institut Pierre-Simon Laplace
	 UMR 8539 Laboratoire de météorologie dynamique
	- UMR 8129 Institut Jean Nicod
	 USR 3308 Centre international de recherche philosophie, lettres, savoirs
	 UMR 8094 Langues, textes, traitements informatiques, Cognition
	 UMR 8546 Archéologies d'Orient et d'Occident
	 UMR 8066 Institut d'Histoire moderne et contemporaine
	 UMR 8547 Pays germaniques : histoire, culture et philosophie
	 UMR 8132 Institut des textes et manuscrits modernes
	 UMR 8097 Centre Maurice Halbwachs
	 UMR 8545 Paris-Jourdan Sciences Economiques
	- UPS 3285 Respublica Literria
	* pour les équipes hébergées à l'ENS
	Education
	Sciences
	 Formation interuniversitaire de Mathématiques Fondamentales et Appliquées
	 Formation interuniversitaire de Physique
	 Formation interuniversitaire de Chimie
	 Formation interuniversitaire de biologie
	– Informatique
	- Géosciences
	- Concepts Fondamentaux de la Physique
	 Master Parisien de Recherche en Informatique
	 Master de chimie
	- Neurosciences
	 Biologie Moléculaire et Cellulaire
	 Ecologie, Biodiversité, Evolution
	 Sciences de la Terre, de l'Environnement et des Planètes
	 Océan, Atmosphère, Climat et Observations spatiales
	 Cogmaster (Sciences cognitives)
	Lettres
	 Master Analyse et politique économiques
	 Master Histoire et philosophie des sciences
	- Master Lettres
	 Master Sciences humaines et sociales sciences du langage
	 Master Sciences de la société
	– Master Histoire
	 Master Sociologie Master Lettres et civilisations
	 Master Antiquité classique textes, méthodes
	 Master Arts du spectacle et audiovisuel
	 Master Etudes cinématographiques et audiovisuelles
	 Master Droit public et droit privé
	 Master droit administration publique
	Research
	UIMR 7045 Laboratoire de physicochimie des surfaces
	- IIMR 7574 Équipe ENSCP du Laboratoire de chimie de la matière condensée de Paris
	 – LIMP 7575 L'aboratoire d'électrochimie, chimie des interfaces et modélisation pour l'énergie
	- UMP 7105 Equipo sciencos analytiquos, biognalytiquos diagnostio et ministurisation
ENSCP	- UNIX 7 195 Equipe sciences analytiques, bioanalytiques diagnostic et miniaturisation,
	 UMR 7223 Laboratorie Charles Frieder UMR 6NDC 9464 UNICERM 4000 Enviro ENCOD de l'Unité de reference le rie chiminue et
	- UNIX CNXS 8151 - U INSERM 1022 Equipe ENSCP de l'Unite de pharmacologie chimique et
	genetique et à imagene
	Education
	- Engineer degree ENSCP
	Research
	- UMR 7083 Gulliver
ESPCI	 UMR 7587 Institut Langevin "Ondes et Images"
	 UMR 7167 laboratoire Matière Molle et Chimie (MMC)
	- UMR 7084 Laboratoire de Chimie Organique
	UMR 7637 Laboratoire de Neurobiologie

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	 UMR 7636 Laboratoire de Physique et Mécanique des Milieux Hétérogènes, UMR 8213 Laboratoire de Physique et d'Étude des Matériaux USR 3149 Laboratoire de Spectrométrie de Masse Biologique et Protéomique UMR 7612 (membre) Laboratoire Sciences Analytiques, Bioanalytiques et Miniaturisation UMR 7612 (membre) Laboratoire de Colloides et Matériaux Divisés Education Engineer degree ESPCI ESPCI Advanced Master in Science and Technology ESPCI shared masters: Sensors measures and instrumentation; Material Science and nano-objects, Material chemistry and physical chemistry, Chemical engineering, Nuclear Chemistry, Molecular Chemistry, Analytical Chemistry, Bio-engineering, Environmental Engineering: water, soils and waste
Observatoire de Paris	Research - UMR 8111 Galaxies, Etoiles, Physique et Instrumentation - UMR 8028 Institut de Mécanique Céleste et de Calcul des Ephémérides - UMR 8112 Laboratoire d'Études du Rayonnement et de la Matière en Astrophysique - UMR 8109 Laboratoire d'Études Spatiales et d'Instrumentation en Astrophysique - UMR 8102 Laboratoire Univers et Théories - UMR 8630 Systèmes de référence Temps-Espace - I'USR 704 Nançay, station de radioastronomie Education - - Master "Astronomie Astrophysique et Ingénierie Spatiale"
Université Paris Dauphine (UPD)	Research - Laboratoire CEREMADE - Laboratoire CEREMADE - Laboratoire de gestion DRM - Laboratoire en science politique et en sociologie IRISSO - Autres contributions en économie LEDa - IRT Finance et Croissance Durable Education - - Licence Gestion - Licence Gestion - Licence Gestion - Master Informatique des organisations et Systèmes d'Information - Master Informatique des organisations et Systèmes d'Information - Master Droit : - Master Conomie de la Modélisation et de la Décision-Math Appliquées - Master Economie de la Santé et Politiques Sociales - Master Economie de la Santé et Politiques Sociales - Master Economie de la Santé et Politiques Sociales - Master Economie de la Société - Master de Dauphine Economie internationale et développement - Master de Dauphine Contrôle de Gestion et Performance - Master Gestion du patrimoine - Master Gestion du patrimoine - Master Geau
Institut Curie	Research - U 830 Institut Curie/INSERM - UMR 3344 Institut Curie/CNRS/UPMC - UMR 218 Institut Curie/CNRS - UMR 3348 Institut Curie/CNRS - U612 Institut Curie/INSERM - UMR 3306 /U 1005 Institut Curie/CNRS/INSERM - UMR 3347 U 1021 Institut Curie/CNRS/INSERM - UMR 144 Institut Curie/CNRS - UMR 3215/U934 Institut Curie/CNRS/INSERM - U 932 Institut Curie/INSERM - U 932 Institut Curie/INSERM - U 759 Institut Curie/INSERM

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	 UMR 168 Institut Curie/CNRS/UPMC 					
	- UMR 176 Institut Curie/CNRS					
	- U 900 Institut Curie/INSERM					
	 Tumor biology department 					
	 Early clinical trials group 					
	Support :					
	 540 Ecole transdisciplinaire « Lettres/Sciences » 					
	= 107 Astronomic at Astronomical Bergard					
	 543 Ecole doctorale de Dauphine 					
	Co-accréditées :					
	 129 Sciences de l'Environnement d'Ile De France 					
	 386 Sciences Mathématiques de Paris centre 					
	- 388 Chimie Physique et chimie analytique de Paris centre					
	 515 Génomique, cellule, développement, microbiologie 					
	 472 Ecole doctorale de l'école pratique des hautes études 					
Ecoles doctorales	 142 Mathématique de la région Paris sud 					
de PSL★	- 465 Ecole doctorale d'économie					
	 109 Sciences de la terre 					
	 158 Cerveau – Cognition – Comportement 					
	– 267 Arts et Media					
	 286 Ecole des Sciences Sociales 					
	Associées					
	 406 Chimie moléculaire de Paris centre 					
	 387 Interdisciplinaire pour le vivant 					
	 389 La physique de la particule à la matière condensée 					
	 397 Physique et chimie des matériaux 					
	 391 Sciences mécaniques, acoustique et électronique et robotique de paris 					
	 - 390 Génie des procédés et technologies avancées 					
Ecole Nationale	Research					
Supérieure des Arts	- EnsadLab (research program post-Master)					
Décoratifs (ENSAD)	Education					
, ,	- Diplôme de l'ENSAD (equivalent of Master)					
Ecole Nationale	Research					
Supérieure des	- New research program (previously called La Seine)					
Beaux-Arts	Education					
(ENSBA)	- Diplôme national supérieur d'arts plastiques (equivalent of Master)					
Conservatoire						
National Supérieur	Research					
de Musique et de	- Centre de recherche et d'édition du Conservatoire (CREC)					
Danse de Paris	Education					
(CNSMDP)	- Dipiome de 2 et 3 cycle superieur (equivalent of Master and post-master)					
Conservatoire						
National Supérieur	Education					
d'Art Dramatique	- Dinlôme national supérieur professionnel du comédien					
(CNSAD)						
(0110/12)						

3. PROJECT AND PROSPECTS

PSL★ has defined a clear ambition to become one of the leading Research Universities. To fulfil this ambition, it can capitalise on many complementary assets, including its tradition of attracting excellent students through demanding selection procedures, its research performance and strategy towards innovation, as well as its location in the heart of Paris. With around 8000 of the best students in France and over 60 world class laboratories, PSL★ will be similar in size and research potential to leading world universities such as Princeton, MIT or Stanford. This combination of agility, powerful research and outstanding teaching, make it the only French institution truly capable of meeting the

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forthcoming challenges of the global market for education and research, to which it is far better adapted than other, larger and less flexible institutions. $PSL \star$ is thus ideally placed to guarantee a rapid return on investment and ensure a successful adaptation, implementation, and transformation of global processes to the French educational and academic space.

The partners of PSL \star are committed to this ambition and have endorsed a set of common values, such as education through research and a commitment to maintaining and developing the existing focus on graduate studies. Similarly, in order for this ambition to become a reality, the partners of PSL \star have established a clear and well structured strategy based on an awareness of the importance of constantly improving their achievements through incentives and a commitment to ongoing assessment and evaluations.

To achieve its goals, $PSL \star$ will promote transdisciplinary research projects and common educational proposals as well as thematic projects of excellence in research, formation and valorisation. The quality of these proposals will guarantee immediate international visibility, both for $PSL \star$ and for French research and education in general.

3.1 RESEARCH

PSL★ is today one of the leading research centres in Europe. It encompasses the entire scope of academic disciplines (hard sciences, medical research, engineering, humanities, social sciences, management sciences, finance and creative arts) and in each of them includes several leading and pioneering research groups. Likewise, PSL★ can build on a strong and long-standing tradition of innovative interfacing between different disciplinary fields.

 $\mathsf{PSL} \star$ can capitalize on the research potential of almost 4000 researchers and 3000 rigorously

$\mathsf{PSL} \bigstar$ and the national research strategy (SNRI)

Emphasis on the three key priorities of the national strategy (life sciences, environment, information technology):

- Emphasis on fundamental research (e.g. physics, mathematics) and in fields where France has a strong leadership (e.g. space sciences)
- Large place given to human and social sciences
- Emphasis on interdisciplinarity
- Strong visibility in the European research area, with more than 30 ERC grants
- Aggressive attitude towards valorization

selected doctoral students, as well as 850 post doctoral fellows (most of whom are foreign). This significant research capacity enables $PSL \star$ to play a leading role in fundamental research as testified by more than 3500 publication listed for 2009 alone in ISI web of science and the more than 30 ERC (both starting and advanced grants) currently active within the perimeter of excellence. PSL \star benefits from a strong support from the main French research institutes, CNRS, INSERM, and INRIA, which all consider PSL \star as a strategic partner.

 $PSL \star$ benefits from a unique research ecosystem comparable to the best Anglo-Saxon Research Universities. It is characterized by a high density of researchers, a practice of tight relations and continuous exchanges between disciplines, and an active and challenging scientific working culture where research is constantly assessed and compared, favouring continuous improvement and innovation. Practices such as the tradition of 10-year turnovers in the Mathematics Department of the ENS ensure dynamism and renewal within the structures of PSL \star and facilitate the global circulation of researchers and dissemination and penetration of ideas. This ensures a strong feedback effect of PSL \star research. Additionally, this research ecosystem can capitalize on common platforms and an existing established and recognized scientific culture, with traditions such as the existence of international scientific committees and review boards in each discipline. This constellation of factors ensures that PSL \star is the adequate perimeter for fertilization.

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The coordinated research strategy adopted by PSL★ aims at further strengthening its research profile and improving the existing research ecosystem by relying on the following three basic pillars:

- Disciplinary Research Centres The existing research excellence of PSL * will be channelled by maintaining and further developing leading Research Centres in all major disciplinary fields, notably by capitalising on the existing infrastructure of Equipex and Labex projects (as exemplified by its 16 Labex projects or beacons such as the Pierre-Gilles de Gennes Foundation) and complementing them with specific actions, coupled with a dynamic system of incentives to ensure adaptability.
- Transdisciplinary Axes of Research The tradition of research interdisciplinarity within PSL* will be developed in the form of transdisciplinary research axes around three structuring transversal research programmes, namely (1) Environment, Energy and Universe, (2) Life Sciences/Hard Sciences Interface and Health, and finally (3) Rationalities and Human Behaviour.
- Implementation, best practices and technology transfer To support research both within and across disciplinary lines, PSL * will adopt a strong set of instruments to facilitate research workflows. These include an emphasis of technology transfers from research to entrepreneurial innovation, a powerful strategy of institutionalised knowledge management, an emphasis on the valorisation and further development of international ties and exchanges, and a commitment to ongoing monitoring and evaluation.

PSL★ RESEARCH: A RESEARCH UNIVERSITY FROM FUNDAMENTAL THEORY TO ADVANCED ENGINEERING

Based on the research capacities mentioned above, $PSL \star$ partners have already established a number of innovative common actions such as 16 Labex projects (out of which 10 are carried by $PSL \star$ institutions) or the Pierre-Gilles de Gennes Foundation:

Physics and Astrophysics • 15 UMR, 1 FR • International impact • 3 LABEX/ 1 EQUIPEX demands	Chemistry 13 UMR International impact LABEX/ 1 EQUIPEX demands	Biology • 7 UMR • International impact • 2 LABEX/ 2 EQUIPEX demands	Earth Sciences • 2 UMR, 1 FR • International impact • 1 EQUIPEX demand	Mathematics and Computer Sciences • 4 UMR • International impact	Cognitive Sciences • 5 UMR • International impact	Economics, Finance and Management • 12 UMR • International impact • 1 LABEX/ 2 EQUIPEX demands	Human and Social Sciences • 2 UMR • International impact • 1 LABEX demand				
Environment, energy and universe											
Hard sciences / Life Sciences & Health											
Rationalities and Human Behaviour											
		Me	thodologies and Kn	owledge Manageme	ent						

The Excellence Initiative will trigger a common ambition at the disciplinary level and empower new value-adding projects which will have a strong transforming impact. In the course of these projects,

A key aspect of the IDEX support to the projects will consists in international research chairs. These chairs will for 5 years and renewable. They will include the scientist's salary and seed funds; a "package" for optimal attractiveness will be proposed, if needed. There will be three main types of chairs: the distinguished chair, the senior chair and the junior chair.

The pioneering research conducted in disciplines will thus necessarily contribute to the enrichment and development of the defined transversal programmes of the Initiative:



A WORLD CLASS CENTRE IN MATHEMATICS AND COMPUTER SCIENCES

Excellence in mathematics and computer science is of strategic importance. PSL scientists in these two domains come from world-class laboratories and institutions, widely known on the international

scene. They include chairs at the Collège de France (chairs), the Department of Mathematics & Applications (DMA) and the Department of Computer Science (DI) at the ENS, the "Astronomie et Systèmes Dynamiques" group (ASD) at the Observatoire de Paris, and the CEREMADE (Centre de REcherche en Mathématiques de la DEcision) and LAMSADE (Laboratoire d'Analyse et Modélisation de Systèmes pour l'Aide à la DEcision) at Paris-Dauphine University.

Existing research profile

Current research at DMA is organized around

PSL★ mathematicians and computer scientists distinctions

- 4 Fields medals
- 4 members of the French Academy of Sciences
- 1 member of the French academy of engineering
- 1 Fellow of the Royal Society
- 1 gold medal and 3 silver medals from CNRS
- 6 grand prizes from the Academy of Sciences

ENS has educated the best French mathematicians for decades, including all the French Fields medalists

three broad themes in mathematics: "Algebra and Geometry", "Partial Differential Equations", and "Probability and Statistics". The constant renewal of research themes at DMA is facilitated by the "tenyear rule" (no one can stay for more than 10 years at DMA), research areas are thus constantly

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updated to keep up with the latest trends. At the Collège de France, the four chairs in mathematics are held by the most famous French mathematicians and concern fields similar to those of DMA. Research at CEREMADE is oriented towards applications and interactions with other sciences: evolution equations (in cooperation with DMA), quantum systems, economics and finance, risk, medical and biological imaging (in cooperation with the Biology Department at ENS).

Research at DI can be characterized as mathematical computer science ("Informatique Mathématique", or IM), with the dual goals of providing a mathematical understanding of fundamental computer science issues and using the insights gained by this analysis in better algorithms and systems. It is conducted by the nine teams of the LIENS ("Laboratoire d'Informatique de l'ENS", a joint ENS/CNRS/INRIA laboratory), and concentrates on four broad areas of IM: theory of computation, theory of programming, IM models of biological systems, and IM models of machine perception and inference.

The DMA and DI of ENS, as well as the CEREMADE and the Collège de France, are part of the Labex project proposed by the Foundation of Mathematical Sciences of Paris.

Structuring mathematics and informatics research within PSL *****: the "Institut des Hautes Etudes en Informatique Mathématique" (IHEIM):

Hosted by the new ENS/INRIA building to be built in the Jourdan campus of ENS, the IHEIM will include the DI/LIENS teams as well as internationally renowned researchers within PSL*. A showcase for excellence in IM, it will also host the recipients of the research chairs in mathematical informatics. It will thus become an integral hub of the mathematics and computer science research centre within PSL*.

Mathematics and computer science projects within the framework of PSL \star

Increased interdisciplinary collaborations between outstanding teams

Mathematics and computer science research within $PSL \star$ is a classic case where research has been assuming a more and more interdisciplinary character over the last years. The decision to aggregate both disciplines within a single Centre will considerably extend the interactions of mathematics and computer science with one another and with applied mathematics, as well as with the humanities and the hard sciences.

Within PSL \star , we therefore intend to focus on new, ambitious projects in fundamental areas of mathematics and computer science which will add to the core methodological strengths of PSL \star (e.g., in fields such as algorithmics), while reinforcing the interdisciplinary aspects of work in fields such as natural language processing (in partnership with the Humanities) and image processing, machine learning and computer vision where a partnership between pure mathematics at DMA, applied mathematics at the CEREMADE, and mathematical computer science at the DI already exists as part of VideoWorld, a ERC project. Some projects have the potential to result in major industrial applications such as those related to the interface of computer science, mathematics, and the study of the physical world (such as theoretical research aimed at a mathematical understanding of the architecture of the human brain, with direct applications in medical imaging on the one side and special effects in the entertainment industry on the other).

PSL★ will strengthen this interface between computer science and other disciplines and provide it with a solid institutional basis by creating a Research Centre in cooperation with the Institute for Cognitive Sciences. This Centre will provide expertise for the further development of the knowledge management infrastructure for PSL★ as a whole (see insert at the end of the chapter on Research). It will provide key inputs on the theoretical aspects of information modelling for knowledge management, a topic which extends to all disciplinary fields and as already resulted in close collaboration with the Social Sciences and Humanities during the preparation of the EQUIPEX GEOPAST.

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A refined education strategy, broader cooperation and extended openings for prospective students

Mathematics and computer science are already an example of collaborative teaching within PSL★. DMA and DI are involved in collaborative teaching with other institutions, notably through the MS programme EDP-MAD with Dauphine in mathematics, the Paris MS programme in computer science (MPRI), and the MS programme in applied mathematics hosted by ENS Cachan (MVA).

In mathematics, the position of PSL \star is so strong that it already attracts almost all the top students in mathematics in France and many top foreign students. Our ambition is to build upon and extend this international recognition to attract more top-level international students (another 15-20 per year) and to encourage them to stay on in France through attractive doctoral and post-doctoral programmes.

In computer sciences, an increase in the number of PhD students is planned. The strategy here calls for recruiting top students at the undergraduate level (from 8 to 20) and retaining them for PhDs and careers in research, an approach which $PSL \star$ is ideally equipped to handle, building upon established practice at institutions such as the ENS.

PSL★ also has a strong programme of chairs and visiting fellowships. This builds upon the existing yearly rotating chair sponsored by INRIA which has been created at the College de France; it attracts world class scientists and complements teaching delivered in other PSL★ institutions. The DMA is another such example; because of its central location in the French mathematical landscape, it has a strong tradition of receiving distinguished international visitors. The DI has likewise managed to attract and retain internationally renowned researchers from abroad including famous researchers on industrial chairs: A. Shamir (Turing prize) on a France Telecom chair, and A. Zisserman (Fellow of the Royal Society) on an EADS chair. Building upon this practice, the PSL★ proposal calls for the establishment of further chairs, and the continuing support of CNRS and INRIA, which will provide the means to continue and reinforce this strategy. Like prestigious institutions such as CalTech, Harvard, and Princeton, the ambition of PSL★ is to conduct world-class research in clearly defined research areas. Our international strategy and the collaborations afforded by the IDEX will be key in achieving this objective.

Detailed IDEX actions:

- Two international senior research chairs packages to attract prominent highly qualified scientists,
- One research Initiative on « Assessment of quantitative methodologies in Finance" aiming to contribute to a better scientific understanding of the systemic changes, risks, needs and challenges, induced by the massive development of quantitative modeling in Finance.
- Post-docs: In order to be able to attract top young researchers, the IDEX will fund two two-year positions per year in mathematics;
- Higher education in Mathematics : 15 three-year fellowships for outstanding foreign students preparing the ENS diploma
- Higher education in Computer Sciences: We aim at selecting every year twelve top-level French and foreign students interested in obtaining the diploma of ENS. We envisage a four-year programme, consistent with the duration of studies at ENS.

Key IDEX projects:

- Two international senior research chairs to attract prominent highly qualified scientists,
- Two post-doctoral positions to attract top young researchers,;

- 15 three-year fellowships in Mathematics for outstanding foreign students preparing the ENS diploma
- 12 four-year fellowships in Computer Sciences for top-level French and foreign students interested in obtaining the diploma of ENS.

Funding requested: 6 596 KEUR for four years and 16 490 KEUR for ten years

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PHYSICS AND ASTROPHYSICS, FROM FUNDAMENTAL THEORY TO ADVANCED ENGINEERING

PSL★ institutions are leaders at the highest international level in several pioneering research areas in contemporary physics. The teams of the ENS, ENSCP, ESPCI, Observatoire and Collège de France have a century-long track record of excellence and a rich tradition of leadership on the national and international scenes (PSL★ institutions have trained or employed all 6 of the French laureates of the Nobel Prize in Physics since 1960).

The ambition of $PSL \star$ for physics is (1) to maintain its leadership in basic science; (2) to explore ground-breaking new types of research; (3) to improve valorisation with the creation of innovative materials and devices and the creation of high-technology companies.

Current research

Tight networks of outstanding research groups are distributed among PSL institutions:

- <u>Research in quantum mechanics</u> ranges from atomic physics to applications in metrology using space-borne experiments. Applied work such as space-borne atomic clocks to test general relativity at an unprecedented precision builds on Nobel-winning research also carried out in the perimeter of PSL★. Test in the drift of fundamental constants with time combines lab experiments and astrophysics observations.
- <u>Theoretical physics research</u> encompasses pioneering insights in cosmology at the Collège de France, breakthroughs in statistical physics at ENS and ESPCI, including the physics of glasses, with important applications. Much of this work forms the backbone of modern fundamental physics.
- <u>Soft condensed-matter research</u>, including the physics of polymers which was spearheaded at PSL, stretches the entire spectrum from basic theory to industrial applications involving polymers, colloids and biophysics.
- <u>Hard condensed-matter physics</u> ranges from nanophysics and world-leading mesoscopic research, to studies of quantum phase transitions, electronic properties of single nano-objects, strongly correlated systems.
- Magneto-<u>hydrodynamics and plasma physics, nonlinear physics</u>: research groups at ESPCI, ENS, and Observatoire de Paris are pioneers in that field, with world-leading expertise in experiment, astrophysical observation, computational-physics and theory.
- <u>All domains of astrophysics</u> are present at the highest level at Observatoire de Paris which represents about one third of the national astronomical community acting in the fields of planetology, stellar physics and exoplanets, galactic and extragalactic physics and the physics of interstellar medium.

These research axes cover the forefront of physical theory, conduct pioneering work in instrumentation and in experiments, and share several world-renowned platforms for the fabrication of devices and for the exchange of information.

Projects in the framework of the IDEX

Research in physics finds its primary expression in four Labex proposals. The ambition of $PSL \star$ in physics is to become the connecting hub catalysing these four major and transforming projects.

- <u>ENS-ICFP</u> is a project carried by the ENS Physics department, aiming at positioning itself durably as a world leading centre of research and training in fundamental physics. The actions will include the creation of an ENS Junior research chair programme, an ENS master/graduate school of Physics, and a dedicated technology transfer project.
- <u>The Institut Langevin WIFI</u> aspires to become the world reference in the field of wave physics and imaging, by combining in a multidisciplinary approach high-level fundamental research, applied