Interfaces pour le vivant

Title of the research project: **Modelling of the gut microbiota and its interaction with the immune system**

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Subject description :

In a human body, bacteria have been estimated to be in approximately equal number as human cells, most of them in the digestive tract. A question that has just started being addressed is how the physical environment may explain the organization of the microbiota in the gut. Besides the flow in the gut, there are also biotic factors, which mechanism of action may actually be physical. The main effector of the adaptive immune response in the gut is a type of antibodies, which mainly protect the host by binding bacteria together, as we contributed to show. The aim of the PhD project is to develop a more comprehensive model of the physical and mechanical environment in the gut and its consequences for microbiota. The project will be structured in 3 axis. A first aim is to simulate numerically and then develop effective analytical approximations to model the peristaltic transport in the gut, which moves forward and mixes the content of the gut. The second aim is to extend the modeling of the clusters of bacteria linked by antibodies. One direction is to model different geometries of links between bacteria. Another direction is to include the kinetics of antibodies binding to bacteria, especially as a function of the concentration of bacteria and antibodies. The third aim is to integrate the findings of the first two aims in a spatial model of the interaction of the adaptive immune system with the gut microbiota. The student will develop simulations, analytical tools, and analyze experimental data in mice. This project will be co-advised at Sorbonne Université by physicists of the Laboratoire Jean Perrin, and co-advised by the immunologist Emma Slack (ETH Zürich), building on an existing collaboration.