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Press Release

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Collaborative research project

Focus on microbial communities

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A research project by ETH Zurich, MIT with other US universities will receive 15 million US dollars in funding from the New York-based Simons Foundation. Over the next five years, researchers will investigate how microbial communities are organised and function, with a focus on the oceans.

Microorganisms: without them, there would be no oxygen, humans and animals would not be able to digest food, and the cycles of the elements on our planet would come to a standstill. An interdisciplinary team of scientists now plans to shed light on microbial communities. Led by ETH Zurich and the Massachusetts Institute of Technology (MIT), three ETH research groups are collaborating with several US universities to investigate microbial ecosystems, with a special focus on the oceans. The research project, named Theory of Microbial Ecosystems (THE-ME), is supported by the Simons Foundation, which will provide 15 million US dollars over a period of at least five years. The foundation was founded by James Simons and his wife Marilyn. James Simons is an eminent mathematician and pioneer of quantitative trading. Since 1994, the Simons Foundation has been supporting research in mathematics and the basic sciences.

How do microorganisms interact?

It is well known that microbes, although invisible to the naked eye, constitute the majority of all organisms and shape nearly every environment on the planet. These microorganisms generate biomass, produce and consume greenhouse gases, recycle the elements of life and form the basis of the marine food web. “Over the past 20 years, genomic analyses have provided a vast quantity of data about individual species,” explains Roman Stocker, a professor in the Department of Civil, Environmental and Geomatic Engineering at ETH Zurich. “However, despite microbial communities’ vital significance for humans and the environment, we know astonishingly little about how they function,” says Stocker, who initiated the project together with Professor Otto Cordero of MIT.

Marine microbes as a model of microbial communities

The researchers aim to discover the principles behind how microbial communities form and function. Understanding how different species work with – and sometimes against – each other within these

communities will play a decisive role in assessing, for example, the consequences of climate change on the many processes that microbes mediate. Stocker believes that this overarching understanding is currently lacking: scientists still have very limited knowledge of how microbial communities form, organise and behave. It is therefore particularly difficult to predict how microbes will react to changes in their environment. “We want to develop a model of microbial ecosystems that bridges the gap between the physiology and behaviour of individual cells, and the large-scale ecological processes that microbes mediate, for example in the oceans,” he explains.

Ten research groups involved – three from ETH Zurich
Developing a comprehensive theory of microbial communities is no easy undertaking. The project’s founders are deliberately pursuing an interdisciplinary approach that combines the ideas and methods of physicists, biologists and mathematicians. Ten research groups are involved in the project, three of them from ETH Zurich. The first is the Stocker lab, which focuses on the interactions between aquatic microorganisms and their environment using video microscopy and mathematical modelling. Sebastian Bonhoeffer’s and Martin Ackermann’s groups are also involved. Bonhoeffer is a professor of theoretical biology and specialises in modelling complex population dynamics and microbial evolution, while Professor Ackermann is a distinguished researcher in the field of microbial ecology, affiliated with both ETH and Eawag, the Swiss Federal Institute of Aquatic Science and Technology.

The three researchers have high hopes for the collaborative project. “Over the last few decades, molecular and systems biology have made tremendous contributions to our understanding of individual organisms,” says Ackermann. “We hope to gain similar insights into how communities consisting of multiple interacting organisms function.” The researchers expect to be able to apply some of their results to other microbial communities, which in the future could help improve understanding of the human microbiome, among other applications.

The first studies began already in May 2017. The other institutions participating in the collaboration are the California Institute of Technology (Caltech); the University of Georgia; the University of California, San Diego; and the University of Southern California.

Further Information:
Simons Foundation→
Stocker-Lab→
Bonhoeffer Group→
Ackermann Group→

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