Scientific
report

LABEX

ESEP

Exploration Spatiale des Environnements Planétaires

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Coordinating laboratory : LESIA (http://lesia.obspm.fr/)

Coordinating Institution : Observatoire de Paris (http://www.obspm.fr/)

Tutorship Institute : IDEX Paris-Sciences et Lettres-Research University (http://www.psl.fr)

1.ETAT D'AVANCEMENT DU PROJET / PROGRESS OF THE PROJECT

1.1 Governance (10% budget – 40k€ per year in average)

ESEP personnel: administrator, paid by Paris Observatory

The Laboratoire d'Excellence ESEP (Exploration Spatiale des Environnements Planétaires) has been selected in May 2011. Kick off meetings in July and September 2011 have established the guidelines of the governance, and proposed to the tutorship for starting activities at the end of 2011. A network of 9 laboratories engaged in space exploration (Paris Observatory : LESIA, IMCCE, LERMA, USN; Université Pierre et Marie Curie : LMD, IAP; Université Paris-Est-Créteil: LISA; Université Versailles-Saint-Quentin : LATMOS; Université d'Orléans : LPC2E),under the coordination of LESIA (laboratory) and Observatoire de Paris (tutorship institute). The IDEX Paris-Sciences et Lettres-Research University is the holder institute for ESEP. The governance, fully supported by the tutorship institutions, consists classically in:

* An **executive committee**, composed of the directors (or their representatives) of the nine laboratories constituting the labex; the committee elects the director, under approval of the institutional committee. The task of the executive committee is to prepare the actions proposed by the scientific committee, to report to the tutorship committee and propose new actions.

* A **bureau**, composed of the director of ESEP, the administrator, and the system engineer is in charge of the current activities: it executes the decisions discussed in the executive committees, and place the resources allocated by the science committee. It reports before all the labex committees.

* A **science committee** is composed of 12 members (6 from the ESEP laboratories, 6 external members). It is in charge of preparing the announcement and proposals, selecting the proposals after review (doctoral, post-doctoral and ingeneers contracts), reviewing the reports from the executive committee, and more generally defining the scientific strategy in the context of space exploration, following the general science scheme of ESEP activities.

* A **trusteeship committee** is composed of representatives of all the presidents of the establishments governing the ESEP laboratories, and imoprtant partners: Observatoire de Paris, Universities Pierre et Marie Curie, Paris-Est-Créteil, Orléans, Versailles Saint Quentin, CNRS, CNES, PSL and ANR. It validates the strategy of the science committees, reviews yearly the actions of the bureau and executive committee, and discuss of general orientations, external contracts or international collaborations engaged in ESEP. It validates the composition of the committees and the nomination of the director of ESEP

In order to present ESEP in all the teams of the participating laboratories, each director is responsible to discuss in his laboratory council the activities of ESEP, and validates them with the institutional structures (usually the "Unités Mixtes de Recherche", i.e. Joint Research Units, associating universities and CNRS).

A balance has been established since the beginning between ESEP and laboratory projects, to avoid overlapping or redundancies in actions. A synergy between laboratory and ESEP activities (mostly devoted to networking and transverse support) has been established, and is discussed within the executive committee.

The table shows the list of meetings of each committee since the beginning, with a total of 22 meetings. Two kick-off meetings in July and September 2011, have been followed by regular meetings

Committee	Executive	Science	Institution
2011	16-dec		
2012	11-jun; 3-oct	10-May ; 5-Oct	22-nov
2013	5-feb; 30-jun; 1-oct	25-Mar ; 4- Nov	27-nov
2014	27-jan; 8-apr; 30-jun; 10-oct	26-Mar; 18-Jun; 24-Nov	4-Dec
2015	20-janv	10-Apr	

Despite a relatively complex structure due to the number of actors within ESEP, there has been a good coordination of work between the committees, and no conflict appeared to define orientations of the activities.

1.2 Recherche/Research (budget: 55% 220k€ in average per year)

ESEP personnel: System Engineer (Ingénieur d'Etudes) + consulting (ESA-retired ingineer)

ESEP research activities cover three domains: exoplanets, planetary exploration and space weathering. By construction, the main objectives of ESEP are for instrumental research, but this domain has been defined in a broad sense, including preparatory studies (to define new science objectives for future missions), as well as processing data from existing missions (to define the limitations in current instrumentation). This scientific line has been decided in the science committee and applied in the selection of proposals since 2012. The list of 9 thesis, 3 post-doc and 2 CDD is given in the report as separated file. The selection process ensures the excellence of the recruitments comes in two stages :

The research proposals are selected by the scientific committee, in charge of verifying the quality of the proposal, the adequacy to ESEP objectives, and a balance on a pluriannual basis between the different thematics. A pressure factor between 2 and 3 has been observed (reminding that the proposal are limited to the ESEP laboratories only, which have themselves been included in ESEP for their recognized excellence in their area).

ESEP has decided not to open proposal for chairs of excellence or invited professors: it has been considered that enough other opportunities exist already from regional or national institutional calls. The highest demand from ESEP laboratories is in operational workforce for the projects more than for opening new ways of research through senior recruitment. This choice has been fully and explicitly validated by the science committee.

A census of Research and Development between the nine laboratories of ESEP (more specifically between the 4 main space laboratories LESIA, LATMOS, LPC2E, LISA) has been established by ESEP system ingeneer : this has been an important step to identify the line of actions for ESEP efforts. Identifying the RD activities was not as straightforward as it could seem, because of the large area covered by the many laboratories of ESEP, and the dissemination of some activities between various teams. Three main technical domains have been identified:

* In situ measurements : development for future miniaturized mass spectrometers, microcaptors
* Plateforms and associated technologies (On Board Data Handling, ground segment, cubesats)
* Remote sensing instrumentation : radioastronomy, coherent optics, UV polarimetry, etc.

A special mention has to be made for nanosatellites activities: it has been supported since 2012 by ESEP (project OGMS/SA from LISA). The growing interest in laboratories and institution for future activities in this domain has been anticipated by ESEP by proposing to create the Campus Spatial Etudiant of PSL, CERES. Starting activities in 2014, a dedicated center will be built in Paris Observatory (Meudon site) in 2015 to host these nanosatellite activities.

The research activities of ESEP have been presented during 4 workshops (one day each):

Institut d'Astrophysique de Paris, 26 March 2013 : general presentation of ESEP

Université Paris-Diderot, 7 novembre 2013 : Astrochemistry

Université d'Orléans : 27 May 2014 : Space Weatherings, asteroids and meteors

Université Pierre et Marie Curie : 13 décembre 2014 : Nanosatellites
These one-day meetings allow the ESEP community to learn about various activities within ESEP, to enlarge the vision of PhD students of ESEP to other domains, and for the ESEP executives to identify new directions of research from recent work in the laboratories.

1.3 Formation/Training (budget 24% - 100k€ per year in average)

ESEP personnel : software engineer in charge of e-learning programming (Ingénieur d'études)
E-learning : SESP (Sciences pour les Exoplanètes et les Systèmes Planétaires). The human resources have been obtained partly directly from ESEP budget, partly from contributions of the ESEP laboratories. In particular the PhD system incites PhD students to participate to teaching activities, and ESEP has obtained the validation of its project for these activities from Ecole Doctorale. The opening of SESP is expected in September 2015 and it is envisaged to include SESP in MOOC activities in the future.
* Relations with the Master OSAE (Outils et Systèmes de l'Astronomie et de l'Espace). This master, hosted by Paris Observatory, but with participating institutions from Paris area is devoted to instrumentation and trains engineers students through courses by teachers from space agencies, space industry or university. ESEP is associated with OSAE to develop the CERES student space campus, for promoting and studying nanosatellites. A call for ideas has been proposed since 2014 (second call announced in March 2015), with a selection of ideas by the ESEP science committee and a support to engage phase A studies with student projects of several universities.
* Master "Space and Applications" of the University of Science and Technology of Hanoi (Vietnam) : this master is supported in collaboration with Paris Observatory, Univeristy Paris-Diderot and several other partners in France to start an engineering master in Vietnam for space applications. ESEP supports this collaboration through a budget for teachers travelling to Vietnam, and to host master student projects in the future to develop concepts in particular for nanosatellites technology.
* The ESEP system ingeneer is involved in teaching activities of the ITI module 'space engineering of PSL.

1.4 Valorisation/Result exploitation

Relations with industrial partners are numerous, in particular space industrials
* Airbus Defense Industry, participating to Master OSAE and solicited for the support of CERES campus
* Instruments in partnership with industrial contracts : Orbitrap
* Instrumental concepts for nanosatellites : micro propulsion (GEMAC laboratory),
* GPU technology for on board processing (NVIDIA)
Nevertheless, no patent activity can be anticipated in the main domain of ESEP, which is positioned mostly in the integration of new technology, more than the development of new systems .

1.5 Outreach activities (budget 14% - 55k€ per year in average)

ESEP personnel : scientific mediation fellow (Ingénieur d'Etudes)
Science and outreach activities have been developed with support to exhibitions with parners inside the perimeter of ESEP institutions (e.g. Astronomy Exhibition by Paris Observatory in 2014), support of workshops with outreach dimension.
A web site is developed (http://www.esep.pro) to show off all ESEP activities.
In 2015 a large exhibition on comets and Rosetta results is in preparation, for an opening on June 27 in Le Bourget (Musée de l'Air et de l'Espace) : this will be the largest achievement of ESEP in terms of outreach. ESEP is managing the organization and preparation of the exhibition, with partnerships from ESA, CNES and ESEP institutions.
Finally, it must be noticed that ESA has appointed the ESEP science mediation engineer in its Rosetta communication team (Roscom) for the outreach activities related to Rosetta.

2 / Impact de la labellisation et du financement associé / Label and associated funding impact

A) Description des réalisations scientifiques/Scientific achievement description

The positioning of Research activities of ESEP has to be considered within the PSL-Research University strategy, ESEP being financed through the Research budget of PSL. ESEP is entirely devoted to space activities and is therefore the major actor of Space Research for PSL. It must be reminded here that the French Government "Stratégie Nationale de la Recherche et de l'Innovation" (SNRI) has placed Space exploration and instrumentation among the main axes of its prospective.

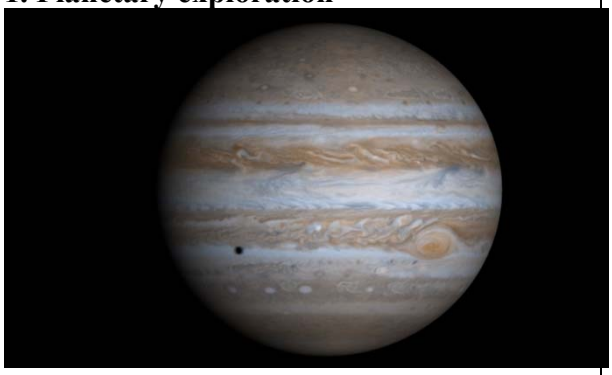
Nevertheless, the positioning of ESEP in Paris area research infrastructure is not straightforward, as several laboratories are linked to other IDEX (Sorbonne University for LATMOS, Paris-Est for LISA, etc.)– some laboratories, like its coordinating laboratory LESIA being themselves under trusteehip of institutions from several IDEX/COMUE. Instead of deploring the complexity of the ESEP position in the landscape of research in Paris area, it has been to be taken as an advantage for the mutual relations between IDEX/COMUE to initiate some transverse activities. Space activity which are largely national and international activities, cannot be bounded within the moats of a particular institution, but needs transversal projects. ESEP, with the help of PSL and thanks to its particular positioning, can become the catalyzer of future projects, through its initiatives.

ESEP is by essence a networking structure, and the competences of laboratories devoted to instrumentation, associated with teams specialized in modelization and theory, covers the full area of space exploration.

One of the main achievements of ESEP after three years of full range activities is in the support to instrumental PhD thesis. It must be reminded that instrumental PhD are difficult to attract from the science community, because it falls between engineers and academic studies, with the dichotomy in the French system making it difficult for engineers to spend three years in a PhD, and to students from astronomy masters to specialize in instrumentation. The impulse from the annual announcement of opportunity by ESEP is therefore particularly welcome in this domain. It not only adds another source of budget for research activities in the laboratories, but it redirects specific orientation towards technology concepts, in partnership with CNES in particular, which opens PhD position only for co-funding.
From the beginning of ESEP activities, a partnership has been engaged with the "Ecoles Doctorales" of the domain, in particular the "Ecole Doctorale d'Astronomie et d'Astrophysique" (ED127) which is a thematic school in Paris area involving transversally most of the Universities – a dialog has also been established with other structures for Orléans and Paris-Est who are not associated with the previous one.
The director of the ED127 is member of the executive committee and can coordinate the doctoral and research activities within ESEP. ESEP has received good feedback both from ED127 and from CNES for his actions in PhD support. In particular, ESEP is recognized as an interlocutor with the CNES selection committee of PhD thesis, to coordinate the complex selection procedure of projects/students.

The three thematics of ESEP:

1. Planetary exploration

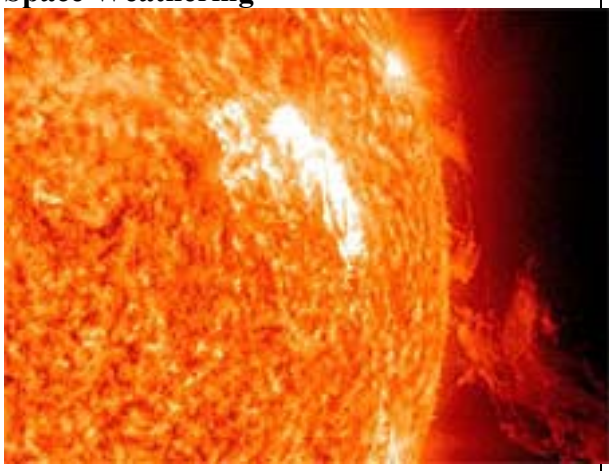


Three thesis are supported by ESEP in the field of planetary exploration, for data interpretation of previous mission or instrumental preparation for future mission (JUICE in particular for Jupiter exploration by ESA in 2030.

Exoplanets

Exoplanet studies are a rapidly evolving domain; ESEP supports one thesis and one post-doc for science investigations with ground based instrumentation in exoplanets (SPHERE on VLT and radiotele

Space Weathering



Support of PhD and engineers have been provided by ESEP for instrumentation on radiotelescopes and study of Space Weathering.

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To begin the instrumental research activities of ESEP, a census of R&D activities has been obtained and a summary is in the table below:

	Retour Resp.Tech.	Nb. Actions	Remarques
IAP	-	0	
IMCCE	11/10	3	Segments sol (OV) et vol (OBDH)
LATMOS	25/07	13 (+2?)	dont 1 ac°LISA, 1 ac°LPC2E, dont ***Postdoc ESEP***
LERMA	14/10	1	***Thèse ESEP***
LESIA	17/09	8	
LISA	26/09	7	dont 1 ac°LPC2E, 1 ac°LATMOS dont ***Thèse ESEP***
LMD	20/09	0	
LPC2E	25/09	9 (+...)	dont 1 ac°LISA, 1 ac°LATMOS dont ***CDD ESEP*** (+ac° prospectives)
USN	27/09	1	(contribution à 1 ac° prospective)

This table has been used to guide the repartition of resources among the line of force of ESEP laboratories by the Science Committee.

To facilitate the networking activities of ESEP, regular day-workshop have been organized to present internally to the laboratories of the labex the current activities in different domains, and to identify new domain of activities, possibly expanding in the future for new activities. These rendez-vous are important both for reporting the current activity and prepare the future developments within ESEP.

Four workshops have been organized between 2012 and 2015. These rendez-vous are highly beneficial to the ESEP community, to cement the research activities between different teams , especially the new students and post-docs who are systematically invited to present their results.

1st workshop (Paris, IAP, 2013 March 26)

During this workshop, the general activities of ESEP were presented to the participants from all the involved laboratories: Space weather, exoplanets and planetary exploration. The main goals of ESEP were discussed, as well as some organization procedures. This meeting can be considered as a first overview meeting for ESEP Science, after one year of activity

The teaching activities were also reviewed, with the involvement in the starting of the master with USTH and the e-learning plan of development.

2d workshop (Paris-Diderot, 2013, Nov 7) : astrochemistry

This workshop was intentionally organized in the Paris-Diderot University. Despite not a trusteeship university, Paris-Diderot is supporting the labex Univearths which shares seveal common objectives with ESEP. Moreover, both LISA and LESIA laboratories have Paris-Diderot as co-trusteeship institution and it was time to establish some links between ESEP activities and Univearths. Both labex are involved in the Master for Space Science of the University of Science and Technology of Hanoi, and share also some common objectives in this international collaboration.

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4th workshop (10 décembre 2014) : Nanosatellites

This workshop was the opportunity to demonstrate the strong relationships between ESEP, its tutorship institution PSL and the Université Pierre et Marie Curie, trusteeship and co-tutorship institution of several ESEP laboratories (LESIA, LERMA, IMCCE, IAP, LATMOS, LMD). Introduced by vice-presidents of PSL and UPMC, a common strategy in the forward looking development of nanosatellites projects with space campus of Sorbonne University and PSL were discussed, on concrete projects.

3d workshop (Orléans, 2014, May 27) : Space weathering : solar activity, geocrossing asteroids and meteorites

Space Situation Awareness is a central theme of ESEP activities, with Space Weathering and asteroidal studies. The workshop in Orléans was the opportunity to strengthen the relations with Orléans University (LPC2E) and the USN (Nançay radioastronomy service of Paris Observatory).

Most of the actions within ESEP are joint actions with laboratories and their universities. The true benefit of the LABEX is therefore in a facilitation effect, and an impulse for the projects. Even if the recognition of this effort is not directly translated into indicators like publication list or selection of instruments on space mission (which is usually a decade long effort), the effects of ESEP are already addressed and supported by

- The Ecole Doctorale acknowledge the benefit of ESEP

- the laboratories for the support to technology PhD thesis

- the trusteeship institutes for which ESEP enhance the visibility in the space sector of activity

- the collaboration with CNES : it must be mentioned that ESEP was for itself directly involved in the preparation of the "colloque de prospective du CNES" in La Rochelle in 2014, to present its activities during preparatory meetings

Regional collaboration :
ESEP has been formally associated in a proposal to "Region Ile de France" for constructing a ground segment for nanosatellites (antenna, ground support and project support) with laboratories AIM (CEA, tutored by Paris-Saclay IDEX) and LATMOS (ESEP/PSL and Paris Saclay)

International collaborations
* A convention with the Taiwan University NCKU has been signed by Paris Observatory to support the development of technology research for nanosatellites, in particular, but not only, in the context of the BIRDY interplanetary nanosatellite, supported by ESEP

* The collaboration with the University of Science and Technology of Hanoi (USTH) in the Master for Space application is directly supported through ESEP involvement (travel budget for teaching personnel and support for exchange of students

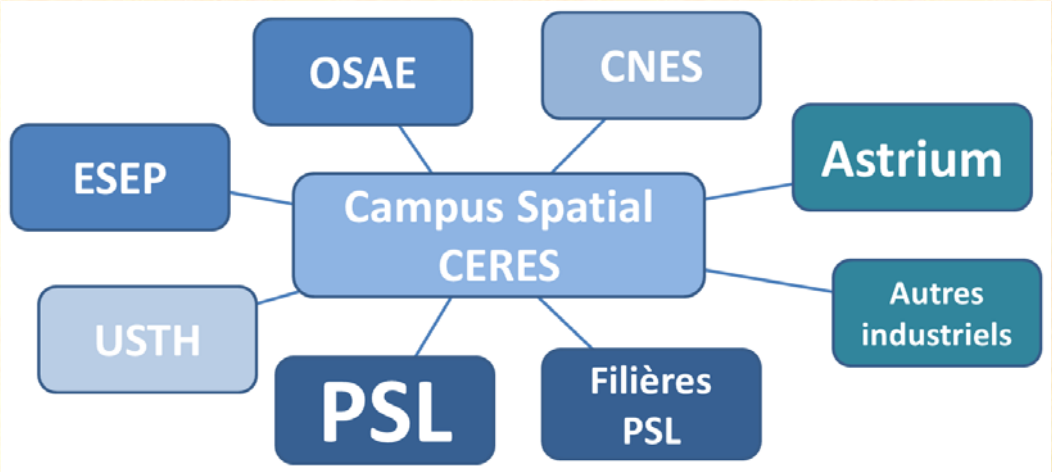
* ESEP was involved in the preparation of the answer to European Infrastructure Europlanet (H2020) which has been selected in 2015 for planetary research especially in the domain of Virtual Observatories.

The CERES Student Space Campus of PSL

The activity in the field of nanosatellites is from the beginning a strategic axis of development for ESEP. A first project supported by ESEP since 2012 is the LISA project OGMS/SA developed and tutored by Paris-Creteil University in the frame of QB50 cubesats (N. Grand, LISA). ESEP support has been essential in providing environment support, budget for grants for master students, and budget for small equiments and mission; although limited to a facilitator support, ESEP has been recognized by LISA as important to ensure the project advancement : the role of "catalyzer" defended by ESEP is here particularly visible.

Student nanosatellites have been developed in the recent times by various actors, with support of CNES restricted to the University context. The question of developing science research with nanosateliites is still largely open. ESEP has contributed to raise the questions with the support to two well attended seminars: with Paris Observatory in December 2013 (CIAS), and with its own workshop in December 2014. The development of a dedicated campus in PSL for these

activities is necessary, to take advantage of the the testing facilities provided by the laboratories of ESEP, in particular LESIA in Paris Observatory. With support of Paris Observatory and PSL, the CERES project started in 2014, and is already functioning with selected projects from the call of ideas of ESEP in 2014 (a second call was sent in March 2015)



The CERES Student Space Campus and its partners -

CNES partnership provides software tools for CIC activities under the supervision of ESEP system engineer (Boris Segret) : this facility and the ability of ESEP engineers to introduce student teams to the use of complex professional software tools are unique and essential for the advancement of projects.

In 2014 an ESEP call for idea has been launched, with the selection of the following projects for further studies, usually in collaboration with other Universities:
* Circus Characterization of the Ionosphere using a Radio receiver on a CUbeSat (Arnaud Zaslavsky,LESIA) : UPMC / CERES
* Meteor : Nanosatellite Pour l'Étude des Météores (Nicolas Rambaux, IMCCE) UPMC/CERES
* Birdy Bleeping Interplanetary Radiations Determination Yo-Yo (Boris Segret,LESIA): NCKU, Taiwan/CERES
* GPU Utilisation de La technologie GPU Pour des applications spatiales (Damien Gratadour,LESIA) : Paris-Diderot/CERES

B) Ressources humaines/Human resources

Two kinds of human resources are managed within ESEp :
1) ESEP recruitments for engineers are devoted to the actions within the perimeter of ESEP
- ESEP System engineer (ingénieur de recherche, Boris Segret) : in charge of coordinating R&D activities, nanosatellites, call for ideas and management of research

- ESEP Science Mediation engineer (ingénieur de recherche, Séverine Raimond) : in charge of all the mediation activities, relation with the press, web site, workshop organization, and project manager for the ESEP exhibition "COMETS" in 2015

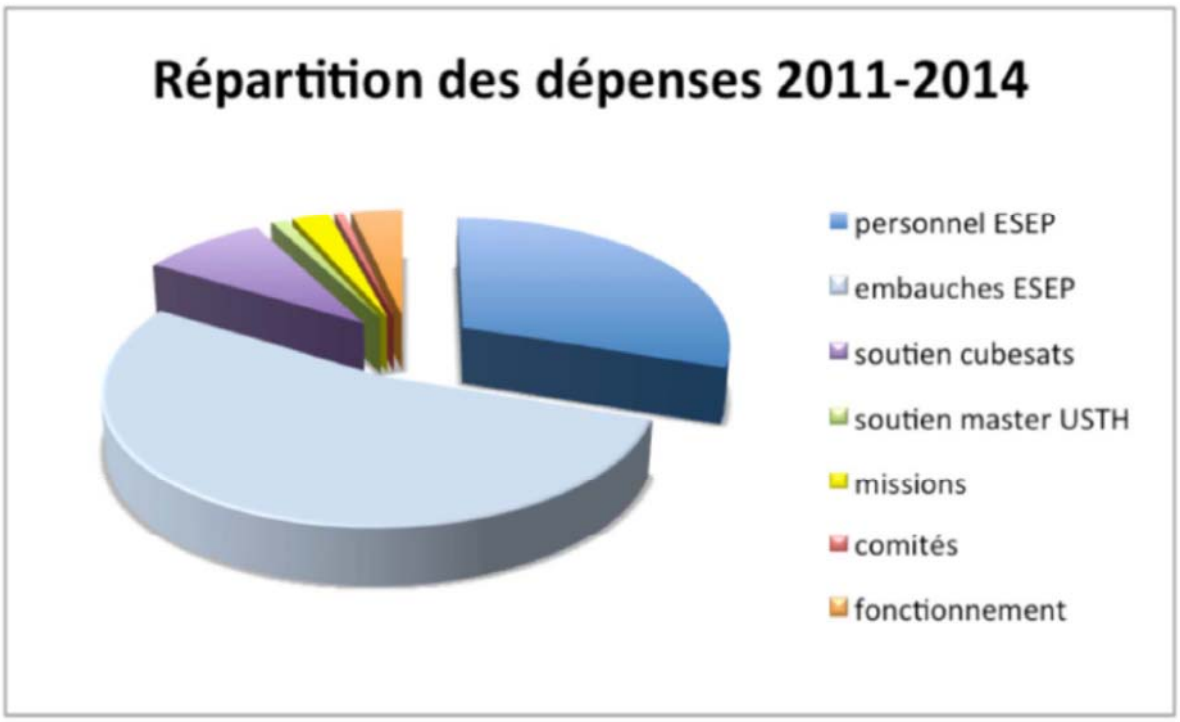
- ESEP software ingeneer (ingénieur de recherche, Cédric Schott) : in charge of developing the software activities for the e-learning branch of ESEP (SESP) : programs associated with exercise and tools for teaching expertise, etc.

2) PhD contracts (see list of contracts in the report) :
Nine contracts have been provided, 4 ESEP full contracts, 5 contracts in partnership with CNES or University. These contracts are selected by the scientific committee within the ESEP thematics

3) Short term contracts for engineers or post-docs (1 or 2 years) for ESEP projects in R&D
These projects are selected within the priority in R&D identified after the census of activities in the laboratories. One is with the "ORBITRAP" project devoted to future miniaturized mass spectrometers (LPC2E), and another one in the nanosatellite developed by LISA. The other projects concerns technical development for LATMOS and LESIA. Other short term contracts concern LOFAR activities, related to ground based radioastronomy of next generation.

Research and Development activities are only long term productive activities, and it is not expected to have in the 3 years of effective functioning of ESEP an effect on the permanent position recruitment in the laboratories. The first thesis will be defended in autumn 2015. In terms of internal team activity, there is clearly a benefit from the ESEP support for the development of the thematics mentioned above.

C) Moyens financiers, effets leviers/Financial resources, leverage effect



The budget of ESEP has the following repartition :
Research : 55% : proposal for docs/post-docs/ ESEP system engineer and functioning
Teaching : 24% : SESP project, international collaboration with USTH and Master OSAE projects; software engineer
Outreach : 14% mainly devoted to the preparation of the ESEP exhibition in 2015 + Science Mediation engineer

The ESEP activities are inside the mainstream activities of the laboratories, and therefore projects are usually co-funded by laboratories (and their partners) with the support of ESEP. In a project like CIRCUS supported by ESEP, the budget is coming from many sources : CNES (R&D), PSL grant and ESEP/

Projects involving ESEP in support of a proposal:
* H2020/Research Infrastructure : EUROPLANET project has been selected in 2015; ESEP is involved in the data processing (Observatoire Virtuel) concept; co-lead of the project is within LESIA (Athena Coustenis), and ESEP activities are related to the project

* Region Ile de France : equipment proposal (2015) to install and operate a ground segment, including the S-band antenna in support of the data reception from nanosatellite projects. ESEP is explicitly involved in the project in collaboration of other labex and institutes

D) Impact du Labex sur la politique de son écosystème/ Labex Impact on its ecosytem policy

As described above, ESEP is centered on networking activities, coordinating actions in space research, especially in Research and Development for new instrumentation in space exploration. This activity is fully in line with the concept of Research University of PSL : the expertise of its laboratories allows ESEP to coordinate and impulse activities in his domain, and also to prepare a future generation of research scientists and engineers through teaching activities – not forgetting outreach activities. In addition, ESEP is at the crossroad of several "Investissement d'Avenir" organisms (PSL, Sorbonne University, Paris Est for institutional relationships, but also Sorbonne Paris-Cité and Paris-Saclay for collaborations). These collaborations have begun to be formalized in the important domain of Space Campus and nanosatellites activities :
An example is a proposal to the "Region Ile de France" initiated by the three laboratories LATMOS, LESIA and AIM for developing a reception antenna for nanosatellites in S band, together with support to nanosatellite projects. Supported by letter of recommendation from institutes of these different IDEX or COMUE, it is a benchmark for future coordinated work, which is mandatory in Ile de France for space physics, in terms of credibility to present projects to national agencies like CNES or CNRS.

ESEP is ideally placed to impulse, coordinate and eventually lead this kind of projects.
Another example is for technologies transverse to space activities : one project for improving space computation architecture with use of GPU (Graphics Processor Units). Widespread today in computing projects on the ground, its use for real-time large telescopes, and space missions is still challenging and poorly explored. ESEP has initiated such an initiative among its "nanosatellites call for ideas" in 2014. Also transverse to several IDEX, but centered and managed by PSL through ESEP, this activity has already international inputs in the frame of the USTH projects, also supported by ESEP.

Relations with UPMC (Sorbonne University) : CIRCUS nanosatellite project from LESIA
Relations with Paris Est Creteil: OGMS/SA, nanosatellite project from LISA
Relations with SPC (labex Univearths) : GPU, USTH
Relations with Paris-Saclay (labex P2IO) : ground segment for nanosatellites : project submitted to "Region Ile de France" in 2015.

Other Labex can be mentioned were contacts and exchange of information are provided regularly : these are
- labex PLAS@PAR from UPMC (LERMA leaded) for plasma physics (mostly laboratory physics)
- labex IPSL (LMD leaded) : the Institut Pierre Simon Laplace has similarities with ESEP as a network of laboratories involved in space observation of the Earth ; several ESEP laboratories have also some teams inside IPSL; exchange within the scientific committee of IPSL have been regularly made to exchange ideas and structure of management models
- labex Voltaire (Orléans), whose the LPC2E is member, sharing its activities between ESEP and Voltaire (Earth observation).

3 / IMPACT SOCIO ECONOMIQUE / SOCIO-ECONOMIC IMPACT

3.1 ***Partnerhips with social and economic actors (industrial actors, competitiveness clusters, fundations…) and established agreements; start-up creation; hosting of industrial actors in the Labex for instance…***

The role of ESEP is not directly in the production of patents, as exposed above, because most of the activities are in integration and testing of devices produced by industrial partners. The expertise is therefore in the space environment integration, which is not or only marginally directed to production of patents. Space exploration, contrary to Earth observations or space communication, is also devoted to unique or very low number of instruments. The relations with industry are therefore more as an "expert client".
Two activities can be mentioned in this field :
Orbitrap is a concept of instrument developed by LPC2E in partnership with other laboratories and industry to use the miniaturized concept and apply to space mission

Spatialization of Graphics Processor Units for satellites (or nanosatellites), one of the ESEP projects is developed in partnership with NVIDIA

3.2 – 3.3 : not relevant to ESEP

3.4 *Promotion measures for knowledge dissemination ; schedule, durability of the measures (excluding publications in scientific journals)*

Outreach activities have been considered from the beginning as an important aspect of ESEP, and a part of the budget has been attributed to these activities. In addition to internal communication with the science mediation engineer recruited for ESEP (organization of workshop, website, etc.), support of outreach actions has been provided (exhibition by Paris Observatory in 2014 "*L'astronomie se la raconte*".)

The main project of ESEP will be in 2015 a dedicated exhibition, fully managed and organized by ESEP to be presented in the "Musée de l'Air et de l'Espace" in Le Bourget, after the annual Air and Space exhibition. Partnership from ESA and CNES has been obtained. The exhibition called "COMETS, at the origin of planetary systems" will present the current knowledge on the comets, at the time of the first results of the ESA mission Rosetta, for which many laboratories of ESEP are involved. It will describe the mission itself, some of its results, some simple experiments and models of the Rosetta spacecraft and Philae lander provided by ESA and CNES.

COMMENTAIRES LIBRES / FREE COMMENTS

To define a strategic plan for the prospective of the second phase of ESEP, a dedicated one-day meeting has been organized in Rambouillet on the 6th of March 2014. All activities of ESEP have been discussed with a panel of participants including representatives of all the laboratories, from the ESEP science committee, Paris Observatory and PSL.

It is clear that the second half of the life of the labex ESEP is strongly supported by the participants due to the recognition of :
- the support to research human resources for the laboratories
- the experience of teaching with expanding e-learning developments towards MOOC
- an expansion of the domain of R&D towards nanosatellites projects

The good cooperation with CNES and with the "Ecoles Doctorales" for selection of thesis in the thematics of ESEP is a booster for this science sector
A large part of the future activities (but not all) will be directed to nanosatellites

It has been decided to organize a large ESEP science conference in 2016 in a larger frame than the 1-day dedicated workshops which will continue on a 1 year pace.

For the future of the ESEP activities after the term of the IA support, it is clear that it has to be taken within the research strategy of PSL : as the unique space networking of PSL, possibly expanded to several other laboratories within the perimeter of PSL, the natural continuation of ESEP as the "space campus" of PSL is highly supported; it would include not only a student campus (CERES), but also a mutualisation of equipment in the spirit of a "groupement d'interet scientifique" (GIS) named MOTESPACE for test equipment of space missions. This extension is being discussed in the next two years with the different organism and institutions (CNRS, CNES, PSL and others): a balance between the necessity of a visibility of every IDEX in space domain, and an equivalent necessity to collaborate between the different IDEX is now fully realized by our institutions. ESEP, being already a transverse structure beyond PSL has the capacity to initiate and coordinate this project.