EVGUENI (JENIA) TEVELEV

Department of Mathematics and Statistics
University of Massachusetts at Amherst
710 N. Pleasant Street, Amherst, MA, 01003, USA
e-mail: tevelev@math.umass.edu
www.math.umass.edu/~tevelev/

Employment

- Professor, University of Massachusetts in Amherst, 2016–present
- Associate Professor, University of Massachusetts in Amherst, 2010–2016
- Assistant Professor, University of Massachusetts in Amherst, 2006–2010
- Instructor (postdoc), University of Texas in Austin, 2002–2006

Research awards

- Fulbright Scholarship, 2019
- Simons Fellowship, 2019
- Sloan Fellowship, 2007

Research grants from the National Science Foundation

- DMS-2101726, *New Frontiers of Algebraic Geometry*, 2021–2024
- DMS-1701704. *Moduli Spaces: New Directions*, 2017–2021
- DMS-1303415, 1539510. *Moduli Spaces of Curves and Surfaces*, 2013–2017
- DMS-1001344. *Geometry of Moduli of Curves and Surfaces*, 2010–2013
- DMS-0701191, 0827994. *Geometry of Compact Moduli Spaces*, 2007–2010

Conference grants from the National Science Foundation

- DMS-1937705, 1360543, 1064426, 0963853. *Algebraic Geometry NorthEastern Series*
- DMS-1935081, *Latin American School of Algebraic Geometry and Applications*

Visiting research positions (with external funding)

- Oberwalfach Research Fellow, MFO, Germany, Summer 2022
- Fulbright Professor, Universidad Católica de Chile, Fall 2019–Spring 2020
- Visiting Professor, Fields Institute, Toronto, Canada, Fall 2016
- Member, Mathematical Sciences Research Institute, Berkeley, CA, Fall 2009
- Member, Institut des Hautes Études Scientifiques, France, Summer 2007
- Postdoctoral research fellow, University of Basel, Switzerland, 2000–2001

Education

- Moscow State University (Russia), PhD in Mathematics, 2000
- Moscow State University (Russia), Diploma with Honors in Mathematics, 1995

Languages: English, Russian, Spanish

Postdocs mentored at the University of Massachusetts

- Luca Schaffler, 2017–2020, currently at Roma Tre University, Rome, Italy
  https://ricerca.matfis.uniroma3.it/users/lschaffler/
- Giancarlo Urzua, 2008–2011, Universidad Catolica de Chile, Santiago, Chile
  https://www.mat.uc.cl/personas/perfil/urzua
- Ana-Maria Castravet, 2006 – 2007, Université de Versailles, Paris, France
  https://sites.google.com/view/castravet/home

Graduate students

- Arie Stern (currently at University of Massachusetts)
  Anticanonical Models of Smoothings of Cyclic Quotient Singularities
- Sebastian Torres (University of Miami).
  Windows in Algebraic Geometry and Applications to Moduli
- Tassos Vogiannou (Physics Programmer at Media Molecule)
  Spherical Tropicalization
- Julie Rana (Lawrence University), Distinguished Thesis Award
  Boundary Divisors in the Moduli Space of Stable Quintic Surfaces

Selected service experience

- Managing Editor, Transformation Groups (Springer Nature, Switzerland)
- Director of Graduate Admissions (Dept. of Mathematics and Statistics, UMass)
- Panelist and reviewer for National Science Foundation (USA), NSA (USA), NSERC (Canada), National Research Agency (France), FONDECYT (Chile)
- Research and Training Program in Algebraic Geometry

  Since 2007, a year-long training program has been supported by the National Science Foundation and internal grants from UMass Amherst. The program kicks off in the Spring semester with a comprehensive reading course on algebraic geometry followed by a REU in the summer. In the Fall semester, the program offers another independent study to help students concentrate on their writing skills and complete either an Honors thesis or a paper. The program provides support and guidance for graduate school and scholarship applications, along with mentoring to help students achieve their career goals. Overall, this program offers a comprehensive and in-depth training experience that is tailored to the unique needs of each individual student. Selected alumni of the program:
  - Pranav Ramakrishnan (enrolled in Masters program at Columbia University)
  - Elizabeth Pratt (UC Berkeley PhD program), NSF Graduate Fellowship.
  - Shelby Cox (University of Michigan at Ann Arbor PhD program). NSF Graduate Fellowship, UMass Rising Researcher award.
  - Greg McGrath (UC Santa Barbara PhD program)
  - Stephen Obinna (Brown University PhD program)
  - Morgan Opie (now at UCLA). Masters from Cambridge, PhD from Harvard, Alice T. Schafer Prize runner-up (a national prize for excellence in mathematics by an undergraduate woman), NSF Graduate Fellowship, UMass Rising Researcher award, Churchill scholarship.
  - Nic Reyes (now at UT Austin). PhD (UT Austin), NSF Graduate Fellowship.
  - Nate Harman (now at U Michigan Ann Arbor). Received PhD from MIT, NSF Graduate Fellowship.
  - Ilya Scheidwasser (now at athenahealth). PhD from Northeastern University.

Selected research achievements and publications

- **Proof of the Narasimhan conjecture**

  (1) *Braid and Phantom*, 39p. (2023), arXiv:2304.01825
  (2) *BGMN conjecture via stable pairs*, with S. Torres, 47p. (2021), arXiv:2108.11951

  Let C be a smooth projective curve of genus $g > 1$ and let N be the moduli space of stable rank 2 vector bundles on C of odd degree. We construct a semi-orthogonal decomposition of the bounded derived category of N conjectured by Narasimhan and by Belmans, Galkin and Mukhopadhyay. It has two blocks for each i-th symmetric power of C for $i = 0, ..., g-2$ and one block for the $(g-1)$-st symmetric power. The proof uses new vanishing theorems for vector bundles on moduli spaces of stable pairs and weaving patterns in derived categories.

- **Proof of the Manin–Orlov conjecture** (in joint papers with Ana-Maria Castravet)

(3) *Derived category of moduli of pointed curves – II*, arXiv:2002.02889) (2020)
(4) *Exceptional collections on Hassett spaces*, Épijournal de Géom. Alg. **4** (2020), 1–34
(5) *Derived category of moduli of pointed curves – I*, Alg. Geom. **7** (6) (2020), 722–757

The moduli space $\overline{M}_{0,n}$ of stable rational curves with n marked points has a full exceptional collection permuted by the action of the symmetric group S_n. In particular, the K-group of $\overline{M}_{0,n}$ is a permutation S_n-lattice. Objects of the collection have modular interpretation and the proof uses windows in derived categories and their behaviour under wall-crossing,

- **Birational geometry of $\overline{M}_{0,n}$ and blown-up toric varieties**

(6) *Blown-up toric surfaces with non-polyhedral effective cone*, with Ana-Maria Castravet, Antonio Laface and Luca Ugaglia, Crelle's Journal (2023), 44 p.
(7) *$\overline{M}_{0,n}$ is not a Mori Dream Space*, joint with Ana-Maria Castravet, Duke Mathematical Journal, **164**, no. 8 (2015), 1641–1667
(8) *Hypertrees, Projections, and Moduli of Stable Rational Curves*, joint with Ana-Maria Castravet, Crelle's Journal, **675** (2013), 121–180

In (8), we introduced a large number of exceptional divisors (called hypertree divisors) on $\overline{M}_{0,n}$ with many remarkable properties. In (7), we related birational geometry of $\overline{M}_{0,n}$ to blow-ups of toric varieties at a general point. Using work of Goto, Nishida and Watanabe on symbolic Rees algebras of monomial primes, we proved that $\overline{M}_{0,n}$ is not a Mori Dream Space in characteristic 0 and for large n, disproving a conjecture of Hu and Keel. In (6), we constructed projective toric surfaces whose blow-up at a general point has a non-polyhedral pseudo-effective cone. As a consequence, the pseudo-effective cone of $\overline{M}_{0,n}$ is not polyhedral (and thus it is not a Mori Dream Space) for $n \geq 10$ in every characteristic.

- **Probabilistic Brill Noether theory**

(9) *Scattering amplitudes of stable curves*, arXiv:2007.03831 (2020)

We interpret leading singularities of scattering amplitude forms in N=4 SYM as the study of statistics of images of n marked points on a Riemann surface under a random meromorphic function uniformly distributed with respect to the volume form of the Jacobian. We investigate a beautiful emerging geometry for various classes of algebraic curves: smooth, stable, hyperelliptic, real algebraic, etc.

- **Deformation theory and moduli theory of stable algebraic surfaces**

(10) *Categorical aspects of the Kollár-Shepherd-Barron correspondence*, with Giancarlo Urzua, 43p. (2022), arXiv:2204.13225
(11) *Flipping Surfaces*, with Paul Hacking and Giancarlo Urzua, Journal of Algebraic Geometry, **26** (2017), 279–345
(12) *The Craighero-Gattazzo surface is simply-connected*, with Julie Rana and Giancarlo Urzua, Compositio, **153** (2017), 557–585

In (12), we show that the Craighero-Gattazzo surface is simply-connected, as conjectured by Dolgachev and Werner. We prove this purely topological fact using an algebraic reduction mod p technique and deformation theory. In (11), we classify possible flips of semistable extremal threefold neighborhoods and show that extremal neighborhoods of type k2A and more general neighborhoods of type k1A belong to the same deformation family as conjectured by Mori. In (10), we categorify the Milnor fiber of a smoothing of a 2-dimensional cyclic quotient singularity to the derived category of a path algebra of a quiver without relations. We give applications to the derived categories of Dolgachev surfaces.

- **Moduli spaces of hyperplane arrangements and del Pezzo surfaces**

(13) *Compactifications of moduli spaces of points and lines in* $\mathbb{P}^2$, with Luca Schaffler, International Math. Research Notices (2021), 79p.
(14) *Stable Pair, Tropical, and Log Canonical Compact Moduli of Del Pezzo Surfaces,* with Paul Hacking and Sean Keel, Inventiones Math. **178** , no.1 (2009), 173–228
(15) *Compactification of the Moduli Space of Hyperplane Arrangements*, with Paul Hacking and Sean Keel, Journal of Algebraic Geometry **15** (2006), 657–680
(16) *Geometry of Chow Quotients of Grassmannians*, with Sean Keel, Duke Math. Journal **134**, no. 2 (2006), 259–311

In (15) and (16), we consider the moduli space $X(r,n)$ of arrangements of n hyperplanes in general position in projective $(r-1)$-space. We identify the closure of $X(r,n)$ in the KSBA moduli space of stable pairs as Kapranov's Chow quotient compactification, give an explicit description of the pairs at the boundary, and compute limits of one parameter degenerations. In (14), we give a functorial normal crossing compactification of the moduli space of smooth marked cubic surfaces with the arrangement of 27 lines entirely analogous to $\overline{M}_{0,n}$. In (13), following ideas of Gerritzen and Piwek, we construct a compact moduli space parametrizing reducible degenerations of $\mathbb{P}^2$ with n smooth points.

- **Tropical algebraic geometry**

(17) *Spherical Tropicalization*, with Tassos Vogiannou, Transformation Groups **26** (2021), 691–718 (Ernest Vinberg memorial volume)
(18) On a Question of Teissier, Collectanea Math., 65, no. 1 (2014), 61–66
(19) Elimination Theory for Tropical Varieties, with Bernd Sturmfels, Math. Research Letters **15**, no.3 (2008), 543–562
(20) *Compactifications of Subvarieties of Tori,* Amer. J. of Math. **129** (2007), 1087–1104

In (20), we study compactifications of subvarieties of algebraic tori defined by imposing a sufficiently fine polyhedral structure on their non-archimedean amoebas. These compactifications have many nice properties, for example any k boundary divisors intersect in codimension k. In (17), we extend tropical compactifications to subvarieties of spherical homogeneous spaces. These techniques are used in (19) to develop new tools for elimination theory and implicitization and in (18) to answer positively a question of B. Teissier on the existence of a resolution of singularities inside an equivariant map of toric varieties.

- **Equations and syzygies of moduli spaces**

(21) *Equations for* $\overline{M}_{0,n}$, with Sean Keel, Intern. J. of Math. **20**, no.9 (2009), 1–26
(22) *Hilbert's 14-th Problem and Cox Rings*, with Ana-Maria Castravet, Compositio **142** (2006), 1479–1498

In (21), we show that the log canonical bundle of $\overline{M}_{0,n}$ is very ample, the homogeneous coordinate ring is Koszul, and the homogeneous ideal of the projective embedding is the sum of the homogeneous ideals of many Segre embedded copies of $\mathbb{P}^1 \times \mathbb{P}^2 \times \ldots \times \mathbb{P}^{n-3}$, permuted by the symmetric group. The main result of (22) is the description of generators of the total coordinate ring of the blow-up of $\mathbb{P}^n$ in any number of points that lie on a rational normal curve. We also prove the finite generation of the algebras of invariants of actions of vector groups related to T-shaped Dynkin diagrams introduced by Mukai.

- (23) *Projective Duality and Homogeneous Spaces*, Springer 2005

A large survey on projective duality.