

# CENTRE FOR QUANTUM GEOMETRY OF MODULI SPACES (QGM)

QGM was established in 2009 as a Center of Excellence funded by the Danish National Research Foundation. The research objective is to address fundamental mathematical problems at the interface between geometry and theoretical physics.

Based at Aarhus University and directed by Professor Jørgen Ellegaard Andersen, QGM hosts a strong team of high-profile, internationally acclaimed researchers, and with the continuous generation of groundbreaking results, the Centre together with its international collaborators are recognized throughout the mathematics community worldwide as one of the leading research institutions in its research field.

## Background and research mission

The role of mathematics in our understanding of nature has been recognized for millenia, and its importance is especially poignant in modern theoretical physics as the cost of experiments escalates, and the mathematical complexity of physical theories increases. QGM set out to become the world-leading center in quantum geometry of moduli spaces at the crucial interface between mathematics and theoretical physics, with the aim of contributing to the mathematical underpinnings of contemporary and future physical theories.

## Organization

QGM has on top of the permanent professors at Aarhus University eleven internationally renowned scholars based at other research institutions, who regularly visit QGM and with whom resources and research efforts are shared. The core staff thus comprise:

Prof. Jørgen Ellegaard Andersen, Aarhus University  
Associate Prof. Cristiano Spotti, Aarhus University  
Associate Prof. Artan Sheshmani, Aarhus University  
Prof. Nicolai Reshetikhin, University of California, Berkeley  
Prof. Edward Frenkel, University of California, Berkeley  
Prof. Denis Auroux, University of California, Berkeley  
Prof. Maxim Kontsevich, Institut des Hautes Études Scientifiques (IHÉS)  
Prof. Nigel Hitchin, University of Oxford  
Prof. Alexander Ritter, University of Oxford  
Prof. Dominic Joyce, University of Oxford  
Prof. Hiroshi Ooguri, Caltech  
Prof. Sergei Gukov, Caltech  
Prof. Anton Kapustin, Caltech  
Prof. Robert Penner, Caltech/IHÉS

## Mission statement

- To contribute to defining quantum field theory as a mathematical entity
- To contribute to unify quantum theory with quantum gravity.

## Original main research focus

- The Geometric Langlands Program and Higgs bundle moduli spaces
- Toeplitz operators and geometric quantization of moduli spaces
- Combinatorial models for moduli spaces and quantum moduli spaces
- Quantum representation theory and perturbative invariants.

## New core areas

- Moduli spaces and macromolecules
- Topological Quantum Field Theory and Topological String Theory
- Quantum computing.

## New directions

- Wall crossing
- Gauge theory
- Contact geometry
- Symplectic geometry.

## Conceptual goals

- To significantly advance the understanding of moduli spaces and their quantization
- To train the next generation of scholars and researchers to build the Centre into a world-renowned catalyst for collaborative cutting-edge research
- To develop the quantum geometry of moduli spaces, in order to provide complete mathematical models for a number of quantum field theories.

The academic profile of the Centre is additionally shaped by a steady population of postdocs (some shared with Caltech) and PhD students, (some based at University of Oxford and UC Berkeley, respectively).