Alexander B. Atanasov

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Education

Harvard University
PhD. Theoretical Physics, 2018 – present.

Yale University
M.S. Mathematics, B.S. Mathematics, B.S. Physics 2018.
Honors: Phi Beta Kappa, *magna cum laude*, distinction in the majors.
GPA: Physics 3.97; Mathematics 4.00; Total 3.92
- Advisors: David Poland (Physics), Philsang Yoo (Mathematics)
- Thesis: "Magnetic Monopoles, 't Hooft Lines, and Geometric Langlands"

Thomas Jefferson High School for Science and Technology
Concentration in Optics and Modern Physics, 2014.
GPA: 3.92 unweighted

Publications

5. A.B. Atanasov, A.J. Hillman, and D. Poland. *Bootstrapping the Minimal 3D SCFT*. July 2018. (arXiv:1807.05702)

4. A.B. Atanasov and E. Schnetter. *Sparse Grid Discretizations based on a Discontinuous Galerkin Method*. October 2017. (arXiv:1710.09356)

3. A.B. Atanasov and J.C. Ellenbogen. *Simple, accurate electrostatics based formulas for calculating ionization potentials, electron affinities, and capacitances of fullerenes.* Phys. Rev A95. March 2017.

2. A.B. Atanasov and Erik Schnetter. *GalerkinSparseGrids.jl: A Module for Sparse Grid Discretization using Discontinuous Galerkin Bases.* github.com/ABAtanasov/GalerkinSparseGrids.jl. August 2016.

1. A.B. Atanasov. *Complex Analysis: In Dialogue & Appendix of Color Plots.* CreateSpace Publishing. October 2013. (Amazon)
   A book written in high school, teaching complex analysis via Socratic dialogue.

Research

Undergraduate Researcher: 3D Conformal Bootstrap and the Ising Model
Yale Dept. of Physics – Supervised by Prof. David Poland
August 2016 - Present

- Developed a module to perform numerical investigations on 3D conformal field theories (CFTs) sharing similar operator structures to the 3D Ising model.

- Excluded a large portion of previously unexplored potential CFTs using a technique called θ-scan. Found new numerical bounds for the $\mathcal{N} = 1$ supersymmetric Ising CFT. Published results.

- Supplemented by directed reading on topics in three-dimensional CFT and relationship to 3D quantum field theories.

Software Engineering Intern: Machine Learning and Computer Vision
Google Inc. – Supervised by Dr. Nhat Vu
Summer 2017

- Worked to port TensorFlow models onto embedded devices for real-time face detection and recognition, achieving a 6x speedup in run-through time for inference from the start of the project without loss in accuracy.
- Presented results to Hiroshi Lockheimer and the mobile machine vision teams.

Visiting Researcher: Sparse Grid Discretization for Relativistic Astrophysics
Perimeter Institute for Theoretical Physics – Supervised by Dr. Erik Schnetter
Summer of 2016, Winter of 2016-2017

- One of seven students selected internationally to participate in Perimeter's undergraduate program.
- Studied numerical solutions to Einstein's equations and Galerkin methods in hyperbolic differential equations.
- Designed and implemented a sparse-grid based solver for hyperbolic equations, decreasing cost at resolution N in d-dimensions from $O(N^d)$ to $O(N \log^{d-1} N)$. Successfully evolved a wave equation in $6 + 1$ dimensions with high accuracy and low memory requirements. Paper submitted for publication.
- Organized 10 meetings of weekly undergraduate lecture seminar. Presented two lectures on complex and algebraic geometry in physics.
- Engaged high schoolers in the ISSYP program as a lecturer and guest mentor.

Undergraduate Researcher: Dynamical Models of Recurrent Neural Networks
Yale School of Medicine, Dept. of Psychiatry N3 Division – Under Dr. John Murray
January 2016 - Present

- Built TensorFlow-based package for modeling neural dynamics in various cognitive tasks.
- Used CUDA, the Yale computing cluster, and tools in high-dimensional data science to generate results for upcoming publication.

Multi-scale Modeling of Carbon Nanomaterials
MITRE Corporation Student Program – Supervised by Dr. James Ellenbogen
Summer of 2014 & 2015. Winter of 2014-2015 & 2015-2016

- Studied techniques in quantum chemistry and density functional theory.
- Developed electrostatic model with quantum modification from symmetry breaking to account for the scaling regularity of the capacitance trends of certain carbon nanostructures. Published results.

SEAP Program: Plasma Cloud Generation using Cavity Resonators
Naval Research Laboratory – Supervised by Dr. Paul Bernhardt
Summer of 2013

- Studied electromagnetic wave equations and impedance in transmission lines, cavity resonators, and waveguides. Built voltage amplifier and tuned impedance to generate plasma clouds in confined region.

Conferences Attended	**"Conformal Bootstrap Workshop and Summer School 2018"** Caltech, Pasadena CA, June 2-14 2018 **"Gauge Theory, Geometric Langlands, and Vertex Operator Algebras"** Perimeter Institute, Waterloo ON, March 21-25 2018
Talks	**The Geometric Satake Correspondence in Physics** *Seminar on the Langlands Program, Mar. 2017* (notes: [1][2]) **Conformal Field Theories beyond Two Dimensions** *Yale Graduate Representation Theory Seminar, Nov. 2017* (notes) **2D Conformal Field Theory and Lattice Models of BPZ** *Seminar: Topics in Conformal Field Theory for Prof. David Poland, Dec. 2016* (notes) **Instantons on R^4, Nakajima Quiver Varieties, and the Heisenberg Algebra** *Seminar: Topics in Representation Theory for Prof. Igor Frenkel, Nov. 2016* (notes: [0][1][2]) **6j-symbols and the Tetrahedron** *Seminar in Modern Algebra for Prof. You Qi, Apr. 2016* (notes) **Phase Transitions in Graphs and the Margulis-Russo Theorem** *Seminar in Modern Combinatorics under Prof. Van Vu, Dec. 2015*
Teaching	**Guest Mentor and Lecturer** *Bulgaria HSSIMI Summer Research School, 2018* • Presented lectures on Hamiltonian mechanics, symplectic geometry, and the beginnings of quantum mechanics. **Grader and TA, Computer Science Department** *Yale University* • Deep Learning Theory and Applications, Spring 2018 **Grader and TA, Mathematics Department** *Yale University* • Representation Theory, Spring 2018 • Intro. to Complex Analysis, Fall 2016 & Fall 2017 • Vector Analysis on Manifolds, Spring 2017 & Spring 2017 • Intro. to Abstract Algebra, Fall 2015 **Guest Mentor and Lecturer** *Perimeter International Summer School for Young Physicists, 2016* • Presented lecture on *Covariance, Contravariance, Manifolds, and their Flows* for high school audience (lecture video here).
Awards and Fellowships	**Phi Beta Kappa** 2018, for academic performance at Yale University **Howard L. Schultz Prize** 2018, awarded to outstanding senior in the Yale physics department **Yale College Mellon Fellowship** 2018, towards participating in an international colloquium on the geometric Langlands program in physics for senior thesis research **Yale Morse College Richter Fellowship** 2016, towards international study at the Perimeter Institute **Yale Dean's Research Fellowship** 2016, towards research in computational neuroscience

William L. Putnam Mathematics Competition Top 300
2016, 2018
U.S.A. Physics Olympiad Semifinalist
2013

Languages
and Skills

English (native), Bulgarian (native), Latin (proficient)
Programming Languages (most to least proficient):
    Python, Mathematica, Julia, C, C++, Java, Matlab/Octave, HTML, Excel, R
Parallel and High-Performance Computing Tools:
    TensorFlow, OpenMP, MPI, CUDA, Julia Toolkit
Strong background in tutoring, public speaking, and academic lecturing.
Last but not least, LaTeX.

References

James Ellenbogen
Nanosystems Group
MITRE Corporation
ellenbgn@mitre.org

David Poland
Theory Group, Dept. of Physics
Yale University
david.poland@yale.edu

Erik Schnetter
Strong Gravity Group
Perimeter Institute
eschnetter@perimeterinstitute.ca

John Murray
Dept. of Psychiatry N3 Division
Yale School of Medicine
john.murray@yale.edu

Philsang Yoo
Dept. of Mathematics
Yale University
philsang.yoo@yale.edu