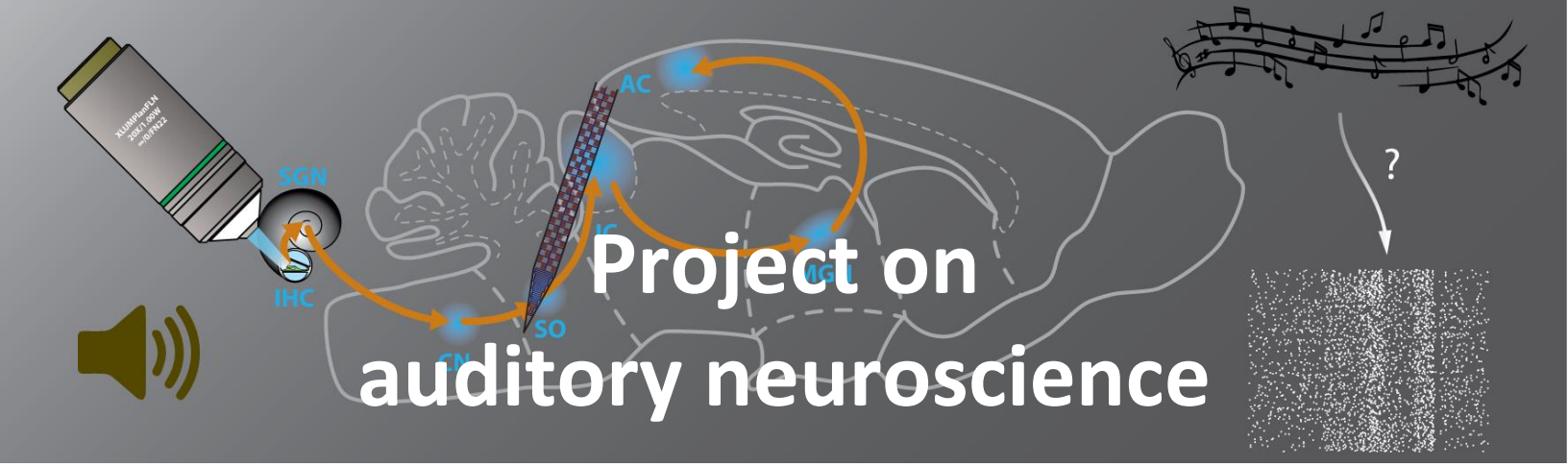


Project on auditory neuroscience

Lab's description

Living systems are never at rest. They are highly dynamic in order to perceive the ever-changing world. In the Barral lab, we are generally interested in the interface between biophysics and neurosciences and more specifically in the biological strategies that organs and organisms have developed to actively sense their environment. These strategies are best illustrated in the sense of hearing. We study this issue from a physical perspective at the level of the peripheral auditory system and at the level of the central nervous system.

Project summary

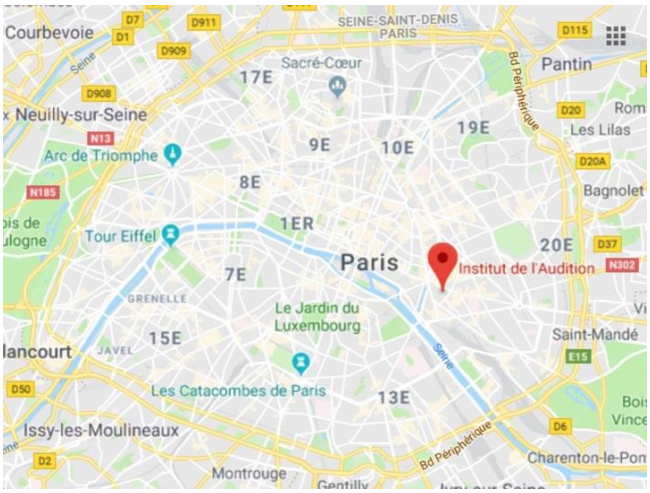
Processing of auditory information in the brain is complex because information not only flows from the auditory periphery to the central nervous system but also from the brain to the ear. As a result, efferent neuronal signals can modulate the mechanical properties of the cochlea. Ideally, we would like to know the cochlear output precisely to study its effect on neural representations. However, because cochlear mechanics and neuronal processing are reciprocally coupled through mechanoelectrical feedback, it will require specific tools to uncouple them and to decode the transformation of complex acoustic stimuli by the brain.

The aim of this project is to study how information about sound frequency is propagated from the auditory periphery to the cortex. To understand how sound features are encoded in the brain we would need to vary specific parameters of the input and measure how it affects neuronal firing. Recent progress in optogenetics have allowed to activate neuronal circuits precisely. Here we will use these tools to control the cochlear output and activate optogenetically cochlear hair cells *in vivo*. Optical methods allow to focalize the beam of a laser onto several cellular targets and rapidly update the temporal pattern of stimulation. The postdoc will develop a setup based on holographic light patterning to be able to stimulate simultaneously (but independently) single hair cells with millisecond precision.

Contact: jeremie.barral@pasteur.fr

Website: http://www.barral-lab.org
https://www.institut-audition.fr/en

Institution: Institut de l'Audition
63 rue de Charenton
75012 Paris
France



Requirements

We are looking for individuals who want to study neural coding in the context of hearing and who meet the following criteria:

1) PhD in neuroscience, biophysics, engineering, or related field.

2) Experience in one the following areas would be appreciated: *in vivo* electrophysiology, 2-photon imaging, optogenetics, microscopy.

3) Enthusiasm, curiosity, ambition, and happy to work in a team.

Please send a brief letter of interest describing how your current experience, skills, and future goals align with this position, along with a C.V. and contact information of two potential references to jeremie.barral@pasteur.fr.

Funding

Funding is secured for both the equipment required for the project and the salary of the postdoc. However, application for alternative sources of funding will be encouraged.

Environment

The Hearing Institute is a Center from the Institut Pasteur and aims at understanding hearing from both a fundamental and clinical perspective. It combines various approaches from genetics and cell biology to biophysics and from human cognition and psychoacoustics to computational neuroscience to create a genuinely interdisciplinary research environment. The Institute is located nearby the Vision Institute, thereby creating a center for system and sensory neuroscience research in one of the liveliest districts in the heart of Paris.

References

General reviews about the research subject

Panzeri S, Harvey CD, Piasini E, Latham PE, Fellin T. Cracking the neural code for sensory perception by combining statistics, intervention, and behavior. **Neuron**, 2017 Feb 8;93(3):491-507.

Ronzitti E., et al., Recent advances in patterned photostimulation for optogenetics. **Journal of Optics**, 2017. 19(11).

Theunissen FE and Elie JE, Neural processing of natural sounds. **Nat Rev Neurosci**, 2014. 15(6): p. 355-66.

Yizhar O., et al., Optogenetics in neural systems. **Neuron**, 2011. 71(1): p. 9-34.

Fettiplace R and Hackney CM, The sensory and motor roles of auditory hair cells. **Nat Rev Neurosci**, 2006. 7(1): p. 19-29.

Selected publications from the supervisor:

Barral J, Wang XJ, and Reyes AD (2019). Propagation of temporal and rate signals in cultured multilayer networks. **Nature Communications** 10(1):3969

Barral J, Jülicher F, and Martin P (2018). Friction from transduction channels' gating affects spontaneous hair-bundle oscillations. **Biophysical Journal** 114(2) : 425-436

Barral J and Reyes AD (2016). Synaptic scaling rule preserves excitatory/inhibitory balance and salient neuronal network dynamics. **Nature Neuroscience** 19 :1690-1696

Barral J and Martin P (2012). Phantom tones and suppressive masking by active nonlinear oscillation of the hair-cell bundle. **P.N.A.S.** 109 : E1344-51

Barral J, Dierkes K, Lindner B, Jülicher J, and Martin P (2010). Coupling a sensory hair-cell bundle to cyber clones enhances nonlinear amplification. **P.N.A.S.** 107 : 8079-8084