26th meeting of the Club of Invertebrate Neurobiology

Dijon, April 23rd-24th, 2026

PROGRAM & ABSTRACT BOOK

Organizers: Pierre-Yves MUSSO & the GustaBrain team

(Gustation and Brain, Dijon)

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A scientific conference with an ecological focus

Since 1999, the Club of Invertebrate Neurobiology has played an active role in promoting knowledge derived from invertebrate models, which have made major contributions to the advancement of the biological and neuroscientific sciences.

This contribution is grounded in a fundamental observation: invertebrates represent the overwhelming majority of the animal kingdom. This group encompasses an extraordinary diversity, accounting for 90% of all animal species. Invertebrates play a crucial role in many biological and environmental processes, contributing to crop, forest, and livestock protection, as well as pollination, human health, and water quality. Through their diversity, their biological specificities, and the wide range of scientific questions they allow researchers to address, invertebrate models have become essential tools in scientific research.

This biological and scientific importance explains the central place they have occupied in the history of neuroscience. Invertebrate models have led to many major advances and continue today to provide essential insights into the cellular, genetic, molecular, and behavioural mechanisms of the nervous system.

The work presented during this meeting in Dijon reflects this richness and diversity. It spans a broad range of topics, from behavioural studies to cellular, genetic, and molecular approaches, including neurodevelopment, normal and pathological nervous system function, and ecology.

This meeting therefore provides a valuable opportunity to share the latest scientific and technological advances, while also fostering the development of collaborations at both national and international levels.

For more than a decade, climate change has been at the forefront of scientific research as well as political and public discourse. Like all sectors of our society, the research community is now being called upon to examine its practices and consider the changes required to reduce its carbon footprint. For several years now, there has been a growing body of work aimed at quantifying the environmental impact of research activities and better understanding the links between this impact, scientific practices, and research organizational models.

In this context, we felt it was essential to design the 26th Conference of the Club of Invertebrate Neurobiology in alignment with these challenges. **The goal is not only to limit the environmental footprint of this conference as much as possible, but also to contribute to a broader discussion on how to organize scientific events differently**. It is in this spirit that the **GustaBrain** laboratory has sought to implement various measures to make this conference as sustainable and responsible as possible, while also working to estimate its carbon footprint.

A key focus of this initiative is catering. **Our catering program is designed with a focus on quality, local sourcing, and waste reduction**. We have chosen to work with partners committed to environmentally friendly practices, prioritizing organic, local, and seasonal products, while paying special attention to waste reduction. In line with this, we have also made sure not to use disposable cutlery or glasses during meals.

Our primary caterer, **Ciboulette**, will offer fresh, balanced meals and buffets prepared using local ingredients. Their homemade cuisine relies on fresh, seasonal ingredients, with a strong focus on zero waste. The Ciboulette team takes pride in creating varied and flavorful dishes while minimizing product transportation as much as possible. Special attention is also given to dietary diversity, with options tailored for vegetarians, as well as gluten-free and lactose-free diets.

The second caterer selected is **La Fée Végée**, the first caterer in Burgundy to be certified organic for 100% of its recipes. This company is committed to creating dishes in which all agricultural ingredients are sourced from organic farming, in accordance with Level 3—the highest level—of the specifications for organic catering. In addition, the cuisine is entirely homemade, prepared exclusively from fresh, seasonal ingredients. This choice reflects our commitment to offering catering services that align with the ecological values promoted by this event.

We also wanted to highlight other local partners. **Le Moulin Bakery** will be part of this initiative. What sets it apart is its close connection to **Minoterie Forest**, a local flour mill—100% Burgundian—based in Bray, in the Saône-et-Loire land. Using flour milled on-site from 100% French wheat selected locally, Le Moulin Bakery will offer products made using traditional methods. This partnership fully aligns with our commitment to supporting local supply chains and quality products.

For the "apéritif", the cheese will come from the **Delin cheese shop**, located in Gilly-lès-Cîteaux, further reinforcing our desire to work with producers deeply rooted in the region.
The selected wines come from the **Ghislain Kohut estate**, located in the heart of Burgundy, in Couchey. Certified as a Level 3 High Environmental Value farm, this vineyard is representative of Burgundy, placing greater emphasis on its vines and soil than on its cellar, because here, more than anywhere else, it is the "climate" that makes all the difference (UNESCO). The soil, geologically very rich, is composed of clays and limestones that vary greatly from one plot to another. Each plot is tiny, which is quite specific to Burgundy vineyards. Similarly, the various appellations are planted exclusively with two grapevines cultivars: Pinot Noir for red and Chardonnay for white, with no blending. These two varieties are carefully selected by Ghislain, and some of his vines are nearly a century old! He thus produces several wines by vinifying each plot separately, to bring out its own distinct identity.

The lemonades served at the conference will be provided by **La Mortuacienne**, headquartered in Morteau, in the Doubs department of Franche-Comté. As an iconic local brand, it carries on a long tradition of artisanal craftsmanship. Since the bottles are returnable, this choice also aligns with a commitment to reuse and waste reduction.

Beyond catering, we wanted to incorporate other aspects of our operations into an initiative focused on reuse and reducing waste. For this purpose, coffee and tea breaks will feature **mugs and mazagrans** gathered from **La Recyclade**.

La Recyclade is a recycling center based in the Dijon region, whose mission is to collect, repurpose, and resell items that were originally destined for the trash. Founded in March 2016, the nonprofit organization champions a strong vision, summed up by its motto: "*Let's* *prove that waste can be a resource and create jobs.*" By partnering with this organization, we wanted to support a local initiative that combines waste reduction, the reuse of items, and social engagement.

In the same vein, the water carafes used throughout the conference will be provided by **Bocaux & Co**. **This circular economy project, developed across the Dijon metropolitan area, is dedicated to the reuse of jars**. Its activities are based on three pillars: the sale and rental of reused containers, the hosting of workshops on preserving food in jars, and the implementation of a shared deposit system for the sale of meals as part of a zero-waste approach. This partnership is fully in line with our commitment to prioritizing concrete reuse solutions.

As part of this **26th edition of the Invertebrate Neurobiology Club**, we wanted to assess the event's environmental impact to inform our discussions. To this end, we have created a questionnaire designed to estimate the carbon footprint of this gathering. **We invite each participant to take the time to fill it out individually and anonymously, and then to submit it to us before leaving**.

Everyone's participation is essential to obtaining results that are as representative and accurate as possible. The data collected will not only help us better assess the impact of this conference but also inform a broader discussion on practices to encourage for organizing more sustainable scientific events.

As this is the first initiative of its kind for our laboratory, we are also very interested in your comments and suggestions to help us improve this tool. We hope that, over time, this initiative can be expanded, strengthened, and shared with other laboratories wishing to engage in a similar reflection.

Finally, in an effort to minimize the use of resources, the lanyards and badges used at this conference were loaned to us by **INRAE** research institute and **Dutscher company**. We thank you in advance for returning them to us when you leave.

Through all of these choices, we have sought to make this conference part of an approach that is practical, consistent, and collaborative. Although this initiative alone cannot address all the environmental challenges posed today by the organization of research, it nonetheless demonstrates a sincere desire to do better, on our own scale, by rethinking certain practices, prioritizing local stakeholders, and supporting more responsible practices. **We hope to contribute, modestly but fully, to a more sustainable way of organizing future scientific meetings**.

The GustaBrain team

Program

Thursday, April 23rd, 2026

13:00-14:00 **Greeting with coffee**

14:00-14:10 **Opening**

14:10-15:00 Invited conference 1: **Audrey Dussutour**, University of Toulouse, Center for Research on Animal Cognition (CRCA), Toulouse, France
"Learning Without a Brain: Evidence from Ciliates and the Slime Mold"

Session 1: Disease and immunity *(chair: Pierre-Yves Musso)*

15:00-15:15 **Léo Sillon**, GustaBrain lab, Dijon
When Microbe Taste Primes Innate Immunity

15:15-15:30 **Camille Dumas**, BFA lab, Paris
Influence of a neuronal regulatory subunit of vacuolar ATPases on Parkinson's disease pathogenesis studied in Drosophila models

15:30-15:45 **Ema Turki**, BFA lab, Paris
Evaluation of a novel regulatory axis of iron-sulfur cluster biogenesis in Drosophila as a potential therapeutic target for Friedreich's Ataxia

15:45-16:00 **Aishwarya Padmanabhan**, MNSB lab, Paris
Lifelong regulation of structural identity in locomotion-modulating dopaminergic neurons by homeodomain factors

16:00-16:20 **Coffee break**

Session 2: Memory *(chair: Pierre-Yves Musso)*

16:20-16:35 **Enisa Aruçi**, GustaBrain lab, Dijon
From neural circuits to behavior: Sweeteners reshape feeding in Drosophila

16:35-16:50 **Miguel Pavao Delgado**, Felsenberg lab, Basel
Creating true and false memories from forgotten information in Drosophila

17:05-17:20 **Claire Brossier**, Energy & Memory, Paris
Mitochondrial calcium regulates neuronal mitochondrial metabolism to sustain long-term memory formation

17:20-17:35 **Nesrine Merabet**, Perisse lab, Montpellier
Hypercapnic stress modulation of aversive value coding in Drosophila

17:35-17:50 **Bastien Lemaire**, Centre d'Etude en Ethologie et Cognition, Caen
Innate sensitivity to animacy cues and early experience with congeners shape predatory behaviour

17:50-18:10 **Club general assembly meeting**

18:10-20:00 **Aperitif-poster**

20:30-23:00 **Dinner at Cellier de Clairvaux**

Friday, April 24th, 2026

08:30-09:00 **Greeting with coffee**

Session 3: Cognition *(chair: Enisa Aruçi)*

09:00-09:15 **Anna Chrzanowska**, Brain Dev lab, Paris
Can lateralized circuits limit experience-dependent behavioral change in Drosophila?

09:15-09:30 **Matthias Durrieu**, *Ramdya lab, Lausanne*
Object manipulation and affordance learning in Drosophila

09:30-09:45 **Maria Villar**, Insect Cognitive Neuroethology lab, Paris
Dissecting Aminergic Contributions to Visual Discrimination Learning in Honey Bees Using a Virtual Reality Paradigm

09:45-10:00 **Catherine Macri**, Insect Cognitive Neuroethology lab, Paris
Serotonergic-dependent awareness is required for trace conditioning in honeybees

10:00-10:15 **Lydie Stoclet**, CRNL, Lyon
Sleep and neuroglial interactions in a critical period of the Drosophila olfactory system

10:15-10:40 **Coffee break**

Session 4: Sensory *(chair: Justin Flaven Pouchon)*

10:40-10:55 **Julie Vittet**, PERSING lab, Dijon
Balancing Pest Control and Pollinator Safety: Butyric and Propanoic Acids Impair Drosophila suzukii Reproduction While Preserving Honey Bee Cognition

10:55-11:10 **Julia Mariette**, EGCE, Paris
Sexual pheromone processing in the honey bee brain

11:10-11:25 **Hervé Cadiou**, INCI, Strasbourg
Behavioural and Molecular characterization of planarian nociception

11:25-11:40 **Eléonore Braun**, IEES, Paris
Role of a glutathione S-transferase in the olfactory system of Drosophila melanogaster

11:40-11:55 **Enrico Bertolini**, Auer lab, Fribourg
Evolution of taste processing shifts dietary preference

11:55-12:10 **Paul Clémençon**, IEES, Paris
Diversity pheromone temporal coding disruptions by plant volatiles

12:10-12:25 **Loris Garino**, IBDM, Marseille
Mapping neuronal circuits underlying oviposition behaviour divergence between Drosophila melanogaster and Drosophila suzukii

12:30-13:45 **Standing lunch and poster session**

13:45-14:00 **group photo**

14:00-15-00 Invited conference 2: **Volker Dürr**, Bielefeld University, Faculty of Biology and Centre for Cognitive Interaction Technology (CITEC), Germany
"Search, touch, grasp & climb: Sensorimotor ecology of stick insects"

Session 5: Evolution and Development (chair: Léo Sillon)

15:00-15:15 **Hendrik Wollenberg**, Brain Dev lab, Paris
Induction of delayed synaptic maturation in the dorsal cluster neurons by gene-knockout of drp1 and pink1 in Drosophila melanogaster

15:15-15:30 **Nils Ravel**, Noselli lab, Nice
Brain laterality: genes, circuits and behaviours in the Drosophila model

15:30-15:45 **Leonardo Campana**, LGBDI-USP, Brasil
Species-specific brain transcriptional profiles underlie aggression and behavioral specialization in stingless bees

15:45-16:00 **Charline Gal**, IGF, Montpellier
Drosophila chemokine -like Orion regulates glia infiltration and phagocytosis in a presentation-dependent manner during neuronal remodeling

16:00-16:15 **Julie Ebert**, PERSING lab, Dijon
The glial LAT1 transporter plays a key role in the neurogenic niche during brain development in Drosophila

16:15-16:30 **Rebekah Ricquebourg**, Konstantinides lab, Paris
Spatial factors alter temporal patterning of neuronal stem cells to regulate neuronal diversity

16:30-16:45 **Farewell Word**

Posters' list:

Poster 1: Alice Adiletta – *What does "more" mean to a fly? Circuit and development of spontaneous numerosity preference*

Poster 2: Cécile Bellanger – *Neurotoxicity of pharmaceuticals in the developing brain of a cephalopod: ex vivo assessment on primary cell culture*

Poster 3: Elyne Berthon—Grelat – *Single-neuron dopaminergic activation reveals heterogeneous teaching signals in Drosophila larvae*

Poster 4: Salomé Brousseau – *Towards a standardized model of learning and memory in Sepia officinalis using ecological fear conditioning*

Poster 5: Philippine Chartier – *Electrophysiological and pharmacological study of the acetylcholine receptors of the tick Ixodes ricinus*

Poster 6: Francesca Sara Colizzi – *The clock-related neuropeptide Pigment Dispersing Factor is essential for the photoperiodic reproductive switch of the pea aphid*

Poster 7: Léa Droesbeke-Fuente – *Impact of internal state on the behavior and neurophysiology of Honeybee (Apis mellifera)*

Poster 8: Samuel Eberl – *Nutritional state gates long-term memory consolidation through glial-neuronal metabolic coupling*

Poster 9: Justin Flaven Pouchon – *Post-ingestive malaise induces taste aversive memory in D. melanogaster*

Poster 10: Stéphane Fraichard – *Characterization of the brain gustatory neurons in Drosophila*

Poster 11: Alain Garces – *A light-mediated neuronal circuit controlling sleep-wake arousal in Drosophila melanogaster*

Poster 12: Clara Guiraud – *Neural mechanisms of value-based decision-making in Drosophila melanogaster*

Poster 13: Burak Gür – *Sensory compensation enhances visual learning in Drosophila*
Poster 14: Evan Laisney – *Butyrate intake in new drosophila colitis model shows beneficial effects on survival*
Poster 15: Claire Marcout – *Impact of alarm pheromone on honey bee olfactory neurophysiology*
Poster 16: Caroline Martin – *Glug transporter imports glucose in astrocytes and supports LTM formation*
Poster 17: Pauline Minquilan – *The maternal effect of the snoRNA jouvence predetermine the metabolic parameters, which affect the aging of the brain, and the lifespan, in Drosophila*
Poster 18: Nicolas Montagné – *Evolution of pheromone detection in granary weevils*
Poster 19: Pierre-Yves Musso – *Modulation of taste sensitivity by the olfactory system in Drosophila*
Poster 20: Andrea Pasini – *Mechanisms underlying negative mechanotaxis in a neuronless animal*
Poster 21: Ana Ricciuti – *Balancing opposing memories: Circuit mechanisms of flexibility in Drosophila*
Poster 22: Camilla Roselli – *Investigating non-motor symptoms of Parkinson's Disease using Drosophila melanogaster as model*
Poster 23: Laurent Seugnet – *Amino acids dynamics across Sleep-wake cycle in Drosophila*
Poster 24: Johanna Schweizer – *Integration of information in the absence of action in Drosophila*

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ABSTRACT BOOK
INVITED TALKS

Invited Talk 1: Audrey Dussutour – *CRCA, Toulouse, France*

Learning Without a Brain: Evidence from Ciliates and the Slime Mold

Laboratory / Team: CRCA, Toulouse

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The survival of all species depends on the ability to produce appropriate behavioral responses to environmental challenges. Although single-celled organisms lack the neural architecture of a true brain, they inhabit complex ecological niches and face decision-making challenges strikingly similar to those of animals: they must forage, adapt to changing conditions, detect and avoid predators, and locate suitable microclimates. Yet learning has been investigated almost exclusively in multicellular neural organisms, and unequivocal demonstrations in unicellular organisms remain rare. Acellular slime molds belong to the Amoebozoa (a lineage considered a sister group to fungi and animals) and have emerged as powerful models for studying cognition in aneural systems. They navigate mazes, construct efficient transport networks, exploit social information, anticipate periodic events, and make multi-attribute decisions. In the first part of this talk, I will present experiments demonstrating that slime molds exhibit robust habituation — a reversible, stimulus-specific reduction in response to repeated innocuous stimulation — and discuss what this reveals about the mechanisms underlying non-neural learning. In the second part, I will broaden the comparative perspective by examining habituation in ciliates, exploring what convergent evidence across distantly related unicellular lineages tells us about the deep evolutionary origins of learning. Finally, I will show how slime molds serve as a uniquely accessible tool for science outreach. It enables large-scale citizen science initiatives that foster public understanding of research, raises awareness of societal challenges and cultivates critical thinking.

Invited Talk 2: Volker Dürr – Bielefeld University

Search, touch, grasp & climb: Sensorimotor ecology of stick insects

Laboratory / Team: Bielefeld University, Faculty of Biology and Centre for Cognitive Interaction Technology (CITEC), Bielefeld, Germany

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Insects use their limbs not only for walking but for a wide range of behaviours, including manipulation, active exploration and communication. Even when focusing on locomotion, limbs should be viewed as sensorimotor (sub-)systems that not only control posture, force and movement but also acquire sensory information about contact position, load and displacement. Accordingly, our understanding of insect behaviour is tightly linked to our understanding of the sensorimotor function of limbs. In my talk, I will focus on the behavioural physiology and sensorimotor modelling of stick insect motor behaviour. Having served as study organisms for more than a century – with a strong focus on motor physiology and locomotor behaviour – stick insects are particularly promising for integrative research on active movement and sensory exploration in natural behaviour: sensorimotor ecology. This approach links aspects of stochastic step cycle generation to the control of heading, whole-body kinematics to the internal representation of posture, and spatial coordination of antennae and legs to spatial exploration and attention.

When Microbe Taste Primes Innate Immunity

Léo Sillon, Naziha Bouich, Isabelle Chauvel and Pierre-Yves Musso

Laboratory / Team: GustaBrain lab, CSGA, Dijon, France

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Animals continuously ingest microorganisms with their food. We discovered that the nervous system of Drosophila melanogaster detects these microbes and directly modulates innate immunity. Specific gustatory circuits detect microorganisms and regulate immune status. Activation of certain gustatory pathways is sufficient to modulate cellular immunity, even in the absence of infection.
The same gustatory neurons that orchestrate this immune response also modulate feeding behavior toward these microorganisms. They simultaneously process microbial sensory information, flavors, chemical compounds, while modulating immune defenses. This new mechanism reshapes our understanding: innate immunity can be stimulated through direct sensory activation, where gustatory perception and immune preparedness are intimately linked. These findings reveal that gustatory neurons act as a dual sensor: they assess microbial risk by priming innate immunity while simultaneously modulating feeding decisions toward these microorganisms.

Influence of a neuronal regulatory subunit of vacuolar ATPases on Parkinson's disease pathogenesis studied in Drosophila models

Camille Dumas[1], Amina Dulac[2] and Serge Birman[1]

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The degeneration of dopaminergic neurons in Parkinson's disease (PD) generally begins at synapse terminals before spreading to the cell bodies. The α-synuclein protein, a central player in PD, interacts with membranes and synaptic vesicle (SVs) components, and its pathogenic forms interfere with neurotransmission. Vacuolar ATPases (V-ATPases) are highly conserved proton pumps that acidify intracellular compartments such as SVs. Recent data have reported interactions between V-ATPase subunits and PD-linked proteins, as well as alterations in their expression levels across various PD models. A new V-ATPase regulatory subunit, VhaAC45RP, specifically expressed in neurons, has recently been identified in our group. It was shown to be essential for Drosophila survival, acidification of SVs, and neurotransmitter release. Studying this protein could lead to a better understanding of the role of neuronal V-ATPases and SVs in the progression of PD-associated neurodegeneration. Our results show that the knockdown of VhaAC45RP in dopaminergic neurons has no impact on development or startle-induced locomotor responses in adult flies in physiological conditions. In contrast, under exposure to the pesticide paraquat, a pro-oxidant agent that causes PD in humans, knocking down VhaAC45RP in dopaminergic neuron subsets enhanced stress resistance and fly survival. Overall, our study aims to determine if the activity of VhaAC45RP and V-ATPases associated with SVs contributes to behavioral defects and synapse degeneration in Drosophila models of PD.

Evaluation of a novel regulatory axis of iron-sulfur cluster biogenesis in Drosophila as a potential therapeutic target for Friedreich's Ataxia

Ema Turki[1], Kristian Want[2], Estelle Jullian[1], Anne Filipe[1], Hubert Gorny[2], Benoit D'Autréaux[2] & Véronique Monnier[1].

Laboratory / Team:
1. Université Paris Cité, CNRS, Unit of Functional and Adaptive Biology (BFA), UMR 8251, Paris, France
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Evaluation of a novel regulatory axis of iron-sulfur cluster biogenesis in Drosophila as a potential therapeutic target for Friedreich's AtaxiaEma Turki1, Kristian Want2, Estelle Jullian1, Anne Filipe1, Hubert Gorny2, Benoit D'Autréaux2 & Véronique Monnier11.Université Paris Cité, CNRS, Unit of Functional and Adaptive Biology (BFA), UMR 8251, Paris, France2.Université Paris-Saclay, CEA, CNRS, Institute for Integrative Biology of the Cell (I2BC), Gif-sur-Yvette, FranceFriedreich's ataxia (FA) is a neurodegenerative and cardiac disease caused by a deficiency in frataxin, a mitochondrial protein involved in the synthesis of iron-sulphur clusters (ISC). Iron-sulfer clusters are essential co-factors for numerous proteins involved in various biological processes. ISC biosynthesis is orchestrated by a multi-protein complex that includes NFS1, ISCU, frataxin (FXN), and ferredoxin-2 (FDX2). Although frataxin deficiency has been extensively linked to defective ISC production, the regulatory interactions within this machinery remain incompletely understood. Our collaborators (Team of B. D'Autréaux, I2BC) have shown, using an in vitro reconstituted ISC synthesis machinery, that FXN and FDX2—which are involved in two successive steps of ISC biosynthesis—compete for the same site on the assembly complex and exert an inhibitory effect when in excess. Optimal ISC synthesis therefore requires balanced levels of both proteins. We show in Drosophila that a decrease in frataxin levels leads to the overexpression of Fdx1, the orthologue of human FDX2, further exacerbating the imbalance between these two partners. Furthermore, a moderate RNAi-induced reduction in Fdx1 improves the survival of frataxin-deficient Drosophila. These findings reveal a novel regulatory mechanism for ISC synthesis. They also open a new therapeutic avenue for Friedreich's ataxia. We are now further exploring the mechanisms involved in the transcriptional regulation of the components of the ISC machinery.

Lifelong regulation of structural identity in locomotion-modulating dopaminergic neurons by homeodomain factors

Aishwarya Padmanabhan, Daniel Rahman, Ruibao Zhu, Salah Khorbtli, Sarugan Sathianathan, Bastien Le Flohic, Lauren Assanga Bisse, Bertrand Mollereau, Cheng Huang, Nikos Konstantinides, A Raouf Issa

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The locomotor system that governs essential behaviors such as infant crawling and adult walking, is functional at birth because the post-mitotic neurons that form this system are already established during embryonic development. Yet, how these neurons maintain their function throughout life remains unclear. Neuronal function is defined by neuronal identity, including neurite morphology and gene expression pattern. This identity is initiated during neuronal differentiation under the tight control of development regulators, including homeodomain transcription factors. Recent studies show that certain homeodomain factors remain expressed in post-mitotic neurons beyond development, suggesting that they form a molecular program that maintains neuronal identity and supports lifelong locomotor function. To address this hypothesis, we focus on the homeodomain gene Antp, recently shown to be expressed throughout life in a subset of dopamine neurons (persistent DANs) that remodel to modulate locomotor function across life stages of *Drosophila*. Having observed that Antp is required in persistent DANs for locomotor maintenance, we find that its reduction disrupts DAN neurite arborization. To further explore how Antp regulates neurite organization, we analyzed single-cell transcriptomic datasets of $Antp^{+}$ DANs, combined with bioinformatics and molecular assays, identifying cell-adhesion and guidance genes (Beat-Ib and Toll-6) as potential downstream targets through which Antp exerts effects on neurite structure. Together, our findings indicate that homeodomain factors are reused in DANs to regulate neurite arborization required for locomotion. Our ongoing work will define whether critical periods exist for Antp regulatory effects and how these temporal windows contribute to neurite remodeling/plasticity across the lifespan of DANs.

From neural circuits to behavior: Sweeteners reshape feeding in Drosophila

Enisa Aruçi and Pierre-Yves Musso

Laboratory / Team: GustaBrain, CSGA, Dijon, France

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Sweeteners are commonly used as sugar substitutes because they provide sweetness without, or with very little, caloric content. Although widely consumed, their effects on feeding regulation remain insufficiently understood. In particular, the uncoupling between sweet taste perception and caloric intake has emerged as an important factor influencing feeding behavior across species, from insects to humans.

Using *Drosophila melanogaster* as a model organism, we investigated how sweeteners affect feeding behavior, metabolic responses, and the neuronal circuits involved in food evaluation. To do so, we combined two complementary behavioral approaches: the Proboscis Extension Response (PER), to assess feeding initiation, and the fly Activity Detector (flyPAD), to quantify feeding dynamics with high temporal resolution.

Our data show that sweetener consumption induces major alterations in feeding behavior. Notably, it promotes the formation of a Caloric Frustration Memory (CFM) caused by the uncoupling between sweet taste perception and the expected caloric reward. This experience subsequently leads to abnormal feeding responses, suggesting that sweeteners can durably alter food valuation. These findings support the idea that sweet taste-calorie uncoupling not only affects immediate behavior, but also reshapes the integration of sensory and post-ingestive signals within the brain.

This work identifies Drosophila as a relevant model to study the biological impact of sweeteners and provides new insight into how non-caloric sweet compounds influence feeding through behavioral and neural mechanisms.

Creating true and false memories from forgotten information in Drosophila

Wenbin Yang*, Benedetta Zattera*, **Miguel Pavão-Delgado*,** Carolin Warnecke, Johanna Aurelia Schweizer, Ana Ricciuti, Büşra Çoban and Johannes Felsenberg

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While regaining access to forgotten information can be advantageous, targeted memory recovery carries the inherent risk of generating false memories. Our understanding of neuronal processes that govern true memory recovery and false formation is still in its infancy. Here, we demonstrate in Drosophila that re-exposure to memory-related cues as reminders can recover forgotten memories. We find that forgotten memories are maintained as silent memory traces stored in behaviorally neutral mushroom body output neurons. From this silent state, memories can be recovered by reinstating the initial memory trace for learned avoidance in approach-coding mushroom body output neurons. However, modifying the reminder can distort the recovery process, leading to false memory formation. The effectiveness of misguiding recovery depends on whether the information presented as a reminder is encoded as part of the training event. We show that true memory recovery and false memory formation are both context-dependent processes gated by separable dopaminergic pathways. Together, our findings suggest that forgotten memories can re-emerge through a memory system that allows for the flexible integration of stored information and recent experiences. Understanding how this system reconstructs memories is crucial for addressing the broader challenges of memory distortion and misinformation.

Mitochondrial calcium regulates neuronal mitochondrial metabolism to sustain long-term memory formation

Claire Brossier[1*], T. Comyn[1*], J. de Juan-Sanz[2], T. Preat[1], P.-Y. Plaçais[1#], A. Pavlowsky[1#]

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Long Term Memory (LTM) formation is a highly energy-demanding process for the brain, critically relying on the timely and controlled upregulation of mitochondrial metabolism in Mushroom Body (MB) neurons, the center of associative memory. In Drosophila, the upregulation of mitochondrial metabolism required for the formation of olfactory LTM depends on post-learning dopamine signaling via the DAMB receptor, which is coupled to two downstream effectors DAG and IP3. We have recently demonstrated that activation of the DAG pathway upon LTM formation is coupled to mitochondrial metabolism upregulation via the PKCδ kinase. However, whether the canonical calcium-based IP3 pathway is also necessary was not investigated. In mammals, calcium is a well-established activator of mitochondrial metabolism. In neurons, a specific regulator of mitochondrial calcium uptake, MICU3, has been identified in vitro as key to adjust mitochondrial metabolism to neuronal activity.

Here, by combining behavior and in-vivo imaging of either mitochondrial calcium or pyruvate in MB neurons, we demonstrate that the upregulation of mitochondrial metabolism required for LTM formation depends on MICU3-regulated mitochondrial calcium uptake. We then show that this uptake of mitochondrial calcium is triggered by the activation of the DAMB/IP3 pathway via the ITPR/RyR-mediated calcium-ER release. Finally, disrupting critical molecular actors of ER/mitochondria interaction results in LTM defect. This data suggests that ER-mitochondria spatial coupling is required to facilitate calcium transfer.

Altogether these findings demonstrate in vivo that mitochondrial calcium serves as a key regulatory signal that adapts neuronal mitochondrial metabolism, thus serving as a critical control point LTM formation.

Hypercapnic stress modulation of aversive value coding in Drosophila

Nesrine Merabet, Clara Guiraud, Pascal Züfle, Margaux Vieu, Clara Zirah, Anh-Kiet Truong, Carlotta Martelli and Emmanuel Perisse

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Avoiding threat is paramount for survival. Moreover, past experience and internal states shape the way animals learn the negative value associated with noxious threat and respond to it. Notably, acute stress can induce analgesia therefore significantly influencing the representation and responses to future noxious stimuli. However, the neural mechanisms underlying how stress-induced analgesia can alter the perception and integration of noxious stimuli in the central nervous system to modulate the computation of aversive value coding remains poorly known. Here, we used the tractable Drosophila combined with behavioural analysis, neural manipulation, anatomical characterisation and in vivo two-photon calcium imaging to uncover how a prior noxious/stressful experience can alter fly nocifensive response and aversive value coding during associative learning. We report that in an intensity-dependent manner, a prior noxious experience induces analgesia and elicits the release of stressful carbon dioxide (CO_2) in the fly's environment. The respiratory system, but not olfactory, requires the Gr28b receptors in tracheal dendrite (td) neurons to relay stressful hypercapnia (high CO_2 in the organism). Td neurons activation induces analgesia while their inhibition during shock/CO_2 pre-exposure cancels analgesia. Connectomics showed that td neurons interact with nociceptor and ascending nociceptive circuits via GABAergic neurons. High CO_2 pre-exposure decreased punishment dopaminergic neurons' response to electric shock therefore decreasing aversive memory formation. We propose that in hypercapnic stressful situation, td neurons modulate nociceptive information and aversive value coding in the brain to enable appropriate naïve and learned response.

Innate sensitivity to animacy cues and early experience with congeners shape predatory behaviour

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As for many animals, detecting prey is essential to the survival of newly hatched cuttlefish that need to develop and feed on their own from hatching. However, the precise visual cues underlying this capacity remain poorly understood. Research in terrestrial vertebrates, from primates to birds, has revealed that animacy cues specific shapes or motion patterns typical of living organisms serve to identify prey, predators and conspecifics in the environment. Whether invertebrates like cuttlefish also rely on animacy cues to detect prey akin to those observed in terrestrial vertebrates for the detection of prey is an open question. Using video screens, we exposed 5-day-old inexperienced cuttlefish, reared individually or in groups, to 8 stimuli varying in animacy from a static shrimp image to a live shrimp video and quantified their behavioural responses using a deep learning multivariate pipeline. We identified 6 behavioural states ranging from passive states to active strike. Our results demonstrated that individually reared cuttlefish which never had visual experience with prey or onspecifics expressed sharply stimulus-dependent responses, shifting from passive states when facing static stimuli to approach and strike behaviours when facing stimuli with varied animacy cues. Interestingly, group-reared cuttlefish which had experienced conspecifics but not prey expressed a stimulus-invariant attentive posture regardless of the animacy cues presented. These results suggest that inexperienced cuttlefish possess an innate sensitivity to cues typical of living organisms, and that early experience with congeners redirects behavioural responses.

Can lateralized circuits limit experience-dependent behavioral change in Drosophila?

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Fruit flies show stable individual differences in their behavior. In the Buridan navigation task, they naturally adopt a walking "personality" (straight-walking or meandering style), which is correlated to differences in asymmetric brain wiring of dorsal cluster neurons (DCNs, also known as LC14). Specifically, straight walking flies have more asymmetric DCN dendritic branching. We tested whether this innate behavior can be modified through experience and whether the level of DCNs asymmetry constrains such plasticity. Our preliminary results indicate that appetitive conditioning can selectively reshape this object-fixation behavior in a subset of individuals. Young (4-day-old) straight-walking flies shifted toward a meandering pattern after appetitive conditioning, a change that persisted for at least 24 hours after training. Meandering flies, however, did not shift their behavior. Older (7-day-old) flies showed no significant behavioral change, suggesting reduced plasticity. These results show that individualized, seemingly hardwired behaviors can be modified early in adulthood, particularly in individuals with stronger neural lateralization.

Object manipulation and affordance learning in Drosophila

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Adaptation to novel situations requires learning how objects in the environment can be acted upon—an ability known as affordance learning. While this concept has been widely explored in naturalistic animal behavior, the underlying neural mechanisms remain poorly understood. Here, we establish an experimental framework in Drosophila melanogaster to study object manipulation and affordance learning. Flies are placed in a narrow corridor obstructed by a movable ball. Through repeated interactions, they learn to push the ball forward with increasing efficiency, even in the absence of explicit reward, demonstrating spontaneous discovery of an action possibility. Flies also generalize this learned manipulation to a distinct ball in a novel context, indicating experience-dependent flexibility. Using a large-scale neuronal silencing screen, we identify distributed contributions of multiple brain regions to ball-pushing behavior. Higher-order centers, including the mushroom body and dopaminergic circuits, are critical for learning of object affordances, while visual pathways mediate initial engagement and olfactory circuits modulate behavioral drive. Together, these results show that object manipulation in flies relies on interactions between sensory, motivational, and associative circuits. This work establishes Drosophila as a genetically accessible model to study the neural basis of affordance learning, providing insight into how compact brains integrate perception, learning, and motor control to support flexible interaction in complex environments.

Dissecting Aminergic Contributions to Visual Discrimination Learning in Honey Bees Using a Virtual Reality Paradigm

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The honey bee is a powerful model for studying visual cognition in insects. Over the past decades, numerous studies have explored how bees detect, recognize, and discriminate visual objects. However, dissecting the contribution of specific neuromodulatory pathways during visual learning has proven challenging because most experiments rely on free-flying bees, in which invasive neurophysiological approaches are not feasible. To overcome this limitation, we used a closed-loop virtual reality (VR) system in which tethered honey bees walk on a spherical treadmill while actively navigating a controlled 3D visual environment. Neuromodulatory pathways were pharmacologically manipulated through microinjections delivered via the median ocellus. This approach enables the study of visually guided behavior while maintaining experimental access to the nervous system.
Using this approach, we investigated the role of dopaminergic and serotonergic signaling in bees trained to discriminate landmarks of different colors. Pharmacological activation of dopamine receptors accelerated the emergence of stable discrimination between rewarded and non-rewarded visual stimuli, whereas dopamine receptor blockade strongly impaired both acquisition and short-term memory expression. In contrast, serotonergic manipulations produced subtler, dose-dependent effects: increasing serotonergic signaling did not support stable discrimination learning, whereas receptor blockade resulted in a non-monotonic pattern in which learning was impaired at low doses but partially restored at higher doses.
By combining immersive VR with targeted neuropharmacology, this study provides new insights into how distinct aminergic systems shape visual learning in actively behaving insects. More broadly, our results highlight the potential of VR paradigms to link neuromodulatory function, cognition, and behavior under conditions that preserve self-generated movement and sensory feedback.

Serotonergic-dependent awareness is required for trace conditioning in honeybees

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In humans, trace conditioning—where a temporal gap separates conditioned (CS) and unconditioned (US) stimuli—requires awareness and is sensitive to distraction, unlike delay conditioning. Here, we show that honeybees exhibit comparable features, suggesting cognitively demanding processes akin to awareness. Using the olfactory conditioning of the proboscis extension response, we found that bees learned in both paradigms, but trace conditioning resulted in weaker acquisition and memory. Strikingly, trace—but not delay—conditioning was impaired by visual and mechanosensory distractors. Neuropharmacological blockade of serotonin signaling selectively disrupted trace conditioning, implicating serotonergic circuits in bridging CS-US intervals. A computational model of the bee olfactory network supported this interpretation. Our findings reveal that bees engage higher-order cognitive mechanisms under temporal uncertainty, suggesting that core features of awareness may be evolutionarily conserved across distant taxa.

Sleep and neuroglial interactions in a critical period of the Drosophila olfactory system

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During development, some neuronal circuits are remodeled by experience and the environment during specific time windows, termed critical periods (CPs). Sleep is more abundant during these CPs, promotes plasticity, and its disruption can have long-term consequences on neuronal functioning. The mechanisms involved in CPs remain enigmatic. We already know that synapse-astrocyte contacts regulate neurotransmission and synaptogenesis in a sleep-dependent manner. In both mammals and insects, neuroglial interactions play a central role in CPs, but the underlying mechanisms are poorly described.
This project aims to clarify the relationship between sleep, neuroglial interactions and CP, by exploiting the potential of a simple, well-characterized and flexible model: long-term habituation (LTH) to CO2 in the olfactory system of Drosophila with CP that ends in early adulthood. Different neuronal populations are involved in LTH to CO2. Using the GRASP technique (GFP Reconstitution Across Synaptic Partners), we observed that exposure to CO during CP leads to a significant increase in the size and number of contacts between astrocytic membranes and presynapses of several populations: GABAergic interneurons and CO-specific olfactory neurons. These neuroglial contacts could explain the increase in glomerular volume observed following habituation and underlie the functional changes in the glomerular network. To assess the influence of sleep on LTH and CP, we modulate sleep quotas using different stimulation regimens to reduce or promote sleep.
The findings of this project could have general relevance for CPs, while highlighting the importance of sleep and the need to protect it, particularly during CP.

Balancing Pest Control and Pollinator Safety: Butyric and Propanoic Acids Impair *Drosophila suzukii* Reproduction While Preserving Honey Bee Cognition

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Crop-pest control has long relied on toxic and persistent chemicals with detrimental effects on pollinators and human health. Recent strategies to manage invasive pests increasingly emphasize pesticide-free approaches, including behavioral disruption mediated by volatile organic compounds. Here we show that short-chain fatty acids propanoic acid and butyric acid disrupt courtship behavior and inhibit copulation in the invasive pest *Drosophila suzukii*. Given their potential role in pest control, we investigated their impact on the cognitive functions of the pollinator Apis mellifera, including olfactory learning and memory, which are essential aspects for foraging and pollination. This study shows that honey bees can detect, discriminate, and learn both compounds. Moreover, at the same dilutions able to modulate courtship and copulation behavior in *D. suzukii*, propanoic and butyric acids do not induce detectable sublethal effects on honey bee cognitive performance. Nevertheless, our data indicate that elevated exposure levels of both acids can negatively impact olfactory associative learning. These results advocate the potential interest of butyric and propanoic acids in pest control. At the same time, they highlight the importance of concentration-dependent risk assessment when designing a method of application of short-chain fatty acids in field conditions for sustainable crop protection.

Sexual pheromone processing in the honey bee brain

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To ensure reproduction, animals efficiently detect and process intraspecific cues, such as sexual pheromones, highly described in many insect species but overlooked in Hymenoptera. This study addresses how the brain of the honey bee, *Apis mellifera*, processes the unique sex pheromone described, the 9-oxo decanoic acid (9-ODA), which triggers male attraction toward virgin queens during mating. The 9-ODA is detected by olfactory receptor *Amel*OR11, the most overexpressed receptor in male antennae compared to workers'. It also activates a specific, enlarged glomerulus in the antennal lobe, called macroglomerulus 2 (MG2). This neuronal pathway is the only one described for the processing of 9-ODA within the male honey bee brain. To test whether it is exclusively responsible for male attraction, and to better understand how this pheromone is processed in the male brain, we generated *Amel*OR11 knock-out males using CRISPR-Cas9 genome-editing. Mutant males showed no response to 9-ODA neither in their antennae using electroantennography and nor in their antennal lobe using *in vivo* calcium imaging recordings. Moreover, KO males showed an atrophied or even absent MG2. We assessed males' attraction towards 9-ODA using a four-way olfactometer and discovered that *Amel*OR11-KO males show no behavioural response to this compound. However, associative conditioning experiments showed that mutant males still associate 9-ODA with a sucrose reward, revealing a capacity to still detect 9-ODA. It therefore appears that the neural pathway involving OR11 and MG2 is probably directly responsible for sexual attraction behaviour, while other receptors may enable the detection of 9-ODA without triggering sexual attraction.

Behavioural and Molecular characterization of planarian nociception

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Planarians are renowned not only for their remarkable regenerative abilities but also as versatile model organisms across diverse fields, from pharmacology to toxicology. Despite their evolutionary divergence from vertebrates, their nervous systems exhibit striking similarities—including unipolar neurons and a predominance of chemical synapses—making them particularly valuable for sensory physiology research. Their ease of maintenance further enhances their utility as experimental models. Previous studies have demonstrated that planarians perceive their environment through photoreception, chemoreception, electroreception, and even magnetoreception. Recently, our laboratory and others have provided evidence that they also experience nociception, the detection of noxious stimuli. For example, exposure to AITC, a well-known TRPA1 agonist (a highly conserved nociceptive ion channel), elicited a dose-dependent nociceptive scrunching gait (EC_{50} = 34.65 µM, $n \approx 4$). This behaviour was modulated by pre-treatment with common analgesics (such as morphine and meloxicam) and was suppressed by RNAi-based TRPA1 knockdown. Similar responses were observed with other TRPA1 agonists, including cinnamaldehyde and hydrogen peroxide. In thermal nociception assays, planarians exhibited a strong aversion to heat, spending minimal time on the hot side (14.0 ± 2.6%, $n = 15$, $p < 0.001$). This heat-induced response was significantly attenuated by meloxicam but, surprisingly, not by morphine. However, contrary to earlier reports, we were unable to demonstrate mechanical nociception in planarians. Ongoing research aims to identify the opioid receptor and localize nociceptor cells in these organisms.

Role of a glutathione S-transferase in the olfactory system of *Drosophila melanogaster*

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Glutathione S-Transferases (GSTs) are key detoxification enzymes mainly studied in insects for their role in the biotransformation of plant defense chemicals and insecticide resistance. GSTs are primarily expressed in the detoxification organs of insects, such as the fat body and digestive tract. However, several studies have shown that many of them are also associated with the chemosensory organs, suggesting potential functions in chemical communication, beyond detoxification. In Drosophila melanogaster, 36 cytosolic GST genes have already been identified. Using transcriptomics analysis, we characterized and compared the expression profiles of these GSTs in chemosensory tissues (male and female antennae, proboscis + maxillary palps, legs, ovipositor and head of larvae). Then we focused on a GST gene that showed specific expression in antennae and a possible association with olfactory neurons, as suggested by single-cell RNAseq data analysis. We also showed that this GST was secreted, which is quite unusual for this enzyme family. In order to elucidate the physiological role of this GST in olfaction, we used a GST mutant strain and performed electrophysiological analysis to test the antenna response to different compounds of various chemical classes in this mutant strain compared to a wild-type strain. At the same time, we produced the recombinant enzyme and performed enzymatic activity tests to identity the catalytic efficiency of the enzyme with regards to various odorant molecules. Overall, our results support a role of this GST in olfactory processes, and the mechanisms potentially involved will be discussed.

Evolution of taste processing shifts dietary preference

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Food choice is an important driver of speciation and invasion of novel ecological niches. However, we know little about the mechanisms leading to changes in dietary preference. In this project, we use three closely related species, *Drosophila sechellia*, *D. simulans*, and *D. melanogaster*, to study taste circuits and food choice evolution. *D. sechellia*, a host specialist, feeds exclusively on a single fruit (Morinda citrifolia; noni), whereas the other two are generalists living on diverse diets. Using quantitative feeding assays, we recapitulate the preference for noni in *D. sechellia* and detect conserved sweet but altered bitter sensitivity by means of calcium imaging in peripheral taste neurons. Noni activates bitter-sensing neurons more strongly in *D. sechellia* than in the other two species owing to a small deletion in a single gustatory receptor. Using volumetric calcium imaging in the ventral brain, we show that instead of peripheral physiology, species-specific processing of noni and sucrose signals in sensorimotor circuits recapitulates differences in dietary preference. Our data indicate that altered food choice may not be explained by peripheral receptor changes alone but rather by modifications in how sensory information is transformed into feeding motor commands.

Diversity pheromone temporal coding disruptions by plant volatiles

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Moth pheromone-sensitive olfactory receptor neurons (Phe-ORNs) encode the intermittent structure of pheromone plumes through precisely timed spikes, a mechanism that is essential for odor plume tracking behavior in flying insects. However, natural olfactory scenes are composed of diverse volatile plant compounds (VPCs) with complex temporal dynamics whose effects on pheromone signal intermittency encoding remain unclear. The two lines of research: encoding of pheromone intermittency and background interference, remains largely disconnected. Here, we performed electrophysiological recordings from moth Phe-ORNs to quantify their responses to temporally structured pheromone stimuli under a diversity of plant volatile constant or fluctuating backgrounds. We found that some plant volatiles reversibly disrupted the rate and temporal coding of various subregions of the pheromone plume and the trial-to-trial variability. Although pheromone coding performance was generally negatively correlated with VPC-evoked responses, notable exceptions were observed, with some VPCs disrupting temporal coding without activating Phe-ORNs and others activating Phe-ORNs without altering temporal coding. Altogether, our results indicate a diversity of ways how coding fidelity of complex pheromone plume is challenged at the sensory periphery. Timing is key for olfactory navigation, and our results raise questions regarding how downstream circuits process noisy sensory inputs. The pheromone detection system must contend with multiple forms of background noise rather than a uniform disturbance.

Mapping neuronal circuits underlying oviposition behaviour divergence between *Drosophila melanogaster* and *Drosophila suzukii*

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Behaviour evolution can promote the emergence of agricultural pests by changing ecological niche. We use as a model a behavioural shift the pest *Drosophila suzukii* to identify neuronal modifications underlying behavioural evolution. Unlike other species such as *D. melanogaster* which prefer to lay their eggs in rotten fruits, *D. suzukii* has shifted its oviposition preference to ripe, non-fermented fruits, causing significant damage to fruit crops worldwide. We investigate the chemosensory changes underlying *D. suzukii*'s evolutionary transition. We have shown that *D. suzukii* values fruit sugars more highly than *D. melanogaster* during oviposition decisions and this contributes to *D. suzukii*'s preference shift towards ripe fruits. However, this change is not caused by an increased sensitivity at the level of sugar Gustatory Receptor Neurons (GRN).
Using the *D. melanogaster* connectome, we have uncovered a circuit of about 140 neurons potentially connecting sugar GRNs to the oviposition-triggering oviDN neurons. We have confirmed a role of some of these neurons in oviposition decisions using available split-Gal4 lines in *D. melanogaster*. In parallel, we are generating tools to target the homologous neuronal populations in *D. suzukii*. Our goal is to compare the function and physiology of these neurons across species via behavioural assays and calcium imaging in the brain of behaving flies.

Induction of delayed synaptic maturation in the dorsal cluster neurons by gene-knockout of drp1 and pink1 in Drosophila melanogaster

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Heterochrony or more specifically neoteny understood as the retention of juvenile features into adulthood is well known to play a crucial role in phylogenesis not only of humans but also in invertebrates. However, the timing of its molecular mechanism is still unknown and therefore we want to study the molecular basis of such developmental prolongation in the brain using *Drosophila melanogaster*. To induce a neoteny-like developmental pattern in Drosophila melanogaster's visual system, *i.e.* the dorsal cluster neurons, we manipulate genes important for mitochondrial quality control (pink1) and homeostasis (drp1) and characterize the changes in synapse formation and axonal architecture. Across four developmental stages we'll use established synaptic markers and analyse axonal tree morphology. In accordance to this hypothesis, our preliminary data indicates that perturbing drp1 and / or pink1 specifically in these neurons results in longer axons with less synapses. After having introduced such genetic knockout model of neoteny, we will try to test the learning performance of these flies in a behavioural paradigm. Establishing such model will provide an experimental framework to further explore the molecular and developmental origins of brain-wide neoteny.

Brain laterality: genes, circuits and behaviours in the Drosophila model

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Left–right asymmetry is a fundamental property of living organisms. In the nervous system, it underlies behavioral lateralization and cognitive processes such as language and memory. In humans, defects in brain asymmetry are associated with neurological disorders, including autism and schizophrenia, highlighting the importance of understanding its underlying mechanisms.

Our laboratory uses Drosophila as a model to study neural asymmetry, focusing on H neurons (neu-H), which project their axons toward the right asymmetric body. We previously identified a key role for the conserved Netrin B (NetB) pathway: the ligand NetB acts asymmetrically in LALv1 neurons, activating NetB signaling in adjacent neu-H. Loss of this pathway leads to bilateral neu-H projections, a phenotype associated with long-term memory defects. Additionally, inhibition of DL1 neurons induces random lateralization, suggesting a hierarchical circuit (DL1 > LALv1 > neu-H) controlling asymmetry direction.

We carried out a sensitive, unbiased genome-wide modifier screen and identified 20 new genes implicated in neu-H asymmetry, 19 of which have human orthologs. Most act in DL1 neurons, leading to randomized or inverted neu-H projections, while others act in LALv1 (similarly to NetB) or in yet unidentified neuronal populations, suggesting additional components of the asymmetry network.

We find that genes acting in DL1 neurons control asymmetry through two distinct mechanisms: by affecting DL1 neuronal specification or by disrupting their activity. Upcoming experiments will aim to precisely dissect and characterize these mechanisms. Finally, behavioral consequences of different asymmetry phenotypes will be assessed using neu-H-dependent feeding preference assays.

This work will establish the first hierarchical brain asymmetry network in flies, linking conserved genes, neural circuits, and behavior.

Species-specific brain transcriptional profiles underlie aggression and behavioral specialization in stingless bees

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Stingless bees are highly diverse and exhibit substantial interspecific variation in key social traits, including worker aggression and division of labor. While some species display strong defensive responses against intruders, others are comparatively docile. To investigate the molecular basis underlying these behavioral differences, we generated comparative brain transcriptomes of workers from three stingless bee species—*Scaptotrigona bipunctata*, *Melipona quadrifasciata*, and *Frieseomelitta* varia—across four life stages: newly emerged workers, nurses, guards, and foragers. Behavioral observations indicate that guards of *S. bipunctata* are more aggressive, whereas *M. quadrifasciata* and *F. varia* exhibit more docile defensive responses. Principal component analysis revealed that newly emerged workers and nurses form distinct clusters in all species, whereas guards and foragers cluster more closely in docile species but are more transcriptionally distinct in the most aggressive species, *S. bipunctata*. Consistently, guards of *S. bipunctata* showed a higher number of differentially expressed genes compared to foragers than observed in the more docile species. Functional enrichment analyses revealed that early life stages are characterized by processes related to cellular maintenance and neural maturation, whereas later stages show enrichment of pathways associated with neuronal signaling, synaptic function, and metabolic activity. Notably, guards of the most aggressive species, *S. bipunctata*, displayed specific enrichment of genes associated with heat shock proteins and chromatin organization, a pattern not observed in the more docile species. These findings suggest that species-specific brain transcriptional profiles are associated with differences in worker aggression and behavioral specialization.

Drosophila chemokine -like Orion regulates glia infiltration and phagocytosis in a presentation-dependent manner during neuronal remodeling

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Nervous systems are initially overpopulated with neurons and overwired. This is followed by a critical period of remodeling, during which a subset of inappropriate connections is removed to optimize adult functions. An interaction between glia and neurons is required for this developmental neuronal remodeling.

A Chemokine-like protein, called Orion, was recently identified as a key protein necessary in neuron-glia communication during Drosophila mushroom body (MB) γ-neuron remodeling. The neuronal secretion of Orion induces both astrocyte-like cell infiltration into the MB γ axon bundle and phagocytosis of neuronal debris. However, the molecular mechanisms required for each of these glia activation steps are unknown. Therefore, we aim to understand how Orion, triggers specific glial behaviors by dissociating glia infiltration and phagocytosis. Firstly, we showed that Orion mutations on a glycosaminoglycan (GAG) binding site block glia infiltration into the γ axon bundle, suggesting that GAGs mediate Orion presentation to glia. Secondly, to mimic GAG presentation of Orion to glia, we expressed a membrane-tethered Orion in MB neurons, preventing its "free secretion". This form of Orion was sufficient for glia infiltration but phagocytosis was strongly impaired, suggesting that a “free secreted” form of Orion is required for phagocytosis. Finally, using differential centrifugation and neurogenetic tools we found that Orion is an exosome-associated protein. In addition, blocking the exosome pathway in neurons led to debris clearance defects.

Based on these data, we propose that the manner in which Orion is presented to astrocytes determines glia behavior during MB pruning.

The glial LAT1 transporter plays a key role in the neurogenic niche during brain development in Drosophila

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In various research models, glia, neural stem cells and their progeny form the neurogenic niche, regulating neurogenesis. Extrinsic signals such as hormones or metabolites are required for neural stem cell proliferation. Some neurodevelopmental disorders are associated with a lack of essential amino acids availability due to a deficiency in specific transporters such as L-type amino acid transporter 1 (LAT1). LAT1 mutations alter brain development by inducing microcephaly as well as behavioral and motor defects in mammals. However, the cellular and molecular mechanisms linking LAT1 to altered brain development remain poorly understood.

Using Drosophila larvae as a neurodevelopment model, our research aims to characterize the roles of the LAT1 ortholog Minidiscs (Mnd) in the neurogenic niche. Within the niche, we focus on the neural stem cell called neuroblast (NB) and the blood-brain barrier (BBB) glial cells. Our preliminary immunostaining data show that Mnd is present in NB and glial cells, most notably in the BBB. We observed that glial Mnd deficiency induces glial lipid droplet accumulation in the larval brain, a hallmark of cellular stress. Our results also demonstrate that glial Mnd knockdown causes developmental delay and reduced brain size related to decreased NB proliferation. Surprisingly, we observed Mnd-positive vesicle-like structures in NB when Mnd is inhibited exclusively in glia. Next, we will investigate glial Mnd influence in cell cycle progression, apoptosis, oxidative stress, mitophagy, and endoplasmic reticulum stress. Our data strongly support the hypothesis that LAT1 plays a crucial role in brain development by controlling proliferation in the neurogenic niche.

Spatial factors alter temporal patterning of neuronal stem cells to regulate neuronal diversity

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The generation of vast neuronal diversity from a limited pool of neural stem cells (NSCs) remains one of the most compelling questions in developmental neurobiology. The visual system of *Drosophila melanogaster* provides a powerful model, comprising about 120,000 neurons of around 200 types. Its complexity arises from two mechanisms: temporal patterning, where NSCs sequentially express transcription factors to change neuronal output, and spatial patterning, driven by region-specific transcription factors expression.
Most visual neurons derive from the Outer Proliferation Center (OPC), divided into the main OPC (mOPC) and the *wingless* (*wg*) -expressing tips (tOPC). These regions follow distinct temporal series. My PhD project aims to characterize this divergence at molecular and evolutionary levels and assess its impact on neuronal diversity and circuitry.
My results suggest the presence of a conserved feedback loop involving a pair of transcription factors: *Sp1* and *buttonhead* (*btd*), regulating *wg* expression, and vice versa. Moreover, my results suggest that *wg* specifies tOPC identity by inhibiting the mOPC identity through *Sp1/btd*. Secondly, to compare mOPC- and tOPC-derived neurons, I have reconstructed known tOPC-derived neurons' connectome using FlyWire, showing that they are involved in color vision and object perception. Finally, using immunohistochemistry and RNA fluorescence *in situ* hybridization, I have shown that a tOPC-like structure is conserved in insects that diverged from *Drosophila melanogaster* up to 390 million years ago (MYA), with a loss of one of the tips in the coleopteran *Tribolium castaneum* (325 MYA).

POSTER COMMUNICATIONS

Poster 1: What does "more" mean to a fly? Circuit and development of spontaneous numerosity preference

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Across species, animals display spontaneous preferences for specific sensory patterns from the very onset of life, suggesting that perception and valuation are already coupled before any learning occurs. One notable example is the preference for larger numerosities, a bias documented across taxa, suggesting an evolutionarily conserved mechanism through which the brain assigns value to sensory inputs. But how does this work at the circuit level? Drosophila melanogaster offers a unique opportunity to address this question: despite its small brain, the fly shows the same spontaneous preference for larger numerosities, and its neural circuits are accessible with single-cell precision. Therefore, this project aims to determine how this innate numerical bias arises from circuit-level interactions, and to what extent its expression is shaped by early experience. To first establish whether the bias is fixed or already sensitive to developmental input, we manipulated the sensory environment during rearing. Results showed that such manipulations can shift numerosity preference, suggesting that, while the bias may originate from preconfigured circuits, its expression could remain plastic and sensitive to early manipulations. This directly motivates the next step: linking these effects to underlying mechanisms. We are now developing an approach focused on the interaction between LC11 visual neurons, recently linked to numerical discrimination in flies, and dopaminergic systems, whose conserved role in salience attribution makes them strong candidates for mediating early value assignment. Combining targeted manipulations with functional imaging in controlled choice paradigms, we aim to understand how numerical information is mapped onto value signals that guide action.

Poster 2: Neurotoxicity of pharmaceuticals in the developing brain of a cephalopod: ex vivo assessment on primary cell culture

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The nervous system is highly vulnerable to toxicant effect, especially during early developmental stages. Therefore, assessment of the neurotoxicity of environmental pollutants on wildlife is of major importance. The embryonic and juvenile stages of the cuttlefish (cephalopod) take place in coastal waters; thus, their developing brain is likely to be subject to aquatic pollution. In this context, MEDSENE project (founded by AESN) is investigating the neurotoxic potential of pharmaceuticals on the cuttlefish. This project focus on the ten pharmaceutical substances most frequently found in the surface waters of the Seine-Normandy area (years 2016-2019). The constraints associated with cuttlefish farming, combined with ethical considerations, limit in vivo exposure experiments to pollutants and encourage the development of biotests. This study examines the neurotoxic potential of these drugs on primary cultures of cuttlefish nerve cells. To this end, cells isolated from the central nervous system (optic lobes) of cuttlefish at perinatal stages are maintained in a suitable culture medium supplemented with the drugs of interest (either separately or as a mixture of the 10 molecules). Three concentrations of each substance are used, based on their respective concentrations found in surface water (environmental concentration, EC): EC, ECx10 and ECx100. Cell viability is assessed after 72 of exposure and normalized against control cultures. The majority of the drugs studied do not significantly affect the viability of nerve cells, regardless the concentration, with the exception of those known to affect the nervous system (e.g., psychotropic drugs), for which a reduction in cell viability was observed.

Poster 3: Single-neuron dopaminergic activation reveals heterogeneous teaching signals in Drosophila larvae

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The ability to form new associations and update them in a changing environment is essential for behavioral adaptation. Dopaminergic neurons (DANs) are known to modulate the plasticity of neural circuits underlying learning and memory via dopaminergic teaching signals. However, it remains unclear whether and how different dopaminergic teaching signals affect associative learning.

This question can be addressed in the larva of Drosophila melanogaster, whose learning center, the Mushroom Body (MB), contains a limited number of neurons, enabling precise analysis of complex neural circuits.

We used two approaches: First, we exposed larvae to an associative learning paradigm in which an odor was paired with optogenetic activation of single identified DANs to assess different parameters of memory formation. Second, we recorded the response of these DANs using two-photon calcium imaging to determine how different light intensities directly affect their activity.

Our preliminary results suggest that the strength of learned behavior scales differently across DANs with training and stimulation intensity, while calcium responses show similar dynamics across the DANs.

Poster 4: Towards a standardized model of learning and memory in Sepia officinalis using ecological fear conditioning

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Among invertebrates, coleoid cephalopods (cuttlefish, octopus, squid) have evolved complex centralized brains, supporting sophisticated behaviors and vertebrate-like cognitive abilities. They successfully perform a diverse array of learning paradigms (i.e. discrimination, associative, spatial learning…) and demonstrate advanced forms of memory such as episodic-like memory. However, the neural correlates underlying these faculties remain poorly characterized, most knowledge arising from lesional studies lacking temporal and spatial resolution. The development of standardized behavioral assays and reliable neuroimaging tools, difficult to implement in these challenging species, has therefore become an urgent need. Building on well-established mammalian paradigms, we sought to adapt the classical fear conditioning to test cuttlefish, as this procedure allows exploration of a wide range of cognitive processes: trace, delay or contextual memory. The common electric shock used in rodents was replaced by an ecologically relevant stimulus, a looming predator silhouette, known to induce freezing antipredator responses in cuttlefish. This unconditioned stimulus (US) was paired with a neutral stimulus (light pulses, the conditioned stimulus; CS) while recording behavioral changes including body pattern dynamics. When using immediate early gene as markers of neuronal activation, decoupling CS and US in control animals allows differentiation of neural activation linked to sensorimotor vs cognitive demand (i.e. learning). Here, we report initial efforts to implement this novel experimental framework to study cuttlefish memory, from the validation of behavioral assays to the establishment of a neuroimaging methodology. Investigating neural circuits in cephalopods will provide unique opportunities to understand how computationally demanding cognitive processes are supported by alternative brain architectures.

Poster 5: Electrophysiological and pharmacological study of the acetylcholine receptors of the tick Ixodes ricinus

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Ticks are hematophagous ectoparasites transmitting a wide range of pathogens, (including bacteria, viruses, and protozoa), to animals and human. In Europe, *Ixodes ricinus* (the "sheep tick") is the most abundant tick species, and is the vector of at least 20 pathogens, such as the bacteria *Borrelia burgdorferi* responsible for Lyme disease. During a blood meal, pathogens acquired from a previous host can cross the midgut epithelium, disseminate through the tick's body, and colonize the salivary glands, where they can multiply. They are then delivered to a new host via saliva during their next meal. It has recently been discovered that the salivary glands are controlled by neural projections from the central nervous system, the synganglion, with cholinergic pathways playing a fundamental role. In particular, molecular analyses indicate that *I. ricinus* expresses two pharmacologically distinct muscarinic receptor types, Ir-mAChR-A and Ir-mAChR-B. My thesis project consists in the characterization of these 2 receptors both electrophysiologically and pharmacologically. Our initial results indicate that acetylcholine, pilocarpine and bethanecol act as agonists of Ir-mAChR-A, whereas atropine acts as an antagonist. Next, generated mutants of the Ir-mAChR-A and Ir-mAChR-B will allow us to identify the molecular determinants underlying atropine sensitivity. Finally, it will be important to determine the signaling pathways and associated ion channels coupled to these receptors. Taken together, dissecting the neural pathways that regulate salivary gland function and salivation in ticks could provide valuable leverage for developing novel strategies to reduce tick feeding success and ultimately limit pathogen transmission.

Poster 6: The clock-related neuropeptide Pigment Dispersing Factor is essential for the photoperiodic reproductive switch of the pea aphid

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The pea aphid, *Acyrthosiphon pisum*, is a paradigmatic photoperiodic species with a life cycle closely linked to seasonal changes in day length. The neuropeptide pigment-dispersing factor (PDF) is known to regulate circadian and seasonal responses in other insect species, but its presence in *A. pisum* had not been confirmed until our recent study. Indeed, we identified a PDF-coding gene and developed a specific antibody that stained four neurons in each brain hemisphere, co-expressing the circadian core-clock protein Period. These neurons exhibit daily and seasonal plasticity, similar to that observed in Drosophila PDF neurons, and their terminals overlap with insulin-like peptide (ILP)-positive neurosecretory cells and Cryptochrome (CRY)-positive clock neurons. Given the proposed roles of ILP in seasonal adaptation and CRY in photoperiod detection, these observations suggest that PDF is involved in aphid seasonal timing. To test this hypothesis, we generated pdf knockout mutants via the CRISPR/Cas9. While these mutants were viable and showed no defects under long-day conditions, they completely lost the ability to produce sexual females under short-day photoperiods. This demonstrates that PDF is essential for the short-day–induced production of sexual females. In contrast, male production was unaffected, indicating that male and female sexual morph production relies on distinct photoperiodic pathways, with PDF specifically required for female sexual differentiation. This study provides the first functional evidence that PDF is a key component of the aphid photoperiodic system and establishes CRISPR/Cas9 as a tool for functional genetics in *A. pisum*, enabling future investigation of ILPs and other candidate genes.

Poster 7: Impact of internal state on the behavior and neurophysiology of Honeybee (*Apis mellifera*)

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Cognitive biases refer to systematic alterations in information processing induced by an individual's emotional state. In humans, negative biases promote pessimistic interpretations of ambiguous stimuli, whereas positive biases promote optimistic interpretations.
Recently, the development of non-verbal tasks has allowed researchers to evaluate judgment biase effects in many non-human animal species. They confirmed that responses to ambiguous stimuli are shaped by internal affective states, making cognitive bias tests promising tool for studying animal emotional states. While these biases are now well described across species, underlying neural mechanisms remain largely unknown.
The aim of this project is to identify the neural basis of positive and negative judgement bias in the domestic honey bee (*Apis mellifera*). Specifically, we will investigate how positive or negative experiences influence bees' interpretation of ambiguous olfactory cues. To address this question, bees will be trained with the proboscis extension response differential conditioning paradigm, where one odorant is associated with an appetitive reward, while the second odorant is associated with unpleasant stimulus. After learning, bees will be exposed either to an unexpected appetitive reward or to a one-minute shaking in order to induce a positive or negative emotional state, respectively. By measuring their response to an ambiguous stimulus (*i.e.*, a 50/50 mixture of the rewarded and the punished odorants) we will evaluate whether they display optimistic or pessimistic judgment bias. Building on this behavioral paradigm, we will use a pharmacological approach to examine role of key neuromodulators (*i.e.,* dopamine, serotonin and octopamine) in modulating judgment biases in bees. Finally, with a functional imaging approach we will observe whether negative or positive experiences can modulate olfactory coding and perception.

Poster 8: Nutritional state gates long-term memory consolidation through glial-neuronal metabolic coupling

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The dynamics of memory formation vary according to the type of learning and the internal state of the organism at the time of learning. In Drosophila, the formation of long-term memory (LTM) illustrates such context-dependency: in the olfactory aversive paradigm (odor paired with electric shocks), multiple spaced training sessions are required to establish LTM, whereas a single training session suffices in the appetitive paradigm (odor paired with sugar). How appetitive LTM is so rapidly consolidated, however, remains poorly understood.
We previously showed that the metabolic state of the animal during aversive conditioning determines whether LTM is formed, and that this process is linked to specific neuron-glia metabolic architectures within the mushroom bodies (MBs). The appetitive paradigm engages a distinct metabolic state, which we term the fasting exit (FE), a transition in which a fasted animal encounters and feeds on a caloric food source. Here, we propose that the FE is characterized by a distinct metabolic program within the MBs that enables rapid LTM consolidation. Our data show that, during the FE, gluconeogenesis in cortex glia and glycolysis in α/β Kenyon cells are each independently required for appetitive LTM, while leaving short-term memory intact.
These findings place neuron-glia metabolic interactions at the core of appetitive LTM consolidation, and reveal a novel mechanism by which nutritional state gates memory efficiency.

Poster 9: Post-ingestive malaise induces taste aversive memory in D. melanogaster

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Avoiding toxic food is essential for survival. The co-evolution of plants and insects has driven the diversification of plant defensive compounds and, in parallel, the expansion of insect sensory repertoires to detect them. However, how do insects respond to novel toxins, or to harmful compounds masked by palatable cues such as sweet nectar? Can they learn to avoid foods based on their post-ingestive consequences? Here, we demonstrate that a salt classically used in mammals to induce conditioned taste aversion also triggers a robust aversive memory in Drosophila. Using flyPAD/optoPAD-based assays, we characterize this learning process and its underlying neurobiological mechanisms. We show that ingestion induces a transient post-ingestive malaise mediated by gut oxidative stress, lasting up to 12 h. Remarkably, a single 10-min exposure is sufficient to form a long-lasting memory detectable at 24 h. This form of learning, which we term TAPIM (Taste Aversion Induced by Post-Ingestive Malaise), depends on de novo protein synthesis and the activity of Kenyon cells. Ongoing work aims to systematically define the parameters of TAPIM and to establish a comprehensive framework for comparison with conditioned taste aversion in mammals.

Poster 10: Characterization of the brain gustatory neurons in Drosophila

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Simple sugars such as glucose and fructose play an essential role in metabolic balance and the regulation of feeding behavior. This internship is part of an approach aimed at understanding how these sugars are perceived not via peripheral sensory organs, but by internal receptors located in the brain. Using the drosophila as an experimental model, we studied two gustatory receptor neurons expressed in the brain : Gr43a, involved in the detection of fructose, and Gr64a, sensitive to glucose disaccharides. With the help of genetic tools allowing activation or inactivation of these neurons, combined with immunohistochemistry and automated behavioral tests (flyPAD, optoPAD, and STROBE), we were able to demonstrate that these neurons are both necessary and sufficient to influence the feeding preferences of Drosophila. Our results suggest that neural circuits provide an internal evaluation of nutritional value, functioning independently of peripheral detection. This work contributes to a better understanding of the cerebral bases of feeding motivation and opens up perspectives for the study of metabolic disorders in model animals.

Poster 11: A light-mediated neuronal circuit controlling sleep-wake arousal in Drosophila melanogaster

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Nearly all species have evolved biological timers known as circadian clocks that allow animals to anticipate day-night transitions. In light-dark cycles Drosophila melanogaster flies display a bimodal locomotor activity peaking around dawn and dusk. Light is a powerful synchronizing cue and flies perceive light thanks to a multifaceted visual system, composed of specialized structures such as compound eyes, ocelli and Hofbauer-Buchner eyelet. These sensory organs are made of photoreceptors, set of highly specialised neurons expressing different light receptors molecules named rhodopsins. How light synchronizes the firing of the clock neurons to elicit 24hr behavioral activity/sleep rhythms is to date not completely understood. Our ongoing project aims at describing the circuit architecture of the visual system of Drosophila, its inputs to the clock neuron network and how it branches into the sleep neuronal centers. We are conducting our research from the larval stages to the adult fly by mapping the synaptic wiring diagram and neurotransmitters used by the different neuronal components that form these circuits. More precisely, we aim at deciphering the cellular and molecular logic acting during the establishment of this system from early development stages onwards. Additionally, we are interested in understanding how genetic and/or environmental perturbations (such as exposure to different conditions of light intensities and/or wavelengths) during critical periods of this synaptic wiring phase in the larva or in the adult will impact the physiology and functioning of the circadian clock and sleep behaviour in adult flies.

Poster 12: Neural mechanisms and value-based decision-making in Drosophila melanogaster

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Value-based decision-making allows animals to select between competing options based on past experiences to predict outcomes. To make the best choice, flies must evaluate the costs and benefits associated with each option and select the most appropriate one. However, how these comparisons are made depending on task difficulty remains poorly understood. To investigate this process, we manipulate task complexity in Drosophila using an olfactory conditioning paradigm: two odors are paired with electric shock of different intensities. By varying this difference, we modulate the absolute value of each option and the relative value between options that flies use to compare and choose the best option. To study decision-making behavior, we developed the Drosobox, a high-resolution binary choice arena allowing real-time tracking of single fly. Unlike traditional T-maze assays, this setup tracks the full decision dynamics. To decipher this behavior, we combined tracking software (Flytracker) with a custom MATLAB pipeline. Beyond classical locomotor features such as speed and zone exploration, we quantified decision-related behavior including transitions between compartments and hesitation-like dynamics. To understand the underlying mechanisms, we explore the role of dopaminergic circuits, well-established modulators of value-based decision-making in all species. In Drosophila, the PPL1 and PAM dopaminergic neuron clusters signal punishment and rewards values, respectively, during learning and enable the comparison of options. By using optogenetic, we study the involvement of dopaminergic circuits during decision dynamic. This work aims to provide a more comprehensive circuit-level understanding of value-based decision processes.

Poster 13: Sensory compensation enhances visual learning in Drosophila

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The loss of a sense can be compensated by adaptive processes that enhance the remaining sensory pathways. However, our understanding of how such cross-modal compensation supports cognitive functions remains limited. In this study, we show that compromising olfaction in both larval and adult Drosophila leads to enhanced visual learning capacities. Through connectomic and functional analyses of hyposmic flies, we demonstrate that this compensation is achieved by reorganizing the integration of visual information within the mushroom body, the fly's memory center, through structural modifications of visual inputs, adjustments in cross-modal inhibition, and the recruitment of a previously dormant visual pathway. These findings establish the presence of cross-modal compensation in the Drosophila brain across developmental stages and provide insights into adaptive mechanisms that promote cognitive flexibility following sensory loss.

Poster 14: Butyrate intake in new drosophila colitis model shows beneficial effects on survival

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Inflammatory bowel (IBD) diseases such as Crohn's disease or ulcerative colitis are multifactorial diseases and intestinal dysbiosis (i.e. an imbalance in the microbiota composition and function) has been pointed out in IBD 15 years ago. In IBD patients, dysbiosis has been characterized as a decrease in the abundance of beneficial butyrate producing bacteria such as *Faecalibacterium* bacteria. There is no known cure for these diseases, however palliative treatment such as probiotics can be used to lessen the symptoms. *Faecalibacterium duncaniae* (ex *prausnitzii*) A2165 strain has been described as a new generation probiotic with anti-inflammatory proprieties in preclinical murine and in vitro models. However underlying cellular and molecular mechanisms remain poorly understood and most of the data comes from a single A2165 academic strain. With this work, we aim to develop a Drosophila melanogaster colitis model using the Ecc15 phytopathogenic bacteria model to better characterize anti-inflammatory and anti-proliferative properties of different strains of *Faecalibacterium*. We first were interested in butyrate effect. By feeding Drosophila with sodium butyrate, we performed survival assays, quantified antimicrobial peptide (AMP) transcripts using RT-qPCR, and imaged the intestine to assess proliferating cells. We observed that butyrate has a strong protective effect against oral infection by Ecc15. This is the first demonstration of a beneficial effect of butyrate in Ecc15 survival test and the underlying mechanism remain to be defined.

Poster 15: Impact of alarm pheromone on honey bee olfactory neurophysiology

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Alarm signals enable animals to adjust behavior in response to threat, often suppressing food-related activities in favor of defensive responses. Such state-dependent behavioral shifts are observed across vertebrate and invertebrate species and are supported by rapid changes in neural processing that alter how sensory information is perceived and acted upon.

In honey bees (Apis mellifera), alarm pheromone exposure shifts behavior from foraging to aggression and disrupts appetitive olfactory learning and memory. The main component of the alarm pheromone, isoamyl acetate, is known to induce defensive responses. Yet its effects on early olfactory processing and the neuromodulatory mechanisms underlying its cognitive impact remain poorly understood.

This study addresses (A) if and how isoamyl acetate influences olfactory coding and perception, and (B) which neuromodulatory pathways mediate its effects on olfactory cognition and neurophysiology. First, we will reproduce previous findings on the effects of isoamyl acetate on olfactory appetitive learning using the proboscis extension reflex conditioning paradigm. Then, we will perform functional calcium imaging of antennal lobe, to investigate whether the pre-exposure to isoamyl acetate can alter the neural representation - hence the perception - of neutral and appetitive odorants. Finally, we will investigate the underlying neuromodulatory mechanisms using a pharmacological approach. Specifically, we will perform olfactory conditioning, with or without isoamyl acetate pre-exposure, under pharmacological manipulation of octopamine, dopamine, and serotonin receptors using selective agonists and antagonists. This approach will allow us to identify the monoaminergic pathways mediating alarm state-induced changes in olfactory cognition and neurophysiology. By linking behavior, neural coding, and neuromodulation, this work will help our understanding of how internal state signals dynamically reconfigure sensory systems.

Poster 16: Glug transporter imports glucose in astrocytes and supports LTM formation

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Astrocyte-to-neuron H_2O_2 signalling (ANHOS) supports long-term memory (LTM) formation in Drosophila and is impaired in an Alzheimer's disease model. ANHOS is notably fuelled by glucose supplying the astrocytic pentose phosphate pathway which generates NADPH used by NOX for $O_2°^-$ synthesis. However, how astrocytic glucose involved in ANHOS enters astrocytes and which pathways it fuels remain unknown. We thus focused on glucose flux and transmembrane glucose transporters, Glug, Glut1 and Nebu. We used behaviour with spaced associative aversive olfactory conditioning to study LTM and in vivo glucose imaging in astrocytes. We uncovered that Glug knockdown in astrocytes causes a specific LTM defect. However, neither Glut1 or Nebu present an LTM defect in astrocytes. This suggests that Glug may support the ANHOS pathway in astrocytes by transporting glucose to sustain it thus promoting astrocytic glucose influx. To study and activate ANHOS, we stimulated nAChRα7 in astrocytes using nicotine. To question whether astrocytic glucose increased during ANHOS we expressed FLII12Pglu-700μδ6 in astrocytes while stimulating nAChRα7. No glucose flux increase in astrocytes was observed. These results put together could indicate that while Glug transports glucose into astrocytes, this transporter might not be involved in ANHOS or that the effect is subtle. To generate physiological conditions of ACh release, we will use conditioning under the microscope (5x spaced) and search for a change in glucose flux. Glug may also act permissively for ANHOS, and maintain basal glucose level in astrocytes enabling ANHOS. Thus, we will test if Glug knockdown reduces astrocytic glucose in naive flies.

Poster 17: The maternal effect of the snoRNA jouvence predetermine the metabolic parameters, which affect the aging of the brain, and the lifespan, in Drosophila

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Ageing and longevity are complex physiological processes that results from the progressive accumulation of deleterious damages in cells. Our team is investigating a cluster of three snoRNAs in Drosophila, which includes the snoRNAs jouvence, sno2, and sno3. All three are involved in ageing, longevity, and neurodegeneration/neuroprotection (Soulé et al., 2020). These three snoRNAs have been characterized as regulators of intestinal homeostasis, including sterols and triglycerides metabolism, providing a neuroprotection (Al Issa et al., 2025). They are all expressed in enterocytes, as well as in nurse cells of the ovaries.

Up to now, only their expression in enterocytes has been shown to have an impact on longevity, metabolic parameters, and neurodegeneration. Thus, the function of these three snoRNAs in the ovaries remains to be determined.

Here, we show that each snoRNAs are deposited within the oocytes, and that each of them affects, already at 7 days-old, the metabolic parameters, while at 30 day-old they have an impact on the the neurodegeneration, and finally the lifespan, demonstrating that all of these parameters are predetermined by the mother, thus involving a maternal effect.

Therefore, we are currently studying how these snoRNAs, already present in the egg before fertilization, modulate longevity, metabolic parameters, and neurodegeneration. The main hypothesis being investigated is that these snoRNAs modulate chromatin structure throught epigenetics and imprinting mechanisms. To study this question, genetic, genomic, immuno-histological, and physiological approaches, complemented by Chip-Seq, Dam-ID, and Cut&Tag approaches, will be used.

Poster 18: Evolution of pheromone detection in granary weevils

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Weevils of the genus Sitophilus are among the most destructive pests of stored cereals and cereal products worldwide. In particular, the rice weevil (*S. oryzae*), the corn weevil (*S. zeamais*) and the granary weevil (*S. granarius*) cause significant grain losses. Like many weevils, these species rely on male-produced aggregation pheromones to locate and colonize new grain resources. *S. oryzae* and *S. zeamais* produce (4S,5R)-5-hydroxy-4-methylheptan-3-one (sitophinone), whereas *S. granarius* emits (2S,3R)-1-ethylpropyl 2-methyl-3-hydroxypentanoate (sitophilate). In insects, pheromones are detected by olfactory sensory neurons that express odorant receptors (ORs). Analysis of the *S. oryzae* genome recently identified 100 OR genes, but their functions remain unknown and the pheromone receptors have not been identified. Here, we first used transcriptomics to identify ORs and quantify their expression levels in the antennae of the three Sitophilus species, hypothesizing that pheromone receptors would exhibit elevated expression levels. The OR repertoire was largely conserved, except for one OR whose sequence was more variable and which was highly expressed in all three species. We then studied its response spectrum in each of the three species using heterologous expression in Drosophila olfactory neurons. This revealed that this OR is indeed an aggregation pheromone receptor, tuned to sitophinone in *S. oryzae* and *S. zeamais*, and to sitophilate in *S. granarius*. These results demonstrate that a single OR adapted to detect two structurally distinct pheromones.

Poster 19: Modulation of taste sensitivity by the olfactory system in Drosophila

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An animal's sensory percepts are not raw representations of the outside world. Rather, they are constructs influenced by many factors including the species, past experiences, and internal states. One source of perceptual variability that has fascinated researchers for decades is the effect of losing one sensory modality on the performance of another. Typically, dysfunction of one sense has been associated with elevated function of others, creating a type of sensory homeostasis. For example, people with vision loss have been reported to demonstrate enhanced tactile and auditory functions, and deafness has been associated with heightened attention to visual inputs for communication. By contrast, smell and taste—the two chemosensory modalities—are so intrinsically linked in their contributions to flavor that loss of smell is often anecdotally reported as leading to deficiencies in taste. However, human studies specifically examining taste are mixed and generally do not support this widely-held belief, and data from animal models is largely lacking. Here, we examine the impact of olfactory dysfunction on taste sensitivity in Drosophila melanogaster. We find that partial loss of olfactory input (hyposmia) dramatically enhances flies' sensitivity to both appetitive (sugar, low salt) and aversive (bitter, high salt) tastes. This taste enhancement is starvation-independent and occurs following suppression of either first- or second-order olfactory neurons. Moreover, optogenetically increasing olfactory inputs reduces taste sensitivity. Finally, we observed that taste enhancement is not encoded in the activity of peripheral gustatory sensory neurons, but is associated with elevated sugar responses in protocerebrum anterior medial (PAM) dopaminergic neurons of the mushroom bodies. These results suggest a level of homeostatic control over chemosensation, where flies compensate for lack of olfactory input by increasing the salience of taste information.

Poster 20: Mechanisms underlying negative mechanotaxis in a neuronless animal

Andrea Pasini, Marvin Leria, Moina-mkou Daroueche, Magali Requin, Fabrice Richard, Nicolas Brouilly, Roman Hill, André Le Bivic, Raphaël Clément

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Trichoplax is a small marine benthic animal, belonging to the phylum Placozoa, which crawls on the sea floor thanks to the coordinated beating of thousands of motile cilia. The anatomy of Trichoplax is extremely simple simplicity, being essentially constituted of two layers of ciliated epithelial cells which enclose an internal cavity, without organs, neurons or muscle cells. In addition, Trichoplax has an ameboid aspect, with no fixed body axis and with the ability to constantly change its shape. Despite its simplicity, Trichoplax is capable of complex behaviours, such as coordinated movements, mechanotaxis and chemotaxis. Here we describe a phenomenon of very fast, Ca2+-dependent, coordinated reorientation of the cilia which allows Trichoplax to quickly change its direction of movement when challenged with potentially noxious mechanical stimuli. This reveals the existence of mechanisms that allow a very simple animal to interact in complex ways with the surrounding environment without relying on a network of interconnected neurons.

Poster 21: Balancing opposing memories: Circuit mechanisms of flexibility in *Drosophila*

Ricciuti, Ana; Schweizer, Johanna; Gür, Burak; Pleijzier, Markus; Felsenberg, Johannes

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Animals form memories from experience and when facing similar situations, stored information can be retrieved to guide goal-directed behavior. Since the world is rarely steady, previously acquired information may not be true at a later timepoint. Thus, animals need to be able to update their representation of the environment and adapt their expectations accordingly.

Conflictive information presented after learning can lead to two mutually exclusive phenomena: the formation of a new memory with opposing valence, or the update of the original memory. The understanding of the neuronal circuits underlying these two different mechanisms is in its infancy.

In counter-conditioning, conflicting information is presented and the valence associated with a cue is reversed. Our experiments suggest that this protocol leads to the formation of a parallel memory and that internal state can modulate the expression of opposing memories. In addition, a candidate circuit could potentially encode how these conflictive memories interact to drive behavior.

Poster 22: Investigating non-motor symptoms of Parkinson's Disease using Drosophila melanogaster as model.

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Parkinson's Disease (PD) is a neurodegenerative disorder characterized by typical motor symptoms (MS). PD is also characterized by the largely understudied non-motor symptoms (NMS). Gastrointestinal symptoms, which include constipation and feeding defects, are one of the most common NMS and appear up to ten years before MS' insurgence. The gastrointestinal tract has a pivotal role in regulating body's physiology and pathology partly via the "brain-gut axis", the communication route between the gut and the brain. Studying how the gut and the gut-brain axis influence gastrointestinal NMS in PD is challenging in mammals due to the anatomical complexity and limited understanding of gut–brain communication. To overcome these limitations, I am using the model organism Drosophila melanogaster. Drosophila shares similarities in brain and gut cell composition as well as in signaling pathways with mammals. However, Drosophila provides sophisticated genetic tools to allow spatiotemporal control of gene expression which in mammalian systems are currently unavailable. I am investigating how impairment of PD–associated genes, such as mitochondrial gene Pink1, results in gastrointestinal phenotypes characteristic of the disorder. I am focusing on how Pink1 influences gut physiology, neuronal degeneration and mitochondrial function. My results show that Pink1 null mutants exhibit a constipation-like phenotype and feeding defects in female Drosophila, in line with what seen in human patients. Building on these data I now aim to 1) identify the cellular nature (in the gut or in the brain) of NMS' insurgence; 2) elucidate the timeline of mitochondrial dysfunction appearance in the enteric epithelial cells and dopaminergic neurons.

Poster 23: Amino acids dynamics across Sleep-wake cycle in Drosophila

Sandrine Parrot, Jacob Crehan, Chloé Aman, Philippe De Deurwaerdère, Matthew Thimgan, **Laurent Seugnet**

Laboratory / Team: CRNL/Laurent Seugnet, Lyon Neuroscience Research Center (CRNL), Bron, France

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The intense metabolic activity of the brain requires a substantial supply of nutrients compared to other organs. This is reflected in the strong and complex interactions between regulation of the sleep/wake cycle and dietary need, as well as in the metabolic disturbances associated with sleep disruption. For instance, the consumption of glucose and sugar can promote sleep across species. Relatively underexplored in this context is the significance of amino acids. Unlike other nutrients, amino acids cannot accumulate in intracellular storage systems such as glycogen and lipid droplets. To begin deciphering brain-periphery interactions across the sleep wake cycle, we evaluated free amino acid levels in brain and hemolymph samples from single wild type and per0 flies, devoid of a functional circadian clock. A proportion of these amino acids displayed time-of-day and/or clock-dependent variations. In addition, cross-correlation analysis of the datasets revealed that most amino acids are mutually interconnected in a time-of-day and clock dependent manner. Altogether this work suggests that a comprehensive view of whole-brain amino acid levels hold the potential to provide valuable insights into the brain's state, given the mutual interconnections through metabolism, food intake, and neurotransmission.

Poster 24: Integration of information in the absence of action in Drosophila

Johanna A. Schweizer, Dennis Goldschmidt, Johannes Felsenberg

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In dynamic environments learned information must be continuously revised to predict the most feasible outcome of a situation and initiate appropriate behavioral responses. Associations that turn out to be unreliable must be updated by new learning. Thus, learning from repeated non-reinforced re-exposure to cues that elicit inadequate fear or favor drug-related relapse provides an opportunity to alleviate the consequences of maladaptive memories. Extinction based therapy has the potential to weaken associations between cues and reinforcement thereby helping to prevent relapse and promoting new learning. However, whether such extinction learning requires the expression of learned responses is not known. Here we provide evidence that extinction of reward memories does not require conditioned food seeking behavior. Satiated flies (Drosophila melanogaster) do not express learned approach behavior to a sugar predicting odor. However, despite the absence of food seeking behavior, satiated flies learn about the omission of the predicted sugar and adapt their behavior accordingly. This learning in the absence of seeking behavior depends on peripheral sensing of the sweet taste of the food. However, interference of novel stimuli can perturb extinction learning in satiated but not hungry flies. Thus, although extinction learning can take place in the absence of behavioral expression of the memory, it seems to be more sensitive to contextual information. Understanding how extinction learning does or does not depend on behavioral responses will be essential to improve its application in therapeutic approaches. Furthermore, the decoupling of computation of information from action might allow to understand cognitive operations.

LIST OF THE 89 ATTENDEES

Abed-Vieillard Dehbia, CSGA, Dijon, France
Adiletta Alice, ICM, Paris, France
Akyel Irem, ICM, Paris, France
Alves George, CSGA, Dijon, France
Andrea Pasini, IBDM, Marseille, France
Aruçi Enisa, CSGA, Dijon, France
Baumann Vincent, IBPS, Paris, France
Bellanger Cécile, CEEC, Luc-sur-mer, France
Bergé Léna, CSGA, Dijon, France
Berthon—Grelat Elyne, NeuroPSI, Paris-Saclay, France
Bertolini Enrico, University of Fribourg, Switzerland
Birman Serge, Paris-Cité, Paris, France
Boulanger Ana, IGF, Montpellier, France
Braun Eléonore, iEES, Paris, France
Brossier Claire, ESPCI Paris, France
Brousseau Salomé, CEEC, Luc-sur-mer, France
Cadiou Hervé, INCI, Strasbourg, France
Campana Leonardo, LGBDI-USP, Brazil
Caroline Martin, ESPCI, Paris, France
Cavey Mathieu, IBDM, Marseille, France
Chakraborti Udipta, IBPS, Paris, France
Chartier Philippine, P2E, Orléans, France
Chauvel Isabelle, CSGA, Dijon, France
Chlemaire Amandine, CSGA, Dijon, France
Chrzanowska Anna, ICM, Paris, France
Clémençon Paul, IEES, Paris, France
Colizzi Francesca Sara, IGEPP, Le Rheu, France
De Las Heras José, LGBC, Paris, France
Devaud Jean-Marc, CRCA, Toulouse, France
Droesbeke-Fuente Léa, CSGA, Dijon, France
Dumas Camille, Paris-Cité, Paris, France
Dupas Stéphane, CSGA, Dijon, France
Dura Jean-Maurice, IGH, Montpellier, France
Durr Volker, Bielefield university, Germany
Durrieu Matthias, Ramdya lab, EPFL, Switzerland
Dussutour Audrey, CRCA, Toulouse, France
Eberl Samuel, ESPCI, Paris, France
Ebert Julie, CSGA, Dijon, France
Flaven Pouchon Justin, CSGA, Dijon, France
Fraichard Stéphane, CSGA, Dijon, France
Franchet Adrien, CSGA, Dijon, France
Gaillard Thomas, ISM, Marseille, France
Gal Charline, IGF, Montpellier, France
Garces Alain, CRNL, Lyon, France
Garino Loris, IBDM, Marseille, France

Gho Michel, IBPS, Paris, France
Giurfa Martin, IBPS, Paris, France
Goerlinger Alexandre, CIIl Pasteur Lille, France
Grosjean Yaël, CSGA, Dijon, France
Guiraud Clara, IGF, Montpellier, France
Gür Burak, FMI, Basel, Switzerland
Guth Antonin, CSGA, Dijon, France
Hendrik Wollenberg, ICM, Paris, France
Hubleur Anne-Valérie, Easy Behavior, Lisbon, Portugal
Huillet Eugénie, Probihôte-Micalis, Jouy-en-josas, France
Issa Raouf, ESPCI, Paris, France
Itskov Pavel, Easy Behavior, Lisbon, Portugal
Laisney Evan, Probihôte-Micalis, Jouy-en-josas, France
Lemaire Bastien, CEEC, Caen France
Lemaitre-Guillier Christelle, CSGA, Dijon, France
Macri Catherine, IBPS, Paris, France
Manière Gérard, CSGA, Dijon, France
Marcout Claire, CSGA, Dijon, France
Mariette Julia, IDEEV, Paris, France
Martin Jean-René, NeuroPSI, Paris-Saclay, France
Marty Simon, CRCA, Toulouse, France
Merabet Nesrine, IGF, Montpellier, France
Minquilan Pauline, NeuroPSI, Paris-Saclay, France
Monnier Véronique, Paris-Cité, Paris, France
Montagné Nicolas, iEES, Paris, France
Musso Pierre-Yves, CSGA, Dijon, France
Nataraj Nandita, CRCA, Toulouse, France
Padmanabhan Aishwarya, ESPCI, Paris, France
Paoli Marco, CSGA, Dijon, France
Pavao-Delgado Miguel, FMI, Basel, Switzerland
Pavlowski Alice, ESPCI, Paris, France
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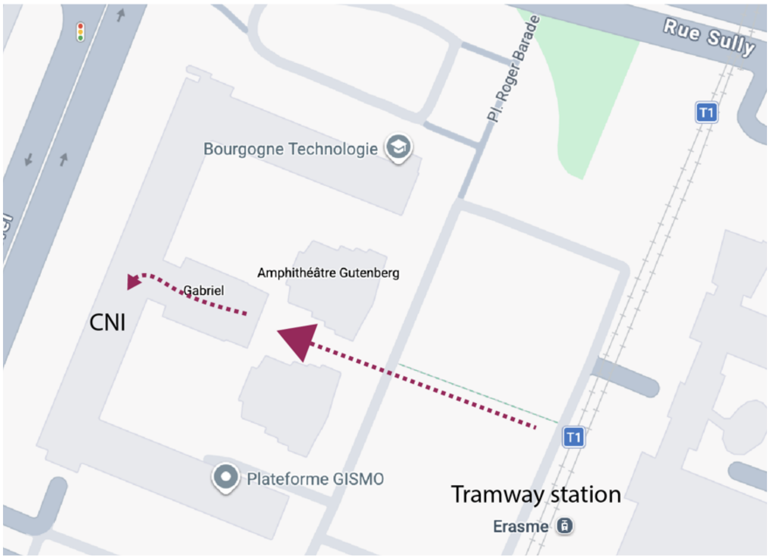
Plaçais Pierre-Yves, ESPCI, Paris, France
Ravel Nils, IBC, Nice, France
Ricciuti Ana, FMI, Basel, Switzerland
Ricquebourg Rebekah, Jacque Monod, Paris, France
Roselli Camilla, ICM, Paris, France
Schweizer Johanna, FMI, Basel, Switzerland
Seugnet Laurent, CRNL, Lyon, France
Sillon Léo, CSGA, Dijon, France
Stoclet Lydie, CRNL, Lyon, France
Turki Ema, Paris-Cité, Paris, France
Villar Maria, IBPS, Paris, France
Vittet Julie, CSGA, Dijon, France

Practical information

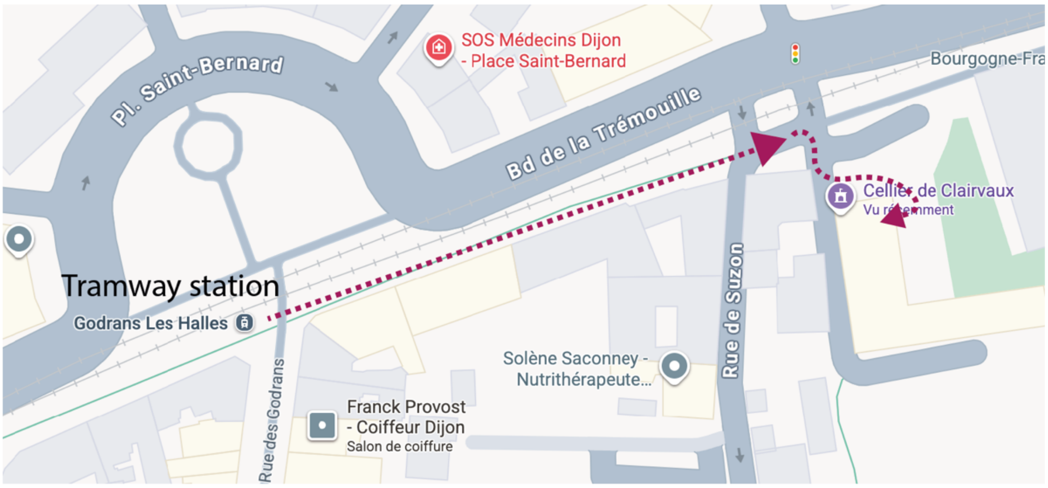
The conference will take place in the Gabriel building, on the University Bourgogne Europe campus (6 Bd Gabriel, 2100, Dijon) at the amphitheater ORBIGNY

It can be reached by public transport from Dijon train station:
- **T1 tramway** heading to “Quetigny-la parenthèse” then 20 minutes later, stop by “Erasme”.



Dinner at “le Cellier de Clairvaux »

Dijon Municipality kindly lend us one of the most beautiful places in Dijon, “le Cellier de Clairvaux”, where we will have dinner on Thursday night.
It can be reached by public transport from Erasme train station:
- **T1 tramway** heading to “Gare Dijon” then 20 minutes later, stop by “Godrans les Halles”.



Looking forward to meeting you all!

Pierre-Yves Musso and his team.

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