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 Superconformal Field Theory.* J. High Energy Physics. Nov 2018. (arXiv:1807.05702).
Work presented at Princeton's Hamilton Colloquium series and at the Simons Conformal Bootstrap Collaboration 2018 annual meeting.

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

3. A.B. Atanasov and J.C. Ellenbogen. *Simple, accurate electrostatics based formulas for calculating electron detachment energies 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.* 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.

Works in Progress:

***** A.B. Atanasov. *Representations of the Physical Universe.* Expected: Spring 2019. [link]
Intro to mathematical physics, based off lectures given at past summer schools.

Research

Undergraduate Researcher: 3D Conformal Field Theory and the Ising Model
Yale Dept. of Physics – Supervised by Prof. David Poland
August 2016 - July 2018

- Developed a module to perform numerical investigations on the parameter space of 3D conformal field theories (CFTs) with structures similar to the critical Ising model.
- Used new techniques to exclude a large, previously unexplored region of this space. Obtained new bounds for the structure of the 3D supersymmetric Ising CFT.

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 without loss in accuracy.
- Presented to Chrome/Android VP Hiroshi Lockheimer and the 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, Summer of 2018

- 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.

- Developed a sparse-grid based solver for these 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.
- Extended this to nonlinear settings over 2018. Preparing paper for publication.

Undergraduate Researcher: Dynamical Models of Recurrent Neural Networks
Yale School of Medicine, Dept. of Psychiatry N3 Division – Under Dr. John Murray
January 2016 - May 2018

- 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

- Developed and published electrostatic model with quantum modification from symmetry breaking explaining the capacitance trends of certain carbon nanostructures.

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.

Awards and Fellowships

Fannie and John Hertz Fellowship – 2019
One of 11 chosen from 850 to receive full graduate funding for 5 years

National Defense Science and Engineering Graduate Fellowship (NDSEG) – 2019
One of 200 chosen from 3,000 to receive full graduate funding for 3 years

National Science Foundation Graduate Research Fellowship – 2019 (declined)
One of 2,000 chosen from 12,000 to receive graduate funding for 3 years

J.M. Pierce Fellowship– 2018
Full support for first year graduate study at Harvard University

Phi Beta Kappa – 2018
For outstanding academic performance at Yale University

Howard L. Schultz Prize – 2018
To an outstanding senior in the Yale physics department

Yale Mellon Fellowship – 2018
For attend conference on gauge theory for senior thesis work

Morse College Richter Fellowship – 2016
Towards summer research at the Perimeter Institute

Yale Dean's Research Fellowship – 2016
Towards research in computational neuroscience at Yale

William L. Putnam Mathematics Competition, Top 300 – 2016, 2018

U.S.A. Physics Olympiad Semifinalist – 2013

Conferences Attended

"CFT Perspectives on Thermalization and Chaos"
Princeton Center for Theoretical Science, Princeton NJ, March 14-16

"Conformal Bootstrap Program Annual Meeting 2018"
Simons Foundation, New York City NY, Nov 8-9 2018.

"Entanglement, Chaos, and Complexity in Field Theory and Gravity"
CUNY, New York City NY, Oct 26 2018.

"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

Introduction to Topological Quantum Field Theory
Harvard University Graduate Seminar, Sep. 2018
The Geometric Satake Correspondence in Physics
Seminar on the Langlands Program, Mar. 2018 (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 $\mathbf{R}^4$, Nakajima Quiver Varieties, and the Heisenberg Algebra
Seminar: Topics in Representation Theory for Prof. Igor Frenkel, Nov. 2016 (notes: [0][1][2])
6-j Symbols and the Tetrahedron
Seminar in Modern Algebra for Prof. You Qi, Apr. 2016 (notes)

Teaching

Mentor and Lecturer – *Bulgaria HSSIMI Summer Research School, 2018*
Presented lectures on Hamiltonian mechanics as motivation for early quantum mechanics
Grader and TA, Mathematics and CS Departments – *Yale University*
Representation Theory (Spring 2018), Complex Analysis (Fall 2016, Fall 17), Vector Analysis on Manifolds (Spring 2017, Fall 2017), Intro. to Abstract Algebra (Fall 2015), Deep Learning Theory and Applications (Spring 2018)
Mentor and Guest Lecturer – *International Summer School for Young Physicists, 2016*
Presented lecture on *Manifolds, and their Flows* for high school audience (lecture video).

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.