

# Geometry and Topology at Cambridge

*Burt Totaro, Lowndean Professor of Astronomy and Geometry*

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## *Algebraic geometry*

Alessio Corti

J. P. Pridham

Nick Shepherd-Barron

P. M. H. Wilson

Jonathan Woolf

## *Differential geometry*

Konstantin Feldman

Alexei Kovalev

Marta Mazzoco

Gabriel Paternain

Ivan Smith

## *Topology*

Dennis Barden

J. O. Button

W. B. Raymond Lickorish

C. B. Thomas

Burt Totaro

## *Other activities*

Seven Ph.D. students

Geometry seminar

Graduate student topology seminar

# Minimal model theory: classification of complex manifolds

Nick Shepherd-Barron

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Mori (1979): A smooth compact complex manifold with ample tangent bundle must be projective space  $\mathbf{CP}^n$ .

Mori-Mukai conjecture: Let  $X$  be a smooth compact complex  $n$ -manifold with  $\det(TX)$  ample. (That is,  $X$  is a Fano variety.) Suppose that all rational curves in  $X$  have degree at least  $n + 1$  with respect to  $\det(TX)$ . Then  $X$  is isomorphic to  $\mathbf{CP}^n$ .

Proved by Cho, Miyaoka, and Shepherd-Barron (2002).

Leads to classification of singularities of complex symplectic varieties.

# Minimal model theory: classification of complex manifolds

Alessio Corti

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19th century: Every Fano complex surface (for example, a cubic surface in  $\mathbf{CP}^3$ ) is birational to  $\mathbf{CP}^2$ .

Iskovskikh-Manin (1971): The generic smooth quartic 3-fold in  $\mathbf{CP}^4$  is Fano, but not birational to  $\mathbf{CP}^3$ .

Corti-Pukhlikov-Reid (2000): For each of the 95 families of Fano 3-fold hypersurfaces of index 1 in a weighted projective space, the generic variety in the family is not birational to  $\mathbf{CP}^3$ .

Stronger: these varieties are birationally rigid.

# Mirror symmetry: geometry and physics

Alexei Kovalev

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Construction of new closed 7-manifolds with G2-metrics (2000).

First genuine confirmation of Strominger-Yau-Zaslow conjecture: a special Lagrangian fibration of a closed Calabi-Yau 3-fold (2003).

P. M. H. Wilson

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Degeneration of the Ricci-flat metric on a K3 surface and the SYZ conjecture (with Mark Gross, 2000)

# Topological methods in algebraic geometry

Burt Totaro

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Definition of the Chow ring of the classifying space of a group (1999).

New examples for the integral Hodge problem.

Goresky-Macpherson's problem: determination of the possible characteristic numbers for singular spaces. The elliptic genus of a singular variety (2000; 2002 International Congress of Mathematicians).