



Sciences biologiques,  
Écologie et Environnement  
**CONFÉRENCES  
JACQUES-MONOD**



**Roscoff (France), 30 juin – 4 juillet 2012**

**Imagerie des fonctions neuronales : des molécules aux  
circuits**

*Imaging neuronal functions: from molecules to circuits*

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**Rapport sur la Conférence**

*Conference Report*

## **CONFERENCE REPORT**

### **Final report from the Jacques-Monod Conference entitled: Imaging neuronal functions, from molecules to circuits Roscoff, June 30 – July 4, 2012**

#### **1. Report on administrative aspects**

The conference “**Imaging neuronal functions, from molecules to circuits**” took place in Roscoff from June 30 to July 4, 2012. In total, 115 scientists participated. 30 were invited speakers and 85 were selected applicants, among which 8 were selected for short talks. The national composition of the participants was as follows:

<b>Country</b>	<b>Invited Speakers</b>	<b>Short Talks</b>	<b>Regular Attendees</b>
Canada		1	
France	10	3	41
Germany	4	2	7
Hungary			2
Japan	1	1	3
Poland			1
Slovenia			1
Spain			2
Sweden			2
Switzerland	1		4
The Netherlands	1		
U.S.A.	8	1	1
United Kingdom	5		13
<b>Total</b>	<b>30</b>	<b>8</b>	<b>77</b>

The meeting was composed of one special lecture, seven sessions with scientific talks (~25 minutes duration each), two session with short talks (~15 minutes duration each), and four poster sessions.

In total, we invited 30 speakers. The invited speakers were selected to cover both the molecular / cellular level and the network level of brain function. The main criterion for the selection was scientific excellence. The list of speakers was very different from that of previous meetings.

The meeting was advertised by two different strategies. First, Mme Lidoreau sent out several advertisement posters, covering the interested labs within France. Second, the organizers sent approximately 300 posters to selected labs in the UK, USA, France and Germany, Third, the organizers sent about 2000 emails from a data base of neuroscientists all over the world. As a result of this advertisement, we received 106 applications. 5 applications

obviously did not meet the requirements and were not considered further. 85 applications were approved. Based on the quality and the topic of the submitted abstracts, 8 were selected for short oral presentations (short talks).

All but one of the invited speakers who had agreed to participate came to the conference. Only one of the invited speakers in the end was unable to attend, due to family problems. The talks of the invited speakers were of extremely high quality. In most cases, the scientific material presented was unpublished, and in many cases, the data had not even been shown at prior scientific conferences. The sessions of the meeting were arranged in a bottom-up manner, proceeding from the molecular level to the network level, whereas the chairpersons were selected in opposite order. This was done on purpose to enhance scientific interactions between different levels. The session of minitalks (15 minutes duration) and the poster sessions were also highly successful. Posters were of consistently high quality. The poster sessions were strongly visited, and several intense scientific discussions took place during and after these sessions.

The organization of the meeting, mainly performed by Dominique Lidoreau, was perfect, as it was for the prior meetings. The lecture theater near the coast provided an excellent environment for scientific discussions. The technical support was extremely good, without exceptions.

The funding the meeting was to a large extent provided by the CNRS, which we very gratefully acknowledge. Extensive additional industrial sponsoring made it possible to increase the proportion of USA and Japan speakers. Most interestingly, the Gatsby foundation provided special funding that allowed us to waive registration fees for 8 students that requested it. The other sponsors were:

- Nature Methods
- Chroma
- Coherent
- ERROL
- Fluofarma
- Nikon
- Explora Nova
- Leica microsystems
- Oxxius
- Roper Scientific

The traditional excursion to the island of Batz was particularly pleasant, as the weather was unusually nice at that time. The free evening (on Monday) was also very well received, and was used extensively for informal talks and discussions. Both the excursion and the free evening enabled us to establish several new scientific and social interactions.

At the business meeting on Wednesday morning, Angus Silver, UCL London, UK, was confirmed as the president of the next meeting. Furthermore, Christophe Mulle,

Bordeaux, France, was unanimously elected as the new vice-president. This choice of president and vice-president indicate the new direction into which the conference series will develop. Based on the success of the present meeting, which for the first time brought together scientists working at the level of molecules and cells and scientists working at the level of neuronal networks, increasing focus will be placed on the analysis of network function in vivo in the future meetings.

In summary, the organizers feel that the meeting was a great success. Many participants confirmed that it was one of the best meetings they ever attended, and some said that it was the best conference in which they had ever participated.

## **2. Report on scientific aspects**

A new term “the connectome” has recently been launched to describe the ensemble of datasets required to understand the function of the human brain. It comprises the structural and the functional description of all the elements and connections forming the brain. Understanding the “connectome” is indispensable to explain how perception, action or consciousness are implemented in the brain and how its dysregulation can account for brain disease. Although many techniques have been available to monitor neural activity for decades, from single cell recordings to whole-brain imaging, new tools discovered by chemists and molecular biologists in the last 5 years, have recently emerged which, combined with advances in optics and spike-sorting analysis, enable neurobiologists to selectively monitor or manipulate neural activity with an astonishing spatial and temporal control. The goal of the meeting we organized was to show how these new advances have allowed neurobiologists to investigate the functional part of the "connectome" at the level of single neurons, synapses and small brain ensembles such as cortical columns, in the living brain.

In the conference “Imaging neuronal functions: from molecules to circuits”, we tried to introduce such a multi-level approach to brain function. In particular, the goal of the present meeting was to examine the properties of synaptic signaling and plasticity in neuronal networks both in vitro and in vivo. The key idea of the meeting was to boost the interaction between scientists working at different levels of brain research.

The main lectures were chosen to cover both the molecular / cellular and the network level. One main lecture was given by Stefan Hell (Goettingen, Germany) about new revolutionary super resolution imaging methods. This lecture very nicely showed the way for future neuroscience research using these new imaging methods.

The scientific sessions were structured in a bottom up manner, beginning at the molecular level and ending at the level of highest complexity.

A first session addressed new methods using light to probe and control cell function. Adam COHEN (Cambridge, U.S.A.) talked about Imaging voltage with microbial rhodopsins.

Valentina EMILIANI (Paris, France) presented new approaches for two-photon optogenetics. Ehud ISACOFF (Berkeley, U.S.A.) discussed the Optical control of glutamate receptor signaling: spatio-temporal gating of synaptic plasticity. This was followed by two short talks by Suzie DUFOUR (Laval and Quebec, Canada) on resolving membrane properties extracellularly using a micro-optrode for in vivo single cell optogenetics and Julie PERROY (Montpellier, France) presenting BRET imaging to unveil the spatio-temporal remodeling of scaffolds in dendritic spines to control neuronal excitability. Richard KRAMER (Berkeley, U.S.A.) then presented non-genetic photochemical tools for controlling neural activity with light, Erwin NEHER (Göttingen, Germany) introduced a new approach for multispectral imaging for Neuroscience

A second session addressed the dynamic structure and function of synapses. Haruo KASAI (Tokyo, Japan) presented data on synaptic competition between the dendritic spines. Valentin NÄGERL (Bordeaux, France) investigated the structure-function relationship of synapses by STED microscopy. Antoine TRILLER (Paris, France) talked about adaptive synaptic plasticity of inhibition. This was followed by the first poster session. Then Thomas BLANPIED (Baltimore, U.S.A.) presented data on dynamic nanometer-scale substructure within the living postsynaptic density. Timothy RYAN (New York, U.S.A.) talked about control of calcium channel abundance and function at nerve terminals. Daniel CHOQUET (Bordeaux, France) presented a nanoscale view into the dynamic of AMPA receptor organization in synapses. Stephan SIGRIST (Berlin, Germany) used new microscopy to shed light on the assembly of synapse structure and function.

A third session addressed the link from receptors to networks. Troy MARGRIE (London, United Kingdom) presented a talk on intrinsic biophysical diversity within neuronal networks. This was followed by Roberto MALINOW (La Jolla, U.S.A.) on NMDA receptor dependent long-term synaptic depression and Leon LAGNADO (Cambridge, United Kingdom) on synaptic transmission of visual information in the retina . Then two short talks from Eirini PAPAGIAKOUMOU (Paris, France) on shaping two-photon excitation deep inside scattering tissue and Thomas KNÖPFEL (Saitama, Japan) on optogenetic monitoring of neuronal circuit dynamics. After, Frédéric SAUDOU (Orsay, France) talked about axonal transport and energy support.

A fourth session was devoted to imaging neuronal activity at different scales. Arthur KONNERTH (Munich, Germany) presented data on functional mapping of dendritic spines in cortical neurons in vivo. Serge CHARPAK (Paris, France) talked about imaging neuronal activity from capillaries while Xiaowei ZHUANG (Cambridge, U.S.A.) returned to super-resolution fluorescence imaging of neurons. This was followed by two short talks by Jean-Christophe PONCER (Paris, France) on function and modulation of the KCl co-transporter in dendritic spines and Martin HEINE (Magdeburg, Germany) on neurexophilin modulate presynaptic dynamic of alpha-neurexin. Then Christophe MULLE (Bordeaux, France) presented lipid mediated retrograde signaling at hippocampal synapses and Isabel LLANO (Paris, France) presented in vivo imaging of the mouse cerebellar cortex.

A fifth session addressed the function of networks and the properties of network dynamics. Fritjof HELMCHEN (Zurich, Switzerland) presented simultaneous BOLD fMRI and fiber-optic calcium recording in rat neocortex. Angus SILVER (London, United Kingdom) talked about monitoring fast neuronal signaling in 3D with an Acousto-Optic Lens 2-photon microscope and Bernardo SABATINI (Boston, USA) presented new approaches for the study of neuron structure and function. Gero MIESENBOCK (Oxford, United Kingdom) talked about minimal neuronal state changes underlying sensory discrimination, David DIGREGORIO (Paris, France) about dendritic computations by thin dendrites of cerebellar interneurons. Then, Boris BARBOUR (Paris, France) presented the transmission properties and plasticity at the granule cell-Purkinje cell synapse and Matthias VERHAGE (Amsterdam, The Netherlands) the trafficking, docking and fusion of secretory vesicles in neurons.

Finally, a sixth session was devoted to the issue of controlling neuronal networks. Robert ZUCKER (Berkeley, U.S.A.) and Thomas KUNER (Heidelberg, Germany) presented short talks on optical signals from SNARE proteins and three-dimensional, tomographic super-resolution fluorescence imaging of serially sectioned thick samples. Then Michael HÄUSSER (London, United Kingdom) concluded the meeting with a talk on dendritic computation.

The conference provided insights into several extremely interesting molecular, cellular, and network aspects of brain function. In addition, the meeting has led to two more general conclusions which show the way for the future development of neuroscience.

First, although the gaps between the different levels of brain research remain large, a conclusion of the present meeting is that there is both a common denominator of understanding and a common language. This was impressively demonstrated in the scientific discussions, which indicated a high level of mutual understanding. We are confident that the meeting may serve as a primer to intensify the interactions between different levels.

Second, a major conclusion of the meeting was that new imaging methods provide an incredibly powerful new set of tools that could lead to a quantum leap in our understanding of how the brain works.

In summary, the conference successfully brought together scientists working on the function of the brain at very different levels. Thus, the meeting made an important contribution to current attempts to merge bottom-up and top-down approaches, leading to a more unified understanding of higher brain functions. We found this interdisciplinary approach to the problem of communication between neurons extremely stimulating, and hope that this outstanding series of conferences will continue.

### **3. Concluding remarks and recommendations for future meetings**

The conference was a big success at all levels. The main purpose of the meeting, to foster interactions between scientists working at the molecular, the cellular, and the network level, was achieved. For possible future conferences, the organizers would like to make the following suggestions:

- Strengthening of the in vivo part of the meeting. This may also imply reversal of the sequence of presentations from bottom-up to top-down. The choice of the new president and vice-president indicates a development of the topic of the conference along these lines.
- Pursue the minitalks sessions. Based on the extremely positive resonance, it would seem appropriate to re-iterate these invited short talks. This gives a number of young scientists early in their career the opportunity to present their results to a high-profile scientific audience.

January 31, 2013

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President

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