Thesis projects, Teaching philosophy and courses

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Thesis projects

Mst of the projects listed below can form the basis for a Master of Science thesis or a longer PhD thesis. The topics listed below reflect to a large extent my own interests and research topics. Below you will also find links to actual thesis projects.

Large-scale diagonalization methods and quantum mechanical systems.

Studies of dense nuclear matter.

Time-evolution of quantum-mechanical systems.

Molecular dynamics and computational structural biology.

Many-body methods and quantum computing.

Many-body methods and machine learning.

Theoretical aspects of many-body methods.

High-performance computing and quantum-mechanical systems.

Computing in science education research problems.

Quantum chromodynamics and effective field theories on the lattice.
You can read more here about the above topics, with explict proposal for thesis topics.

Courses, study programs and educational initiatives

I am strongly involved in teaching at all levels. I have been heading the bachelor program Physics, Astronomy and Meteorology (FAM) in the period 2002-2011. I am also strongly involved in the project Computing in Science Education. Furthermore, with European and American colleagues, we have established the recent successful Nuclear Talent initiative.

Since 1999 I have established an activity in computational physics at the Department of Physics at the University of Oslo. I have also started from scratch and developed several courses on computational physics and many-body physics. This activity was recognized with the Excellence in Teaching award from the University of Oslo in 2015. During the last twenty years I have guided more than 100 graduate students (Master of Science and PhD) and post-doctoral fellows.

With colleagues at the University of Oslo, I have been strongly involved in the development of a totally new teaching philosophy which merges computation with the traditional science amd mathematics curriculum . This project is called Computing in Science Education and has received considerable support from the University of Oslo and the Norwegian Ministry of research and education. It received the University of Oslo award for excellence in teaching in 2011 and the NOKUT award in 2012.

With colleagues from the USA and other European countries, we have started the Nuclear Talent initiate":"http://www.nucleartalent.org", where we aim at providing an advanced and comprehensive training to graduate students and young researchers in low-energy nuclear theory. The network aims at developing a broad curriculum that will provide the platform for a cutting-edge theory for understanding nuclei and nuclear reactions.

I initiated in 2015 and chair the new Master of Science program on Computational Science at the University of Oslo. This is a new and multi-disciplinary program across several disciplines at the College of Natural Science of the University of Oslo.

I teach or have taught recently the following courses at the University of Oslo and Michigan State University:

- FYS3150/4150 Computational Physics I, Fall semester, senior undergraduate level (Oslo)

- FYS4411 Computational Physics II: Quantum mechanical systems, graduate level, Spring semester (Oslo)

- FYS-KJM4480 Quantum mechanics for many-particle systems, graduate level, Fall semester (Oslo)

- PHYS981 Nuclear Structure, graduate level, Spring semester (MSU)

- PHY480/905 Computational Physics (MSU), undergraduate and graduate level, Spring semester

From the fall of 2018 I have developed and teach the new course on **Applied Data analysis and Machine Learning** at the University of Oslo. This course is a compulsory course that is part of the new interdisciplinary Master of Science program Computational Science. The link to the course is

- FYS-MAT3155/4155 Data Analysis and Machine Learning, senior undergraduate and graduate level, Fall semester (Oslo)

- PHY321 Classical Mechanics, MSU, undergraduate course, spring semester. First time spring 2020.

I have also taught introductory quantum physics, FYS2140, 2000-2004, Statistical Mechanics, FYS4130, 1990-1994 and I have developed an advanced course on FYS-KJM4480 Quantum mechanics for many-particle systems, 2009-2014, all at the at the University of Oslo, Norway. At Michigan I have also taught an advanced course in Nuclear Structure Physics PHYS981 Nuclear Structure, graduate level, Spring semester, 2013-2016. In addition, with Scott Bogner at Michigan State University, we taught a specialized course on Nuclear Force, PHY989, during the fall semester of 2018.

Teaching Awards:

1. University of Oslo award for excellence in teaching, 2000 (250kNOK)

2. University of Oslo award for excellence in teaching for the **Computing in Science Education** project, 2011 (250kNOK)

3. NOKUT (Norwegian entity of quality assessment in higher education) award for excellence in teaching for the **Computing in Science Education** project, 2012

4. University of Oslo award for excellence in teaching for developing the Computational Physics group, 2015 (250kNOK)

5. Favorite graduate teacher at the Department of Physics and Astronomy at Michigan State University, 2016

6. **Olav Thon Foundation** National prize for excellence in teaching award (National, all Norwegian higher education institutions, 500kNOK), 2018

7. Thomas H. Osgood Faculty Teaching award at Michigan State University, 2018