

## Kyle Broder – Curriculum Vitae

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- Academic Interests** Complex Differential Geometry; Several Complex Variables; Algebraic Geometry; Riemannian Geometry.
- Academic Employment** I am a postdoctoral research fellow at The University of Queensland. Funded by the Australian Research Council Discovery Grant held by Artem Pulemotov, Wolfgang Ziller, and Mark Gould. Before coming to The University of Queensland, I was a Ph.D. student at the Australian National University and Beijing University under the supervision of Ben Andrews and Gang Tian.
- Brief Research Statement** I am interested in curvature characterizations of complex-analytic and algebro-geometric notions of hyperbolicity and non-hyperbolicity. In more detail, I am particularly interested in the curvature aspects of Kobayashi hyperbolic manifolds, moduli problems, rationally connected manifolds, Oka and special manifolds.
- Education**
- (2015–2017). B. Sc. Australian National University.
  - (2018). B. Sc. (First Class Honours). Australian National University.
    - Supervisor: Alexander Isaev.
    - Thesis: On the Theory of Stein Spaces.
  - (January 1st, 2019–July 31st, 2022). Ph.D. Australian National University and Peking University.
    - Supervisors: Ben Andrews (Australian National University) and Gang Tian (Beijing University, Princeton University).
    - Thesis: Complex Manifolds of Hyperbolic and Non-Hyperbolic-Type. [Available here.](#)
- My Ph.D. was awarded on July 13th, 2023.
- Published Articles**
1. Second-Order Estimates for collapsed limits of Ricci-flat Kähler metrics, [arXiv:2106.13343](https://arxiv.org/abs/2106.13343), Canadian Mathematical Bulletin, <https://doi.org/10.4153/S0008439522000765>
  2. The Schwarz Lemma in Kähler and Non-Kähler Geometry, [arXiv:2109.06331](https://arxiv.org/abs/2109.06331). Asian Journal of Mathematics, vol. 27, No. 1, pp. 121–134, 2023.
  3. The Schwarz Lemma: An Odyssey, [arXiv:2110.04989](https://arxiv.org/abs/2110.04989), Rocky Mountain Journal of Mathematics, vol. 52 (2022), no. 4, pp. 1141–1155, DOI: [10.1216/rmj.2022.52.1141](https://doi.org/10.1216/rmj.2022.52.1141)
  4. On the Nonnegativity of the Dirichlet energy of a weighted graph, Bull. Aust. Math. Soc., 1-5. [doi:10.1017/S0004972721001015](https://doi.org/10.1017/S0004972721001015) (2021).
  5. An eigenvalue characterization of the dual EDM cone, Bull. Aust. Math. Soc., DOI [doi:10.1017/S0004972721000915](https://doi.org/10.1017/S0004972721000915) (2021).
  6. Remarks on the Quadratic Orthogonal Bisectional Curvature, [arXiv:2211.05362](https://arxiv.org/abs/2211.05362), Journal of Geometry, [doi:10.1007/s00022-022-00653-3](https://doi.org/10.1007/s00022-022-00653-3) (2022).

7. (joint with Kai Tang). On the Weighted Orthogonal Ricci Curvature, [arXiv:2111.00346](https://arxiv.org/abs/2111.00346), J. Geom. and Phys., 104783, doi: <https://doi.org/10.1016/j.geomphys.2023.104783>.
8. (joint with Kai Tang). On the altered holomorphic curvatures of Hermitian manifolds, [arXiv:2201.03666](https://arxiv.org/abs/2201.03666). To appear in the Pacific Journal of Mathematics.
9. (joint with James Stanfield). On the Gauduchon curvature of Hermitian manifolds, [arXiv:2211.05973](https://arxiv.org/abs/2211.05973), International Journal of Mathematics, <https://doi.org/10.1142/S0129167X23500398>

### Preprints

1. Twisted Kähler–Einstein Metrics and Collapsing, [arXiv:2003.14009](https://arxiv.org/abs/2003.14009).
2. (joint with Kai Tang).  $(\varepsilon, \delta)$ -Quasi-Negativity and Positivity of the Canonical Bundle, [arXiv:2305.01881](https://arxiv.org/abs/2305.01881).
3. Some Remarks on the Wu–Yau Theorem, [arXiv:2306.06509](https://arxiv.org/abs/2306.06509).

### Books

1. Lectures on Vector Calculus.  
The current textbook for MATH2305 at the Australian National University.
2. Complex Manifolds of Hyperbolic and Non-Hyperbolic-Type, Ph.D. Thesis, Australian National University and Beijing International Center of Mathematical Research.

### Journals Refereed for

- Advances in Mathematics.
- Journal of Geometry and Physics.
- Proceedings of the Edinburgh Mathematical Society.
- Journal of Mathematical Sciences.

### Invited Talks

- April 23, 2018 – Analytic functions of several complex variables; Australian National University.
- October 29, 2019 – Canonical metrics in Kähler geometry; University of Sydney.
- November 12, 2019 – Canonical metrics in Kähler geometry; Australian National University.
- December 10, 2019 – Twisted Kähler–Einstein metrics and Collapsing; Beijing International Center for Mathematical Research.
- April 15, 2020 – Collapsed limits of Ricci-flat Kähler metrics; Beijing International Center for Mathematical Research.
- September 16, 2021 – The Schwarz Lemma: An Odyssey; Australian National University.
- December 7, 2021 – Recent developments on the curvature of Hermitian manifold; AustMS, Geometry with Symmetries.
- March 25, 2022 – A Kähler–Ricci flow proof of the Wu–Yau Theorem (part 1); Australian Geometric PDE Seminar.
- April 1, 2022 – A Kähler–Ricci flow proof of the Wu–Yau Theorem (part 2); Australian Geometric PDE Seminar.
- June 1, 2022 – Recent developments concerning the Bochner technique in the Hermitian category; Beijing International Center for Mathematical Research.
- June 8, 2022 – Recent developments concerning the Bochner technique in the Hermitian category; Monash University.

- November 1, 2022 – Curvature and Moduli – Some Intimations and Propaganda; University of Queensland.
- November 25, 2022 – Curvature and Moduli – Some Intimations and Propaganda; Australian Geometric PDE Seminar.
- March 3, 2023 – Curvature Aspects of Hyperbolicity in Complex geometry – Differential Geometry Days at UQ; The University of Queensland.
- May 17, 2023 – Complex Manifolds of Hyperbolic and Non-Hyperbolic-Type; The University of Adelaide.
- May 18, 2023 – Curvature Aspects of Hyperbolicity in Complex Geometry; The University of Adelaide.
- June 3, 2023 – Recent Developments on the Schwarz Lemma; The University of Rome Tor Vergata.
- June 5, 2023 – Curvature Aspects of Hyperbolicity in Complex Geometry; Complex Analysis, Geometry, and Dynamics – Portorož 2023.

## zbMath Reviews

1. Fino, A., Grantcharov, G., Vezzoni, L., Solutions to the Hull-Strominger system with torus symmetry, *Commun. Math. Phys.* 388, 947-967 (2021). <https://zbmath.org/?q=an:07425781>
2. Dajczer, M.; Onti, C.-R.; Vlachos, Th., A class of Einstein submanifolds of Euclidean space, *J. Geom. Anal.* 32, Paper No. 64, 20 p. (2022). <https://zbmath.org/?q=an:07472148>
3. Foscolo, L., Haskins, M., Nordström, J., Complete noncompact  $G_2$ -manifolds from asymptotically conical Calabi-Yau 3-folds, *Duke Math. J.* 170, 3323-3416 (2021). <https://zbmath.org/?q=an:07442556>
4. Alonso, I., Salvatore, F., On the existence of balanced metrics on six-manifolds of cohomogeneity one, *Ann. of Global Anal. and Geom.* (2022), 61:309–331. <https://zbmath.org/?q=an:07491580>
5. Mondello, I., Mondino, A., Perales, R., An upper bound on the revised first Betti number and a torus stability result for RCD spaces, *Comment. Math. Helv.* 97, 555–609 (2022). <https://zbmath.org/?q=an:07574048>
6. Anella, F., Huybrechts, D., Effectivity of semi-positive line bundles, *Milan J. Math.* 90, pp. 389–401 (2022). <https://zbmath.org/?q=an:07626078>
7. Belegradek, I., Index theory and deformations of open nonnegatively curved manifolds, *J. Diff. Geom.* 122, pp. 185–203 (2022).

## Lecturing

I have lectured the following courses:

- (2022 Sem1, ANU). MATH2305 – Advanced Vector Calculus and Differential Equations. Weeks 1–6. My lecture notes are [available here](#). Teaching evaluations for this course and lessons I learned from lecturing this course are [available here](#).
- (2023 Sem1, UQ). MATH4408 – Measure Theory. Week 2. My lecture notes are [available here](#).
- (2023 Sem2, UQ). MATH3405 – Differential Geometry. Weeks 1–3.
- (2023 Sem2, UQ). MATH4407 – Advanced Ordinary and Partial Differential Equations. Weeks 7–12.

## Course Development

I developed the MATH2305 – Advanced Vector Calculus and Differential Equations course in Semester 1 of 2022 at the Australian National University.

## Tutoring

I have been a tutor/teaching assistant for the following courses:

- (2018 Sem1, ANU). MATH1013 – *Mathematics and Applications 1*.
- (2018 Sem2, ANU). MATH1014 – *Mathematics and Applications 2*.
- (2019 Sem2, USYD). MATH1014 – *Introduction to Linear Algebra*.
- (2020 Sem1, USYD). MATH1021 – *Calculus of one variable*.
- (2020 Sem1, USYD). MATH2021 – *Vector Calculus and Differential Equations*.
- (2020 Sem2, USYD). MATH1023 – *Multivariable Calculus and Modelling*.
- (2021 Sem1, USYD). MATH1011 – *Applications of Calculus*.
- (2021 Sem1, USYD). MATH1111 – *Introduction to Calculus*.
- (2021 Sem1, USYD). MATH2021 – *Vector Calculus and Differential Equations*.
- (2021 Sem1, USYD). PHAR1821 – *Pharmacy Practice 1*.
- (2021 Sem2, USYD). MATH1023 – *Multivariable Calculus and Modelling*.
- (2022 Sem2, USYD). MATH1023 – *Multivariable Calculus and Modelling*.

## MathSciNet Reviews

1. Suh, Young Jin, Fischer-Marsden conjecture on real hypersurfaces in the complex hyperbolic two-plane Grassmannians, *Anal. Math. Phys.* 12 (2022), no. 5, Paper No. 126, 45 pp.
2. Yu, Weike, Tamed exhaustion functions and Schwarz type lemmas for almost Hermitian manifolds, *Bull. Korean Math. Soc.* 59 (2022), no. 6, 1423–1438
3. To, Tat Dat, Degenerate J-flow on compact Kähler manifolds. *Math. Z.* 303 (2023), no. 4.

## Other Academic Activities

- I completed the AMSI winter school in the mathematical sciences on curvature (2–13 July 2018, The University of Queensland). This involved completing postgraduate courses in: Curvature in Conformal Geometry; Curvature Flow of Networks; Comparison Geometry; Heat Flow and Geometry.
- In semester 2 of 2018 I helped organize a graduate reading group in complex differential geometry at the Australian National University.
- From November 2018 to January 2019 I helped in the organization of a graduate reading group in geometric measure theory at the Australian National University.
- I have a reasonably successful math YouTube channel ( $\sim 8300$  subscribers): <https://www.youtube.com/channel/UckDicHMdLaJQ30Ily7B6wug>
- To help in the transition to online learning during the beginning of the pandemic, I was tasked by Jonathan Spreer to help tutors get acquainted with the *Ed forum*. This is an online forum that was used by the University of Sydney to facilitate communication between students, tutors, and lecturers.

**Research  
References**

- **Benjamin Andrews**, the Australian National University.  
Em: Ben.Andrews@anu.edu.au
- **Gang Tian**, Princeton University, Beijing University.  
Em: gtian@math.pku.edu.cn
- **Peter Petersen**, University of California Los Angeles.  
Em: petersen@math.ucla.edu
- **Fangyang Zheng**, Chongqing Normal University  
Em: 20190045@cqnu.edu.cn

**Teaching  
Reference**

- **Lilia Ferrario**, the Australian National University.  
Em: Lilia.Ferrario@anu.edu.au