

SYMPOSIUM LAPHIA 2019

7^e édition

12-13 novembre 2019

Institut d'Optique d'Aquitaine (amphithéâtre)

Le Cluster d'Excellence LAPHIA a le plaisir d'accueillir nos confrères québécois de l'INRS et de l'Université LAVAL membres du LIA LUMAQ. Ce symposium a pour ambition de mettre en lumière les complémentarités en matière de recherche des deux pôles photoniques transatlantiques. Cette rencontre a également pour objectif de présenter les programmes financés par le LAPHIA. Aussi, les présentations des projets annuels du LAPHIA se répartiront entre des sessions thématiques journalières :

Mardi 12 novembre 2019

Projets LAPHIA - & - Structuration du site bordelais

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Mercredi 13 novembre 2019

Projets LAPHIA - & - Coopérations internationales (LIA LUMAQ / RISE FUNGLASS / LAPHIA)

Mardi 12 novembre

Mercredi 13 novembre

08h30	Accueil	Accueil
09h00	Introduction LAPHIA / LIGHT S&T / Alpha RLH / CEA	Introduction LUMAQ / Univ. Bx
09h30	Sylvain DANTO, ICMCB "Fiber drawing activity in Bordeaux: recent results and perspectives"	Patrizio ANTICI, EMT, INRS, Canada "Intense Laser for Advanced Material Science"
10h00	Frédéric CASTET, ISM "Simulation of nonlinear optical responses: from molecules to functionalized surfaces"	Philippe LALANNE, LP2N "Light interaction with nanoresonators: mode volume and quasinormal mode expansion"
10h30	Pause	Pause
10h45	Alexis CASNER, CELIA "Techniques expérimentales avancées en support et préparation d'expériences LMJ PETAL"	Martin BERNIER, U. Laval, Canada "Recent advances in mid-infrared fiber lasers"
11h15	Yannick PETIT, CELIA ICMCB "Femtosecond laser induced Waveguide Bragg Gratings in the VISible range"	Julien BURGIN, LOMA "Brownian Motion at Short time Scales"
11h45	Poster session	Poster session
12h30	Déjeuner	Déjeuner
14h00	Pierre BON, LP2N "Towards Resolution enhancement by photon reassignment in reflectance confocal microscopy"	François LÉGARÉ, EMT, INRS, Canada "Extreme nonlinear optics in solids and applications"
14h30	Dominique VERREAULT, ISM "Hyper-Rayleigh Scattering as Novel Chiroptical Method in Study of Nonlinear Optical Activity of Aromatic Oligoamide Foldamers"	Luis CARLOS, RISE FUNGLASS, Univ. Aveiro, Portugal "Thermometry at the Nanoscale: Light in Action"
15h00	Philippe BALCOU, CELIA, LEAP "Physique des lasers pour le programme régional Lasers et Santé"	Marcelo NALIN, RISE FUNGLASS, UNSEP, Brésil "Exploring new possibilities with magnetic glasses"
15h30	Pause	Pause
16h00	Giorgio SANTARELLI, LP2N "Lasers à haute cadence dans l'infrarouge, le visible et l'UV"	Stefan DILHAIRE, LOMA "Ultra fast nanoscale multiphysics imaging"
16h30	Simon JOLY, IMS "Portable, RObust and Sensitive SEnsor for Environmental Pollutant Detection"	



LUMAQ

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RISE FUNGLASS

- Luis CARLOS, Univ. Aveiro, Portugal : Thermometry at the Nanoscale: Light in Action – [p.7](#)
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Programmes structurants LAPHIA :

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Programme régional

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Martin BERNIER

COPL, Université Laval, Canada

Recent advances in mid-infrared fiber lasers

Significant research interests are currently relying on sources of coherent radiation spanning the mid-infrared spectral region. This strong interest is fueled by numerous high-end applications in various fields such as industrial processes, medicine, environment, and defense & security. The mid-infrared, also known as the molecular fingerprint region, actually comprises the fundamental optical resonances from most molecular species, which allows for the strongest interaction with them, either for remote detection or for precision ablation purposes. These applications are calling for the development of compact and powerful sources operating above 2 μm . Fluoride glasses are particularly suitable for the development of high power mid-infrared fiber lasers since it can be heavily doped with rare-earth ions and can be drawn in low-losses optical fibers. Based on an approach integrating fiber Bragg gratings (FBGs), we developed all-fiber RE-doped lasers emitting at high power between 2.8 and 3.9 μm . During the presentation, significant progresses that were recently reported for both cw and pulsed mid-infrared fiber lasers will be reviewed and discussed.

François LÉGARÉ

EMT, INRS, Canada

Extreme nonlinear optics in solids and applications

Over the recent years, high harmonic generation (HHG) has been successively extended to the solid state promising the possibility of using this technique as a probe of ultrafast dynamics in the condensed matter. During this talk, I am going to show that the insulator to metal phase transition (IMT) in VO₂ can be tracked by measuring the yield of intraband harmonics [1]. A mid-infrared laser pulse (drive) at 10 μm is used to drive high harmonic generation (HHG) from a 100 nm thick, epitaxial VO₂ sample. The sample is photoexcited with a 50 fs, 1.5 μm laser pulse (pump) to initiate the IMT. The fifth harmonic (as well as the third) signal is recorded as a function of the time delay between the pump and the high harmonic driver. Within the range of pump fluence where Morrison et al. have reported the observation of the thermodynamically hidden monoclinic metallic \mathcal{M} phase, we measured a drop of the harmonic signal at zero delay when electrons are promoted to the conduction band, followed by a recovery of the harmonic yield within a picosecond as measured using UED [2]. This demonstrates the potential of high harmonic spectroscopy as a complementary technique for tracking ultrafast dynamics in solids. Furthermore, recent results will be presented showing additional information extracted using high harmonic spectroscopy.

[1] M.R. Bionta et al., "Tracking ultrafast solid-state dynamics using high harmonic spectroscopy," under review (2019).

[2] V.R. Morrison et al., "A photoinduced metal-like phase of monoclinic VO₂ revealed by ultrafast electron diffraction," Science 346, 455 (2014).

Patrizio ANTICI

EMT, INRS, Canada

Intense Laser for Advanced Material Science

The advent of high-power ultra-short lasers has opened up the field of laser-driven particle acceleration, in particular proton and electron acceleration. The investigation of these laser-accelerated beams and its use is currently challenging many research laboratories worldwide, in particular for the improved characteristics of these sources such as compactness, versatility and tunability. As such, this new acceleration technique has a strong potential of being employed in diverse applications.

In this talk I will present different applications using laser-generated particles in material science embracing several domains such as cultural heritage and material analysis:

First, I will introduce the use of an In-Air Plasma-Induced-Luminescence (*In-Air-PIL*) Spectroscopy, produced by strong focusing of a mJ-class laser in air, as an alternative to classical chemical and crystallographic methods employed in materials science. I will focus on a case study related to the field of Cultural Heritage and in particular to evaluate the suitability of the suggested technique on investigating the effect of light aging on the darkening of five pristine yellow pigments commonly employed in artworks.

Then, I will present the use of laser-accelerated protons as powerful diagnostics in the analysis of materials, namely in the Particle-Induced X-Ray Emission (PIXE) technique, where the intense, short and large proton beam should allow for a quicker analysis of the materials. This is of benefit for pollution detection, cultural heritage and cancer treatment.

Finally I will talk about using laser-accelerated protons for stress testing materials.

Luis CARLOS

Physics Department and CICECO-Aveiro Institute of Materials, University of Aveiro, Portugal

Thermometry at the Nanoscale: Light in Action

The emergence of luminescent nanothermometry during the last decade opened up the possibility of measure thermal flows at spatial scales below 1 μm , unreachable by conventional electrical methods [1]. In fact, diverse phosphors capable of providing a contactless thermal reading through their light emission properties have been examined, e.g., polymers, DNA or protein conjugated systems, organic dyes, quantum dots, and trivalent lanthanide ions incorporated in organic-inorganic hybrids, multifunctional heater-thermometer nanoplateforms, upconverting, downconverting and downshifting nanoparticles.

In the last couple of years, the focus of luminescence thermometry has gradually shifted from the fabrication of more sensitive nanoarchitectures towards the use of the technique as a tool for thermal bioimaging and for the unveiling of properties of the thermometers themselves and of their local surroundings [2-5].

After a general historical perspective of the work done on ratiometric luminescent nanothermometers since the explosion of the field at one decade ago, the lecture will be focused on recent examples illustrating the potential of the technology.

References

- [1] C. D. S. Brites, A. Millán, L. D. Carlos, in Handbook on the Physics and Chemistry of Rare Earths, J.-C. Bünzli, V. K. Pecharsky, Eds., Amsterdam: Elsevier Science B.V., Vol. 49 (2016), 339–427.
- [2] R. Piñol et al., ACS Nano 9 (2015) 3134–3142.
- [3] E. C. Ximendes et al., Nano Lett. 16 (2016) 1695–1703.
- [4] C. D. S. Brites et al., Nature Nanotech. 11 (2016) 851–857. 5. C. D. S. Brites et al., Nano Lett., 2017, 17, 4746–4752.

Marcelo NALIN

UNSEP, Brésil

Exploring new possibilities with magnetic glasses

In the last years many efforts have been done in order to develop new and more sensible devices to detect magnetic fields. Crystals, like terbium gallium garnet (TGG) are still the most common material used, however glasses are arising as a competitive alternative for several applications. Among the qualities of glass compositions we highlight the tunability of compositions, allowing for example, to explore a larger range of energies, from the UV up to infrared. The facility to obtain larger bulk samples also is an advantage face the more expensive crystal growth techniques. In spite of a large number of studies, in the majority exploring the high Verdet constant of rare earth containing glasses, be available in the literature, few studies are dedicated to understand the high paramagnetic effect os such glasses. We understand that the comprehension of such properties allied to chemistry of new glass compositions may help advance for new applications in the near future.

Julien BURGIN

LOMA

Brownian motion at short time scales

Since the observation of Brownian motion by Robert Brown at the beginning of the XIXe century, this random movement has been tremendously investigated (P. Langevin, J. Perrin, A. Einstein, ...). A huge difficulty faced by scientists is the measurement of instantaneous velocity of the particle since it depended on the time sampling rate: the particle position was considered continuous but not differentiable. Although Einstein thought no one could ever be able to measure instantaneous velocity, this has been recently done recently with trapped particles in several environments (liquids and gas) by Mark Raizen group (Austin, USA). The pioneering works of Arthur Ashkin (Nobel Prize 2018) in the 1970s and 1980s on the optical control and manipulation of dielectric particles have led to major advances in cold atomic physics and biophysics. Moreover, it has also many prospects for statistical and non-linear physics : optical trapping is a perfect tool for the investigation of Brownian motion.

In this framework, our team investigate Brownian motion at ultra-short time scales in order to reveal unknown features of Brownian motion such as the effect of water compressibility. We will present results obtained by a newly developed setup that yield state of the art detection noise; this setup allowed us to measure the instantaneous velocity of a Brownian particle and the transition between diffusive and ballistic regime. We will also present the ongoing roadmap to reach even shorter time resolution taking advantage of ultrafast spectroscopy.

Frédéric CASTET

ISM

Simulation of nonlinear optical responses: from molecules to functionalized surfaces

Molecules exhibiting large and photoswitchable second-order nonlinear optical (NLO) responses are ideal candidates for photonic technologies with multiple storage and non-destructive readout capacity. Filling the gap between isolated molecular NLO switches and photoresponsive materials nevertheless remains a quite challenging task, which requires anchoring with a non-centrosymmetric spatial organization the molecular photochromes on a 2D substrate while preserving (i) the reversibility of the switching process, and (ii) the NLO responses of both switching states, as well as their contrast. In complement to surface engineering and spectroscopic characterizations, the rational design of NLO devices and optimization of their performances calls for the development of computational strategies that provide a fundamental understanding of the relationships linking the interfacial molecular organization to the dynamical behaviour and NLO responses of the material. The project SWITCH funded by Laphia allowed to develop the first computational approach providing a fundamental understanding of the impact of intermolecular interactions on the NLO responses of disordered materials. This approach combines molecular dynamic (MD) simulations and DFT calculations, and was applied to photoresponsive self-assembled monolayers (SAMs) constituted of azobenzene and indolino-oxazolidine photoswitches grafted onto amorphous SiO₂ surfaces. This computational tool was proved reliable for rationalizing the amplitude of the NLO responses of these systems, as well as their contrast upon commutation.

Philippe LALANNE

LP2N

Light interaction with nanoresonators: mode volume and quasinormal mode expansion

Microcavities and nanoresonators are characterized by their modes, called quasinormal modes because they are the eigensolution of non-Hermitian operators. In contrast to waveguide and free space modes, quasinormal modes are not well documented in the literature, although nanoresonances play an essential role in current developments in nanophotonics. The reason is due to mathematical difficulties, see details in the recent review article [1], and especially to the fact that quasinormal modes cannot be normalized by their energy. Quasinormal modes are characterized their quality factors Q and mode volumes V . While Q can be unambiguously defined and interpreted [1], there are still open questions on V and in particular on its complex-valued character, whose imaginary part is linked to the non-Hermitian nature of open systems. Mode Volume. The concept of complex V 's [Phys. Rev. Lett 110, 237401 (2013)] is recent. It seems to be rooted in important phenomena of light-matter interactions in non-Hermitian open systems [1]. For instance, the ratio $\text{Im}(V)/\text{Re}(V)$ quantifies the spectral asymmetry of the mode contribution to the modification of the spontaneous emission rate of an emitter weakly coupled to a cavity. For strong coupling, it modifies the usual expression of the Rabi frequency by blurring and moving the boundary between the weak and strong coupling regimes. Despite these strong roots, complex V are often seen as a mathematical abstraction.

Helped by cavity perturbation theory, see related earlier work in [2], and near field experimental data, we clarify the physics captured by the imaginary part of V and show how a mapping of the spatial distribution of both the real and imaginary parts can be directly inferred from perturbation measurements. This result shows that the mathematically abstract complex mode volume in fact is directly observable.

Quasinormal mode expansion. The modal theory of optical resonators has recently achieved very important improvements, and we may say future works will mostly focus on refinements rather than on fundamental developments. At the conference, we will present the state of the art of the reconstruction of the fields scattered by resonators in their quasinormal mode basis [4].

- [1] P. Lalanne, W. Yan, K. Vynck, C. Sauvan, and J.-P. Hugonin, Laser Photonics Rev. 12, 1700113 (2018). "Light interaction with photonic and plasmonic resonances"
- [2] J. Yang, H. Giessen, P. Lalanne, Nano Lett. 15, 3439 (2015). "Simple Analytical Expression for the Peak-Frequency Shifts of Plasmonic Resonances for Sensing"
- [3] K. G. Cognée, W. Yan, F. La China, D. Balestri, F. Intonti, M. Gurioli, A. F. Koenderink, and P. Lalanne, Optica 6, 269 (2019). "Mapping Complex Mode Volumes with Cavity Perturbation Theory"
- [4] W. Yan, R. Faggiani, P. Lalanne, Phys. Rev. B 97 205422 (2018). "Rigorous modal analysis of plasmonic nanoresonators"

Simon JOLY

IMS

Portable, RObust and Sensitive SEnsor for Environmental Pollutant Detection

Environment, health and safety areas have an increasing need to develop sensitive, selective and inexpensive sensor. The PROSEED project aims to develop integrated optical sensors (Optical Microring Resonators - OMR), based on polymer or silicon oxynitride (SiON) materials, sensitive, selective, user-friendly and portable for real-time in-situ detection of pollutants in water, such as heavy ions or pesticides, elements with deleterious effects starting from the ppb (thresholds of the order of $0.1 \mu\text{g/L}$). To meet these requirements, we propose a portable optical sensor integrating (as monolithically as possible) the source, the transducer and the photodetector.

To achieve a robust integrated system, our efforts have been and are still concentrated on two parallel paths: the first one is devoted to the development of polymer and SiON optical integrated structures operating in the visible range while the second one is dedicated to the implementation of a complete set integrating transducer, light, detection and fluidic. Moreover, one of the main sensing modes is volume detection that can be analyte-specific using colorimetric reaction and few studies in literature have addressed performance of optical microring resonator for absorption spectroscopy. We proposed an analytical model to provide a guideline to optimize ring resonator design and parameters in order to reach maximum sensitivity, including a study on the enhancement of the evanescent field using nano- structuration of the waveguide.

Thanks to the LAPHIA grant, an optical/microfluidic bench is now implemented for the optical characterization of the optical transducer on the optical table of the OPERAS platform at IMS Lab. The set up operates at telecommunication wavelengths (1550 nm) and is available to characterize the response of an optical integrated device associated to a microfluidic cell. The spectrum of a resonance peak of OMR is measured with a high spectral accuracy at high speed (60 Hz) using different relatively low-cost parts (i.e. commercial DFB Laser, photodiode, PDMS cell). The methodology is now applied to optical integrated structure operating in the visible range and currently manufactured at UMI CNRS LN2 at the Université de Sherbrooke (Quebec), through a postdoctoral position and two PhDs in co- supervision.

Sylvain DANTO

ICMCB

Fiber drawing activity in Bordeaux: recent results and perspectives

Here we present an overview of the research conducted recently in Bordeaux in optical fibers. Firstly, we expose composite photosensitive silver containing phosphate-based glass fibers. Silver containing phosphate glass materials have proven to form a promising matrix for the heavy loading of silver ions, clusters or metallic particles, which could in turn leads to the fabrication of devices taking advantage of novel functionalities. Methodology for the fabrication of photosensitive, photo-writable fibers is presented and discussed. Secondly, we demonstrate the shaping ability of neodymium-doped zinc-phosphate glasses into unusual rectangular core fiber for, for instance, nonlinear mode conversion. Physico-chemical and luminescence properties of the developed materials is investigated and a modified stack-and-draw technique is used to produce multimode rectangular-core optical fibers. Then, we report on the production of crystal-free, light guiding fibers using preform-to-fiber approach in the germano-gallate glass systems, from germanium-rich to gallium-rich glasses. These results show that the germano-gallate glasses represent promising mid-infrared materials over an extended fiber drawing domain. Finally, we present recent progresses in the fabrication of glass-metal composite fibers using tellurite-based glasses. The drawing of architectures merging electrical and optical features in an elongated wave-guiding structure will enable to develop new in-fiber sensing functionalities based on hybrid electric/optic effects.

Yannick PETIT

CELIA, ICMCB

Femtosecond laser induced Waveguide Bragg Gratings in the VISible range

Novel integrated photonics components are highly demanded to develop photonic integrated circuits, or sensing applications with lab-on-chip or lab-on-fiber approaches. Femtosecond laser inscription has demonstrated to be a very attractive approach being highly versatile as well as compatible with laser manufacturing technological transfer. In this framework, some of the innovations to come will result from optimized laser-based processing in prepared materials, namely in specialty glasses with a designed photosensitivity enhancement under laser irradiation.

In this framework, we recently demonstrated a new type of waveguides, for which the positive refractive index modification is sustained by the laser-induced photochemistry of silver-containing phosphate glasses. Some of the inner features of the refractive index structures and associated waveguides show mesoscale dimensions of a few hundreds of nanometers, which is of interest for produce sub-wavelength modifications. In this paper, we will present recent results concerning the mask-less fabrication of first-order Bragg grating in the red/near-IR range. Based on the coupled mode theory, these waveguide Bragg gratings show strong coupling constants, up to 3.9 mm⁻¹ depending of the chosen Bragg grating geometry, which is relevant for applicative perspectives in integrated optics. Detailed description of these silver-sustained waveguide Bragg gratings will be provided, including the spatial distribution of silver clusters, the associated index modulation and the modal overlapping of the Bragg structure, which allows for discussing both limitations and potentialities of the proposed innovative approach for the production of Bragg gratings in such photosensitive glasses.

Pierre BON

LP2N

Towards Resolution enhancement by photon reassignment in reflectance confocal microscopy

Confocal microscopy (CM) has become one of the most used techniques as it offers some advantages such as its resolution and optical sectioning properties. Usually, transmittance fluorescence CM using a single point detector is the most current version in a confocal microscopy. However, confocal microscopy has been evolving from using a single point detector up to use a CCD for photon reassignment. The idea of pixel reassignment has been implemented mainly for fluorescence imaging. Here we present some modifications to the CM using an incoherent white light source for a reflectance confocal microscopy where the resolution of the microscope can be envisioned to be enhanced using photon reassignment by projecting the image directly to a CCD instead of a single point detector.

Giorgio SANTARELLI

LP2N

*Programme structurant LHC : Lasers à
haute cadence dans l'infrarouge, le visible
et l'UV*

TBA

Stefan DILHAIRE

LOMA

Programme structurant Nano Imagerie : Ultra fast nanoscale multiphysics imaging

Heat transport is not yet understood from nano-scale to macro-scale neither from femtosecond to nanosecond. We will introduce a unique experimental device to study multicarrier energy transport at nanoscale.

Light is an ideal tool to produce nanometric hot spots. Light can easily be highly confined in nanospace, and the optical field is locally enhanced when plasmons are excited in nanostructures. The properties of the local optical fields near the metal nanostructures are strongly influenced by the spatial and temporal characteristics of plasmons, thus, the direct observation of the spatiotemporal behaviour of plasmons is of fundamental importance. The spatial scale of plasmons in metal nanostructures is essentially smaller than the diffraction limit of light (a few hundred nanometers), and the time scale of plasmon dynamics is faster than the rapid dephasing process in the range of few femtoseconds to 20 fs. Therefore, we will simultaneously realise via plasmonic excitation, high spatial and temporal confinement to further understand the fundamental mechanisms of heat transfer.

Recent advances have allowed to study plasmons in metal nanostructures with various shapes and sizes in microscopic techniques with nanometric spatial resolution, such as scanning near-field optical microscopy [Yoshio Nishiyama et al J. Phys. Chem. C, 119, 16215–16222, (2015)], photoelectron emission microscopy [Eleonora Lorek et al. Opt. Express | Vol. 23, No. 24 (2015)], and electron microscopy with cathodo-luminescence detection [Vesseur, E. J. R. et al. Nano Lett., 7, 2843–2846, (2007)] or with electron energy loss spectroscopy [Schmidt, F.-P. et al. s. Nano Lett., 12, 5780–5783, (2012)].

The combination of near field technique with Time Domain Thermoreflectance has the potential to achieve nanometer and femtosecond spatiotemporal resolution, the presently proposed technique has, to our knowledge, never been reported in the literature.

Dominique VERREAULT

ISM

Programme Structurant Photonic Materials : "Hyper-Rayleigh Scattering as Novel Chiroptical Method in Study of Nonlinear Optical Activity of Aromatic Oligoamide Foldamers"

The detection of molecular and supramolecular chirality remains an important issue in a broad range of physical sciences. In practice, the detection and quantification of chirality is done with standard linear chiroptical methods such as, for example, optical rotation (OR), circular dichroism (CD), and Raman optical activity (ROA).^{1,2} Yet, a drawback of these methods lies in their rather low sensitivity ($< 10^{-3}$) such that chiral discrimination remains in some cases a challenging task. In contrast, nonlinear optical (NLO) methods such as hyper-Rayleigh/Raman scattering could potentially overcome this limitation and offer a complementary approach.⁴ In particular, hyper-Rayleigh scattering (HRS), an incoherent second-order NLO probing technique, has long been predicted to be sensitive to the optical activity of chiral media.⁵ Yet, there has been up until now no report of hyper-Rayleigh optical activity (HROA) from molecular and supramolecular organic systems. In this work, the HRS responses of a set of aromatic foldamers, rationally functionalized with electron-donating and/or electron-withdrawing groups, were assessed using either linearly polarized or circularly polarized incident light. Both methods allowed to observe nonlinear optical activity that was quantified, for the first time, through circular differential scattering intensity ratios. The study revealed that the hyper-Rayleigh optical activity (HROA) originates from charge transfer differences within the aromatic foldamers, which depends on the helix handedness and on the extent of electronic polarization induced by the appended substituents. The origin of the enantiomeric difference is discussed considering both achiral and chiral contributions.

(1) N. Berova, P. L. Polavarapu, R. W. Woody (eds.), *Comprehensive Chiroptical Spectroscopy: Instrumentation, Methodologies, and Theoretical Simulations*, Vol. I. (Wiley, Hoboken, NJ, 2013).

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(5) D. L. Andrews, *J. Chem. Phys.* 1979, 70, 1027.

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Alexis CASNER

CELIA

*Programme Structurant HDE : Techniques
expérimentales avancées en support et
préparation d'expériences LMJ PETAL*

TBA

Philippe BALCOU

CELIA

LEAP : Physique des lasers pour le programme régional Lasers et Santé

Le projet LEAP s'inscrit dans le cadre « d'Alliances technologiques laser », dont le schéma de co-développement et de co-investissement entre recherche académique et industrielle lèvera les verrous scientifiques et technologiques pour concevoir des produits innovants pour le secteur médical (projet XPULSE – mammographie X par laser) et le traitement des matériaux pour le secteur aéronautique-spatial-défense et l'automobile (projets HELIAM et COMPOCHOC, sur le traitement et le contrôle non destructif des matériaux).

Le projet LEAP vise spécifiquement la nouvelle génération de lasers à haute puissance moyenne et haute énergie en repoussant les limites des systèmes actuels ou en développant de nouvelles briques technologiques. Le projet LEAP est décomposé en 4 axes selon 2 tranches de 3 ans. Les Axes A et D impliquent le CNRS et l'Université de Bordeaux pour le laboratoire CELIA (Centre Lasers Intenses et Applications, Unité mixte de recherche CNRS-Université De Bordeaux-CEA), et les Axes B et C concernent le département des lasers de puissance du CEA/CESTA.

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