Research Profile

Mathematics is essential to all the natural sciences. It is the most abstract and pure of scientific disciplines and has applications in all other sciences.

The academic staff at the Department of Mathematics not only includes researchers in pure mathematics with international expertise in algebraic geometry, number theory, differential geometry, functional analysis, and real/complex analysis, but also mathematical statisticians dealing with extreme values, non- and semiparametric statistics and robust statistics as well as applied mathematicians working in plasma-astrophysics and computational fluid dynamics.

Research Groups

Algebraic Geometry and Number Theory
- polynomial equations in several variables, singularities, algebraic curves and surfaces
- zeta functions (Igusa, topological, motivic, Hasse-Weil), Bernstein polynomials
- non-archimedean geometry, toric and tropical geometry, rational points over discretely valued fields
- asymptotics of oscillating integrals, exponential sums
- computational number theory
- mathematical logic, model theory

Algebraic Topology and Group Theory
- Crystallographic actions of polycyclic-by-finite groups
- Expanding maps and Anosov diffeomorphisms of infra-nilmanifolds
- Cohomology of infra-nilmanifolds, virtually nilpotent groups and solvable Lie algebras
- Fixed point and coincidence theory for infra-nilmanifolds

Classical analysis
- Riemann-Hilbert methods and non-intersecting Brownian motions
- Asymptotic analysis of special functions
- Discrete and continuous Painlevé equations
- Hermite-Padé rational approximation
- Eigenvalues of random matrices
- Orthogonal and multiple orthogonal polynomials

Functional analysis
- Von Neumann algebras
- Kazhdan’s property (T), rigidity phenomena and operator algebras
- Subfactors and II_1 factors
- Ergodic theory of measure preserving group actions
- Geometric group theory
- Quantum groups and quantum metric spaces
- Non-commutative geometry
Differential Geometry
- Riemannian manifolds and submanifolds (e.g. intrinsic and extrinsic curvatures and their relations, constant mean curvature surfaces in homogeneous spaces, calibrated submanifolds)
- Lorentzian geometry and applications to general relativity
- Poisson and symplectic geometry, generalized complex geometry
- L-infinity algebras and deformation theory
- singular foliation theory, Lie algebroids and Lie groupoids
- centro-affine and affine differential geometry
- applications of differential geometry in exact, applied, medical and human sciences

Financial Mathematics and Actuarial Statistics
- Lévy jump models and jump driven models
- Modelling financial risks
- Multivariate financial engineering
- Extreme value analysis
- Loss reserving models
- Stochastic mortality models

Non- and Semiparametric Statistics and Smoothing
- Smoothing techniques
- Investigating dependencies between variables, via e.g. copula functions
- Flexible modelling and generalised regression models
- Varying coefficients models and additive models
- Variable selection and sparsity issues
- Estimation of frontiers and boundaries

Robust Statistics
- High-breakdown estimators for covariance and regression
- Robust estimators for high-dimensional data
- Robust inference and model selection
- Robust functional data analysis
- Robust multiway analysis
- Depth-based procedures

Plasma Astrophysics
- The magnetohydrodynamic model describing all large-scale plasma dynamics in the known universe
- Kinetic theory for particle-based descriptions of plasma phenomena
- Solar physics applications, modelling plasma dynamics in the solar corona, coronal seismology
- Relativistic plasma dynamics in astrophysical jets, pulsar wind nebulae, up to gamma-ray bursts
- Parallel grid-adaptive computations of fluid and plasma dynamics.

Space Weather
- Study of variabilities in the heliosphere and the Earth’s magnetosphere which are caused and driven by the solar activity
- Mathematical modelling of space weather aspects
- Magnetic reconnection and particle acceleration
- High performance computing for multi-scale plasma dynamics

Figures

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<td>Postdoctoral researchers</td>
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<td>PhD researchers</td>
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(figures October 2017)