



July 5th,  
2024



9:00 AM - 17:00 PM



SJD Barcelona  
Children's Hospital



**SJD Barcelona Children's Hospital**

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# 1<sup>st</sup> SYMPOSIUM CONNECTION BETWEEN PHYSICS & METABOLISM IN BRAIN FUNCTION

**JULY 5, 2024  
BARCELONA**

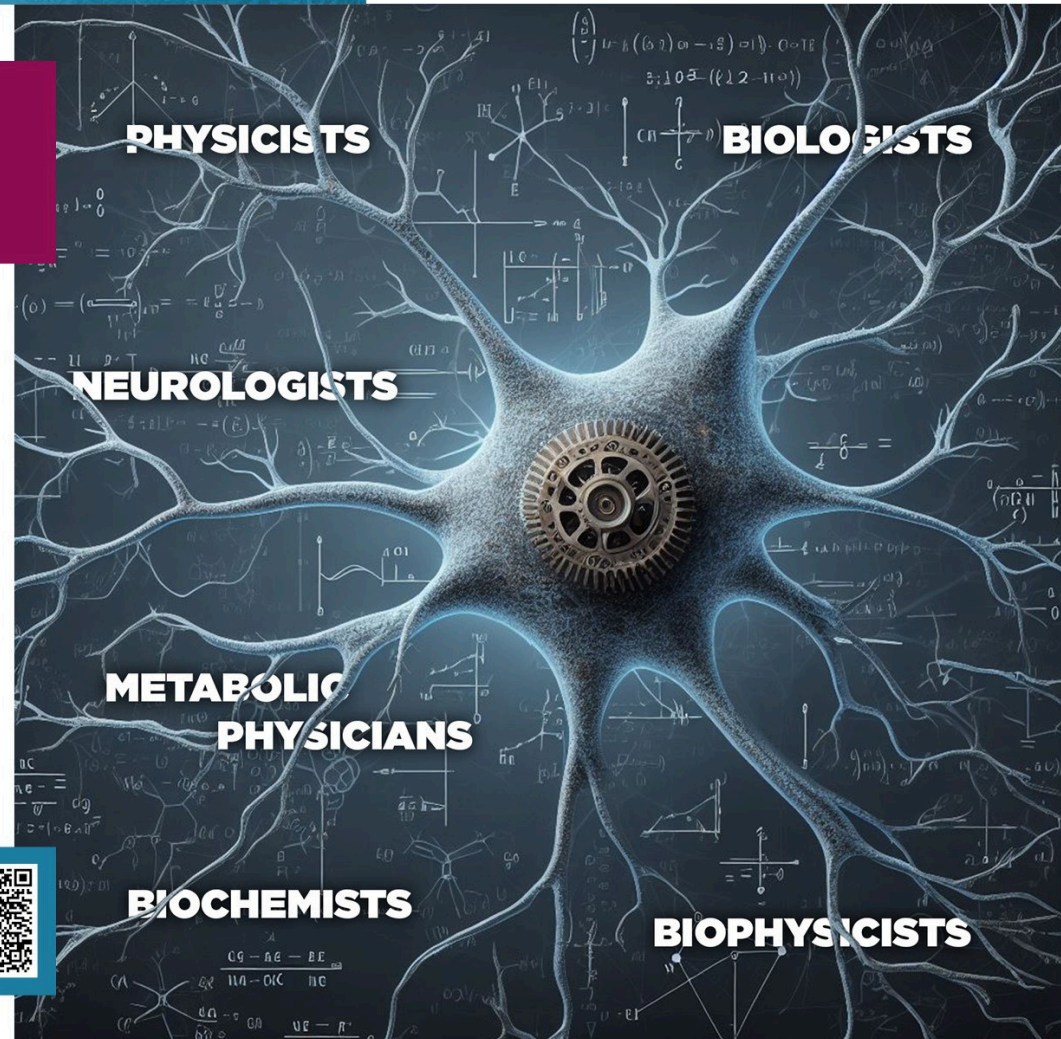
📺 This conference will also be broadcast live.

The laws of physics govern essential metabolic processes such as cell mechanics, membrane dynamics, neuronal signaling, and cell bioenergetics. This international symposium will bring together for the first time world experts in physics and neurobiology to better understand the mechanisms underlying these metabolic processes in the brain, with the aim of fostering new interdisciplinary collaborations. Join us and interact with prestigious speakers who will discuss the physics of life, the physics of metabolism and the physics of the brain!


## REGISTRATION FEES

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

[Link to the registration](#)



# FIRST SYMPOSIUM ON THE CONNECTION BETWEEN PHYSIC and METABOLISM in BRAIN FUNCTION

 July 5, 2024 - Barcelona

**Moderators:** Fanny Mochel, Angeles García-Cazorla, Adrien Hallou, Pau Gorostiza

**Brainstormers:** Leticia Pías Peleteiro, Alfonso Oyarzábal

**Artists:** Nicky Broekhuysen, Abel Coll and "Pianos Vius" and "amateur" artists

**Meeting facilitator:** Juliana Ribeiro Constante

## Session 1 – Introductory talks

**09:00 -9:30 am. Why neurometabolism needs the contribution of physics.**

Fanny Mochel (Pitié-Salpêtrière Hospital and Sorbonne University, Paris, France)


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

**09:30-10.00 am. Basic science concepts: Spatial mechano-transcriptomics.**

Adrien Hallou (Oxford University, Oxford, UK)

**10:00-10:30 am. Clinical concepts: Microtubules in neuropediatric disorders – Diagnostic and therapeutic opportunities.**

Stuart Hameroff (Center for Consciousness Studies, University of Arizona, Tucson, USA)

10:30 - 11:00 h. Break 

## Session 2 - Physics in biology

**11:00-11:30 am. The physics of life: Assembly theory quantifies novelty and intelligence.**

Lee Cronin (University of Glasgow, Glasgow, UK)

**11:30 am-12:00 pm. The physics of metabolism: Computational approaches to model cellular metabolism and to obtain insight from metabolic data.**

Marta Sales-Pardo (Universitat Rovira i Virgili, Tarragona, Spain)

**12:00-12:30 pm. The physics of the brain: Mechanics in the nervous system.**

Eva K. Piliñai (European Molecular Biology Laboratory, Heidelberg, Germany and Pasteur Institute, Paris, France)

12:30 -02:00 h. Lunch. 

## Session 3: Metabolic pathways and dynamics

**02:30 -02:30 pm. Neurotransmission: Dynamic regulation of presynaptic function and plasticity in health and disease.**

Nils Brose (Max Planck Institute, Göttingen, Germany)

Fran López Murcia (IDIBELL, Universitat de Barcelona, Spain)

**02:30-03:00 pm. Cell trafficking: Microtubule cytoskeleton and intracellular transport.**

Anne Straube (Centre for Mechanochemical Cell Biology, University of Warwick, Coventry, UK).

**03:00-03:30 pm. Endocytosis: Some membrane biophysics insights on endocytic processes.**

Patricia Bassereau (Institut Curie and Sorbonne University, Paris, France)

15:30 - 16:00 h. Break.



## Session 4: Practical applications of physics in brain functions

**04:00-04:30 pm. A contribution from physics to revealing nanoscale dynamic processes in the brain.**

Laurent Cognet (Institut d'Optique d'Aquitaine, Université de Bordeaux, Bordeaux, France)

**04:30-05:00 pm. Mechanomodulation of brain ageing.**

Kevin Chalut (Altos Labs Cambridge Institute of Science, Cambridge, UK)

## Closing session

**05:00-05:30 pm. Where do we go from today's symposium? Suggestions for future collaborations.**

Fanny Mochel, Angeles Garcia-Cazorla, Adrien Hallou, Pau Gorostiza, Leticia Pías Peleteiro, Alfonso Oyarzábal

## Cocktail

With the endorsement of

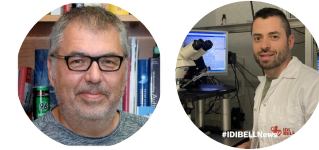
**SSIEM**



MetabERN, ERN-RND,  
EpiCARE





**Nils Brose**

Max Planck Institute, Göttingen, Germany

**Fran López Murcia**

IDIBELL, Universitat de Barcelona, Spain

**Dynamic regulation of presynaptic function and plasticity in health and disease**My talk in a few words

The process of synaptic vesicle priming is an essential determinant of synapse function, strength, and plasticity, because it maintains a pool of readily releasable vesicles at any given time and determines the time course of synaptic fatigue and recovery. The corresponding forms of synaptic short-term plasticity determine multiple complex brain functions, from sensory adaptation to working memory. Our talk will summarize the underlying molecular mechanisms and disease-related aberrations.

**Anne Straube**

Centre for Mechanochemical Cell Biology, University of Warwick, Coventry, UK

**Microtubule cytoskeleton and intracellular transport**My talk in a few words

I will summarize what we know about microtubule organization in neurons, intracellular transport and the regulation of motors. I will describe how transport cargoes can move in both directions and talk about mutations in motors that cause hereditary spastic paraplegia.

**Patricia Bassereau**

Institut Curie and Sorbonne University, Paris, France

**Some membrane biophysics insights on endocytic processes**My talk in a few words

Synaptic transmission involves the constant formation of new synaptic vesicles through endocytosis, after their fusion with the plasma membrane. Biophysical tools and concepts have contributed to understand the mechanisms by which proteins and membrane cooperate to form small buds and scission them. I will review some of the related work.

**Laurent Cagnet**

Institut d'Optique d'Aquitaine, Université de Bordeaux, Bordeaux, France

**A contribution from physics to revealing nanoscale dynamic processes in the brain**My talk in a few words

I will show how the combination of single-molecule optical microscopy approaches with the co-development of near-infrared emitting nanoparticles and analytical methods derived from super-resolution microscopy, has enabled us to shed new light on the dynamic molecular organization of brain molecules and structures, with a particular focus on the extracellular space of living brain tissue in healthy and pathological conditions.

**Kevin Chalut**

Altos Labs Cambridge Institute of Science, Cambridge, UK

**Mechanomodulation of brain ageing**My talk in a few words

The extracellular matrix (ECM) changes in the brain with ageing and disease. I will discuss how a healthy ECM in the brain could support brain health. I will also discuss how the ECM changes with age and disease, and address evidence that those changes in the matrix lead to loss of function and exacerbate disease states.

**Meet the speakers****Fanny Mochel**

Pitié-Salpêtrière Hospital and Sorbonne University, Paris, France

**Angeles Garcia-Cazorla**

Sant Joan de Déu Hospital and Universitat de Barcelona, Spain

**Why neurometabolism needs the contribution of physics**Our talk in a few words

As the number of inherited metabolic diseases affecting cellular trafficking and membrane dynamics keeps expanding (>350), our attention came to the key role of physical processes in brain functions. We propose that physical studies of cell mechanics, neuronal signaling, and cell bioenergetics in the brain will provide critical insights in the understanding of neurometabolism and rare diseases affecting brain metabolism.

**Adrien Hallou**

Oxford University, Oxford, UK

**Spatial mechano-transcriptomics**My talk in a few words

I propose a new computational framework that enables the joint statistical analysis of transcriptional and mechanical signals at single cell resolution in the context of spatial transcriptomics. Applying this framework to the developing mouse embryo, we identify mechanical and gene expression signatures that are predictive of cell fate decisions and spatial patterning at the tissue and whole organism level.

**Stuart Hameroff**

Center for Consciousness Studies, University of Arizona, Tucson, USA

**Microtubules in neuropediatric disorders – Diagnostic and therapeutic opportunities**My talk in a few words

Psychotropic treatments are aimed at neuronal surface membrane receptors and synaptic functions but deeper, faster activities of cytoskeletal microtubules inside brain neurons (and glia?) play key roles in mood, cognition, and consciousness. Ultrasound (megahertz mechanical vibrations for imaging) has been used therapeutically to treat mental and cognitive disorders and may do so by resonating endogenous microtubule megahertz vibrations. I will discuss possible applications of low intensity transcranial ultrasound to treat pediatric developmental disorders.

**Lee Cronin**

University of Glasgow, Glasgow, UK

**Assembly theory quantifies novelty and intelligence**My talk in a few words

Assembly theory is a new theory that explains the emergence of evolution before evolution but also has applications in explaining evolution in biology, the emergence of complexity including brain structures and the ability to process information. Ultimately assembly theory should be able to quantify intelligence and novelty in information processing systems including the higher order abstractions formed by consciousness itself.

**Marta Sales-Pardo**

Universitat Rovira i Virgili, Tarragona, Spain

**Computational approaches to model cellular metabolism and to obtain insight from metabolic data**My talk in a few words

Computational approaches are powerful tools to study metabolism and to help integrate different types of data. I will discuss how the use network science and probabilistic approaches combined with metabolic reconstructions of cellular metabolism can be used to identify how external perturbations affect different metabolic pathways.

**Eva K. Pillai**

European Molecular Biology Laboratory, Heidelberg, Germany and Pasteur Institute, Paris, France

**Mechanics in the nervous system**My talk in a few words

I will present an overview of mechanical forces in the nervous system, including (a) mechanical signals encountered by the nervous system, (b) mechanisms of mechanotransduction, (c) mechanical regulation of various developmental processes and an example or two of mechanics in disease states.