Department of Mathematics
Stanford University
Stanford, CA 94305
bvchurch@stanford.edu
web.stanford.edu/~bvchurch
github.com/benvchurch
+1-914-839-0323

Benjamin V. Church

PhD Candidate, Mathematics, Stanford University

EDUCATION

Stanford University
Ph.D. in Mathematics   *2021 - Present*
Advisor: Ravi Vakil

Columbia University
B.A. in Mathematics and Physics with Honors, Summa Cum Laude   *2016 - 2020*
GPA: 4.13 (Overall)

RESEARCH INTERESTS

Algebraic geometry, with a focus on birational geometry and arithmetic geometry in positive characteristic. Algebraic topology. Astrophysics and particle cosmology.

PUBLICATIONS

Church, B. V., Mocz, P., & Ostriker, J. P. (2019). Heating of milky way disc stars by dark matter fluctuations in cold dark matter and fuzzy dark matter paradigms. Monthly Notices of the Royal Astronomical Society, 485(2), 2861–2876. https://doi.org/10.1093/mnras/stz534

Church, B. V., Williams, H. T., & Mar, J. C. (2019). Investigating skewness to understand gene expression heterogeneity in large patient cohorts. BMC Bioinformatics, 20(S24). https://doi.org/10.1186/s12859-019-3252-0

AWARDS

John Dash van Buren, Jr. Prize in Mathematics, Columbia University	*2020*
Departmental Honors – Mathematics, Physics, Columbia University	*2020*
Phi Beta Kappa Junior Inductee	*2019*
MIT Battlecode AI Competition Finalist	*2017*
Science Research Fellow – Columbia University	*2016 - 2020*

RESEARCH PROJECTS

Ongoing research projects include:

Rational Curves on Supersingular Surfaces
Using foliations to produce rational curves on certain supersingular surfaces over finite fields. Forming elliptic surfaces (birationally) as quotients of supersingular surfaces to produce elliptic curves over function fields of large rank.

Real Bott Periodicity in Algebraic Geometry
Defining a new Bott periodicity homotopy equivalence between suitably defined algebraic classifying stacks of Clifford modules.

PAST PROJECTS

Curves on Toric Surfaces and Regular Models
Supervisor: Prof. Johan de Jong, Columbia University   *2020*

Studied obstructions to embedding smooth curves on toric surfaces and applicability of the method of Tim Dokchitser for constructing regular models of curves via toric embeddings. Gave explicit examples of curves which fail these critera.

REU on Toric Geometry and Convex Analysis
Supervisor: Prof. Huayi Chen, Paris Diderot University   *Summer 2019*

Coursework on inequalities in convex geometry and their relation to intersection counting problems for line bundles on toric varieties. Estimated lower bounds for special cases of the Monge-

Kantorovich transport problem on rational polytopes.

Higher-Spin Gravity in de Sitter Space
Supervisor: Prof. Frederik Denef, Columbia University   *2018 - 2019*

Computed de Sitter space thermodynamic partition function via group character formulae for irreducible spin-representations of the de Sitter space isometry group $SO(1, d+1)$.

REU on Surfaces over Finite Fields
Supervisor: Prof. Daniel Litt and Prof. Alex Perry, Columbia University   *Summer 2018*

Implemented algorithms to efficiently compute the zeta functions and numerical invariants of diagonal hypersurfaces in weighted-projective space over finite fields. Constructed an infinite family of irrational supersingular diagonal hypersurfaces whose minimal covering Fermat surface is not supersingular.

Heating from Ultra-Light Bosonic Dark Matter
Supervisor: Prof. J. P. Ostriker, Columbia University   *Summer 2018*

Used heating from gravitational fluctuations produced by standing wave "soliton" distributions of bosonic dark matter to compute the time-evolution of stellar disc structure and temperature. Set a lower bound on the mass of the ultra-light boson conjectured to comprise dark matter using observations of the Milky Way disc thickness and heating profile.

TEACHING

Graduate Teaching Assistant: MATH145 Algebraic Geometry
Stanford University
Instructor: Prof. Hunter Spink   *Spring 2022*
Taught students in office hours and graded problem sets.

Graduate Teaching Assistant: MATH56 Proofs and Modern Mathematics
Stanford University
Instructor: Prof. András Vasy   *Autumn 2021*
Taught students in office hours and graded problem sets.

Counselor at Ross Mathematics Program
Instructor: Prof. Daniel Shapiro   *Summer 2020*
Guided students through number theory coursework and graded assignments.

Teaching Assistant: Accelerated Physics
Columbia University
Instructor: Prof. Brian Cole   *2017 - 2018 and 2018 - 2019*
Taught weekly recitations and graded problem sets.

SERVICE

Co-organizer for the student algebraic geometry seminar   *2021-2022*
Topics: method of Deligne-Illusie (Autumn 2021), bend and break (Winter 2022), variations of Hodge structures (Spring 2022)
Directed Reading Program Mentor   *2021*
Mentored an undergraduate reading *Model Theory: an Introduction* by David Marker
President, Columbia Society of Physics Students   *2019 - 2020*
Organized talks, educational outreach, and mentorship opportunities.
Board Member, Columbia Undergraduate Mathematics Society   *2019 - 2020*
Organized talks, help sessions for new students, and teaching materials.

SKILLS

Programming Languages: C/C++, Python, LaTeX, Sage