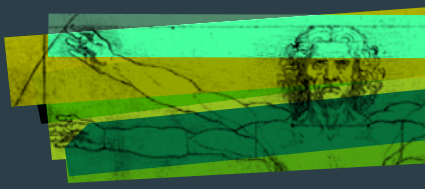
LE STUDIUM

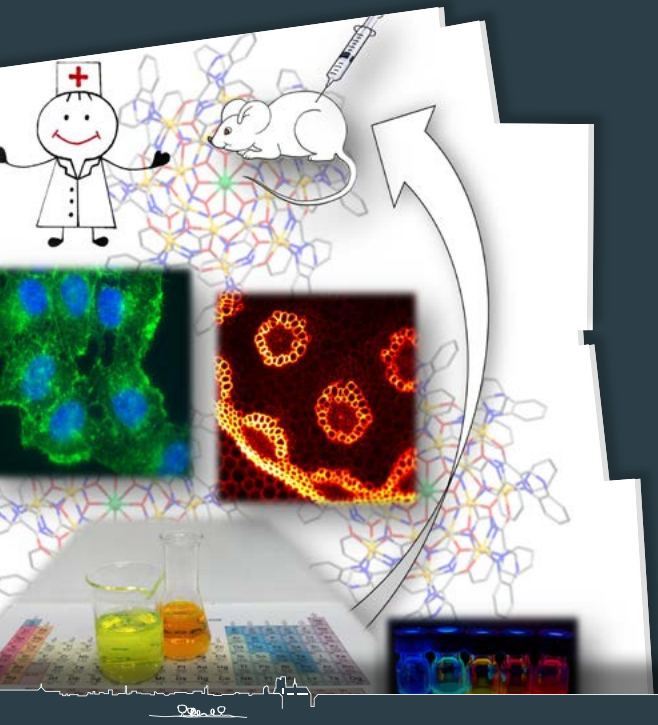
CONFERENCES

ORLEANS | 2025



26-28 May 2025

Seeing the Invisible: from Imaging Agents Design to Biological and Clinical Applications



LOCATION

Hôtel Dupanloup
1 rue Dupanloup
45000 Orléans - FR

CONVENORS

Vincent Pecoraro
LE STUDIUM RESEARCH PROFESSOR

FROM University of Michigan - USA

IN RESIDENCE AT Center for Molecular Biophysics (CBM)/CNRS - FR

Svetlana Eliseeva & Stéphane Petoud
Center for Molecular Biophysics (CBM)/ CNRS - FR

PROGRAMME - INSCRIPTION

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LE STUDIUM Loire Valley Institute for Advanced Studies
RÉGION CENTRE VAL DE LOIRE
Co-funded by the European Union
ORLÉANS MÉTROPOLE

LE STUDIUM

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ABSTRACTS

Seeing the Invisible: from Imaging Agents Design to Biological and Clinical Applications

CONVENORS

Vincent Pecoraro,
LE STUDIUM Research Professor
FROM: University of Michigan - USA
IN RESIDENCE AT: Center for Molecular Biophysics (CBM)/CNRS - FR

Svetlana Eliseeva & Stéphane Petoud,
Center for Molecular Biophysics (CBM)/CNRS - FR

ORGANISATION COMMITTEE

Sophie Gabillet, General Secretary

Dr Aurélien Montagu, Scientific Manager

Maurine Villiers, Communication and Events Manager

LE STUDIUM Loire Valley Institute for Advanced Studies • Région Centre-Val de Loire • FR

EDITO

Created in 1996 on the CNRS campus in Orleans La Source, LE STUDIUM has evolved to become the multidisciplinary Loire Valley Institute for Advanced Studies (IAS), operating in the Centre-Val de Loire region of France. LE STUDIUM has its headquarters in the city centre of Orleans in a newly renovated 17th century building. The amazing facilities are shared with the University of Orleans. In 2014 new developments and programmes linked to the smart specialisation of the Centre-Val de Loire region came to strengthen existing IAS collaborative relationships with the local and the international community of researchers, developers and innovators.

LE STUDIUM IAS offers to internationally competitive senior research scientists the opportunity to discover and work in one of the IAS's affiliate laboratories from the University of Tours, the University of Orleans, National Institute of Applied Sciences (INSA) Centre Val de Loire and ESAD Orléans, as well as of nationally accredited research institutions located in the region Centre-Val de Loire (BRGM, CEA, CNRS, INSERM, INRAE). Our goal is to develop and nurture trans-disciplinary approaches as innovative tools for addressing some of the key scientific, socio-economic and cultural questions of the 21st century. We also encourage researchers' interactions with industry via the IAS's links with Poles of Competitiveness, Clusters, Technopoles, and Chambers of Commerce etc.

LE STUDIUM has attracted more than three hundred and forty experienced researchers coming from 48 countries for long-term residencies. In addition to their contribution in their host laboratories, researchers participate in the scientific life of the IAS through attendance at monthly interdisciplinary meetings called LE STUDIUM THURSDAYS. Their presentations and debates enrich the regional scientific community at large (researchers of public and private laboratories, PhD students, research stakeholders' representatives, etc...)

For the period 2015-2021, LE STUDIUM has coordinated a Marie Skłodowska-Curie Actions COFUND award from the European Commission, a scheme that supports the mobility of international researchers. In 2022, LE STUDIUM joined the FIAS programme (French Institutes for Advanced Study) alongside six other French institutes, also supported by a COFUND award. A recently signed grant agreement extends the collaboration with the French Network of Institutes for Advanced Study until 2030. Since 2013, LE STUDIUM has also been an official partner of the Ambition research and development programmes initiated by the Centre-Val de Loire Regional Council to support the smart specialisation strategy (S3) around priority domains: biopharmaceuticals, renewable energies, cosmetics, environmental metrology, digital twins, materials, forestry and natural and cultural heritage. Our links with the ATHENA and NEOLAIA European Universities in the region, through the Universities of Orléans and Tours, allow us to develop new international collaborations with the members of these consortia. Visiting Researchers programmes strengthen these alliances by bringing researchers to Orléans and Tours.

Researchers are invited and supported by the IAS to organise, during their residency and in collaboration with their host laboratory, a two-day LE STUDIUM CONFERENCE. It provides them with the opportunity to invite internationally renowned researchers to a cross-disciplinary conference, on a topical issue, to examine progress, discuss future studies and strategies to stimulate advances and practical applications in the chosen field. The invited participants are expected to attend for the duration of the conference and contribute to the intellectual exchange. Past experience has shown that these conditions facilitate the development or extension of existing collaborations and enable the creation of productive new research networks.

The present LE STUDIUM CONFERENCE named «*Seeing the Invisible: from Imaging Agents Design to Biological and Clinical Applications*» is the 161th in a series started at the end of 2010 listed at the end of this booklet.

We thank you for your participation and wish you an interesting and intellectually stimulating conference. Also, we hope that scientific exchanges and interactions taking place during this conference will bring opportunities to start a productive professional relationship with presenting research laboratories and LE STUDIUM Loire Valley Institute for Advanced Studies.

Ary Bruand

Chairman
LE STUDIUM

INTRODUCTION

The global ageing of the population creates a growing demand for advanced diagnostic tools that will address a large number of challenges for disease diagnosis, prognosis, and treatment. Biological imaging techniques are highly attractive for this purpose as they allow one to visualize different objects (such as tumors) or processes (such as the variation of metabolites) and obtain precise information at the molecular and anatomical levels. In addition, recent advances in instrumentation and in the development of innovative imaging modalities have revolutionized the field of medical and biological detection, drastically improving the possibilities and accuracies of fast screening, diagnosis, prediction and treatment. For example, real-time optical image-guided surgery, the monitoring of drug delivery, the precise detection of tumour boundaries or tumour infiltration patterns, and the early detection of numerous different diseases have become feasible. However, to take full advantage of all these advanced technological developments, it is crucial to design innovative, versatile imaging agents that will address all the specific requirements of a particular biological need.

This multidisciplinary meeting will bring together experts in the design, chemical synthesis and characterization of molecular and nanosized imaging agents with biologists and medical doctors who will benefit from them for innovative biological and clinical imaging. The topics will cover:

- Peculiarities of the design, synthesis and characterization of molecular and nanosized imaging agents
- Optical imaging and sensing applications
- Biological imaging
- Clinical imaging

This project is co-financed by the Loire Val-Health project, funded by the ANR and France 2030 under the number ANR-23-EXES-0007.

WITH THE SUPPORT OF

Biospace Lab

Biospace Lab, established in 1989 by Nobel Laureate Georges Charpak (1992), has been a pioneer in preclinical in vivo optical imaging. Headquartered near Paris, the French company has consistently driven innovation in bioluminescence, fluorescence, and near-infrared (NIR I & II) imaging technologies and autoradiography, serving key research domains such as oncology and beyond. By maintaining strong ties with the scientific community, Biospace Lab tailors its high-performance imaging solutions to meet evolving research needs.

At the core of its offering is the PhotonIMAGER OPTIMA, a modular imaging platform featuring exceptional sensitivity, ultra-high spatial resolution, and rapid temporal acquisition, enabling real-time capture of dynamic, low-intensity biological signals (even in awake animals). This performance is underpinned by over 30 years of R&D, culminating in the proprietary Dynamic Acquisition Technology, designed to overcome the inherent challenges of preclinical optical imaging.

The company's systems support integration with 3D, X-ray, and high-throughput modalities, and are used by leading pharmaceutical firms and academic centers globally. As a subsidiary of its long-standing industrial partner Ateliers Laumonier, Biospace Lab combines ISO 9001-certified manufacturing with a strong reputation for scientific excellence and customer support in the global life sciences research community.

BIOSPACE LAB

Further information is available at https://biospacelab.com/

Loire Val Health

Loire Val-Health is a transformative initiative led by the University of Tours, aiming to revolutionize health research and education in the Centre-Val de Loire region. As a recipient of the French national «ExcellencES» program under France 2030, this project fosters an interdisciplinary alliance encompassing human and animal health, biomedical sciences, and the humanities, all within a «One Health» framework.

The project focuses on three strategic areas: mental health and neuroscience, biomedicines, and infectious diseases. It promotes collaborative governance by uniting regional academic institutions, research centers, and healthcare providers, including the University of Orléans, CNRS, INRAE, INSERM, and the University Hospital Centers of Tours and Orléans.

Loire Val-Health emphasizes interdisciplinary research through initiatives like the Neuroimaging Federation, participatory studies with patient associations, and partnerships with entities such as MabImprove and the BIO3 Institute. It also supports emerging talent by offering master's scholarships and doctoral fellowships.

In education, the project aims to develop innovative, modular, and transdisciplinary programs, including dual degrees in medicine, pharmacy, dentistry, and veterinary sciences, leading to PhDs. The establishment of a regional Graduate School is planned, offering master's and doctoral programs aligned with European standards and enhanced by international mobility opportunities through the NEOLAiA alliance.

With a budget of €11.8 million over eight years, Loire Val-Health aspires to position the Centre-Val de Loire as a leader in health innovation, research, and education, addressing current and future public health challenges through a comprehensive and collaborative approach.

Loire Val-Health is the winner of the ANR call for projects «Excellence in all its forms» under number ANR-23-EXES-0007.

HORIBA

HORIBA Fluorescence Instruments: Applications in Bio & Healthcare Research

HORIBA's fluorescence instruments play a key role in bio and healthcare research, offering advanced solutions for studying molecular and cellular mechanisms. These technologies support investigations ranging from biomarker detection to real-time cellular analysis. Among these instruments, the Duetta spectrofluorometer stands out as a versatile, high-performance tool for fluorescence and absorbance analysis.

Duetta, HORIBA's compact and powerful spectrofluorometer, provides simultaneous fluorescence and UV-visible absorbance measurements in a single, streamlined experiment. Designed for high-throughput applications, Duetta is ideal for biomolecular interaction studies, drug screening, and diagnostic research, where speed, sensitivity, and data richness are essential. Its capacity to analyze a wide array of samples — from biological fluids to tissue sections — makes it a valuable instrument in biomarker discovery and the development of therapeutic targets.

Complementing Duetta, the Aqualog Fluorescence Spectrometer offers advanced capabilities for simultaneous fluorescence and absorbance acquisition across a wide spectral range. Widely used in biomarker research, Aqualog enables the precise quantification of fluorescence in complex biological matrices such as serum, plasma, and tissue. It is particularly relevant in the study of fluorescence signatures associated with neurodegenerative diseases and other chronic conditions.

The Flimera Fluorescence Lifetime Imaging Microscope adds a spatial and temporal dimension to fluorescence analysis. By measuring fluorescence lifetimes, Flimera provides detailed insights into molecular interactions and the intracellular environment. This technology is especially suited for examining protein dynamics, cellular responses to drugs, and protein-protein interactions, offering a powerful window into live-cell imaging and functional biology.

All HORIBA fluorescence instruments are supported by robust software platforms that streamline data acquisition and analysis, ensuring precision and reproducibility. These tools significantly contribute to research in cancer, neurodegeneration, and other biomedical fields by enabling early-stage biomarker identification and mechanistic studies.

In summary, HORIBA's fluorescence instrumentation — led by Duetta and supported by Aqualog and Flimera — delivers comprehensive solutions that enhance the understanding of molecular and cellular dynamics, accelerating progress in life sciences and healthcare research.

PROGRAMME

MONDAY 26TH MAY 2025

12:30 Welcome lunch & registration

14:00 Official Opening - **Vincent Pecoraro** (LE STUDIUM Research Professor, University of Michigan) & **Sophie Gabillet** (General Secretary of LE STUDIUM)

SESSION 1 : Design of Imaging Agents for Biomedical Applications

Chair : Vincent Pecoraro

14:30 Clotilde Policar
Metal Complexes in Cells: from SOD Mimics to Imaging

15:00 Cyrille Richard
Persistent Luminescence Applied to Bioimaging and Biosensing

15:20 Franck Suzenet
Pyrazinotriazapentalene (PyTAP) a New Family of Fluorescent Scaffold for Cellular Imaging

15:40 Lucie Norel
Control of 4f Complexes Luminescence with Organic Photochromic Units

16:00 Coffee break & Posters session

16:30 Matteo Tegoni
Metallacrowns: from Encapsulation of Lanthanides to Ln-Containing Luminescent Peptides

17:00 Timothée Lathion
Functionalized Lanthanide Metallacrowns for Near-Infrared Biological Imaging

17:20 Jacob Lutter
A Structural Survey and Examination of Lanthanide Emission Properties of Gallium- or Zinc-Containing Compounds Featuring Metallacrown Motifs

17:40 Julie Bourseguin
A New Approach for the Optical Detection of Breast Cancer Cells Using NIR Imaging Agents Based on Lanthanide Complexes Incorporated into Nanoparticles

18:00 Arrival audience for public lecture

18:30 Michele Diana
L'IA et les robots révolutionnent la chirurgie
Public lecture in French, LE STUDIUM LECTURE

20:00 Wine & cheese cocktail

TUESDAY 27TH MAY 2025

08:45 Welcome coffee

SESSION 2 : Magnetic Resonance imaging and Related Imaging Modalities

Chair : Matteo Tegoni

09:00 Tom Meade
Seeing is Believing: But Just What are We Really Seeing?

09:50 Luke Marchetti
Zinc-Responsive Bioinspired Magnetic Resonance Imaging Contrast Agents

10:10 Janet Morrow
Transition Metal Coordination Cages for Biomedical Imaging

10:40 Coffee break & Poster session

11:10 Eva Jakab Toth
Manganese and Iron Chelates for ^{1}H and ^{19}F MRI

11:40 Angélique Sour
Bio-Inspired Cu(II)-Responsive MRI Contrast Agents

12:00 Lunch & Poster session

SESSION 3 : Optical and Multimodal Imaging

Chair : Svetlana Eliseeva

14:00 Eszter Boros
Catch and Release: Manipulating the Chemistry of Radioactive Metal Ions to Develop the Next Generation of Diagnostics and (Radio)Metal-Based Medicines

14:50 Fabien Caillé
Isotopic Radiolabeling of Drugs for PET Translational Developments: Application to Drug Development and HIV Imaging

15:10 Vladimir Lysenko
Carbon Dots@DOTA-Gd Nanohybrids and their Multi-Modal Bio-Imaging Applications

15:30 Ling Peng
Self-Assembling Dendrimer Nanosystems for Biomedical Imaging

16:00 Coffee break & Poster session

16:30 Daniel Jaque
Biomedical Applications of Luminescent Nanothermometers: Present and Future

17:00 Hélène Merceron
Single-Cell Measurements of Metabolic O_2 Fluxes in *Chlamydomonas reinhardti*

17:20 **Anthony Delalande**
Ultrasound and Microbubble-Based Theranostic Applications: Focus on Central Nervous System Drug Delivery

17:40 **Joëlle Tchicaya Bouanga**
Discover the Full Potential of Real Time Imaging and Near Infrared Spectrum to Go Over the Limit of *in vivo* Detection

18:00 Guided tour of the city center

19:30 Socal dinner

WEDNESDAY 28TH MAY 2025

08:45 Welcome coffee

SESSION 4 : Biomedical/Functional Imaging Towards Clinical and Therapeutic Applications

Chair : Stéphane Petoud

09:00 **Michele Diana**
Surgical Optomics and Robotics: the Combo towards Surgical Precision

09:50 **Jean-Luc Coll**
Nanotheranostic Approaches: Photons Can Help for Diagnotics and Therapy of Cancer

10:20 **Sara Lacerda**
Novel Peptide-Based MRI Probe Targeting Netrin-1 : Early Detection of Metastatic Breast Cancer

10:40 Coffee break & Posters session

11:10 **Gilles Gasser**
Metal-Based Photosensitizers for Anticancer Photodynamic Therapy

11:40 **Xavier Druart**
pCLE *in vivo* Imaging for Preclinical Development of New Contraception Methods

12:00 **Peggy Carver**
Targeting the Invisible: Pathogen-Specific Imaging for the detection of Infectious Diseases

12:30 End of the conference

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CONVENORS

SPEAKERS

CONVENORS

Vincent Pecoraro

LE STUDIUM Research Professor

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Professor Vincent L. Pecoraro is a major contributor in the fields of inorganic, bioinorganic and supramolecular chemistries. He has risen to the upper echelons of these disciplines with over 300 publications (an h-index of 91), 4 book editorships and 5 patents. He has served the community in many ways including as an Associate Editor of Inorganic Chemistry for 20 years and was previously President of the Society of Biological Inorganic Chemistry. In addition to his Le Studium Professorship, his numerous honors include the highly prestigious Blaise Pascal International Chair for Research, the Alexander von Humboldt Stiftung and the 2016 ACS Award for Distinguished Service in the Advancement of Inorganic Chemistry. He was recently ranked as one of the world's top 1,000 most influential chemists.

Svetlana Eliseeva

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Dr Svetlana V. Eliseeva, CNRS researcher, graduated from Lomonosov Moscow State University (MSU, Russia), earning a degree in chemistry with honors in 2003 and a PhD degree in inorganic chemistry in 2006. After three postdoctoral stays at MSU/Saint-Gobain company, EPFL in Lausanne (Switzerland) and KU Leuven (Belgium), in 2011 she joined the CNRS Center for Molecular Biophysics in Orléans (France), first, as Le Studium research fellow (2011-2013), and, then, as a Marie-Curie fellow (2013-2015). Her research activity is reflected in more than 120 peer-review articles and reviews (h-index = 37) and have been recognized by excellency awards in Russia and in France. Her current research interests focus on the design of luminescent lanthanide-based coordination compounds and nanoparticles for biological applications and material sciences, as well as their advanced spectroscopic and microscopic characterization.

Stéphane Petoud

Center for Molecular Biophysics (CBM)/CNRS - FR

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Stephane Petoud is a Professor of Biochemistry and an INSERM research Director at the CNRS Center for Molecular Biophysics in Orléans France and an Adjunct Professor of Chemistry in the Department of Chemistry of the University of Pittsburgh. He has an extensive expertise in lanthanide coordination and material chemistry, luminescence spectroscopy and optical biological imaging. He has promoted and worked on the vision to use the near-infrared emission of lanthanide compounds for optical biological imaging in cells and small animals since he started his independent career in the Department of chemistry at the at the University of Pittsburgh. His research is highly interdisciplinary in nature, bridging different domains of chemistry, biology and material sciences.

SPEAKERS

SESSION 1

Clotilde Policar

Ecole normale supérieure, NS-PSL

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Clotilde Policar is a professor in bio-inorganic chemistry at the Ecole normale supérieure (ENS-PSL) in Paris (https://ens-bic.fr/) https://orcid.org/0000-0003-0255-1650. Her work focuses on the study metal complexes directly in cellular or biological environments. On the one hand, her group design metal complexes mimicking anti-oxidant metalloenzymes such as superoxide dismutases or catalases. For their evaluation in cells, they combine functional characterization (bio-activity valuation, including cell feedback to treatment with the antioxidants), with quantification, imaging and speciation study. On the other hand, they have initiated work on metal-based probes, including metal–carbonyl as multimodal bio-probes and organelles trackers that they have validated for in IR and X-fluorescence.

Co-authors : Clotilde Policar, Nicolas Delsuc, Hélène Bertrand, Alice Balfourier, Christine Rampon, Michel Volovitch Sophie Vriz - Laboratoire Chimie physique et chimie du vivant, CPCV, UMR8228, Département de chimie, École normale supérieure, Sorbonne Univ., CNRS, PSL University, 24 rue Lhomond, 75005 Paris - FR.

Metal Complexes in Cells: from SOD Mimics to Imaging

Metal complexes are increasingly used for biological applications, as metallodrugs or metalloprobes.[1] Metal based antioxidant can be developed as superoxide dismutase mimics.[2] We focus on how they can be studied directly in cells: evaluation of the bioactivity,[3] analyses of the speciation,[3,4] and evaluation by a redoxomic approach,[5] with two applications:

- as anti-inflammatory agents in link with inflammatory bowel diseases using bacteria for delivery in cells and in vivo,[6]
- to mitigate the side effects of Pt-based drugs and neuropathy effects.[7]

Probes consisting of a central metal-CO core, can be mapped using unconventional imaging techniques such as IR and X-fluorescence imagings. Several examples will be presented including a SOD mimic conjugated with a $Re(CO)_3$-based probe,[8] with imaging used to explore the integrity of the complex[4] in cells, and the design of $Re(CO)_3$-based organelle trackers,[9] that can be used for X-fluorescence mapping.

References:

[1]C. Policar, J.B.I.C., 2025, ASAP. | [2]C. Policar, et al., C.R. Chim., 2024, 27, 1. | [3]G. Schanne, et al. Oxid. Med Cell Longev., 2022, Art. 3858122. | [4]M. Zoumpoulaki, et al., Angew. Chem. Int. Ed., 2022, e202203066. | [5]M. Zoumpoulaki, et al., Angew. Chem. Int. Ed., 2025, e202422644. | [6]G. Schanne, et al., Free Rad. Res., 2025, doi.org/10.1080/10715762.2025.2478121. | [7]C. Prieux-Klotz, et al., IJMS, 2022, 23, 12938. | [8]E. Mathieu, et al. Chem. Commun., 2020, 56, 7885. | [9]G. Schanne, et al., Inorg. Chem. Front., 2021, 8, 3905.

Cyrille Richard

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Cyrille Richard is a research director at CNRS. He works at the Unité de Technologies Chimiques et Biologiques pour la Santé (UTCBS), at the Faculty of Pharmacy of Université Paris Cité, where he develops nanoparticles with innovative optical properties for biological applications.

Persistent Luminescence Applied to Bioimaging and Biosensing

One of the research activities of the UTCBS laboratory is the development of nanoprobes for biological applications. We are particularly interested in persistent luminescence materials. As their name indicates, persistent luminescence (PersL) is the property of some materials that can continue emitting light for a long time (from minutes to hours) after their excitation has ceased. The main application of this phenomenon is for night vision. In daylight, materials as strontium aluminate doped with europium and dysprosium ($SrAl_2O_4$:Eu,Dy) are excited and can store the excitation energy in traps, which are defects present in the materials. At night, when the excitation is stopped, the energy stored in the traps is released to produce a green emission. To be used in biology, we had to change the composition, to have light emission in the NIR, in the tissue transparency window, and we also had to change the preparation method to form nanoparticles. I will show how we have been able to use such nanomaterials in vivo and what their main advantage is when applied to bioimaging. [1,2] I will also show how we can use PersL nanoparticles for biosensing.[3,4]

References :

[1] Liu et al, Adv Drug Deliv Rev 2019, 138, 193-210; [2] Cai et al, Chem Eng J 2024, 490, 151643; [3] PCT WO 2024/061937 A1; [4] Liu et al, Small 2023, 2303509

Franck Suzenet

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F. Suzenet defended his PhD in 1998 (chemistry of organotin derivatives, Univ Nantes). He then worked on the synthesis of analogues of natural anticancer drugs (Prof M. Shipman, UK). In 2000, he joined the Institute of Organic and Analytical Chemistry (ICOA, Univ Orléans UO). Since 2014, Prof F. Suzenet has led the CHeMBioLight team whose research activities focus on the chemistry of heteroaromatic systems (synthetic methodologies, organic fluorescent probes and organic chromophores absorbing in the near IR) for applications in life chemistry (therapeutic chemistry, fluorescent probes, etc.). F. Suzenet is head of the Master's program in Chemical Engineering for Therapeutic and Cosmetic Innovation (CMI CITC, UO). He received a SCF-DCO award in 2011. He is the co-author of 117 publications and 9 patents.

Pyrazinotriazapentalene (PyTAP) a New Family of Fluorescent Scaffold for Cellular Imaging

Fluorescent organic molecules are essential compounds for the detection, quantification and understanding of biological processes applied in chemical biology, biochemistry, biomedical research and diagnostic. The main advantages of organic fluorescent molecules include high versatility, moderate molecular size and weight, chemical stability, and ability to exhibit switchable or activatable spectroscopic properties. Although numerous fluorophores have been already described in the literature, the diversity of the molecular frameworks of those commonly used for cell imaging probes is often limited to coumarin, xanthene (fluorescein, rhodamine, Texas), BODIPY and cyanine cores. All these dyes can still not be considered as ideal probes for optical imaging since none of them combines high fluorescence with optimal absorption and emission wavelengths, good chemical and photostability, easy modularity, sufficient water solubility and small molecular weight/size.

In this context, we have designed a new family of organic fluorophores: the pyrazino-1,3a,6a-triazapentalene (PyTAP). This innovative compact scaffold, initially design for energetic properties, shows promising photophysical properties i.e. large Stokes shift, emission wavelength beyond 500nm, quantum yields up to 75% and good photostability. Thanks to the synthetic strategies we have developed, PyTAP can be modulated as desired to optimize and design fluorescent probes for various applications in live cell imaging.

Lucie Norel

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Lucie Norel obtained her PhD degree from the University Paris-6 in 2008 in the field of Molecular Magnetism. Then she joined Jeanne Crassous to work on the synthesis of metallahelicenes. Since 2009, she has developed a research project around photoswitchable Lanthanide complexes for luminescence and magnetism at Université de Rennes. She became Professor in 2022 and junior member of the Institut Universitaire de France in 2023.

Control of 4f Complexes Luminescence with Organic Photochromic Units

Lanthanide complexes are of particular interest due to their unique photophysical properties. The pioneering combination of an organic photochrome with emissive lanthanide(III) ions[1] demonstrated that the changes in optical response of a photochrome can be used to modulate europium(III) emission with light and to advance applications such as anticounterfeiting, bioimaging, and information encryption.[2] Our group specialises in the photoswitching of NIR emitters, and we have achieved both good ON/OFF contrast and good fatiguability with various ytterbium(III) complexes.[3] We have also recently developed systems with spontaneous return to the ON state.[4] In this presentation, I will show the properties of various photoswitchable red or NIR emitting complexes and discuss their photophysics to initiate discussions on their potential for bioimaging.

References :

[1]Tetsuya, N.; Kazuhiko, A.; Takuya, N.; Yasuchika, H.; Tsuyoshi, K., Chem. Lett. 2007, 36, 372-3.

[2]Fréroux, Y.; Caussin, L.; El Beyrouti, N.; Rigaut, S.; Norel, L., Chapter 338 - Control of 4f complexes luminescence and magnetism with organic photochromic units. In Handbook on the Physics and Chemistry of Rare Earths, Bünzli, J.-C. G.; Kauzlarich, S. M., Eds. Elsevier: 2024; Vol. 65, pp 35-91.

[3](a) Selvanathan, P.; Tufenkjian, E.; Galangau, O.; Roisnel, T.; Riobé, F.; Maury, O.; Norel, L.; Rigaut, S., Inorg. Chem. 2023, 62, 2049-57. (b) Al Sabea, H.; Hamon, N.; Galangau, O.; Norel, L.; Maury, O.; Riobé, F.; Tripier, R.; Rigaut, S., Inorg. Chem. Front. 2020, 7, 2979-89. (c) Al Sabea, H.; Norel, L.; Galangau, O.; Roisnel, T.; Maury, O.; Riobé, F.; Rigaut, S., Adv. Funct. Mater. 2020, 2002943.

[4]Norel, L.; Bernot, K.; Gendron, F.; Gould, C. A.; Roisnel, T.; Delbaere, S.; Le Guennic, B.; Jacquemin, D.; Rigaut, S., Chemistry Squared 2020, 4, 2.

Matteo Tegoni

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Matteo Tegoni is Associate Professor of Inorganic Chemistry at the University of Parma. He has been visiting student at the University of Leiden (with Jan Reedijk) and visiting researcher at the University of Michigan (with Vincent Pecoraro). His interests are in the field the thermodynamics of formation in solution of transition metal complexes with peptides and proteins, and in the study of the self-assembly of metallacrowns in solution. He has been coordinator of a Marie Curie IRSES project on Metallacrowns and coordinator of two bilateral Italy- USA projects (de novo designed metallopeptides and metallacrowns). He delivered invited lectures at international conferences on bioinorganic chemistry and he chaired the 1st International Symposium on Metallacrowns and Metallacryptates.

Metallacrowns: from Encapsulation of Lanthanides to Ln-Containing Luminescent Peptides

Metallacrowns (MCs) are the inorganic analogues of crown ethers. MCs can be obtained by self-assembly of metal ions and hydroxamic acids, and have the property to encapsulate lanthanide ions in their cavity. In the past two decades we have studies the thermodynamics and the kinetics of self assembly of lathanide metallacrowns with different ring metals such Cu(II) and Ni(II). Also, we have elucidated the NMR behaviour of Ln(III)/Mn(III) and Ln(III)/Ga(III) 12-MC-4 complexes in terms of magnetic anisotropy and fluxionality. More recently, we explored strategies for the functionalization of the periphery of luminescent Ln(III)/Ga(III) 12-MC-4 complexes with biomolecules such as biotin.

In this communication we will provide details on the stability in solution of Ln-containing MCs, their structural features, and our most recent results on the design of artificial proteins provided with MC complexes as artificial luminescent metal sites.

Timothée Lathion

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Timothée Lathion earned his PhD in inorganic chemistry at the University of Geneva - CH in 2018 under the supervision of Prof. C. Piguet. He studied complexes of Fe^{II} exhibiting spin crossover and its effect on Eu^{III} luminescence. In 2021, he joined the research group of Prof V. L. Pecoraro at the University of Michigan - USA to work on the design and synthesis of lanthanide-based metallacrowns exhibiting emission in the near-infrared domain. In 2023, he moved to Centre de Biophysique Moléculaire in Orléans - FR and joined the research group of Prof. S. Petoud. His current research interests focus on the development of supramolecular assemblies incorporating metallacrowns for advanced biological imaging applications and controlled drug release.

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Functionalized Lanthanide Metallacrowns for Near-Infrared Biological Imaging

Optical imaging in the near-infrared (NIR) window has become a tool of major importance for biological research and medical diagnostic as in this range of wavelengths, biological autofluorescence and light scattering are strongly reduced, allowing the recording of images with higher signal-to-noise ratio and resolution from deeper tissues. NIR emitting lanthanides (Ln^{III}) are ideally adapted for such imaging applications as they display sharp and characteristic emission bands in this spectral domain. $[Ln2Ga8]^{2-}$ metallacrowns[1,2] (MCs, Figure 1, left) are able to efficiently sensitize several NIR-emitting Ln^{III} and protect them from non-radiative deactivations that induce luminescence quenching, yielding to exceptional quantum yield values. However, in these MCs, the Ln^{III} sensitization is limited to the UV range, which is detrimental to biological samples. To overcome this limitation, small and biocompatible organic chromophores such as coumarins can be appended to the MC scaffold (Figure 1, middle). With the help of these additional chromophores absorbing in the visible domain, we have been able to sensitize several NIR-emitting Ln^{III}. In addition, we have demonstrated that these functionalized MCs are highly efficient for NIR biological imaging of living HeLa cells (Figure 1, right).

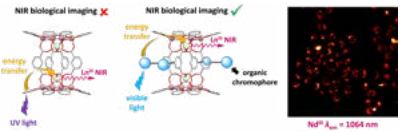

Figure 1. Left: $[Ln_2Ga_8]$ MC. Middle: $[Ln_2Ga_8]$ MC functionalized with organic chromophores absorbing in the visible. Right: NIR biological imaging of living HeLa cells using Nd^{III}.

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Dr. Lutter began his career in chemistry at Shippensburg University working with Dr. Curt Zaleski on a fascinating class of coordination compounds known as metallacrowns. Having fallen head over heels for metallacrowns, continued to explore these compounds in the context of lanthanide ion sensitization with Prof. Vince Pecoraro for his PhD at the University of Michigan. Afterwards, Dr. Lutter began a postdoc position with Dr. Matt Allen at Wayne State University working on divalent europium based compounds that were soluble in liquid perfluorocarbons. Since 2022, Dr. Lutter has been an Assistant Professor of Chemistry at the University of Southern Indiana. He is still an avid member of the metallacrown research community, sharing his passion with new generations of scientists.

A Structural Survey and Examination of Lanthanide Emission Properties of Gallium- or Zinc-Containing Compounds Featuring Metallacrown Motifs

Since their discovery in 1989 by Pecoraro and Lah as inorganic analogs to crown ethers, metallacrowns (MCs) have contributed to the advancement of a wide range of scientific fields including host–guest chemistry, magnetic phenomena, and more recently, lanthanide(III) (Ln) based luminescence. Ln ions emit light as characteristic and narrow emission bands due to the isolated nature of 4f valence electrons. Their lifetimes typically range from µs to ms timescales since 4f–4f transitions are parity forbidden; however, these relatively long lifetimes sacrifice photoabsorbance. Therefore, in order to remove this limitation, "antenna" chromophores are used to sensitize the Ln emissions instead of direct Ln excitation. The organic fragments of MC complexes provide such antenna, e.g. via the hydroximate of the MC and auxiliary carboxylate ligands that compose the structure, especially when using a transition metal with a full 3d10 electron configuration. Here, we present the structures of gallium(III)- or zinc(II)-based coordination compounds that feature metallacrown motifs. Many of the compounds contain multiple Ln binding sites and examples of Ln-based emission are also reported ranging across the visible and near-infrared spectral regions.

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Julie Bourseguin earned her PhD in Life Sciences and Health at the Université Paris-Saclay (France) under the supervision of Prof. F. Rosselli, in 2016. From 2017 to 2021, she was working in the group of Dr. S. Khoronenkova at the University of Cambridge on the role of glial cells in the neurodegeneration in patients with genomic instability syndromes. In 2021, she joined the University of Orléans and the research group of Dr. S. Morisset-Lopez at Centre de Biophysique Moléculaire, where she explored the role of serotonin receptors in the regulation of glial cells in different types of neurodegenerative diseases. In 2022, she was appointed as Associate Professor in the group of Prof. S. Petoud in which she is designing and using lanthanide-based complexes and nanoparticles for near-infrared optical imaging in cancer and in neurodegenerative diseases

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A New Approach for the Optical Detection of Breast Cancer Cells Using NIR Imaging Agents Based on Lanthanide Complexes Incorporated into Nanoparticles»

Near-infrared (NIR) optical imaging is of strong interest for biological research and medical diagnostic. In addition to deeper tissues penetration, emission in the NIR allows to improve both detection and image resolution. The luminescence of lanthanide cations (Ln^{3+}) is attractive as they exhibit sharp emission bands that are not affected by any environmental changes. Ln^{3+} are sensitized with a chromophore that absorbs excitation light and transfers the resulting energy. Metallacrowns (MCs) form a scaffold that coordinate and efficiently sensitize the Ln^{3+} [1,2,3,4]. In order to address the required biocompatibility and selectivity of detection, we have developed a methodology to encapsulate a large number of Ln^{3+}-based MCs in functionalized polystyrene nanoparticles (PS-NPs) through a rapid swelling procedure[5]. In this project, HER2-positive breast cancer was taken as a model to develop targeted Ln^{3+}-based NIR optical imaging agents. The first PS-NPs containing NIR-emitting MCs with specific HER2 targeting, addressed by the surface conjugation with monoclonal antibodies, were synthesized and characterized. These PS-NPs showed: (i) specific binding properties to HER2 at the surface of cancer cells, (ii) unique photophysical properties in the NIR range due to Yb^{3+} emission, and (iii) an absence of cytotoxicity. These PS-NPs constitute a versatile system that can be easily adapted to other targets, including multiplex and/or multimodal imaging.

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SESSION 2

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Thomas J. Meade is the Eileen M. Foell Professor of Cancer Research and the Charles Deering McCormick Professor of Teaching Excellence at Northwestern University, where he holds joint appointments in Chemistry, Molecular Biosciences, Neurobiology, and Radiology. He earned his M.S. in Biochemistry and Ph.D. in Inorganic Chem. followed by an NIH fellow at Harvard Medical School and a postdoc appointment at the California Institute of Technology. His research lies at the interface of coordination chemistry and biology, with a focus on molecular imaging, zinc finger transcription factor inhibition, and the development of electronic biosensors for DNA & protein detection. He has authored over 340 peer-reviewed publications, holds 120 U.S. patents, and is the founder of five biotech companies.

Seeing is Believing: But Just What are We Really Seeing?

We have developed new classes of magnetic resonance (MR) imaging probes that are conditionally activated by specific enzymatic activity. These bioresponsive probes have been applied to image both in vivo gene therapy and the presence of cellular senescence.

Lysosomal storage diseases (LSDs), which have a median survival of only five years and are typically fatal, represent some of the most severe prognoses in medicine. Due to their monogenic origin and well-defined genotype-phenotype relationships, LSDs are strong candidates for gene therapy. However, there remains a critical lack of non-invasive tools to assess the biodistribution and therapeutic activity of gene therapies in patients. This limitation forces clinicians and researchers to rely on indirect or delayed indicators of efficacy, hindering real-time evaluation and optimization of treatment strategies.

In parallel, cellular senescence has emerged as a key contributor to musculoskeletal (MSK) disorders, including osteoarthritis. Senescence is a response to aging and environmental stress that results in irreversible cell-cycle arrest and the secretion of pro-inflammatory factors. Triggering events such as trauma or oxidative stress lead to transient arrest in local cell populations—including synoviocytes, chondrocytes, and bone marrow cells—ultimately promoting chronic inflammation and tissue degradation.

To support the identification of patients who may benefit from emerging senolytic therapies, and to enable longitudinal monitoring of treatment response, we have designed a new class of enzyme-responsive MR imaging agents. These probes allow for real-time, non-invasive tracking of enzymatic activity in various tissues, including the central nervous system (CNS), peripheral nervous system (PNS), and MSK disorders.

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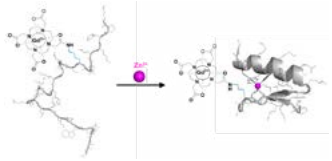
Luke Marchetti earned his BSc in Chemistry from Maynooth University in 2017, before pursuing a PhD under the supervision of Prof Rob Elmes, focusing on the design, synthesis, and evaluation of responsive systems for anion recognition and transport. Following his PhD, Luke remained under the supervision of Prof Elmes as a post-doctoral researcher, collaborating with Janssen Pharamaceuticals to investigate novel zinc ionophores as cancer and anti-microbial therapeutics. In 2023, Luke moved to the Centre de Biophysique Moléculaire in Orléans to work under the guidance of Dr Célia Bonnet. His research now lies in the interface of bioinorganic chemistry and biomedical imaging, where he is involved in the development of bioinspired MRI contrast agents for Zn^{2+} detection in vivo.

Zinc-Responsive Bioinspired Magnetic Resonance Imaging Contrast Agents

Zinc is the second most abundant metal ion in the body, essential for both homeostasis and the immune system.[1] Zn^{2+} concentration is tightly regulated and its disruption has been implicated in neurodegenerative diseases and various cancers.[2,3] Detecting and monitoring Zn^{2+} in vivo is crucial for the early diagnosis and to gain a greater understanding of zinc's role in such pathologies. Magnetic resonance imaging (MRI) has proved to be a powerful tool in this field due to its ability to obtain anatomical images with high spatial and temporal resolution, unlimited tissue depth imaging, and its non-invasive nature. The utilisation of Gd^{3+}-based MRI contrast agents for the detection of Zn^{2+} in vivo has made great strides in recent years.[4] The main approach used by our group and others is to design small molecular complexes and play with the difference of affinity for a given protein in the absence and in the presence of Zn^{2+},[5,6] or the Gd^{3+} hydration number.[7,8] Herein, we will present a bioinspired approach for Zn^{2+} detection using a zinc-finger peptide conjugated to a Gd^{3+} chelate, displaying high affinity and selectivity, algonside inherent biocompatibility. In the presence of Zn^{2+}, the peptide adopts a ββα-fold resulting in an increased MRI efficacy.[9] Modification of the peptide allows for the tuning of the response mechanism.[10] Ongoing work includes modifications of the zinc-finger peptide and the Gd chelate to increase bio-stability and optimise Zn-response of the probe.



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Janet Morrow is SUNY Distinguished Professor and Larkin Chair at the University at Buffalo, the State University of New York. She received her B.S. in Chemistry at the University of California, Santa Barbara and her Ph.D. in Inorganic Chemistry at the University of North Carolina, Chapel Hill. From there she did postdoctoral work at the University Bordeaux, France on an NSF postdoctoral fellowship and then at the University of California, San Diego. She began her independent career at the University at Buffalo and moved up through the ranks to her current position. Her research interests focus on transition metal complexes as probes for biomedical imaging and drug delivery. She is the CSO of Ferric Contrast, a company developing iron-based MRI contrast agents.

Transition Metal Coordination Cages for Biomedical Imaging

Efforts are underway to prepare MRI probes that produce increased signal intensity. One way to design such probes is through the incorporation of multiple metal ions into coordination cages of high symmetry with sizes of 2-3 nm. Our group is preparing Co(II), Ni(II), and Fe(III) cages with tetrahedral or octahedral shapes as shift agents for paraCEST and paraSHIFT applications or T1 probes as relaxivity agents. Co(II) or Ni(II) octahedral cages with methyl-pyridine donor groups show relatively sharp and highly shifted proton resonances that suggest a racemic mixture of two homochiral enantiomers. Hyperfine-shifted proton resonances vary with pH or temperature as paraSHIFT probes. Incorporation of exchangeable amino protons into the pyridine donor groups is one approach towards paraCEST agents. Related Fe(III) coordination cages with octahedral shapes are effective T1 MRI probes. Solubility, relaxivity and serum protein binding can be modulated by varying overall charge in these easily derivatized cages. Tetrahedral Fe(III) coordination cages are also effective T1 MRI probes and accumulate in murine tumor models. The host-guest chemistry of the coordination cages will be presented as a strategy for metallodrug delivery.

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Eva Jakab Toth is a coordination chemist interested in the design and characterization of metal complexes for Magnetic Resonance Imaging. After a PhD at the University of Debrecen, Hungary, she occupied research positions at EPFL Lausanne, Switzerland. In 2005, she became CNRS research director at the Centre of Molecular Biophysics in Orléans, France ; she was the head of this institute between 2012 and 2021. Her recent research interests involve biomarker detection and the development of manganese chelates as MRI agents. Her work has been recognized by various prizes, including the CNRS Silver Medal, the Grand Prix Achile Le Bel of the French Chemical Society or the Torsten Almen Award for Pioneering Contrast Media Research.

Manganese and Iron Chelates for ^{1}H and ^{19}F MRI

Following recent toxicity concerns related to the use of Gd^{3+} complexes in MRI, there is an active research for more biocompatible alternatives. Among these, Mn^{2+} chelates have great promise. However, the lower charge and the lack of ligand-field stabilization energy for Mn^{2+} are not favorable to achieve high thermodynamic stability, and the highly labile nature of Mn^{2+} sets an even more difficult challenge to meet. We have recently demonstrated that rigid and pre-organized bispidine ligand structures are particularly interesting in this respect.

We have also explored the potential of fluorine-containing small Mn^{2+} or Fe^{3+} chelates as alternatives to perfluorinated nanoparticles in ^{19}F MRI. In chelates where several magnetically equivalent ^{19}F atoms are placed at an appropriate distance from the metal center, these paramagnetic ions generate maximized relaxation effects which can be efficiently harvested by using ultrafast acquisition sequences. The redox properties of these metal ions can be further exploited to design redox responsive ^{19}F MRI agents.

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Angélique Sour earned a PhD in chemistry in 1994, working on ruthenium complexes, under the supervision of Dr. J.-P. Sauvage. She joined Pr. G. Newkome's group as a postdoctoral fellow in Tampa (University of South Florida, USA) and was appointed as a CNRS researcher at the University of Paris South in 1996 in the team of Dr. M.-L. Boillot. She then joined the group of Pr. A. Merbach in Lausanne (EPFL) to work on MRI contrast agents (2000-2006). Back to Strasbourg, she worked successively in the fields of copper-based molecular machines (with Dr. J.-P. Sauvage), theranostic -MRI and photo dynamic therapy- agents (with Pr. V. Heitz), and copper-related agents (with Pr. P. Faller). Her main current scientific interest is the development of bio-inspired copper-responsive MRI contrast agents.

Co-authors: [1]E. Falcone, M. Okafor, N. Vitale, L. Raibaut, A. Sour, P. Faller, Coord. Chem. Rev. 2020, 433, 213727, [2]K. Zimmeter, B. Vileno, C. Platas-Iglesias, B. Vinjamuri, A. Sour, P. Faller, Inorg. Chem. 2023, 62, 9429–9439, [3]K. Zimmeter, A. Pallier, B. Vileno, M. Sanadar, F. Szeremeta, C. Platas-Iglesias, P. Faller, C. S. Bonnet, A. Sour, Inorg. Chem. 2024, 63, 23067–23076, [4]M. Sanadar, K. Zimmeter, H. Martin, A. Pallier, B. Vileno, P. Faller, A. Sour, C. S. Bonnet, Eur. J. Inorg. Chem. 2025, e202500049.

Bio-inspired Cu(II)-Responsive MRI Contrast Agents

Numerous biological processes can be visualized by MRI at the molecular and cellular level. Monitoring copper(II) in blood is of fundamental and applied interest to understand Cu-homeostasis and the impact of Cu-targeted therapeutic treatment. While significant progress has been made in the development of Ca^{2+} and Zn^{2+}-responsive MRI contrast agents, the design of MRI probes for Cu^{2+} detection, with high relaxivity response, appropriate Cu^{2+}-affinity and high selectivity, remains a challenge. We will present the design and study of specific Cu^{2+} chelators bio-inspired by the N-terminal site for Cu^{2+}-chelation of serum albumin. Conjugation of these Cu2+ chelators with Gd^{3+} complexes give rise to MRI sensors. Spectroscopic and relaxometric studies of these sensors have been performed. Very high selectivity for Cu^{2+}, especially vs Zn^{2+}, has been obtained. Unprecedented relaxivity response of nearly 400 % upon Cu^{2+} complexation has been reached. The affinity for Cu^{2+} has been improved. This systematic approach used for the design and study of Cu^{2+}-responsive MRI probes contributes to the understanding of metal ion coordination chemistry and paves the way for the development of responsive MRI agents.

SESSION 3

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I was trained as an inorganic chemist at the University of British Columbia under the mentorship of Prof. Chris Orvig where I successfully developed new, targeted tracers based on the radioisotopes $^{67/68}$Ga and ^{111}In. As a Swiss National Science Foundation postdoctoral fellow, I joined the lab of Prof. Peter Caravan at the Martinos Center for Biomedical Imaging at Massachusetts General Hospital and Harvard Medical School (Department of Radiology). There, I was involved in the design, synthesis, characterization and in vivo evaluation of new high-relaxivity MRI contrast agents in rodents and development of multimodal PET probes. I was recruited as tenure-track Assistant Professor of Chemistry at Stony Brook University in 2017 and transitioned to UW-Madison as Associate Professor of Chemistry with tenure in June 2023. Since November 2024, I also hold an affiliate appointment with the Department of Medical Physics University of Wisconsin School of Medicine and Public Health. I have won various junior faculty awards, such as Dreyfus, Sloan, Moore, and secured a large funding portfolio spanning DOE, NIH, NSF.

Catch and Release: Manipulating the Chemistry of Radioactive Metal Ions to Develop the Next Generation of Diagnostics and (Radio)Metal-Based Medicines

Stable and radioactive metal ions possess attractive properties for biomedical imaging and therapy. Our lab applies a cross-disciplinary approach that combines physical inorganic chemistry, coordination chemistry, chemical biology and preclinical imaging to transform aqua ions into tools for non-invasive diagnostic imaging, optical probes for image-guided surgical resection and targeted radiotherapy of cancers. I will discuss 1) strategies to stabilize hydrolytic, radioactive metal ions as mononuclear coordination complexes for targeted imaging and 2) thermally activated isotope capture and release systems for the synthesis of radiopharmaceuticals with readily tunable pharmacokinetics and theranostic capabilities.

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Fabien CAILLÉ is a radiochemist at the Service Hospitalier Frédéric Joliot (SHFJ) of the French Atomic Energy Commission (CEA). He completed a PhD in chemistry at the University of Orléans in 2011 dedicated to the synthesis and characterization of bimodal contrast agents for MRI and optical imaging. In 2012, Fabien Caillé moved to New Haven CT (USA) to work at Molecular Neuroimaging LCC on the design of radiotracers for PET imaging of neurodegenerative disorders. Since 2013, Fabien Caillé hold a research position at the CEA focusing on the development of original radiotracers for PET. He is also the head of the radiochemistry platform. Fabien Caillé is the co-author of 69 peer-reviewed scientific publications in the field of chemistry for medical imaging. He obtained his HDR in 2024.

Isotopic Radiolabeling of Drugs for PET Translational Developments: Application to Drug Development and HIV Imaging

Positron emission tomography (PET) is the state-of-the-art imaging technique to visualize and quantify (patho)physiological patterns at the molecular level and at the whole-body scale. PET imaging craves for new radiotracers targeting original biomarkers for diagnostic, therapeutic follow up or to support drug development. Drugs or drug candidates represent an attractive reservoir of molecules with broad biological properties. To transform a drug into a radiotracer, isotopic labeling is necessary to introduce a radioisotope without changing the chemical structure of the drug. With the preserved biological properties and the known toxicity of the original drug, the translational development of the radiotracer can be accelerated to the clinical stage.

At the CEA-SHFJ we develop original radiolabeling strategies using either carbon-11 (β^+, $t_{1/2}$=20.4 min) or fluorine-18 (β^+, $t_{1/2}$=109.8 min) and apply them to the isotopic labeling of drug for PET imaging. As an example, we have created the Staudinger/aza-Wittig approach to radiolabel ureas and carbamates with C-11. This strategy supported the drug development of Serodolin, a 5-HT_7 biased agonist with antinociceptive properties. In another example, isotopic labeling with F-18 of Dolutegravir, an anti-retroviral drug used in tritherapy, was designed to detect HIV reservoirs and understand pharmacological sanctuaries in infected non-human primates using PET imaging.

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Vladimir Lysenko received his M.S. degree in semiconductor physics and electronics from Kiev National Shevchenko University in 1995 and his Ph.D. degree in the field of integrated electronic devices from Ecole Centrale de Lyon (France) in 1998. He was employed as scientific researcher by French National Center of Scientific Researches in 2002. Currently, he works at Light Matter Institute (UCBL/CNRS) as a member of «Formation, elaboration of nanomaterials and crystals» team. His main scientific interest is focused on elaboration, spectroscopic studies of physico-chemical properties and multi-disciplinary applications of nanomaterials of the IVth group

Carbon Dots@DOTA-Gd Nanohybrids and their Multi-Modal Bio-Imaging Applications

Different nanoscale materials are discovered to be extremely efficient for theranostic applications. Among them, hybrid nanomaterials, or nanohybrids (NHs), have attracted particular interests in biomedicine, owing to their highly-enriched distinctive physical and chemical properties. NHs integrate both organic and inorganic moieties in a single entity showcasing synergistic properties of the constituents and a new prospect towards clinics. For example, AGuIX and Cornell Dots are ultra-small nanostructures (with hydrodynamic diameter <10 nm) that allow rapid renal elimination to avoid long retention in the body and eventual toxicity after intravenous administration.

The main general objective of our research work is the development and multi-functional application of carbon-based NHs for diagnostics and therapy. In particular, the most promising type of the developed NHs consists of carbon dots (CDs) produced by chemical synthesis from organic compounds and functionalized with DOTA chelating Gd^{3+}-ions. Various physico-chemical properties (sizes, Z-potentials, surface chemistry, UV-visible absorption and fluorescence, etc.) of the NHs were studied in details. A special attention was focused on in-vitro and in-vivo toxicity as well as on bio-distribution of the synthesized NHs. Their application for fluorescent bio-imaging and MRI of small animals will be also reported.

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Dr. Ling Peng is a research director at the French National Scientific Research Center (CNRS) in France. She has been working actively at developing functional dendrimers for biomedical applications. Recently, she has pioneered the concept of self-assembling supramolecular dendrimers, and applied it to deliver nucleic acid therapeutics, anticancer drugs and imaging agents as theranostics and for precision medicine. Based on her achievement, Dr Ling Peng was awarded with the Prize of Dr & Mme Henri Labbé of the French Academy of Sciences, the André Collet Prize of supramolecular chemistry of French Chemical Society, and the Grand Prize of SFC SUD PACA.

Self-Assembling Dendrimer Nanosystems for Biomedical Imaging

Nanotechnology-based bioimaging is endowed with unique advantages of increasing imaging sensitivity and specificity. This is because nanosystems are able to carry large amount of imaging reporters with the targeting ability, hence significantly improving imaging outcome while avoiding adverse effect. Dendrimers are ideal precision nanomaterials for biomedical imaging by virtue of their well-defined structure and multivalent cooperativity. We have recently developed self-assembling dendrimer nanosystems for magnetic resonance imaging (MRI),[1] single photon emission computed tomography (SPECT)[2] and positron emission tomography (PET)[3], showing great promise in specific targeting and significant increase of imaging quality, outperforming the current clinical gold references. In particular, these dendrimer nanosystems are modular and adaptive, providing new perspectives for constructing multimodality imaging and theranostics in cancer diagnosis and image-guided personalized medicine.

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Prof. Daniel Jaque is a physicist specialized in nanomaterials and bioimaging. He leads the nanoBIG group at UAM, pioneering luminescence sensing. He has coordinated major European projects (COST, Marie Curie, FET-OPEN) and delivered invited talks at international conferences. He has held academic leadership roles as Vice-Rector for Scientific Policy at UAM and supervised numerous PhD theses. Prof. Jaque has also been an invited professor in the UK, Brazil, China, and Australia, fostering global collaborations in physics and nanotechnology.

Biomedical Applications of Luminescent Nanothermometers: Present and Future

A luminescent nanothermometer is a nanoparticle whose luminescence results strongly temperature dependent. These nanomaterials allow remote thermal sensing. If the nanothermometers operate in the infrared (the so-called biological windows) are capable of remote thermal sensing in cells, tissues, organs and animals. Remote reading of the temperature of living organisms has been used for understanding their vital functions, to control treatments and to diagnosis diseases. But the use of nanothermometers for thermal sensing in biological systems is not free from artefacts and uncertainties that could make the thermal reading useless. To avoid them, new nanomaterials and technologies must be developed and combined. In this talk examples of these new approaches leading to reliable and precise thermal sensing in biological media will be described to demonstrate the actual potential of nanothermometry in biomedicine.

Hélène Merceron

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I am a 3rd year PhD student in the team of Ludovic Jullien at the CPCV lab in the Chemistry department of the ENS Paris and in the team of Karim Benzerara at the IMPMC (MNHN-SU). My work focuses on developing and characterizing analytical tools for sensing molecules especially oxygen. My area of expertise is very transdisciplinary and includes luminescent sensors, microscope development, photosynthesis and biogeochemistry.

Single-Cell Measurements of Metabolic O_2 Fluxes in *Chlamydomonas reinhardti*

The freshwater algae Chlamydomonas reinhardtii is the model organism for studies regarding photosynthesis and respiration of photosynthetic species. In both cases, oxygen is a key parameter to assess. Numerous studies report measurements of oxygen fluxes for colonies of microalgae in various conditions. Conversely, collecting the same kind of data down to the single cell level has not been reported yet and is key to improve our understanding of metabolic pathways. In this work, we developed a luminescent sensor for oxygen, resulting as a polymeric nanoparticle labelled with a phosphorescent platinum complex. We performed full characterization of the sensor. In order to measure oxygen concentrations with spatial resolution, we developed a lifetime imaging protocol named RIOM. It originates from a thorough theoretical analysis, which showed that modulated illumination of any reversibly photoactivable luminophore probed at high frequency generates components of the luminescence dynamic response detectable at low frequency. We then implemented RIOM on the oxygen sensors to retrieve oxygen fluxes produced by a single cell of Chlamydomonas reinhardtii under illumination. These measurements have been compared and are supported by diffusion theorical computations. This work not only brings a novel methodological strategy to measure oxygen concentrations with spatial resolution, but also gives indications of the disparity of individual behaviour in a same colony.

Anthony Delalande

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Anthony Delalande is an associate professor in physiology at the University of Orléans. He recently joined the Inserm laboratory US55, based at the University Hospital of Orléans. He is an expert in ultrasound- and microbubble-mediated drug and gene delivery. His research focuses on novel formulations for nucleic acid delivery, with a particular interest in brain-targeted therapies and the development of dedicated ultrasound devices for blood-brain barrier opening and gene therapy.

Ultrasound and Microbubble-Based Theranostic Applications: Focus on Central Nervous System Drug Delivery

Overcoming the blood-brain barrier (BBB) remains a key obstacle in the development of effective therapies for central nervous system (CNS) disorders. Microbubbles, originally designed as ultrasound contrast agents, have evolved into powerful vectors for targeted drug and gene delivery. When combined with focused ultrasound (FUS), they enable transient, localized, and non-invasive BBB opening, allowing a wide range of therapeutic agents including small molecules and nucleic acids to reach the CNS.

This presentation will introduce an integrated theranostic strategy that couples multimodal imaging with FUS-mediated delivery to optimize therapeutic access to the brain. The use of indocyanine green (ICG) as a near-infrared and photoacoustic imaging probe for real-time BBB opening imaging will be presented illustrating the efficacy and safety of ultrasound- and microbubble-mediated BBB opening in models of glioblastoma and neurodevelopmental disorders.

Finally, a presentation of custom microbubbles, engineered for enhanced acoustic responsiveness and nucleic acid loading, as a promising platform for CNS-targeted gene therapy. We will highlight the integration of photoacoustic and ultrasound imaging for real-time monitoring of delivery events, paving the way for a fully image-guided, precision medicine framework.

These technologies represent a versatile and translational strategy for non-invasive, spatially controlled treatment of neurological diseases such as glioblastoma and Fragile X syndrome.

Joëlle Tchicaya Bouanga

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Dr. Joëlle Tchicaya Bouanga is an Application Engineer at Biospace Lab, specializing in optical imaging and imaging system development. She earned her Ph.D. in Oncogenesis from Université de Paris, France (U1132 BIOSCAR), where she gained hands-on experience working with the Biospace Lab system during her research. With a strong background in animal experiment design and in vitro assays, she brings over four years of expertise to Biospace Lab, contributing to advancements in imaging technologies.

Discover the Full Potential of Real Time Imaging and Near Infrared Spectrum to Go Over the Limit of *in vivo* Detection

Among all imaging modalities, Optical Imaging is a great alternative to assess cellular and molecular processes in vivo as it is a non-ionizing, non-invasive and cost-effective modality. It uses light to obtain functional and quantitative information on ongoing biological processes in living organisms but also in cells and ex vivo samples. This allows longitudinal studies and high throughput analysis which strengthen the biological relevance. Moreover, the development of Near Infrared cameras especially above 1000nm have made possible the study of deep-seated processes in vivo with reduced autofluorescence, scattering and absorption.

Taken all these advantages of together, Biospace Lab has developed over the years imagers in the visible and the NIR 1 spectrum (400nm- 900nm) that are based on single photon detection. This unique technology allows to detect single cells and perform real time imaging for accurate results. These systems are modular (ZOOM option, 3D, non-anesthetized mice imaging...) to optimize the studies.

In the NIR 2 spectrum (1000nm-1700nm) Biospace Lab has developed tools such as fluorescent tomography or luminescent nanothermometry allowing to achieve a detection over 2cm in mice with great sensitivity (pmol).

SESSION 4

Michele Diana

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Prof. Michele Diana, MD, Ph.D, EMBA, obtained the Medical Degree in Rome, Italy, and specialized in General Surgery in Switzerland. He obtained a Ph.D in Medical Sciences and received the Venia Legendi at the University of Strasbourg (France). Additionally, he holds an Executive Master in Business Administration from INSEAD Business School. He is faculty member of leading scholar surgical societies, including the SAGES, the European Association of Endoscopic Surgery (EAES), the International Society of Fluorescence Guided Surgery (ISFGS) and the International Society of Medical Innovation and Technology (iSMIT). His main translational research interests include image-guided surgery, surgical robotics and surgical applications of machine and deep learning. He has authored more than 250 peer-reviewed papers and book chapters (h-index 51). He is Founder and Chief Medical Officer of ASTRANICE (Strasbourg), a medtech start up in the field of Fluorescence-guided surgery.

Surgical Optomics and Robotics: the Combo towards Surgical Precision

Intraoperative optical technologies such as Near-Infrared Fluorescence imaging, multispectral or hyperspectral imaging enable an improved visualization of unapparent anatomical structures, the evaluation of metabolic activities and the enhanced visualization of tumor tissue, when compared to white light evaluation alone. Thanks to some groundbreaking innovations, optical imaging can well be a powerful theranostic tool that can help tackling the challenges of surgical oncology: to ensure a complete removal of tumor tissue and to reduce the risk of surgical complications. An extensive intelligence and networking activity, including main opinion leaders in the field, has allowed identifying 4 major axes of development of optical imaging, including:

1) Software: the integration of computer-assisted interpretation of the optically generated signal through dedicated software solution and Artificial Intelligence, machine and deep learning approaches, towards the building of an *OPTOMICS* paradigm, in analogy with other omics (genomics, proteomics, metabolomics, radiomics).

2) Hardware: the development of improved hardware solutions, with optimized sensitivity and improved ergonomics.

3) Chemistry: the development of innovative probes, which recognize precisely biological targets or tumor cells and allow for image-guided removal of cancers by focused energy delivery or surgical ablation.

4) Techniques: improvement of state-of-the-art techniques (surgical or interventional) by the implementation of optical imaging AND development of innovative minimally invasive organ-sparing techniques specifically enabled by optical imaging and surgical robotics. Surgical Optical Imaging (augmented eye) and Surgical Robotics (augmented hand) are natural partners on the road of precision. In this lecture, the intertwined relationship between them is conceptually explored in the light of the current experience and future vision.

Jean-Luc Coll

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Jean-Luc Coll is Director of Research at INSERM and Team leader in the Institute for Advanced Biosciences in Grenoble. Dr Coll is a biologist with strong experience in oncology. He is using fluorescence, nanotechnologies, chemistry and large instruments for physics, to develop theranostic nanoparticles for the treatment of tumors and their metastases. His team is in particular focused on the use of near-infrared labeled nanoparticles to target tumors, guide surgery and enhance radiotherapy, phototherapy or innovative therapies. In addition to the developments of nanovectors, he is also involved in the generation of adapted medical devices.

Nanotheranostic Approaches: Photons Can Help for Diagnotics and Therapy of Cancer

I will present our recent work on the production of theranostic nanoparticles (TN) that we designed to combine diagnostic and therapeutic capabilities for the treatment of cancer. We are using a variety of materials, including metals, polymers and lipids, and we formulate them with different types of drugs and/or photoactive compounds.

They can then be used and tested in animal models as contrast agents to precisely detect and delineate the region to treat using MRI, X-rays, Near-infrared light or ultrasounds and, in addition, our NT can be remotely and precisely activated on site using non-ionizing and/or ionizing radiations to specifically deliver combined synergistic therapeutic activities to the target tumor cells and their microenvironment, allowing for more effective treatments with fewer side effects.

These nanosystems can also be used intraoperatively for optical guided surgery of cancer.

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Sara Lacerda received her PhD from the Univ. of Lisboa (2009) during which she developed and studied theranostic agents. After, she did a short postdoc at the Univ. of Lübeck (DE) on Fragment-Based Drug Discovery. In 2010-2012, she focused on bimodal Optical/MRI lanthanide-based nanoparticle contrast agents, at Centre de Biophysique Moléculaire (CBM, Orléans, FR). In 2013-2015, she worked as a Research Associate at King's College London (UK). There, she developed on PET/MRI contrast agents targeted for cardiovascular diseases. In 2016 she re-joined CBM as CNRS Researcher. Her current project focuses on multimodal peptide-based contrast agents. She is also Co-Scientific Manager of the In vivo Imaging Centre, CNRS Orléans.

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Novel Peptide-Based MRI Probe Targeting Netrin-1 : Early Detection of Metastatic Breast Cancer

Despite significant progress in cancer imaging and treatment, early diagnosis and metastasis detection remain a challenge. Molecular magnetic resonance imaging (MRI) is well adapted to fulfil this need, but requires contrast agents targeting specific tumor biomarkers. The emerging biomarker Netrin-1, overexpressed in metastatic breast cancer, is an extracellular protein implicated in tumor progression and metastasis appearance[1-3]. We provide the first example of MR imaging of tumors using a Netrin-1-specific probe, which holds multimodal potential.[4] Our probe, consists on a targeting peptide (**K**), designed based on x-ray structures of Netrin-1/DCC complex[5], conjugated to a DOTA-like unit. Molecular docking and in vitro binding studies revealed sub-µM Netrin-1 affinity but similar than other MRI peptide-based probes.[6] The relaxivity of **Gd-K** is 2.3-fold higher than Dotarem, the MRI gold standard contrast agent. *Ex vivo* biodistribution in murine models of triple negative breast cancer, overexpressing (metastatic 4T1) or non-expressing (MDA-MB-231) Netrin-1, using the ^{111}**In-K** analogue, showed that the difference in small the tumor uptake (4h post injection, vol≈50mm^3) is higher for 4T1 and significant between the two models (p=0.0102). MRI studies at different stages of tumor evolution using **Gd-K** and Dotarem (9.4T, 0.2mmol/kg) showed 3-fold higher signal enhancement for **Gd-K** than the gold standard Dotarem for small 0-50 mm^3 4T1-tumors; enabling early-stage tumor detection.

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Gilles Gasser started his independent scientific career at the University of Zurich in 2010 before moving to Chimie ParisTech, PSL University in 2016 to take a PSL Chair of Excellence. He was the recipient of several fellowships and awards including the Alfred Werner Award from the Swiss Chemical Society, an ERC Consolidator Grant and Proof of Concept, the European BioInorganic Chemistry (EuroBIC), the Pierre Fabre Award for therapeutic innovation from the French Société de Chimie Thérapeutique, the Coordination Chemistry Prize from the French Chemical Society (Senior Level) and recently the Seqens Prize from the French Academy of Sciences for outstanding work in medicinal chemistry.

Metal-based Photosensitizers for Anticancer Photodynamic Therapy

Photodynamic Therapy (PDT) has expanded the range of treatment opportunities for some fungal and bacterial infections and cancer. The first clinically approved photosensitizer (PS) was Photofrin®, which is used to treat various types of cancer (e.g., non-small lung, bladder, oesophageal or brain cancer). As the majority of clinically accepted and investigated PSs are based on the same structural scaffold, these compounds are usually associated with similar drawbacks (e.g., poor water solubility, tedious synthesis and purification, photodegradation and slow clearance from the body causing photosensitivity). To overcome these limitations, existing PSs have been modified and new classes of PS developed. As an emerging class of compounds, Ru(II) polypyridyl complexes have gained much attention due to their attractive chemical and photophysical properties (e.g., high water solubility, high ROS production, chemical stability and photostability). Despite recent research efforts, the majority of investigated Ru(II) polypyridyl complexes lack absorption in the biological spectral window (600-900 nm), limiting their use for the treatment of large or deep-seated tumours. During this talk, we will present our latest results (including in vivo!) on the use of novel Ru(II) as well as Os(II) polypyridyl complexes as long wavelength absorbing PSs for PDT. We will also discuss our recent endeavours to selectively bring our PSs to cancer cells.

Xavier Druart

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My scientific interest is focused on animal reproduction, more specifically on mechanisms involved in the sperm interaction with the female genital tract during fertilization. A better understanding of biological processes occurring during sperm migration in the female will allow to improve fertility of domestic animals in animal production systems or to help to develop contraceptives in human.

pCLE *in vivo* Imaging for Preclinical Development of New Contraception Methods

One of our objectives is to develop a platform for in vivo assessment of the efficacy of novel sperm-targeted nonhormonal human contraceptives. Understanding the mechanics and dynamics of the transit of spermatozoa in the female reproductive tract is a key factor for evaluating nonhormonal contraceptives targeting sperm function. Measuring the efficacy of bioactive molecules targeting sperm function is possible using in vivo models such as the sheep and the horse, for the assessment of sperm transit using *in vivo* sperm imaging and quantification (probe-based confocal laser endomicroscopy (pCLE) methodology) of sperm function and motility. This requires the development of fluorescent probes suited for sperm *in vivo* imaging. To date, several probes have been validated and allow now sperm *in vivo* imaging in various animal models.

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Peggy Carver, PharmD, FCCP, FIDP is Associate Professor of Pharmacy at the University of Michigan and a Clinical Pharmacist in Infectious Diseases. She has presented at national and international conferences and received multiple research and teaching awards. A fellow of the American College of Clinical Pharmacy, she has held leadership roles in the Society of Infectious Diseases Pharmacists and ASHP. Her research focuses on antifungal therapy and the role of metal ions in infectious diseases.

Targeting the Invisible: Pathogen-Specific Imaging for the Detection of Infectious Diseases

Diagnostic delays in infectious diseases significantly contribute to morbidity and mortality, yet remain understudied. Conventional imaging provides limited structural insights, lacking specificity and the ability to monitor antibiotic efficacy. Molecular imaging technologies offer promising, noninvasive alternatives by enabling real-time visualization of infections at the cellular level. These tools can identify pathogens, track antibiotic distribution, and assess treatment response without reliance on invasive sampling. Invasive pulmonary aspergillosis (IPA), a severe fungal infection in immunocompromised patients, exemplifies current diagnostic challenges: existing biomarker tests are insensitive, and CT imaging, though widely used, shows nonspecific patterns shared with other infections. This presentation explores the limitations of current diagnostic approaches, reviews guideline recommendations, and outlines the potential of next-generation molecular imaging to distinguish infection from inflammation and malignancy—an essential goal in advancing the diagnosis and treatment of infectious diseases. Additionally, the development of specific imaging tracers for pathogens such as *Aspergillus* could transform clinical management by enabling earlier and more accurate treatment decisions, while offering new insights into host-pathogen interactions in vivo.

PUBLIC LECTURE

Michele Diana

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Diplômé en médecine à Rome, Michele Diana s'est spécialisé en chirurgie générale en Suisse. Il détient également un doctorat en sciences médicales et une habilitation à diriger des recherches délivrée par l'Université de Strasbourg. En parallèle de son parcours médical, il a complété un Executive MBA à l'école de commerce INSEAD, l'une des plus prestigieuses au monde. Aujourd'hui, il occupe plusieurs postes clés dans le domaine de l'innovation chirurgicale : Directeur de l'Innovation Chirurgicale aux HUG, Professeur invité à la Faculté de Médecine de l'Université de Genève, membre de l'équipe de recherche ICube, spécialisée en photonique pour la santé, à Strasbourg, fondateur et directeur médical de la start-up ASTRANICE, dédiée aux technologies médicales innovantes. Le Professeur Diana est également membre actif de plusieurs sociétés savantes internationales de chirurgie et d'innovation médicale. Ses recherches portent principalement sur la chirurgie assistée par l'image, la robotique chirurgicale, ainsi que sur l'utilisation de l'intelligence artificielle dans le bloc opératoire. Il est l'auteur de plus de 250 publications scientifiques et chapitres d'ouvrages, avec un indice h de 49, reflétant l'impact de ses travaux dans le monde scientifique.

L'IA et les robots révolutionnent la chirurgie

Les progrès réalisés ces dernières années en robotique, en informatique et en intelligence artificielle imprègnent tous les aspects de la vie humaine. Appliquées à la chirurgie, ces révolutions technologiques ouvrent de nouveaux scénarios. Les technologies cybernétiques permettent d'améliorer le cerveau, les mains et les yeux du chirurgien. Nous nous dirigeons vers une véritable médecine de précision, où l'ensemble du parcours du patient est numérique et contrôlé par des approches automatisées, du dépistage et du diagnostic au traitement et au suivi. Aujourd'hui, les chirurgiens ont toujours le rôle principal de prise de décision, soutenus par la technologie. À l'avenir, lors de la transition vers une médecine de précision automatisée, nous devrons surmonter des obstacles techniques, juridiques et éthiques majeures. Un seul patient représente une quantité énorme de données (biochimiques, génomiques, protéomiques, métabolomiques et radiomiques). Ces données représentent le carburant essentiel pour alimenter les algorithmes d'intelligence artificielle, mais leur valeur ne s'exprime que lorsqu'elles sont correctement traitées et organisées à grande échelle, par des technologies cognitives. Le monde universitaire et l'industrie déploient d'énormes efforts pour harmoniser la robotique, l'intelligence artificielle, la gestion des données, les systèmes d'imagerie avancés et la nanotechnologie de manière transdisciplinaire. La pierre angulaire d'une chirurgie de précision plus sûre et plus efficace est représentée par les nouveaux systèmes d'imagerie, car l'œil chirurgical augmenté est la grande fenêtre ouverte pour regarder positivement vers l'avenir. Le but de cette lecture est de donner un aperçu des développements actuels et futurs de la chirurgie assistée par l'IA et, par induction, de produire un message d'optimisme sur l'avenir du travail en général. Le paradoxe technologique sera discuté à la lumière des données publiées par l'Organisation mondiale de la santé en 2021 dans la revue Lancet : 5 milliards de personnes n'ont pas accès aux technologies d'imagerie médicale et 2,5 milliards de personnes n'ont pas accès aux thérapies chirurgicales les plus élémentaires… Où allons-nous ? Avons-nous besoin de l'humain ou du transhumain ?

Cette conférence bénéficie d'un co-financement via le projet Loire Val-Health, financé par l'ANR et France 2030 sous le n° ANR-23-EXES-0007.

POSTERS

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A Folded Gallium 12-MC-4 That Encapsulates Visible And Near-Infrared Emitting Lanthanide Ions

Lanthanide ions have valence electrons in their 4f orbitals, which gives them unique magnetic and electronic properties at the cost of relatively weak photon absorbance. Organic "antenna" chromophores such as salicylhydroxamic acid (H3shi) can be used to sensitize the lanthanide ions and circumvent this issue. One prolific class of compounds that uses this "antenna" effect are metallacrowns (MCs). Here, we present an example of a lanthanide-containing 12-MC-4 made with Ga^{3+}, salicylhydroxamic acid, and sodium salicylate, such that the salicylate ligands form bridges that sequester the lanthanide ions within the metallacrown cavity. Unlike previous examples of Ga^{3+} 12-MC-4s, this scaffold features a single shi^{3-} that is folded out of the plane of the metallacrown. In addition, lanthanide-based emission is also observed spanning the visible and near-infrared electromagnetic regions.

Clara Cohen

2

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Revisiting The Optimal ADC Threshold For Ischemic Core Delineation

Background: In ischemic stroke, the reference Apparent Diffusion Coefficient (ADC) threshold to delineate the ischemic core on MRI diffusion-weighted-imaging (DWI) is $620\times10^{-6}mm^2/s$. This threshold was defined by overlaying the final infarct onto the baseline ADC (ADC_0) in patients recanalized by intravenous-thrombolysis without thrombectomy. Follow-up MRI at 90 days implied infarct underestimation due to atrophy. We re-evaluated the ADC threshold in patients with early recanalization by endovascular thrombectomy.

Methods: Stroke patients treated by thrombectomy within 90mins after MRI (MRI0) and who underwent control-MRI at 24h (MRI_{24h}) were included. Baseline and final ischemic lesions (DWI_0 and $Infarct_{24h}$) were delineated on initial and control DWI. The DWI0/Infarct24h intersection (='core') was overlayed onto ADC0. A ROC analysis compared 'core' to 'non-core' voxels. The optimal ADC threshold corresponded to the higher Youden index.

Results: Across 56 patients (median age: 73; female 52%), the optimal ADC threshold was 611×10^{-6}mm2/s. Baseline core volumes were significantly smaller using the optimized versus the standard threshold. However, the absolute difference was small (>3 mL in one patient only). Conclusion: The ADC core threshold derived from patients with ultra-early complete recanalization was 611×10^{-6}mm2/s, only slightly smaller than the standard 620×10^{-6}mm2/s, and with only minor clinical impact on baseline core volume.

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Lanthanide-Based Imaging Probes for Real-Time Detection of SKCa Channel Activity in Tumor Cells

Small conductance Ca^{2+}-activated K^+ (SKCa) channels (SK1–SK3) have emerged as promising biomarkers and potential therapeutic targets in multiple tumor types, including breast, melanoma, prostate, colon, pancreas, osteosarcoma, and ovary. Their activity is inhibited by cAMP/PKA signalling, yet the molecular mechanisms—whether due to direct inactivation, internalization, or redistribution—remain unclear. One major limitation is the absence of highly specific imaging agents to monitor their dynamics in tumor cells and tissues.

To overcome this challenge, we are designing and synthesizing novel bioimaging probes based on lanthanide complexes emitting in the second near-infrared window (NIR-II), chemically conjugated to SKCa-blocking peptides. These multifunctional probes will allow the real-time imaging of SKCa channels at the plasma membrane, with a unique potential for multiplex detection. The use of NIR-II wavelengths ensures imaging of deeper tissues with higher spatial resolution and minimal background noise.

This multidisciplinary approach bridges molecular imaging, chemistry and cancer cell physiology, integrating expertise in lanthanide photophysics and SKCa channels biology. Beyond fundamental insight into SKCa regulation, these probes may serve as next-generation tools for non-invasive cancer diagnostics. If peptide bioactivity is retained, the platform could serve in theragnostic applications, uniting targeted detection and therapeutic modulation in a single system.

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HORIBA Invertau, A Turnkey FLIM Platform For Inverted Microscopes To Simply Access High Resolution Fluorescence Lifetime Images In The Biological And Life Science Fields

Fluorescence lifetime imaging (FLIM) applications continue to expand in fields of cell biology, oncology and clinical diagnostics. This has led to a need for FLIM systems to move out of the traditional setting of specialised instrument centres to more common laboratories. This requires a system designed to meet increasing demands for sensitivity, speed, and robustness, while being simple to use. Here we introduce the InverTau, a laser scanning galvanometer based system designed to attach to a side port of an inverted microscope. The computer controlled optics and intuitive software are designed for simplicity of use. Fluorescence lifetimes are obtained using the time-correlated single-photon counting (TCSPC) technique, which is generally considered the preferred method by which to obtain fluorescence lifetimes. The employment of the fluorescence lifetime parameter is also the best way in which to obtain FRET (Förster resonance energy transfer) data and using the EzTime Image software images of the FRET efficiency can easily be displayed or data can be exported to use in other programs. Here we present the use of the InverTau demonstrated using some fixed cell samples, which have been stained with multiple dyes. As well as showing the different cellular structures, aspects of cell division are shown. The ability to distinguish different tissues is also demonstrated. Making use of two photon excitation the fluorescence from a leaf was examined and the SHG signal determined.

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TCSPC Camera For Real Time Fluorescence Lifetime Imaging At Different Distance Scales: From Micro To Macro.

The specificity and advantages of using the lifetime parameter have shown an increase in the use of fluorescence lifetime imaging (FLIM). Although the technique is not new, advances in technology especially involving CMOS (complementary metal oxide semiconductor) are enabling a wider uptake and expanding the application of its employment. FLIM cameras based on CMOS technology are especially versatile and robust, typically making use of single-photon avalanche photodiode (SPAD) arrays. They have shown promise in a variety of imaging scenarios, ranging from widefield microscopy, light sheet applications to macro imaging. The CMOS process allows for the fabrication of both detection and timing elements on a single chip and this coupling can enable in-pixel timing with the ability to collect thousands of fluorescence decays simultaneously. Time-correlated single-photon counting (TCSPC) is generally considered the preferred method by which to obtain the fluorescence lifetime and the fully parallel approach of in-pixel timing enables it to be applied in real time, which is advantageous to monitor kinetics and moving samples. Here we employ a simple to use commercial TCSPC camera, based CMOS technology, to image over different distance scales; from inside the cell to a whole leaf (ie. from microns to centimeters). The same device and technique can be used to characterize cancer tumors in clinical applications.

The use of the TCSPC camera in a macro set up is further demonstrated in the area of time-domain near infra-red imaging (TD-NIRS).

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PiB-derivative Metal Complexes for Selective Imaging of Amyloid Peptides

Aggregation of misfolded peptides is a hallmark of increasingly prevalent diseases, including type 2 diabetes mellitus (T2DM) and Alzheimer's disease (AD), implying amyloid forms of amylin and Aβ-, respectively.1 The AD brain is characterized by the presence of amyloid plaques and neurofibrillary tangles. On the other hand, the accumulation of amylin (islet amyloid polypeptide, IAPP) that is co-secreted with insulin and deposited in the Langerhans Islets contributes to cell toxicity.2,3 Increasing evidence suggests a link between T2DM and AD, likely mediated by fibril "cross-seeding" processes when one amyloid protein promotes aggregation of another. In this context, selective visualization of amylin and Aβ-amyloids becomes important.4,5 Here we report the development and initial characterization of new imaging probes for the selective detection of amylin. After multi-step synthesis of different imaging probe candidates, we have recently identified two chelates, named GdLcis and GdLtrans, with selectivity for amylin- vs. Aβ-fibrils. Dissociation constants (Kd) measured by SPR are 2-3 orders of magnitude higher for amylin- than for Aβ-fibrils. These complexes are the first examples with several orders of magnitude higher affinity for amylin fibrils than for Aβ-fibrils. The reasons for this selectivity are not yet identified. Novel complexes are currently investigated in order to gain insight into the structural parameters and charge effects that might be responsible for selectivity.

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Photoelectric Imaging of Biological Cells

Optical methods using the phenomena of luminescence, polarization, interference etc., to create informative contrast of individual cells and their components have been already successfully developed in recent decades. A completely new visualization approach reflecting electronic and chemical properties of an interface between a semiconductor substrate and a liquid has been elaborated by our team. This new method allows creation of electronic bioimages and fingerprints of various bio-objects, such as: cells or tissues. When a semiconductor silicon wafer is illuminated with strongly absorbed light, an excess of charge carriers is concentrated near the wafer surface and an ambipolar diffusion movement of these carriers into the semiconductor occurs. Moreover, the concentration profile and thus photocurrent depend on the electronic properties of the semiconductor surface and the semiconductor/bio-object interface. Thus, the main idea of our approach is to study 2D distribution of the photocurrent conditioned by electronic interaction of a specially designed silicon substrate and a biological tissue or cell culture. As a result, the photocurrent map reflects the heterogeneous electronic properties of cells or tissues due to their local biochemical properties. Finally, we have also suggested a way in which electronic component of the created photoelectric images of animal or plant cells is separated from the optical one.

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Encapsulation, transport and controlled release of gold(I) drugs using MRI active coordination cage

Magnetic resonance imaging (MRI) is an effective scanning tool, that uses iron or gadolinium based contrast agents to non-invasively detect soft tissues for diagnosing certain cancers. In this aspect, iron based metal organic coordination (MOC) cage serves as high contrast MRI inducer due to the involvement of multiple paramagnetic iron centres. At the same time, MOCs have fixed cavity sizes with tunable features for encapsulation of guest molecules. Most popular applications of these coordination cages include catalysis and sensing. Possible application of such cages in biomedical area remains challenging due to incompatibility and low water solubility. Gold complexes such as auranofin and its analog particularly Au(PEt3)Cl exhibit promising in vitro anticancer activity. Yet, a majority of gold(I) complexes are insoluble in water, which makes their administration challenging. Therefore we are investigating an alternate strategy where encapsulation of a gold(I) metallodrug within a coordination cage could lead to its potential delivery. Our studies from T1 weighted MRI analysis have shown that the iron cage, being a blood pool agent cleared mostly through vena cava over several hours. Injection of both caged drug "Au(PEt3)(OH2)@1" and free drug "Au(PEt3)Cl" lead to accumulation in the murine tumor over 1-48 hours. Encapsulated gold complex exhibited pH dependent speciation and gold(I) release. Ex-vivo biodistribution of caged drug differs from that of the free drug in blood, heart, kidney and liver. The detailed encapsulation, serum albumin affinity studies, in vitro cytotoxicity, and in vivo evaluation will be presented. .

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Combining Highly Luminescent Ternary Ln(III) Complexes With Gold Nanoparticles: The New Gold Stan-dard For Sensitive Diagnostics?

Lanthanide luminescence, being predictable; sharp; long-lived and intense, is a leading means of sensitive detection across biological applications, from immunoassay to bioimaging.[1] While direct excitation of Ln(III) is inefficient, sensitisation of luminescence through the 'antenna effect' by instead exciting an organic ligand is effective. Among the best studied sensitisers are β-diketonates, as their complexes with Ln(III) are stable, and they sensitise both visible (e.g. Eu) and NIR (e.g. Yb) emitters.[1,2] Ancillary ligands, e.g. 1,10-phenanthroline (phen), may act as an additional chromophore and prevent solvent quenching. Although bright, such complexes are limited by poor aqueous solubility, which hinders their use in biological media.

Here, we present the first example to our knowledge of dinuclear, ternary Ln(III) (Ln = Eu, Yb) complexes appended to gold nanoparticles (AuNPs) in aqueous suspension. The resulting nanoconjugates, anchored together by an ancillary phen-derived disulfide ligand (phenSS), retain the strong luminescence of the parent Ln(III) complexes[3], $Ln_2bisDBM_3$, and have a high Ln:Au ratio, allowing its properties to be exploited in an aqueous environment for sensitive diagnostics or imaging with high signal-to-noise ratio.

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