

# Education for the future

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## **Master program in Computational Physics, Mathematics and Life Science**

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### **Strategic importance**

The program will educate the next generation of cross-disciplinary science students with the knowledge, skills, and values needed to pose and solve current and new scientific, technological and societal challenges. The program will lay the foundation for cross-disciplinary educational, research and innovation activities at the Faculty. The program will contribute to building a common cross-disciplinary approach to the key strategic initiatives at the Faculty: Energy, Materials, Life Science, and Enabling Technologies.

A particular strength of physics students is their ability to pose and solve problems that combine physical insights with mathematical tools and now also computational skills. This provides a unique combination of applied and theoretical knowledge and skills. These features are invaluable for the development of multi-disciplinary educational and research programs. In this program we build on and refine this philosophy. The main focus is not to educate computer specialists, but to educate students with a solid understanding in basic science as well as an integrated knowledge on how to use essential methods from computational science. This requires an education that covers both the specific disciplines like physics, biology, geoscience, mathematics etc with a strong background in computational science.

## Scientific and educational motivation

**Applications of simulation.** Numerical simulations of various systems in science are central to our basic understanding of nature and technology. The increase in computational power, improved algorithms for solving problems in science as well as access to high-performance facilities, allow researchers nowadays to study complicated systems across many length and energy scales. Applications span from studying quantum physical systems in nanotechnology and the characteristics of new materials or subatomic physics at its smallest length scale, to simulating galaxies and the evolution of the universe. In between, simulations are key to understanding cancer treatment and how the brain works, predicting climate changes and this week's weather, simulating natural disasters, semi-conductor devices, quantum computers, as well as assessing risk in the insurance and financial industry. These are just a few topics already well covered at the University of Oslo and that can be topics for coming thesis projects as well as research directions.

**Job market.** A large number of the candidates from the four involved departments get jobs where numerical simulations are central and essential. The proposed program will raise the educational quality in this area, because our candidates need a broader understanding of the possibilities and limitations of computation-based problem solving.

## Multiscale modeling is the big open research question

Today's problems, unlike traditional science and engineering, involve complex systems with many distinct physical processes. The wide open research topic of this century, both in industry and at universities, is how to effectively couple processes across different length and energy scales. Progress will rely on a multi-disciplinary approach and therefore a need for a multi-disciplinary educational program.

The proposed program will foster candidates with the right multi-disciplinary background and computational thinking for understanding today's simulation technology and its challenges.

## Career prospects

Candidates who are capable of modeling and understanding complicated systems in natural science, are in short supply in society. The computational methods and approaches to scientific problems students learn when working on their thesis projects are very similar to the methods they will use in later stages of their careers. To handle large numerical projects demands structured thinking and good analytical skills and a thorough understanding of the problems to be solved. This knowledge makes the students unique on the labor market.

The program has also a strong international element which allows students to gain important experience from international collaborations in science, with the opportunity to spend parts of the time spent on thesis work at research institutions abroad.