

RESEARCH AREA

# MATHEMATICS



## RESEARCH AREA MATHEMATICS

**COORDINATOR**  
Ugo Bruzzo

**AREA COMMITTEE**  
Andrei Agrachev  
Gianni Dal Maso  
Antonio DeSimone  
Boris Dubrovin  
Cesare Reina

The researchers of the **Mathematics Area** work in geometry (algebraic, differential and noncommutative geometry, with applications also to quantum field and string theory), mathematical analysis (calculus of variations, control theory, partial and ordinary differential equations), mathematical methods in quantum mechanics, mathematical modelling (mechanics of solids and fluids, complex and biological systems, multiscale analysis), mathematical physics (classical and quantum integrable systems and their applications), and numerical analysis and scientific computing (applied to partial differential equations and to control problems).

The Mathematics Area is involved in the activities of two laboratories:

- **SISSA Mathlab**: a laboratory for mathematical modelling and scientific computing
- **SAMBA**: a laboratory in collaboration with the Cognitive Neuroscience Group

Moreover, together with the Department of Mathematics and Geosciences of the University of Trieste, the Mathematics Area jointly runs an **MSc Course in Mathematics** (Laurea Magistrale in Matematica). Additional information about the course can be found at: [www.math.sissa.it/content/education](http://www.math.sissa.it/content/education)



## RESEARCH AREA MATHEMATICS

# MATHEMATICAL ANALYSIS, MODELLING AND APPLICATIONS

## COORDINATOR GIANNI DAL MASO

The activity in **Mathematical Analysis** is mainly focused on ordinary and partial differential equations, on dynamical systems, on the calculus of variations, and on control theory. Connections of these topics with differential geometry are also developed.

The activity in **Mathematical Modelling** is oriented to subjects for which the main technical tools come from mathematical analysis. The present themes are multiscale analysis, mechanics of materials, micromagnetics, modelling of biological systems, and problems related to control theory.

The **Applications of Mathematics** developed in this course are related to scientific computing and to the numerical analysis of partial differential equations and control problems. This activity is organized in collaboration with **MathLab** for the study of problems arising from the real world, from industrial applications, and from complex systems.

### Main research lines:

- Calculus of Variations and Multiscale Analysis
- Conservation Laws and Transport Problems
- Geometric Control Theory and Sub-Riemannian Geometry
- Infinite Dimensional Dynamical Systems
- Mechanics of Materials and of Biological Systems
- Nonlinear Analysis
- Numerical Analysis

## The most recent placements after PhD at SISSA:

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Ecole Polytechnique, Palaiseau, France

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University of Oxford, UK

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California Institute of Technology, Pasadena, USA

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Carnegie Mellon University, Pittsburgh, USA

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Hausdorff Center of Mathematics, Bonn, Germany

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Rutgers University, USA

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Universität Zürich, Switzerland

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Additional information about the courses and the research activity can be found at:  
[www.math.sissa.it/node/36](http://www.math.sissa.it/node/36)  
Info: [phd@sisssa.it](mailto:phd@sisssa.it)

Short fellowships may be awarded to candidates taking the entrance exam. These fellowships cover travel and accommodation expenses and entitle students to visit the school before the selection.



## RESEARCH AREA **MATHEMATICS**

# GEOMETRY AND MATHEMATICAL PHYSICS

## COORDINATOR **BORIS DUBROVIN**

The **PhD programme in Geometry and Mathematical Physics** focuses on the study of analytic and geometric aspects of physical phenomena that are of fundamental interest in both pure and applied sciences, and covers a wide spectrum of topics in modern algebraic and differential geometry and their applications.

### The main research areas are:

- Integrable systems in relation to differential, algebraic and symplectic geometry, as well as to the theory of random matrices, special functions and nonlinear waves, Frobenius manifolds
- Deformation theory, moduli spaces of sheaves and of curves, in relation to supersymmetric gauge theories, strings, Gromov-Witten invariants, orbifolds and automorphisms
- Quantum groups, noncommutative Riemannian and spin geometry, applications to models in mathematical physics
- Mathematical methods of quantum mechanics
- Mathematical aspects of quantum Field Theory and String Theory
- Symplectic geometry, sub-Riemannian geometry
- Geometry of quantum fields and strings

## The most recent placements after PhD at SISSA:

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Mathematical Sciences Research Institute, Berkeley, USA

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Harvard University, Cambridge, USA

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Mathematical Institute, University of Oxford, UK

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DAMTP, University of Cambridge, Cambridge, UK

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Max Planck Institute, Bonn, Germany

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École Polytechnique, Palaiseau, France

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More information [www.sissa.it](http://www.sissa.it)



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