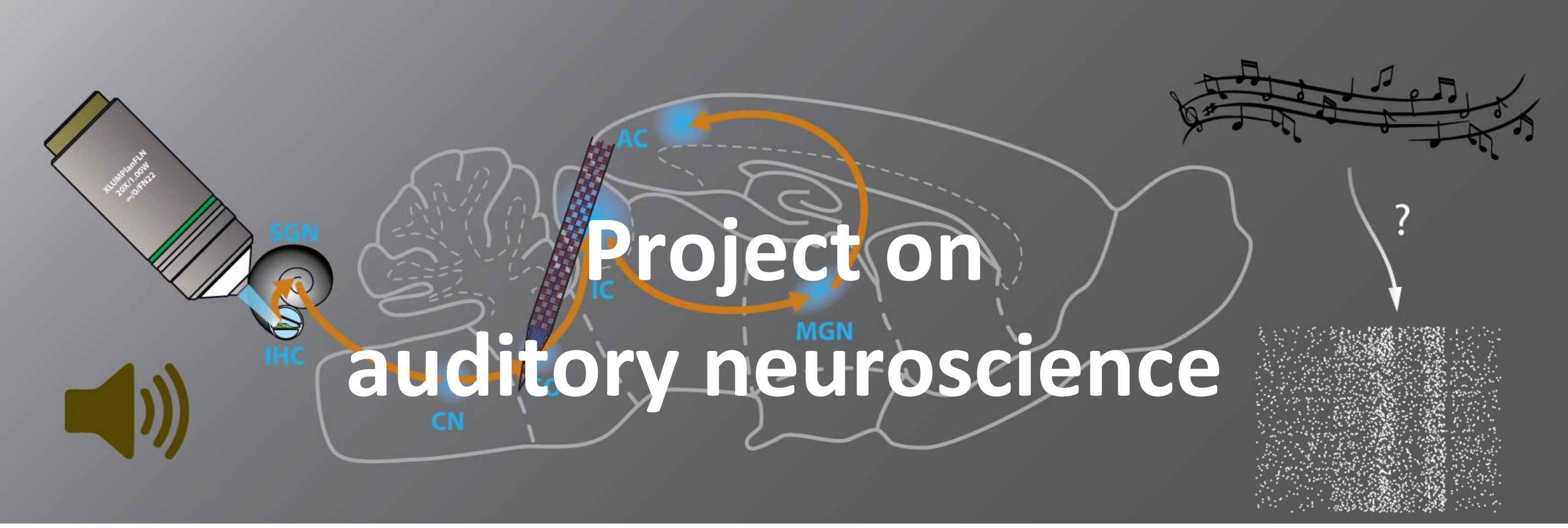
Project on auditory neuroscience



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 realize the first optogenetic activation of 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 student will design a setup based on holographic light patterning to be able to stimulate simultaneously (but independently) single hair cells with millisecond precision.

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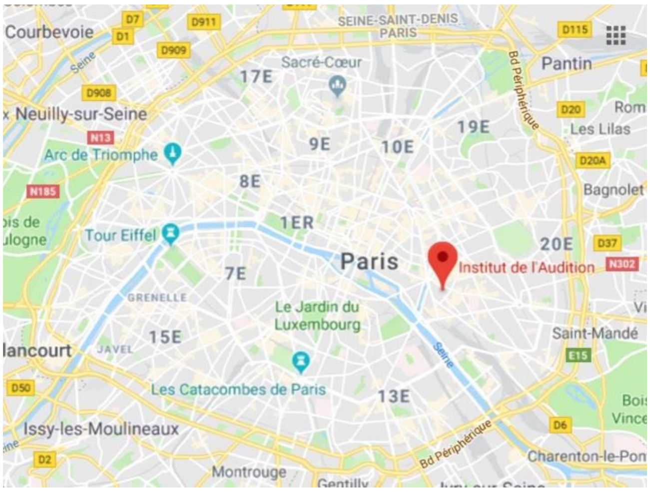

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cnrs HFSP Institut de l'Audition Centre de l'Institut Pasteur

References

General publications about the research subject

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

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