C2RT

Our portfolio of technological core facilities

September 2021

INSTITUT PASTEUR
TECHNOLOGY

Center for technological resources and research

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More than ever, technology plays a crucial role in biological research. The C2RT core facilities make use of their state of the art equipment and competences to take part in Institut Pasteur's research into the basis of pathological processes, from the molecular to the organism scale with the aim of diagnosis, prevention and therapy .

Michael Nilges,

Vice-president for technology of Institut Pasteur,
director of the center for technological resources and research

Institut Pasteur / Technology department - 25-28, rue du Docteur Roux - 75724 Paris Cedex 15.
Photo credits: Institut Pasteur's library / François Gardy.
Design and achievement: Sponsorship and communication direction / Image Service / Jean-François Charles.

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INTRODUCTION

A favorable technological environment

Providing Institut Pasteur research teams with a favorable and enabling technological environment to advance their discoveries is a priority of the strategic plan of the institute.

To support research in a cost-effective manner and achieve higher usage and impact of cutting-edge equipment requiring high-level expertise for its operation, a set of strategic technological resources are gathered within the Center for Technological Resources and Research (C2RT).

Support in animal research and animal models is provided through the Center for Animal Resources and Research (C2RA), allowing animal experiments to be performed in the best ethical and regulatory conditions. Detailed information on the Center for Animal Resources and Research (C2RA) is available in a companion brochure.

Access to a large panel of biological resources and associated expertise is provided by the Biological Resource Centre (CRBIP) which is a cross-functional structure that brings together five biobanks.

Mission of the Center of Technological Resources and Research

The mission of the C2RT is to support Institut Pasteur research teams and scientific departments in achieving their research objectives by addressing their present and future technology needs.

C2RT aims at:

- Providing researchers with state-of-the-art equipment, services and technical expertise to enable the success of their projects
- Providing training and education on advanced technologies and methods
- Sourcing new and emerging technologies through technological watch
- Proposing to research teams technological and methodological developments
- Identifying in close connection with the Scientific Departments the strategic needs for technological equipment and expertise

Organized in 4 Technology and Service Units (UTechS) and 16 Technology core facilities covering a large range of technological areas, C2RT is a key component of Institut Pasteur's research ecosystem.

A development of core facilities in close interaction with Institut Pasteur research Departments and teams

Each Unit of Technology and Service and Technology core facility of the C2RT works in close connection with the Scientific Departments at several levels. This ensures that their activities, developments and strategy are aligned with the needs of Institut Pasteur's research community:

- organizational level: most of the C2RT Units of Technology and Service and Technology core facilities are affiliated to the Direction of Technology (DT) and to a scientific Department.
- research team support level: user committees and general assemblies are organized regularly by the Units of Technology and Service/Technology core facilities.
- strategic level: Scientific Departments are represented at the Steering Committees organized by each Unit of Technology and Service/Technology core facility. Steering Committees help define a strategic vision for the core facility in terms of technological developments, acquisition of large equipment and recruitment of personnel that would support these developments and the associated funding strategies.

OMICS, PROTEOMICS, METABOLOMICS AND SINGLE CELL

Biomics core facility

A structure dedicated to the sequencing of second (short-reads) and third (long-reads) generation

Head of Core Facility: Marc Monot

Contact

Mail: biomics@pasteur.fr
Website: https://biomics.pasteur.fr

Mission

The mission of the Biomics core facility is to facilitate scientific discovery through high-throughput sequencing technologies.

To this end, it offers personalised support per project, ranging from training in the various sequencing methods, including the use of autonomous sequencers, to complete management, from sampling to data analysis, for the most complex projects.

On the other hand, Biomics carries out internal development projects to be able to continue to offer the latest advances in sequencing.

What we do

Biomics is a structure dedicated to the high-throughput sequencing of second (short-reads) and third (long-reads) generation. The short-reads sequencing is centered on the Illumina technology for which we are equipped with ISeq, MiSeq and NextSeq instruments. We have acquired a Pacific Bioscience Sequel instrument for long-reads sequencing and also have access to Oxford nanopore technologies.

Our team provides training on the autonomous use of equipment (BioAnalyzer, QuBit, Covaris, ISeq, NextSeq) for the realization of stand-alone sequencing.

We are constantly optimizing and adapting new protocols. This includes the automation of workflows and working with degraded or low-concentration samples. For data analysis, our dry-lab offers many standard pipelines as well as the development of dedicated pipelines.

Our expertise includes

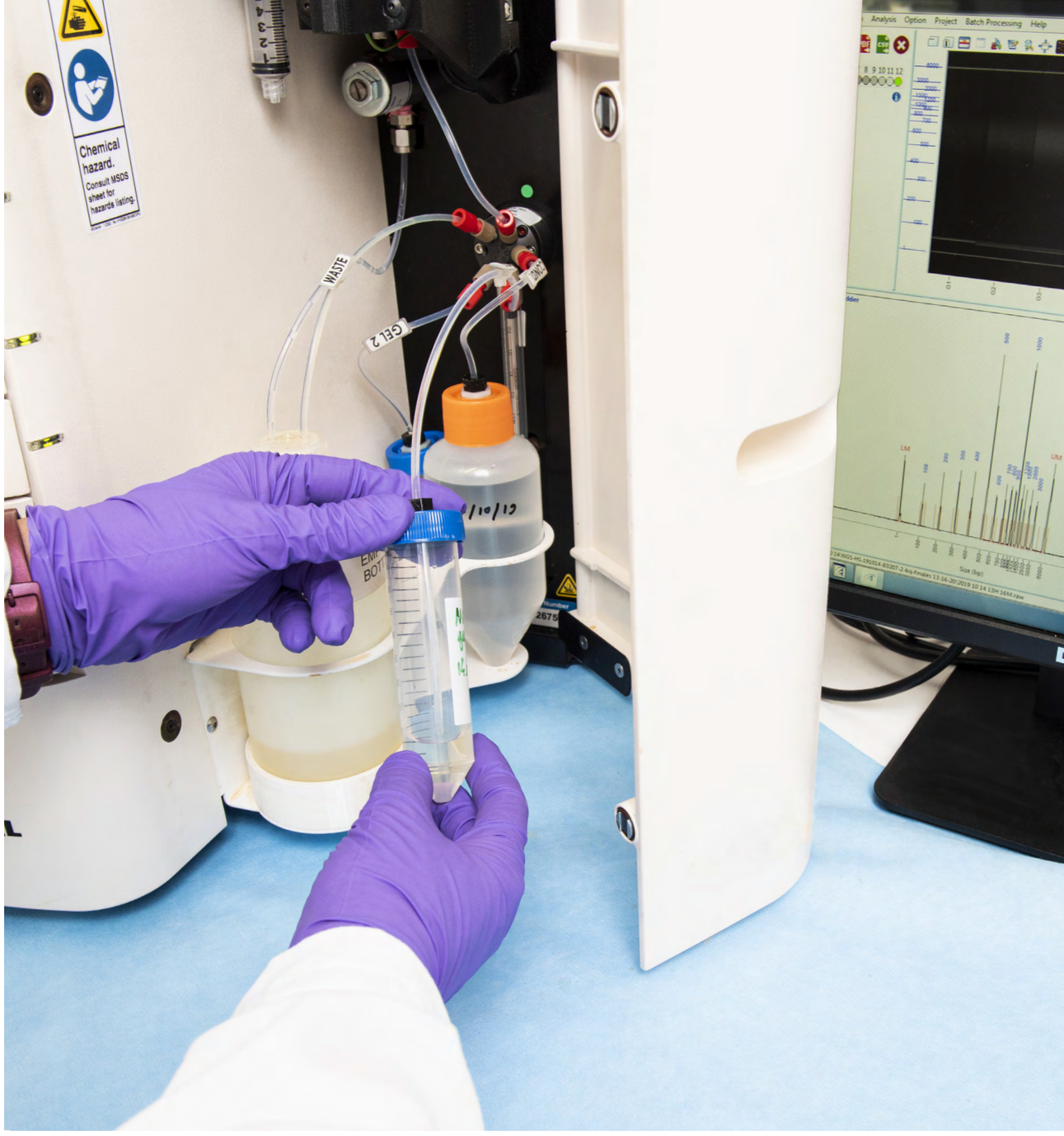
- Technology: Short-Reads (Illumina), Long-Reads (PacBio & Nanopore)
- DNA-Seq: Sequencing de novo and targeted
- RNA-Seq: Transcriptomic Analysis
- Metagenomic: Targeted sequencing studies (16S, 18S, ITS) or random (Shotgun)
- Bioinformatics: NGS data analysis (Variant, Assembly, Methylation study…)

Some examples of success stories

Biomics involvement in Sequana, a Python framework designed to provide pipelines to analyse NGS data sets, has lead to the publication of a dynamic graphical interface (Sequanix) and a stand-alone application to decipher genomic variation (sequana_coverage).

How to work with us/how to apply for support

A request for support starts by asking a question or submitting a new project via our project manager: https://biomics.pasteur.fr. Then you will be put in contact with a Biomics project manager who will explain the next steps of your sequencing project (kickoff, libraries, sequencing, data analysis…).



Certifications and Networks

We are IBiSA labeled and ISO 9001 certified.

We are cofounder of the France Génomique Consortium.

Mass Spectrometry for Biology (MSBio UTechS)

Towards a deeper exploration of proteomes

Proteins are the chief actors in cells, carrying out the activity specified by the information encoded in genes. The large-scale analysis of proteins can therefore provide significant insight into many cellular processes and their dysregulation. The last decade has seen amazing advances in mass spectrometry-based proteomics and the technology is now used for large variety of biological applications. The objective of the MSBio UTechS is to develop innovative mass spectrometry-based proteomics approaches for applications in biology and human health with a particular emphasis in infectious diseases.

Head of UTechS: Julia Chamot-Rooke
Head of Core Facility: Mariette Matondo

Contact

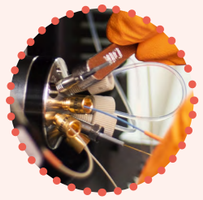
Mail: msbio@pasteur.fr
Website: https://research.pasteur.fr/fr/team/mass-spectrometry-for-biology/

Mission

The Mass Spectrometry for Biology (MSBio) Unit aims at developing service and research activities in mass spectrometry for the analysis of proteins.

It comprises a facility, providing mainly service in bottom-up proteomics (large scale analysis of peptides after protein enzymatic digestion) and a research group with two main technological research axes: top-down proteomics (analysis of intact proteins) and structural proteomics (analysis of protein complexes).

MSBio is equipped with the latest generation of high-resolution mass spectrometers: Orbitrap Q-Exactive Plus, Orbitrap Q-Exactive HF, Orbitrap Fusion Lumos (Thermo Fisher Scientific). The MSBio UtechS is also a CNRS Unit of Service and Research (USR 2000).



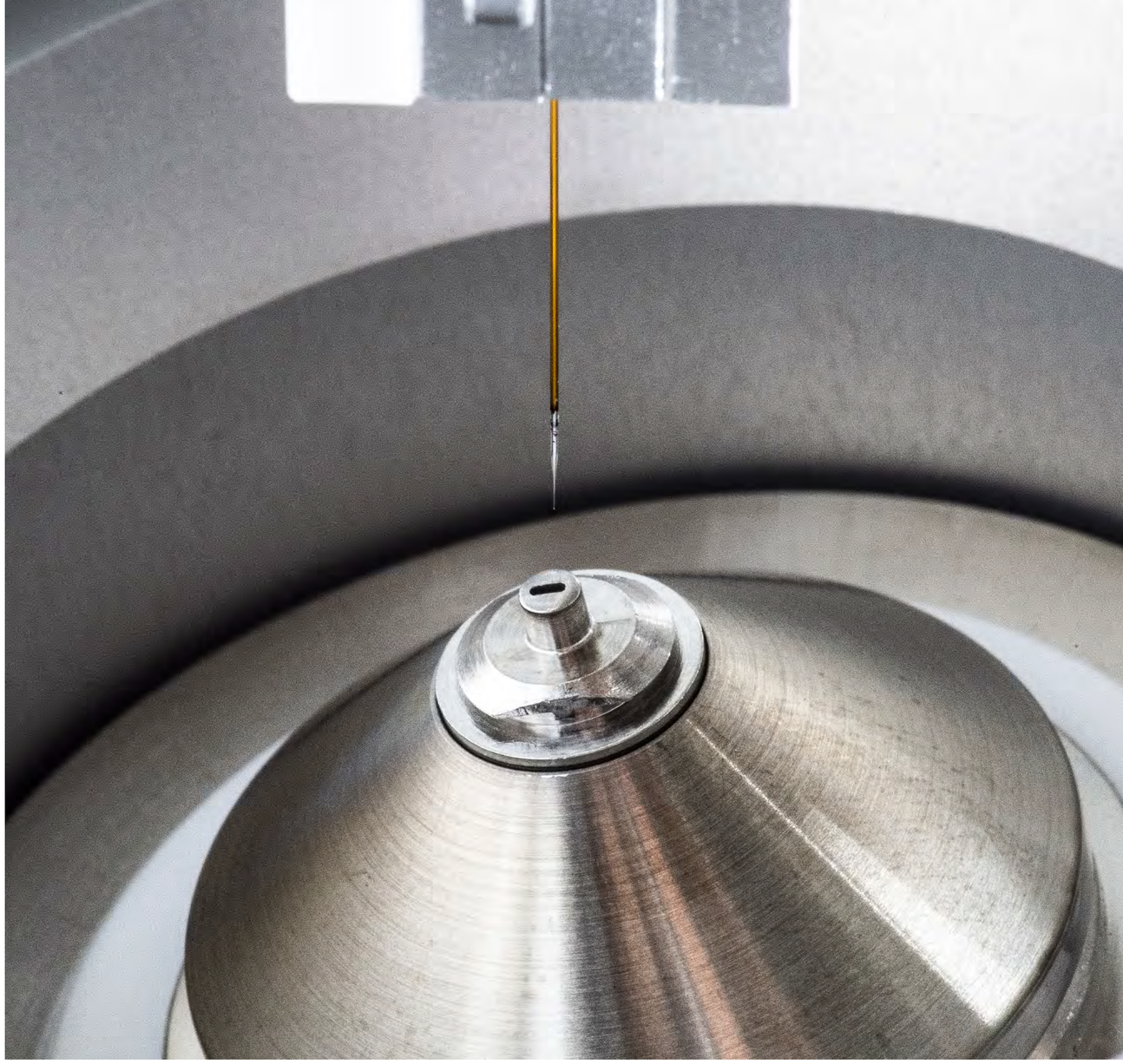
What we do

Our Unit provides custom-tailored and innovative analytical solutions to meet the challenging demands of both academic laboratories and private companies. Our highly-trained staff offers expertise and counseling from sample preparation to data analysis in:

- Identification of low abundant proteins in complex biological matrices
- Advanced relative and absolute quantitative proteomic strategies
- Characterization of post-translational modifications (PTMs)
- Analysis of proteoforms (intact proteins) using top-down MS approaches
- Large-scale analysis of protein complexes (in vivo cross-linking MS)
- Structural analysis of proteins and protein complexes (Hydrogen/Deuterium Exchange MS, Native MS).

Some examples of success stories

- Unique French partner of the European Proteomics Infrastructure providing Access, EPIC-XS; https://epic-xs.eu)
- Optimization of a Top-Down Proteomics Platform (Dupré M *et al., JPR*. 2020)
- Characterization of the human Midbodies (Addi C *et al., Nat.Comm.* 2020)



How to work with us/how to apply for support

A request for support starts by sending a mail to msbio@pasteur.fr

For the proteomics facility, a request form is available online. To contact platform members directly: proteomics@pasteur.fr

Certifications and Networks

We are IBiSA labeled and ISO 9001 certified.

We are part of Core for Life, CTLS, Labex IBEID, EPIC-XS European Infrastructure.

Metabolomics core facility

For a large-scale biochemical characterization of the phenotype

Metabolomic analyses allow the identification and quantification of small biochemical molecules <1500 Da (metabolites) which reflect a biological activity. These metabolites have been transformed during metabolism as substrates, products or effectors in a system and at a given time. Also considered as metabolites are xenobiotics (drugs, pesticides, environmental chemicals, ...) and molecules produced by the bacterial flora constituting the intestinal microbiota which can be partially metabolized by the host.

All of these metabolites (metabolome) therefore serve as direct signatures of the dynamic biochemical activity of the cell and are easily correlated with the phenotype without any direct link strictly with gene expression. Metabolomics then enables a better understanding of systems biology by highlighting metabolic interactions that could not be detected with traditional biochemical approaches.

Head of Core Facility: Sandrine Aros

Contact

Mail: metabolomics@pasteur.fr
Website: https://research.pasteur.fr/en/team/metabolomics-core-facility/

Mission

The Metabolomics platform will aim to provide to Pasteur's research departments a pipeline of analyses for both metabolic phenotyping and the absolute and relative quantification of biochemical molecules (metabolites and lipids) in biological systems.

The platform will also develop new analytical approaches adapted to specific requests compatible with the platform's fields of expertise. On the other hand, particular attention will be paid to the development of new analytical and computational methods in order to increase the performance of non-targeted metabolomics in terms of detection, identification of metabolites and interpretation of metabolic signatures.

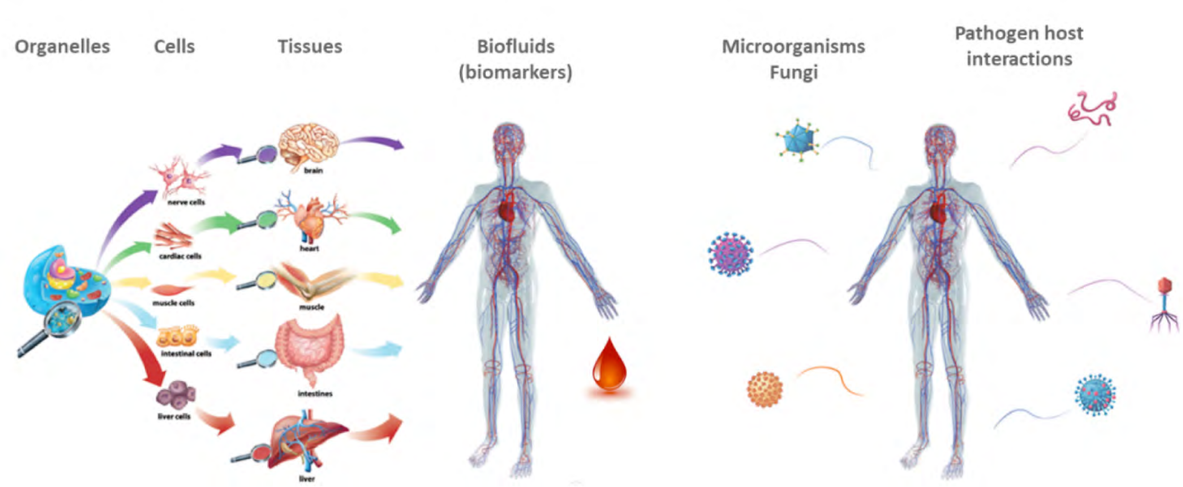
What will we do ?

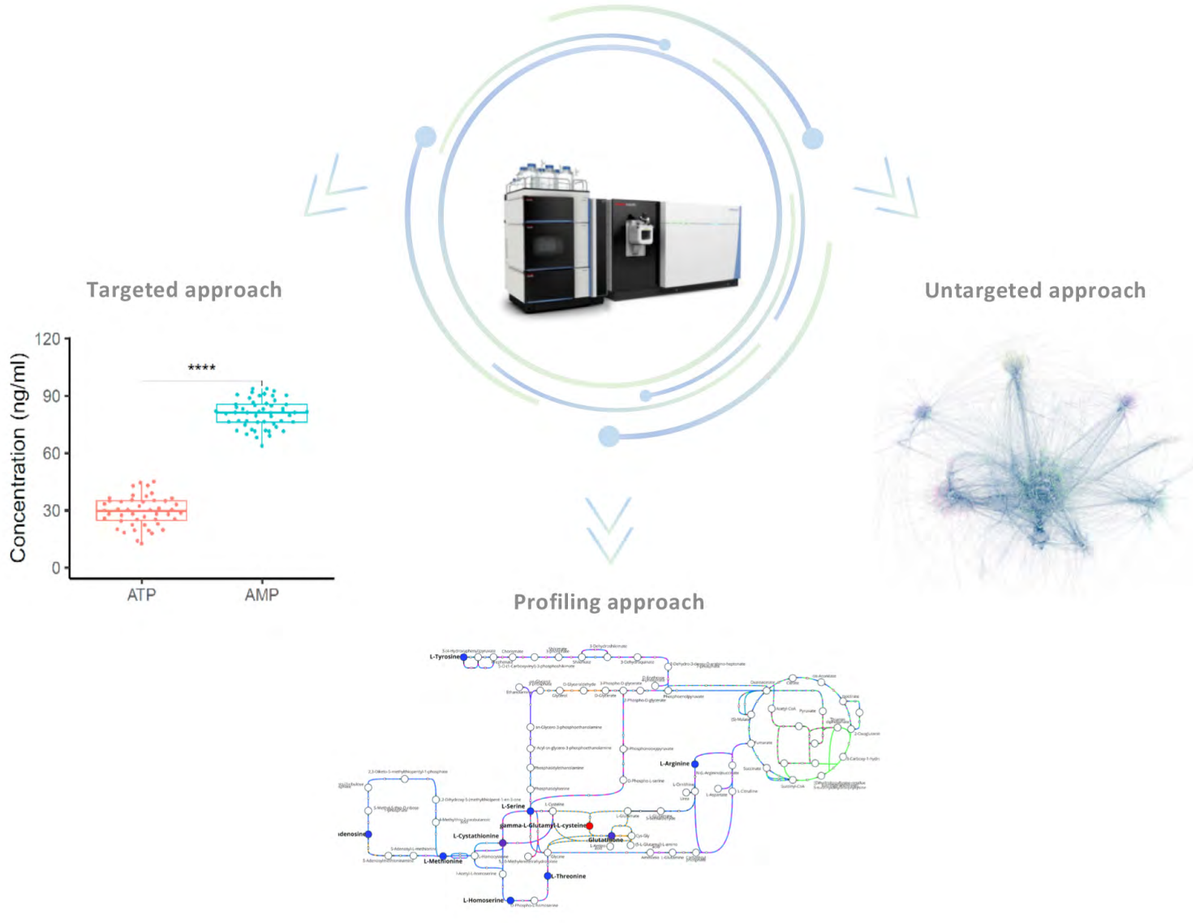
Large-scale metabolomic analyses can provide us with important information about many cellular processes and their disturbances.

- Comparison of metabolomes between two biological systems under study allows genotypes and phenotypes to be linked.
- On the other hand, the comparison of metabolomes within the same group of biological systems under different conditions makes it possible to elucidate the influence of the environment on the expressed phenotype.

One of the main challenges of these analyses is to be able to measure metabolites with extremely diverse physico-chemical properties and to date we do not have an exhaustive knowledge of all existing metabolites.

One of the specificities of this platform will be to elucidate on a large scale these unknown compounds for a fine understanding of cellular physiological mechanisms.





Cytometry and Biomarker (CB UTechS)

Full support to a biomedical project within a single core facility

Through its unique configuration, the CB UTechS provides project-tailored solutions for fundamental, translational and clinical research, from sample processing to data analysis.

Head of CB UTechS: Milena Hasan
Head of the Cytometry Platform: Sophie Novault

Contact

Mail: crt-tc@pasteur.fr
Website: https://research.pasteur.fr/en/team/technical-core/

Mission

The CB UTechS has the mission of facilitating biomedical research through state-of-the-art technologies. Our 30 instruments have been selected to allow cell phenotyping and sorting, protein and RNA profiling and single cell OMICS. A significant part of the equipment is installed within fully equipped Bsl2+ cell culture laboratories to permit manipulation of human and infectious material.

What we do

Our team provides high-quality service and training. Expert advice is available for experimental design and data analysis. We develop bioinformatic tools to analyze complex data generated by our technologies. We collaborate with researchers for the development and application of microfluidics-based technologies for 3D-spheroid and single cell/single pathogen studies.

We are strongly engaged in annual teaching programs and in practical work for Master courses.

Our expertise includes

- Cell phenotyping and sorting (Symphony A5, SP6800, MARKII, Astrios, FACSAria Fusion)
- Single-cell OMICS (10X Chromium, MARS-Seq)
- RNA (NanoString) and protein profiling (Bioplex and SiMoA)
- Live-content imaging (Incucyte) and cellular metabolism (Seahorse)
- Experimentation under hypoxia (Xvivo)
- Bioinformatic support
- Immunomonitoring

Some examples of success stories

We are the core facility of the LabEx project "Milieu Intérieur" (www.milieuinterieur.com). Through this collaboration we have established standardized pipelines for multi-level immunophenotyping and have contributed to publications in high-impact journals.

In collaboration with F. Spitz and H. Marlow we participated to the implementation to the MARS-Seq pipeline at Institut Pasteur (Sebe-Pedros, *Cell*, 2018).

How to work with us/how to apply for support

The CB UTechS is an open-access facility that currently welcomes 145 projects, and 300 users from Institut Pasteur and its International Network, from academia, clinics and industry.

The access is per-project based, upon submission of the project through our electronic project submission tool (http://crtechnologycore.pasteur.fr/v2/forms/login.php). Training request and instrument booking are available through PPMS. Researchers wishing to include our support in grant applications are encouraged to contact us by email.

Certifications and Networks

The CB UTechS is a highly collaborative core facility, both nationally and internationally. We are a Center of Excellence of the Federation of Clinical Immunology laboratories (FOCIS) and a member of the Afribiota and the "Milieu Intérieur" consortia. We are an IBiSA-labeled core facility.

Since 2011 the CB UTechS is ISO 9001 certified, providing quality assurance of our service.

CB UTechS is part of Core for Life and CTLS (Core Technologies for Life Science).

MULTISCALE IMAGING

Photonic BioImaging (PBI UTechS)

Providing optical imaging expertise in life sciences and especially their application in studies on infectious biology

Head of UTechS: Spencer L. Shorte
Head of Core Facility: Nathalie Aulner

Contact

Mail: pbi.contact@pasteur.fr
Website: https://research.pasteur.fr/en/team/photonic-bioimaging-utechs-pbi/

Mission

Our vision is highly multi-disciplined, and collaborative, with the mission goal focused on the use of quantitative imaging and analysis to understand the processes of cell/tissue-biology, and their usurpation by infection and disease.

What we do

Our team carries out support tasks and develops new protocols for optical imaging, including service rendering, training, technology-driven research and technology development. The R&D is founded upon the need to develop optical imaging methods that bring new understanding of host-pathogen interactions and *in situ* high-content imaging techniques and their application to infection, cell biology, and cellular microbiology. We work on novel techniques extrapolating quantitative information on spatiotemporal dynamics *in situ* and we push the limits of existing approaches aiming to enhance their performance thereby broadening their experimental utility.

Our expertise includes

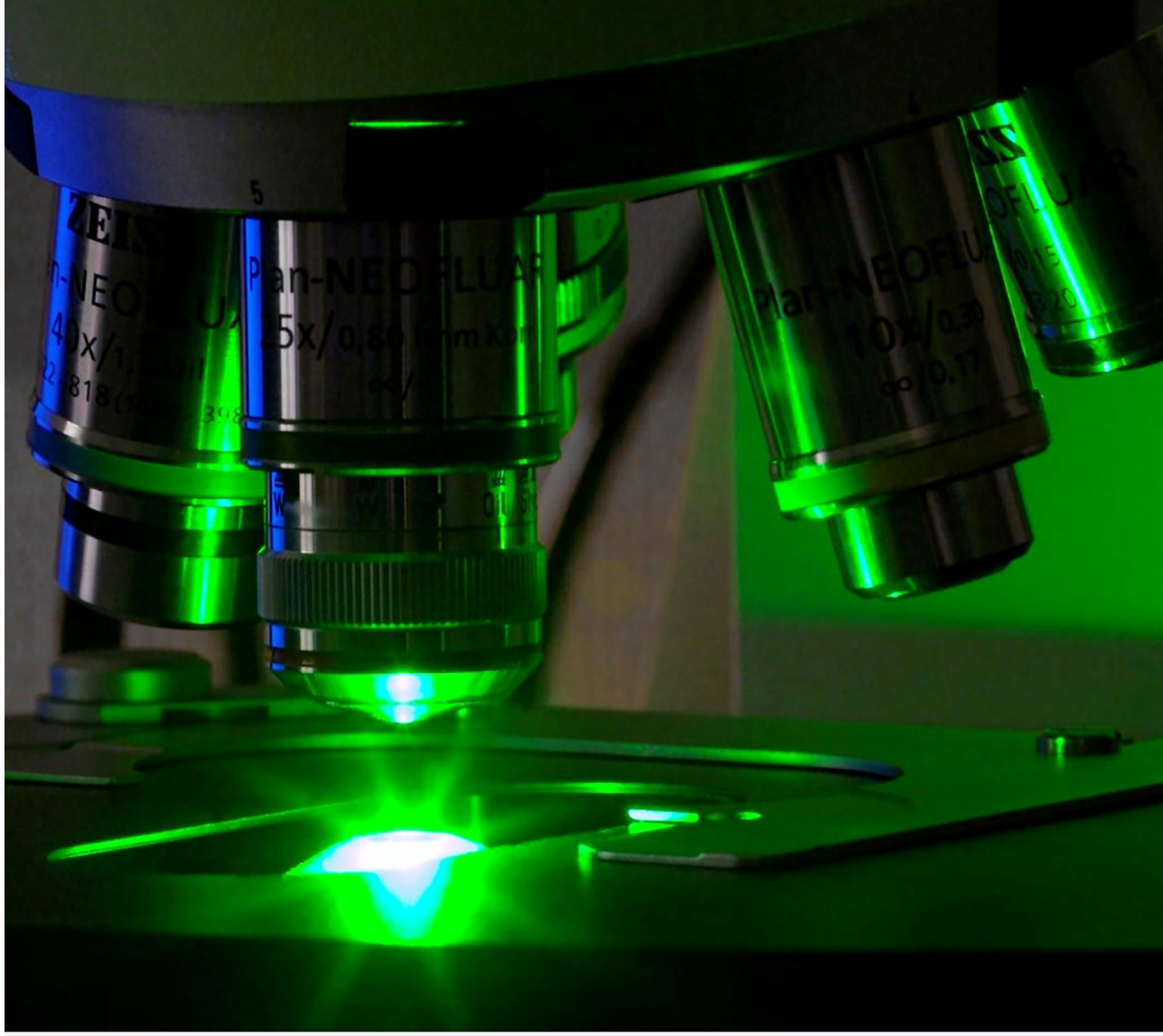
- Intravital imaging
- *In vivo* technologies
- Super resolution technologies including sample preparation
- Molecular dynamics (SPT/FCS/FRAP/FLIM)
- High Content Imaging and Analysis
- Bioluminescence in cells, tissues and whole organism
- Technological development and implementation (optics, probes, data analysis)

Some examples of success stories

1. Muscle J: a high-content analysis method to study skeletal muscle with a new Fiji tool (PI: A. Danckaert).
   Mayeuf-Louchart, *et al*., 2018. *Skelet Muscle* **8**, 25.
   Danckaert A. and Mayeuf A. (2018): "MuscleJ". DI 2018-40, dépôt à l'Agence de Protection des Programmes.
2. BioImage analysis of Shigella infection (PI: P. Sansonetti and B. Marteyn).
   Arena ET *et al*. (*Proc Natl Acad Sci U S* A. 2015 Jun **23**,112:E3282-90)
   Tinevez JY *et al*. (*Nat Microbiol*. 2019 Aug 5)

How to work with us/how to apply for support

Open desks are organized every other Monday afternoon to make a first contact with the team. A request for support starts by filling a form on our PPMS website for training, assisted session or collaboration. Based upon your request, you might be asked to fill additional documents (GMO, live pathogens or primary cells imaging). We aim to promote the vast majority to autonomous use of our instruments.



Certifications and Networks

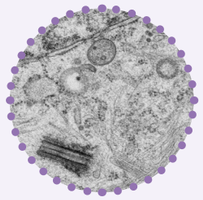
We are IBiSA labeled and ISO 9001 certified.

We are part of the following networks: CTLS (core technologies for life sciences, cofounder), C4L (core for life), FBI (France BioImaging), FLI (France Life Imaging), ELMI European Light Microscopy Initiative, cofounder), RTmfm (Réseau de Microscopie de Fluorescence Multidimensionnelle), EuroBioImaging, Global-BioImaging, EuCAI (European Cell-based Assay Interest group, Cofounders).

Ultrastructural BioImaging (UBI UTechS)

Seeing is believing

Electron microscopy (EM) is the method of choice to see fine details of cells and pathogens and to study how pathogens interact with their host in the most direct way. You feel your project would benefit from EM approaches? Come and talk to us: we will help you find the best solution to address your biological question.



Head of UTechS: Guillaume Dumenil

Contact

Mail: ubi.all@pasteur.fr
Website: https://research.pasteur.fr/en/team/ultrastructural-bioimaging-utechs-ubi/

Mission

We provide scientific and technical support in Scanning and Transmission Electron Microscopy to research groups of Institut Pasteur and external institutes. We routinely perform a wide range of sample preparations and imaging techniques at room temperature, in cryo or in 3D. The ultrastructural characterization of pathogens and host-pathogen interactions is an important focus but a large array of samples is analyzed. We also develop new sample preparations and imaging pipelines that can be applied in the projects of our users.

What we do

- Sample preparation
- Scanning Electron microscopy
- Transmission Electron microscopy
- Cryo-methods
- Immunolabelling
- Correlative Approaches
- 3D Electron Microscopy : Electron tomography, FIB-SEM
- Implementation of new methods

Some examples of success stories

- Characterization of tunneling nano-tubes by 3D-CryoEM:

  Correlative cryo-electron microscopy reveals the structure of TNTs in neuronal cells.
  Sartori-Rupp A *et al.*, 2019.
  Nat. Commun. **10**, 342.
  doi: 10.1038/s41467-018-08178-7

- Anterograde/retrograde transport in the flagellum of trypanosomes by 3D EM:

  Bidirectional intraflagellar transport is restricted to two sets of microtubule doublets in the trypanosome flagellum.
  Bertiaux E *et al.*, 2018.
  J. Cell Biol. **217**, 4284-4297.

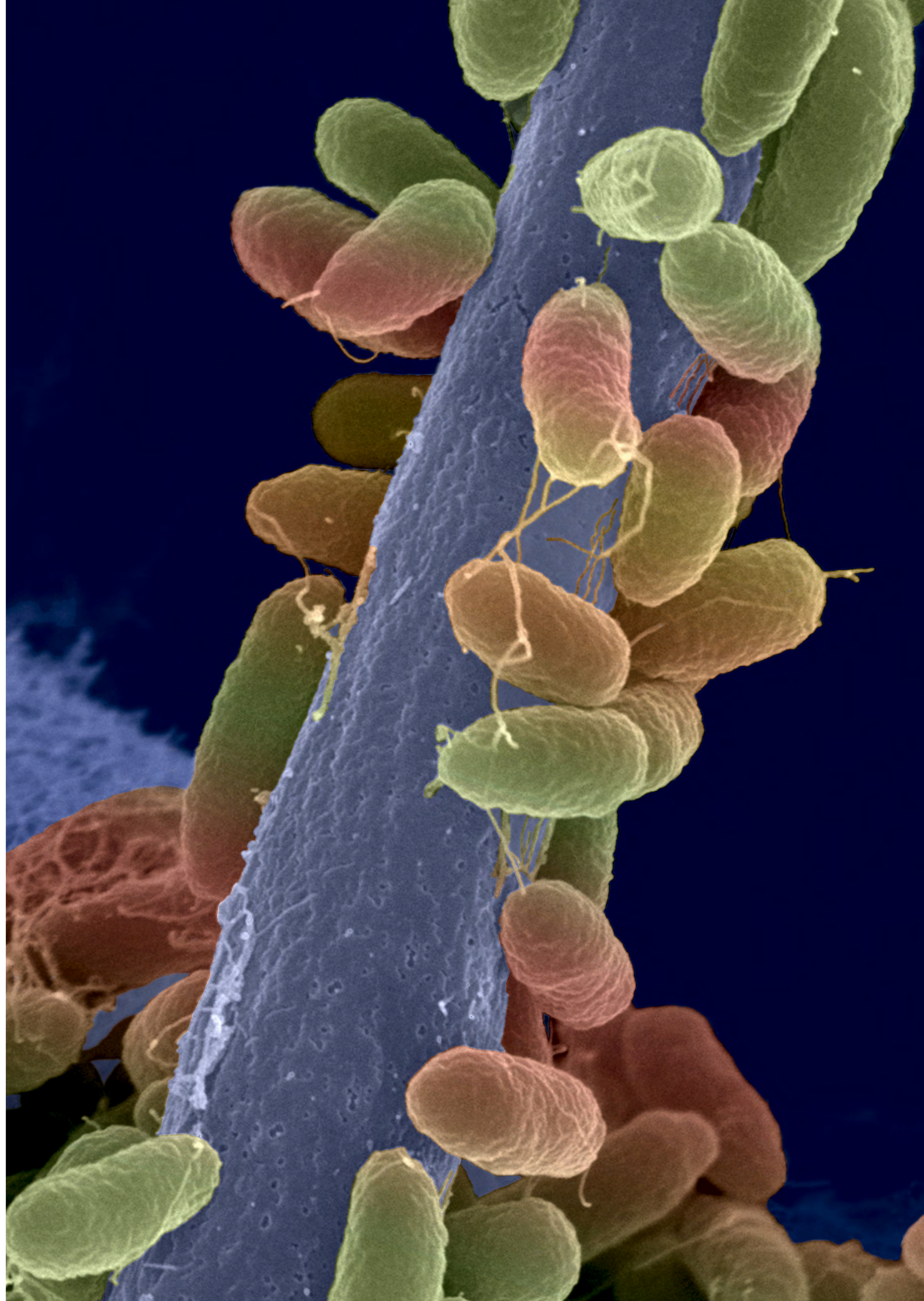
- Ultrastructural morphology by scanning and transmission electron microscopy:

  Tetanus toxin synthesis is under the control of a complex network of regulatory genes in *Clostridium tetani*.
  Chapeton-Montes D *et al.*, 2020.
  Toxins (Basel). May 15;**12**, 328.
  doi: 10.3390/toxins12050328.

How to work with us/how to apply for support

New projects should be requested via our online system PPMS (https://www.pasteur.fr/ppms/login/?pf=5).

You will be asked to briefly present your project in our weekly team meeting.



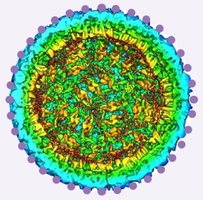
Nano-Imaging Core Facility (NCF)

Cryo-Electron Microscopy for all who need it, or never thought they needed it

Head of Core Facility: Dr. Matthijn Vos

Contact

Mail: nanoimaging@pasteur.fr
Website: https://research.pasteur.fr/en/team/nanoimaging/



Mission

To make the technology of cryo-electron microscopy in all its forms accessible and available for all working at, or collaborating with Institut Pasteur.

What we do

The Nanoimaging core facility provides high throughput cryo-electron microscopy aimed at resolving the structure of isolated proteins in solution as well as imaging at the nanometer scale inside the cellular environment.

Our expertise includes

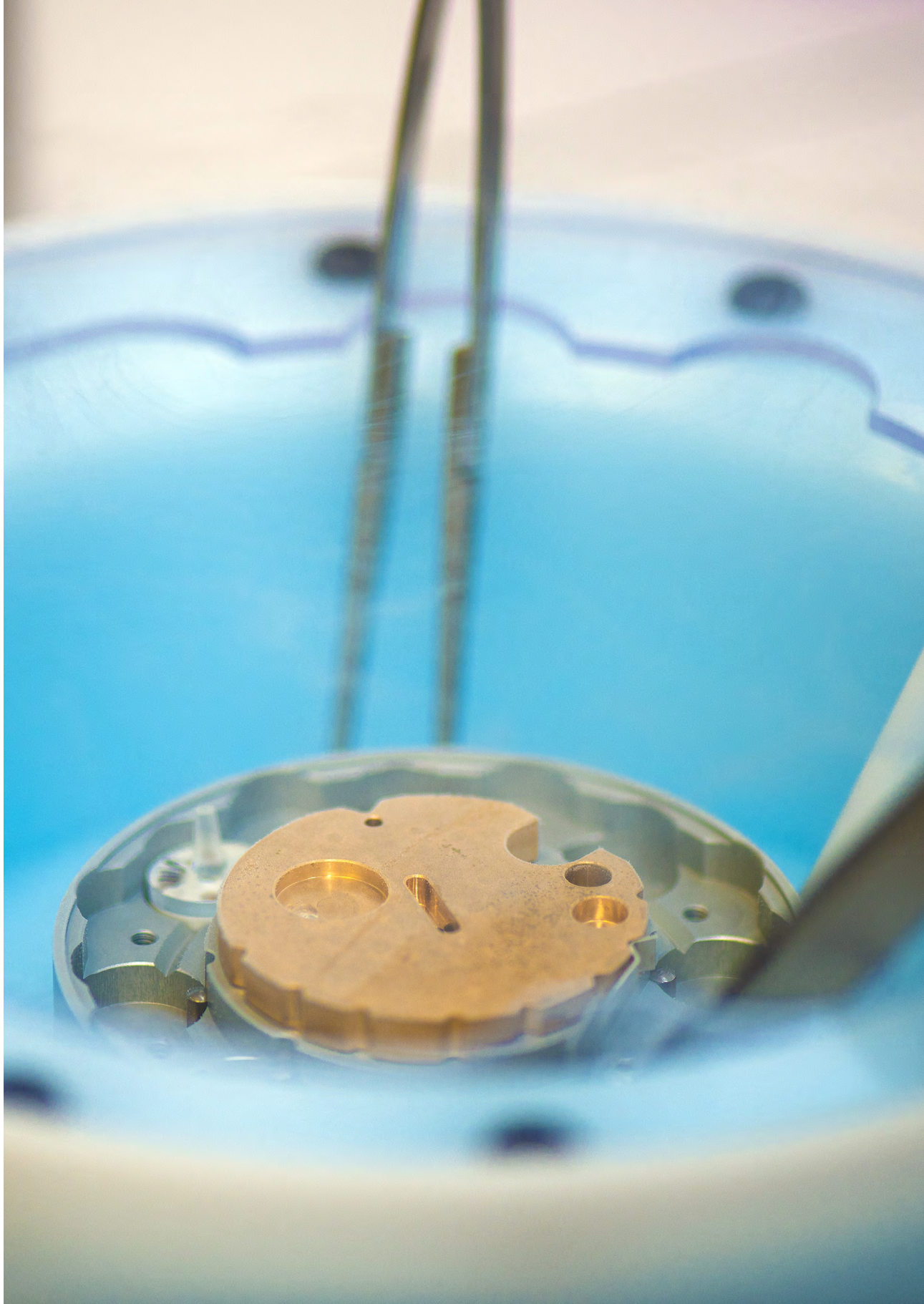
- High-throughput sample preparation and screening
- High-throughput single particle analysis data collection
- Focussed Ion beam milling under cryogenic conditions
- High-throughput cryo-electron tomography
- Cryo-electron microscopy and sample preparation training and scientific consultancy

Some examples of success stories

The core facility started full operation on October 7, 2019. As of October 23, the core facility has screened over 80 samples, imaged over 20.000 images, served 4 Unit PI's with 7 users multiple times and received 11 project submissions and produced 3 protein structures with 3 more being processed. The highest resolution obtained so far was a 2.3Å structure of Apoferritin.

How to work with us/how to apply for support

Applications for access will be accepted on a "first-come-first-served" basis for the initial phase of operation. The imaging days will be assigned in succession based on their date of submission. Each unit is allowed one day of imaging at a time. The second day can be requested after the first submission has been imaged, allowing each unit equal chance to image their projects under a fair use policy. Before the day of imaging, we advise to meet with the core staff to discuss the different projects and how to best approach the sample preparation and imaging, this is, however, not mandatory. It is up to the unit head to decide the order of imaging if a unit has multiple projects from different group leaders within the unit. Users can use the microscope without supervision only after sufficient training and proven ability to operate the microscope as well as approval from the core staff. Details on how to apply can be found on our website.



The Image Analysis Hub (IAH)

An open access / equal access core facility dedicated to services in Bioimage Analysis

The recent technological progresses in microscopy and probes fostered tremendous advances in Life Sciences fuelled by imaging. They opened the way to unique understanding of the mechanisms of life, in particular investigating the processes and dynamics of single cells and organelles. But these advances left us with a large quantity of image data and a new challenge to address: extracting quantitative information from images to get new insights.

The IAH was established at the end of 2017 to support researchers with the tools of Bioimage Analysis. We will help you getting quantitative information from images, either by collaborating with you on your project, building new image analysis tools for your research, training you, or by giving you access to commercial software for image analysis.

Head of Core Facility: Jean-Yves Tinevez

Contact

Mail: iah@pasteur.fr
Website: https://research.pasteur.fr/en/team/image-analysis-hub/

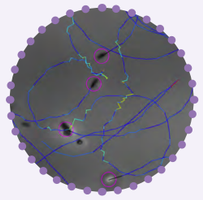
Mission

Our mission is to support researchers with the tools of Bioimage Analysis. We are an open access, equal access core facility committed to offering support in image analysis for the Institut Pasteur campus. All requests involving images are considered.

What we do

Our services are organized mainly around 4 activities:

1. Offer walk-in support and trainings for questions involving image analysis.
2. Build and deploy custom analysis tools for projects requiring special developments.
3. Maintain an infrastructure for autonomous image analysis. Deal with complex tool deployments.
4. Develop original and innovative software tools for image analysis, whose scope exceeds user projects.



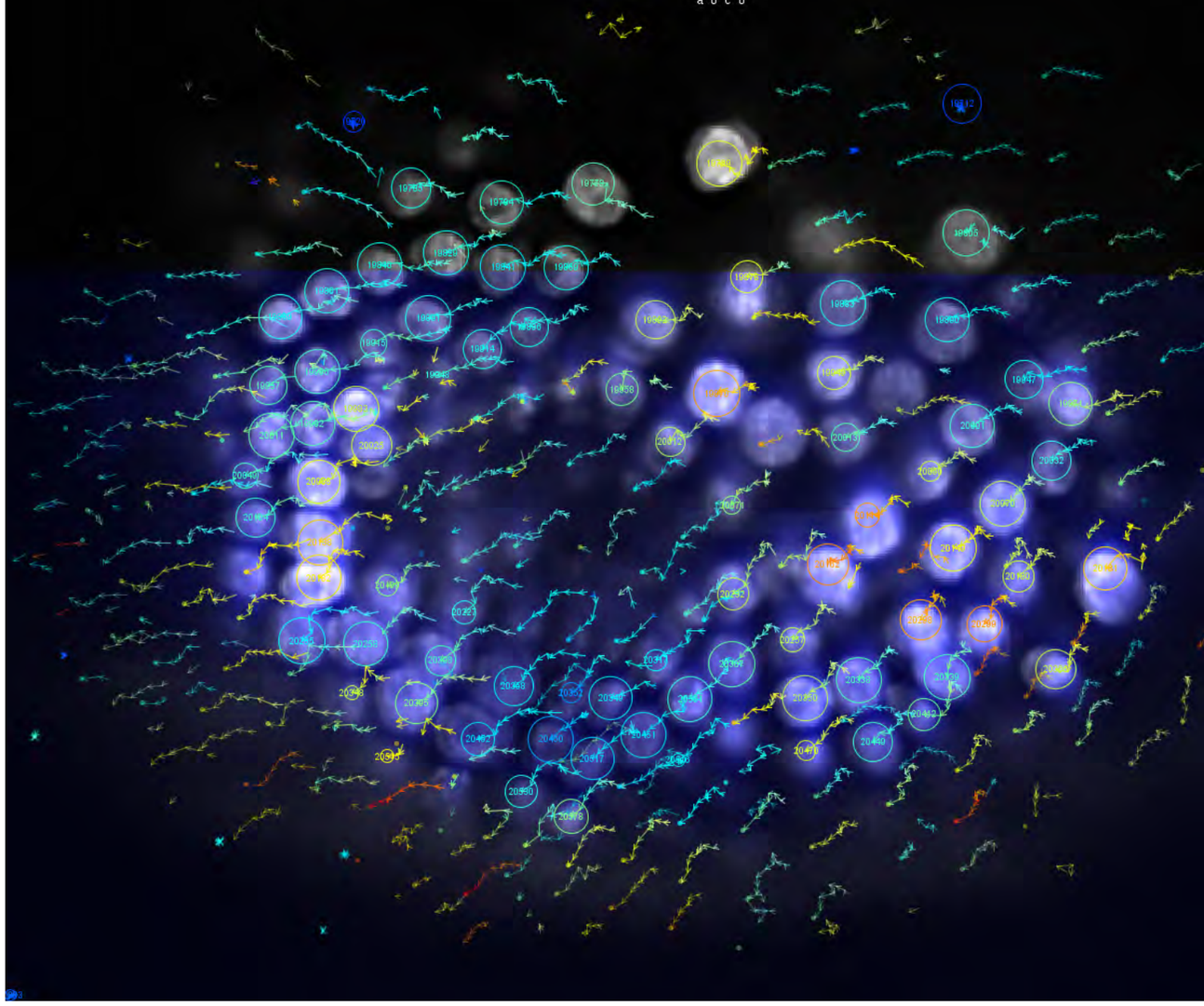
We also conduct or contribute to several development projects that aim at building several end-user software tools for image analysis, whose scope exceeds that of a single user project. These tools include Icy, Fiji, TrackMate, Mastodon, etc. These tools give us platforms to answer future requests quicker, and give a competitive advantage to early adopters.

Our expertise includes

- image analysis techniques
- handling large images
- deep-learning
- biophysics
- software development

Some examples of success stories

- Shigella-mediated oxygen depletion is essential for intestinal mucosa colonization. Tinevez, Arena *et al*, *Nature Microbiology* 2019.
- Multi-view light-sheet imaging and tracking with the MaMuT software reveals the cell lineage of a direct developing arthropod limb. Wolff, Tinevez, Pietzsch *et al*, *Elife* 2018.



How to work with us/how to apply for support

Open desks are organized every two weeks on Thursday mornings to make a first contact with the team. You can also submit a project or request a training on our PPMS page: https://www.pasteur.fr/ppms/?IAH.

We typically collaborate with our users, contributing scientifically to their projects with image analysis. We also organize trainings and workshops to disseminate know-how to the campus.

Certifications and Networks

We are ISO 9001 certified.

We are part of the NEUBIAS (Network of European BioImage Analysts) consortium (http://neubias.org) and of France-Bioimaging (https://france-bioimaging.org/).

NANOBODY DISCOVERY, PROTEIN PRODUCTION, MOLECULAR BIOPHYSICS AND STRUCTURAL BIOLOGY

Production and Purification of Recombinant Proteins Technological Core Facility (PF3PR)

A versatile protein production and purification core facility for your projects

Head of Core Facility: Stéphane Pêtres

Contact

Mail: PF3PR@pasteur.fr
Website: https://research.pasteur.fr/en/team/production-and-purification-of-recombinant-proteins/

Mission

The PF3PR facility was created to provide large amounts of high-quality purified proteins for the researchers from Institut Pasteur and other academic or non-academic institutions.

What we do

Our team provides high-quality recombinant proteins produced in baculovirus, mammalian cells, *E. coli* or yeast, mainly for structural (X-ray, NMR or Cryo-EM) or functional studies. PF3PR has the expertise staff and large-scale range equipment to deliver proteins through a standardized "pipeline": automated screening of host-vector expression systems in micro-plates (Tecan platform), optimization of processes in low scale micro-bioreactors, culture scale-up in large volume conventional bioreactors, and chromatographic protein purifications using AKTA systems.

Our core facility is widening the automated processes of culture screening, purification and analyses to a larger number of eukaryotic and prokaryotic expression systems through the implementation of new equipment and new methodologies.

Our expertise includes

- Providing high quality purified proteins in large quantities in the context of services or scientific collaborations, taking into consideration the requirements of delivery in times and costs.
- Optimization and scale-up of protein production using eukaryotic and prokaryotic multiple expression systems.
- Technological and methodological developments to diversify expression systems and biotechnological tools to overcome the expression of difficult proteins.
- Providing to the users of our core facility, scientific and technical training and expert advices concerning the choice of expression systems, culture processes and protein purification

Some examples of success stories

- Recognition determinants of broadly neutralizing human antibodies against dengue viruses.
  Rouvinski A *et al, 2015. Nature*. **520**, 109-13.
- The stress sigma factor of RNA polymerase RpoS/σ^S is a solvent-exposed open molecule in solution.
  Cavaliere P, *et al,* 2018. *Biochem J.* 2018, **475**, 341-354.
- The biosynthesis of flavin cofactors in *Listeria monocytogenes*.
  Sebastián M, Arilla-Luna S, Bellalou J, Yruela I, Medina M, 2019. *J Mol Biol*. **431**, 2762-2776.
- A comparison of four serological assays for detecting anti-SARS-CoV-2 antibodies in human serum samples from different populations.
  Grzelak L, Temmam S, Planchais C *et al*, 2020. *Sci Transl Med*.**12**, 559.

How to work with us/how to apply for support

In order to check the adequacy between our proposed services and your project, please send us a few lines to PF3PR@pasteur.fr.

Then you will be asked to complete the form available for download on our website to submit a project.

Regular open desks are organized with other core facilities involved in protein science (from production to structure, dynamics and biophysics) to make a first contact with the team and to discuss your project.

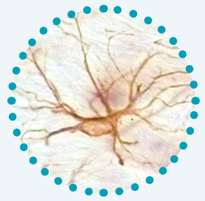
Certifications and Networks

We are IBiSA labeled and member of CTLS (Core Technologies for Life Sciences) and P4EU (Protein Production and Purification in Europe).

Antibody Engineering Core Facility (PFIA)

To raise nanobodies for basic science support, in vivo *imaging and diagnosis*

Nanobodies or VHHs are variable antibody fragments isolated from Heavy chain antibodies that are naturally occurring in only Camelidae (camel, dromedaries, llamas, alpacas). These molecules behave like full antibodies in term of antigen binding but they possess some very interesting features allowing them to be potent biotechnological tools: they are small, they diffuse extensively in body tissues, they penetrate into the brain and they bind intracellular antigens. VHHs are useful for basic science, brain imaging, viral diagnosis / neutralization, etc.



Our team carries out support tasks and develops new protocols for immunization (DNA or cell-based immunization) and for site-specific labeling of nanobodies.

We have been deeply involved in the Covid-19 pandemia. We have raised VHHs against nucleoprotein, spike protein and RNA polymerase. The VHHs directed against the nucleoprotein are being used to develop rapid diagnostic tests (antigenic tests). Some of these VHHs are able to neutralize the virus by blocking the interaction between the spike and the human receptor ACE2.

Head of Core Facility: Pierre Lafaye

Contact

Mail: anticorps@pasteur.fr
Website: https://research.pasteur.fr/fr/team/antibody-engineering/

Mission

Our core facility provides support in developing and characterizing VHH/nanobodies against the desired antigens. The main goal of this collaboration is to provide the right nanobodies that suit to the need of the user. We try not only to provide nanobodies but we can modify them: for example, according to the need, the nanobodies can be engineered to add a fluorochrome, to perform imaging; in this way, bispecific molecules can be created.

What we do

We immunize alpacas with the antigen. After immunization, we recover lymphocytes to isolate RNA. By RT-PCR we obtain cDNA encoding for nanobodies genes. These genes are then cloned in a phagemid vector to obtain phage displayed nanobody libraries. Pannings with the antigen are performed to isolate the specific VHHs. The selected VHHs are then expressed and characterized.

Our expertise includes

- Phage display of phage VHH libraries
- Expression and characterization of VHH/nanobodies
- Site specific labeling with fluorochromes
- Droplet based microfluidic
- Automatization of the process
- Rapid diagnostic tests

Some examples of success stories

- Charles-Orszag *et al*, Adhesion to nanofibers drives cell membrane remodeling through 1D wetting. *Nature Communication*, 2018, **9**, 4450.
- Pothin *et a,* Brain delivery of single-domain antibodies: A focus on VHH and VNAR. *Pharmaceutics*, 2020, **12**, 937.
- Gransagne M*et al*, Single Domain antibodies against the nucleoprotein of SARS-CoV-2. *US patent 63/086, 911*.

How to work with us/how to apply for support

Regular open desks are organized with other core facilities involved in protein science (from production to structure, dynamics and biophysics) to make a first contact with the team.

Alternatively, a request for support starts by sending a mail (anticorps@pasteur.fr).

A meeting is organized to analyse the feasibility of the project and the needs of the applicant. Then a form has to be filled and submitted as a project.

Certifications and Networks

We are IBiSA labeled.

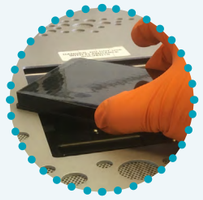
We are part of the EuroMabnet Network and CTLS (Core technologies for life sciences).

Molecular Biophysics Technological Core Facility (PFBMI)

All you need to master your biological system at the molecular level

The PFBMI brings together a large panel of complementary technologies that allow to dissect the molecular processes involved in life and disease, and to design efficient therapies and prophylaxes. The PFBMI experts will help you to obtain meaningful insights into the physicochemical properties of the biological macromolecules and assemblies of YOUR project. You will also be able to receive high-quality training and to develop new skills under our guidance.

Head of Core Facility: Patrick England



Contact

Mail: biophysique@pasteur.fr
Website: www.pasteur.fr/biophysics/

Mission

At the PFBMI, you will find the largest panel of molecular-scale characterization approaches available in France, enabling you to gather precise quantitative data about your proteins (or other macromolecules) and the interactions in which they are involved.

The PFBMI provides cutting-edge instrumentation and expertise to support the campus and the scientific community in general (both in academic and industrial contexts).

For each technology, expert support is available and users can be trained to gain operational autonomy. Turnkey solutions for quality control of purified protein samples are also provided.

PFBMI also develops innovative approaches, in particular regarding the analysis of membrane proteins, large multi-molecular complexes and lipid-protein interactions.

What we do

The following biophysical technologies are available on campus:

Analytical ultracentrifugation (AUC), Circular dichroism (CD), Fluorescence spectroscopy (including anisotropy and DSF), Light scattering (DLS and MALS) Microcalorimetry (ITC and DSC), Microscale thermophoresis (MST), Real-time biosensing (SPR and BLI) and Taylor dispersion/viscometry. PFBMI also provides access to synchrotron facilities for small-angle X-ray scattering (SAXS) measurements.

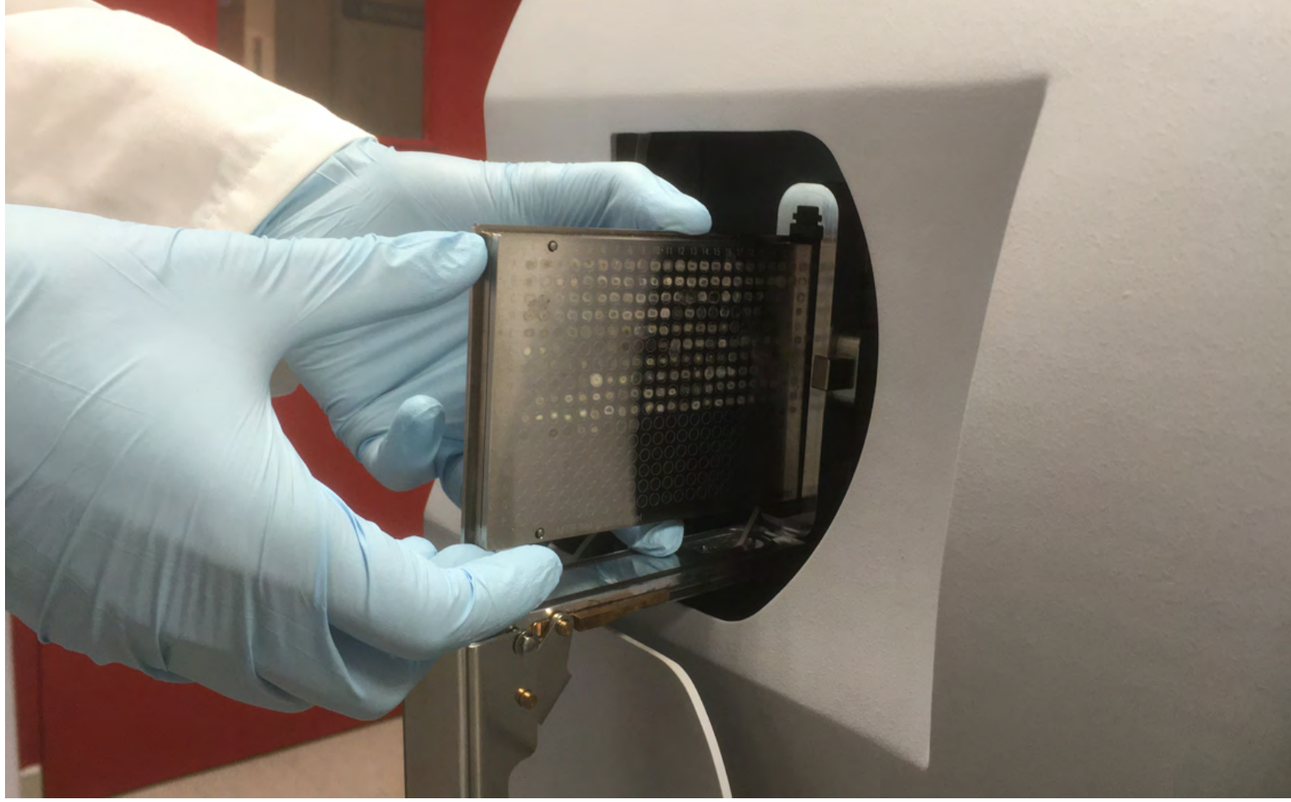
You feel lost among all these technologies and acronyms? Don't worry: we are here to help you through and make sure you go back home with more than what you expected!

Our expertise includes

- Molecular interactions
- Hydrodynamics
- Spectroscopy
- Kinetics
- Thermodynamics
- Purified protein quality control

Some examples of success stories

- The PFBMI plays an essential role in the development of novel therapeutic antibodies against a variety of targets, involved notably in viral and autoimmune diseases. Fruitful collaborations have been developed over the years, for instance with the teams of Felix Rey and Pierre Bruhns, leading to recent high profile publications (Nature, Science, Nature Biotechnology) and patents.



- Efficient international networking is necessary for a core facility to remain at the forefront. The PFBMI coordinates a pan European network in molecular-scale biophysics, which was lacking until 2014. ARBRE-MOBIEU (see below) currently connects more than 150 laboratories from 30 European countries. By working with us, you will be in touch with all the expert stakeholders in the field, wherever they are situated.

How to work with us/how to apply for support

You can meet with the PFBMI team at regular open desks that are organized jointly with the other C2RT core facilities involved in the field of protein science.

Requests should be submitted by e-mail to biophysique@pasteur.fr

An initial face-to-face meeting allows to design a tailored experimental strategy and to agree together on an implementation procedure (potentially involving both the PFBMI personnel and that of the requesting lab).

The PFBMI always tries to ensure that it provides a significant added value to each project it is involved in. After initial proof-of-concept experiments, partnerships are strongly valued and encouraged (for instance joint grant applications, student co-tutorship...).

Furthermore, the PFBMI encourages the users to become autonomous and trains them accordingly.

Certifications and Networks

We have been labeled by IBiSA as a core facility of national relevance since 2008.

We initiated in 2014 a network of molecular-scale biophysics core facilities, infrastructures and resource laboratories: ARBRE-MOBIEU (Association of Resources for Biophysical Research in Europe / Molecular Biophysics in Europe). This large network, coordinated by Patrick England, currently is a large pan European COST Action and is widely recognized as the reference in the field.

Crystallography Platform (PFX)

High-throughput crystallization screening and 3D structure determination of biological macromolecules

X-ray crystallography is the most widely used technique to reveal the three-dimensional structure of biological macromolecules at atomic resolution. These structures are essential to understand the molecular details of protein function, protein-protein interactions and overall mechanistic reactions.
The biological macromolecules studied by research groups at Institut Pasteur are of major concern in the field of life sciences related to human health. With this powerful technique, our goal is to solve the three-dimensional structures of biological macromolecules for therapeutic, diagnostics and vaccine development.

Head of Core Facility: Ahmed Haouz

Contact

Mail: pf6@pasteur.fr
Website: https://research.pasteur.fr/fr/team/crystallography/

Mission

The crystallography core facility provides research groups working in the field of macromolecular crystallography with the expertise and technology required for high-throughput crystallization screening, X-ray diffraction measurements, and crystallographic computing.

We offer expertise in crystallography, from the crystallization of selected protein targets to the resolution of crystal structures of biological macromolecules. We ensure this mission by participating as a partner in scientific research projects (ANR, PTR, and individual collaborations) involving studies of single proteins and protein complexes.

What we do

We offer services for high-throughput crystallization screening, crystal optimization, X-ray diffraction data collection and structure determination.

The core facility is equipped with state-of-the-art instrumentation and robotics for the 3D structure determination of biological macromolecules by X-ray crystallography. This equipment includes automated systems for liquid handling, nano-dispensing, storage and imaging of crystallization plates.

For X-ray data collection, the core facility is a member of the BAG (Block Allocation Group) of Institut Pasteur for regular access to synchrotrons ESRF (Grenoble) and SOLEIL (Saclay).

Our expertise includes

- Protein Biochemistry
- Liquid handling automation
- Crystallization of biological macromolecules
- X-Ray Diffraction
- 3D Structure determination and refinement
- Computing for crystallography

Some examples of success stories

1. Lisa MN *et al*, Double autoinhibition mechanism of signal transduction ATPases with numerous domains (STAND) with a tetratricopeptide repeat sensor. *Nucleic Acids Res*. 2019, **47**, 3795-3810.
2. Hu H *et al*, Electrostatics, proton sensor, and networks governing the gating transition in GLIC, a proton-gated pentameric ion channel. *Proc Natl Acad Sci USA*. 2018,**115**, E12172-E12181.
3. Williams AH *et al*, "A step-by-step in crystallo guide to bond cleavage and 1,6-anhydro-sugar product synthesis by a peptidoglycan-degrading lytic transglycosylase." *J Biol Chem*. 2018, **293**, 6000-6010.
4. Barba-Spaeth G *et al*, Structural basis of potent Zika-dengue virus antibody cross-neutralization. *Nature*. 2016, **536**, 48-53.

How to work with us/how to apply for support

For crystallography projects, depending on the expertise of the users, three options are offered: service provision, instrument allocation, and scientific collaboration.

Please apply by e-mail to: pf6@pasteur.fr

You can meet with the PFX team at regular open desk meetings organized jointly with the other C2RT core facilities involved in the field of protein science.

Certifications and Networks

We are GIS-IBiSA labeled and ISO-9001 certified.

Biological NMR Technological Core Facility (PF BioNMR)

NMR and HDX-MS technologies for your structural biology needs

Nuclear Magnetic Resonance (NMR) and Hydrogen/Deuterium eXchange followed by Mass Spectrometry (HDX-MS) are powerful and versatile techniques to tackle challenging biological questions and offer complementary information to X-ray and cryo electron microscopy.

Head of Core Facility: Iñaki Guijarro

Contact

Mail: bionmr@pasteur.fr
Website: wwwBioNMR

Mission

We provide state of the art solution NMR and HDX-MS techniques to study at an atomic or molecular level protein interactions, dynamics, structure, fragment and ligand screening, post-translational modifications, real-time kinetics, chemical structure of carbohydrates and small compounds.

What we do

We are equipped with three NMR spectrometers: an 800 MHz and a 600 MHz (Bruker) dedicated to biological NMR. Both are equipped with high sensitivity cryogenic probes and automated sample changers. Our 500 MHz (Agilent) is dedicated to routine QC for chemists. HDX-MS is performed on a SynaptG2-Si HDMS (Waters) with ETD, an ACQUITY UPLC M-Class system, and a LEAP-Pal robot for automated sample handling and data acquisition.

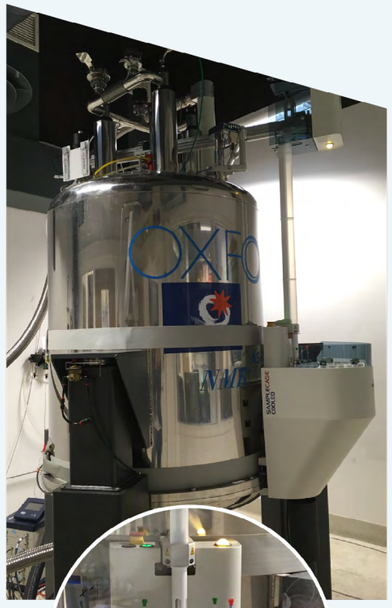
Our team carries out support tasks, provides analysed data and develops innovative methods in HDX-MS to aid in the rapid statistical validation and visualization of large HDX-MS datasets (MEMHDX software), to study membrane proteins and proteins in complex environments.

Our expertise includes

- Molecular interactions with proteins (proteins, nucleic acids, carbohydrates, compounds…)
- Fragment/Ligand screening, hit validation and characterisation
- Protein and protein-complex dynamics over a large time-scale (picoseconds – hours)
- Intrinsically disordered proteins and protein folding
- Post-translational modifications (phosphorylations, acetylations…)
- 3D solution structure of small proteins

Some examples of success stories

- The structural analysis of *B. pertussis* CyaA toxin led to a publication in *FASEB J.* 2019 (**3**, 10065-10076) on the role of acylation in the control of the function and folding of the toxin – collaboration with A. Chenal.
- NMR and HDX-MS used with cryoEM to unravel the dynamics of a type 2 secretion system pseudopilus – collaboration with N. Izadi and M. Nilges (*J Biol NMR*, 2019,**73**, 293-303).



How to work with us/how to apply for support

You can meet with the BioNMR core facility team at regular open desks that are jointly organized with the other C2RT core facilities involved in the field of protein science.

A request for support starts by sending an email to bionmr@pasteur.fr, contacting us by phone or personally, prior to submit an application and a sample description form available on our website. We will shortly organize a meeting to define with you the feasibility, the experimental strategy and the schedule.

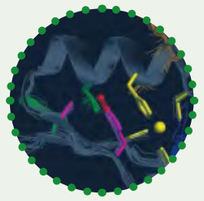
In most instances, we will perform experiments and analyse the data. For relatively long studies (> 1.5 years), we will provide hands-on training and technically support PhD students or postdocs throughout their project to become autonomous. In addition, we provide spectrometer time for NMR experts or we record data to be analysed by the users.

SCREENING, MICROFLUIDICS AND ORGAN ON CHIPS

Chemogenomic and Biological Screening Core Facility (CCB)

Exploring the world of small molecules and biologics for new medicines and deciphering biological networks

Chemogenomic and biological screening are important steps in precision medicine and for the discovery of new medicines, as well as in dissecting molecular pathways and biological networks.



Head of Core Facility: Fabrice Agou

Contact

Mail: pfccb@pasteur.fr
Website: https://research.pasteur.fr/fr/team/fabrice-agou-team/

Mission

We support researchers in improving the efficiency of their target-based (HTS) and phenotypic (HCS) screening bioassays, in identifying genetic modulator of function, in assessing target engagement, in isolating high quality chemical or biological substances of therapeutic, diagnostic or mechanistic interest, as well as in using core technologies typically applied to miniaturization and automation of bioassays.

What we do

We assist research teams with the development of robust target-based (HTS) and phenotypic (HCS) assays, and provide high quality hits. For HCS, phenotypic analysis can be carried out either with a conventional automated microscope (IX83, Olympus) or the new microscope StellarVision (Optical Biosystems, USA) that uses structured illumination and Synthetic Aperture Optics (SAO). For HTS screening, we have the ability to support cellular and biochemical assays using a wide variety of HTS readouts (absorbance, fluorescence anisotropy, AlphaScreen, HTRF, luminescence and TSA). We also make available the Octet HTX instrument, which enables high throughput label-free detection via biolayer interferometry (BLI) technology (FortéBio, Molecular Devices).

With our liquid acoustic dispenser (Echo550, Labcyte), we can very easily reformate multiwell plates for you (96, 384 and 1536 format), offer cherry-picking service and prepare any daughter plates from our biological and chemical collections. Finally, we also provide strong supports for developing chemical probes as well as drug candidates (hit to lead and lead optimization), especially for some promising projects with a high therapeutic index.

Our expertise includes

Assay development for HCS and HTS screening bioassay; protein-protein and RNA-protein interaction inhibitors; medicinal chemistry; target deconvolution following phenotypic screen; various functional and chemical libraries including small molecules, cyclic peptidomimetics, antibody-like protein and siRNA/gRNA (ubiquitome and personalized siRNA libraries).

Some examples of success stories

- Fanucchi S, Fok ET, Dalla E, Shibayama Y, Börner K, Chang EY, Stoychev S, Imakaev M, Grimm D, Wang KC, Li G, Sung WK, Mhlanga MM. 2019, *Nat Genet*. **51**, 364.
- K. Nhabane Said Halidi, E. Fontan, L. Davignon, A. Boucharlat, M. Charpentier, M. Boullé, R. Weil, A. Israël, E. Laplantine & F. Agou 2019. *IScience* (Cell Press), **20**, 292-309.
- K. Nozeret, A. Boucharlat, F. Agou & N. Buddelmeijer* (2019). Sci Rep, **9**, 15978.

How to work with us/how to apply for support

A request for support starts by sending a mail to pfccb@pasteur.fr. You will be asked to give us an overview of your project at first, submit your project to our steering committee, and then meet in person to give us any details so we can figure out together the best way to develop and miniaturize your HTS or HCS bioassay. We can also assist and train you to become autonomous on some automated equipment, help you during every steps of the screening process, and can perform for you a small, medium and large screening campaign.

Certifications and Networks

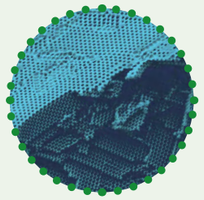
France: Société de Chimie Thérapeutique (SCT) and ELRIG (European Laboratory Research & Innovation Group).

Europe: Core for Life; USA: HTRC Rockefeller, NY (High Throughput & Spectroscopy Research Center).

Biomaterials and Microfluidics Core Facility (BMcf)

Designing and producing your advanced cell culture system

Today's biomedical research heavily relies on fast-pace innovation. The use of state-of-the-art technologies offers an important competitive advantage. Both microfluidics and 3D cell culture technologies opened new venues for the development of innovative cellular assays as they allow a better recapitulation of the biophysical and biochemical microenvironment.



Head of Core Facility: Samy Gobaa

Contact

Mail: bmcf@pasteur.fr, microfluidics@pasteur.fr, samy.gobaa@pasteur.fr
Website: https://research.pasteur.fr/fr/team/biomaterials-and-microfluidics/

Mission

Our objective is to bridge biology and engineering in order to help the development of biomedical projects with a strong technological focus. To this end, we provide a set of tools targeted for the better understanding of complex cell-pathogen and or cell-microenvironment interactions.

What we do

We provide the campus with microfluidic chip design and production capabilities, a library of synthetic hydrogels dedicated to 3D cell culture. We are also investigating multiple organoid protocols. Finally, we are operating an Organ-on-Chip Center that offers microfluidic systems capable of recapitulating organ/tissue function *in vitro*.

Our expertise includes

- Microfabrication
- Microfluidics
- Hydrogels
- Micro-patterns
- 3D cell culture
- Organ-on-Chip

Some examples of success stories

- In collaboration with the team of Nathalie Sauvonnet we have developed a new model of intestinal infection based on a microfluidic Organ-on-Chip device. This tool showed that *Shigella* infection can be faithfully recapitulated in by mimicking the mechanical forces of the intestinal microenvironment (including shear stress and peristaltic motion) on-chip.
- Bioengineered Human Organ-on-Chip Reveals Intestinal Microenvironment and Mechanical Forces Impacting Shigella Infection. Grassart A, Malardé V, Gobaa S, Sartori-Rupp A, Kerns J, Karalis K, Marteyn B, Sansonetti P, Sauvonnet N.

How to work with us/how to apply for support

You've got an idea. You think (bio)engineering can help.

Then feel free to contact the BMcf team for a joint brainstorming, consulting or even for outlining a future collaboration. Classically we run 3 types of projects.

1. Do it Yourself. There you are the boss. BMcf will just provide training on the equipment and ensure proper maintenance and operation.
2. Proof of Concept projects. Here BMcf will start the project in order to perform a set of exploratory experiments.
3. Co-Development. This is the most integrated form of collaboration. Usually it involves joint application to grants and dedicated WP for BMcf.

You can reach us by e-mail, by phone or just by simply dropping by the lab anytime. Our philosophy is to accept all the (technologically feasible) requests (no prioritization). We commit ourselves to providing you with a first answer on feasibility within a few days.

Diagnostic Test Innovation & Development Core Facility (CF Diag)

Imagine and design tomorrow's bioassays for health

The COVID-19 pandemic has shown the importance of in vitro diagnostic assays to evaluate the prevalence of the infection in local or world-wide populations.
New generations of prognostic, diagnostic and therapy follow-up bioassays blossom from science and technology innovation supporting and improving our health care systems from point-of-care to high-throughput laboratories.

Head of Core Facility: Thierry Rose

Contact

Mail: diag@pasteur.fr
Website: https://research.pasteur.fr/en/team/diagnostic-test-innovation-and-development-core-facility/

Mission

This new core facility aims to be a precursor of tomorrow's diagnostic tests for a better care of each patient from the corner of the street to the end of the world. Along collaborative projects, we design, develop, assess and run innovative technologies, methods or reagents up to pre-industrial maturity for assaying specific biomarkers in samples for diagnostic purposes.

What we do

We develop in vitro assays for specific biomarkers at high-throughput on multi-well plates, highly multiplexed on slides, rapid tests on lateral flow devices and instant tests in tubes with standard or innovative detection modes: absorbance, fluorescence, FRET, fluorescence polarization, time-resolved fluorescence, time-resolved FRET, luminescence, BRET, AlphaScreen®, AlphaLISA®, plasmonic resonance intensity or phase. Biomarkers can be proteins or nucleic acids of scientific, clinic, veterinarian, epidemiologic or environmental interest and samples are human or animal body fluids, cell or tissue lysates, culture media or environmental water or waste. Assays are mainly based on constructs involving a probe and a reporter. We design or screen probes for their binding properties such as antibodies, single-chain variable domain antibody fragments and nanobodies (VHH) which can be displayed in libraries of phages (M13/PIII) or *Escherichia coli* (intimin). For the reporting component, we design and develop high-performance luciferases for bioluminescence, protein domains for fluorescence, FRET or BRET, nanogold binding tails as well as streptavidin binding tags.

The high-sensitivity and high-throughput plate reading is achieved using multi-mode apparatus (Mithras 2 or Centro from Berthold Technologies) or, single tube monitoring apparatus (LSC from Hydex, Lumat from Berthold). Our plate washer/loader (Zoom, Berthold) also insure reproducible and high-performance operations. We design and develop lateral flow device prototypes in our dedicated workshop. Our programmable liquid handling automates (EVO, Tecan) can be used for loading or reformatting samples in tubes, multi-well plates (from 6 to 1536 wells), membrane as well as slides, and running large series of samples (up to 20,000 LuLISA assays/day) for scientific, clinic or epidemiologic collaborative studies using new or gold standard methods.

We also develop mechanic force assays on cells or protein-coated beads using acoustic (Lumicks), laminar flow, centrifugation or optical tweezers (ISIR). Cell-cell interactions, cell adhesions to coated beads or surface can be measured at the single cell level from one to several thousand of cells to detect alteration and/or decipher activation or recognition mechanism in order to diagnose cellular alterations associated with infection, cancer and immune pathologies from blood drops.

We collaborate with internal and external research and technical teams (start-ups, companies, institutions) for methodological or technological development of their assays, their automation and their evaluation using gold standard methods and reference samples.

Our expertise includes

Multi-mode immunoassay development, bioluminescence applications in imaging and bioassay, mechanobiology method development for cell adhesion and cell-cell interaction assay.

Some examples of success stories

- Le Vu S, Jones G, Anna F, Rose T, Richard JB, Bernard-Stoecklin S, Goyard S, Demeret C, Helynck O, Escriou N, Gransagne M, Petres S, Robin C, Monnet V, Perrin de Facci L, Ungeheuer MN, Léon L, Guillois Y, Filleul L, Charneau P, Lévy-Bruhl D, van der Werf S, Noel H. *Nat Commun*. 2021, **12**, 3025.
- Roederer T, Mollo B, Vincent C, Nikolay B, Llosa AE, Nesbitt R, Vanhomwegen J, Rose T, Goyard S, Anna F, Torre C, Fourraey E, Simons E, Hennequin W, Mills C, Luquero FJ. *The lancet Public Health* 2021, **6**,e202-e209.
- Anna F, Goyard S, LalanneAI, Souque P, Louis D, Gillon V, Clement-Bidard F, Savignoni A, Delost M, Gransagne M, Escriou N, Dejardin F, Pètres S, Helynck O, Janin Y, Charneau P, Perez F, Rose T, Lantz O. *Eur J Immunol.* 2021, **51**, 180–190.
- Goyard S, Balbino B, Chinthrajah RS, Lyu SC, Janin YL, Bruhns P, Poncet P, Galli SJ, Nadeau KC, Reber LL, Rose T. *Allergy*. 2020, **75**, 2952-2956.
- Kamsma D, Bochet P, Oswald F, Ablas N, Goyard S, Wuite GJL, Peterman EJG, Rose T. *Cell Reports*. 2018, **24**, 3008-3016.

How to work with us/how to apply for support

Send us (at diag@pasteur.fr) a very short description of your project and your expectations. We will provide you with a feedback shortly including a planning of the next steps. For assay development missions requiring more 5 consecutive days of work, your project will have to be submitted to our steering committee.

Certifications and Networks

We have an incentive networking action in the field of bioassays and diagnostics. We are affiliated to the innovation accelerator of the Institut Pasteur benefiting of its business development and intellectual property supports.

SCIENTIFIC COMPUTING

High Performance Computing Core Facility (HPC)

We can help you make your pipelines and workflows run faster!

Head of Core Facility: Youssef Ghorbal

Contact

Mail: hpc@pasteur.fr
Website: https://research.pasteur.fr/en/team/hpc-core-facility/

Mission

We provide comprehensive High Performance Computing (HPC) resources and services for Institut Pasteur researchers.

What we do

Install and operate HPC clusters: Provide computing resources including cutting edge computing facilities (GPUs, high bandwidth and low latency network, very fast scratch file system).

User assistance: clusters access and on-boarding, jobs monitoring, etc.

Software management and development: install and maintain relevant software collections and reference data catalogues on all HPC clusters

How to work with us/how to apply for support

A request for support starts by sending a mail/ request to ask-hpc@pasteur.fr.

We opt for opensource software as much as possible.

Our expertise includes

- Slurm Scheduler System management
- Software development for CPUs and GPUs (CUDA)
- Code Profiling, Optimization and Parallelization
- Assistance in third-party software suites cluster integration
- Retrieval and indexing of reference data catalogue (Genomes data banks) automation

ANNEXES

DATA MANAGEMENT CORE FACILITY

Providing access to data management expertise for research data

Head of Core Facility: Anne-Caroline Delétoille
Contact: datamanagement@pasteur.fr
Website: https://research.pasteur.fr/fr/team/data-management-core-facility/
Webcampus: https://webcampus.pasteur.fr/jcms/c_915693/fr/plateforme-de-data-management

Our tool: REDCap®
eMail: redcap@pasteur.fr
Website: https://redcap.pasteur.fr/home/

Mission: Our main objective is to give support to research units and Core Facilities at Institut Pasteur for the management of their data. We are also involved in transversal projects to structure the organization of research data within the Institute and the integration of the FAIR principles in research projects.

What we do: Within the Core Facility, we respond to requests for expertise or we can dedicate a data manager for your project. Our support is provided through the following tasks and responsibilities:

- Plan and anticipate data management needs
- Create, test and validate databases and train users
- Implement consistency checks to validate data and metadata quality and integrity and clean up data
- Ensure data long-term storage (standards, open formats…). Also, we can help on the selection of data to store
- Facilitate data sharing with the scientific community in compliance with regulatory standards
- Write documentation/user guides
- Implement process in order to ensure the findability, the accessibility, the interoperability and the reusability of the data

The core facility can also provide support for the eCRF tool REDCap® (redcap.pasteur.fr/home).
We can help you to set up your eCRFs:

- Advices in eCRF creation
- Trainings
- User Support (The core facility can only provide support for uses of RedCap® in research projects purpose).

Our expertise includes:

- Data management of clinical and epidemiological data
- Planning data life cycle
- Checking data quality
- Expertise on data standards

Some examples of success stories: The DM-CF was quickly mobilized for the creation of data collection databases as part of the fight against the SARS-COV-2 virus, mainly for the CORSER, RC-COVID and SocialCov studies. The DM-CF is also involved in the data management of the Milieu Intérieur cohort and AIMS-2-Trial study.

How to work with us/how to apply for support: Applications for access will be accepted on a "first-come-first-served" basis. A request for support starts by sending an email to datamanagement@pasteur.fr. You can ask for expertise or collaboration or for a training. Based upon your request, you might be asked to fill additional documents. Researchers wishing to include our support in grant applications are encouraged to contact us by email.

Specific questions on REDCap® can be sent to redcap@pasteur.fr.

Certifications and Networks: The Core Facility collaborates with the international REDCap® community and leads the French node of the REDCap® community. The Core Facility is also part of the RDA (Research Data Alliance) and the Ac@DM (groupe des Data Managers académiques).

GUIDELINES

Relationships between users and C2RT/C2RA core facilities members & Acknowledgement of contributions from C2RT/C2RA core facilities members

Institut Pasteur continuously invests to provide its research teams with access to a state-of-the-art environment through core facilities and technology and service units (UTechS) located on its campus.

These resources are coordinated by the technology department (DT) through two centers: the technological resources and research center (C2RT) and the animal resources and research center (C2RA).

Through their expertise, services and shared equipment, the C2RT/C2RA core facilities support research teams in the technological and animal research components of their projects from grant writing to project implementation and publication.

The entities of C2RT and C2RA, as shared resources, aim to support all the research teams of the campus. They are also open to external users from national and international research organizations or private institutions.

The guidelines outlined in this document aim to facilitate interactions between the users and C2RT/C2RA teams all along the life of a project. In addition, they are also intended to allow as many people as possible to access these resources. The guidelines have been established by the technology department (DT) in collaboration with all the Scientific Departments and have been validated by the scientific direction committee (CODIS).

They apply to any type of project involving a user and a C2RT/C2RA team (including training, assisted sessions, routine or non-routine service, scientific collaboration, etc.).

This document presents a first version of these best practice guidelines. To ensure continuous improvement, they may evolve over time.

	Key practices applicable to both users and C2RT/C2RA teams	Key practices specific to users / research teams	Key practices specific to C2RT/C2RA teams
Upstream of a project between a user and a C2RT/C2RA team	Discuss about **the user's request** as early as possible after its filing in order to identify the **technological challenges** and qualify the **feasibility of the project**. Discuss the constraints faced by the user and by the C2RT/C2RA team as soon as possible.	Specify the **key elements** of the request, the **expected results** and how the request fits into the research project.	Acknowledge receipt of the user's request. Recall the principle of **equal access** to C2RT/C2RA core facilities. Present the core facility's operation modalities and the **criteria used for prioritizing /selecting projects**. Indicate what level of involvement of the user will be necessary for the successful implementation / completion of the project. Provide the user/PI with an **estimate of the cost** of the project and of the **expected timeframe**, including approximate time periods between the **main steps** of the process.
Definition & planning	Frame the project while remaining flexible. Define the **key elements** (for example project objectives, project steps and associated milestones, the nature of the work to be done (routine or non-routine), the distribution of **roles and responsibilities**, the **necessary resources**, the associated **deadlines and fees**). Define in particular how each project participant shall be involved (both on the side of the requesting laboratory and the platform). Indicate the **risks/ uncertainties** related to the project and how they would be handled. Establish a **«roadmap»** of the project together with the associated cost estimate (when applicable) and send it to the **PI for validation**.	Define the **contact people** for the project implementation (scientific and administrative). Ensure that all the people who will be directly involved take part in the **definition and planning phase** of the project.	Define the **contact people** for the scientific and administrative components of the project especially if the project goes beyond the routine activities of the core facility. If, from the Core Facility's viewpoint, the project goes **beyond routine activities** and requires significant **intellectual involvement**, inform the user and his/ her PI/group leader from the beginning. Define, **in agreement** with the PI, the expectations regarding **authorship** (see appendix below).

	Key practices applicable to both users and C2RT/C2RA teams	Key practices specific to users / research teams	Key practices specific to C2RT/C2RA teams
Execution and follow-up	**Interact periodically** throughout the project, and monitor achievements and difficulties encountered if any. **Inform** each other as soon as possible of any **change** that may affect the project.	**Alert** the Core Facility team as early as possible if any change occurs in the project expectations. Jointly define the **changes to be made**. If these changes are important, it may be better to close the project and define a new one.	**Alert** the user and research team leader/PI as early as possible if **any difficulty** occurs in the implementation of the project. **Discuss** with the user and with his/her group leader or PI to define the actions to be taken to overcome the encountered difficulties. **Alert** the user and his/ her PI if the **intellectual contribution** of the core is greater than originally planned. If appropriate, close the project and define a new one.
Closing of the project and beyond	In case the project needs to be overhauled, close it and file a new application. Hold a **final meeting** to **review the results**. Invite if needed the **PI/group leader** to participate in this meeting. To ensure **continuous improvement**, share the encountered difficulties, the adequacy of the solutions provided during the project, the possible improvements.	Provide **feedback** on the exploitation of the results obtained and their integration into the overall project framework. **Acknowledge** the contribution of the Core Facility team. When appropriate invite them to contribute to the drafting of the **publication** (see appendix below). Proceed to the **payment** of the related invoices.	Hand over the **deliverables** that were agreed on and, if necessary, the associated **raw data**. When appropriate, assist the user in the drafting of the **publication(s)** associated with the project (see appendix).

Appendix

Acknowledgement of the contributions of C2RT / C2RA core facility members in manuscripts and grants

Acknowledgment of the contributions of core facility staff in publications and grants (application and reports) is regarded as a key indicator of the impact of their activities. It is also an element that is taken into account by funders when evaluating funding applications filed by core facilities, as well as by evaluation bodies when rating core facility staff and deciding on their career progression.

Guideline 1

Acknowledge the contribution of a core facility in publications and grants (both application and reports) every time its services and/or equipement have been used. If the project goes beyond the routine activities of the core facility and requires significant intellectual involvement, the PI or the head of the research group involved and the head of the core facility jointly agree on the most appropriate way to acknowledge the contribution of the core staff (acknowledgment or invitation to be a co-author).

Guideline 2

Format of acknowledgement in a publication: name whenever possible the person (s) who contributed or by default the core facility as a whole, and indicate the official name of the entity along with its center of attachment (C2RT or C2RA): « we thank (names of people involved) of (official name of the core facility or UTechS) of C2RT / C2RA for ..... » or, by default, « we thank the staff of (official name of the core facility y or UTechS) of C2RT / C2RA for ..... »

The official names of the entities of C2RT and C2RA are available at:

research.pasteur.fr/center/C2RT

research.pasteur.fr/center/C2RA

Format for co-authorship: Name of the co-author, Name the entity (official name of the core facility or UTechS), center of affiliation (C2RT or C2RA), Institut Pasteur, Paris (75015) France.

Guideline 3

A core facility staff member may refuse to be a co-author of a publication. In this case, the core facility will be mentioned in the acknowledgments (see guideline 2).

Guideline 4

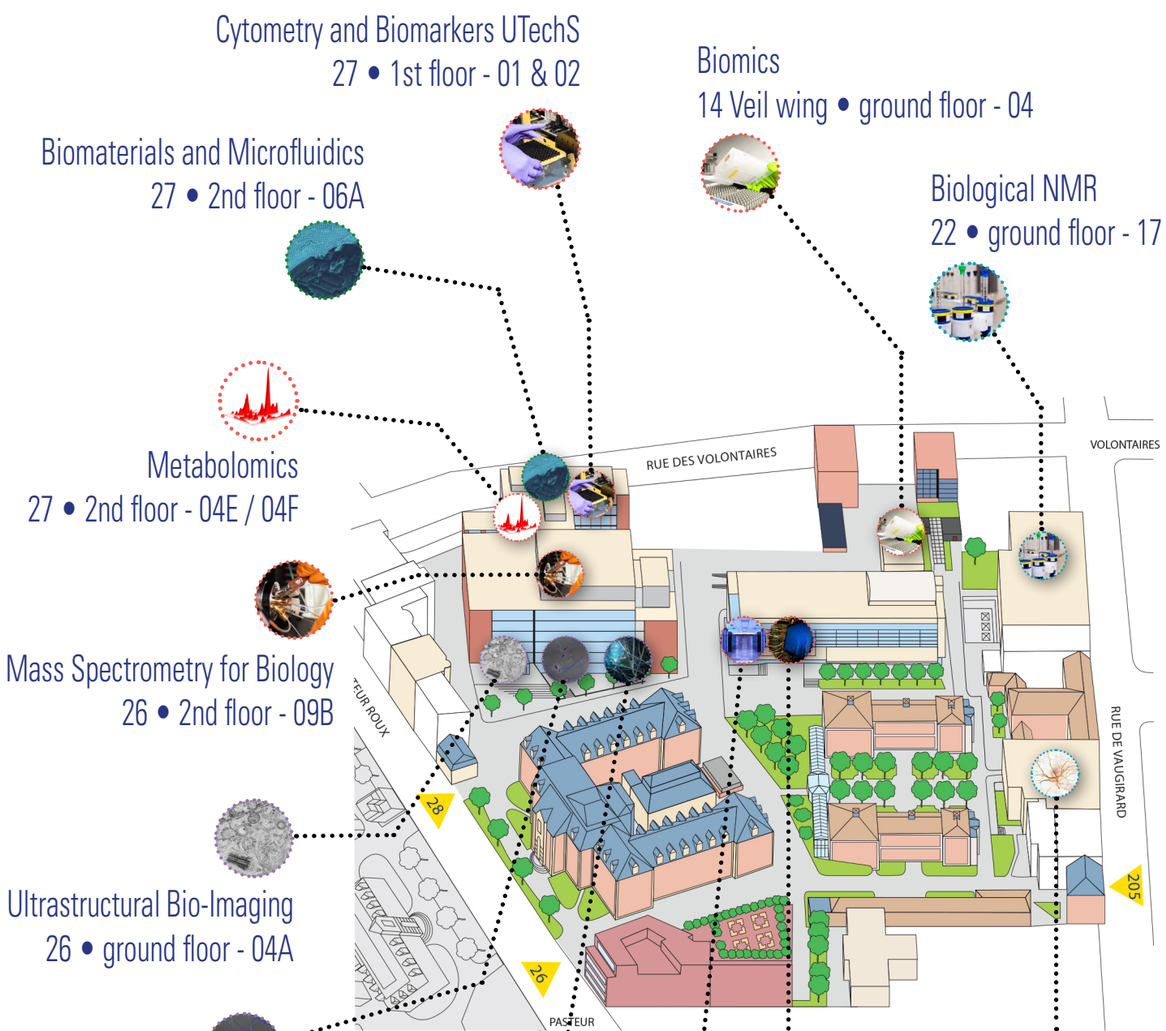
Disagreements over the type of recognition shall first be handled by the head of the core facility/UtechS and the PI, who will make their best efforts to find an agreement meeting their respective expectations as well as those of their collaborators.

If a mutually agreeable solution cannot be found, the PI or the head of the core facility /UtechS shall refer the matter to the vice president for technology and scientific programs. As a last resort the case shall be addressed to the ethics committee of Institut Pasteur.

Affiliation of C2RT UTechS / CFs to Scientific Departments

Technological domain	Core Facilities	Heads	Departements
Omics, Proteomics and Single Cell	Biomics	Marc Monot	Genomes and Genetics
	Mass Spectrometry for Biology UTechS	Julia Chamot-Rooke Mariette Matondo	Structural Biology and Chemistry
	Metabolomics	Sandrine Aros	Microbiology
	Cytometry and Biomarkers UTechS	Milena Hasan Sophie Novault	Immunology
Multiscale imaging	Photonic Bio-Imaging UTechS	Spencer Shorte Nathalie Aulner	Cell Biology and Infection
	Ultrastructural Bio-Imaging UTechS	Guillaume Dumenil	Cell Biology and Infection
	Nano-Imaging	Matthijn Vos	Structural Biology and Chemistry
	Image Analysis Hub	Jean-Yves Tinevez	Cell Biology and Infection
Nanobody discovery, Protein production, Molecular Biophysics and Structural Biology	Production and Purification of Recombinant Proteins	Stéphane Pêtres	Structural Biology and Chemistry
	Antibody Engineering	Pierre Lafaye	Structural Biology and Chemistry
	Molecular Biophysics	Patrick England	Structural Biology and Chemistry
	Crystallography	Ahmed Haouz	Structural Biology and Chemistry
	Biological NMR	Iñaki Guijarro	Structural Biology and Chemistry
Screening, Microfluidics and organ on chips	Chemogenomic and Biological screening	Fabrice Agou	Structural Biology and Chemistry
	Biomaterials and Microfluidics	Samy Gobaa	Developmental and stem cell biology
	Diagnostic Test Innovation & Development	Thierry Rose	—
Scientific computing	High Performance Computing	Youssef Ghorbal	—

Location of UTechS / CFs



Cytometry and Biomarkers UTechS
27 • 1st floor - 01 & 02

Biomics
14 Veil wing • ground floor - 04

Biomaterials and Microfluidics
27 • 2nd floor - 06A

Biological NMR
22 • ground floor - 17

Metabolomics
27 • 2nd floor - 04E / 04F

Mass Spectrometry for Biology
26 • 2nd floor - 09B

Ultrastructural Bio-Imaging
26 • ground floor - 04A

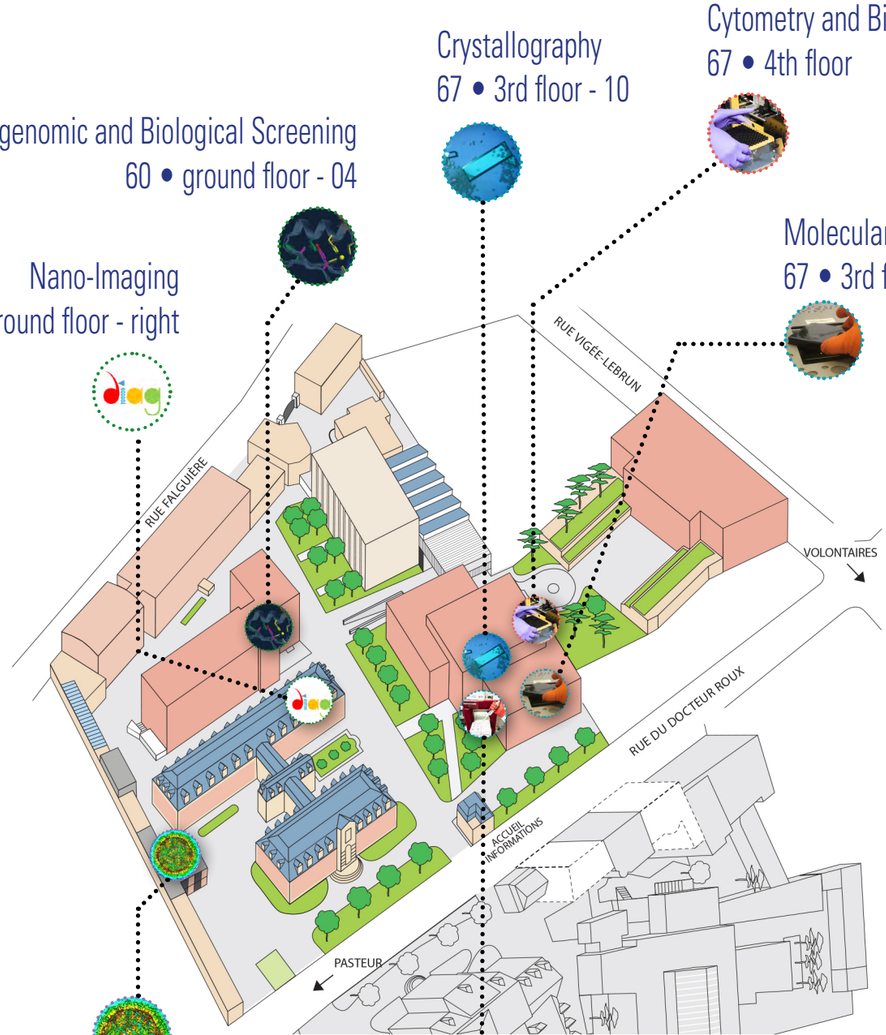
Image Analysis Hub
26 • 1st floor - 17B

Photonic Bio-Imaging
26 • 1st floor

Data management
25 • 1st floor

High Performance Computing
25 • 1st floor

Antibody Engineering
12 • 1st floor - 03



Chemogenomic and Biological Screening
60 • ground floor - 04

Crystallography
67 • 3rd floor - 10

Cytometry and Biomarkers CF
67 • 4th floor

Molecular Biophysics
67 • 3rd floor - 07

Nano-Imaging
55 • ground floor - right

Nano-Imaging
55 • ground floor - right

Production and Purification of Recombinant Proteins
67 • 1st floor - 05

TO FIND OUT MORE ABOUT

The Center for Technological Resources and Research (C2RT)

- research.pasteur.fr/center/C2RT
- c2rt@pasteur.fr

The Center for Animal Resources and Research (C2RA)

- research.pasteur.fr/center/C2RA
- c2ra@pasteur.fr