Paris Brain Institute (ICM)
Sorbonne University (SU)
Paris, France

14 - 16 JUNE 2023

ZENITH SYMPOSIUM

June | 2023

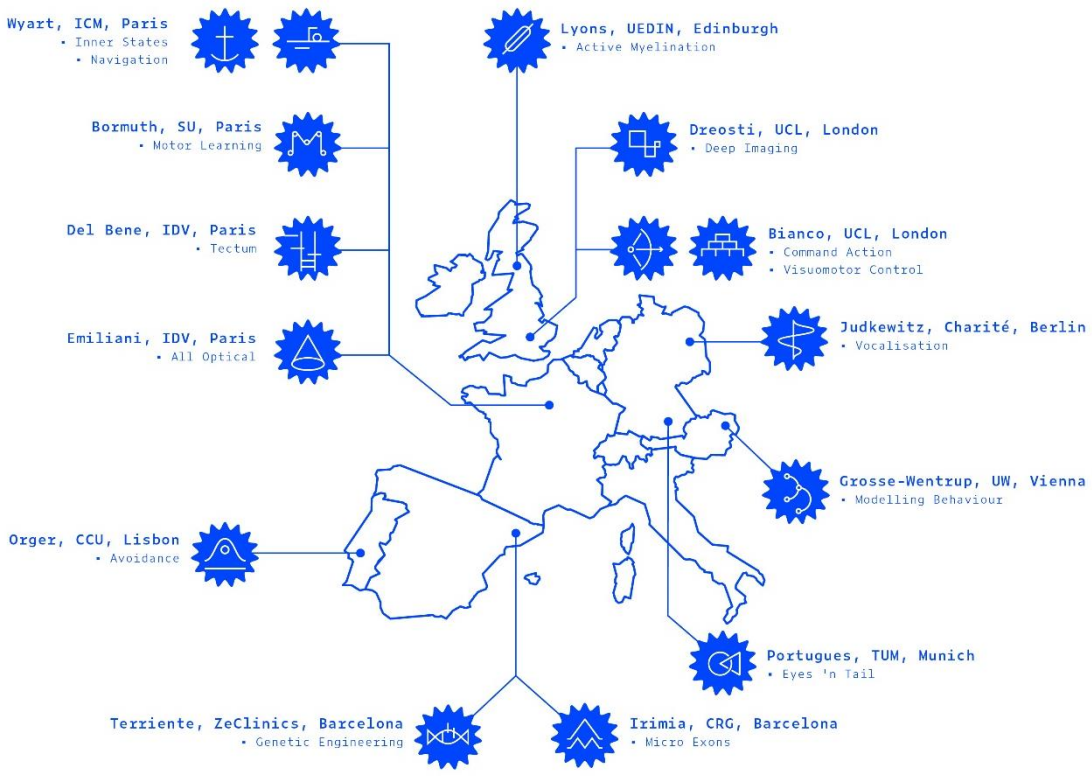
Zenith

ABOUT ZENITH

The ZEbrafish Neuroscience International Training Hub (ZENITH) PhD Program trains a new generation of neuroscientists in cutting-edge approaches that bridge biology, physics, computer science and mathematics to uncover the mysteries of brain formation and function.

ZENITH exploits the power of zebrafish and Danionella to study brain formation and function at scales that span from the molecular properties of single cells through to the activity of entire neural networks and whole animal behaviour.

ZENITH is international, interdisciplinary and intersectoral. It trains 15 students, hosted by 13 laboratories, who undertook projects that address major questions in neuroscience:



For more information, visit www.zenith-etn.com!

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie actions, grant agreement #813457.

Zenith

WELCOME ADDRESS

Welcome to the final Symposium Meeting of the interdisciplinary European doctoral training network ZENITH! This meeting will be an opportunity to hear about the work and vision of a selected number of renowned guest scientists in the neuroscience field, and to meet the 15 graduate students trained from 13 different labs across Europe who will present their body of work accomplished over the last 3 years. The Symposium will promote idea exchange and foster collaboration. We encourage the Zenith students to interact with speakers and guests, to talk about their vision on the most exciting methodological and conceptual directions to follow in the development of neuronal circuits underlying behavior. We are looking forward to welcome you in Paris at this magical time of the year where terraces flourish, enabling informal discussions along the river.

Claire Wyart
ZENITH coordinator

Joana Guedes
ZENITH project manager

Keywords: neuroscience, neuronal circuits, behaviour, motor control, sensorimotor, spinal cord, vestibular system, visual, connectomics, anatomy, cell types, zebrafish, danionella, PhD

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie actions, grant agreement #813457.

Zenith

GENERAL INFORMATION

VENUE & ACCOMODATION

The Symposium will take place in two different locations! It will start at the Paris Brain Institute (ICM) on the 14 June and continue at the Sorbonne University (SU) on the 15 and 16 June, in Paris, France. Please find below information on the venues. Access plans are available on Annex 2.

1. Institut du Cerveau (ICM) - Hôpital Pitié Salpêtrière, 83, Bd de l'hôpital 75013 Paris (please click on the link for the access plan, a PDF version is available here)

2. Sorbonne University (SU), Amphithéâtre Charpak, Campus de Jussieu, 4 place Jussieu 75005 Paris (please click on the link for the access plan)

For a number of participants the accommodation (breakfast included) has been arranged in one of the hotels below:

Hôtel Rosalie, 8 bis Avenue de la Sœur Rosalie, 75013 Paris - Check in is from 14:00 and check out before 12:00.

- 20 min walk or 15 min by metro (line 5 or 6) to the venue - Institut du Cerveau (ICM)
- 30 min walk or 20 min by metro (line 7) to the venue - Sorbonne University (SU), Amphithéâtre Charpak

Hôtel Saint-Marcel, 3 Boulevard Saint Marcel, 75013 Paris

- 10 min walk to the venue - Institut du Cerveau (ICM)
- 25 min walk, 15 min by metro (line 7) or 10 min by taxi to the venue - Sorbonne University (SU), Amphithéâtre Charpak

If you need assistance with the transports please contact the organisers.

MEALS

Coffee, tea and refreshments will be served during morning and afternoon coffee breaks. The welcome coffees do not include food, only beverages. Buffet lunches and refreshments will be provided during all lunch breaks. We will offer a cocktail on Wednesday evening with canapés and food to share, a dinner is booked at a local restaurant for Thursday (*Le Buisson Ardent*, located at a 5 min walk from the venue), and there will be also small plates to share at the boat party on Friday evening. In addition, a list of local restaurants is provided on Annex 3. Please communicate any dietary restrictions.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie actions, grant agreement #813457.

AMENITIES AROUND

Paris does not need presentations but located close to the Symposium venues you have the beautiful Jardin des Plantes, the Grande Mosquée de Paris, the Institut du Monde Arabe and many other. For more tips of Paris, just reach out to the Paris-based researchers!

SOCIAL MEDIA

If you wish to tweet about the conference use @zenith_etn. We are also on Instagram @zenith_etn.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie actions, grant agreement #813457.

Zenith

PROGRAM AT A GLANCE

	Wednesday 14 Paris Brain Institute (ICM)		**Thursday 15** Amphithéâtre Charpak, Sorbonne University		**Friday 16** Amphithéâtre Charpak, Sorbonne University	
08h30-09h00	Welcome coffee					
09h00-09h30	**Hackathon**		**Andy Bass - Cancelled**	Chair: Tanita	**Kevin Briggman**	Chair: Giulia
09h30-09h45			**Matthew Lovett-Barron**		**Sharbatanu Chatterjee**	
09h45-10h00				Timer: Edouard	**Tanita Tzotzolaki**	Timer: Alizée
10h00-10h15			**Elena Putti**		**David Schoppik**	
10h15-10h30			**Tahnee Mackensen**			
10h30-11h00			Coffee Break/Posters		Coffee Break/Posters	
11h00-11h30			**Alex Schier**	Chair: Sadiq	**Corinne Houart**	Chair: Sharbat
11h30-11h45			**Alizée Kastler**		**Bushra Raj**	
11h45-12h00			**Shuhong Huang**			
12h00-12h15			**Takashi Kawashima**	Timer: Phil	**Xinyu (Cilia) Jia**	Timer: Verity
12h15-12h30					**Chung Yuen (Joe) Chan**	
12h30-13h00			**Misha Ahrens**		**Marnie Halpern**	
13h00-13h30			Lunch		Lunch	
13h30-14h00						
14h00-14h30			**Aleksandra Walczak**		**Dave McLean**	
14h30-14h45			**Thomas Soares Mullen**		**Martha Bagnall**	Chair: Phil
14h45-15h00			**Verity Cook**			
15h00-15h30	**WELCOME & INTRO** Claire Wyart		Coffee Break/Posters	Chair: Tahnee	Coffee Break/Posters	Timer: Sadiq
15h30-15h45	**Edouard Dumon**	Chair: Thomas				
15h45-16h00	**Giulia Zuccarini**			Timer: Sharbat		
16h00-16h15	**Sadiq Adedayo**		**Herwig Baier**		**Karl Kilborn**	
16h15-16h30	Coffee Break		**Gautam Sridhar**		**CLOSURE**	
16h30-16h45			**Philipp Braaker**			
16h45-17h00						
17h00-17h30	**Joe Fetcho**	Timer: Gautam	**James Fitzgerald**		Free time/ Networking	
17h30-17h45						
17h45-18h15	**Srinivas Turaga**		**Posters: Session II**			
18h15-18h30	**Posters: Session I**					
18h30-18h45						
18h45-19h00			Free time/ Networking			
19h00-19h30					Happy Hour **BOAT PARTY**	
19h30-	Welcome Cocktail		Dinner			

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie actions, grant agreement #813457.

Zenith

INVITED SPEAKERS

Joseph R. Fetcho

Cornell University, Department of Neurobiology and Behavior, United States

Session:
Wednesday, June 14, 17:00 - 17:45, ICM Auditorium
I don't have the answers, but I always have opinions… *(Abstract 04)*

Srinivas Turaga

HHMI's Janelia Research Campus, United States

Session:
Wednesday, June 14, 17:45 - 18:15, ICM Auditorium
How to simulate a connectome? *(Abstract 05)*

Andrew H. Bass

Cornell University, Department of Neurobiology and Behavior, United States

Session:
Thursday, June 15, 09:00 - 09:30, SU Amphi Charpak
Telencephalic diversity: new challenges of paedomorphic *Danionella* *(Abstract 06)* – **session cancelled**

Matthew Lovett-Barron

University of California San Diego (UCSD), Department of Neurobiology, United States

Session:
Thursday, June 15, 09:30 - 10:00, SU Amphi Charpak
Collective Movement of Danionella Cerebrum *(Abstract 07)*

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie actions, grant agreement #813457.

Zenith

Alex Schier

University of Basel, Biozentrum, Switzerland

Session:
Thursday, June 15, 11:00 - 11:30, SU Amphi Charpak
Reconstructing cellular biographies *(Abstract 10)*

Takashi Kawashima

Weizmann Institute of Science, Israel

Session:
Thursday, June 15, 12:00 - 12:30, SU Amphi Charpak
Voltage imaging of distributed sensorimotor computations across brain areas *(Abstract 13)*

Misha B. Ahrens

HHMI's Janelia Research Campus, United States

Session:
Thursday, June 15, 12:30 - 13:00, SU Amphi Charpak
Molecular mechanisms and fast-acting antidepressant modulation of glia-neuron communication in behavioral state switches *(Abstract 14)*

Aleksandra Walczak

École Normale Supérieure (ENS), Laboratoire de Physique, France

Session:
Thursday, June 15, 14:00 - 14:30, SU Amphi Charpak
Inferring interactions in neural and behavioural networks *(Abstract 15)*

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie actions, grant agreement #813457.

Zenith

Herwig Baier

Max Planck Institute (MPI) for Biological Intelligence, Germany

Session:
Thursday, June 15, 16:00 - 16:30, SU Amphi Charpak
Labelled lines for flexible codes — the zebrafish perspective on vision *(Abstract 18)*

James Fitzgerald

HHMI's Janelia Research Campus, United States

Session:
Thursday, June 15, 17:00 - 17:30, SU Amphi Charpak
Identifying key structural connections from functional response data *(Abstract 21)*

Kevin L. Briggman

Max Planck Institute (MPI) for Neurobiology of Behavior – Caesar, Germany

Session:
Friday, June 16, 09:00 - 09:30, SU Amphi Charpak
Visually-guided and context-dependent spatial navigation in *Danionella cerebrum* *(Abstract 22)*

David Schoppik

New York University (NYU) Langone Health, United States

Session:
Friday, June 16, 10:00 - 10:30, SU Amphi Charpak
The Early Life of Extraocular Motor Neurons: Birth, Function, and Disease *(Abstract 25)*

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie actions, grant agreement #813457.

Zenith

Corinne Houart

King's College London, United Kingdom

Session:
Friday, June 16, 11:00 - 11:30, SU Amphi Charpak
A FoxG1 transformation tunes local decisions in neurons *(Abstract 26)*

Bushra Raj

University of Pennsylvania (UPenn), Dept. of Cell & Developmental Biology, United States

Session:
Friday, June 16, 11:30 - 12:00, SU Amphi Charpak
Large-scale capture of Notch signaling activity in the developing zebrafish brain *(Abstract 27)*

Marnie E. Halpern

Dartmouth College, Geisel School of Medicine, United States

Session:
Friday, June 16, 12:30 - 13:00, SU Amphi Charpak
Mapping neural circuits the genetic way *(Abstract 30)*

David McLean

Northwestern University, Department of Neurobiology, United States

Session:
Friday, June 16, 14:00 - 14:30, SU Amphi Charpak
Spinal basis of direction control during locomotion in larval zebrafish *(Abstract 31)*

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie actions, grant agreement #813457.

Zenith

Martha Bagnall

Washington University School of Medicine, Department of Neuroscience, United States

Session:
Friday, June 16, 14:30 - 15:30, SU Amphi Charpak
Structure and Function of Circuits for Balance *(Abstract 32)*

Karl Kilborn

Intelligent Imaging Innovations (3i), United States

Session:
Friday, June 16, 16:00 - 16:30, SU Amphi Charpak
Going to the not-so-dark side: An entrepreneur's perspective on neuroscience research *(Abstract 33)*

ZENITH STUDENTS

Edouard Dumon

University College London (UCL), Bianco's lab, United Kingdom

Session:
Wednesday, June 14, 15:30 - 15:45, ICM, Salle 1-2
Understanding supraspinal locomotor control in the larval Zebrafish *(Abstract 01)*

Giulia Zuccarini

University College London (UCL), Bianco's lab, United Kingdom

Session:
Wednesday, June 14, 15:45 - 16:00, ICM, Salle 1-2
Neural circuits underlying hunting sequence generation *(Abstract 02)*

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie actions, grant agreement #813457.

Zenith

Sadiq Adedayo

University of Vienna, Grosse-Wentrup Lab, Austria

Session:
Wednesday, June 14, 16:00 - 16:15, ICM, Salle 1-2
Granger Causality from Causal Bayesian Networks Perspectives: Towards Linking Neuronal Circuits to Behavior and Plasticity *(Abstract 03)*

Elena Putti

Sorbonne Université, Institut de La Vision (IDV), Del Bene Lab, France

Session:
Thursday, June 15, 10:00 - 10:15, SU Amphi Charpak
Lrrn2 and Lrrn3a govern precise retino-tectal circuit formation in the zebrafish visual system *(Abstract 08)*

Tahnee Mackensen

Centre De Regulacio Genomica (CRG), Irimia Lab, Spain

Session:
Thursday, June 15, 10:15 - 10:30, SU Amphi Charpak
Understanding the impact on early microexon misregulation on zebrafish sleep/wake behaviour *(Abstract 09)*

Alizée Kastler

University College London, Dreosti Lab, United Kingdom

Session:
Thursday, June 15, 11:30 - 11:45, SU Amphi Charpak
Social Context Modulates Pain Tolerance in Juvenile Zebrafish *(Abstract 11)*

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie actions, grant agreement #813457.

Zenith

Shuhong Huang

Technical University of Munich (TUM), Portugues Lab, Germany

Session:
Thursday, June 15, 11:45 - 12:00, SU Amphi Charpak
From Sensation to Action: Quantifying Sensorimotor Transformation in Whole-brain Circuits *(Abstract 12)*

Thomas Mullen

Champalimaud Center for the Unknown, Orger Lab, Portugal

Session:
Thursday, June 15, 14:30 - 14:45, SU Amphi Charpak
Inferring the neural control signals that drive locomotion in the larval zebrafish *(Abstract 16)*

Verity Cook

Charité – Universitätsmedizin Berlin, Judkewitz Lab, Germany

Session:
Thursday, June 15, 14:45 - 15:00, SU Amphi Charpak
Acoustic communication in *Danionella Cerebrum* *(Abstract 17)*

Gautam Sridhar

Institut du Cerveau (ICM), Wyart Lab, France

Session:
Thursday, June 15, 16:30 - 16:45, SU Amphi Charpak
Uncovering principles of long timescale behavior during sensory evoked navigation *(Abstract 19)*

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie actions, grant agreement #813457.

Zenith

Philipp Braaker

University of Edinburgh, Lyons Lab, UK

Session:
Thursday, June 15, 16:45 - 17:00, SU Amphi Charpak
Metabotropic glutamate receptors sense neuronal signals and mediate activity-driven myelination in zebrafish *(Abstract 20)*

Sharbatanu Chatterjee

Sorbonne Université, Laboratoire Jean Perrin (LJP), Bormuth Lab, France

Session:
Friday, June 16, 09:30 - 09:45, SU Amphi Charpak
Behavior strategies & neuronal circuits for adaptive posture control *(Abstract 23)*

Tanita Tzotzolaki

ZeClinics, Terriente Lab, Spain

Session:
Friday, June 16, 09:45 - 10:00, SU Amphi Charpak
Deep phenotypic analysis of zebrafish models of Parkinson's disease *(Abstract 24)*

Xinyu (Cilia) Jia

Institut du Cerveau (ICM), Wyart Lab, France

Session:
Friday, June 16, 12:00 - 12:15, SU Amphi Charpak
Optogenetic mapping of V2a reticulospinal neurons reveals a medullary network for forward locomotion *(Abstract 28)*

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie actions, grant agreement #813457.

Zenith

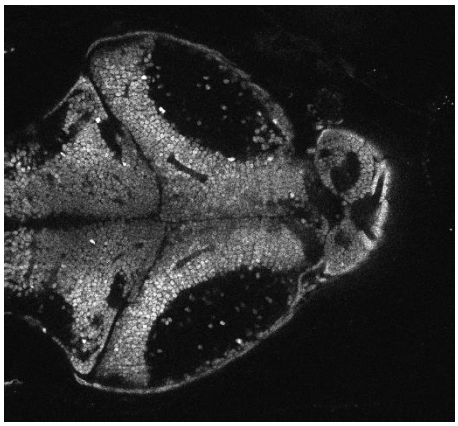
Chung Yuen (Joe) Chan

Sorbonne Université, Institut de La Vision (IDV), Emiliani Lab, France

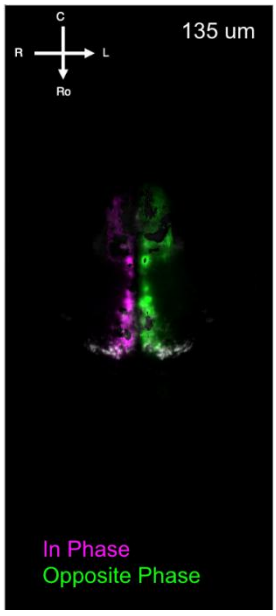
Session:
Friday, June 16, 12:15 - 12:30, SU Amphi Charpak

In vivo high-throughput probing of synaptic connectivity using two-photon holographic optogenetic stimulation and compressed sensing strategies *(Abstract 29)*

Credit : Alizée Kastler. Social Juvenile Zebrafish (21dpf).Tamron 18-200mm F/3.5-6.3 Di II VC Zoom Lens.



Credit: Tahnee Mackensen. Gcamp6s with Isaac Bianco's 2P.



Credit: Sharbatanu Chatterjee. V2a neurons activity in phase and out of phase with a sinusoidal vestibular input in the hindbrain of a genetically modified zebrafish larva.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie actions, grant agreement #813457.

Zenith

DETAILED AGENDA

Wednesday, 14 June 2023

All sessions at the Institut du Cerveau (ICM) - Hôpital Pitié Salpêtrière

15:00 - 15:30	Welcome and introduction (ICM, Salle 1-2) ***Claire Wyart***
15:30 - 16:15	**Zenith's students presentations** (ICM, Salle 1-2) *Edouard Dumon (abs 01)* - **Understanding supraspinal locomotor control in the larval Zebrafish** *Giulia Zuccarini (abs 02)* - **Neural circuits underlying hunting sequence generation** *Sadiq Adedayo (abs 03)* - **Granger Causality from Causal Bayesian Networks Perspectives: Towards Linking Neuronal Circuits to Behavior and Plasticity** (Chair: Thomas; Timer: Gautam)
16:15 - 17:00	**Coffee break** (ICM, Salle 1-2)
17:00 - 17:45	**Invited talk: "I don't have the answers, but I always have opinions…"** (ICM, Auditorium) ***Joe Fetcho*** *(abs 04)* (Chair: Thomas; Timer: Gautam)
17:45 - 18:15	**Invited talk: How to simulate a connectome?** (ICM, Auditorium) ***Srinivas Turaga*** *(abs 05)* (Chair: Thomas; Timer: Gautam)
18:15 - 19:30	**Posters: Session I** (ICM, Espace 1-2) *Edouard Dumon (abs 01)* *Giulia Zuccarini (abs 02)* *Sadiq Adedayo (abs 03)* *Elena Putti (abs 08)* *Tahnee Mackensen (abs 09)* *Alizée Kastler (abs 11)* *Shuhong Huang (abs 12)* *Ryosuke Tanaka (abs 34)* *Emiliano Marachlian (abs 35)* *Xhuljana Mingaj (abs 36)*
19:30-	**Welcome Cocktail** (ICM, Espace 1-2)

Thursday, 15 June 2023

All sessions at the Sorbonne University, Campus de Jussieu, Amphithéâtre Charpak

07:00 - 08:30	Buffet breakfast at the Hotel *(for hotel guests only)*
08:30 - 09:00	**Welcome coffee** (SU, Amphithéâtre Charpak)

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie actions, grant agreement #813457.

09:00 - 09:30	**Invited talk: Telencephalic diversity: new challenges of paedomorphic *Danionella* – cancelled** ***Andy Bass*** *(abs 06)* (Chair: Tanita; Timer: Edouard)
09:30 - 10:00	**Invited talk: Collective Movement of Danionella Cerebrum** ***Matthew Lovett-Barron*** *(abs 07)* (Chair: Tanita; Timer: Edouard)
10:00 - 10:30	**Zenith's students presentations** *Elena Putti (abs 08)* - **Lrrn2 and Lrrn3a govern precise retino-tectal circuit formation in the zebrafish visual system** *Tahnee Mackensen (abs 09)* - **Understanding the impact on early microexon misregulation on zebrafish sleep/wake behaviour** (Chair: Tanita; Timer: Edouard)
10:30 - 11:00	**Coffee break/Posters**
11:00 - 11:30	**Invited talk: Reconstructing cellular biographies** ***Alex Schier*** *(abs 10)* (Chair: Sadiq; Timer: Phil)
11:30 - 12:00	**Zenith's students presentations** *Alizée Kastler (abs 11)* - **Social Context Modulates Pain Tolerance in Juvenile Zebrafish** *Shuhong Huang (abs 12)* - **From Sensation to Action: Quantifying Sensorimotor Transformation in Whole-brain Circuits** (Chair: Sadiq; Timer: Phil)
12:00 - 12:30	**Invited talk: Voltage imaging of distributed sensorimotor computations across brain areas** ***Takashi Kawashima*** *(abs 13)* (Chair: Sadiq; Timer: Phil)
12:30 - 13:00	**Invited talk: Molecular mechanisms and fast-acting antidepressant modulation of glia-neuron communication in behavioral state switches** ***Misha Ahrens*** *(abs 14)* (Chair: Sadiq; Timer: Phil)
13:00 - 14:00	**Lunch**
14:00 - 14:30	**Invited talk: Inferring interactions in neural and behavioural networks** ***Aleksandra Walczak & Xiaowen Chen*** *(abs 15)* (Chair: Tahnee; Timer: Sharbat)
14:30 - 15:00	**Zenith's students presentations**

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie actions, grant agreement #813457.

	Thomas Mullen (abs 16) - **Inferring the neural control signals that drive locomotion in the larval zebrafish** *Verity Cook (abs 17)* - **Acoustic communication in *Danionella Cerebrum*** (Chair: Tahnee; Timer: Sharbat)
15:00 - 16:00	**Coffee break/Posters**
16:00 - 16:30	**Invited talk: Labelled lines for flexible codes — the zebrafish perspective on vision** ***Herwig Baier** (abs 18)* (Chair: Tahnee; Timer: Sharbat)
16:30 - 17:00	**Zenith's students presentations** *Gautam Sridhar (abs 19)* - **Uncovering principles of long timescale behavior during sensory evoked navigation** *Philipp Braaker (abs 20)* - **Metabotropic glutamate receptors sense neuronal signals and mediate activity-driven myelination in zebrafish** (Chair: Tahnee; Timer: Sharbat)
17:00 - 17:30	**Invited talk: Identifying key structural connections from functional response data** ***James Fitzgerald** (abs 21)* (Chair: Tahnee; Timer: Sharbat)
17:30 - 18:45	**Posters: Session II** *Thomas Mullen (abs 16)* *Verity Cook (abs 17)* *Gautam Sridhar (abs 19)* *Philipp Braaker (abs 20)* *Sharbatanu Chatterjee (abs 23)* *Tanita Tzotzolaki (abs 24)* *Xinyu (Cilia) Jia (abs 28)* *Chung Yuen (Joe) Chan (abs 29)* *Fanny Eggeler (abs 37)* *Hagar Lavian (abs 38)* *Alejandro Uribe (abs 39)*
18:45 - 19:30	**Free time/ Networking**
19:30-	**Dinner at *Le Buisson Ardent*** (25 Rue Jussieu, 75005 Paris)

Friday, 16 June 2023

All sessions at the Sorbonne University, Campus de Jussieu, Amphithéâtre Charpak

07:00 - 08:30	Buffet breakfast at the Hotel *(for hotel guests only)*
08:30 - 09:00	**Welcome coffee** (SU, Amphithéâtre Charpak)

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie actions, grant agreement #813457.

09:00 - 09:30	**Invited talk: Visually-guided and context-dependent spatial navigation in Danionella cerebrum** ***Kevin Briggman*** *(abs 22)* (Chair: Giulia; Timer: Alizée)
09:30 - 10:00	**Zenith's students presentations** *Sharbatanu Chatterjee (abs 23)* - **Behavior strategies & neuronal circuits for adaptive posture control** *Tanita Tzotzolaki (abs 24)* - **Deep phenotypic analysis of zebrafish models of Parkinson's disease** (Chair: Giulia; Timer: Alizée)
10:00 - 10:30	**Invited talk: The Early Life of Extraocular Motor Neurons: Birth, Function, and Disease** ***David Schoppik*** *(abs 25)* (Chair: Giulia; Timer: Alizée)
10:30 - 11:00	**Coffee break/Posters**
11:00 - 11:30	**Invited talk: A FoxG1 transformation tunes local decisions in neurons** ***Corinne Houart*** *(abs 26)* (Chair: Sharbat; Timer: Verity)
11:30 - 12:00	**Invited talk: Large-scale capture of Notch signaling activity in the developing zebrafish brain** ***Bushra Raj*** *(abs 27)* (Chair: Sharbat; Timer: Verity)
12:00 - 12:30	**Zenith's students presentations** *Xinyu (Cilia) Jia (abs 28)* - **Optogenetic mapping of V2a reticulospinal neurons reveals a medullary network for forward locomotion** *Chung Yuen (Joe) Chan (abs 29)* - **In vivo high-throughput probing of synaptic connectivity using two-photon holographic optogenetic stimulation and compressed sensing strategies** (Chair: Sharbat; Timer: Verity)
12:30 - 13:00	**Invited talk: Mapping neural circuits the genetic way** ***Marnie Halpern*** *(abs 30)* (Chair: Sharbat; Timer: Verity)
13:00 - 14:00	**Lunch**
14:00 - 14:30	**Invited talk: Spinal basis of direction control during locomotion in larval zebrafish** ***Dave McLean*** *(abs 31)* (Chair: Phil; Timer: Sadiq)

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie actions, grant agreement #813457.

14:30 - 15:00	**Invited talk: Structure and Function of Circuits for Balance** ***Martha Bagnall*** *(abs 32)* (Chair: Phil; Timer: Sadiq)
15:00 - 16:00	**Coffee break/Posters**
16:00 - 16:30	**Invited talk: Going to the not-so-dark side: An entrepreneur's perspective on neuroscience research** ***Karl Kilborn*** *(abs 33)* (Chair: Phil; Timer: Sadiq)
16:30 - 16:45	**CLOSURE**
16:45 - 19:00	**Networking/free time**
19:00 -	**Happy Hour & boat party** (*Le Kiosque Flottant,* 10 Port de la Gare 75013 Paris)

POSTER SESSIONS

There will be two designated poster sessions as indicated on the detailed agenda. In addition, the posters of the ZENITH students will be up for the entire duration of the Symposium.

PARTICIPANTS

ZENITH Students	Contact
Alizée Kastler (ESR1)	a.kastler@ucl.ac.uk
Chung Yuen (Joe) Chan (ESR2)	chung-yuen.chan@inserm.fr
Tanita Tzotzolaki (ESR3)	tanita.tzotzolaki@zeclinics.com
Tahnee Mackensen (ESR4)	tahnee.mackensen@crg.eu
Verity Cook (ESR5)	verity.cook@charite.de
Elena Putti (ESR6)	elena.putti@inserm.fr
Giulia Zuccarini (ESR7)	g.zuccarini@ucl.ac.uk
Philipp Braaker (ESR8)	p.braaker@ed.ac.uk
Xinyu (Cilia) Jia (ESR9)	xinyu.jia@icm-institute.org
Thomas Soares Mullen (ESR10)	thomas.mullen@research.fchampalimaud.org
Sharbatanu Chatterjee (ESR11)	sharbatanu.chatterjee@sorbonne-universite.fr
Shuhong Huang (ESR12)	shuhong.huang@tum.de

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie actions, grant agreement #813457.

Sadiq Adedayo (ESR13)	sadiq.adedayo@univie.ac.at
Gautam Sridhar (ESR14)	gautam.sridhar@icm-institute.org
Edouard Dumon (ESR15)	e.dumon@ucl.ac.uk

ZENITH PIs & Co-PIs	Contact
Isaac Bianco	i.bianco@ucl.ac.uk
Volker Bormuth	volker.bormuth@upmc.fr
Flavia De Santis	flavia.desantis@zeclinics.com
Filippo Del Bene	filippo.del-bene@inserm.fr
Elena Dreosti	e.dreosti@ucl.ac.uk
Valentina Emiliani	valentina.emiliani@inserm.fr
Moritz Grosse-Wentrup	moritz.grosse-wentrup@univie.ac.at
Manuel Irimia	manuel.irimia@crg.eu
Benjamin Judkewitz	benjamin.judkewitz@charite.de
Dave Lyons	david.lyons@ed.ac.uk
Mike Orger	michael.orger@neuro.fchampalimaud.org
Ruben Portugues	ruben.portugues@tum.de
Dimitrii Tanese	dimitrii.tanese@inserm.fr
Javier Terriente	javier.terriente@zeclinics.com
Claire Wyart	claire.wyart@icm-institute.org

Invited speakers	Contact
Misha Ahrens	ahrensm@janelia.hhmi.org
Martha Bagnall	bagnall@wustl.edu
Herwig Baier	herwig.baier@bi.mpg.de
Andy Bass	ahb3@cornell.edu
Kevin Briggman	kevin.briggman@mpinb.mpg.de
Joe Fetcho	jfetcho@cornell.edu
James Fitzgerald	fitzgeraldj@janelia.hhmi.org
Marnie Halpern	marnie.e.halpern@dartmouth.edu
Corinne Houart	corinne.houart@kcl.ac.uk
Takashi Kawashima	takashi.kawashima@weizmann.ac.il
Karl Kilborn	karl@intelligent-imaging.com
Matthew Lovett-Barron	mlb@ucsd.edu
Dave McLean	david-mclean@northwestern.edu

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie actions, grant agreement #813457.

Bushra Raj	bushra.raj@pennmedicine.upenn.edu
Alex Schier	alex.schier@unibas.ch
David Schoppik	schoppik@gmail.com
Srinivas Turaga	turagas@janelia.hhmi.org
Aleksandra Walczak	aleksandra.walczak@phys.ens.fr

Other participants	Contact
Shahad Albadri	shahad.albadri@inserm.fr
Laura Belleri	laura.belleri@studenti.unimi.it
Martin Carbo-Tano	martin.carbotano@icm-institute.org
Xiaowen Chen	xiaowen.chen@phys.ens.fr
Monica Coraggioso	m.coraggioso@studenti.unipi.it
Antonio Costa	antonio.costa@phys.ens.fr
Julie Dang	julie.dang@inserm.fr
Georges Debregeas	georges.debregeas@upmc.fr
Leonardo Demarchi	leonardo.demarchi@sorbonne-universite.fr
Linéa Desarbre	linea.desarbre@etu.u-paris.fr
Mahalakshmi Dhanasekar	m.dhanasekar@icm-institute.org
Mattéo Dommanget-Kott	matteo.dommanget-kott@sorbonne-universite.fr
Fanny Eggeler	fanny.eggeler@inserm.fr
Giulia Faini	giulia.faini@inserm.fr
Marcus Ghosh	m.ghosh@imperial.ac.uk
Iacopo Hachen	ihachen@ab.mpg.de
Elim Hong	elim.hong@inserm.fr
Antoine Hubert	antoine.hubert@sorbonne-universite.fr
Soumaiya Imarraine	soumaiya.imarraine@sorbonne-universite.fr
Tihana Jovanic	tihana.jovanic@cnrs.fr
Francois Kroll	francois@kroll.be
Hagar Lavian	hagar.lavian@tum.de
Guillaume Lebourdelles	guillaume.le-bourdelles@inserm.fr
Matthias Loidolt	matthias.loidolt.21@ucl.ac.uk
Elias Lunsford	elias.lunsford@icm-institute.org
Emiliano Marachlian	marachli@bio.ens.psl.eu
Julia Meng	jmeng3@exseed.ed.ac.uk
Xhuljana Mingaj	xhuljana.mingaj@institutimagine.org
Nicole Ortiz	nicole.ortiz@sorbonne-universite.fr

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie actions, grant agreement #813457.

Emanuele Paoli	emanuele.paoli@tum.de
Tom Ryan	t.ryan@ucl.ac.uk
Germán Sumbre	sumbre@bio.ens.psl.eu
Ryosuke Tanaka	ryosuke.tanaka@tum.de
Alejandro Uribe	uribe@bio.ens.psl.eu
Massimo Vergassola	massimo.vergassola@ens.psl.eu
Ehud Vinepinsky	ehpinsky@gmail.com
Tom Welch	tom.welch-honnart@etu.u-paris.fr
Maroun Youne	maroun.a.younes@gmail.com
Valeria Zampini	valeria.zampini@inserm.fr

Teaching Assistants (Hackathon)	**Contact**
Manuel Eder	a01638744@unet.univie.ac.at
Faustine Ginoux	faustine.ginoux@icm-institute.org
Akshey Kumar	akshey.kumar@univie.ac.at
Mathilde Lapoix	mathilde.lapoix@icm-institute.org
Christoph Luther	cph.luther@gmail.com
Mauricio Gonzalez Soto	mauricio.gonzalez.soto@univie.ac.at

Careers session (Hackathon)	**Contact**
Pascale Brochard	brochard@oshaliang.eu
Samuel Bucourt	sbucourt@imagine-optic.com
Fabrice Harms	fharms@imagine-optic.com

Support	**Contact**
Joana Guedes (Zenith & Wyart lab)	joana.guedes@icm-institute.org

CONTACT

For any doubts or queries, please contact Joana Guedes:

joana.guedes@icm-institute.org

+33 (0)7 69 52 31 02

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie actions, grant agreement #813457.

ANNEX 1: SYMPOSIUM ABSTRACTS

Please have in mind that the name mentioned on the abstract is only of the presenter and not necessarily of all people conducting the work and collaborators. Also no funding acknowledgement is provided. For information about the authors and funding please contact the presenters.

Abstract 01

Understanding supraspinal locomotor control in the larval Zebrafish

Edouard Dumon, University College London (UCL)

Locomotion in vertebrates requires the production of a diverse repertoire of movements. The brainstem plays a crucial role in supplying the descending commands underlying this behavior to spinal cord motor circuits, yet it remains unclear what information these commands convey, and how they arise from brainstem neuronal population activity. We sought to address these questions by studying supraspinal locomotor control in the larval zebrafish. Using 2-photon functional calcium imaging, we recorded neural activity in the brainstem of larvae presented with visual stimuli designed to elicit a wide variety of swims. To map locomotion-related neural activity in our imaging volume, we examined the pixel-wise correlation of fluorescence with swim-vigor-derived regressors. We identified widespread swim-related activity, both in regions with and without known involvement in locomotor control. To further characterize swimming behavior, we analyzed data pooled from 25 fish, and found that most fish drew from an 8-dimensional shared distribution of swim kinematics. To relate this behavioral complexity to neural activity, we used canonical correlation analysis to identify correlated neural and behavioral spaces. Canonical components of behavior described behavioral space and were shared across datasets. To investigate the neural circuits controlling these variables, we built linear decoding models, and found that most behavioral canonical components could be accurately inferred from neural activity using specific but distinct subsets of brainstem neurons. In summation, our data suggests that multi-dimensional descending inputs arising from brainstem population activity command the diverse locomotor repertoire of larval zebrafish. Next, we will use hierarchical decoding to distinguish the roles of identified brainstem populations and use interventional experiments to test their causal involvement in behavior.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie actions, grant agreement #813457.

Abstract 02

Neural circuits underlying hunting sequence generation

Giulia Zuccarini, University College London (UCL)

Animals typically accomplish goal-directed behaviours by chaining together simpler motor actions in a behavioural sequence, but it is not well understood how the brain controls such sequences.
In larval zebrafish, hunting is an innate, visually guided behaviour, composed of a sequence of specialised motor outputs that are dynamically selected and tuned in response to a constantly changing visual input.
Previous work in the Bianco lab has identified a population of pretectal neurons that command hunting initiation, and neurons in the nucleus isthmi that are essential for the progression of hunting sequences. However, the dynamics of these and other neural populations during hunting sequences are largely unknown.
By combining a closed-loop virtual hunting assay and functional calcium imaging, we monitored neural activity during extended virtual hunting sequences.
In addition to neural activity encoding visual input and motor outputs, we identified activity that appears to be related to the progression of the hunting sequence per se, specifically in a small population of cells of the intermediate hypothalamus.
Circuit tracing using photoactivatable GFP revealed anatomical connections between this region of hypothalamus and the locus of pretectal hunting command neurons and preliminary laser ablations suggest that this pathway is required for hunting. In future work, we plan to perform optogenetic gain-of-function experiments to investigate the effects of activating this pathway on hunting sequence structure and progression.

Abstract 03

Granger Causality from Causal Bayesian Networks Perspectives: Towards Linking Neuronal Circuits to Behavior and Plasticity

Sadiq Adedayo, University of Vienna

Explaining how neurons coactivate to give rise to behavior is a central question in neuroscience. Characterizing these relationships requires knowledge of interactions among neurons and their respective contributions to behavior. This necessitates identifying neuronal networks that interact and exchange information. Granger causality (GC) has been a computational tool of choice for neuroscientists, alongside other available methods. However, GC has limitations and has been criticized as being a predictive tool only, not supporting interventions, and susceptible to the presence of latent confounders. In this study, we examine GC from the perspective of Causal Bayesian Networks (CBNs) and provide a proper causal interpretation under certain assumptions. We further present a

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie actions, grant agreement #813457.

statistical test for latent confounding and discuss why GC may perform well even in the presence of latent confounders. We illustrate our arguments on simulated data as well as on a v2a reticulospinal neurons dataset of larva zebrafish (D. rerio).

Abstract 04

I don't have the answers, but I always have opinions…

Joseph R. Fetcho, Cornell University

Xinyu (Zenith student) asked me to "talk about my vision of the most exciting methodological and conceptual directions to follow in the development of neuronal circuits underlying behavior". That is what I will do, with a focus on what I think it actually means to understand the neuronal basis of behavior and what I think is the goal of such work, using examples from our work as well as work from other well-studied animals. There will also be some methodological direction comments with examples from our work at Cornell. In other words, I listened to the Xinyu, as students usually know best.

Abstract 05

How to simulate a connectome?

Srinivas Turaga, HHMI's Janelia Research Campus

We can now measure the connectivity of every neuron in a neural circuit, but we are still blind to other biological details, including the dynamical characteristics of each neuron. The degree to which connectivity measurements alone can inform understanding of neural computation is an open question. We show that with only measurements of the connectivity of a biological neural network, we can predict the neural activity underlying neural computation. Our mechanistic model makes detailed experimentally testable predictions for each neuron in the connectome. We found that model predictions agreed with experimental measurements of neural activity across 24 studies. Our work demonstrates a strategy for generating detailed hypotheses about the mechanisms of neural circuit function from connectivity measurements.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie actions, grant agreement #813457.

Abstract 06

Telencephalic diversity: new challenges of paedomorphic *Danionella*

Andrew H. Bass, Cornell University

Danionella are a genus of paedomorphic fishes, closely related to zebrafish. Among the smallest known vertebrates, once sexually mature, they retain characters which have made larval zebrafish a prominent model for neuroscientific research. *Danionella* adults lack scales, remain largely transparent and have a cranial roof that does not ossify. Their size and transparency as adults, and tractability of zebrafish genetic tools, allows non-invasive, brain-wide optical access. Unlike zebrafish, *Danionella* are sonic. Temporal and spectral characters of the sonic repertoire vary between species. Male *D. dracula* possess a hypertrophied lower jaw, unique among *Danionella species,* that they extend during aggressive interactions, concomitant with heightened sound production. This morphological and behavioral diversity makes *Danionella* a compelling new "model clade" (cf. Jourjine & Hoekstra, Neuron, 2021) to identify general principles of neural circuit function.

Compared to the brainstem of teleost fishes, the telencephalon remains relatively unexplored. We have found surprising neuroanatomical diversity between *Danionella* species as compared to zebrafish across several developmental stages. Although we can identify major subdivisions of the pallium and subpallium characteristic of zebrafish and other teleosts, *Danionella* have fewer migrated cell populations and unique lobed-like divisions of the caudal pallium. *D. dracula* alone also has a laterally compressed dorsal pallium. To what extent this diversity can be mapped onto functional differences between *Danionella* and zebrafish is an especially challenging avenue of investigation.

Abstract 07

Collective movement of *Danionella Cerebrum*

Matthew Lovett-Barron, UC San Diego

Many animals engage with the world as part of a cohesive group, including flocks of birds, swarms of insects, and schools of fish. Collective behavior emerges from interactions amongst individuals, where each animal's movements are influenced by the actions of their neighbors. Here I will discuss my lab's progress in quantifying the collective schooling behavior of *Danionella cerebrum*, and early efforts to record neural activity from adult animals.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie actions, grant agreement #813457.

Abstract 08

Lrrn2 and Lrrn3a govern precise retino-tectal circuit formation in the zebrafish visual system

Elena Putti, Sorbonne Université, Institut de La Vision (IDV)

Leucine-rich repeat proteins (LRR) play critical roles in various aspects of neuronal circuit development, from synapse formation to axon guidance. Within the LRR protein family, the leucine-rich repeat neuronal (LRRN) subfamily comprises distinct adhesion molecules, including Lrrn2 and Lrrn3a. Remarkably, their expression patterns are conserved across species, ranging from Drosophila to humans. However, the functional significance of Lrrn2 and Lrrn3a in the context of visual system formation and axonal targeting remains elusive. In Drosophila, the orthologous protein Capricious governs the synaptic targeting of specific photoreceptors to precise laminae in the fly brain. To determine if similar mechanisms are at play in vertebrates, we examined the expression patterns of *lrrn2* and *lrrn3a* in the retina of zebrafish larvae. Our findings reveal sparse expression of these adhesion molecules in the developing retinal ganglion cells (RGCs). The absence of Lrrn2 and Lrrn3a lead to mistargeting defects in a specific subset of RGCs. These RGCs fail to reach their designated laminae in the retino-recipient optic tectum, impairing the formation of precise synaptic connections. Moreover, behavioral analyses reveal compromised hunting abilities in *lrrn2* and *lrrn3a* mutants. Together, our findings highlight a crucial role for Lrrn2/3a in the specification and function of precise retino-tectal circuits in the vertebrate visual system.

Abstract 09

Understanding the impact of early microexon misregulation on zebrafish sleep/wake behaviour

Tahnee Mackensen, Centre De Regulacio Genomica (CRG)

The need for sleep or a sleep-like state is universally observed in the animal kingdom and crucial for survival. Disruptions in regulated sleep states are frequently observed in neurodevelopmental disorders such as autism spectrum disorders (ASD). In this study, we investigated a conserved neuron-specific splicing program of microexons, which are known to fine-tune neurodevelopmental processes related to brain circuitry such as synaptogenesis. However, the impact of microexons on behavioral states, including sleep/wake patterns, remains poorly understood. To address this, we utilized a knock-out zebrafish model targeting the master regulator of microexon splicing, srrm3. Our observations revealed a complex hyperactivity phenotype with sleep loss in the zebrafish, supported by neuronal-level hyperactivity observed through calcium imaging. Pharmacological screening indicates these phenotypic changes may be explained by elevated levels of cyclic AMP (cAMP), a second messenger molecule increased in ASD patients and previously linked to motor control and neuronal activity increase. Subsequent investigations involving bulk- and single-cell RNA sequencing aim to establish a

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie actions, grant agreement #813457.

direct link between microexon misregulation and elevated cAMP levels. This research provides insights into the mechanisms underlying brain development and how their intricate interplay shapes brain activity states, particularly sleep-wake behavior.

Abstract 10

Reconstructing cellular biographies

Alex Schier, University of Basel

The development of systems ranging from embryos to brains is governed by the sculpting of cells into structurally and functionally specialized units. I will describe our recent efforts to use single-cell RNA sequencing and genome editing to reconstruct these differentiation trajectories.

Abstract 11

Social Context Modulates Pain Tolerance in Juvenile Zebrafish

Alizée Kastler, University College London (UCL)

Supportive social environments are known to have an analgesic effect, significantly reducing the perception of pain. While this effect is recognized, its neurobiological basis and molecular mechanisms remain poorly understood.

To address this, we combined behavioural assays with light-sheet microscopy to generate 3D-map of whole-brain cfos activity, identifying brain regions activated during nociception and social interaction in juvenile zebrafish. Using In-Situ-hybridization we further characterized these areas through the labelling of cell-types. Our findings show that nociceptive and social circuits share overlapping areas of activity in the brain, highlighting anatomical and molecular markers of the social modulation of pain. Moreover, exposing juvenile zebrafish to both social and noxious heat stimuli revealed that the mere sight of other conspecific zebrafish leads to increased thermal noxious tolerance. This data suggests that social context can modulate pain tolerance in zebrafish through a descending pain modulatory pathway, similar to humans.

Overall, this work provides valuable insights into the mechanisms of pain modulation and highlights the importance of social environment in pain management.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie actions, grant agreement #813457.

Abstract 12

From Sensation to Action: Quantifying Sensorimotor Transformation in Whole-brain Circuits

Shuhong Huang, Technical University of Munich (TUM)

A sensorimotor circuit is a neural network that connects sensory inputs to motor outputs, allowing an organism to perform coordinated movement within its environment. Sensorimotor circuits may thus contain both general-purpose sensory representations that encode the external world and motor-relevant representations that meet the demands of specific behaviors. Most neuroscience studies assume that motor-relevant representations first emerge in the motor system, permitting sensory systems to focus on the efficient encoding of sensory environment. However, learning in artificial neural networks relies upon sequential nonlinear processing that gradually sculpts input representations into the output.

Whether the brain similarly contains intermediate sensory representations that are best understood in terms of the statistics of the motor outputs is largely unknown. Here we develop a theoretical framework for comparing how well neuronal activity matches the statistics of the sensory and motor peripheries, and we use our method to identify those visual regions that contain signals directly relevant for optomotor and optokinetic behaviors. Our results indicate that, in contrast to the tectum, which mainly retains the correlation information inherent in the sensory input, the pretectum better captures the stimulus correlations derived from the motor output. In addition, our model reveals a progressive functional relation from the pretectum to the anterior hindbrain within the sensorimotor circuit. This framework endeavors to introduce the fewest assumptions to infer the similarity between peripheral (either sensory or motor) coding and intermediate neural representations. As such, it presents a novel and general perspective for understanding sensorimotor transformations, providing fresh insight into the complexities of neural processing.

Abstract 13

Voltage imaging of distributed sensorimotor computations across brain areas

Takashi Kawashima, Weizmann Institute of Science

Vertebrate sensorimotor behavior is mediated by a precise sequence of different types of neural activity across brain areas. Larval zebrafish is an ideal model for studying brain-wide neural dynamics, but technologies for recording neural activity at millisecond time resolution have been limited. Here we performed population voltage imaging in three important areas of the zebrafish brain, the optic tectum, cerebellum, and midbrain nucleus, and analyzed the modulation of membrane potential and spiking activity in neurons while the fish performed a sensorimotor task. We found diverse types of sensorimotor responses that have varying delays to the motor output and the sensory input. These

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie actions, grant agreement #813457.

results provide a glimpse of the global landscape of the flow of sensorimotor computations across brain areas and demonstrate the potential for further scaling up this methodology to a whole-brain scale.

Abstract 14

Molecular mechanisms and fast-acting antidepressant modulation of glia-neuron communication in behavioral state switches

Misha B. Ahrens, HHMI's Janelia Research Campus

Animals plan their future actions according to the outcomes of their past actions. Behaviors related to learned helplessness demonstrate how behavioral futility can lead to a loss of motivated behavior. In larval zebrafish, it has been demonstrated that norepinephrinergic activation of astrocytes underlies the switch to a passive behavioral state when swimming is futile (futility-induced passivity). Here, we investigated by what molecular signal astrocytes communicate with neurons, and found evidence that this occurs by astroglial secretion of ATP, its conversion to adenosine, and through adenosine receptors on downstream neurons. In parallel, by analogy to the modulation of learned helplessness-related behaviors in rodents, we investigated the effect of exposure to fast-acting antidepressants like ketamine on futility-induced passivity in the 'futile swim test' (FST). Consistent with results in rodents, animals were less passive in the FST an hour or 24 hours after ketamine exposure. During ketamine exposure, neuronal activity was overall lower, but intracellular astroglial calcium rose transiently to high levels. Following exposure, the astrocytic response to norepinephrine was reduced, and chemogenetic activation of astrocytes also led to reduced passivity. These results suggest that ketamine and related fast-acting antidepressants act through astrocytes by reducing the integration of the norepinephrinergic futility signal. These findings shed light on the importance of glia-neuron communication for the long-timescale integration of behaviorally-important signals.

Abstract 15

Inferring interactions in neural and behavioural networks

Aleksandra Walczak & Xiaowen Chen, École Normale Supérieure (ENS)

One challenge in neuroscience and collective behaviour is to understand how information flows between the elements of the network, either neurons, or animals. On one hand, I will discuss the challenges and possibilities of using Granger causality to infer causal interactions at the cell resolution level. On the other, I will show how we can learn the dynamical interaction rules in a group of mice living in an ecological habitat.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie actions, grant agreement #813457.

Abstract 16

Inferring the neural control signals that drive locomotion in the larval zebrafish

Thomas Mullen, Champalimaud Center for the Unknown

To perform successful tasks we need to generate precise and efficiently controlled behavioural output. In larval zebrafish, motor behaviours are generated by patterns of activity in the spinal cord, which are in turn shaped by descending inputs from the brainstem. How these inputs control different parameters of behavior is not completely understood. To address this question, we frame the tail movements of the fish as a dynamical system, which encapsulates the range of movements available through the fish's motor pattern generator, and which is driven by a low-dimensional control input. We use a recently proposed method, iLQR-VAE, to learn the latent dynamics that describe swimming behavior and estimate the unobserved inputs which drive this latent dynamical system to generate motor output. We constrain the network to use sparse inputs, which promotes it to generate bout dynamics autonomously and aligns with biological reasoning about swim generation. We have learned a low-dimensional input space that can accurately reconstruct the full behavioural repertoire. Furthermore, the topology of the latent space preserves structures relating to previously identified bout categories as well as kinematic features such as turn angle and bout frequency. Finally, we can make linear predictions of gross movement features such as turn direction, distance and heading change from a low dimensional subspace of the initial input state. Overall, this generative approach has allowed us to compress behaviour into a low-dimensional, sparse representation which can be used to describe and to make predictions about sensorimotor systems in the larval zebrafish.

Abstract 17

Acoustic communication in *Danionella Cerebrum*

Verity Cook, Charité – Universitätsmedizin Berlin

Acoustic communication is prevalent across the entire animal kingdom. Studying the context and behaviour around vocalisations helps us understand the relationship between animals and their environment and can provide insights into the underlying neuronal circuits driving this behaviour. The males of the teleost Danionella cerebrum have a simple vocal repertoire, with calls composed of short, loud pulses produced at a rate of either 60 or 120 Hz. Using a combination of high-speed videos and anatomical studies, we reveal the mechanism used by this small fish to produce sounds louder than 140 dB. Using tracking and triangulation methods, we have begun to study the social context of these vocalisations.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie actions, grant agreement #813457.

Abstract 18

Labelled lines for flexible codes — the zebrafish perspective on vision

Herwig Baier, Max Planck Institute (MPI) for Biological Intelligence

Over the past decade, the visual system of zebrafish has developed into one of the best studied preparations in behavioral and systems neuroscience. Around 40 molecularly and morphologically defined types of retinal ganglion cells (RGCs) serve as matched filters for behaviorally relevant stimulus features, including background lighting, optic flow, prey objects, objects on a collision course and, possibly, conspecifics. RGCs distribute their signals via axon collaterals to 13 retinorecipient areas in forebrain and midbrain. The major visuomotor hub, the optic tectum, harbors ten RGC input layers, which are retinotopically ordered, forming separate maps in which individual features, such as object size and direction of motion, are combined. Retinal and tectal space are regionally adapted to visual scene statistics and behavioral demands. Tectal output is organized as a regionally specialized motor map, with axonal projections to the hindbrain and tegmentum segregated by dimensions of the behavior (eye vs. tail; avoidance vs. approach; forward vs. sideways movement). Each visually evoked behavior is controlled by a multi-station pathway that resembles a labeled line. Two satellites of the tectum, the nucleus isthmi and the torus longitudinalis, appear to be involved in sensory-driven attention and predictive remapping, respectively, providing an opportunity for dissecting the cellular basis of such elementary cognitive functions. Together, work in the zebrafish is challenging widely held views of the visual system: Information processing appears to be largely experience-independent and carried out by functionally segregated circuits that operate in a feedforward combinatorial fashion. Memory, attention and prediction are embedded into its visuomotor circuitry by modulatory and feedback loops, supporting the neuronal code's sole purpose: driving adaptive behavior.

Abstract 19

Uncovering principles of long timescale behavior during sensory evoked navigation

Gautam Sridhar, Institut du Cerveau (ICM)

Animals skillfully navigate intricate environments by seamlessly connecting short locomotor bouts into extended sequences. Simultaneously identifying the primary drivers of long-term behavior and investigating their dynamic interactions poses a formidable challenge, as behavior quantification relies on incomplete variables. To address this challenge, we examined freely swimming larval zebrafish exposed to a diverse range of sensory stimuli. By focusing solely on the fish's tail pose, we constructed a maximally predictive state space and studied the temporal evolution of behavior using transfer operators. Our investigations unveiled that larval zebrafish modulate behavior along three pivotal

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie actions, grant agreement #813457.

axes, wherein the most prolonged timescales encode orientation change and speed, while a third axis encodes directional preference.

Notably, we observed that stimuli actuate behavior along these axes depending on stimulus saliency and exposure timescale. Brief exposures to aversive stimuli cause an abrupt response along these axes, while the presence of prey elicits a comprehensive shift by instigating hunting strategies and subsequent post-hunt exploratory behavioral adjustments to match prey presence. Prolonged encounters with darkness showcase a gradual preference evolution along these axes, signifying the fish's habituation to its environment. Our ensemble model successfully captures the dynamical differences among fish across various sensory stimuli, even at the level of individual fish. By leveraging the interplay between variability and stereotypy, we demonstrate that individual variability in fish behavior manifests as a baseline shift along the long timescale axes, pointing to latent states that possibly influence behavior at the experimental timescale. Our results offer insights into how the brain generates and modulates motor strategies in response to environmental stimuli, shedding light on the complex multiscale dynamics underlying animal behavior.

Abstract 20

Metabotropic glutamate receptors sense neuronal signals and mediate activity-driven myelination in zebrafish

Philipp Braaker, University of Edinburgh

Myelination is a dynamic process that responds to neuronal activity. To investigate how active neurons transmit their need for myelin to oligodendrocytes (OLs), we visualize neuron-OL communication through in vivo live-imaging transgenic zebrafish. We can trigger the activity of neurons and record the Ca^{2+} activity of myelin sheaths along axons and use CRISPR to identify receptors expressed by OLs that can sense neuronal activity and regulate myelination. Glutamate has previously been implicated as a signal that regulates activity-regulated myelination, with prospective roles for AMPA and NMDA receptors previously investigated. We are currently assessing how metabotropic glutamate receptors regulate myelination. During this presentation, evidence will be presented that mGluR activity regulates myelin Ca^{2+} activity and myelination by oligodendrocytes. These observations provide insights into mechanisms of activity-regulated myelination.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie actions, grant agreement #813457.

Abstract 21

Identifying key structural connections from functional response data

James Fitzgerald, HHMI's Janelia Research Campus

A mechanistic understanding of brain function requires that neuroscientists be able to link functional patterns of neuronal activity to structural patterns of synaptic connectivity. A major challenge is that many networks can give rise to similar functional responses, and the same network can function differently depending on context. Whether certain patterns of synaptic connectivity are required to generate specific network-level computations is largely unknown. Here we introduce a geometric framework for identifying synaptic connections required by steady-state responses in recurrent networks of threshold-linear neurons, and we illustrate the framework by identifying essential synaptic connections for binocular integration in the zebrafish pretectum. Assuming that the number of specified response patterns does not exceed the number of input synapses, we analytically calculate the solution space of all feedforward and recurrent connectivity matrices that can generate the specified responses from the network inputs. We use this geometric characterization to derive certainty conditions guaranteeing a non-zero synapse between neurons. Intriguingly, our approach identified a sparse set of synapses that appear to be critical for binocular integration. These include retinal connections to previously conjectured relay neurons, outgoing synapses from these relay neurons to binocular neuron types, and several unexpected connections that underscore the utility of data-driven approaches for discerning key components of neural circuitry.

Abstract 22

Visually-guided and context-dependent spatial navigation in *Danionella cerebrum*

Kevin Briggman, Max Planck Institute (MPI) for Neurobiology of Behavior – Caesar

Danionella cerebrum (DC) is a promising vertebrate animal model for systems neuroscience due to its small adult brain volume and inherent optical transparency, but their cognitive repertoire has not been described. In this work, we established a behavioral paradigm to study visual spatial navigation in DC and investigate their navigational capabilities and strategies. We initially observed that adult DC exhibit strong negative phototaxis in groups but less so as individuals. Using this innate dark preference as a motivator, we designed a spatial navigation task inspired by the Morris Water Maze. Through a series of environmental cue manipulations, we found that DC utilize visual cues to anticipate a reward location and find evidence for both landmark-based and contextual navigational strategies. When subsets of visual cues were occluded, DC were capable of using distant contextual visual information to solve the task. In total, our behavioral results suggest DC can be used to study the neural

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie actions, grant agreement #813457.

mechanisms underlying spatial navigation with cellular resolution imaging across an adult vertebrate brain.

Abstract 23

Behavior strategies & neuronal circuits for adaptive posture control

Sharbatanu Chatterjee, Sorbonne Université, Laboratoire Jean Perrin (LJP)

To control posture, which is essential for survival, animals must respond to a continuous stream of sensory inputs from their environment, notably vestibular input. Vestibular information from the inner ears is converted to motor commands in the brain, and sent via the spinal cord to muscles to exert corrective forces. This sensorimotor computation must constantly adapt to development and environmental changes. However, the behavioral strategies and brain-wide circuit mechanisms behind this remain elusive. In my project, I exploit the unique advantages of larval zebrafish: genetic accessibility, transparency and small size, which allow brain-wide neuronal recordings combined with genetically targeted labeling. Using a rotating light-sheet microscope, I rolled head-fixed fish away from their preferred dorsal-up posture and recorded behavioral responses and brain activity. I found two responses: a 'continuous' pivoting tail response, which is tonic during the stimulus and saturates at 10° of rotation, and 'discrete' tail bouts, which are more likely to occur with increasing body destabilization. I then identified brain areas that were differentially active during the two strategies. Using genetically specified neuron types in the resulting response maps in transgenic fish lines, I have also identified the importance of V2a neuronal activity in the two strategies. I have found that these specific reticulospinal neurons are heavily informed in vestibular computation. This project thus demonstrates brain-wide circuits behind a complex highly-conserved robust behavior response which can help in understanding basic mechanisms of control in the vertebrate brain and have implications on the study of vestibular deficits and motor control dysfunction.

Abstract 24

Deep phenotypic analysis of zebrafish models of Parkinson's disease

Tanita Tzotzolaki, ZeClinics

Parkinson's disease (PD) is a progressive disorder of the nervous system, affecting 1% of the ageing population. Common motor symptoms include tremor and bradykinesia, while non-motor symptoms range from constipation to sleep disturbances. The neuropathological hallmarks involve the loss of dopaminergic neurons in the substantia nigra and abnormal intra-neuronal accumulation of Lewy bodies. Currently, there is no cure available for PD.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie actions, grant agreement #813457.

Here, the zebrafish model is used to investigate the molecular and behavioural defects associated with PD. Mutations of *PARK2*, *PINK1*, *PARK7*, *LRRK2* and *SNCA* genes cause different forms of PD in humans. Using CRISPR/Cas9 gene editing, we generate knockout models of these PD-associated genes in zebrafish.

While the zebrafish models exhibit a loss of certain diencephalic populations of dopaminergic neurons, this does not result in clear motor symptoms. Thus, we use high-throughput behavioural assays with high spatio-temporal resolution to characterise fast escape responses, slow forward swims and turns in a free-swimming paradigm. Zebrafish models exhibit a long-latency response, with reduced tail kinematics, in response to acoustovestibular stimuli. A tendency to perform more turns than forward swims is observed, correlating with the impact of disease on motor control. Given the progressive nature of PD, the dopaminergic circuitry is also characterised in the adult stage along with analysis of locomotor phenotypes at juvenile stage. Finally, we explore sleep and gut defects to understand the non-motor symptoms of PD.

Ultimately, building a complete phenotypic profile could enable zebrafish to facilitate and accelerate the progress of screening for new therapeutic targets and candidate chemicals for PD.

Abstract 25

The Early Life of Extraocular Motor Neurons: Birth, Function, and Disease

David Schoppik, New York University (NYU) Langone Health

Vertebrate vision relies on exquisite control of eye movements by extraocular motor neurons. We have a deep and clinically-useful understanding of extraocular motor neuron function. In contrast, we know little about the development of either these motor neurons or the eye movements they control. This gap constrains our ability to address developmental disorders of the oculomotor system. We have established the zebrafish as a model to study the development of the oculomotor system / eye movements. Larval zebrafish are a small vertebrate with exceptional optical and genetic access to conserved neural circuits that control eye movements.

I will discuss the development of extraocular motor neurons in cranial nuclei nIII/nIV that generate torsional/vertical eye movements. These motor neurons are responsible for implementing the gravito-inertial vestibulo-ocular reflex. I'll begin with our discovery that an extraocular motor neuron's "birthdate" predicts which muscle it will control and where its soma lies within nIII/nIV. Next, I'll describe a new model for a type of congenital incomitant (gaze angle dependent) strabismus, or misalignment of the eyes. We've generated a mutant line of zebrafish that no longer express the gene *phox2a*. These fish lose extraocular motor neurons in nIII/nIV leaving only the lateral rectus motor neurons in nVI intact. We observe that their eyes deviate towards the ears, similar to human patients

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie actions, grant agreement #813457.

with CFEOM type 2, who have mutations in *PHOX2A.* I'll share our continued efforts to use transcriptomics to discover other genes that regulate extraocular motor neuron development. Finally, I'll end by showing how we use a new imaging technique (Tilt In Place Microscopy, or TIPM) to define the emergence of selectivity and sensitivity in the responses of developing extraocular motor neurons.

Abstract 26

A FoxG1 transformation tunes local decisions in neurons

Corinne Houart, King's College London

Cellular decisions depend on tight controls of gene expression by transcription factors (TFs) sitting in the nucleus. However, these TFs may have unexpected additional function. We uncover such unexpected role for FOXG1. A fraction of the protein is cleaved and transported into axons in wildtype neurons, where it is required for local decisions. FOXG1 syndrome zebrafish and patient iPSC-derived neurons express in abundance a short protein similar to the cleaved product. Correcting this excess improves the disease phenotype. These findings provide insights into a complex interplay between nuclear and axonal control of neuronal local decisions.

Abstract 27

Large-scale capture of Notch signaling activity in the developing zebrafish brain

Bushra Raj, University of Pennsylvania (UPenn), Dept. of Cell & Developmental Biology

Developmental signaling inputs of the Notch pathway regulate neural cell fates. However, the cell types that respond to Notch input at critical stages of neurogenesis are not well characterized. We describe a technology to generate Notch signaling atlases of the developing zebrafish brain using CRISPR-Cas barcoding coupled with scRNA-seq. Our system activates Cas9 in a Notch-dependent manner with inducible control. The activated Cas9-sgRNA complex mutates a genomic barcode array. As progenitors divide, mutations are passed onto daughter cells, providing a "signaling history" during development. We are investigating which neuron subtypes and progenitor classes are derived from common ancestors that were stimulated by the Notch pathway. We anticipate our method will be broadly applicable to other signaling pathways and disease states.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie actions, grant agreement #813457.

Abstract 28

Optogenetic mapping of V2a reticulospinal neurons reveals a medullary network for forward locomotion

Xinyu Jia, Institut du Cerveau (ICM)

The reticulospinal neurons (RSNs) in the brainstem are a key command center for locomotion across vertebrates. Mapping the functional organization of the RSN will reveal how they integrate descending motor signals and ascending sensory inputs. However, this question remains poorly understood due to the intermingling of excitatory and inhibitory cells and vast heterogeneity of neurons across the hindbrain. We leveraged the genetic tractability of larval zebrafish to focus on the V2a neurons labeled by the transcription factor *vsx2+*. We optically labeled every hindbrain V2a neuron that projects to the spinal cord. This allows us to quantify the V2a excitatory drive to different regions of the spinal cord and reveal the distribution of V2a RSNs across the brainstem. Using high-speed volumetric recording in tail-free larvae, we showed that V2a RSNs reliably recruited during forward locomotion reach far to contact the caudal spinal cord while neurons recruited for turns vary drastically for the length of their projection. We then demonstrated, using high prevision optogenetics, that a subset of caudal medullary V2a RSN is sufficient to trigger forward locomotion. Furthermore, we provided first evidence using all optical experiment showing possible recurrent networks within the medullary V2a neurons sustaining forward locomotion. Our findings provide a basis for comparative studies of the functional organization of the reticulospinal neurons in vertebrates and highlighted a key command region for forward locomotion.

Abstract 29

In vivo high-throughput probing of synaptic connectivity using two-photon holographic optogenetic stimulation and compressed sensing strategies

Chung Yuen Chan, Sorbonne Université, Institut de La Vision (IDV)

A comprehensive description of patterns and properties of synaptic connections between a population of neurons provides the most relevant insights into the neuronal circuits underlying brain functions. Here we investigated synaptic connectivity between putative excitatory neurons at layer 2/3 of mouse visual cortex in vivo by combining two-photon (2P) holographic optogenetic stimulation and whole-cell recording. Fast, temporally precise, and spatially selective action potential (AP) was induced in each of potential presynaptic neurons by using 2P holographic illumination onto opsin-expressing cell soma and the current activity in a postsynaptic neuron was monitored by inserting one patch pipette for voltage-clamp recording. Spatially-confined 2P holographic light-spot of 12-µm diameter was generated by using computer-generated holography plus temporal focusing and focused into the brain

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie actions, grant agreement #813457.

tissue in lightly anesthetized animals. By using soma-illumination of 2P holographic light of 0.15-0.3 mW/µm2, AP of peak latency <10 ms and jitter <1 ms was induced in a potential presynaptic cell expressing the soma-restricted opsin ChroME. An optimized pipeline for fast sequential photostimulation of single cells enabled probing ~100 potential presynaptic cells in ~5 minutes. Connectivity mapping was further accelerated by a parallel multi-cell photostimulation strategy combined with a compressive sensing algorithm to retrieve the connections. Taken together, our approach allows high-throughput mapping of local synaptic connections to a postsynaptic neuron in vivo with unprecedented speed, precision, and accuracy.

Abstract 30

Mapping neural circuits the genetic way

Marnie E. Halpern, Dartmouth College, Geisel School of Medicine

The habenulo-interpeduncular forebrain to midbrain pathway has been implicated in diverse functions, addiction, and mood disorders, yet our understanding of the neuronal cell types and how they connect is lacking. Using bioinformatic strategies and CRISPR-Cas9 targeted integration to label neuronal subpopulations in the zebrafish, we have begun to establish a connectivity map between dorsal habenular cell types and subregions of the interpeduncular nucleus. We have also applied a new transgenic strategy, based on *trans*-Tango transsynaptic labeling initially developed for *Drosophila*, to trace neural connectivity more generally throughout the zebrafish brain.

Abstract 31

Spinal basis of direction control during locomotion in larval zebrafish

David McLean, Northwestern University, Department of Neurobiology

Navigation requires steering and propulsion, but how spinal circuits contribute to direction control during ongoing locomotion is not well understood. To fill this gap, we have examined the activity patterns of spinal neurons in larval zebrafish during 'fictive' swimming in response to directional visual stimuli. We find directed swimming involves unilateral changes in the duration of motor output and increased recruitment of motor neurons on the turning side, without impacting the timing of output across or along the body. Current-clamp recordings from premotor interneurons responsible for phasic excitation and inhibition during swimming revealed two types of recruitment patterns. Direction-sensitive V2a and V1 interneurons are preferentially recruited on the turning side, while direction-agnostic V2a and V1 interneurons show no preference. Among V2a neurons, these functional distinctions are also linked to morphology. Our findings support the modular control of steering and

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie actions, grant agreement #813457.

propulsion by spinal premotor circuits, where recruitment of distinct subsets of interneurons controlling movement amplitude and timing simplifies adjustments in direction while on the move.

Abstract 32

Structure and Function of Circuits for Balance

Martha Bagnall, Washington University School of Medicine, Department of Neuroscience

Motor circuits develop in sequence from those governing fast movements to those governing slow. Here we examine whether upstream sensory circuits are organized by similar principles. Using serial-section electron microscopy in larval zebrafish, we generated a complete map of the gravity-sensing (utricular) system spanning from the inner ear to the brainstem. We find that both sensory tuning and developmental sequence are organizing principles of vestibular topography. Patterned rostrocaudal innervation from hair cells to afferents creates an anatomically inferred directional tuning map in the utricular ganglion, forming segregated pathways for rostral and caudal tilt. Furthermore, the mediolateral axis of the ganglion is linked to both developmental sequence and neuronal temporal dynamics. Early-born pathways carrying phasic information preferentially excite fast escape circuits, whereas later-born pathways carrying tonic signals excite slower postural and oculomotor circuits. These results demonstrate that vestibular circuits are organized by tuning direction and dynamics, aligning them with downstream motor circuits and behaviors.

Abstract 33

Going to the not-so-dark side: An entrepreneur's perspective on neuroscience research

Karl Kilborn, Intelligent Imaging Innovations (3i)

Most exciting methodological and conceptual directions to follow in imaging and advice on how to start a company after a PhD.

Abstract 34 (poster)

Using a panoramic virtual reality system to study vision and navigation in larval zebrafish

Ryosuke Tanaka, Technical University of Munich (TUM)

The ability to control visual stimuli precisely and flexibly is vital to neuroscience of vision and beyond. Here, we present a panoramic visual stimulation system based on a DLP projector and mirrors, which

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie actions, grant agreement #813457.

can easily achieve azimuthal and elevational coverage of 270° and 90°, with a minimal modification to a popular bottom-projection setup. An OpenGL-based real time rendering of 3D scenes allow immersive virtual reality presentation to embedded fish. The system will be broadly useful to characterize receptive field properties of visual neurons across the brain, as well as to study neural bases of navigation in larval zebrafish.

Abstract 35 (poster)

Noradrenergic Mediated Brain State Switch

Emiliano Marachlian, École Normale Supérieure (ENS)

The environment is complex and continuously changing whereby brains need to be able to adapt and quickly shift between resting, working or arousal states in order to allow adaptative behaviors. These global state shifts are intimately linked to the brain-wide release of the neuromodulators. Although the neurons that release neuromodulators generally have projections throughout the whole brain, there are only studies showing neuromodulators effects in specific functions and/or specific brain areas and still remains unclear what is the effect in the whole brain dynamics and how neuromodulators affect the information flow and computations in the entire brain.
In order to disentangle the specific circuit involved in the brain dynamic changes associated with noradrenaline release We used zebrafish larva as experimental model in combination with light-sheet microscopy.
Whole-brain dynamics with single-neuron resolution was monitored while simultaneously recording free tail movement as a behavioral output. In addition optogenetic manipulation and cell type identification were performed.
Results show a noradrenergic neurons mediated switch in the brain state when animals perform a strong scape behavior. The switch is characterized by the shutting down of a vast majority of active neurons at the same time that the inactive neurons start up. The activation of neurons located in the Locus Coeruleus (LC) seem to trigger the switch.
In addition we found that, when the switch is spontaneous, before the LC activation there is a ramping activity in a neuronal subpopulation located in another noradrinergic area, the NE-MO. I will present a characterization of the brain dynamic before and after the shift (by using spontaneous, stimuli and optogenetically triggered events) together with a components, role and dynamics description of the noradrenergic neuronal circuit involved in the brain state and behavior switch.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie actions, grant agreement #813457.

Abstract 36 (poster)

Identifying motor neuron specific alterations in FUS deletion mutant zebrafish model of ALS

Xhuljana Mingaj, Institut Imagine - INSERM

FUS, mutated in ALS patients, is an RNA-binding protein, involved in multiple aspects of RNA metabolism, including RNA splicing, trafficking and translation. The majority of FUS mutations are localized in exon 15, which encodes for NLS (nuclear localization signal), causing FUS redistribution into the cytoplasm with consequent clearance from the nucleus. Previous studies in our team reported for the first time the generation and phenotypic characterization of a stable zebrafish line mutant for the unique FUS orthologue. In this genetic line, we demonstrated that the loss of its function reduces lifespan of homozygous individuals and leads to locomotor disabilities. Also, post-synaptic features including alterations at the mitochondrial network specifically at the muscle level were later observed in this model. Importantly, we have identified several dysregulated metabolites and proteins that are altered in heterozygotes (+/-) and homozygous (-/-) lines. From metabolomic and proteomics of whole zebrafish larvae at 3 dpf (days post fertilization) we observe important mitochondrial pathways are specifically deregulated. One of the pathways involved has been rescued by supplementing zebrafish larvae with 10 µM Acetyl-L-Carnitine administered at 2 dpf. We observe a locomotion and survival rate recovery of 40%. In parallel to this *fus* deletion mutant model we are generating the *fus* ΔNLS zebrafish line, in order to recapitulate all the features reported for FUS-ALS pathology in patients. We will use a CRISPR technology to generate the line and subsequently validate the interact omics results observed in the *fus* KO deletion mutant in the novel zebrafish line. These strategies will allow us to identify genetic and chemical modifiers that could rescue the phenotype due to FUS inactivation. Our objective will be to rapidly translate these findings to define therapeutics for the human pathophysiology of FUS-induced ALS.

Abstract 37 (poster)

Meteorins regulate the formation of the left-right organizer and the establishment of vertebrate body asymmetry

Fanny Eggeler, Sorbonne Université, Institut de La Vision (IDV)

During vertebrate embryonic development left-right symmetrybreaking is innated by a ciliated organ called the Node. Within the Node, a leftward flow of extraembryonic fluid named the Nodal flow mediates the asymmetric expressions of Nodal factors. Although downstream Nodal pathway components leading to the establishment of the embryonic leftright axis are well known, less is known about the development and formation of the embryonic Node itself. Here, we reveal a novel role for

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie actions, grant agreement #813457.

the Meteorin protein family in the establishment of the left-right axis and in the formation of the Kupffer's vesicle, the Node equivalent structure in zebrafish. The CRISPR/Cas9 genetic inactivation of each or all three zebrafish Meteorin members family (*metrn, metrnl1 and metrnl2*) led to defects in the properties of the Kupffer's vesicle (KV) caused by an impaired assembly and migration of the dorsal forerunner cells (DFCs) that shape the KV. As a consequence, we show that Metrns loss-of-function results in disturbed Nodal factors expression, notably leading to heart looping defects. We demonstrate that through the genetic interaction with the Integrins ItgαV and Itgβ1b, Metrn proteins regulate the DFC clustering. Together, our results identify a new role for the Meteorin protein family in the left-right asymmetry patterning during early embryonic vertebrate development. With the goal of identifying Metrns putative receptor(s), we are currently investigating the cellular pathway(s) in which Meteorin proteins are involved in and are developing approaches to validate the identified candidates as *bona fide* Metrns receptor(s).

Abstract 38 (poster)

Integration of motor and visual information in the zebrafish heading direction system

Hagar Lavian, Technical University of Munich (TUM)

Animals can use different strategies to navigate. They may guide their movements by relying on external cues in their environment or by using an internal cognitive map of the space around them. In many species, the heading direction of the animal is represented by heading direction neurons and can be affected by both motor and visual information. We have discovered, for the first time in a vertebrate, a topographically organized heading direction system in the larval zebrafish hindbrain. This network consists of GABAergic neurons that arborize in the interpeduncular nucleus, where their connectivity pattern supports the implementation of a ring attractor network. This network appears to be unaffected by visual inputs and shows similar dynamics and efficiency in the presence of visual feedback and in darkness. We further used two photon calcium imaging to investigate how visual inputs are integrated downstream of this network. We detected visually responsive neurons in the anterior hindbrain and interpeduncular nucleus, in which heading direction is integrated. Furthermore, we identified neurons with receptive fields responses and show that these neurons send excitatory projections to the interpeduncular nucleus. Our findings point to a potential mechanism that allows zebrafish to generate a more accurate representation of their heading direction by integrating efference copies with visual information.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie actions, grant agreement #813457.

Abstract 39 (poster)

Radial astrocyte synchronization modulates the visual system during behavioral-state transitions

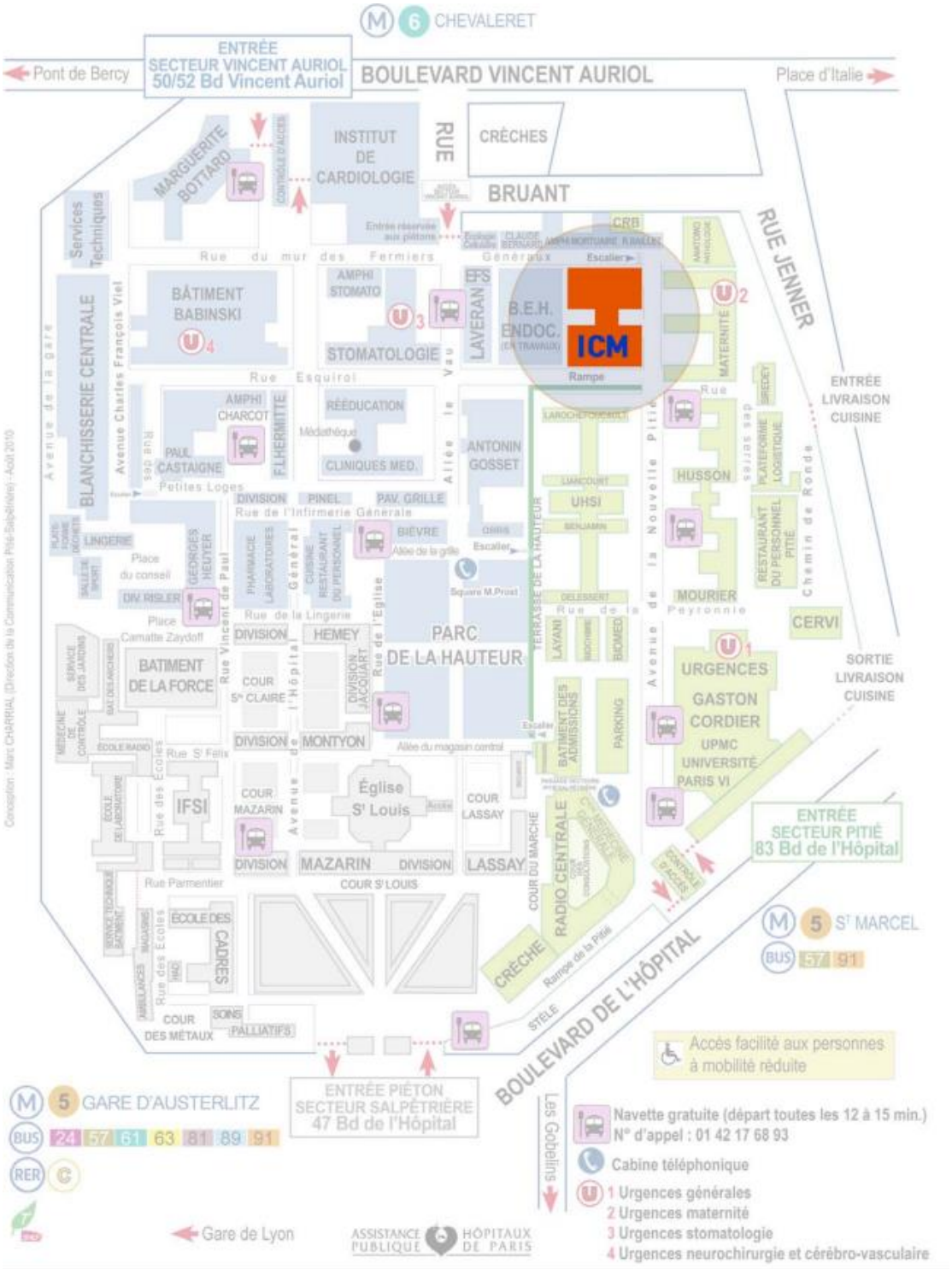
Alejandro Uribe, École Normale Supérieure (ENS)

Glial cells were thought to support the function of neurons. Recent evidence show that astrocytes are involved in brain computations. To explore whether and how their excitable nature affect brain computations and motor behaviors, we used two-photon Ca 2+ imaging of zebrafish larvae expressing GCaMP in both neurons and Radial Astrocytes (RAs). We found that in the optic tectum, RAs synchronize their Ca2+ transients immediately after the end of an escape behavior. Using optogenetics and ablations, we observed that RA synchronous Ca 2+ events are mediated by the locus-coeruleus-norepinephrine circuit. RAs synchronization modulated the direction selectivity of tectal neurons and their long-distance functional correlations. This mechanism may support freezing behavior following a switch to an alerted state and improve visual detection. These results show that LC-mediated neuro-glia interactions modulate the visual system during transitions between behavioral states.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie actions, grant agreement #813457.

Zenith

ANNEX 2: ACCESS MAPS



This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie actions, grant agreement #813457.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie actions, grant agreement #813457.

ANNEX 3: LOCAL RESTAURANTS

Restaurant	Address
Le Petit Pontoise	9 Rue de Pontoise 75005 Paris
Les Belles Plantes	47 rue Cuvier 75005 PARIS
Le Paradis Latin	28 rue du Cardinal Lemoine 75005 Paris
Le Passage	46 rue des Fossés St Bernard 75005 Paris
Les Petit Pois	3 rue Linné 75005 Paris
Marty	20 avenue des Gobelins 75005 Paris
Le Ziryab	1 Rue des Fossés SaintBernard 75005 Pa
Xinh Xinh	6 Rue des Wallons, 75013 Paris, France
Les Editeurs	4, carrefour de l'Odéon 75006 PARIS
Le Hibou	16 CARREFOUR DE L'ODÉON 75006 PARIS
Le Relais Odéon	132 Boulevard SaintGermain, 75006 Paris, France
Le Flore en L'ile	42 QUAI D'ORLÉANS - 75004 PARIS
Le Bon Saint Pourçain	10bis, rue Servandoni 75006 Paris, FR

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie actions, grant agreement #813457.