# ***INTERNSHIP PROPOSAL***

Laboratory name: ISIR
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Internship location: ISIR, 4, place Jussieu, 75005 Paris

Thesis possibility after internship: YES
Funding: NO If YES, which type of funding:

**Mechanosensitivity and habituation of protozoa**

Protozoan are unicellular eukaryotes that display many animal-like behaviors. Among protozoan, ciliates form a complex and diverse group that swim by beating many cilia. Many ciliates are extremely mechanosensitive. Some, like *Stentor* and *Spirostomum*, contract in a few milliseconds when they are touched. Others, like *Paramecium*, swim backward when touched on the anterior end, or accelerate when touched on the posterior side. This mechanosensitivity is known to be mediated by mechanoreceptors, which trigger a transmembrane ionic current when the membrane is stressed.

In addition, the mechanosensitive behavior of ciliates shows habituation, a phenomenon first studied in animals, considered the most elementary form of learning. When the organism is repeatedly stimulated, its reaction weakens (for example, it stops contracting); after stopping the stimulation for a while, the organism becomes sensitive again. Habituation has been characterized most exhaustively in the contraction behavior of *Stentor*, but we have recently observed it in the modulation of swimming in *Paramecium*, which is more amenable to electrophysiogical studies (measurement of mechanotransduction currents).

The goal of this project is to develop a biophysical model of mechanotransduction and habituation in ciliates. Depending on the student's interest, the project can be theoretical and/or experimental. On the theoretical side, the student can exploit a number of experimental studies on several ciliates to build a model, which include electrophysiological and behavioral studies. The lab has considerable experience in biophysical modeling of neurons as well as of ciliates. In particular, we recently developed an electrophysiogical model of the action potential of *Paramecium*, coupled to its motion. Experimentally, the lab has been working for many years on *Paramecium* with electrophysiology, modeling, behavior and molecular biology. The lab is equipped with an electrophysiological setup to measure mechanosensitive responses (currents) with controlled mechanical stimuli. We have also developed tracking software to measure behavioral responses, as well as a vibrating device (controlled by an Arduino) to trigger mechanosensitive responses. The lab also has experience in using pharmacological blockers as well as genetic tools (RNA interference to inhibit specific genes).

*- Elices I, Kulkarni A, Escoubet N, Pontani L-L, Prevost AM, Brette R. An electrophysiological and kinematic model of Paramecium, the "swimming neuron." PLOS Comp Biol. 2023;19: e1010899.*
*- Machemer H, Deitmer JW. Mechanoreception in Ciliates. In: Autrum H, Ottoson D, Perl ER, Schmidt RF, Shimazu H, Willis WD, editors. Progress in Sensory Physiology. 1985. pp. 81–118.*
*- Wood DC. Parametric studies of the response decrement produced by mechanical stimuli in the protozoan, Stentor coeruleus. Journal of Neurobiology. 1969;1: 345–360.*

Please, indicate which speciality(ies) seem(s) to be more adapted to the subject:

Condensed Matter Physics: YES Soft Matter and Biological Physics: YES
Quantum Physics: NO Theoretical Physics: NO