Emanuele Macrì

Academic career

2006	PhD, International School for Advanced Studies (SISSA), Trieste, Italy
2006 - 2007	Postdoc, Max Planck Institute for Mathematics, Bonn
2007 - 2008	Postdoc, Hausdorff Center for Mathematics, University of Bonn
2008 - 2010	Assistant Professor, University of Utah, Salt Lake City, UT, USA
2010 - 2011	Professor (W2, Bonn Junior Fellow), University of Bonn
2011 - 2014	Assistant Professor (tenure-track), Ohio State University, Columbus, OH, USA
Since 2015	Associate Professor, Northeastern University, Boston, MA, USA

Invited Lectures

2005	“Heterotic Strings, Derived Categories and Stacks”, Oberwolfach Research Institute for Mathematics (MFO), Oberwolfach
2006	“KIAS school on derived categories of coherent sheaves”, Korea Institute for Advanced Study (KIAS), Seoul, South Korea
2006	“Giornate di Geometria Algebrica e Argomenti Correlati VIII”, International School for Advanced Studies (SISSA), Trieste, Italy
2006	“Categorical constructions of primitive forms, II”, Research Institute for Mathematical Sciences (RIMS), Kyoto, Japan
2007	“Stability conditions, derived categories, etc”, Max Planck Institute for Mathematics, Bonn
2007	“Categorical aspects of algebraic geometry in mirror symmetry”, Research Institute for Mathematical Sciences (RIMS), Kyoto, Japan
2007	“Seminario di natale”, University of Milano, Italy
2008	“First CTS conference on vector bundles”, TIFR, Mumbai, India
2008	“Bundles, gerbes, and derived categories in string theory”, University of Salamanca, Spain
2009	“Derived categories and the Langlands programme”, FU Berlin
2009	“BPS state countings, stability structures, and derived algebraic geometry”, University of Hamburg
2009	“WAGS”, University of California, Los Angeles, CA, USA
2010	“School on birational geometry and moduli spaces”, University of Utah, Salt Lake City, UT, USA
2010	“Categorical methods in geometry and gauge theory”, Chern Institute, Tianjin, China
2011	“Derived Categories”, University of Tokyo, Japan

Research Projects and Activities

DFG Collaborative Research Centre SFB/TR 45 “Periods, moduli spaces, and arithmetic of algebraic varieties”
Member
NSF grant, 2010 - 2013

Research profile

My field of interest is algebraic geometry.

In particular, I work on derived categories of coherent sheaves on algebraic varieties.
In my past research, I studied autoequivalence groups of the derived category (in [2, 1, 4, 7]) and stability conditions in the sense of Bridgeland (in [8, 5, 3]).
Recently, I am studying three dimensional projective varieties. More precisely, I am working on generalizations of the classical Bogomolov-Gieseker inequality for stable sheaves on surfaces to stable complexes on threefolds, and applications of this to birational geometry.
I am also studying deformations of K3 categories embedded in derived categories of cubic fourfolds together with Martí Lahoz (University of Bonn).

Former Research Area E I belong to the research area E (and partly connected with C).

During my first year at HCM I wrote two preprints and completed two papers (one appeared in print and one is going to appear in 2011).
Preprints.
[11] "Bridgeland stability conditions on threefolds II: An application to Fujita's conjecture" (with A. Bayer, A. Bertram and Y. Toda), preprint 2011.
In this paper we show that the conjectural inequality for stable two-term complexes we formulate in the preprint [12] has applications towards Fujita's conjecture on threefolds. More precisely, the conjecture implies a Reider-type theorem for threefolds, that $K_X + 6L$ is very ample for L ample, and that $5L$ is very ample when K_X is trivial.
[12] "Bridgeland stability conditions on threefolds I: Bogomolov-Gieseker type inequalities" (with A. Bayer and Y. Toda), preprint 2011. Also arXiv:1103.5010.
In this paper we construct new t-structures on the derived category of coherent sheaves on smooth projective threefolds. We conjecture that they give Bridgeland stability conditions near the large volume limit. We show that this conjecture is equivalent to a Bogomolov-Gieseker type inequality for the third Chern character of certain stable complexes. We also conjecture a stronger inequality, and prove it in the case of projective space, and for various examples.
Finally, we prove a version of the classical Bogomolov-Gieseker inequality, not involving the third Chern character, for stable complexes.
Published papers.
In [**?**], we study the space of stability conditions on the total space of the canonical bundle over the projective plane. We explicitly describe a chamber of geometric stability conditions, and show that its translates via autoequivalences cover a whole connected component. We prove that this connected component is simply-connected. We determine the group of autoequivalences preserving this connected component, which turns out to be closely related to $\Gamma_1(3)$.
Finally, we show that there is a submanifold isomorphic to the universal covering of a moduli space of elliptic curves with $\Gamma_1(3)$-level structure. The morphism is $\Gamma_1(3)$-equivariant, and is given by solutions of Picard-Fuchs equations. This result is motivated by the notion of Π-stability and by mirror symmetry.
Finally, in [1], we study the general fibre of a formal deformation over the formal disk of a projective variety from the view point of abelian and derived categories. The abelian category of coherent sheaves of the general fibre is constructed directly from the formal deformation and is shown to be linear over the field of Laurent series. The various candidates for the derived category of the general fibre are compared.
If the variety is a surface with trivial canonical bundle, we show that the derived category of the general fibre is again a linear triangulated category with a Serre functor given by the square of the shift functor.

Selected publications

[1] Daniel Huybrechts, Emanuele Macrì, and Paolo Stellari. Formal deformations and their categorical general fibre. *Comment. Math. Helv.*, 86(1):41–71, 2011.
[2] Daniel Huybrechts, Emanuele Macrì, and Paolo Stellari. Derived equivalences of k3 surfaces and orientation. *Duke Math. J.*, 149(3):461–507, 2009.
[3] Emanuele Macrì, Sukhendu Mehrotra, and Paolo Stellari. Inducing stability conditions. *J. Algebraic Geom.*, 18(4):605–649, 2009.

[4] Emanuele Macrìand Paolo Stellari. Infinitesimal derived torelli theorem for k3 surfaces. *Int. Math. Res. Not. IMRN*, (17):3190–3220, 2009. With an appendix by Sukhendu Mehrotra.
[5] Daniel Huybrechts, Emanuele Macrì, and Paolo Stellari. Stability conditions for generic k3 categories. *Compos. Math.*, 144(1):134–162, 2008.
[6] Emanuele Macrì, Marc Nieper-Wiß kirchen, and Paolo Stellari. The module structure of hochschild homology in some examples. *C. R. Math. Acad. Sci. Paris*, 346(15-16):863–866, 2008.
[7] Emanuele Macrìand Paolo Stellari. Automorphisms and autoequivalences of generic analytic k3 surfaces. *J. Geom. Phys.*, 58(1):133–164, 2008.
[8] Emanuele Macrì. Stability conditions on curves. *Math. Res. Lett.*, 14(4):657–672, 2007.
[9] Claudio Bartocci and Emanuele Macrì. Classification of poisson surfaces. *Commun. Contemp. Math.*, 7(1):89–95, 2005.