

Tristan C. Collins

Education

- 2014 **Ph.D. in Mathematics**, *Columbia University*.
Advisor: Duong H. Phong
- 2009 **B.Sc. in Mathematics (Honours), Minor in Physics**, *University of British Columbia*.

Employment

- 2023– **Associate Professor**, *University of Toronto*.
- 2023– **Associate Professor (without tenure)**, *Massachusetts Institute of Technology*, (on leave).
- 2018 –2023 **Assistant Professor**, *Massachusetts Institute of Technology*.
- 2014 – 2018 **Benjamin Peirce Fellow**, *Harvard University*, (on leave 01/17- 06/16).
- 01/2017- **Visiting Assistant Professor**, *Chalmers University*.
06/2017

Honors

- 2022-2025 Class of 1948 Career Development Assistant Professor, MIT
- 2021 André Aisenstadt Prize, Centre de Recherches Mathématiques
- 2020 Best Paper Award (Gold Medal), International Congress of Chinese Mathematicians
- 2018 Alfred P. Sloan Fellowship, Sloan Foundation

Research Grants and Funding

- 2019 – 2024 NSF CAREER Grant DMS-1944952, \$400,000
- 2022 NSF Collaborative Research Grant DMS-2211917, \$15,250
- 2018 Alfred P. Sloan Foundation, Sloan Fellowship, \$65,000
- 2018 NSF Standard Grant DMS-1810924, \$158,341.00
- 2015 NSF Standard Grant DMS-1506652, \$128,224

Preprints

- *Stability for Line Bundles and Deformed Hermitian-Yang-Mills Equation on Some Elliptic Surfaces*
(with J. Lo, Y. Shi, and S.-T. Yau)
preprint, arXiv:2306.05620
- *The Strominger system in the square of a Kähler class*
(with S. Picard and S.-T. Yau)
preprint, arXiv:2211.03784

- *Recent progress on SYZ mirror symmetry for some non-compact Calabi-Yau surfaces*
(with Y.-S. Lin)
preprint, arXiv:2208.14485
- *Complete Calabi-Yau metrics in the complement of two divisors*
(with Y. Li)
preprint, arXiv:2203.10656
- *On upper bounds in dimension gaps of CFT's*
(with C. Vafa, D. Jafferis, K. Xu, and S.-T. Yau)
preprint, arXiv:2201.03660
- *Spinor flows with flux, I: short-time existence and smoothing estimates*
(with D.H. Phong)
preprint, arXiv:2112.00814
- *The SYZ mirror symmetry conjecture for del Pezzo surfaces and rational elliptic surfaces*
(with A. Jacob, and Y.-S. Lin)
preprint, arXiv:2012.05416
- *Moment maps, nonlinear PDE, and stability in mirror symmetry*
(with S.-T. Yau)
preprint, arXiv:1811.04824
- *K stability and stability of chiral ring*
(with D. Xie and S.-T. Yau)
preprint, arXiv:1606.09260

Publications

- *Uniqueness of some cylindrical tangent cones to special Lagrangians*
(with Y. Li)
Geom. Func. Anal. 33 (2023), no. 2, 376–420
- *Special Lagrangian cycles and Calabi-Yau transitions*
(with S. Gukov, S. Picard and S.-T. Yau)
Comm. Math. Phys., 401 (2023), no. 1, 769–802
- *The Torelli theorem for ALH* gravitational instantons*
(with A. Jacob and Y.-S. Lin)
Forum of Math., Sigma, 10 (2022), Paper No. e79
- *Moment maps, nonlinear PDE and stability in mirror symmetry, I: Geodesics*
(with S.-T. Yau)
Ann. PDE 7 (2021), no. 1, Paper No. 11, 73 pp.
- *Stability of the tangent bundle through conifold transitions*
(with S. Picard and S.-T. Yau)
Comm. Pure and Appl. Math., to appear.
- *Emergent Sasaki-Einstein geometry and AdS/CFT*
(with R. Berman, and D. Persson)
Nature Comm., 13, article 365.
- *On the degeneration of asymptotically conical Calabi-Yau metrics*
(with F. Tong, and B. Guo)
Math. Ann. 383 (2022), no. 3-4, 867–919.
- *Stability and the deformed Hermitian-Yang-Mills equation*
(with Y. Shi), Surveys in Diff. Geom. 24, International Press, Boston, MA, 1–38

- *The space of almost calibrated $(1,1)$ forms on a compact Kähler manifold*
(with J. Chu, and M.-C. Lee)
Geom. Topol. 25 (2021), no. 5, 2573–2619.
- *The Dirichlet problem for the k -Hessian equation on a complex manifold*
(with S. Picard)
Amer. J. Math., 144 (2022), no. 6, 1641–1680.
- *Special Lagrangian submanifolds of log Calabi-Yau manifolds*
(with A. Jacob, and Y.-S. Lin)
Duke Math. J. 170 (2021), no. 7, 1291–1375.
- *Concave elliptic equations and generalized Khovanskii-Teissier inequalities*
Pure Appl. Math. Q. 17 (2021), no. 3, 1061–1082.
- *The inverse Monge-Ampère flow and applications to Kähler-Einstein metrics*
(with T. Hisamoto, and R. Takahashi)
J. Differential Geom. 120 (2022), no. 1, 51–95.
- *The deformed Hermitian-Yang-Mills equation in geometry and physics*
(with D. Xie, and S.-T. Yau)
Geometry and Physics, Volume I: A Festschrift in honour of Nigel Hitch, Oxford University Press, December, 2018.
- *Log-canonical thresholds in real and complex dimension 2*
Ann. Inst. Fourier (Grenoble), 68 (2018), no. 7, 2883–2900.
- *Restricted volumes on Kähler manifolds*
(with V. Tosatti)
Ann. Fac. Sci. Toulouse Math. (6) 31 (2022), no. 3, 907–947.
- *Sasaki-Einstein metrics and K -stability*
(with G. Székelyhidi)
Geom. Topol. 23 (2019), no. 3, 1339–1413.
- *$(1,1)$ forms with specified Lagrangian phase: A priori estimates and algebraic obstructions*
(with A. Jacob and S.-T. Yau)
Camb. J. Math. 8 (2020), no. 2, 407–452.
- *Dimension of the minimum set for the real and complex Monge-Ampère equations in critical Sobolev spaces*
(with C. Mooney)
Anal. and PDE 10 (2017), no. 8, 2031–2041.
- *Concavity of the Lagrangian phase operator and applications*
(with S. Picard and X. Wu)
Calc. Var. Partial Differential Equations 56 (2017), no. 4, Art. 89.
- *Poisson metrics on flat vector bundles over non-compact curves*
(with A. Jacob and S.-T. Yau)
Comm. Anal. Geom. 27 (2019), no. 3, 529–597.
- *Convergence of the J -flow on toric manifolds*
(with G. Székelyhidi)
J. Differential Geom. 107 (2017), no. 1, 47–81.
- *K -Semistability for irregular Sasakian manifolds*
(with G. Székelyhidi)
J. Differential Geom. 109 (2018), no. 1, 81–109.

- *The twisted Kähler-Ricci flow*
(with G. Székelyhidi)
J. Reine Angew. Math., 716 (2016), 179–205.
- *Stability and convergence of the Sasaki-Ricci flow*
J. Reine Angew. Math., 716 (2016), 1–27.
- *$C^{2,\alpha}$ estimates for nonlinear elliptic equations of twisted type*
Calc. Var. Partial Differential Equations 55 (2016), no. 6, Art. 6.
- *A singular Demailly-Păun theorem*
(with V. Tosatti)
C. R. Math. Acad. Paris 354 (2016), no. 1, 91–95.
- *Kähler currents and null loci*
(with V. Tosatti)
Invent. Math. 202 (2015), no. 3, 1167–1198.
- *On the convergence of the Sasaki-Ricci flow*
(with A. Jacob)
Analysis, complex geometry, and mathematical physics: in honor of Duong H. Phong, 11–21,
Contemp. Math. 644 (2015).
- *An extension theorem for Kähler currents*
(with V. Tosatti)
Ann. Fac. Sci. Toulouse Math. (6) 23 (2014), no. 4, 893–905.
- *Uniform Sobolev inequality along the Sasaki-Ricci flow*
J. Geom. Anal. 24 (2014), no. 3, 1323–1336.
- *Remarks on the Yang-Mills flow on a compact Kähler manifold*
(with A. Jacob)
Univ. Iagel. Acta Math., no. 51 (2013), 17–43.
- *The transverse entropy functional and the Sasaki-Ricci flow*
Trans. Amer. Math. Soc. 365 (2013), no. 3, 1277–1303.
- *A multidimensional resolution of singularities with applications to analysis*
(with A. Greenleaf, and M. Pramanik)
Amer. J. Math. 135 (2013), no. 5, 1179–1252.

Research Talks

- 1/31/2012 City University of New York, Geometry and Analysis Seminar.
- 2/3/2012 University of Rochester, Analysis and Geometry Seminar.
- 10/9/2012 Northwestern University, Geometry and Physics Seminar.
- 5/8/2013 Columbia University, Analysis, Complex Geometry, and Mathematical Physics: A Conference in Honor of Duong H. Phong.
- 8/12/2013 Rutgers University, Summer School in Complex Geometry.
- 9/24/2013 Johns Hopkins University, Complex Geometry Seminar.
- 10/7/2013 University of Connecticut, PDE and Differential Geometry Seminar.
- 11/15/2013 Northwestern University, Complex Geometry Seminar.
- 3/25/2014 Duke University, Geometry and Topology Seminar.
- 4/5/2014 University of New Mexico, AMS Spring Sectional Meeting: Special Session on Analysis and Topology in Special Geometries.

- 4/8/2014 Banff International Research Station, Complex Monge-Ampère equations on compact Kähler manifolds.
- 9/30/2014 Temple University, PATCH Seminar.
- 10/10/2014 Harvard University, Gauge Theory, Topology and Symplectic Geometry Seminar.
- 10/21/2014 Harvard University, Differential Geometry Seminar.
- 11/21/2014 Northwestern University, Informal Geometric Analysis Seminar.
- 4/11/2015 Northwestern University, Special Day on Analytic Methods in Algebraic Geometry.
- 4/16/2015 Columbia University, Complex Geometry and PDE Seminar.
- 4/21/2015 University of California, Irvine, Differential Geometry Seminar.
- 5/8/2015 Fields Institute, Geometric Analysis Colloquium.
- 6/2/2015 Jagiellonian University, Hessian Type Equations in Complex Geometry.
- 10/9/2015 Simons Center for Geometry and Physics, Workshop on Toric Kähler Geometry.
- 10/21/2015 University of Pennsylvania, Geometry and Topology Seminar.
- 11/25/2015 Université Paris-Sud, Séminaire Opérateurs de Dirac.
- 3/1/2016 Université de Québec à Montréal, Séminaire Géométrie et Topologie.
- 3/18/2016 Stony Brook University, AMS Sectional Meeting, Special Session on PDE methods in Geometric Flows.
- 3/19/2016 Stony Brook University, AMS Sectional Meeting, Special Session on Complex Geometric Analysis.
- 5/3/2016 Stony Brook University, Geometry/Topology Seminar.
- 5/5/2016 Columbia University, Complex Geometry and PDE Seminar.
- 5/27/2016 Harvard University, Center of Mathematical Sciences and Applications, Members' Seminar.
- 6/15/2016 Institut de Mathématiques de Toulouse, Recent Advances in Complex Geometry.
- 7/18/2016 Hayama Symposium on Several Complex Variables.
- 7/24/2016 University of Tokyo, Trends in Modern Geometry.
- 8/17/2016 American Institute of Mathematics, Workshop on Complex Monge-Ampère Equations.
- 10/8/2016 Virginia Tech, Workshop on the Mathematics and Physics of F-theory.
- 11/4/2016 University of Michigan, Geometry Seminar.
- 1/4/2017 Florida International University, Winter Conference on Geometry, Topology and Applications.
- 1/10/2017 Imperial College, London, Collapse, Adiabatic Limits, and Special Holonomy.
- 1/23/2017 Chalmers University, KASS seminar.
- 2/15/2017 Cambridge University, Algebraic Geometry Seminar.
- 2/27/2017 Chalmers University, KASS seminar.
- 4/24/2017 ICMS Edinburgh, Positivity in Algebraic and Complex Geometry.
- 5/2/2017 Harvard University, Conference Celebrating the 50th Anniversary of JDG.
- 5/15/2017 National University of Singapore, Complex Geometry, Dynamical Systems and Foliation Theory.
- 5/19/2017 Näss Fabriker, Nordan Conference on Complex Analysis.
- 6/8/2017 Institut Fourier, Grenoble, Conference in Honour of Jean-Pierre Demailly's 60th Birthday.
- 6/14/2017 Université Paris-Sud, Séminaire Opérateurs de Dirac.
- 7-5/2017 MFO Oberwolfach, Differentialgeometrie im Großen.
- 9/27/2017 Boston University, Geometry and Physics Seminar.
- 10/9/2017 University of Michigan, Complex Analysis, Dynamics, and Geometry Seminar.
- 11/1/2017 University of Illinois, Chicago, Algebraic Geometry seminar.

11/16/2017 University of Minnesota, Colloquium.
11/17/2017 Rutgers University, Geometric Analysis Conference.
11/27/2017 University of Wisconsin-Madison, Colloquium.
11/30/2017 University of California, San Diego, Colloquium.
12/4/2017 Notre Dame University, Colloquium.
12/7/2017 Northeastern University, Colloquium.
12/12/2017 University of North Carolina, Chapel Hill, Colloquium.
1/3/2018 University of Toronto, Colloquium.
1/8/2018 McGill University, Colloquium.
1/10/2018 Massachusetts Institute of Technology, Special Seminar.
1/17/2018 Michigan State University, Colloquium.
1/19/2018 Duke University, Colloquium.
2/8/2018 Columbia University, Complex Geometry and PDE seminar.
2/9/2018 Simons Foundation, Nonlinear Partial Differential Equations meeting.
3/3/2018 Vanderbilt University, Shanks Workshop on Complex Differential Geometry.
3/10/2018 Notre Dame University, Conference on Complex Geometry and Several Complex Variables.
3/12/2018 Centre de Recherches Mathematiques, Workshop on Geometric Analysis.
4/5/2018 Harvard University, Center of Mathematical Sciences and Applications, Simons Collaboration on Mirror Symmetry.
4/26/2018 University of New Mexico, Geometry and Algebra Seminar.
5/24/2018 Lehigh University, Geometry and Topology Conference.
5/29/2018 Hebrew University, Geometry and Topology Seminar.
8/14/2018 American Institute of Mathematics, Nonlinear PDEs in real and complex geometry.
11/15/2018 Columbia University, Complex Geometry and PDE seminar.
11/30/2018 University of British Columbia, Rising Star Lecture.
1/26/2019 UC San Diego, Southern California Geometric Analysis Seminar.
1/28/2019 UC Berkeley, Differential Geometry Seminar.
2/11/2019 Harvard University, Center of Mathematical Sciences and Applications, Mathematical Physics Seminar.
3/5/2019 Harvard University, Differential Geometry Seminar.
3/20/2019 Harvard University, Workshop on Mirror Symmetry and Stability.
4/2/2019 Maryland University, Geometric Analysis Seminar.
4/8/2019 Northwestern University, Analysis Seminar.
4/13/2019 University of Connecticut- Hartford, AMS Sectional Meeting, Special Session on Recent Developments in Geometric Analysis and PDEs.
4/27/2019 Howard University, Metro Area Differential Geometry Seminar.
5/3/2019 Harvard University, Differential Geometry, Calabi-Yau Theory, and General Relativity, in celebration of the 70th birthday of S.-T. Yau.
5/21/2019 Chalmers University, KASS seminar.
5/24/2019- Higher School of Economics, Moscow, Mini-course on PDE and stability in mirror symmetry.
5/25/2019
5/29/2019 Higher School of Economics, Moscow, Who's who in mirror symmetry.

6/3/2019 Palazzone di Cortona, Current developments in complex and analytic geometry.

10/31/2019 Banff International Research Station, Bridging the Gap between Kähler and non-Kähler Complex Geometry.

11/12/2019 University of Chicago, Geometric Analysis Seminar.

11/14/2019 Simons Foundation, Collaboration on Homological Mirror Symmetry Annual Meeting.

11/20/2019 Princeton University, Geometric Analysis Seminar.

3/5/2020 Columbia University, Complex Geometry and PDE seminar.

4/29/2020 Université Paris-Sud, Séminaire Opérateurs de Dirac (online)

9/29/2020 CUHK- Harvard-YMSC joint Differential Geometry Seminar (online)

9/31/2019 Simons Workshop on Floer and algebro-geometric aspects of SYZ mirror symmetry (online)

10/20/2020 Geometria em Lisboa (online)

11/9/2020 Indian Institute of Science, Geometric Analysis Seminar (online)

11/11/2020 Instituto de Ciencias Matemáticas (ICMAT), Geometry Seminar (online)

12/8/2020 American Institute of Mathematics, Stability in Mirror Symmetry (online)

3/1/2021 Jagiellonian University, Seminar on Complex analysis and Elliptic PDE's (online)

4/24/2021 Stony Brook University, Geometry Festival (online)

9/12/2021 Simons Collaboration on Special Holonomy: Progress and Open Problems (online).

10/12/2021 Tsinghua University, Chern: A great geometer of the 20th century (online).

10/18/2021 UT Dallas, Geometry, Topology, and Dynamical Systems Seminar (online).

11/12/2021 Yale, Geometric Analysis Seminar (online).

11/19/2021 Centre de Recherches Mathématiques, Colloquium (online).

12/5/2021 Canadian Mathematical Society, Winter Meeting, Special Session on Recent Developments in Complex Geometry and Geometric Analysis (online).

12/11/2021 Vanderbilt University, Shanks Workshop on Complex Geometry.

3/29/2022 Zoom Algebraic Geometry Seminar (online).

4/5/2022 Northwestern-UIC Complex Geometry Seminar.

5/3/2022 Columbia University, Deformations of Geometric Structures: a conference in honor of Masatake Kuranishi.

5/3/2022 Beijing International Center for Mathematical Research, Geometric Analysis Seminar (online).

7/15/2022 Simons Center for Geometry and Physics, Forty Years of Ricci Flow: The Geometric-Flow Revolution in Global Differential Geometry (online).

9/22/2022 Columbia University, Complex Geometry and PDE seminar (online).

10/5/2022 Yau Mathematical Sciences Center, Algebraic Geometry Seminar (online).

10/18/2022 Stony Brook University, Geometry and Topology Seminar.

11/28/2022 Johns Hopkins University, Colloquium.

11/30/2022 Boston University, Geometry and Physics Seminar.

12/8/2022 University of Toronto, Colloquium.

1/12/2023 University of California, San Diego, Colloquium.

1/20/2023 University of Miami, IMSA Seminar.

2/2/2023 University of California, Los Angeles, Colloquium.

2/13/2023 Harvard University, Center of Mathematical Sciences and Applications, Colloquium.

3/8/2023 Massachusetts Institute of Technology, Geometric Analysis Seminar.

- 3/10/2023 Stony Brook University, Colloquium.
3/16/2023 Kavli Institute for Theoretical Physics, Santa Barbara, Physics and Special Holonomy.
4/11/2023 Harvard-MIT Algebraic Geometry Seminar.
6/20/2023 Institut de Mathématiques de Toulouse, Journée Scientifique

Teaching Talks

- 3/10/21 Abdul Latif Jameel World Education Lab, Education Experiments Webinar Series (online).
12/1/2021 MIT Open Learning, xTalk Series, Slack in Education: a conversation with colleagues (online).

Teaching Experience

- **Massachusetts Institute of Technology**
 - 18.03 Differential Equations (F20, S22)
 - 18.965 Geometry of Manifolds I (F19)
 - 18.966 Geometry of Manifolds II (S19)
 - 18.103 Fourier Analysis: Theory and Applications (F18)
- **Harvard University:**
 - Math 263: Analytic Techniques in Algebraic Geometry (F16)
 - Math 230a: Differential Geometry (F16, F17)
 - Math 264: Nonlinear Elliptic PDEs (S16)
 - Math 262: The Geometry of the Complex Monge-Ampère Equation, (S15)
 - Math 112: Introductory Real Analysis (S15, S16)
 - Math 136: Differential Geometry of Curves and Surfaces (F14, F15, F17)
- **Columbia University**
 - Ordinary Differential Equations (Sum12, Sum13, Sum14)

Service

- **Scientific Service:**
 - Conference and Seminar Organization
 - Organizer: Geometry and Analysis Seminar for Boston Area Graduate Students, Annual
 - Co-organizer: Conference on Deformations of Geometric Structures in Current Mathematics, May, 2022
 - Co-organizer: Workshop on Stability in Mirror Symmetry, American Institute of Mathematics, December 2020 (Online), April 2022
 - Organizer: Virtual Learning Seminar on Lagrangian Mean Curvature Flow, 2021 - present
 - Organizer: MIT Graduate Student Lunch Seminar, 2019
 - Co-organizer of the Harvard Center of Mathematical Sciences and Applications Colloquium, Spring 2018
 - Co-organizer of the Minischool on Nonlinear Equations, December, 2016 Harvard University
 - Co-organizer of the Differential Geometry Seminar, 2016–2018, Harvard University
 - Co-organizer of the Conference on Nonlinear Equations, April, 2016, Harvard University
 - Co-organizer of the Geometric Analysis seminar, 2015-2016, Harvard University
 - Co-organizer of the Evolution Equations seminar, 2015-2016, Harvard University
 - Co-organizer of the Special Day on Geometry and PDE, October, 2013, Columbia University
 - Co-organizer of the Informal Complex Geometry and PDE Seminar, Columbia University, 2012-2014
 - Organizer of the Graduate Student Geometric Analysis Seminar, Columbia University, 2011-2013
 - Editor, Pure and Applied Mathematics Quarterly
 - Editor (with L. Bieri, P. T. Chruściel, and S.-T. Yau), Nonlinear Analysis in Geometry and Applied Mathematics, Part 2, International Press, 2018
 - Panelist, National Science Foundation: Geometric Analysis Section
 - Proposal Reviewer, Banff International Research Station
 - Proposal Reviewer, Polish National Science Centre
 - Proposal Reviewer, Israeli Science Foundation
 - Referee: Journal of the American Mathematical Society, Annals of Mathematics, Acta Mathematica, Inventiones Mathematicae, Duke Mathematical Journal, Annals of PDE, Journal of Differential Geometry, Journal of the European Mathematical Society, and many others

- **Departmental Service at MIT:**

- Postdoctoral Researchers Supervised:
 - Li, Yang, 2020 - current, CLE Moore Instructor
- Undergraduate Research Students Supervised:
 - Echániz, Samuel Muñoz (MIT, UROP, Spring 2020); current position: PhD Candidate in Mathematics, Cambridge University
 - Padilla, Erick (MIT, UROP, Fall 2022): currently working on ADHM construction
 - Firester, Benjamin (Harvard, class of 2023): supervised research project since Fall 2019: resulting in Goldwater Scholarship.
- Independent Study Supervision (D. Darrow, 2019-2020)
- Graduate Student Admissions Committee, 2018 – present
- Post-doctoral Hiring Committee, 2018– present
- MIT Thesis Defense Committees: Nick Strehlke, Jiewon Park, Ao Sun, Gregory Parker, Feng Gui, Jackson Hance
- MIT Qualifying Exam Committee: Xinrui Zhao, Tang-Kai Lee, Catherine Wolfram, Arun Kannan, Alexander Ortiz, Matthew Nicoletti, Deeparaj Bhat, Pu Yu, Ishaan Levy, Feng Gui, Shengwen Gan

- **Departmental Service at Harvard:**

- Undergraduate Research Students Supervised:
 - Eisenberg, Or
 - Hallas, Christian
 - McNamara, Jacob
- B.Sc. Student Thesis Supervised:
 - Jiradilok, Pakawut (Harvard, class of 2017): Current position: recent PhD in Mathematics from MIT, continuing at MIT as a Postdoc Associate.