

IP Paris Interdisciplinary Center

Biomedical Engineering (BME)

*Engineering and Mathematical Sciences in Biology
and Medicine (EMSBM)*

*Conseil d'administration du 7 juillet 2021
Pièce n°11*



IP Paris Interdisciplinary Center

Emblematic banner for and the point of entry to IP Paris' interdisciplinary activities at the crossroads of physical and engineering sciences on the one hand and life sciences on the other. The Center will **allow us to leverage the strengths of IP Paris in quantitative sciences to shape the future of life sciences and medicine.**

Ambition

To become **the entity of reference** in interdisciplinary quantitative biology and medicine in France and one of the leading such centers in Europe

Center Vision



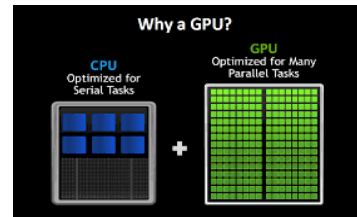
flexible electronics



artificial intelligence



3D bioprinting



ultra rapid computing



nanoscience &
nanotechnology



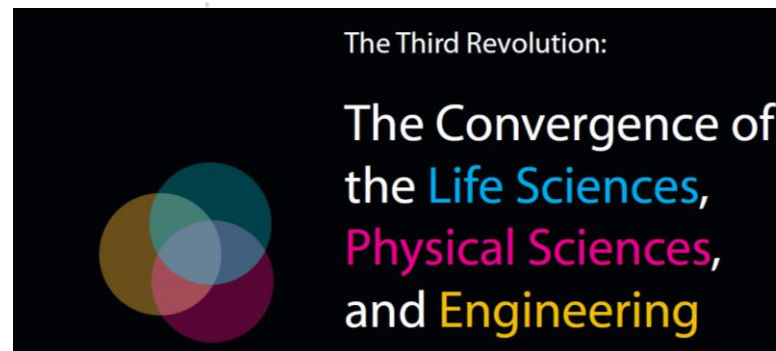
connected devices



Ongoing revolution in biology and medicine

Need appropriately trained students and postdocs

Center Vision



MIT report, 2011

This report is presented to the health science research community to help delineate an important new research model—convergence—which draws on an ongoing merger of life, physical and engineering sciences.

4. RECOMMENDATIONS	28
1. ENSURE THAT CONGRESSIONAL FUNDING MEETS OR BEATS BRDPI, NIH'S BIOMEDICAL RESEARCH INFLATION METRIC, ANNUALLY.	28
2. ESTABLISH A CONVERGENCE ECOSYSTEM BY BUILDING CONNECTIONS ACROSS STOVEPIPED SYSTEMS.	28
3. REFORM PEER-REVIEW PROCESSES TO SUPPORT INTERDISCIPLINARY GRANTS.....	29
4. BALANCE LARGE-SCALE EFFORTS WITH SMALLER GRANT PROJECTS.	30
5. IMPROVE INTERDISCIPLINARY RESEARCH AMONG THE 27 NIH INSTITUTES AND CENTERS.	30
6. EDUCATE, EXPAND, AND SUPPORT THE NEXT GENERATION OF CONVERGENCE RESEARCHERS.....	30

A Bit of Benchmarking

- Imaging
- Biomechanics
- Biophysics
- Sensors and Devices
- Biomaterials
- Modelling/Bioinformatics
- Biology and biochemistry

Imperial College London

Bioengineering
49 faculty



MIT

Biological Engineering +
Institute for Medical
Engineering & Science

40 faculty



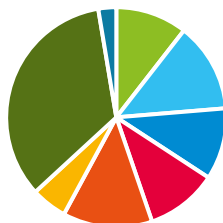
UC Berkeley

Bioengineering
35 faculty



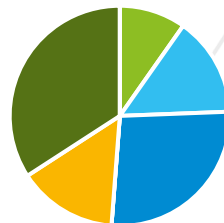
EPFL

Institute of
Bioengineering
38 faculty



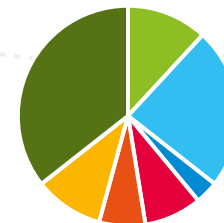
Stanford University

Bioengineering
41 faculty



UC San Diego

Bioengineering
59 faculty



Center Missions

- To provide a clearly identifiable “structure” (a “one-stop shop”) that fosters intersdisciplinarity in the application of the engineering and mathematical sciences to biology and medicine.
- To attract outstanding doctoral students and postdoctoral fellows from around the world who will enable and shape revolutionary changes in biology and medicine.
- To address important societal challenges in biology and medicine using a highly interdisciplinary approach based on engineering and physical sciences.
- To catalyze and facilitate collaborations between our faculty/students and partners from the life science and medical communities.

Examples of Societal Challenges

- **Personalized medicine** - bioinformatics, gene therapy, patient-specific biomechanics, patient-specific imaging, digital twin organisms
- **AI for life sciences and health** - predictive biology/health, connected medicine, bioinformatics, biological/biomedical data mining, biological/biomedical pattern recognition
- **Advanced epidemiological modeling** - viral dynamics, cellular/bacterial population dynamics, growth of small populations, emergence of mutations, antibiotic/drug resistance
- **Multiscale characterization of patho-physiological cells, tissues, and organs** - bench-to-bedside biophotonics and advanced optical imaging
- **Advanced tissue regeneration and organ repair** - mechanobiology, tissue engineering, augmented surgery, 3D bioprinting, organ-on-chip systems

Why IP Paris?

- Outstanding student quality and rigorous training in physical and mathematical sciences
- Track record of impactful research
- Unique teaching/training environment
- Stellar academic innovation and entrepreneurship ecosystem

IP Paris Strengths: Research Personnel

65 faculty members from 12 labs

BIOC - biology

CMAP - modeling

LadHyX - biomechanics, sensors & devices

LIX - bioinformatics

LMS - biophysics, biomaterials, modeling

LOA - biophysics

LOB - imaging, biophysics, sensors and devices, biology and biochemistry

LTCI - imaging, modeling

PICM - imaging, biophysics

PMC - biomechanics, biophysics, biomaterials, modeling

SAMOVAR - imaging, modeling

UME - biomechanics, robotics

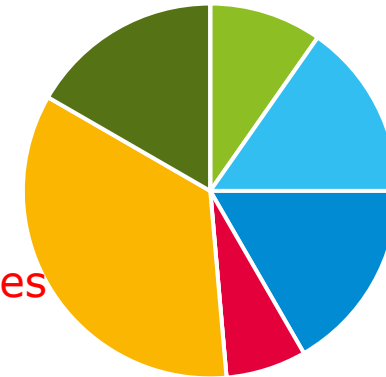
■ Imaging

■ Biomechanics

■ Biophysics

■ Sensors and Devices

■ Modelling/Bioinformatics



IP Paris Strengths: Research Infrastructure (in addition to laboratory facilities)

- *Morphoscope microscopy facility (Equipex grant)*
- *Leducq Cellular Imaging Facility (Fondation Leducq grant)*
- *Biomechanics Lab (Fondation Leducq grant)*
- *Living Lab in Drahi-X center (EUR BERTIP)*
- *Electron microscopy center (CIMEX)*
- *Computational facilities/clusters*



IP Paris Strengths: Teaching/Training

*Life Sciences **PhD Track** with 3 sub-tracks: Mathematics of Living Systems, Biomechanics and Biomedical Engineering, and Biology and Interfaces*

*France's first **doctoral program** in Biomedical Engineering (BME) supported by the EUR BERTIP*

*A new **Mechanics for Clinicians master's program** launched this year in collaboration with the Université de Paris*

*A **BME module** within Ecole polytechnique's **Executive Master's program***

***Ingénieur généraliste** dans le numérique – **parcours Santé** (Télécom SudParis)*

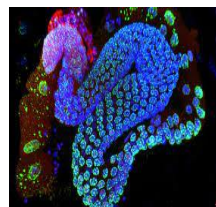
IP Paris Strengths: Chairs/Large Grants



Ingénierie
cellulaire
cardiovasculaire



Synergy grant
HOPE



France Bioimaging



Programme
d'innovation
d'ingénierie
biomédicale



EUR BERTIP



Morphoscope



SANOFI

Innovation
numérique et
sciences des
données en santé

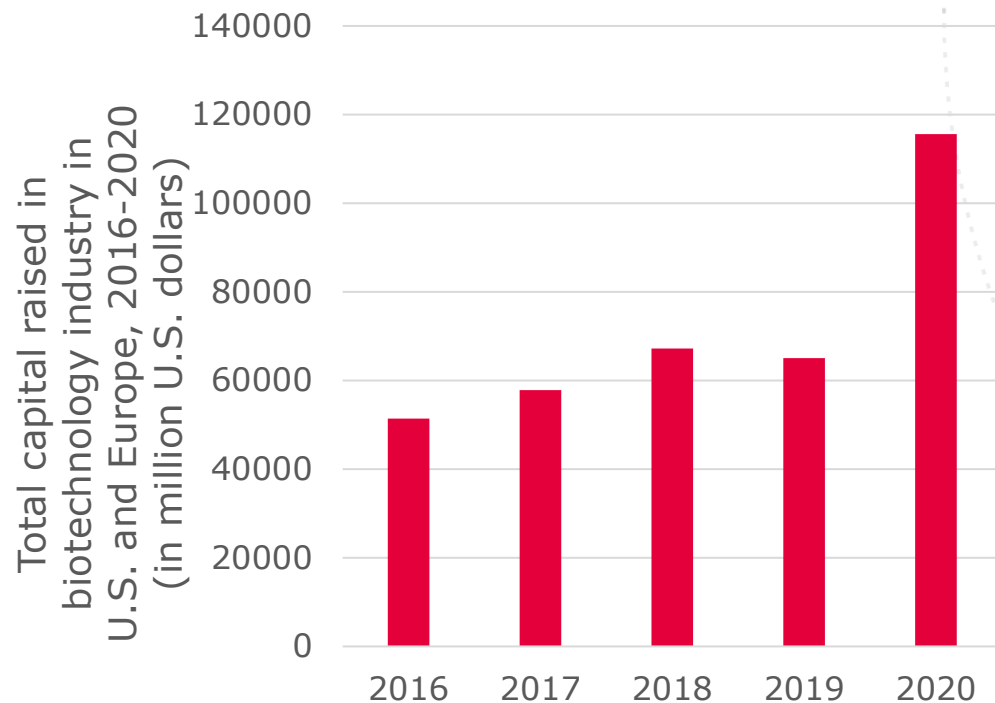


Reconstruction
personnalisée du
processus tumoral



Modélisation
mathématique et
biodiversité

IP Paris Strengths: Innovation/Technology Transfer



Cardiologs
AI serving cardiology

Founded: 2014
Employees: 68
Funds raised:
~19 M€

SENSOME

Founded: 2014
Employees: 22
Funds raised:
~17 M€

stilla

Founded: 2013
Employees: 84
Funds raised:
~34 M€

OKOMERA

Founded: 2020
Employees: 6

LumediX

Founded: 2018
Employees: 8

Key Academic Partners

- Basic Science:
 - Inria
 - CNRS/Inserm
 - Neurospin (possibly) – CEA, cerebral imaging
 - EuroTech Alliance
 - UC Berkeley
- Medicine:
 - *Groupe Hospitalier Paris St. Joseph (GHPSJ)*
 - Columbia University Medical School (leverage Alliance program) – presentation to Columbia provost soon

IP Paris-GHPSJ Strategic Partnership

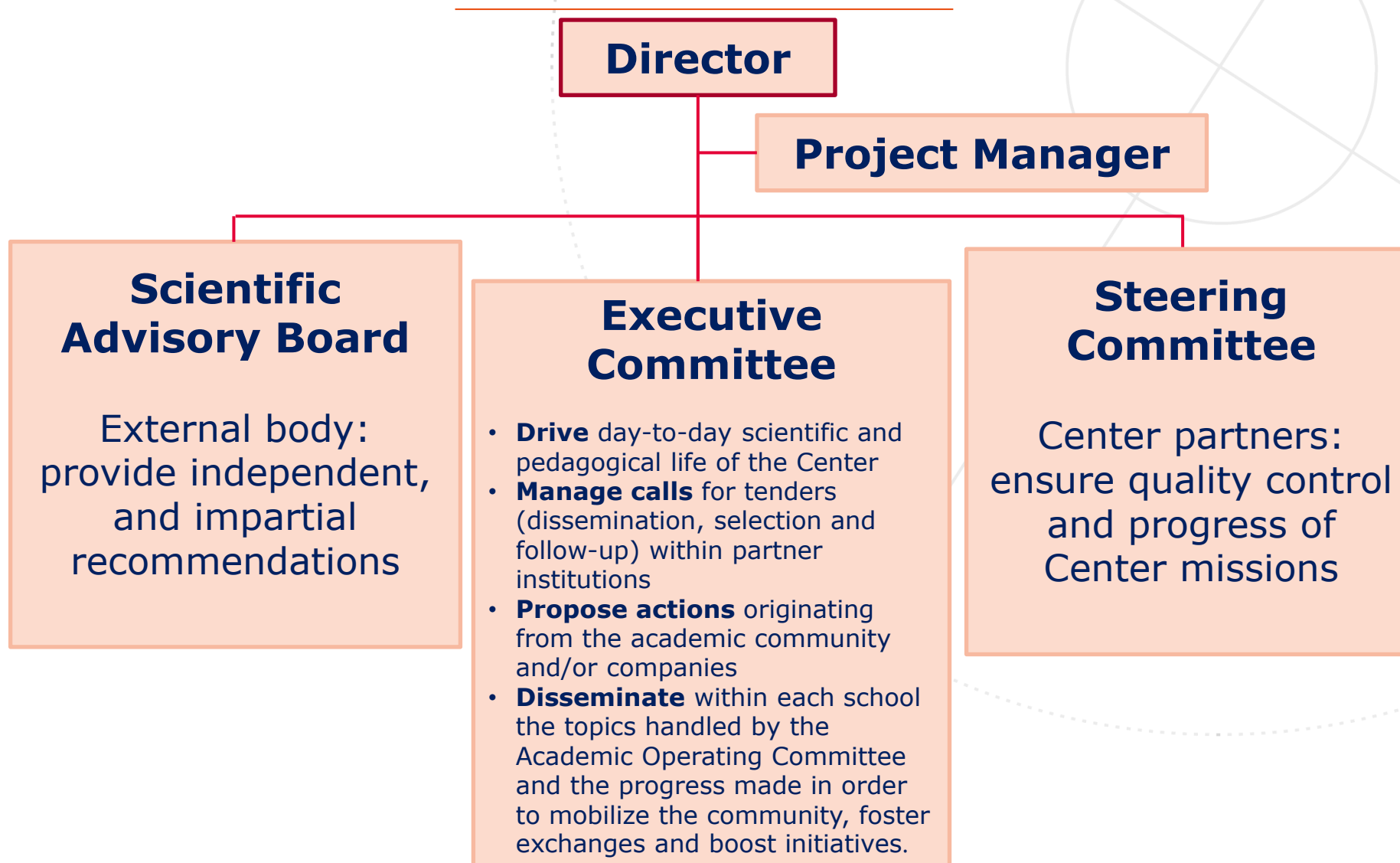
3 concrete actions:

- Involvement of GHPSJ in IP Paris teaching and student supervision
- Medical Fellows Research Program – 1- to 2-year funded research fellowship in IP Paris labs for GHPSJ physicians
- Joint research teams - GHPSJ-to-IP Paris & IP Paris-to-GHPSJ



- Platform for surgery and animal housing
- Education platform
- Dedicated team for clinical trial management
- Full floor dedicated to external partners:
 - 6 x 60 m² modules
 - Core facilities

Center Governance



Center Budget

Annual Budget: Target: ~10 M€/year

- **Personnel**

- Center permanent personnel: ~500 k€
 - Project manager
 - Developmental engineers (experimental and computational)
 - Industrial liaisons/fundraising
 - Purchasing
 - Communications
- Center faculty salaries: ~1 M€ (10 in steady state)
- PhD fellowships: ~2 M€ (20/year)
- Postdoc and medical fellowships: ~3 M€ (30/year)
- Master's internships: ~250 k€

- **Equipment/infrastructure:** ~1 M€

- **Faculty seed grants:** ~600 k€

- **New faculty startup packages:** ~600 k€

- **Operating expenses:** ~300 k€

Potential Industrial and Foundation Partners

Pharmaceutical

Sanofi, Servier, GSK,
Roche, Bayer

Cosmetics

L'Oreal, LVMH

Medical Devices/Imaging systems

Medtronic, GE Healthcare, Siemens
Medical, Sinomed, Biomerieux, Philips,
Eurofins,
Zeiss

Agrifood

Bayer Crop Science,
Nestle, Danone, Limagrain

Insurance

AXA, Generali, CNP
Assurances

Software

Dassault Systemes,
ANSYS

Foundations

Fondation Bettencourt-
Schueller, Fondation Leducq,
Fondation , Fondation
Dassault Systemes, Fondation
Lefoulon-Dellalande

Other

BASF, Getinge, Orange
Healthcare

VCs

Kurma Partners, Truffle
Capital

Quick Personal Biography

- **Education**

- North Carolina State University: BS Nuclear Engineering (1985)
- MIT: MS Nuclear Engineering (1988)
- MIT: PhD Biofluid Mechanics (1994)

- **Academic Positions**

- University of Chicago: NIH Postdoctoral Fellow, Biomedical Engineering (1994-1995)
- UC Davis: Assistant Professor, Mechanical & Aerospace Engineering (1995-2001)
- UC Davis: Associate Professor, Mechanical & Aerospace Engineering (2001-2006)
- UC Davis: Professor, Mechanical & Aerospace Engineering (2006-2012)
- UC Davis: Founding faculty member, Department of Biomedical Engineering (2002)
- Ecole Polytechnique: CNRS Director of Research (LadHyX) and Professor of Mechanics and Biology (2010-present)
- Ecole Polytechnique: Holder of AXA Chair in Cardiovascular Bioengineering (2010-present) and Bettencourt Chair in Biomedical Innovation (2018-present)
- University of New South Wales, Sydney, Australia: Adjunct Professor (2017-present)

- **Research, teaching, and innovation in cardiovascular biomechanics and bioengineering**

Thank You!