2nd SYMPOSIUM
ON THE CONNECTION BETWEEN PHYSICS AND METABOLISM IN BRAIN FUNCTIONS

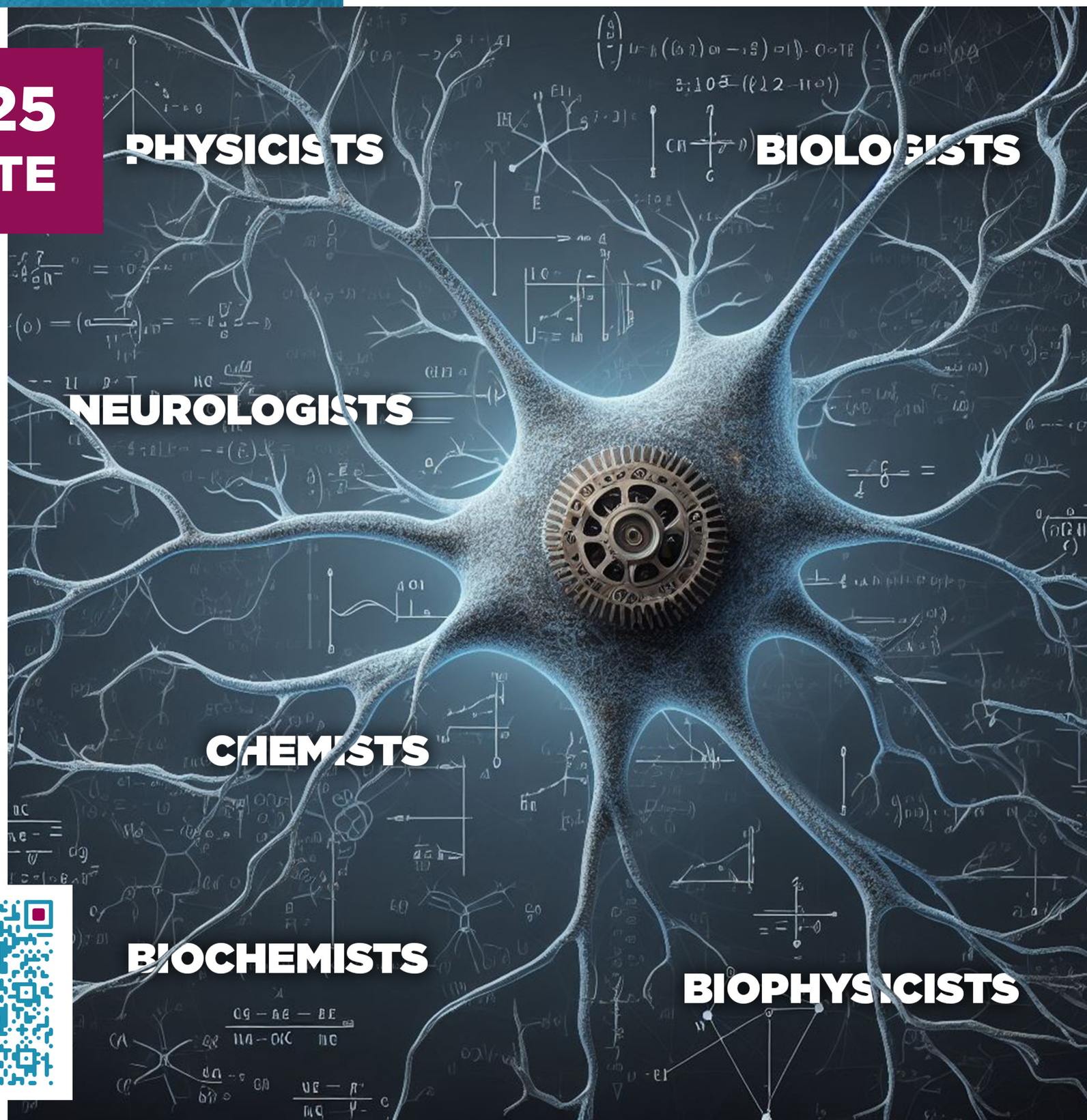
Fanny Mochel,
Professor of Medical Genetics and Neurometabolism,
ICM & Sorbonne University, Paris

Angeles Garcìa-Cazorla,
Professor of Neuropediatrics and Neurometabolism,
SJD & University of Barcelona

NOVEMBER 7, 2025
PARIS BRAIN INSTITUTE

This conference will also be broadcast live to allow a large audience.

Metabolism and cellular mechanics are closely intertwined. Following the success of the 1st international symposium connecting physics and metabolism in brain functions (Barcelona, July 2024), we are pleased to welcome you in Paris for this 2nd edition. This event will bring together world experts in physics, chemistry, neurobiology, and philosophy with the aim of fostering new collaborations and promoting the so-called “night science”, an interdisciplinary approach by which new ideas arise and questions/ hypotheses are generated. Join us and interact with prestigious speakers who will discuss the physics of cellular trafficking, neurotransmission, sensory systems, and beyond. The symposium will also integrate musical pieces to deepen our quest for understanding the living.



REGISTRATION FEES

20€ (online) - **30€** (in-person)
for the one-day symposium

Link to the registration

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Moderators: Fanny Mochel, Angeles García-Cazorla, Adrien Hallou

Artist coordination: Maya Tchikviladze

Meeting facilitator: Juliana Ribeiro Constante

↘ Session 1 – Introductory talks

9:00-9:15 am.
Welcome and opening remarks

Stéphanie Debette (ICM executive director)

Anne-Geneviève Marcelin (Vice-dean of research, Sorbonne University)

9:15-9:45 am.
Why neurometabolism needs the contribution of physics?

Fanny Mochel (Sorbonne University and Paris Brain Institute, Paris, France)

Angeles Garcia-Cazorla (Universitat de Barcelona and Sant Joan de Déu Hospital, Barcelona, Spain)

9:45-10.30 am.
From the primordial universe to the human mind

Sylvie Vauclair (Astrophysicist at IRAP - Institut de Recherches en Astrophysique et Planétologie - Midi-Pyrénées observatory, Emeritus Professor at University of Toulouse and member of Institut universitaire de France)

COFFEE BREAK 10:30–11:00 AM

↘ Session 2 - Physics of cellular trafficking and membrane biology

11:00-11:30 am.
Progression of glioblastoma involves alterations of the mechanobiology of extracellular matrix fibers

Viola Vogel (Department of Health Sciences and Technology and Head of the Applied Mechanobiology Laboratory, Zürich, Switzerland)

11:30 am-12:00 pm.
Membrane chemical biology - Spotlight on lipids

Andre Nadler (Max Planck Institute of Molecular Cell Biology and Genetics, Dresden, Germany)

12:00-12:30 pm.
Tissue mechanics control mitochondrial shape and cellular metabolism

Sirio Dupont (Department of Molecular Medicine, University of Padova, Padova, Italy)

12:30-12:45 pm.
TANGO2 deficiency: connection between energy metabolism and membrane dynamics

Alfonso de Oyarzábal (University Abat Oliba CEU and Sant Joan de Déu Hospital, Barcelona, Spain)

LUNCH 12.45– 2.00 PM

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Session 3
Physics of neurotransmission

2:00 -2.30 pm.
What do we know regarding biophysics of dopamine production?

Aurora Martinez (Department of Biomedicine, University of Bergen, Norway)

2.30-3:00 pm.
How can biophysics help us bridge neurotransmission systems?

Laurent Groc (Head of the Team Developmental Brain Physiology and Pathology, Director of the Interdisciplinary Institute for Neuroscience, Bordeaux, France)

3:00-3:15 pm.
Clinical flash – How clinical observations can help us bridge neurotransmission systems?

Angeles Garcia-Cazorla (Universitat de Barcelona and Sant Joan de Déu Hospital, Barcelona, Spain)

COFFEE BREAK 3:15–3:45 PM

Session 4 - Physics of sensory systems

3:45-4:15 pm.
How mechanotransduction of somatosensory circuits drive brain development?

Francisco Martini (Instituto de Neurociencias de Alicante, Universidad Miguel Hernández-Consejo Superior de Investigaciones Científicas (UMH-CSIC), Sant Joan d'Alacant, Spain)

4:15-4:45 pm.
How mechanotransduction of spinal sensory circuits drive locomotion and morphogenesis throughout life?

Claire Wyart (Navigation, sensorimotor integration brain & body integration lab, Paris Brain Institute, Paris, France)

Closing lecture

4:45-5:15 pm.
Reduction, emergence, and the physics of the brain: a philosophical perspective

Stephan Hartmann (Munich Center for Mathematical Philosophy, Munich, Germany)

5.15-5.30 pm.
Closing remarks

Fanny Mochel (Sorbonne University and Paris Brain Institute, Paris, France)

Angeles Garcia-Cazorla (Universitat de Barcelona and Sant Joan de Déu Hospital, Barcelona, Spain)

CHAMPAGNE COCKTAIL

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↘ Meet the speakers

Fanny Mochel

Geneticist, Pitié-Salpétrière Hospital and Sorbonne University, Paris, France

Angeles Garcia-Cazorla

Child neurologist, Sant Joan de Déu Hospital and Universitat de Barcelona, Spain

Why neurometabolism needs the contribution of physics?
Our symposium in a few words:

This symposium bridges the gap between physics and neuroscience to explore how the fundamental laws of mechanics, chemistry, and energy govern brain metabolism. We will delve into the physical principles underlying cellular trafficking, neurotransmission, and sensory systems, revealing how these processes shape brain function in health and disease, and ultimately challenge our understanding of consciousness itself.

Sylvie Vauclair

Astrophysicist, Midi-Pyrénées Observatory and Paul-Sabatier University of Toulouse, France

From the primordial universe to the human mind

↘ My talk in a few words:

Our scientific knowledge about the place of human beings in the Universe has jumped forward in an impressive way over the past hundred years. My talk will explore how we are faced with the greatest «strange loop» of all time: living beings have developed a cerebral system capable of discovering their own origins.

Viola Vogel

Biophysicist, Department of Health Sciences and Technology, ETH Zurich, Germany

Progression of glioblastoma involves alterations of the mechanobiology of extracellular matrix fibers

↘ My talk in a few words:

Research has long shown that cancer progression increases tissue stiffness through ECM (extracellular matrix) fiber crosslinking, but changes in ECM fiber tension remained unclear. After validating a peptide tension sensor, my team demonstrated in human glioblastoma cryosections that disease progression causes regions where fibronectin fibers lose tension. This loss reshapes microenvironmental niches impacting both immune and cancer cells.

Andre Nadler

Chemist, Max Planck Institute of Molecular Cell Biology and Genetics, Dresden, Germany

Membrane chemical biology - Spotlight on lipids

↘ My talk in a few words:

Lipids are central to life, forming organelle membranes, driving signaling, and storing energy. Yet, tools to visualize lipids at high resolution were lacking. In this talk I will discuss presents new lipid imaging techniques that solve this challenge and reveal the primary mechanisms of intracellular lipid transport.

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Sirio Dupont

Biologist, Department of Molecular Medicine, University of Padova, Italy

Tissue mechanics control mitochondrial shape and cellular metabolism

↘ My talk in a few words:

Cells sense their environment, with ECM cues, adhesion, and geometry shaping proliferation and differentiation. I will talk about how mechanotransduction also impacts metabolism by altering mitochondrial structure. Mitochondria thus act as signaling hubs coordinating transcription factor activity.

Aurora Martinez

Biochemist, Department of Biomedicine, University of Bergen, Norway

What do we know regarding biophysics of dopamine production?

↘ My talk in a few words:

Dopamine synthesis depends not only on biochemistry but also on biophysical forces like structural dynamics and energy transfer. I will highlight recent insights into how proteins and metabolites interacting with tyrosine hydroxylase regulate dopamine production, emphasizing the biophysical methods enabling these discoveries.

Laurent Groc

Neurobiologist, Interdisciplinary Institute for Neuroscience, Bordeaux, France

How can biophysics help us bridge neurotransmission systems?

↘ My talk in a few words:

Single-molecule imaging has transformed our view of neuronal communication in health and disease. I will describe how these methods uncovered the role of NMDA receptors in tuning synaptic transmission under normal and pathological conditions, and how nanoscale probing of the extracellular space reveals dynamic biomolecular processes.

Francisco Martini

Neurobiologist, Institute of Neuroscience, UMH-CSIC, Alicante, Spain

How mechanotransduction of somatosensory circuits drive brain development?

↘ My talk in a few words:

My research investigates how thalamocortical circuits grow and refine during development. Combining molecular, genetic, and imaging tools, his team studies the role of activity and gene programs in connectivity and sensory maps. They also explore plasticity in response to deprivation or injury, with implications for reprogramming.

Claire Wyart

Biophysicist and neurobiologist, Paris Brain Institute, France

How mechanotransduction of spinal sensory circuits drive locomotion and morphogenesis throughout life?

↘ My talk in a few words:

Mechanotransduction in the spinal cord regulates posture during movement and shapes the spine over time. I will show how spinal mechanosensory systems act both by modulating motor neurons and relaying positional feedback to the brain. I suggest that aging-related postural changes may arise from interactions of mechanical and chemical signals in the spinal cord.

Stephan Hartmann

Philosopher, Munich Center for Mathematical Philosophy, Germany

Reduction, emergence, and the physics of the brain: a philosophical perspective

↘ My talk in a few words:

How far can physics take us in explaining the brain? My talk explores the tension between reduction and emergence in brain metabolism, showing how physical laws constrain – but do not exhaust – the explanatory frameworks we need for understanding cognition and consciousness.

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