**APPEL A PROJETS EQUIPEX / CALL FOR PROPOSALS**

**2010**

| Acronyme du projet / Acronym |
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**DOCUMENT SCIENTIFIQUE B / SCIENTIFIC SUBMISSION FORM B**

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| **Acronyme du projet/ Acronym of the project** | **PASS** | |
| **Titre du projet en français** | **Plateforme pour l'Astrophysique et les Sciences Spatiales** | |
| **Project title in English** | **Platform for Astrophysics and Space Science Systems** | |
| **Coordinateur du projet/Coordinatorof the project** | Nom / Name : Jean-Louis Monin<br>Etablissement / Institution : UJF<br>Laboratoire / laboratory : LAOG (IPAG)<br>Numéro d'unité/unit number : UMR 5571 (UMR 5274) | |
| **Aide demandée/ Requested funding** | Tranche 1/Phase 1<br>2500 k€ | Tranche 2/Phase 2<br>1997 k€ |
| **Champs disciplinaires / disciplinary field** | ☐ Santé, bien-être, alimentation et biotechnologies / health, well-being, nutrition and biotechnologies<br>☐ Urgence environnementale et écotechnologies / environnemental urgency, ecotechnologies<br>☑ Information, communication et nanotechnologies / information, communication and nantechnologies<br>☐ Sciences humaines et sociales / social sciences<br>☑ Autre champ disciplinaire / other disciplinary scope | |
| **Domaines scientifiques/ scientific area** | Astrophysique – Plates-formes expérimentales – prototypes – Equipements d'analyses et de mesures - imagerie | |

## Affiliation(s) du partenaire coordinateur de projet/ Organization of the coordinating partner

| Laboratoire(s)/Etablissement(s) Laboratory/Institution(s) | Numéro(s) d'unité/ Unit number | Tutelle(s) /Research organization reference |
|---|---|---|
| LAOG (IPAG) | UMR 5571 (5274) | UJF / CNRS-INSU |

## Affiliations des partenaires au projet/Organization of the partner(s)

| Laboratoire(s)/Etablissement(s) Laboratory/Institution(s) | Numéro(s) d'unité/ Unit number | Tutelle(s)/Research organization reference |
|---|---|---|
| | | |
| **Entreprise(s) / company** | **Secteur(s) d'activité/activity field** | **Effectif/ Staff size** |
| | | |

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**DOCUMENT SCIENTIFIQUE B / SCIENTIFIC SUBMISSION FORM B**


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# 1. RESUME / SUMMARY


Our objective is to establish inside Université Joseph Fourier a downstream technological **P**latform for Ground-based & Space-borne instrumentation for **A**strophysics and Planetary **S**pace **S**ciences (***PASS***). This facility will address system detection (for Astrophysics) and space borne subsystems (for Planetary Space Science). PASS will be managed by the new *Institute of Planetology and Astrophysics of Grenoble* (IPAG, UMR 5274) recently founded from the merging of LAOG (Laboratoire d'AstrOphysique de Grenoble, UMR 5571) and LPG (Laboratoire de Planetologie de Grenoble, UMR 5109). Strictly speaking, IPAG will officially exist on the 1$^{st}$ january 2011.

PASS will bring system expertise at the crossroad between (i) unique Grenoble upstream sensor

technology research, (ii) academic interdisciplinary laboratories expertise in the integration of complex systems for remote and in-situ observation, (iii) original and broadband student formation and (iv) industrial collaboration and already demonstrated Technology transfer capability.

PASS will be operated by IPAG that will bring together for the first time in 2011 most of the researches in astrophysics and planetary sciences on the Grenoble campus, from planetary sub-surfaces to the edge of the universe; it will provide the equipment needed to add a crucial LAOG + LPG expertise in overall system design and characterization, to the remarkable Grenoble know-how for the production of high technology component, providing efficient exchanges between academic system designer and industrial components providers. It will benefit from the unique instrumental skills of IPAG (LAOG + LPG) to design, prepare, develop and validate new concepts and instruments, for ground-based telescopes and space probes subsystems, for imaging & spectroscopy detectors.

The PASS project originates from the finding that:

- For upmost performances remote observations, the sensors characterization performed by industrials manufacturers are often limited to a narrow range of utilization.
- For in-situ space probes, the need to fully characterize the system in the expected environment is currently unfulfilled.

A main keyword of the PASS platform will be “Characterization”: against photons (for detection in astrophysics) and against analog material, atoms + molecules, for in-situ testing of space probes subsystems. PASS will be opened to academic laboratories and industrial partners to test concepts or components in an extended use domain. It will benefit from the global IPAG expertise in detection and chemistry to develop an “optical and chemical characterization” tool for sensors, components and space probes subsystems.

Indeed, Grenoble basin gathers a remarkable, possibly unique, ensemble of skills in the developments of new components (detectors, integrated optics, micro-electronics, MEMS/MOEMS). These upstream technologies are provided by local industrials (eg. Sofradir, E2V, Teem Photonics, Ulis, ST microelectronics), and realization platforms supported by the RENATEC network (PTA, MINATEC), as well as specific laboratory facilities, see Figure 1. Choosing these technologies for an instrument development or a space project requires going through various levels of maturity assessment (Technology Readiness Level, TRL). The last TRL in a project roadmap are properly addressed by the space agencies, mainly through their industrial partnerships. The laboratories where such technologies emerge have to tackle the initial TRL steps. Addressing the intermediate steps (so-called “death valley” by space agencies) requires a specifically joined commitment of technology and system specialists, with a clear knowledge of the instrument implementation and its overall system structure. Crossing this TRL death valley is one of the main goals of the PASS project.

From its privileged position on the UJF campus, close to the Physics L3-M1 teaching building, PASS will welcome many students. The instrumental aspect of the project will be used to support a professional License (L3) as well as Master students at the M2 level, from many M2 categories in UJF. This will be straightforward, thanks to previous IPAG teachers involvement in ‘IUT’ (One of UJF Technological school) teaching. We will also develop numerous “CIFRE” PhDs (French industry-collaborative PhD) between IPAG and our industrial partners.

In IPAG, LAOG has a long tradition of instrumental developments dating back to the 1990s, and has been involved in continuous collaborations with laboratories and major industrials as CEA / LETI, LETI-LIR, Sofradir, E2V, IMEP, Néel Institute, G2Elab, LTM, Teem Photonics. These collaborations have led to 5 patents, one industrial license, the birth of the ALPAO Spin-off, and recently to 3 inter-

ministry ("FUI") funded industrial projects.
Since its inception in 1999, LPG has a strong tradition of laboratory experiments used to validate space experiments. This laboratory plays a key role in developing, managing, and implementing flight instruments on several major space missions currently in flight or in preparation (Cluster, Mars-Express, CONSERT / ROSETTA, Cassini mission on Saturn & Titan).
Engineers and researchers from IPAG have demonstrated their expertise in bringing state-of-the-art laboratory technologies into cutting edge observation instruments, space probes or industrial implementations. Keynotes developments include: VLT/NAOS (first direct image of an extrasolar planet [1]); VLTI/AMBER with now more than 50 rank A publications, including one of the first reconstructed interferometric images in the near infrared (see [2]); IONIC/IOTA who successfully demonstrated interferometric image reconstruction using an integrated optics beam combiner [3]; First time comet nucleus tomography with the Radar CONSERT experiment on the ROSETTA space mission (encounter with a comet in 2014) [15]; Integration of the biggest 2$^{nd}$ generation VLT instrument SPHERE through a 10 M€ contract with the European Observatory ESO; phase A study of the EPICS instrument for extrasolar search on the future 42m E-ELT European telescope; mapping of subsurface water on Mars with MARSIS radar [7]; Detailed description of Titan' atmosphere build-up chemistry [8]; realization of the integrated optics beam combiner of the GRAVITY instrument that will probe the black hole environment at the galactic center ([20]).
Building on these world-class developments, the PASS program will include: - PASS testing of the (FUI) RAPID detectors, - Implementation of the micro-spectrometer SWIFTS on space-borne and ground-based instrumentation, - Space Portage of the Orbitrap Concept.
All these developments will yield to industrial exploitation. Indeed, technology transfer also encounters a "death valley" between conceptual ideas and practical industrial developments. PASS will offer the opportunity to bridge this gap between scientists and industrials. We will use our previous expertise in patents management via the UJF subsidiary Floralis to take care of the future patents and insure protection of the results.
*NB. As this application implies numerous collaborations with laboratories and industrials with various acronyms, a detailed list is provided in section 7.3 for our referees.*

## 2. ENVIRONNEMENT SCIENTIFIQUE ET POSITIONNEMENT DU PROJET D'EQUIPEMENT / SCIENTIFIC ENVIRONMENT AND POSITIONING OF THE EQUIPEMENT PROJECT

### Astrophysics and Planetary Space Sciences as innovation drivers

Astrophysics relies almost entirely on detection of remote photons in a wavelength domain as large as possible. Planetary Sciences add to this challenge the physical contact with the explored medium, via the use of space probes operating in outer space or in alien (e.g. potentially aggressive) environments. Both domains permanently unveil huge technological challenges to improve detection efficiency or operation reliability. History of astrophysics and space sciences shows that each time a new observation window has been opened, new breakthrough discoveries have rapidly followed. Recent examples involving LAOG are: the use of Adaptive Optic technique with NAOS that provided the first extrasolar planet images [1]; high resolution spectroscopy to discover the first exo-Super Earths using HARPS ([33] and references therein); The ESPADON instrument has provided the first

Stellar magnetic fields imaging ([5],[6]). Examples involving LPG include the quantification of subsurface water on Mars [7] and the description of the complex chemistry occurring in Titan' atmosphere [8].

The preparation and validation of new concepts of remote observation or in-situ investigation instruments is thus a vital strategic question for these sciences, and R&T is an intrinsic part of the instrument preparation process. In astrophysics, in order to provide actual new scientific discoveries, new cutting edge instruments cannot be a mere optimization of previous solutions but must be based on breakthrough new concepts. In space sciences, the harsh physical and chemical conditions encountered by space probes and their subsystems in deep space or in alien environment oblige the scientists to push the tests and performances of these systems at their ultimate limit.

As a consequence, astronomers have developed a large network of collaborations with state-of-the-art sensor industrials in order to have access to and be able to test the most sensitive devices available. Examples are: low photon flux IR detector for the ISO satellite by SAT and LETI/LIR [9]; infrared arrays for imagery on the ESO telescopes at 10 and 20µm [10] and for the first adaptive optics system in the near IR [11]; Use of the ORBITRAP concept to access very high-resolution mass spectrometry and therefore perform chemical analysis with outstanding performances, developments of new concepts in radar imagery to investigate the existence of water on Mars, or to study the internal structure of small bodies in the solar system.

This does not apply only to detection devices but also to entire systems. For example, French astronomers have been at the forefront of the development of adaptive optics applied to astronomical observations using technologies previously designed for military purposes. In Grenoble, multi-millions Euros adaptive optics instruments have been and are currently developed by consortia involving or led by LAOG (NAOS & SPHERE instruments). LAOG technological investments have allowed the creation of a dedicated spin-off (ALPAO) for the realization of adaptive optics systems and related components for astronomical applications as well as for a broader domain including ophthalmology and laser science.

In Space sciences, a critical need comes from the necessity to envisage all the possible physico-chemical conditions that "contact" or "in-situ" probes might encounter. If remote measurements and analysis methods are now routinely operated in laboratories, expertise is lacking in the domain of in-situ physico-chemical analysis (CNES report, 2010, [12]). A recent JPL communication [13] insists on the fact that testing must be done in the field and on the mission platform as well as in the expected environment. Many examples show that in-situ analysis undertaken on space missions failed because the extreme conditions actually encountered by the probe were not all anticipated and not properly modeled and characterized in the laboratory.

Such a methodology is a virtuous circle operation. In supplement of breakthrough discoveries, these collaborations give rise to patents and licenses, as well as developments of new devices and systems that were not envisaged at first by the industrials. It also gives birth to spin-offs, creating many jobs. As an example, LAOG holds 5 patents [14] and Grenoble astronomers are involved in ophthalmology applications of Adaptive Optics devices by (REF); LAOG gave birth to the ALPAO Spin-off in 2008, (resulting in 9 jobs as of 2010); LAOG is involved in three Inter-ministry funded projects in collaboration with industrials (FUI), for a total funding of 20 MEuros. LPG has developed expertise in space borne radars that led to its association on almost all mission to come using radars [15]. The laboratory is currently pursuing a research program to develop a space-borne version of the new

Orbitrap mass analyzer concept for in situ chemical analysis [16]. LPG has also the expertise to characterize optical elements playing key roles in asteroids, comets and moon surfaces [17].
A prominent characteristic of our methodology is that these jobs are not related to simple automated production processes that can lately be copied and externalized in foreign countries. On the contrary, they rely on specific *system* expertise on high-tech complex systems with a very high added value that cannot be imitated.

In short, IPAG (formerly LAOG and LPG), is constantly progressing by building new instruments and systems that request uppermost performances components and devices available in their academic or industrial environment, while pursuing specific Research and Technology activity as an essential part of this preparation process. In return, this specific R&T and the associated system expertise that can only be performed in our laboratories lead to a technology transfer toward industrials and thus the global society. A 'smoking gun' example of such a return can be found in the case of the wave-front sensors of the adaptive optics SPHERE instrument (dedicated to exo-planet detection and observation). The development of the required fast and high sensitivity detector led in 2010 to the birth of the DROP program (airport runways monitoring) funded by an Interministry fund (FUI), and that will soon lead to the creation of a dedicated spin-off.

## National and international framework

At the French national level, Astrophysics and Space Sciences instruments developments involve the CNRS *National Institute for Universe Sciences* (INSU) and the *National Space Agency* (CNES).
In addition to these National Agencies, only a few Universities host laboratories with the capacity of developing at the same time top-level ground-based observing facilities and space borne experiments: in Paris, Marseille, Toulouse and now Grenoble, thanks to the IPAG merger of LAOG and LPG.
At the European level, Astrophysics and Space Sciences Instruments developments involve the European Southern Observatory (ESO) and the European Space Agency (ESA).

The achievement of the main science cases of the on-coming European ELT (42m diameter 1 billion Euros ESO Extremely Large Telescope) will rely on the availability of detectors with uppermost performances and characteristics: high dynamics sensors are mandatory for planet detection; ultrafast sensitive sensors are needed to properly drive adaptive optics systems and interferometric instruments; very sensitive large format focal plane arrays are needed for spectroscopic imaging in the near IR. Such detectors with such performances are not yet fully operational or even available.
In the domain of space sciences, the future exploration of our solar system relies on supra national programs, lead by ESA, NASA or JAXA. These agencies can even associate on particularly ambitious missions such as the future return mission to Jupiter, EJSM. If the agencies handle the probe development and operations, they rely on the national space agencies to develop and operate science instruments. The latter, (CNES in France) rely on specialized laboratories that have resources and expertise to handle and manage the final steps of instruments integration. The PASS platform will provide a facility upstream to this framework. Hence, space exploration has entered in the era of "return missions". This means that most planets or moons have now been grazed by probes that remotely characterized their nature and environment. The next step is for contact or in-situ space

probes which will bring need for testing in the expected or representative environment conditions in order to guarantee/maximize their scientific return.
The expertise for the conditioning, the qualification and the optimization of detection systems and space probe sub-systems is essential for the realization of the most efficient instruments. For the detection, such an expertise exists at ESO and in a few foreign laboratories (Germany, UK and Netherland mainly). Grenoble site offers a unique place for a dedicated team able to work with some of the major detector manufacturers and specialists (e.g. Sofradir in the infrared, E2V in the visible). IPAG is able to provide high-level expertise required in such a team.
For space probe sub-systems testing in analog environment conditions, no such "real environment" facility exists in France. With the LPG team, Grenoble hosts a very specific and promising situation: (i) it is the only laboratory where 3 Chemists (from CNRS Chemistry Institute INC) are working in a Universe Sciences laboratory, and (ii) there is a strong heritage of ice and analog sample preparation and characterization, as well as optimized spectroscopic instrumentation. This interdisciplinary situation holds the key to the question posed by the CNES concerning in-the-field testing for contact space probes.

## Grenoble: a unique scientific situation

In UJF, the recently founded *Institute of Planetology and Astrophysics of Grenoble* (IPAG) will gather for the first time the essentials of the Astrophysics and Planetary Space Sciences developments on the site, via the merging of the teams and the expertise of the two laboratories LAOG & LPG. This new institute will gather almost 100 permanent scientists, including a strong instrumental group of 30 ITs (engineers and technicians). Both laboratories are involved in major instrumental realizations among which the present cornerstones instruments are SPHERE for the VLT, GRAVITY for the VLTI, and CONSERT for ROSETTA.
IPAG is situated on the UJF campus, meters away from the international radio-astronomy institute IRAM. IRAM is currently building the currently best mm detectors in the world, and IPAG is a specialist of the visible and IR part of the spectrum. This situation makes IPAG an exceptional place to take a leading role in the vital instrument exploration and characterization cited above in a complementary manner with IRAM.
Indeed, the Grenoble environment is exceptional if not unique, in terms of the gathering of upstream technological industrials and facilities (LIR/Sofradir, PTA, MINATEC, E2V, Teemphotonics, ST microelectronics, see figure below). LAOG holds collaborations with every industrial appearing on this map.

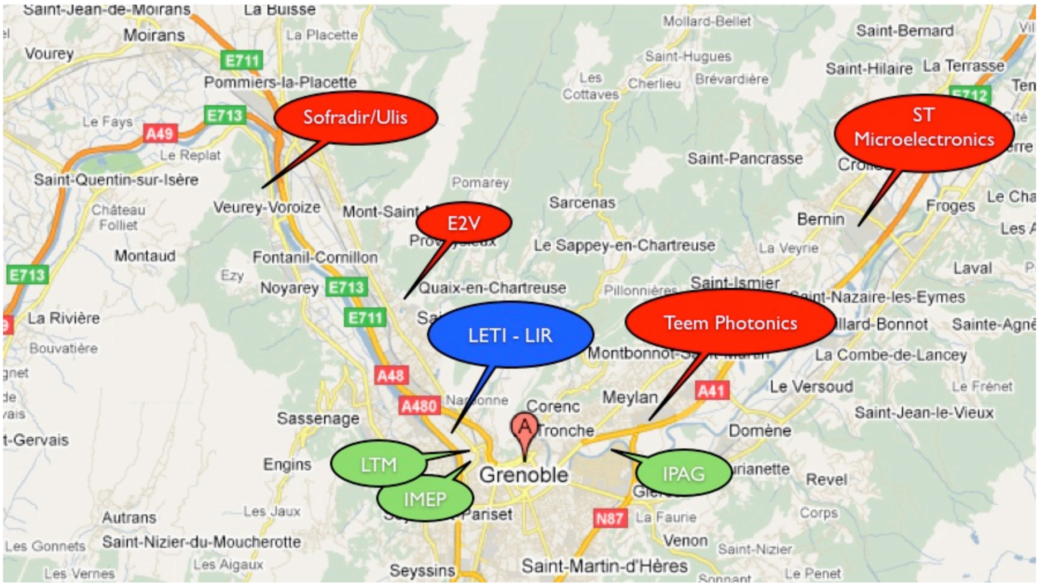


**Figure 1** *PASS & IPAG situation in the local Grenoble detector industrial network. Red: industrials, Blue: High Tech CEA lab; Green: University laboratories.*

Such a remarkable situation allows to develop new concepts and new ideas via reactive and privileged collaboration, and to implement them in future performance demanding instruments. UJF even provides the perfect tool to achieve the industrial dissemination and economic impact of its laboratories R&T activities via its subsidiary "*Floralis*". Indeed, LAOG spin-off ALPAO was initially a Floralis Business Unit hosted in our laboratory. The LAOG patents and License are managed by Floralis, as well as the SWIFT FUI operation.

# 3. DESCRIPTION SCIENTIFIQUE ET TECHNIQUE / TECHNICAL AND SCIENTIFIC DESCRIPTION OF THE ACTIVITIES

## 3.1. ORIGINALITE ET CARACTERE NOVATEUR DU PROJET D'EQUIPEMENT/ORIGINALITY AND INNOVATIVE FEATURE OF THE EQUIPEMENT PROJECT

### A dedicated platform for Astrophysics and Space Sciences

All the developments mentioned in the previous section have been performed "in the margin" and in the wade of pre-existing projects under international contracts and funds. They are the result of the remarkable involvement of top-level Engineers and Scientists in LAOG & LPG. They show that IPAG has the necessary skills and expertise to develop such R&T and related technology transfers.

In this document, we propose to implement in UJF a new technological platform (PASS) that will provide the appropriate environment to assist technological program in the path from concept demonstration to the real scale instrumental implementation, from elementary technology to operational instrument. This platform will benefit from all the complementary interdisciplinary instrumental skills in IPAG, from state-of-the-art detection techniques to space probes subsystems calibration and validation. A central keyword of the PASS project will be "system implementation of

critical technologies". Another keyword of the PASS project will be "Characterization". This characterization will be performed against photons for detection issues in astrophysics, using dedicated testing rooms with all required equipments for the considered investigations.
The characterization will also be performed against analog materials for in-situ testing of space probes subsystems, using a dedicated analog testing chamber. These complementary characterization facilities and skills will interact and fertilize each other as detection specialists will be available to help with tests in space sciences, and the analog chamber will be used for tests of space probes subsystems but also for tests of individual optical components. PASS will be opened to laboratories and industrial partners to test concepts or components in an extended use domain, providing our industrial partners with a specific facility for which they have neither the funds nor the expertise to operate.
This platform will allow driving innovative projects in collaboration between IPAG and academic partners and private industries. One key point is that due to their economical constraints, industrials cannot afford all the necessary equipment and expertise or allocated time to perform exhaustive tests and characterizations to the frontier of their components' performances, and / or with components integrated in complete systems. PASS will provide a natural place to explore the possibilities of specific components and to allow inter-fertilization between academic scientists and private industrials. LAOG is currently in close relation with various industrials either local in the Grenoble environment or at the international level (ALPAO, Teemphotonics, E2V, Sofradir, ST-microelectronics). The implementation of PASS will help to reinforce and structure our relationship with these industrials, allowing their access to specific equipments and system expertise. This is why we will implement a meeting room and visitor offices in the PASS project (see Figure 3).
The foreseen equipment will provide all critical tools for the design, integration and characterization of the detection assemblies of the instruments in their specific environment. It will also provide an 'in-situ' testing module to chemically qualify space borne subsystems against analog materials. PASS will provide a dedicated "instrumental toolbox" at the crossroad between upstream technology platforms and instrumentation center(s) for astrophysics and space science, bringing a cornerstone for the preparation of the next generation large instruments for astrophysics and planetary sciences, dedicated to observation and in situ explorations.

We believe that no French existing institute is currently able to provide such facility and expertise for astrophysical and planetary space sciences purposes, to characterize, test and master the whole detection and observation chain from the visible to the mid-infrared. A unique feature of the IPAG PASS project is the association of the best expertise available in system detection with chemical scientists in the same laboratories. With PASS envisaged equipment, we will be able to optically and chemically test space probe subsystems, analog materials to which they will be submitted, as well as local industrial sensor devices. Such a chemical qualification facility does not currently exist in any French university, although its urgent and essential need has been recently emphasized by national and international agencies and laboratories like the CNES and the JPL ([12]& [13]).

We stress that IPAG is not and will not be a spatial laboratory in any way similar to national facilities available in IAS (Orsay), LATMOS (Versailles), LPC2E (Orleans), or CNES and CESR (Toulouse). On the contrary, we will build on the unique Grenoble opportunity of IPAG where 3 chemical scientists are directly involved in the scientific activities of a planetary science lab (the LPG part of IPAG), which has a clear heritage in terms of analog material synthesis and characterization. This exceptional interdisciplinary environment will allow developing a specific national facility allowing testing space probe subsystems against analog environments. We call this testing "Chemical qualification" of instruments. Examples of previous failed mission that such facility would have allowed to prevent include aerosol analysis in Titan' atmosphere where the collection subsystem was ill designed, leading to no material transport in the analysis instrument. Another example was the difficulty encountered on the surface of mars to bring soil samples inside the chemical analyzer. With PASS chemical equipment, we will be able to explore a large range of potential alien chemical conditions (100-600 K, 1-$10^{-10}$ bar, + various chemical species / aerosols, etc.), testing and validating the use of the envisaged subsystem. Such a facility would be unique in France, and PASS would be opened to academic laboratories partners, as well as to industrials wishing to test their components in harsh physical and chemical conditions. When such a facility is implemented, we will request a National Astronomer (French CNAP) position to work on this service for the benefits of the community.

PASS will be focused on the visible and near infrared (up to 20µm) part of the optical spectrum. IPAG is situated a few meters away from IRAM where the currently best mm and sub-mm heterodyne detectors are built. We will therefore benefit form this exceptional complementary situation.

PASS will also provide a platform where astrophysicists and sensor specialists can efficiently define the devices that are able to meet the strong requirements of future instruments in order to properly prepare the answer to the main agency requests (ESA, CNES, ESO, etc.). From such fruitful collaborations, industrial partners will be suitably prepared for the beginning of the program. PASS facilities will complement testing and calibration facilities for the most demanding characterizations that exceed usual requirements of their standard products. Such a platform will furthermore allow the astrophysicists to optimize the implementation of the sensor in specific instrumental contexts. As an example, OCAM is a good illustration of this potentiality: this E2V based camera, developed in a collaboration driven by LAOG under an FP7 EU program is going to become the indispensable one for any adaptive optics sensor with low noise application throughout the astronomy world, more especially in the context of the realization of the ELT instrumentation.
We have years of expertise that allow us to provide partners with specific services for the development and characterization of integrated optics sub-systems, like fiber optics bundles or interferometric components (GRAVITY, FIRST at LESIA/Paris, LINC-Nirvana at MPIA/Heidelberg)
On going developments for IR low noise detection intend to provide a significant breakthrough in this domain, where up to now all existing instruments were using the product of a single US fabricant, and European products were not considered anymore for more than two decades for astronomical applications in the near IR (ISO satellite and its by-products).

## 3.2. DESCRIPTION DU PROJET / DESCRIPTION OF THE PROJECT

### 3.2.1 PRESENTATION SCIENTIFIQUE DU PROJET/SCIENTIFIC PROGRAMME

The PASS project will build on previous instrumental developments and expertise in previous LAOG and LPG. These developments include imagery detectors in the visible and the infrared, as well as space probes subsystems. All these programs imply collaboration at the national and international levels ; they have world-class impacts, especially for the implementation of future large

observation/exploration programs (ELT & VLT at ESO, Cosmic Vision program of ESA (Jupiter mission EJSM) or Hayabusa 2 for JAXA (Near Earth Asteroïd).
For some of these programs, no equivalent developments exist anywhere in the world except few developments currently in the USA.
Moreover, these developments imply many collaborations with industrials, as exemplified by the 3 current interministry funded (FUI) projects where LAOG is involved.
Among the obtained results and on going remarkable developments, one can identify the following domains:

1- **Visible and IR fast imagery**:
- OCAM in a E2V/OAMP collaboration under FP6 OPTICON funding. A continuation is in progress under FP7 OPTICON funding ([24], [25], [26], [27]).
- RAPID in a LIR/SOFRADIR/ONERA/OAMP collaboration, under FUI funding. The program was approved by MINALOGIC and OPTITEC ([28]).

**2- On chip spectro-detection :**
- SWIFTS in a IMEP/TEEM/E2V/LTM/Floralis collaboration, under FUI funding. The program was approved by MINALOGIC and OPTITEC ([29]).

**3- Mass spectrometer:**
- Space portage of Orbitrap concept (high-resolution mass spectrometer) with CNES R&T started in 2008, aiming for the ESA or NASA EJSM mission towards JUPITER (2019) [16].

**4- Radar:**
- The next-generation "Consert-like" bistatic radar in small instrument on-board of rovers or landers. The low frequency radars are proposed in the frame of the Hayabusa II Near Earth Object sample return mission [31].

From these first results, we will use the PASS platform to develop the following program.

**I. PASS testing of the RAPID detectors.**

IPAG has been involved in many detector developments since the beginning of the 90's. The extent of these developments increased after 2004 with the arrival of the European and the FUI funds. As a consequence, IPAG is now specialized in ultra fast and ultra low noise detector developments, both in the visible and the IR.
The first part of OPTICON detectors was dedicated to the development of a detector, called CCD220 and a camera system, called OCAM that will be used from now and in the next decade by all the European telescopes for their adaptive optics systems. Performances of the system are unique and overwhelm every other such system in the world. Following this success, the current OPTICON detector proposal was also dedicated to wavefront sensor detectors to be used with laser guide stars in the framework of the future giant 42m European telescope E-ELT. A big effort is produced on the detector fabrication but detector testing in the laboratory is not a priority in the OPTICON proposal.
The RAPID FUI is a French funding, dedicated to fast astronomical detectors in the IR. This new technology will be used for the next generation of IR wavefront sensors and interferometric instruments. Our competitors in the world are limited to the *SELEX* company, in the UK. With RAPID, IPAG and its partners will be world leader in fast low noise IR detectors.

IPAG's involvement in the field of detectors is based on a very precise type of applications (fast AND low noise) where competitors are scarce and where our institute, and our partners, are world leaders with an excellent industrial partnership (Sofradir, e2v technologies) and laboratory collaborations (OAMP, ONERA). IPAG works also on a day to day basis with the European Southern Observatory in that field.

PASS will be an invaluable tool to consolidate this detector involvement in a robust platform partly dedicated to detector testing with constrains of the astronomical instruments. Our constraints are by example the photon flux conditions (low flux is common in astronomy), the environmental conditions (cold temperatures, dust, low humidity and electrostatic discharges, earthquakes) and the constraints induced by the astronomical instruments (ESO software compatibility, thermal constraints on its environment, reliability and operability on a telescope). This testing aspect is partially covered by the projects that have been funded (OPTICON FP7 and RAPID), but not totally.
In that way, the detector testing facility foreseen in PASS can offer entirely different possibilities than the detector tests performed by the detector manufacturers. IPAG has the unique capability to test detectors on real astronomical instruments on a telescope. The PASS platform will allow us to perform the initial preparation and testing of the detectors within its dedicated instrument before being integrated on a telescope.

The technical activity associated with detector concerns the detector calibration in the visible and near IR ($\lambda< 3$ µm). This includes the ability to generate flats fields of various levels with calibrated photodetectors in order to compute the gain of the detector, the linearity, the noise, the full well capacity and the quantum efficiency. The detectors can furthermore be tested on adaptive optics and interferometric test benches that have been integrated recently at IPAG.

The deliverables for this activity will be:
D1 Infrared detector characterization test bench (T0+12 months)
D2 Visible detector characterization test bench (T0+18 months)
D3 Clean detectors and cryogenic integration facility (T0+24 months)

To amplify our previous success in the “RAPID” FUI project, and to lead to future fruitful industrial collaborations, a natural following program for PASS in the coming years will be the following:
Task 4.1: Application of the RAPID detectors to IR wavefront sensors.
Task 4.2: Application of the RAPID detector to IR fringe tracking.
A component of integrated optics specifically designed for monitoring fringes (in the IR H and / or K bands) will be mounted next to the RAPID detector to image the output waveguide in the focal plane. This whole assembly will be installed in a cryostat in a second term. The component will be fed by optical fibers from each arm of the interferometer. The upstream part of the bench will be used to simulate an astronomical source in the correct range of wavelengths and to provide the wave plane which will feed both arms of the interferometer.
For astronomy, the needs in terms of RAPID-like components exist at two levels: i) telescope systems, ii) instruments. This involves improving the performance of control systems to reach the ultimate performance of the instrumentation. Current systems can already be considered at their limit for 8m class telescopes for adaptive optics, for meter class telescopes for interferometry. For the next

generation of telescopes (European ELT or USA equivalent), we will to improve the performances on the detectors fitting the adaptive optics systems. While some applications will be able to use visible detectors, most of the demanding ones will require infrared detector arrays with a very low readout noise and high-speed readout rate.
The situation will be similar for applications requiring interferometric fringe tracking working at wavelengths similar to those used for scientific observations, in order to reduce problems related to atmospheric dispersion.
It is therefore clear that the RAPID detectors operating near photon counting limit have a vital interest for these applications in astronomy. They could also be used to upgrade current operational systems.
Five years from now, when these detectors will be available on the market, we can consider that 30 detector arrays / year would be a realistic goal. This estimate is based on the possible installation of two instruments in adaptive optics or interferometry, each with a need for five sensors with the same telescope control systems needs which would also require a dozen components.
In parallel we will have to develop the R & T on scientific instruments or control of the next generation of telescopes, which also will require a dozen components.
The upgrade of existing sensors in adaptive optics and fringe tracking could also use a dozen components.
These estimates are based on European needs. Access to the U.S. market would be quite possible, knowing that there is not currently a competitive product in this area, we could consider providing two dozen of components on the US market.
Furthermore there is currently a major interest from space agencies for this type of avalanche photodiodes. ESA has recently issued a call for tender for monoelements IR APD detectors. Our expertise in the RAPID development, as well as the association of astrophotonics and space subsystem testing in the PASS platform will put us in a very favorable position to meet these future needs.
The field of infrared spectroscopy is also a potential user of RAPID detector. Micro-spectrometers like those developed in the SWIFTS project, currently under development by LAOG and university laboratories and industrial partners, would use RAPID detectors with an important gain in sensitivity due to their low flux operation.
Other scientific applications of the RAPID detectors are foreseen and will be demonstrated using the PASS platform. They include aeronautics and security / military domains to monitor very fast phenomena like airbag explosion or braking heating. The number of needed detectors is currently estimated to 100-200 / year and this number will certainly grow.

**II. Towards SWIFTS on Space and ground based astronomy**

IPAG is at the origin of the SWIFTS's development, its involvement in FUI project is based on its capability to integrate complex systems and its knowledge of the spectrometric and photometric calibration. The recent study "*Technical assessment of SWIFTS technology applications to space missions and study of instrument design concept*" [30] ordered by the European Space Agency reveals that such spectrometers could be a key technology for space application. PASS platform will bring to IPAG the opportunity to use the expertise gained via the SWIFTS 400-1000 project to pursue the transfer of SWIFTS technology. After the merging of LPG (Planetary Sciences lab) with LAOG, new

R&T opportunities have emerged and PASS scientific program will include the development of embarked SWIFT components on a Martian rover to perform in-situ high resolution LIBS analysis.
Main identified domains are:
*Planetary Sciences:*

- **Planetary exploration (rover):** LIBS-RAMAN. Associated to LIBS, Identify elemental composition of soil or rocks. An improved spectral resolution permits one to directly get the isotopic composition for some elements. As it was proposed for Exomars mission, the same spectrometer can be used in Raman version to identify more complex life's organic molecules.
- **Earth or planetary Observation Atmosphere sounding:** 25 parallelized SWIFTS achieve 1250km atmosphere sounding observation with 25km spatial resolution on ground and 0.25 $cm^{-1}$ spectral resolution in LEO orbit
- **Space Astronomy: astrometry by stellar interferometry**: Deep discovering and characterizing the presence of extraterrestrial planet by astrometry measurement using superconducting single photon detectors

*Ground based Astronomy:*

- **Stellar velocity measurement :** SWIFTS is full integrated spectrometer well suited for measure doppler effect of stars below 1m/s
- **Interferometric Multi-telescope beam Combining.** Published in [22], SWIFTS is a way to combine simultaneously more than 8 telescope in a very simple beam combiner.
- **SWIFTS ultimate performances.** Recent SWIFTS developments show that it cannot be considered as a perfect Fourier Transform Spectrometer for the ultimate detection constraints required in astronomy. Our next scientific goal will thus be to understand very precisely these differences at Bragg resonance in order to fulfill the needed requirements.
- **ExtraSolar planets detection.** Measuring Doppler velocity shifts of nearby stars is one of the very few ways to detect extrasolar planets. In 2009, IPAG participated to a European FP7 study for the preparation of Extremely Large Telescope wavelength calibration. The result of this study showed that frequency comb laser are the next generation calibration tools for such instruments. This Ultimate Doppler shift facility will provide a way to study and optimize SWIFTS for velocity measurements.

The PASS platform will provide us with very pure tunable lines. Indeed, classical tunable lasers are not sufficient, and require additional spectral filtering with tunable Fabry-Perot in order to purify residual laser modes.

**III. Space Portage of the Orbitrap Concept.**

Space exploration is dealing more and more with astrobiology or prebiotic environment, requesting for optimized methods of analysis. One of the best methods to evaluate those media is mass spectrometry due to its ability to reveal quantitatively almost any material.
Over the past decade, mass spectrometry has been revolutionized by access to instruments of ultra high mass-resolving power, based on Fourier transform of image currents induced by ion oscillations in the analyzer.

The orbitrap confines ions in an electrostatic quadro-logarithmic potential created between carefully shaped coaxial central and outer electrodes. Ions are pulsed into the device so that they rotate around the central electrode and oscillate along it with axial frequencies of 200–2000 kHz for *m*/*z* of 10–1000. The outer electrode is split into two halves to allow differential image-current detection. Unlike ICR, coherent motion of ion packets is provided during the injection process and detection occurs immediately after all ions have been injected into the trap and after voltage on the central electrode has stabilized.

The orbitrap typically achieves a mass-resolving power of 100,000 at *m*/*z* of 400 u. Resolving power is limited by the observation period duration, the collisions with residual gas molecules, and the imperfections in the electric field (caused, for example, by the ion injection slot and/or inaccuracy of machining), and instability of the high-voltage power supply. Accurate exact mass measurement (<2 ppm) is maintained for dynamic ranges greater than 5000, which is at least an order of magnitude higher than that for TOF.
Since January 2009, CNES has funded a R&D program to develop a space instrument based on the new concept. The analyzer has since been chosen as a candidate analyzer in two instruments: The Ion Laser Mass Analyzer (ILMA) Instrument, proposed on the MASCOT lander of the Marco Polo NEO sample return mission, and on the Dust Detector proposed on the future Jupiter orbiter mission of ESA. The present Technology Readiness Level (TRL) of the analyzer is between 3 and 4. A consortium of 4 laboratories lead by IPAG is involved in a program to bring the TRL at the level of 5. At that level, it will be ready for a formal proposal to the Space Agencies, and further implementation in either of the missions. Except IPAG, the 3 laboratories are spatial laboratories and have all developed mass spectrometry instrumentation in the past: LPC2E Orleans, LATMOS Versailles and LISA Creteil. A prototype is under test in Orleans, but these tests are limited to the conventional electronic, power, mass and mechanical roughness qualification (thermal and vibration). None of the partners involved has a chemical analog characterization facility, neither vacuum chamber in which the mass spectrometer might be put in contact with those analogs. This project therefore lacks one of the key issues stated in the CNES internal report ([12]) and the present PASS project would be an excellent opportunity to implement the facility at the earliest level of the project, as recommended.
Moreover, the availability of such a specific testing platform will allow local industrials to test their components in harsh environment and / or again aggressive chemical situation. This opportunity is a direct positive outcome of the interdisciplinary situation of IPAG (Chemist + Physicist + Engineers + Planetary sciences People + Astronomers, etc.).

**Conclusions**
From a general R&T point of view, PASS will allow to manage the delicate intermediate TRLs at the interfaces between all involved partners including industrials and space agencies. Indeed, the TRL demonstration from the lowest level (concept validation) to the highest one (demonstration of proper operation in real scale conditions) requires specific efforts and resources. Academic groups are often well suited to address the lower TRLs. Some of the higher TRLs corresponding to the real scale demonstration are efficiently address by the group specialist of the instrument realization, while industrial groups are well suited to the assessment of TRLs corresponding to device production.
We expect the PASS facility to become a precious partner for the main agencies that drive major astronomical programs for prospection, evaluation and characterization of state of the art new technology sensors to cross the low-to-high TRLs (“death”) valley.

We estimate that the PASS Platform will allow developing new projects similar to our current FUI funded project SWIFT, RAPID and DROP. These projects currently represent 20 Millions Euros and involve 5 industrial partners, involving about 10 jobs over the coming 3-4 years (more than 60 jobs are foreseen in the RAPID & DROP projects). Such a facility will leverage our possibilities to discover new opportunities within the Grenoble detector and devices environment and will allow us to develop new such collaborative projects.

### 3.2.2 STRUCTURE ET COMPOSITION DE L'EQUIPEMENT /STRUCTURE AND BUILDING OF THE EQUIPMENT

The equipments of the PASS Platform will be installed in a coherent manner within the same building block currently available in one of the IPAG buildings (Figure 2 & Figure 3). We will gather in the same place 2 specific facilities for:

**1- Astrophotonics**

***1.1-*** *Vacuum and cryogenics.*

This will entirely be new "on the shelf" equipment:

- Two standalone pumping systems in order to be able to handle multiple detector systems that will be tested in PASS.
- One He leak detectors.
- Two fully equipped liquid nitrogen tanks (Air Liquide TP).
- One horizontal and one vertical laminar flux systems for clean system integration.
- Vacuum accessories needed to efficiently operate the above described equipment.

This equipment will allow us to quickly and safely integrate and characterize the detectors developed by our industrial partners. The foreseen equipment will be necessary to address IR and visible detectors at the same time.

***1.2-*** *Accurate detector characterization in the visible IR range.*

This will entirely be new "on the shelf" equipment

- Two optical benches (Thorlab) with vibration damping equipment
- Visible and IR integrating sphere and accessories.
- Calibrated IR extended field blackbody.
- Optomechanics accessories for optics mounting etc.

***1.3-*** *Metrology and spectroscopy investigations.*

This will entirely be new "on the shelf" equipment

Ultra-pure tunable line facility using a TiSa laser + a tunable Fabry-Perot filtering, to provide calibrated pure tunable spectral line over 700-950 nm range without ghosts, + an IR similar functionality in the H atmospheric band (1.6$\mu$m). This will allow us to test integrated optics elements in single mode with a very small optical etendue.

- Two optical benches (Thorlab)
- TiSa Laser + pump laser
- Pabry-Perot + controller
- Infrared extention (Tunics laser)
- FTS Spectrometer
- Optomechanics accessories

**2- Space Subsystem testing**

***2.1**- Analog materiel production*

- Moderate vacuum Chamber ($10^{-8}$) equipped with sublimation, cryogenic and reactive plasma will be necessary in order to be able to produce broad variety of materials similar to the one expected during the in-situ planetary exploration

Physico chemical instrumentation to characterize those analogs :

- Visible and IR microscopes
- Spectro goniometer
- UV & fluorescence spectrometers

***2.2**- Chamber for subsystem testing in front of analog material*

This chamber shall have an operative volume of roughly $1m^3$, it will be designed to provide: high and ultra high vacuum conditions, baffled cryogenics down to Liquid Nitrogen temperature, adjustable electromagnetic conditions in order to simulate space environment, as well as planetary atmospheres, a positioning system to vary the relative geometry between analysis instrument and the analog material.

### 3.2.3 ENVIRONNEMENT TECHNIQUE / TECHNICAL ENVIRONNEMENT

PASS will be installed in one of the IPAG buildings, in a very favorable environment on the UJF campus. We will be simultaneously close to IRAM, OSUG, LSP (Spectroscopy lab), and the UJF Physics teaching building (see Figure 2 below).

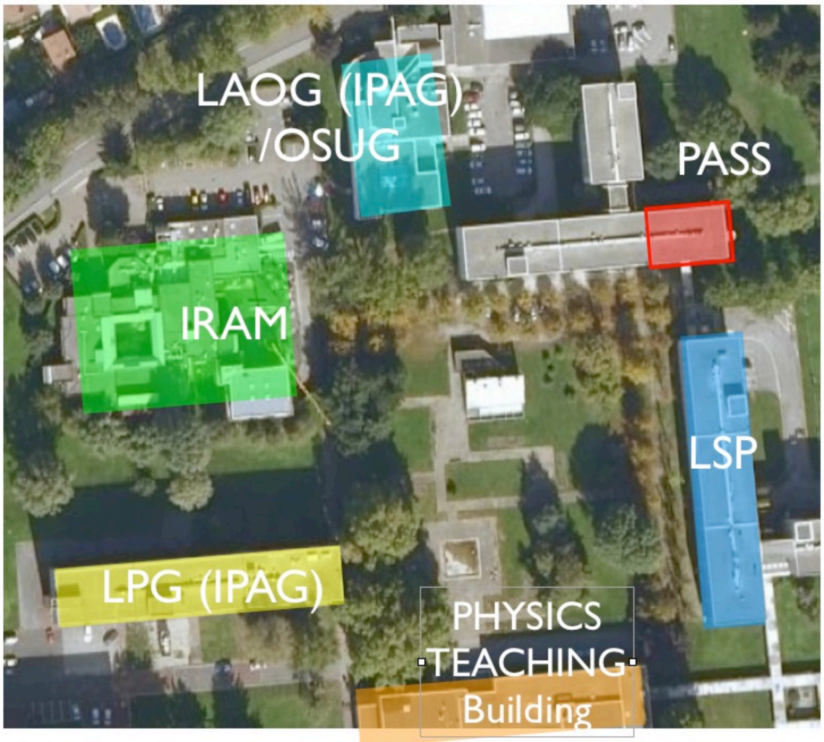


**Figure 2** *PASS situation on the UJF campus*

Within the IPAG building, PASS will assemble dedicated labs and clean rooms together with close visitor offices. Each lab will be individually equipped with specific instrumentation to address Optical & infrared imagery and spectroscopy (astrophotonics), as well as space borne subsystems testing. The CERMO building beside LAOG will provide the adequate technical environment to implement the PASS facility. The following figure displays a preliminary sketch of the PASS premises. It is designed in a coherent manner, with a possible restricted access for confidentiality of the sensor developments and tests. This facility will be located meters away from another block at the same floor, where IPAG ground-based instrumental projects are currently being developed. A visioconference room is already available there, allowing efficient interaction and discussion between PASS partners and users. The cost for the adaptation of the PASS Platform and instruments implementation is estimated in the PASS "A" file financial part. The main PASS partner, UJF, will guarantee that these CERMO rooms will be available for the estimated start of the project, in summer 2011.

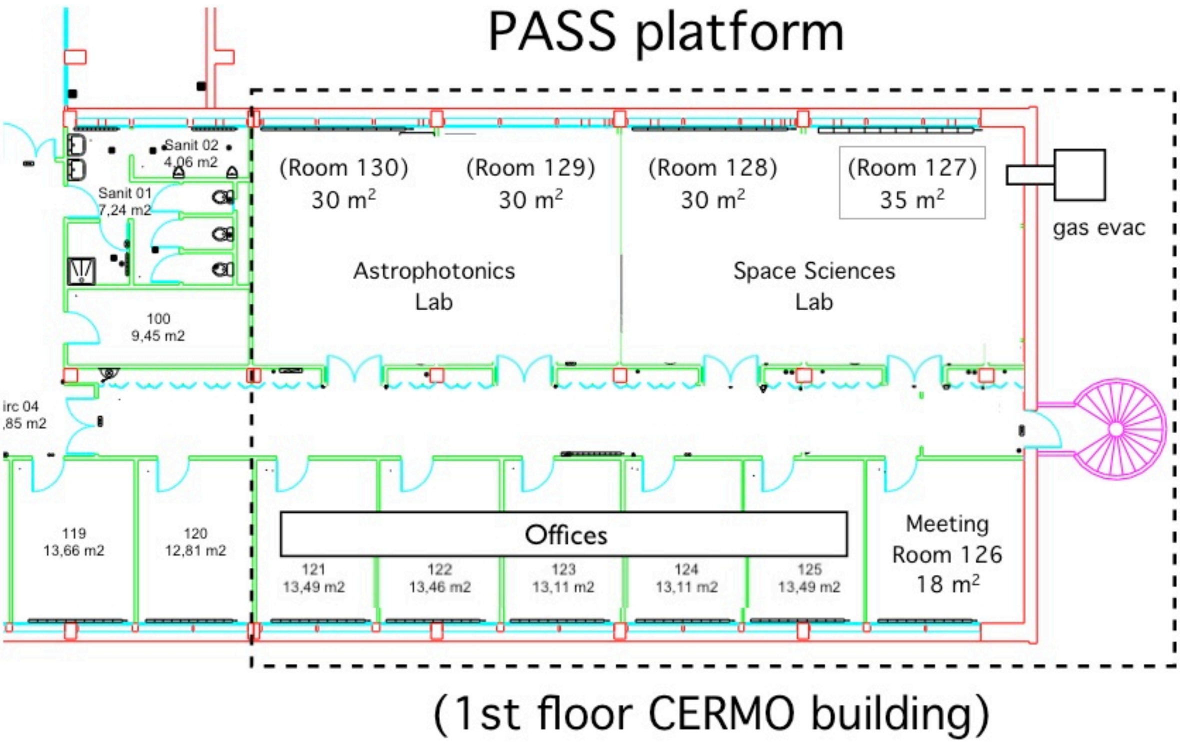


**Figure 3** *Sketch of the proposed PASS implementation in the eastern 1st floor of the CERMO building.*

PASS should provide instrumental results within the first 3 years. Examples of developments to be started with PASS include test and characterisation of the near IR detectors of the RAPID FUI project, and preliminary tests and characterisation of the SWIFT component in space environment, including in-situ testing for a future LIBS applied SWIFT component installed on a Mars rover. Depending on the results of these first projects, we will propose an eventual extension of the PASS platform, possibly implying the construction of a new building.

# 4. STRATEGIE DE VALORISATION DES RESULTATS/ DISSEMINATION AND EXPLOITATION OF RESULTS

PASS will have a multimodal results dissemination strategy. This strategy will involve 1- teaching / formation, 2- scientific results publication and 3- industrial product dissemination.

**1- Teaching / Formation**

From its privileged position on the UJF campus, close to the Physics L3-M1 teaching building, PASS will welcome many students. The instrumental aspect of the project will be used to support a professional License (L3) as well as Master students at the M2 level, from many M2 categories in UJF. This will be straightforward, thanks to previous IPAG teachers involvement in 'IUT' (One of UJF Technological school) teaching. We will also develop numerous "CIFRE" PhDs (French industry-collaborative PhD) between IPAG and our industrial partners.

**2- Publications**

Through our strong implication in instrumental publications (more than 100 SPIE publications over the last 4 years), we will be able to quickly publish in peer reviewed international journals our new tests / discoveries as was already done in the past (see e.g. [21][22][23]).

**3- Dissemination and exploitation of results**

IPAG (via LAOG) has a long-lasting experience of dissemination and exploitation of its instrumental results in the industry. LAOG possesses five patents and one license. We have given birth to a spin-off in 2008 in the domain of micro-mirrors for adaptive optics (*ALPAO*). We are currently involved in 3 "interministry funds" (FUI) developments: *SWIFT*, *RAPID* and *DROP* projects, representing a total funding of 20 Million Euros, with 80% spent in industrial collaborations. These FUI involve more than 10 new jobs. Most of our current exploitation results involve the UJF subsidiary *Floralis* with which we have a large working experience. They take care of the result protection activity. Building on this past and current experience as well as our privileged interaction with Floralis, the PASS platform will be an invaluable place to plan and develop new industrial applications.

We are therefore well placed to have a bunch of new projects flourish that will create strong new interactions with local industries form the Grenoble Basin and provide new jobs. When the PASS platform will be fully equipped, we estimate that less than two years should be necessary to see a new industrial project to be born. We can envisage 10 new jobs to be created quickly. We estimate that 2 new spin-offs should be created within the next 2 years (around the SWIFTS and DROP project).

Technology transfer also encounters a "death valley", between conceptual ideas and practical industrial developments. Here again, the PASS project will offer the opportunity to bridge this gap between scientists and industrials.

Each new development in PASS will be envisaged from an evolutionary point of view: we will study how a specific dedicated industrial component / technology can be adapted to meet astrophysics or space sciences needs. This method intrinsically implies a Technology transfer potential, as the component will have to be tested against new detection conditions and / or analog materials. Such a virtuous circle successful method has already been proven for the following recent developments in LAOG: SWIFT and OCAM.

**Interest of our industrial partners**

IPAG (former LAOG) has been interacting with sensors industrials since many years now. We bring to them a specific expertise in the domain of detection to test their components in conditions they cannot reproduce or finance in their facilities. These collaborations open to them the astronomical market that can later yield to spatial developments.

# 5. MANAGEMENT DU PROJET / PROJECT MANAGEMENT

## 5.1. ASPECTS ORGANISATIONNELS / MANAGEMENT

### 5.1.1 QUALIFICATION DU COORDINATEUR DE PROJET /RELEVANT EXPERIENCE OF THE PROJECT COORDINATOR

Jean-Louis Monin, the project coordinator, is a "Classe exceptionnelle" Astronomy Full teacher of University Joseph Fourier. His research themes have evolved from an instrumental activity concerning the use of new infrared detectors in many applications for high angular resolution observations (imaging, interferometry, adaptive optics) to the study of star formation, evolution of disks and accretion phenomena in double stars, as well as models of young brown dwarfs circumstellar environment.

These studies have accompanied the development of the LAOG activity in the high angular resolution infrared domain, activity that he initiated in the 1990s (via development of infrared cameras for imaging and adaptive optics, infrared interferometry, training of graduate students in the field of infrared detectors used in astronomy). A large part of his work in the domain of infrared detectors led to the supervision of academic-industrial PhDs (3 "CIFRE" contracts). He was one of the firsts LAOG scientists to collaborate with LETI/LIR and Sofradir during his Phd in 1985, to use IR detectors arrays in the field of Astronomy ([32]). He has a large experience of science management, he has been Scientific Director of the Universe Science Department (DS3) in the French Ministry of research (2000-2002), Deputy Director (2003-2006) then Director of LAOG (2007-2010), and will lead the new IPAG laboratory. He was a junior member of the French University Institute (IUF) in 1997. He has published more than 100 papers, out of which more than 50 in peer reviewed international journals. He has supervised 10 PhDs, and some of his former students now have jobs in prestigious research establishments like CNES, ONERA and ESO. With this experience and background, Jean-Louis Monin is amply capable of coordinating the PASS project.

### 5.1.2 MODALITES DE COORDINATION/ COORDINATION MODALITIES

The project will be managed by the coordinating partner (IPAG, UJF), and PASS use will be decided by IPAG and its Scientific Council. The use of the PASS platform will be opened to academic laboratory partners as well as to industrial partners. The PASS project does not currently have partners in the way defined in the "Equipex" call for tender. Instead, we have numerous industrial collaborators who will rapidly use the PASS facility (see e.g. the Support Letter by *TeemPhotonics* enterprise in section 7.4). The use of the specific equipments of the platform will be subject to payment of a fee that we estimate of the order of 50-100 € / hour. The UJF subsidiary *Floralis* will take care of the administration of these fees, and will manage the re-imbursement to UJF and IPAG (see support letter from *Floralis* in section 7.4). We already have a strong expertise in this domain from our previous collaborations with Floralis who currently manages our industrial License concerning deformable mirrors ([14]). If the PASS project gets accepted, we will define a specific PASS executive board, including the IPAG director, a representative of UJF as such, and a representative of the Minalogic competitivity group.

## 5.2. ORGANISATION DU PARTENARIAT / COLLABORATION ORGANIZATION

### 5.2.1 DESCRIPTION, ADEQUATION ET COMPLEMENTARITE DES PARTENAIRES/PARTNERS DESCRIPTION , RELEVANCE AND COMPLEMENTARITY

The PASS project does not currently have partners in the sense defined by the "Equipex" call for tender. Hence, we did not fill the Table provided in section 5.2.2. Instead, we have numerous industrial collaborators who will rapidly use the PASS facility (see e.g. the Support Letter by *TeemPhotonics* enterprise). These collaborations have led to numerous technology transfer projects like the FUI ones described previously in the text. These "collaborative partners" make a very complementary network, from Visible to IR detectors, integrated optics, lasers, deformable mirrors, etc. In the center of this network, the PASS platform will provide the system expertise of IPAG engineers and scientists. Once the PASS facility has started these collaborators will potentially become true partners in a more ambitious version of the project.
These collaborators are hereafter described through their participation to the various FUI projects LAOG is involved into:
FUI "Swift 400-1000": Floralis, TeemPhotonics, E2V, IMEP, LTM
FUI "RAPID": Sofradir, Biospacelab, CEA-LETI, LAM (Marseille), ONERA (Chatillon).
FUI "DROP": Aeromecanics, LAM, ONERA, CEGELEC.

**They bring complementary expertise in a wide range of domains (IR and visibles detectors, Lasers, integrated optics, system expertise, etc.). They are detailed in**

Tableau 1 below.

| Collaborator | Domain of expertise |
|---|---|
| Sofradir | IR detectors, (military and space-borne applications) |
| TeemPhotonics | Integrated Optics and Lasers |
| E2V | Visibles CCDs, (medical, military and space-borne applications) |
| ST microelectronics | Detectors, micro-imagery (CMOS) |
| IMEP-LAHC | Integrated optics; radio frequencies |
| FLORALIS | UJF subsidiary. |
| LTM | Microelectronics technologies |
| CEA LETI-LIR | High technology developments & applications |
| ONERA | Adaptive Optics applications |
| ALPAO | Adaptive Optics astronomical applications (spin-off from LAOG) |

**Tableau 1 : Non exhaustive list of PASS collaborators and domain of expertise**

### 5.2.2 QUALIFICATION, ROLE ET IMPLICATION DES PARTENAIRES / QUALIFICATION, ROLE AND INVOLVEMENT OF INDIVIDUAL PARTNERS

| Partenaire/Partner | Nom/Surname | Prénom/First name | Poste/Position | Discipline/Domain | Organisme de rattachement ou entreprise/Organization or company | Rôle dans le projet (4 lignes max.) / Contribution in the project (4 lines max) |
|---|---|---|---|---|---|---|
| | | | | | | |

## 6. EVALUATION FINANCIERE DU PROJET/ FINANCIAL ASSESSMENT

The global PASS financial needs are summarized in **Tableau 2** below and detailed in the following paragraphs (A, B & C).

| | | |
|---|---|---|
| Investment (A+B) | Hardware 1875 k€ | 2500 k€ |
| | Installation 625 k€ | |
| Operation (C) | | 1997 K€ |

**Tableau 2 : Summary of PASS request for equipment (+installation costs) & 8-years opération (all costs are presented with VAT non included, i.e. "HT")**

**A- PASS installation & implementation: 625 k€.**

The PASS platform will be installed in one of the IPAG building, close to OSUG (see Figure 2). This building will have to be adapted to provide the foreseen facility. This will imply to reorganize the working space. Based on the experience of a similar building currently being refurbished (bat LPG on Figure 2), we estimate this building adaptation to 1 k€/m2, hence a total of 150 k€ for the two PASS facilities (150 $m^2$, i.e. half of the global PASS surface, as we don't include here the offices in this amount).

We need to add an air conditioning + minimum air filtering to this adaptation. Based on our previous experience with our integration hall refurbishing in 2008-2009, we estimate this to 40 k€/room = 80 k€.

To these 230 k€ hardware costs, we will have to add personnel costs to implement the PASS facility. These costs are described below for the two main facilities of the PASS platform (Astrophotonics and Space subsystems). Moreover, We estimate that the astrophotonics and space subsystems facilities will be installed over 2 years, to be subsequently operated for 8 supplementary years.

**Astrophotonics facility**

The installation of the PASS astrophotonics facility will be supervised by 3 "research Engineers" from IPAG, at 10% of their available time. They will supervise the needed personnel to install the facility. We will need one "Ingenieurs d'études" to actually install the facility during 2 years.

**Space subsystems facility**

The installation of this facility will benefit from a strong involvement of planetary scientists from IPAG to supervise this installation. The actual installation will require another "Ingenieurs d'études" during 2 years. To these 2 Engineers, we will require the funding of one technician and 2 post-docs.

The total personnel needed for the implementation of PASS therefore amounts to 355 k€.

Finally, we foresee 20 k€ / year for missions and lab internal billing during the 2 years of PASS installation, for a total of 40 k€.

**B- Total PASS equipment: 1875 k€**

**Astrophotonics facility :**
Most of the astrophotonics equipment listed in section 3.2.2 will be "on the shelf" equipment, and we provide the quotations as much as we could obtain form the providers. Some of these equipments are specific and the quotations could not be obtained before the 15 sept deadline, they will be provided in the printed version of this proposal. Every item in this equipment list will have a 5 year amortization period.

**Space subsystems testing facility**
Concerning the space subsystems facility, the building of the analog testing chamber will have to be performed in situ. The cost estimates of this facility comes from similar equipment installed e.g. on the SOLEIL synchrotron. This facility is estimated to have a 10 year amortization period.

**1- PASS Astrophotonics**

**1.1-** Vacuum and cryogenics : 94 k€

This will be new "on the shelf" equipment

- Two standalone pumping systems Drytel 1025 Standard Pompes ATH31+ / AMD4 : 11 k€ (quotation in section 7.3).
- One He leak detectors Adixen ASM Graph D+: 20 k€ (quotation in section 7.3).
- Two fully equipped liquid nitrogen tanks (Air Liquide TP): 20 k€ (quotation pending).
- One horizontal and one vertical laminar flux systems for clean system integration: 23 k€ (quotation in section 7.3).
- Various vacuum accessories needed to efficiently operate the above described equipment: 20 k€.

**1.2-** Accurate detector characterization in the visible IR range: 167 k€.

This will be new "on the shelf" equipment
- Two optical benches (Thorlab) with vibration damping equipment: 19 k€ (quotation in section 7.3).
- Visible and IR integrating sphere and accessories: 70 k€ (quotation in section 7.3).
- Calibrated IR extended field blackbody: 28 k€ (quotation in section 7.3).
- Various Optomechanics accessories for optics mounting, etc.: 50 k€

**1.3-** Metrology and spectroscopy investigations: 484 k€

This will be new "on the shelf" equipment
Ultra-pure tunable line facility using a TiSa laser + a tunable Fabry-Perot filtering, to provide calibrated pure tunable spectral line over 700-950 nm range without ghosts, + an IR similar functionality in the H atmospheric band (1.6$\mu$m). This will allow us to test integrated optics elements in single mode with a very small optical etendue.
- Two optical benches: 19 k€ (quotation in section 7.3, *Thorlab*).
- TiSa Laser + pump laser: 150 k€ (quotation pending).
- Pabry-Perot + controller: 50.4 + 52.2 k€ (quotation in section 7.3, *ICOS*).

- Infrared extention (Tunics laser): 32 k€ (quotation in section 7.3, *Photonlines*).
- FTS Spectrometer: 130 k€ (quotation in section 7.3, *Vertex*).
- Optomechanics accessories and integration: 50 k€ (based on our experience in the SWIFTS FUI project).

**2- Space Subsystem testing**

**2.1**- Analog materiel production: 630 k€

- Moderate vacuum Chamber ($10^{-8}$) equipped with sublimation, cryogenic and reactive plasma will be necessary in order to be able to produce broad variety of materials similar to the one expected during the in-situ planetary exploration: 200 k€ (estimation from previous experience on SOLEIL synschrotron).

Physico chemical instrumentation to characterize those analogs :

- Visible and IR microscopes: 30 + 130 k€
- Spectro goniometer: 160 k€
- UV & fluorescence spectrometers: 110 k€

**2.2-** Chamber for subsystem testing in front of analog material: 500 k€.

This chamber shall have an operative volume of roughly 1m$^3$, it will be designed to provide: high and ultra high vacuum conditions, baffled cryogenics down to Liquid Nitrogen temperature, adjustable electromagnetic conditions in order to simulate space environment, as well as planetary atmospheres, a positioning system to vary the relative geometry between analysis instrument and the analog material.

**C – Operation cost of the PASS facility (integrated over 8 years): 1997 k€**

The PASS facility will be operated by permanent Research Engineers and Scientists from IPAG, in collaboration with industrial partners wishing to test their detectors against analog materials or in specific conditions. We estimate that 3 Research Engineers working at 30% of their time will operate on PASS, + one Study Engineer at 50% of his time, + 3 scientists at 30%. **This Permanent personnel participation amounts to ~1654 k€**. We will also have (on the average) 2 PhD students and 2 Post-Docs working at full time on PASS projects during the 8 years duration of the platform. We will also request that UJF supports the project by allotting 2 non-permanents Engineers (CDD) to the PASS project for the 8 years projected for the PASS operation. **This non-permanent personnel participation to the project amounts to ~1483 k€**. These costs (with no ANR request) are precisely listed in the accompanying doc A. We will need to request to ANR an estimated cost of 10% of the equipment price for yearly maintenance expenditure, yielding 180 k€ / year x 8 years = 1440 k€ for the whole PASS project.

We will also require the following items:

- Liquid Nitrogen: 10 k€/ year -> 80 k€ over the PASS project operation.
- External services: 10 k€ / year -> 80 k€ over the PASS project operation.
- Missions: 10 k€ / year -> 80 k€ over the PASS project operation.
- Building cost (university fee): 300m2 global PASS surface x 100 €/m2/year = 240 k€ for all the project 8 years operation.

We request 1920 k€ to ANR for PASS operation expenditure over 8 years. Taking into account a 4% fee for money management ("frais de gestion" : 76.8 k€ over the 8 years), this yield to a **grand total request of 1997 k€ to ANR for PASS operation over 8 years**.

# 7. ANNEXES / APPENDICES

## 7.1. REFERENCES BIBLIOGRAPHIQUES DE L'ETAT DE L'ART/STATE OF ART REFERENCES


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## 7.2. ACRONYMES UTILISES / ACRONYMS USED IN THE TEXT

PASS: Platform for Astrophysics and Space Sciences Systems
ESO: European Southern Observatory
ESA: European Space Agency
SOFRADIR: Société Française de détecteurs Infrarouges (Largest French IR detector company).
RAPID: Revolutionary Avalanche Photodiode Infrared detectors
SWIFTS: Stationary Wavefront Interferometry Fourier Transform Spectrometer
DROP: Detection Robotisée d'Objets sur les pistes d'atterrissage (Automated Objects Detection on Runways).
PTA: "Plateforme Technologique Avancée" (Advanced Technological Platform, CNRS facility)
MITATEC: Micro and Nano Technologies Platform.
HARPS: High Accuracy Radial velocity Planet Search project
ESPADON: Spectro Polarimeter on the CFH Telescope.
VLT(I): European Very Large Telescope (+Interferometric mode), four 8-m telescopes in Chile.
NAOS: Nasmyth Adaptive Optics System (ESO VLT)
SPHERE:
CONSERT: Embarked Radar experiment on the ROSETTA mission

IRAM: Institute for Radioastronomy in the millimeter range
IAS: Space Astrophysics Institute (Orsay university)
CESR: CEnter for Space and Radiation Studies (Toulouse University)
IPAG: Institute of Planetology and Astrophysics in Grenoble
LAOG: Astrophysics Laboratory of Grenoble
LPG: Planetary Sciences Laboratory in Grenoble
CERMO: Center for Research on Molecules (OSUG nearby building)
OSUG: Observatory of Grenoble
LTM: Laboratoire des Technologies de la Micro-électronique
IMEP: Institut de Microélectronique Electromagnétisme et Photonique
LAHC: LAboratoire d'Hyperfrequences et de Caractérisation

### 7.3. DEVIS POUR L'EQUIPEMENT/ESTIMATE FOR THE EQUIPEMENT

Astrophotonics (vacuum, detectors, spectroscopy) adixen

by Alcatel Vacuum Technology

| | |
|---|---|
| **Emetteur**<br>**Alcatel Vacuum Technology France**<br>98, avenue de Brogny<br>BP 2069<br>74009 Annecy Cedex<br>FRANCE<br>Tel : 33 (0)4 50 65 77 77<br>Fax : 33 (0)4 50 65 77 89 | CNRS-LABO D'ASTROPHYSIQUE<br>OBSERVATOIRE DE GRENOBLE<br>UNIVERSITE JOSEPH FOURIER<br>414 RUE DE LA PISCINE<br>BP 53<br>38041 GRENOBLE CEDEX 9<br>FRANCE |
| Contact : Jérémy ARMINJON<br>Tel : 0450657853<br>Fax : 0450657584<br>E-mail : jeremy.arminjon@adixen.fr | Attn : M. Philippe FEAUTRIER<br>Tel : 04 76 63 59 81<br>Fax : 04 76 44 88 21<br>E-mail : Philippe.Feautrier@obs.ujf-grenoble.fr |

**OFFRE**

**N°** 20120569 **/ Date** 13.09.2010

Page 1

Vos références :

Madame, Monsieur,

Conformément à votre demande, nous avons le plaisir de vous adresser ci-après notre meilleure proposition pour la fourniture suivante :

| N°. POS | REFERENCE DESIGNATION | QTE | PRIX UNITAIRE HT | VALEUR TOTALE HT |
|---|---|---|---|---|
| | | | EUR | EUR |
| 10 | D025BSNNS820<br>D1025 ATH31+ PP1M HT FR | 1 | 5.500,00 | 5.500,00 |
| | Ce groupe de pompage secondaire est composé d'une pompe à membrane (AMD1) et d'une pompe secondaire robuste (ATH 31+). Ce système de pompage est idéal pour assurer un pompage sec et propre (sans hydrocarbures et sans particules).<br>Sa conception permet d'atteindre une pression limite dans la gamme 10^-8 mbar tout en pouvant assurer des applications en flux jusqu'à une pression d'aspiration de 10 mbar (400 SCCM).<br>Ainsi le DRYTEL 1025 est recommandé pour le pompage de gaz inerte chimiquement avec une performance bien adaptée à des applications comme régénération de pompe cryo, microscope électronique, spectromètre de masse, calibration de jauge ou vanne, vidange de bouteilles de gaz, pompage sec de ligne de gaz, ... .<br><br>Le système DRYTEL 1025 se caractérise entre autres par :<br>- l'universalité de sa tension et fréquence associée à une interface utilisateur simple (interrupteur) qui lui confère une facilité d'utilisation,<br>- un poids faible (16 kg), des dimensions raisonnables (385 x 305 x 240 mm) permettant sa portabilité. | | | |
| 20 | N0R00001A820<br>ASMGRAPHD+ HE JR CI F+M 200-50/60 FR | 1 | 19.500,00 | 19.500,00 |

Du composant à la solution

OPTOPRIM

**M. MOULIN**
**OBSERVATOIRE DE GRENOBLE**
**414 RUE DE LA PISCINE**
**BP 53X**
**38041 GRENOBLE CEDEX**
thibault.moulin@obs.ujf-grenoble.fr

## OFFRE DE PRIX N° 0409191THOR-REV1

**DATE :** 23/04/09

M. MOULIN
Suite à votre demande, nous vous prions de bien vouloir trouver ci-dessous nos meilleures conditions de prix et délais :

| Référence | Désignation | Prix unit H.T | Qté | Total H.T |
|---|---|---|---|---|
| PBI52515 | Optical Breadboard - 1200 x 900 x 110mm | 1.482,40€ | 1 | 1.482,40€ |
| PFP52505 | 800 Work Frame 750 x 900 Passive | 1.697,20€ | 1 | 1.697,20€ |
| PTQ51504 | Optical Table - 2000 x 1000 x 210mm | 2.622,40€ | 1 | 2.622,40€ |
| PTS503 | Active Vibration Isolation, 700mm (28"), Set of 4 | 3.018,90€ | 1 | 3.018,90€ |
| TRANS | Frais de port (livraison au bas du bâtiment, 800Kg environ) | | | 580,00€ |
| | | | TOTAL H.T. | 9 400,90€ |

***Nos prix sont établis en Euros, hors T.V.A. (19.6 % en sus), douane comprise. Ils sont fermes et non révisables.***

***DELAI DE LIVRAISON** : 4 semaines. Une date de livraison ferme sera établie une semaine après réception de la commande.*

***CONDITIONS DE REGLEMENT** : Les règlements sont à 30 jours net date de facture.*

***VALIDITE DE L'OFFRE** : 30 jours*

***Merci de joindre cette offre de prix à votre commande.***

**Maïté LARTIGUE**
☎ +33 (0)1 41 90 33 75
Fax +33 (0)1 41 90 61 89
e-mail : mlartigue@optoprim.com

OPTOPRIM partenaire de THORLABS

**ADS Laminaire**
*air dépoussiéré — stérile laminaire*

Votre contact :
Damien BISSON
01 48 44 66 75 / 06 60 30 74 77
damien.bisson@adslaminaire.com

CNRS 38 OBSERVATOIRE DE GRENOB
Monsieur Thibaut MOULIN
414, rue de la Piscine
38041 GRENOBLE Cedex

Tel Contact : 0476635525 Fax Contact : 0476448821
E-mail Contact : thibaut.moulin@obs.ujf-grenoble.fr

**Devis RA-2009-21-01/B du 11/06/2009**

Page n°1

**Description:**
SBM de 3000 x 2000 mm - ISO 7

| Référence | Désignation | Quantité | Prix Unitaire | Remise | Montant HT |
|---|---|---|---|---|---|
| SBM | SALLE BLANCHE MODULABLE - ISO 7<br>Dimensions de 3.000 x 2.000 mm<br>Hauteur sous flux de 2.200 mm<br>Structure en aluminium reposant sur 4 piètements avec vérins<br>Le plafond est équipé de :<br>- 1 caisson autonome FANJET à régulation automatique<br>- 1 caisson d'éclairage affleurant avec 4 fluo<br>- Plaques de plafond<br>Un tableau de commande TAC VIEWER indiquant le débit, la vitesse et la perte de charge<br>Une commande de mise en veille<br>Une commande d'éclairage<br>La périphérie de la zone est munie de rideaux en vinyle transparent antistatique en bandes de 330 mm | 1,00 | 11 715,00 | -10% | 10 543,50 |
| LIV | Livraison, Installation et Mise en service | 1,00 | 1 170,00 | -50% | 585,00 |
| SAVCONT | Contrôle des vitesses, Comptage particulaire, Intégrité du filtre par balayage au compteur et rapport des contrôles | 1,00 | 360,00 | | 360,00 |

**Total Poste Devis :** **11 488,50 €**

BFi OPTiLAS

**DIVISION INSTRUMENTATION & MESURES**

PROPOSITION DE PRIX
N° **DUVALS1009014**

Affaire suivie par : **Stéphane DUVAL**

Tél : 05 56 32 27 95 / 06 73 18 17 45
Fax: 01 60 79 89 01
E-Mail : Stephane.Duval@bfioptilas.com

**OBSERVATOIRE DE GRENOBLE**
**M. Philippe FEAUTRIER**
**414 RUE DE LA PISCINE**
**BP 53X**
**38041 GRENOBLE CEDEX**

Evry, Le 10/09/2010

A l'attention de M. Philippe FEAUTRIER
V/Tél. : 04 76 63 59 81

## OFFRE BUDGETAIRE

Monsieur FEAUTRIER,

En réponse à votre demande, nous vous prions de bien vouloir trouver, ci-dessous, nos conditions de prix et délais pour la fourniture du matériel LABSPHERE ayant retenu votre attention :

| N° | Réf | Désignation | Qté | Délai (sem.) | P.U.H.T en EUROS | Statut RoHS ** |
|---|---|---|---|---|---|---|
| 1 | LR-4-L | **Source uniforme étalon bas niveau de Radiance** à base de sphère intégrante de 4 pouces (revêtement en Spectraflect) et port de 1.0 pouce en sortie.<br>Le système complet intègre :<br>- Source LR4-L avec détecteur Silicium refroidi, l'alimentation variable pour piloter la lampe Tungsène-Halogène<br>- d8-IGA-100-TE (détecteur InGAs)<br>- d8-IGA-100-TE-E (détecteur InGAs bande étendue)<br>- Keithley 6485<br>- Roue porte-filtres 12 positions avec son jeu de filtres<br>- Atténuateur variable type VA-1 automatique avec son controleur<br>- Etalonnage de l'ensemble et design mécanique et optique. | 1 | 10-12 | **60 000.00** | Co |
| 2 | MONO | **Solution poste 1 avec option monochromateur en remplacement de la roue porte-filtres.** | 1 | / | **+10 000.00** | Co |

| | | |
|---|---|---|
| **- Solution poste 1** | **Total H.T. en EUROS** | **60 000.00** |
| **- Solution poste 1+2** | **Total H.T. en EUROS** | **70 000.00** |

**BFi OPTiLAS SAS**
ZI La Petite Montagne Sud - 4 allée du Cantal - CE 1834 - Lisses - 91018 Evry Cedex - Tél : 01 60 79 59 00 - Fax : 01 60 79 89 01
SAS au capital de 5 552 100 Euros - SIRET 392 078 192 00011 - APE 4652 Z - T.V.A. FR 75 392 078 192 - R.C.S. EVRY

## CONDITIONS DE VENTE

| *POSTE* | *QTÉ* | *DESIGNATION* | *PRIX HT (EUROS)* |
|---|---|---|---|
| 1 | 1 | SOURCE INFRAROUGE DE REFERENCE ECN100H12 | 26 300 |
| | 1 | FRAIS D'EXPEDITION | 100 |
| | | MONTANT TOTAL | 26 400 |

OPTIONS

| *POSTE* | *QTÉ* | *DESIGNATION* | *PRIX HT (EUROS)* |
|---|---|---|---|
| 2 | 1 | LIAISON RS232 | 650 |
| 3 | 1 | LIAISON IEEE488 | 1 200 |
| 4 | 1 | PROTOCOLE ETHERNET | 900 |

Les prix s'entendent hors taxe en Euros. TVA en vigueur 19,6% en sus, frais d'expédition du matériel décrits ci-dessus.

Du composant a la solution

PHOTONICS for research & industry

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thibault.moulin@obs.ujf-grenoble.fr

## OFFRE DE PRIX N° 0409191THOR-REV1

**DATE : 23/04/09**

M. MOULIN
Suite à votre demande, nous vous prions de bien vouloir trouver ci-dessous nos meilleures conditions de prix et délais :

| Référence | Désignation | Prix unit H.T | Qté | Total H.T |
|---|---|---|---|---|
| PBI52515 | Optical Breadboard - 1200 x 900 x 110mm | 1.482,40€ | 1 | 1.482,40€ |
| PFP52505 | 800 Work Frame 750 x 900 Passive | 1.697,20€ | 1 | 1.697,20€ |
| PTQ51504 | Optical Table - 2000 x 1000 x 210mm | 2.622,40€ | 1 | 2.622,40€ |
| PTS503 | Active Vibration Isolation, 700mm (28"), Set of 4 | 3.018,90€ | 1 | 3.018,90€ |
| TRANS | Frais de port (livraison au bas du bâtiment, 800Kg environ) | | | 580,00€ |
| | | | **TOTAL H.T.** | **9 400,90€** |

***Nos prix sont établis en Euros, hors T.V.A. (19.6 % en sus), douane comprise. Ils sont fermes et non révisables.***

***DELAI DE LIVRAISON** : 4 semaines. Une date de livraison ferme sera établie une semaine après réception de la commande.*

***CONDITIONS DE REGLEMENT** : Les règlements sont à 30 jours net date de facture.*

***VALIDITE DE L'OFFRE** : 30 jours*

***Merci de joindre cette offre de prix à votre commande.***

**Maïté LARTIGUE**
☎+33 (0)1 41 90 33 75
+33 (0)1 41 90 61 89
e-mail : mlartigue@optoprim.com

OPTOPRIM partenaire de THORLABS

IC OPTICAL SYSTEMS LTD

190-192 Ravenscroft Road,
Beckenham, Kent BR3 4TW
Tel: 020 8778 5094
Fax: 020 8676 9816
E-mail sales@icopticalsystems.com

**Date:** **27 August 2010**

**Name:** **Dr Le Coarer**

**Company:** **Laboratoire d'Astrophysique de l'Observatoire de Grenoble**

**From:** **Chris Pietraszewski - ICOS**

**Quotation number:** **2760**

*Always reference this quotation number on purchase orders.*

**Validity:** 30 March 2011.

Dear Dr Le Coarer,

Thank you for your recent enquiry. We are pleased to offer the following:

| # | qty | Code | Description | Unit price | Extended price |
|---|---|---|---|---|---|
| 1 | 1 | CS100 | Stabilization system | €50,430 | €50,430 |
| | | | | Total | €50,430 |

The price is ex-work and does not include shipping charges or VAT.

- The VAT rate in the UK is currently 17.5%, but it will increase to 20% on 4 January 2011.
- VAT is only payable if LOAG does not have a VAT registration number.
- The shipping costs will be approximately €250.
- The price is based on the current exchange rate of €1.22/£ and a price of £41,337.

For and on behalf of
IC Optical Systems Ltd.

Chris Pietraszewski
Director.

| | |
|---|---|
| Delivery: | Approximately 6-8 months |
| Prices: | Ex works, excluding delivery charges and taxes etc. |
| Currency: | GBP, Pounds Sterling unless otherwise stated |
| Terms: | 25% with order, balance 30 days net |

IC Optical Systems Standard Terms and Conditions apply.
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Beckenham, Kent BR3 4TW

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190-192 Ravenscroft Road,
Beckenham, Kent BR3 4TW
Tel: 020 8778 5094
Fax: 020 8676 9816
E-mail sales@icopticalsystems.com

**Date:** 13 September 2010

**Name:** Dr Le Coarer

**Company:** Laboratoire d'Astrophysique de l'Observatoire de Grenoble

**From:** Chris Pietraszewski - ICOS

**Quotation number:** 2765

*Always reference this quotation number on purchase orders.*

**Validity:** 30 March 2011.

Dear Dr Le Coarer,

Thank you for your recent enquiry. We are pleased to offer the following;

| # | qty | Code | Description | Unit price | Extended price |
|---|---|---|---|---|---|
| 1 | 1 | ET50-FS-200 | 50mm, λ/200 | € 34,708 | € 34,708 |
| 2 | 1 | BBC-28/50 | Broad Band Coating:ET28/50 | € 4,290 | € 4,290 |
| 3 | 1 | GRC | Glass Reference Capacitor | € 4,006 | € 4,006 |
| 4 | 1 | SC-50 | Sealed Cell: ET50 | € 9,213 | € 9,213 |
| | | | | Total | € 52,217 |

The price is ex-work and does not include shipping charges or VAT.

The etalon will have a standard 10-15 arc minute wedge (ZWA28/50 zero wedge option is available at additional charge) and the cavity spacing will be 10mm±0.003mm. The coating shown is a broadband coating and the specifications will be finalised at a later date.

The sealed cell is option and may not be required and we will offer item 3, the GRC free of charge.

- The VAT rate in the UK is currently 17.5%, but it will increase to 20% on 4 January 2011.
- VAT is only payable if LOAG does not have a VAT registration number.
- The shipping costs will be approximately €250.

For and on behalf of
IC Optical Systems Ltd.

Chris Pietraszewski
Director.

| | |
|---|---|
| Delivery: | Approximately 6-8 months |
| Prices: | Ex works, excluding delivery charges and taxes etc. |
| Currency: | GBP, Pounds Sterling unless otherwise stated |
| Terms: | 25% with order, balance 30 days net |

Registered: England 4277655
Registered Office:

IC Optical Systems Standard Terms and Conditions apply

PHOTON LINES

Auteur: Julien BOUVART

Date de l'offre: 10/06/2010

Numéro de l'offre: JBO09162

**OFFRE DE PRIX N° JBO09162**

| Pte | Référence | Désignation | Qté | PUHT (€) | Délai (1) |
|---|---|---|---|---|---|
| A | **Tunics Plus S/WB** | Plage d'accordabilité à 0 dBm de 1390 à 1540 nm<br>Précision en longueur d'onde : +/- 40 pm | 1 | 31980,00 | 6 à 8 sem. |
| B | Frais de port | **Frais de port** | 1 | 60,00 | |

(1): Délai à réception de commande.

***

**Conditions de vente spécifiques à l'offre n° JBO09162**

**Validité de l'offre** : 30 jours

**Paiement** : 45 jours net à compter de la date de facture

**Port** : En Sus

**Cours** : Ferme

**Garantie** : 1 an pièce et main d'œuvre dans des conditions normales d'utilisation.

# Quote

**Laboratoire D'Astrophysique de**
l'Observatoire de Grenoble
414, Rue de la Piscine
Domaine Universitaire, BP 53
38041 Grenoble
France

NKT Photonics

**NKT Photonics A/S**
Blokken 84
DK-3460 Birkerød, Denmark

| | |
|---|---|
| Phone No. | +45 43483900 |
| Fax No. | +45 43483901 |
| VAT Reg. No | DK10048265 |
| Bank | Danske Bank |
| SWIFT Code | DABADKKK |

Customer No. 1806

| | |
|---|---|
| **Quote No.** | **Q-552** |
| Date | 13-01-10 |

Page 1

| Item No. | Description | Qty.Unit | Unit Price | Amount |
|---|---|---|---|---|
| K94-120-02 | SuperK Extreme 80MHz VIS<br>>4.3W power (460-2400nm)<br>>1.2W power (460-750nm)<br>Collimated output | 1pcs. | 50.000,00 | 50.000,00 |

Freight cost will be charged on the invoice
If you prefer to use a specific carrier, please
provide name of carrier and account no.

CN-Product code: 9027.5000

Delivery time: 4-6 weeks ARO

This order is subject to approval from
the Danish Export Authorities.

NKTP general terms & conditions apply
(attached)

This product is RoHS compliant

| | |
|---|---|
| Payment Terms | Net 30 days |
| Incoterms | FCA, Birkerod |
| Validity of this offer | 13-02-10 |

**Total EUR** **50.000,00**

# DEVIS

Bruker Optics S.a.r.l.

CNRS - Laboratoire de
Planétologie de Grenoble / UMR 5109
Université Joseph Fourier
Monsieur Eric Quirico
Bâtiment D de Physique
122 rue de la piscine, BP 53
Domaine univ. de Saint Martin d'Hères
38041 Grenoble cedex 9

| | | | |
|---|---|---|---|
| Numéro devis | 1210004373 | Numéro client | 1012174 |
| Date | 17.07.2010 | Contact Bruker | M. Fabian Lauer |
| Fin de validité | 15.10.2010 | Téléphone | +33389483113 |
| Délai de livraison | | Fax | +33164618119 |
| à réception de cde. | env. 13 semaines | Email | fabian.lauer@brukeroptics.fr |

Veuillez trouver ci-joint le devis pour le Vertex 80/V :

| Position | Article/Description | Quantité | Prix unitaire EUR | Montant EUR |
|---|---|---|---|---|
| | **Spectromètre** | | | |
| 1 | V80V<br>Spectromètre VERTEX 80V à Transformée de Fourier comprenant: | 1PCE | 85.750,00 | 85.750,00 |

A. SYSTEME OPTIQUE

- Domaine de mesure 8.000-350cm-1; option 50.000 à 5cm-1
- Résolution meilleure que 0,2cm-1; option 0,07cm-1
- Optique: modulaire pour travailler sous vide
- Source MIR haute énergie refroidie par air
- Séparatrice Ge/KBr
- DigiTect Détecteur DLATGS à haute sensibilité
- Convertisseur A/D 24 bits
- Modularité inédite:
5 ports de sortie
2 ports d'entrée
- IVU système de validation interne
- Vitesse d'acquisition 65 spectres/s à résolution 16cm-1;option >100 spectres/sec et/ou Step Scan
- Interféromètre True IntraScan sur coussin d'air à alignement permanent
Changement manuel des séparatrices avec 2 positions de stockage en interne dans le spectromètre.
- Interface micro-ordinateur par connexion Ethernet

B. SYSTEME D'ACQUISITION DES DONNEES OPUS/IR, logiciel d'acquisition et de traitement de données IRTF
conforme BPF et CFR 21 part 11 (option), incluant:
- une bibliothèque de 350 spectres
- le logiciel de quantification multicomposant basé sur les bandes spécifiques

Devis: 1210004373

BRUKER

Bruker Optics S.a.r.l.

| Position | Article/Description | Quantité | Prix unitaire EUR | Montant EUR |
|---|---|---|---|---|
| | (Loi de Beer Lambert)<br>- programmation de macrocommandes | | | |
| | C. EQUIPEMENTS AUXILIAIRES | | | |
| | Pompe à vide sèche et accessoires | | | |
| | **Option haute résolution** | | | |
| 2 | S125/8V<br>Extension de la résolution à 0,06cm-1<br>(Doit être commandé lors de l'investissement du spectromètre)<br>Pour la gamme VERTEX80 | 1PCE | 4.080,00 | 4.080,00 |
| | **Extensions gammes spectrale** | | | |
| 3 | W201/8VP-4<br>Extension IR lointain :FIR IV,680-10cm-1.<br>Comprenant<br>- Q201/8v Source FIR(lampe HG)externe avec support et alimentation<br>- T222/8 Séparatrice multicouche<br>- T205/8 Séparatrice Mylar 50µm<br>- D-201/V Détecteur DTGS/PE avec filtre,préamplificateur et convertisseur numérique incorporés .<br>- W105/V Sélection d'un deuxième détecteur (non compatible avec W105/Z2)<br>- W160/8V Volets d'étanchéité<br>Nécessite:<br>- W108/8V2, W121/Z-E ou W121/ZSE ports d'entrée d'émission | 1PCE | 20.410,00 | 20.410,00 |
| 4 | W501/8<br>Extension de la gamme spectrale (VIS I) 25000-9000cm-1<br>Comprenant :<br>- Q 428/7 lampe tungstène NIR/VIS avec support<br>- T602/8 séparatrice NIR-VIS-UV<br>- D 510/B diode Si avec préamplificateur et convertisseur numérique<br>- F 505 filtre optique avec support<br>- F102 filtre pour faisceau laser HeNe<br>Options recommandées:<br>- W121/Z-x sélecteur de source<br>- W105/Z sélecteur détecteur<br>pour spectromètre de la gamme VERTEX 80 | 1PCE | 9.240,00 | 9.240,00 |
| | **Détecteurs** | | | |
| 5 | D424/B<br>Détecteur InGaAS à température ambiante<br>Gamme spectrale : 12.800 cm-1 - 5.800 cm-1 (780-1725 nm) | 1PCE | 5.200,00 | 5.200,00 |

Devis: 1210004373

Bruker Optics S.a.r.l.

| Position | Article/Description | Quantité | Prix unitaire EUR | Montant EUR |
| --- | --- | --- | --- | --- |
| | Préamplificateur et convertisseur numérique intégrés | | | |
| | **Ports Émissions** | | | |
| 6 | W121/ZSE | 1PCE | 3.500,00 | 3.500,00 |
| | Sélecteur pour seconde source externe NIR/VIS et source externe comprenant une optique de focalisation pour port d'entrée à droite (E1)<br>Recommandé:<br>- bride W162/8V avec fenêtre F131-x pour VERTEX 80v/70v<br>- bride W162/B avec fenêtre F162-x pour VERTEX 70 | | | |
| | **Options Acc. Equipement pur** | | | |
| 7 | S316/V | 1PCE | 590,00 | 590,00 |
| | Débitmètre pour V80V | | | |
| | **OPUS Logiciel de spectroscopie** | | | |
| 8 | O/IR+ | 1PCE | 0,00 | |

OPUS est un logiciel complet dédié à la spectroscopie permettant l'acquisition de données, leur analyse, la création de rapport et le contrôle de procédés. OPUS est conçu pour une prise en main rapide du logiciel permettant ainsi un gain de temps considérable pour vos analyses IRTF
Le module de base d'OPUS comprend:
- Aide en ligne
- Tutorial IRTF Multimédia
- Mesure avec contrôle des paramètres d'acquisition (modes Routine et Avancé)
- Fonctions de traitements classiques
- Comparaison de spectres
- Interprétation spectrale
- Banque de données de base
- Recherche en banque de données
- Création de banque de données
- Analyse quantitative (loi de Beer Lambert)
- Intégration et hauteur de bandes
- Compensation automatique de la vapeur d'eau et du $CO_2$, aucun spectre de référence n'est nécessaire
- Création de macro commandes en langage machine et en Visual Basic
- Cahier de laboratoire
- Formats d'impression prédéfinis et configurables
- Exportation simple de fichiers vers d'autres programmes
- Gestion multi niveaux des utilisateurs, Login individuel
- Conformité BPM/BPF
- Audit trail (fonction historique)
- Toutes les données, traitement et évaluation sont sauvegardés dans un fichier
- Multi Tâche: mesure et traitement/évaluation réalisables en même temps
- Suivi permanent du statut du spectromètre (voyant lumineux)
- Tests Automatiques du spectromètre, 2 niveaux (OQ, PQ)

Devis: 1210004373

BRUKER

Bruker Optics S.a.r.l.

| Position | Article/Description | Quantité | Prix unitaire EUR | Montant EUR |
|---|---|---|---|---|
| | - OPUS Viewer inclus<br>- etc... | | | |
| | Ce module d'OPUS est inclus en standard avec le spectromètre | | | |
| | **Système informatique** | | | |
| 9 | CS81/26P+<br>Ordinateur, "Intel" I5 Processeur, >3GHz<br>4GB de mémoire vive avec un Disque dur de 500GB ou plus<br>8xDVD/Lightscribe Drive<br>2 ports réseau<br>Ecran plat 19"<br>Windows XP Pro<br>Imprimante à jet d'encre couleur<br>Dans le cadre d'un investissement avec un spectromètre | 1PCE | 1.400,00 | 1.400,00 |
| | Montant brut HT | | | 130.170,00 |
| | Total TVA 19,60 % | | | 25.513,32 |
| | **Montant TTC** | | EUR | 155.683,32 |

## 7.4. LETTRES DE SOUTIEN / SUPPORTING LETTERS

Here follow 8 support letters from :

- Grenoble PRES
- University Joseph Fourier
- Teem Photonics enterprise
- ALPAO enterprise
- FLORALIS UJF subsidiary
- IRAM
- INSU CNRS
- SOFRADIR enterprise

UNIVERSITÉ DE GRENOBLE

Soutien à une demande d'équipement d'excellence

Le PRES Université de Grenoble porte l'ambition avec ses partenaires locaux, en particulier les organismes de recherche, d'obtenir le label « initiative d'excellence » dans le cadre des investissements d'avenir. L'initiative d'excellence grenobloise va prolonger les orientations très structurantes qui ont été énoncées dans le projet « Grenoble Université de l'Innovation » élaboré dans le cadre de l'Opération Campus et qui sont enrichies dans les projets stratégiques quadriennaux des membres fondateurs du PRES.

Le soutien que le PRES accorde au projet ci-joint d'équipement d'excellence confirme la place que prend cet équipement dans la construction d'un ensemble cohérent à Grenoble sous la forme de projets de laboratoire d'excellence, d'institut de recherche technologique, d'institut hospitalo-universitaire, etc.

Cet équipement d'excellence bénéficie par ailleurs de lettres de soutien des institutions qui engagent des moyens spécifiques pour assurer son fonctionnement.

Fait à Grenoble le 13 septembre 2010

Farid Ouabdesselam
Président du PRES Université de Grenoble

*Université de Grenoble* - Pôle de recherche et d'enseignement supérieur
BP 52 • DOMAINE UNIVERSITAIRE • 38 402 SAINT-MARTIN-D'HÈRES CEDEX • FRANCE
Tél. +33 (0)476 82 83 84 • E-mail : contact@grenoble-univ.fr
Siret : 130 006 745 00017- NAF : 8542Z

WWW.grenoble-univ.fr

UNIVERSITE JOSEPH FOURIER
SCIENCES.TECHNOLOGIE.SANTÉ.
GRENOBLE 1

September, 13rd, 2010

To: whom it may concern

Object : support of the University Joseph Fourier –Grenoble to the EquipEx project **PASS**

Dear Madam, dear Sir,

The scientific program of the EquipEx **PASS** (*Platform for Astrophysics and Space Sciences Systems*) is fully integrated into the strategy of the University Joseph Fourier to promote research at an internationally leading edge by exploring new scientific fields, advancing existing frontiers, developing enhanced technologies and training the most talented researchers and engineers. PASS will be a downstream Technological Platform for ground-based and space-borne instrumentation, addressing system detection for astrophysics and space-borne subsystems for planetary sciences.

The team in charge of the project has proven internationally recognized scientific quality and ability to conduct major research projects. Recent internationally publicized examples are the "NAOS" instrument for the European Southern Observatory (first exasolar planet image in 2005); the SWIFTS micro-spectrograph (2007, Nature Photonics); the study of sub-surface water on Mars (2010, Icarus); or the complex analysis of Titan's atmosphere (2007, Icarus).

Moreover, this new equipment will offer an ideal scientific environment for intense training of students and young researchers and will be open for innovative technological transfer to industrial partners and state agencies, as was performed by LAOG in 2008 through the creation of the ALPAO spinoff, resulting in 9 jobs as of 2010.

Within the Grenoble area, this EquiPex project is fully integrated into the Grenoble "Initiative d'Excellence" project, as several partners are involved in the LabEx initiative "Observatoire de Grenoble".

Finally, the University Joseph Fourier attests that this EquipEx project will be mainly supported by existing technical staff and hosted in existing facilities. Additional necessary resources have been discussed and will be granted on the basis of the present project description.

Farid Ouabdesselam

President of the University Joseph Fourier – Grenoble I

ADRESSE GÉOGRAPHIQUE : BATIMENT ADMINISTRATIF - 621, AVENUE CENTRALE - DOMAINE UNIVERSITAIRE - SAINT-MARTIN-D'HERES - GIERES
ADRESSE POSTALE : B.P. 53 - 38041 GRENOBLE CEDEX 9 - FRANCE - TELEPHONE : (33) 04 76 51 46 00 - TÉLÉCOPIE : (33) 04 76 51 48 48

## Lettre de déclaration d'intérêt

*Diffusion : Etienne Le COARER*
*Pour information : Monsieur le directeur du LAOG*

Meylan, le 14 septembre 2010

Madame, Monsieur,

Teem Photonics, une PME de 40 personnes basée à Grenoble, spécialisée dans les lasers et les composants optiques, collabore depuis de nombreuses années avec le LAOG (Laboratoire d'AstrOphysique de Grenoble), sur différents sujets concernant des capteurs optiques.
Le projet du LAOG de créer un laboratoire/plateforme de référence pour la caractérisation spectroscopique de systèmes et sous systèmes optiques complexes, intéresse fortement Teem Photonics pour plusieurs raisons.

La première raison est que Grenoble bénéficie d'une forte activité sur les matériaux et procédés d'une part, et sur les composants et logiciel d'autre part, mais manque d'une expertise système, qui permettrait de mieux valoriser, au sein de PME locales, les retombées économiques de ses activités de base. Ce projet de plateforme s'inscrit dans cette évolution nécessaire vers les systèmes.

Une autre raison, plus directement reliée à l'activité actuelle de Teem Photonics, est qu'une telle plateforme permettrait d'accélérer et d'affiner les projets internes, ainsi que les projets collaboratifs en cours, sur le développement de nos lasers et de nos capteurs optiques. En particulier, les retombées du projet « Swifts », projet labellisé Minalogic que nous poursuivons avec le LAOG, bénéficieraient directement d'une telle plateforme.

A terme, Teem Photonics serait très intéressé par former, en partenariat avec les universités utilisatrices de la plateforme, via des financements Cifre, de jeunes doctorants à la maîtrise des équipements de pointe de cette plateforme. Cela permettrait à notre entreprise d'être autonome dans son accès aux moyens de la plateforme. Ce qui est clé pour notre réactivité lors des phases d'industrialisation et de production de petite série, suite aux demandes de nos clients. Dans ce cas, Teem Photonics serait bien entendu prête à payer une participation pour l'accès aux moyens de la plateforme.

Pour Teem Photonics :
Denis BARBIER, Directeur Général

61, chemin du Vieux-Chêne - 38246 Meylan Cedex - France
tél. : +33 (0) 476 04 05 06 - fax : +33 (0) 476 04 03 02 - Web site : www.teemphotonics.com
Société anonyme au capital de 215 338.20 € - SIREN 399 229 434 - TVA FR20 399 229 434

ALPAO ADAPTIVE OPTICS

ALPAO
2217, route de Meylan
38 330 Biviers
France

Obj : lettre de soutien

A toute personne concernée

Biviers, le 14 septembre 2010

Madame, Monsieur,

L'entreprise ALPAO travaille depuis sa création en collaboration avec le LAOG/IPAG dans le domaine de l'optique adaptative. Il est important de souligner que la première technologie de miroirs déformables utilisée par ALPAO dans le domaine de l'instrumentation pour l'astronomie est issue de travaux de recherches menés dans ce même laboratoire.

J'ai récemment été informé de la volonté du LAOG/IPAG de se doter de nouveaux équipements dans le cadre du projet PASS. Grâce à ces équipements (caractérisation de détecteurs, mesure d'éléments optiques à haute résolution, etc.), le LAOG/IPAG sera à même de mener de nouveaux projets innovants.

Il est extrêmement important pour une P.M.E, telle qu'ALPAO, que se constitue une telle plateforme pour plusieurs raisons :

- Permettre aux chercheurs du LAOG/IPAG de développer de nouvelles innovations qui pourront éventuellement être valorisées (brevet, licence, etc.),
- Former des jeunes chercheurs/ingénieurs aux techniques de pointe dans le domaine de l'optique,
- Possibilité pour les entreprises partenaires d'accéder à des équipements uniques (contre rémunération).

Pour toutes ces raisons, je soutiens totalement et sans aucune réserve le projet PASS du LAOG/IPAG. Si une telle plateforme venait à voir le jour, ALPAO serait très certainement intéressée par lancer des collaborations de recherches avec le LAOG/IPAG ou payer pour accéder à ces équipements.

Veuillez agréer, Madame, Monsieur, l'expression de mes sentiments distingués.

ALPAO
SAS au capital de 98 000 €
2217 Route de Meylan
38330 BIVIERS
Tél : 04 76 63 55 05 Fax : 04 76 51 45 3?
SIRET : 504 089 343 00017 APE : 2651 B

Frédéric Rooms
Président d'ALPAO

ALPAO.fr

ALPAO – 2217 route de Meylan, 38330 Biviers, France
Tel : + 33 4 76 63 55 05 - Mail : contact@alpao.fr

Floralis
Cultivons l'innovation

**UJF-Filiale**
SAS au capital de 1,5M€
6 Allée de Bethléem
38610 Gières
452 135 452 RCS Grenoble
NAF : 7490B

**Gières, le 15/09/2010**

**LAOG**
**A l'attention de M. Jean-Louis Monin**

Objet : Lettre de soutien au projet Equipex du LAOG

Monsieur le Directeur,

C'est avec plaisir que je vous adresse cette lettre de soutien pour le montage de votre dossier Equipex.

Le LAOG et Floralis sont engagés conjointement dans plusieurs projets de valorisation d'importance et ce depuis 2005 (ALPAO puis SWIFTS notamment). Il est donc très important pour nous de pouvoir continuer à vous appuyer dans toute nouvelle démarche de valorisation.

Par ailleurs, Floralis est engagée auprès de l'Université dans la valorisation de plusieurs plateformes technologiques dans le domaine des sciences du vivant et plus récemment dans le domaine des radiofréquences, avec la plateforme Pheline. Nous souhaitons donc être à vos côtés pour vous aider à la structuration, à la promotion puis au développement des relations industrielles.

Je vous assure donc de tout le soutien possible de Floralis pour votre dossier et de notre intention de vous accompagner dans la mise en place de votre projet.

Vous en souhaitant bonne réception, je vous prie d'agréer, Monsieur, l'expression de mes sentiments distingués.

UJF - FILIALE
SAS au capital de 1,5 M €
6, allée de Bethléem
38610 GIÈRES
Tél. 04.76.00.78.30 - Fax 04.76.00.70.28
SIRET 452 135 452 00020 - APE 7490 B

Eric Larrey
Directeur

QUA_DOC_016_0.1

Institut de radioastronomie millimétrique

M. Jean-Louis Monin
LAOG.

Saint-Martin d'Hères, le 14 septembre 2010

L'IRAM a de nombreuses collaborations scientifiques avec le LAOG/IPAG depuis de nombreuses années, collaborations qui se sont avérées fructueuses avec sur des questions scientifiques impliquant la complémentarité entre l'utilisation des instruments développés au LAOG (détecteurs infrarouges pour l'instrumentation en astronomie et les télescopes dont l'IRAM a la charge. Un exemple important dans ce contexte est le travail qui a été fait dans le domaine des disques proto-planétaires, des naines brunes.

De plus, le LAOG/IPAG nous permet d'avoir accès à son réseau de connaissances dans le domaine de l'astronomie, notamment du coté des partenaires académiques et de sons insertion dans l'université Joseph Fourier. Ce partenariat ouvre des opportunités de recruter des jeunes chercheurs brillants et de leur offrir des perspectives de carrière via, par exemple, des tâches de service à l'IRAM dans le cadre des grands équipements.

Il est donc important que le LAOG/IPAG se renforce en mettant en œuvre des plates-formes nouvelles telles que proposées dans le projet PASS. Dans cette perspective, l'IRAM soutient donc le projet présenté par le LAOG/IPAG.

Pierre Cox

Pierre Cox
Directeur

IRAM Grenoble
300, rue de la Piscine, Domaine Universitaire, 38406 Saint Martin d'Hères, France
Tel: +33 (0)4 76 82 49 00 Fax: +33 (0)4 76 51 59 38 info@iram.fr http://www.iram.fr

*JMH/SK/2010*

Paris, le 15 septembre 2010

Monsieur Henri-Claude Nataf
Directeur de l'Observatoire des Sciences
de l'Univers de Grenoble
414, rue de la Piscine
BP 53
38041 GRENOBLE CEDEX 9

CNRS INSU
Institut national des sciences de l'Univers

www.insu.cnrs.fr

Campus Gérard-Mégie
3, rue Michel Ange
75794 Paris Cedex 16

T. 01.44.96.40.00

Monsieur le Directeur,

Je vous confirme que l'INSU/CNRS soutient le projet PASS porté par l'IPAG. Le Président de l'Université Joseph Fourier devrait recevoir un courrier officiel du CNRS en ce sens

Je vous prie de croire, Monsieur le Directeur, à l'assurance de mes sentiments les meilleurs.

Jean-Marie Hameury

Directeur Adjoint Scientifique INSU

SOFRADIR

N/ réf : MV/352/2010

**Laboratoire d'AstrOphysique de Grenoble**
**Mr Jean-Louis Monin**
Directeur de l'IPAG
Domaine Universitaire
414, rue de la piscine
BP 53

38041 Grenoble Cedex 9

Veurey Voroize, le 20 septembre 2010

Monsieur,

Sofradir travaille avec le LAOG/IPAG depuis de plusieurs années sur les détecteurs infrarouge refroidis. Dans le cadre de cette collaboration fructueuse, le LAOG/IPAG apporte son expertise dans le domaine de l'utilisation de détecteurs infrarouge pour l'instrumentation en astronomie.

De plus, le LAOG/IPAG permet à Sofradir d'avoir accès à son réseau de connaissances dans le domaine de l'astronomie, non seulement du coté des partenaires académiques (autres laboratoires de recherche, grands instituts comme l'ESO, l'ESA, le CNES) mais également industriels. Ceci nous permet d'ouvrir nos applications et nos produits à de nouveaux marchés.

Cela a par exemple été le cas pour le projet RAPID financé par le FUI (Fonds Unique Interministériel) que nous avons monté en commun et qui est soutenu par la DGA et la DGCIS (Direction Générale de la Compétitivité, de l'Industrie et des Services).

Le projet PASS permettrait au LAOG/IPAG de se renforcer dans le domaine de la caractérisation de détecteurs infrarouge dans un espace de paramètres que nous n'adressons pas de manière standard dans notre entreprise et notamment dans le cadre des applications pour l'astronomie.

Il est donc important que le LAOG/IPAG se renforce en moyens de caractérisation pérennes et réactifs de manière à mieux valoriser notre partenariat mutuel. En conséquence Sofradir soutient fortement le projet présenté par le LAOG/IPAG.

Michel VUILLERMET
Chef de département Projets et R&D
Adjoint du Directeur Technique

**Siège social**
43-47, rue Camille Pelletan - 92290 CHATENAY-MALABRY
Tél. 33 (0) 1 41 13 45 30 - Fax : 33 (0) 1 46 61 58 84
www.sofradir.com

FRANCE

**Centre de développement et de production**
Z.I. - B.P. 21 - 38113 VEUREY-VOROIZE
Tél. 33 (0) 4 76 28 77 00 - Fax : 33 (0) 4 76 53 85 97

S.A.S. au Capital de 6 000 000 Euros - siret 334 835 709 00034 - Code APE 2611Z - tva intracommunautaire FR68 334 835 709

Groupe SOFRADIR