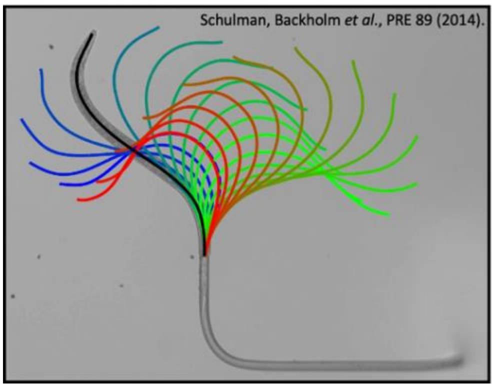
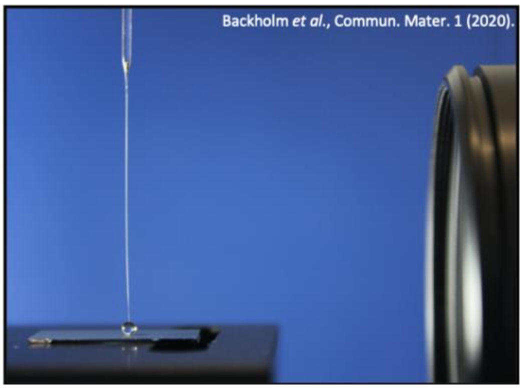
PHYS summer researcher positions in the Living Matter team

The Living Matter group (aalto.fi/living-matter) conducts curiosity-driven physics research on the mechanics, dynamics, and flow of tiny living systems, such as cells, small organisms, and organs. We are looking for motivated students to work on experimental research projects at the interface between physics and biology.



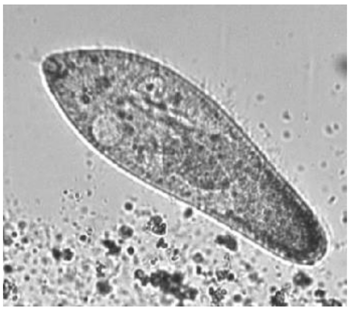


In this summer project, you will study forces in living systems. You will be trained to use the micropipette force sensor technique (M. Backholm *et al.*, Nature Protocols 2019: https://www.nature.com/articles/s41596-018-0110-x), perform hands-on experiments, analyse your data in MATLAB, and present your results during our group meetings. The research topic will be tuned based on your skills, experience, and interests. You will be directly supervised by Prof. Matilda Backholm and advised by a postdoc in our group. We welcome motivated students with a genuine interest in working in a living matter physics lab. Experience with MATLAB is beneficial but not required. This project can constitute a BSc thesis, special assignment, or parts of a MSc thesis.

For the Summer of 2024, we offer four different research projects (see details below). Specify in your application which one(s) you'd prefer to work on. Please contact Matilda (matilda.backholm@aalto.fi, in Finnish/English/Swedish) if you have any questions!

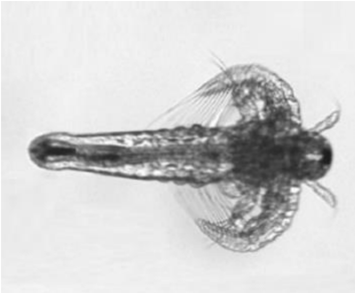
Research projects:

1. ***Escape response in Paramecium*** (advisor: Rafael Ayala Lara)



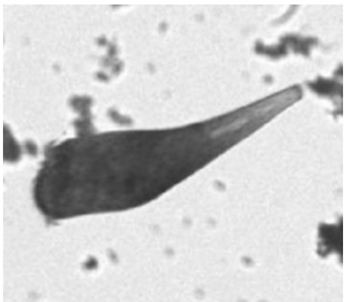
Paramecium is a widespread unicellular ciliate with a length on the order of 100 µm. These cucumber-shaped organisms are fully covered in short hairy structures called cilia, which are essential for movement, sensing, and feeding. To protect itself from danger, Paramecium has developed advanced escape strategies. In this project, your objective is to quantify the escape response of Paramecium through force-based experiments.

2. ***Swimming forces of Artemia*** (advisor: Rafael Ayala Lara)



Artemia salina, also known as brine shrimp, are small (~ mm) crustaceans that live in highly saline waters throughout the world. Young Artemia swim by rhythmically beating their arms (antenna) in a butterfly type of motion. The physics behind how organisms at this length scale swim is still to be discovered. In this project you will perform direct force measurements to probe how different environmental conditions affect the swimming dynamics of Artemia.

3. ***Swimming forces of Stentor*** (advisor: Rafael Ayala Lara)



Stentor coeruleus is a small (~ mm) trumpet-shaped organism whose top is covered with cilia, allowing it to swim in an elegant gliding manner. It is also capable of attaching to surfaces to feed. This organism displays a behaviour known as negative phototactic dispersal, meaning that it actively swims away from direct light sources in favour of dimly lit areas. In this project, you will directly characterize the swimming forces of stentors in different light conditions.

4. ***Mechanical properties of microscopic roots*** (advisor: Anagha Datar)

Darwin said that root tips are the brains of a plant. They not only sense gravity and presence of water which decides the direction of their growth, but they also overcome stresses from soil and the environment to provide a necessary anchorage to the growing shoot. In this project, you will measure and compare mechanical properties of tiny plant roots (see figure: young radish seedling with root hair covering the primary root) to reveal why certain species do better in harsh environments while others wither.