

Daniel Huybrechts



Academic career

1985 - 1992	Studies of Mathematics, HU Berlin and Max Planck Institute, Bonn
1992	PhD, HU Berlin
1993 - 1994	Postdoc, Max Planck Institute, Bonn
1994 - 1995	Postdoc, Institute for Advanced Study, Princeton, NJ, USA
1995 - 1996	Postdoc, Max Planck Institute, Bonn
1996 - 1997	Assistant Professor (C1), University-GH Essen
1997 - 1998	Marie-Curie Fellow, ENS Paris, France
1998	Habilitation, University-GH Essen
1998 - 2002	Professor (C3), University of Cologne
2002 - 2005	Professor, Paris Diderot University (Paris 7), France
Since 2005	Professor (C4/W3), University of Bonn

Honours

2017	Member of the Academia Europaea
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Invited Lectures

2008	Algebraic-Geometric Derived Categories and Applications, Institute for Advanced Study, Princeton, NJ, USA
2009	Classical Algebraic geometry today, Mathematical Sciences Research Institute (MSRI), Berkeley, CA, USA
2010	International Congress of Mathematicians, Hyderabad, India
2011	Moduli spaces and moduli stacks, Columbia University, New York, USA
2011	Spring lectures in algebraic geometry, Ann Arbor, MI, USA
2015	Perspectives on Complex Algebraic Geometry, Columbia University, New York, USA
2015	Schrödinger Lecture, ESI, Vienna, Austria
2016	Homological Mirror Symmetry, Methods and Structures, IAS, Princeton, NJ, USA
2016	Generalised Geometry and Noncommutative Algebra, Clay Mathematics Institute, Oxford, England, UK

Research Projects and Activities

DFG Collaborative Research Center SFB/TR 45 “Periods, moduli spaces and arithmetic of algebraic varieties”
Local coordinator, since 2006
Oberwolfach Workshops on “Algebraic Geometry”
Organizer, 2015, 2017
Conference “Panorama of Mathematics” (Bonn),
Organizer, 2015
DFG Cluster of Excellence “Hausdorff Center for Mathematics”
Principal investigator

Research profile

My main focus is on K3 surfaces and higher dimensional analogues which can be studied in terms of algebraic invariants like Hodge structures and derived categories. K3 surfaces and related moduli spaces are particularly interesting test cases for some of the central conjectures in

algebraic geometry (e.g. Tate, Hodge, Bloch-Beilinson). I have studied Chow groups of K3 surfaces from a geometric and a categorical perspective. In particular, I have introduced the notion of constant cycle curves and studied the action of symplectic automorphisms on Chow groups, providing further evidence for one of Bloch's elusive conjectures. Finite group of symplectic derived auto-equivalences have been classified completely in terms of the Conway group, one of the exotic sporadic simple groups. For Kuznetsov's K3 category associated with any cubic fourfold I have extended work of Addington and Thomas to the twisted case and described the group of auto-equivalences in the generic case. This has subsequently led to a new proof of the global Torelli theorem for cubic fourfolds (with Rennemo).

It has been conjecture that rationality of cubic fourfolds is determined by the structure of the associated K3 category. Further investigations of the structure of Kuznetsov's category should shed more light on the role of derived techniques on rationality questions in broader generality. The bearing of derived techniques on our understanding of cycles on K3 surfaces and cubics hypersurfaces needs to be clarified. Cohomological methods relating classical invariants like the Jacobian ring of a hypersurface with categorical invariants similar to Hochschild cohomology may lead to global Torelli theorems for cubics of higher dimensions. The role of mirror symmetry needs to be explored. Further foundational questions concerning the motivic nature of K3 surfaces shall be addressed.

Editorships

- Bulletin et Mémoires de la SMF (2005 - 2013)
- Kyoto Journal of Mathematics (since 2010)
- Crelle Journal (since 2012)
- Inventiones mathematicae (since 2014)

Research Area DE Moduli spaces of K3 surfaces, hyperkähler manifolds and stability conditions are in the focus of current research. Homological and motivic as well as classical geometric aspects of this central class of varieties are studied together. The rather mysterious link between K3 surfaces and cubic fourfolds has been studied in the twisted case which leads to a complete description of the group of all auto-equivalences for general cubic fourfolds. There are promising links to homological mirror symmetry for K3 surfaces and questions about Chow groups and motives are studied from this angle.

Supervised theses

Master theses: 17, currently 2

Diplom theses: 12

PhD theses: 12, currently 1

Selected PhD students

Marc Nieper-Wißkirchen (2002): "Characteristic Classes and Rozansky-Witten Invariants of Compact Hyperkähler Manifolds",

now Professor, University of Augsburg

Sven Meinhardt (2008): "Stability conditions on derived categories",

now Research Assistant, University of Sheffield, England, UK

Michael Kemeny (2015): "Stable maps and singular curves on K3 surfaces",

now Szegő Assistant Professor, Stanford University, CA, USA

Stefan Schreieder (2015): "Construction problems in algebraic geometry and the Schottky problem",

now Professor, LMU Munich

Ulrike Riess (2016): "On irreducible symplectic varieties: Chow rings and base loci of certain line bundles"

Habilitations

Vladimir Lazic (2015), now Professor, Saarland University

Selected publications

- [1] Daniel Huybrechts. *Lectures on K3 surfaces*, volume 158 of *Cambridge Studies in Advanced Mathematics*. Cambridge University Press, Cambridge, 2016.
- [2] D. Huybrechts. Curves and cycles on k3 surfaces. *Algebr. Geom.*, 1(1):69–106, 2014. With an appendix by C. Voisin.
- [3] Daniel Huybrechts. Chow groups of k3 surfaces and spherical objects. *J. Eur. Math. Soc. (JEMS)*, 12(6):1533–1551, 2010.
- [4] Daniel Huybrechts and Manfred Lehn. *The geometry of moduli spaces of sheaves*. Cambridge Mathematical Library. Cambridge University Press, Cambridge, second edition, 2010.
- [5] Daniel Huybrechts and Richard P. Thomas. Deformation-obstruction theory for complexes via atiyah and kodaira-spencer classes. *Math. Ann.*, 346(3):545–569, 2010.
- [6] Daniel Huybrechts, Emanuele Macrì, and Paolo Stellari. Derived equivalences of k3 surfaces and orientation. *Duke Math. J.*, 149(3):461–507, 2009.
- [7] Daniel Huybrechts, Emanuele Macrì, and Paolo Stellari. Stability conditions for generic k3 categories. *Compos. Math.*, 144(1):134–162, 2008.
- [8] D. Huybrechts. *Fourier-Mukai transforms in algebraic geometry*. Oxford Mathematical Monographs. The Clarendon Press, Oxford University Press, Oxford, 2006.
- [9] Daniel Huybrechts and Richard Thomas. \mathbb{P} -objects and autoequivalences of derived categories. *Math. Res. Lett.*, 13(1):87–98, 2006.
- [10] Daniel Huybrechts. Compact hyper-kähler manifolds: basic results. *Invent. Math.*, 135(1):63–113, 1999.