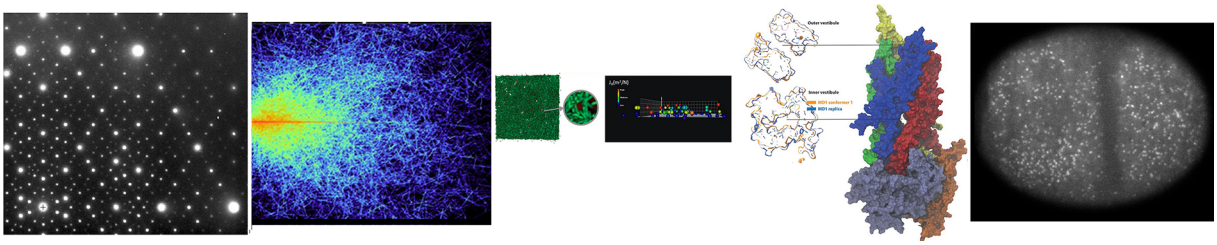

Journée des UFR de Biologie et de Physique
19 octobre 2017 – Amphithéâtre 25

8h30 – **Accueil**

9h00 – **Introduction** : Vincent Maréchal (Directeur UFR de Biologie) et Edouard Kierlik (Directeur UFR de Physique)

Session Instrumentation
(Animation - Stéphanie Bonneau et Marie-Anne Penhoat)

9h15 – **Sylvain Gigan** (LKB) : *Contrôle de front d'onde et imagerie en milieux complexes*

9h35 – **Nicolas Menguy** (IMPMC) : *Microscopies électroniques appliquées aux biominéralisations*

9h55 – **Nicolas Rodriguez** (LBM) : *Coupling electrical, force and optical measurements to study Cell Penetrating Peptides*

10h15 – **Dongdong Li** (IBPS) : *Spatially patterned optogenetics to study neuron-glia interaction*

10h35 –11h00 **Pause café**

Session Mécanique Multi-échelle
(Animation - Michel Labouesse et Philippe Petitjeans)

11h00 – **Eric Clément** (PMMH) et **Nelly Henry** (LJP) : *Physical mechanisms driving bacterial populations*

11h30 – **Julien Heuvingh** (PMMH) : *Mechanics and dynamics of the cytoskeleton probed by micro-magnets*

11h50 – **François Robin** (IBPS) : *Single-molecule dynamics to understand cell and tissue morphogenesis*

12h10 – **Raphaël Voituriez** (LJP) : *Physics of the cytoskeleton and models of cell migration*

12h30 – **Flash-talks**

13h00 – **Pause déjeuner et Session poster**

Session Neurosciences
(Animation - Alexis Prevost et Georges Debrégeas)

14h30 – **Anne-Lise Paradis** (IBPS) : *L'imagerie cérébrale à l'interface de la physique, du traitement de signal et des sciences cognitives*

14h50 – **Alain Trembleau** (IBPS) **:** *Biophysique du développement neuronal - quand la tension axonale régule la fasciculation*

15h10 – **Bruno Delord** (ISIR) **:** *Neurodynamique des représentations et des états mentaux dans les réseaux de neurones récurrents*

15h30 – **Volker Bormuth** (LJP) : *Imagerie du cerveau entier du poisson zèbre par nappe laser*

15h50 – **Pause café**

Session Génomique
(Animation - Maria Barbi et Frédérique Peronnet)

16h20 – **Dominique Weil** (IBPS) et **Julien Mozziconacci** (LPTMC) : *De l'intérêt d'une approche interdisciplinaire : analyse d'un objet cellulaire (P-body) constitué de centaines de protéines et de milliers d'ARN*

16h40 – **Martin Weigt** (IBPS): *Multi-scale coevolution of interacting proteins : statistical and biophysical modelling approaches*

17h00 – **Élodie Duprat** (IMPMC) : *Évolution des répertoires génomiques à l'échelle des structures et fonctions des protéines*

17h20 – **Anne-Florence Bitbol** (LJP) : *Évolution et dynamique des populations*

POSTERS
(FLASH TALKS)

1 - Judith Miné-Hattab, judith.Mine@curie.fr

Titre: Imaging DNA repair at the single molecule level

Résumé: The genome is constantly damaged by a variety of exogenous and endogenous agents. Among the various forms of DNA damage, double-strand breaks (DSBs) are the most cytotoxic and genotoxic for the cell. Failure to repair such lesions leads to genomic instability or cell death. In higher eukaryotes, mutations in DNA repair genes lead to cancer predisposition. Eukaryotic organisms use several mechanisms to repair DSBs: non-homologous end-joining (NHEJ), alternative non-homologous end-joining (Alt-NHEJ) and homologous recombination (HR). Here, we investigate the molecular mechanisms of HR proteins inside cells at the single molecule level in Saccharomyces cerevisiae yeast. In response to DSB, repair proteins colocalize from diffuse distribution to repair foci located at the damaged DNA site. An enduring question in the DNA damage field is how do repair proteins find their correct target and accumulate within repair foci: how do they diffuse before DNA damage, during focus formation when they have to reach the site of damage, and inside such a small sub-nuclear region formed by a repair focus? To answer these questions, we use single particle tracking and PALM approaches allowing us to assess the physical properties underlying repair foci formation and their internal dynamics.

2 - Stéphanie Bonneau, stephanie.bonneau@upmc.fr

Titre: High-speed nanoscopy to decipher the real-time mitochondrial dynamics

Résumé: Numerous studies carried out in recent decades on mitochondria have led to the idea that the organization of these organelles at nano and micrometer scale is interlinked with their biological functions. In particular, a regulatory role of the mitochondrial inner membrane remodeling is today the prevalent hypothesis. However, due to a lack of appropriate experimental methods, this idea still needs evidence. The above mentioned studies were typically carried out by electronic or optical imaging methods. The latter, indeed, has the advantage of allowing a sufficient acquisition speed to follow mitochondrial dynamics. However, their resolution does not allow to visualize the internal mitochondrial nanostructure. The former, in contrast, offers one excellent spatial resolution but requires to work on fixed cells and therefore does not allow to monitor the dynamics and remodeling of these nanostructures.
We wish overcome these limitations by using an optical imaging experimental setup based on a structured illumination of the sample (SIM microscopy). This method, which allows to exceed the limit of optical resolution, has been developed in recent years. We improved this approach in order to increase the speed of acquisition, and so provide the possibility to follow the intra-mitochondrial remodeling in space and in time. Our first experiments, performed during the last year on healthy living cells, have given promising results. For the first time, real-time imaging of the inner mitochondrial structures have been successful with a sufficient resolution to follow their remodeling, and data are now under analysis. We work on both healthy and impaired cells, the physiological state of which will be wellcontrolled by the use of a photo-controlled stress.
We now work to improve the spatial definition of the analysis, by performing multi-color imaging of both the membranes and the inner compartment of the mitochondria, each stained with specific fluorescent probes. Our final goal is to decipher the interrelationship between inner mitochondria topology and mitochondrial regulation.

3 - Vlad Costache, vlad.costache@upmc.fr

Titre: Cortical actomyosin dynamics during contractility pulses in early C. elegans embryos

Résumé: Proper development and morphogenesis relies on fine-tuned spatial and temporal deployment of forces inside cells. The actomyosin cytoskeleton is determinant for the deployment of these forces and so, for the mechanical properties of embryonic cells and tissues. In C. elegans early embryos, the cell cortex includes at least two types of cytoskeletal structures that simultaneously coexist, competing for the actin monomer pool as well as for their various binding partners. Among them, formins are responsible for the polymerization of new actin filaments. Using HILO imaging and the SmPReSS method (Robin *et al.* 2014), we can track single molecules of actin or actin-binding partners (such as the formin CYK-1) in order to understand the biochemical interactions in vivo within cortical actomyosin, and the organisation of the active meshwork during contractility pulses. [Robin *et al.* (2014) Nat. Meth. 11, no. 6: 677–82].

4 - Marie Breau, marie.breau@upmc.fr

Titre: Role of mechanical forces in a developing neuronal circuit

Résumé: During neuronal circuit development, neurons move towards their final location while growing axons towards their target. Whereas the biochemical guidance cues involved in neuronal migration and axon elongation are extensively studied, the contribution of mechanical forces in these processes remains largely unexplored in vivo. We analysed the cellular dynamics driving the construction of the olfactory circuit in zebrafish and investigated the mechanical forces involved. Our findings uncovers a novel mode of neuronal circuit formation, where extrinsic mechanical forces push or pull the cell bodies of neurons away from their axon tips, thereby elongating their axons (passive retrograde axon extension). Our discovery of passive retrograde axon extension and of extrinsic mechanical inputs as a driving force calls for the analysis of this phenomenon in other regions of the nervous system.

5 - Jean Cognet, jean.cognet@upmc.fr

Titre: Modélisation mésoscopique des biopolymères: Approche BCE, Projet « rubAN », Classifications et recherche des formes idéales de l'Elastica 3D "Olivier Ameline 1,2, Xingxi Huang 1,2, Sinan Haliyo 1, Jean A. H. Cognet 2
(1) UMR 7222, Institut des Systèmes Intelligents et de Robotique (ISIR), et (2) UMR 8237 Laboratoire Jean Perrin (LJP), UPMC.

Résumé: Travaux antérieurs: La chaîne sucre-phosphate des acides nucléiques (AN) se comporte aux échelles mésoscopiques comme une poutre élastique, d'où le développement de l'approche de modélisation moléculaire nommée Biopolymer Chain Elasticity (BCE), particulièrement efficace pour les structures d'AN en boucles.
Projet « rubAN » : « Calcul robuste de vrais rubans d'AN pour la modélisation moléculaire interactive à différentes échelles » (Convergence UPMC 2014, IPV 2014-2017). Notre objectif est de généraliser ce modèle novateur pour les biopolymères, AN et protéines, pour visualiser la molécule au moyen de rubans, pour en décrire les propriétés géométriques, physiques et mécaniques, et pour mettre en œuvre une simulation interactive et haptique des déformations et interactions entre molécules.
Résultats : Pour être applicable à tous les biopolymères, l'approche BCE nécessite une méthode de calcul des trajectoires de poutres élastiques pour tous types de conditions d'encastrement. Nous avons réussi à classer les trajectoires possibles en fonction de trois propriétés de chiralités.

6 - Alexis Picot, alexis.picot@parisdescartes.fr

Titre: Thermal model of temperature rise under in vivo two-photon optogenetics brain stimulation

Résumé: Optogenetics has been transforming neuroscience research enabling neuroscientists to drive and read neural circuits. Recent development of new illumination approaches combined with two-photon (2P) excitation has opened the route for brain circuits manipulation with single cell resolution and millisecond temporal precision. Yet, the high excitation power required for multi-target illumination especially under 2P illumination raises questions about the induced local heating inside samples. Here, we present a theoretical model that enables to simulate both 3D light spreading and heat diffusion within scattering samples at unprecedented high spatial and temporal resolution under the illumination configurations most commonly used to perform 2P optogenetics.

7 - Maria Kitsara, maria.kitsara@upmc.fr

Titre: Nanofabricated scaffolds for cardiac regenerative medicine: the role of electrospinning in enhancing physical stimuli

Résumé: Synergy between micro-nanotechnology and regenerative medicine can lead to new tools for health improvement. Engineered scaffolds have been widely used as structural and functional supports on which cells are seeded for the generation of cell therapy products. In the field of cardiac therapy, this approach is challenging but holds a real promise for improving function of the chronically failing myocardium. Electrospinning consists of a highly effective method for the recreation of the natural 3D environment of myocardium, via mimicking the fibrillar structure of the extracellular matrix, which provides essential guidance for cell organization and function. The combination of electrospinning with electroactive polymeric materials can further enhance scaffolds electro-mechanical properties and provide reinforced physical stimuli for their optimum efficacy in heart therapy. Herein, both natural and synthetic electroactive electrospun scaffolds are presented as promising candidates for cardiac regenerative medicine.

8 - Kevin Berlemont, kevin.berlemont@lps.ens.fr

Titre: Neural coding and decoding of categories

Résumé: Categorical Perception is central to cognition in human and mammals: ensembles of stimuli are mapped to categories, such as, trees, faces, colours… In the recent years, experimental and theoretical works in neuroscience and experimental pyschology shed some light on the neural architectures and processes at work in perceptual categorization. Most works focus on either the coding stage (how stimuli are represented in the brain), or on the decoding stage (how the brain decide which category the stimulus belongs to). Here we consider a global framework for modeling both the neural coding and decoding parts, and study the optimal performances in categorization, making use of information theoretic criteria. We extend previous works done at the laboratory by incorporating more realistic neural dynamics in the decision making process. We discuss how the properties at the neural level translate in terms of behaviour (identification performance, reaction times).
[Laurent Bonnasse-Gahot and Jean-Pierre Nadal, Perception of categories: from coding efficiency to reaction times, Brain Research, Volume 1434, 24 January 2012, Pages 47-61; Kevin Berlemont, master thesis, 2016 & work in progress].

9 - Evelyne Kolb, evelyne.kolb@upmc.fr

Titre: Plant root growth interacting with mechanical obstacles

Résumé: The mechanical and topological properties of a soil like the global porosity and the distribution of void sizes greatly affect the development of a plant root, which in turn affects the shoot development. In particular, plant roots growing in heterogeneous medium like sandy soils or structured soils with distribution of aggregate size and strength have to adapt their morphology and exert radial forces depending on the pore size in which they penetrate. Through model experimental systems, we addressed the questions of the coupling and feedback between the root growth and the surrounding constraining substrate, i.e. what are the forces a root is able to develop on its environment and how the mechanical stress affects the root growth.

10 - Sophie Cribier, Sophie.Cribier@upmc.fr

Titre: Assessing the translocation of Cell Penetrating Peptides using force measurements, electrophysiology and emulsions

Résumé: Cell Penetrating Peptides (CPPs) are amongst the major candidates for non-deleterious drug delivery directly inside targeted cells. These peptides are known to be able to cross the membrane with a cargo through two different mechanisms: endocytosis and direct translocation. Although the later is of major interest for therapy, the mechanisms occurring during membrane crossing are unknown. In this work, the adhesion and the translocation of CPPs across biological and model membranes are thus investigated. Two different tecnics are used : Biomembrane Force Probe (BFP) and a model membrane system : the Droplet Interface Bilayer system (DIB).

11 - Yasmina Fedala, yasmina.fedala@espci.fr

Titre: A new full-field interferometry approach for counting and differentiating aquatic biotic nanoparticles.

Résumé: Due to the huge abundance and the major role that viruses and membrane vesicles play in the seas or rivers ecosystems it is necessary to develop simple, sensitive, compact and reliable methods for their detection and characterization. Our approach is based on the measurement of the weak light level scattered by the biotic nanoparticles. We describe a new full-field, incoherently illuminated, shot-noise limited, common-path interferometric detection method coupled with the analysis of Brownian motion to detect, quantify, and differentiate biotic nanoparticles. We validated the method with calibrated nanoparticles and homogeneous DNA or RNA.virus suspensions. The smallest virus size that we characterized with a suitable signal-to-noise ratio was around 30 nm in diameter with a target towards the numerous 20 nm diameter viruses. We show for the first time anisotropic trajectories for myoviruses meaning that there is a memory of the initial direction of their Brownian motions. Significant improvements have been made in the handling of the sample as well as in the statistical analysis for differentiating the various families of vesicles and virus. We further applied the method for vesicles detection and for analysis of coastal and oligotrophic samples from Tara Oceans circumnavigation as well of various rivers.

12 - Arthur Boutillon, arthur.boutillon@ens.fr

Titre: Studying collective migration using the Zebrafish prechordal plate

Résumé: The Zebrafish prechordal plate is a recent model for collective cell migration, but at mesenchymal state. During my M2 and presently for my PhD, along with molecular analysis of migration, I am looking for the origin of the direction of migration. Based on an hypothesis proposed in Weber et al. (2012), where they showed that migrating cells can be oriented upon mechanical force application, I would like to know whether the whole plate can organize itself only because of an asymmetrical distribution of tensions. For that purpose and for the moment, I used laser ablation to assess whether tensions inside the plate are required for correct migration.

13 - Joana Fidalgo, fidalgojoanasales@gmail.com

Titre: RBC flow in biomimetic bifurcating networks

Résumé: Blood flow is highly complex and a subject of extensive research. In particular, at the level of microcirculation, the RBC partitioning is highly dependent on the Fahraeus-Lindqvist and Zweifach-Fung effects. The combination of these effects has a major influence on the way cells divide when facing a bifurcation. In some cases, the uneven distribution of cells is so significant, generating an important reduction of cell volume fraction (haematocrit) in the vessel of lower flow rate to the point that the oxygen delivery into the surrounding tissue is compromised. This could lead to tissue malfunction and, eventually, dead. Even though there are some important numerical studies on this topic, we believe it is of major importance to cross check numerical data with real experiments and try to understand the effect of several effects on RBC partitioning such as flow resistance, haematocrit level, RBC deformability or bifurcation angle. We performed a set of experiments using planar bifurcating networks designed using a biomimetic design rule and we intend to compare some of this data with numerical simulations using HemeLB flow solver for a suspension of deformable RBC in complex geometries.

14 - Marie-Anne Hervé du Penhoat, marie-anne.herve_du_penhoat@upmc.fr

Titre: Radiation-induced damage to biomolecules. *Ab initio* molecular dynamics studies.

Résumé: Our aim is to interpret, at a molecular level, the ultrafast dissociation processes following the double ionization of model bio-molecular systems consisting of small DNA or RNA building blocks, either isolated or solvated by water molecules. Theoretical tools were specifically designed to study ionizing events. The method is based on the localization of a hole created in one of the molecular orbital of a chosen molecule among the sample. Once the initial state specified, the dynamical evolution of the system is followed using *ab initio* molecular dynamics simulations. The dissociation of doubly-ionized water, uracil and deoxyribose molecules was investigated, looking at the influence of the hydration state of the molecule or direct versus indirect mechanisms.

15 - Alexandre Beber, alexandre.beber@curie.fr

Titre: Septins are able to deform the plasma membrane

Résumé: Septins are cytoskeletal membrane binding proteins capable of organizing in filaments and rings involved in several cellular functions such as cytokinesis and membrane integrity. Our goal is to understand the mechanism by which septins are able to maintain cellular shape, to quantify their effect on membrane rigidity, their recruitment mechanisms and organization on curved membranes.

16 - Marco Pascucci, marco.pascucci@parisdescartes.fr

Titre: Super-resolution microscopy by saturated speckle illumination

Résumé: In recent years, super-resolution optical microscopy has been a major breakthrough for biological research, allowing to reach nano-metric details in bio-imaging. Several successful super-resolution techniques (e.g. SSIM, STED/RESOLFT) need highly inhomogeneous and precisely structured illumination patterns. This fact intrinsically limits the application of these techniques in scattering environments, where light is scrambled by random diffraction, giving rise to speckles. Here, we demonstrate the possibility of exploiting speckles to perform super-resolution microscopy, by saturating fluorescence excitation. Moreover, exploiting the pseudo orthogonality of random patterns, we show that 3D super-resolved images can be obtained by a single 2D scan.

17 - Bernard Billoud, Bernard.Billoud@upmc.fr

Titre: Growing the brown algal way: keep stress under control

Résumé: Tip growth is the most widely distributed unidirectional growth process on the planet. In walled cells (plants, algae, fungi) close examination of the physical processes at the cell wall level uncovers a paradox: growth takes place at the tip, where turgor-driven tensile stress is low because of high curvature. All tip-growing cells studied so far overcome this impediment by modulating their cell-wall extensibility, through the localized action of cell-wall-loosening enzymes. In the brown alga Ectocarpus sp., we thoroughly measured key parameters to feed a biophysical model of tip-growth. Results show that Ectocarpus has evolved an alternative tip-growth mechanism in which a finely tuned gradient of cell-wall thickness along the cell compensates for curvature and redistributes the tensile stress. Simulations allow to explore consequences and robustness of this unusual process, and to estimate the flux of cell-wall delivery.

18 - Ulisse Ferrari, ulisse.ferrari@gmail.com

Titre: The role of fast noise correlations in encoding dynamic stimuli in the retina

Résumé: A major challenge in sensory neuroscience is to understand how complex stimuli are encoded by neural circuits. In the retina, several layers of neurons process the visual stimulus, which is ultimately encoded by the spiking activity of ganglion cells. It is still unclear how the visual scene is encoded by the collective activity of ganglion cells. Here we recorded large populations of ganglion cells with multi-electrode array on rat retinas responding to complex stimuli, such as videos of moving objects. We found that neighboring cells exhibit fast correlations that cannot be explained by the joint activation due to the stimulus. The time scale of these “noise correlations” is fast enough to be mediated by gap junctions, and they were present specifically for cells of the same type. In order to investigate the role of these noise correlations in the encoding of the visual scene we have constructed a model capable of predicting both the response of individual single cells (PSTH) and the observed noise correlations. This model is composed of a cascade of two layers of processing, and equipped with a recurrent interaction network among the ganglion cells to reproduce specifically noise correlations. We are currently using this model to measure how noise correlations impact the coding of these complex stimuli, and test if they are helpful or detrimental to the encoding capacity of the retinal network.

19 - Slavica Jonic, Slavica.Jonic@impmc.upmc.fr

Titre: Deciphering continuous motions of biomolecules from cryo-electron microscopy images by a combined use of molecular mechanics simulation, image analysis, and machine learning

Résumé: Elucidation of conformational changes of biomolecular complexes by cryo-electron microscopy (cryo-EM) image analysis is crucial to understand molecular mechanisms of action of these complexes and to develop new drugs. Particularly challenging is the problem of continuous conformational changes (a sequence of many intermediate conformational states of the same complex along a conformational transition pathway). For extensive studies of such conformational changes, it is necessary to develop new methods to allow high-resolution 3D reconstruction of different conformational states of many copies of the same complex imaged simultaneously. We were the first to establish the basis for such a methodology (Jin *et al.*, Structure 2014). Our methodology is based on a combined use of cryo-EM image analysis and normal mode analysis (molecular mechanics simulation), which already allows low-resolution analysis of the conformational variability. To allow high-resolution analysis, we currently investigate the use of this methodology in combination with machine learning approaches such as artificial neural networks.

20 - Claude Loverdo, claude.loverdo@upmc.fr

Titre: Physical mechanisms of the interaction of the immune system with bacteria in the digestive system

Résumé: Immunoglobulin A are antibodies produced by the adaptive immune system and secreted in the gut lumen to fight pathogen bacteria. It has been recently shown that a main physical effect of these antibodies is to enchain daughter bacteria, i.e. to make that dividing bacteria are likely to remain agglutinated. When in clusters, bacteria are less motile and cannot interact with the epithelial cells. We model the dynamics of these clusters. Adhesion between bacteria will break at a certain rate. Using analytical models and simulations, we show that for a range of parameters, the rate of increase in the number of free bacteria (which can interact with the epithelium) has a maximum as a function of the replication rate of bacteria. At low replication rate, the faster the replication, the more the increase of free bacteria. But at higher replication rate, the bacteria replicate before the adhesion between daughter bacteria breaks, leading to growing cluster size and preventing bacteria from escaping the clusters. This enables the gut to select against fast replicating bacteria, which could destabilize the microbiota, and which are more likely to be pathogenic. We study also the evolutionary consequences of the clonality of these clusters.

21 - Kévin PASSADOR, kevin.passador@upmc.fr

Titre: Contribution of biophotonic tools to biological chemistry research - Real-time fluorescence monitoring of innovative anticancer metallodrugs

Résumé: Nowadays, cancer is one of the most important public health issues, and numbers of biochemists around the world are working at finding new molecules to cure this disease. One of the major chemotherapeutic agents is the well-known cisplatin, which suffers from several drawbacks, such as important side-effects. In this context, our group decided to design new metal-based drugs displaying anticancer activity. Starting from half-sandwich iridium complexes, which have particularly attracted interest for their promising antiproliferative activity, we succeeded in introducing a BODIPY fluorescent probe on them, in order to get original trackable anticancer metallodrugs. Thanks to the expertise of the "Plateforme d'Imagerie Cellulaire Pitié Salpêtrière" and the cutting-edge optical microscopy devices they offer, we successfully monitored our new complexes inside living cancer cells by fluorescence videomicroscopy. This way, we notably reported the first real-time monitoring of anticancer iridium complexes cellular uptake. In this communication, we will present our new iridium complexes as promising theranostic anticancer agents and show how fluorescence videomicroscopy can efficiently contribute to biological chemistry research.

22 - Dimitrii Tanese, dimitrii.tanese@parisdescartes.fr

Titre: Optical and molecular focusing for single cell optogenetics

Résumé: Optogenetic control of individual neurons with high spatial and temporal precision would enable powerful explorations of how neural circuits operate. Two-photon computer generated holography enables precise patterning of light, and could in principle enable simultaneous illumination of many neurons in a network, with the requisite temporal precision to simulate accurate neural codes. In this work we couple two-photon patterned illumination with a novel and high efficacy soma-targeted opsin, which is expressed primarily to the cell body of mammalian cortical neurons. This combined optical and molecular approach enabled photostimulation of individual cells in mouse brain slices with single cell resolution and <1 millisecond temporal precision and allowed to perform connectivity mapping on intact cortical circuits.

23 - Clément Molinier, m.clemo2@gmail.com

Titre: Multiplexed spatiotemporal wavefront shaping for high-resolution three-dimensional patterned illumination microscopy

Résumé: Patterning light at the single-cell level over multiple neurons is crucial for a precise optogenetic photostimulation, which can unveil the role of specific components in the brain. To this end we have developed a method for projecting three-dimensional, 2-photon excitation patterns that are confined to many individual neurons. The new versatile optical scheme generates multiple extended excitation spots in a large volume with micrometric lateral and axial resolution. Two-dimensional temporally focused shapes are multiplexed several times over selected positions, thanks to the precise spatial phase modulation of the pulsed beam. This permits, under multiple configurations, the generation of tens of axially confined spots in an extended volume, spanning a range in depth of up to 500 mm. We demonstrate the potential of the approach by performing multi-cell volumetric excitation of photoactivatable GCaMP in the central nervous system of Drosophila larvae, a challenging structure with densely arrayed and small diameter neurons, and by photoconverting the fluorescent protein Kaede in zebrafish larvae. Our technique paves the way for the optogenetic manipulation of a large number of neurons in intact circuits.

24 - Gabriel Dumy, gabriel.dumy@espci.fr

Titre: A novel photoacoustophoretic effect

Résumé: We present evidences of a coupled phenomenon happening when light absorbing particles (beads or cells) are trapped in pressure nodes of a standing ultrasonic field. When enlightened, the until then stable particle aggregates are breaking up, radially ejecting particles from their periphery. This phenomenon shows that optic properties could be added to mechanic ones for microfluidic acoustic cell handling or sorting, and enable original geometries for these microfluidic devices.

25 - Valentin LAPLAUD, valentin.laplaud@espci.fr

Titre: Direct measure of thickness and dynamic response of the cell cortex subjected to compression forces

Résumé: Cell migration is central to many biological and physiological processes and happens in a variety of way. The different actin networks of the cell play different roles in migration either by actively generating forces or by influencing the mechanical properties of the whole cell. In the case of confined migration the cell cortex is often compressed between the outside elements (ECM, other cells…) and the cell nucleus. It has been shown that in constricted microchannels mimicking such environments a perinuclear branched actin network can start polymerizing [1]. Furthermore in vitro experiments on branched actin network have shown a response to confinement in both mechanical properties and polymerization dynamics [2]. Recently the observation of actin waves in 3D [3] also asks questions about the formation and physiological relevance for migration of such complexes structures of branched actin networks. We developed a new tool to study the behavior of the cortex to understand these different types of activities and the mechanics behind complexes actin structures. We use super-paramagnetic beads under a controlled magnetic field: in this situation, the beads develop their own dipolar moment and are attracted to each other with a known force [4]. Thanks to the macropinocytosis ability of dendritic cell we can create a system where we have one bead inside the cell and one outside. We can thus confine the membrane and the cortex between these beads and track their position with a precision around 2nm. This system allows for different measurements and tests upon the cell cortex. Due to the precision available in the tracking of the beads we can measure the thickness of the cortex at different levels of confinement. By combining our system with fluorescent microscopy we can observe a confined portion of cortex for signs of actin polymerization due to confinement. But we also record what seems to be the passage of actin waves between the beads. We can thus study the cortex and its dynamical features in different cases such as with various compressing forces or with drugs to affect the biochemical composition of the cortex.

[1] H. R. Thiam *et al.* - Nat Com 2016
[2] P. Bieling *et al.* – Cell 2016
[3] Fritz-Laylin *et al.* – bioRxiv preprint 2017
[4] T. *Pujol et al. – PNAS 2012*