Noah L. Donald, Ph.D.

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U.S. Citizen | Eligible for security clearance

Date available to begin work: August 15th, 2025

SUMMARY STATEMENT

Researcher with extensive experience developing and computationally implementing theoretical models to solve complex problems. Experience with Python, C++, Mathematica, and Excel for data analysis, algorithm development, and modeling. Strong track record in applying numerical methods, statistical analysis, and optimization techniques. Proven ability to learn new topics and work independently. Adept at collaborating with cross-functional teams, managing multiple priorities, and communicating results.

PROFESSIONAL SKILLS

Computational	Python, C++, Mathematica, LaTeX, Excel.
Analytical	Quantum Field Theory, General Relativity, Model Building, Probability Theory, Optimization, Statistical Analysis, Numerical Modeling, Abstract Algebra, Graph Theory.
Technical	Basic laboratory experience in both an academic and research setting.
Personal	Collaboration, Communication, Time Management, Organization, Scientific Writing.
Language	English (Native), German (Intermediate).

PROFESSIONAL WORK EXPERIENCE

Graduate Student Researcher, August 2020 – May 2025
William and Mary, Williamsburg, VA
Job Type: 30 hours per week, Full-Time
Supervisor: Prof. Christopher D. Carone, (757) 221-2451

I worked on several different projects in the domain of high energy theory during my time as a researcher. Generally, each of these projects involved model building and quantum field theory to construct an extension of the standard model which solves one of the many complex problems facing theoretical physics. I would then code the model in either Mathematica, Python, or C++ to conduct tedious calculations and extract predictions. I would then report these results in a journal publication using LaTeX. All of this was done in close partnership with my advisor and other group collaborators. Presented below are brief abstracts for each of the projects which resulted in a publication, my role in the project, and the skills used during the project:

PROJECT: It has recently been suggested that tuning towards the boundary of the positivity domain of the scalar potential may explain the separation between the electroweak scale and the unification scale in a grand unified theory. My advisor and I explored the possibility that the same type of tuning might account for the generation of the electroweak scale from a much lighter dynamically generated scale in a dark sector. We then presented a model that realizes this idea and provides a proof of principle that the same dark sector can include a viable dark matter candidate. For this project, I assisted in theoretical model building and utilized Mathematica to encode the physics in the scalar sector at tree-level and one loop order in perturbation theory. I also used FeynCalc software in Mathematica to simplify complex algebraic expressions in quantum field theory.

PROJECT: My advisor and I proposed an ansatz for encoding the physics of non-local spacetime defects in the Green's functions for a scalar field theory defined on a causal set. This allowed us to numerically study the effects of nonlocal spacetime defects on the discrete Feynman propagator of the theory defined on the causal set in 1+1 dimensions, and to compare to the defect-free limit. The latter approached the expected continuum result, on average, when the number of points becomes large. When defects were present, two points with the same invariant spacetime interval could have different propagation amplitudes, depending on whether the propagation is between two ordinary spacetime points, two defects, or a defect and an ordinary point. We showed that a coarse-grained description that is only sensitive to the average effect of the defects could be interpreted as a defect-induced mass and wave-

function renormalization of the scalar theory. For this project, I assisted in proposing different models of the defects and how particle propagation ought to be interpreted. I used Mathematica and Python to simulate how spacetime points and defects are Poisson distributed and how particles could propagate in this causal set.

PROJECT: My advisor and I considered the inclusion of TeV-scale, fermionic dark matter in an asymptotically safe model of a gauged baryon number that was been previously proposed [Phys. Rev. D 106, 035015 (2022)]. The new gauge boson served as a portal between the dark and the visible sectors. The range of the baryon number gauge coupling and the kinetic mixing between baryon number and hypercharge were constrained by the requirement that nontrivial ultraviolet fixed points were reached. We showed that this asymptotically safe dark matter model could achieve the correct dark matter relic density while remaining consistent with direct detection bounds. For this project, I assisted with theoretical model building. I also used C++ software called PYR@TE3 to generate renormalization group equations for the model and then I used Mathematica and Python for the data analysis. Additionally, I used FeynCalc software in Mathematica to evaluate complex expressions in quantum field theory.

PROJECT: My advisor and I considered a model with gauged baryon number that could be rendered asymptotically safe when gravitational effects above the Planck scale were taken into account. We studied the ultraviolet fixed points in this theory and determined the restrictions on the parameter space of the model at the TeV scale following from the requirement that the asymptotic fixed points were reached. Assuming that the new gauge symmetry is broken at the TeV scale, we then commented on the phenomenological implications of these restrictions. For this project, I assisted with theoretical model building. I also used C++ software called PYR@TE3 to generate renormalization group equations for the model and then I used Mathematica and Python for the data analysis. Additionally, I used FeynCalc software in Mathematica to evaluate complex expressions in quantum field theory.

OTHER WORK EXPERIENCE

Teaching Assistant, August 2020 – May 2022, August 2024 – May 2025
William and Mary, Williamsburg, VA
Job Type: 15 hours per week, Full-Time
Supervisor: Dr. Bjorg Larson, (757) 221-1667

I worked as a teaching assistant (TA) for one of several different professors in the physics department depending on the semester. Below I will outline my role as a teaching assistant for each of the courses:

For four semesters, I worked as a laboratory TA for an introductory physics course. This course taught basic concepts in classical mechanics, thermodynamics, and electricity/magnetism. I would construct short weekly lectures to remind the students of core principles covered in lecture, take attendance, give quizzes, oversee student lab work, and grade weekly lab reports.

For one semester, I served as the grader for a graduate level mathematical physics course. This course covered the mathematical background primarily used to formulate key concepts in theoretical physics. I graded homework assignments which were submitted bi-weekly.

For one semester, I served as the grader for an undergraduate level astronomy course. This course taught the foundational topics in modern astronomy with a focus on historical developments and observational techniques. In this role, I graded both homework assignments, midterms, and student essays. I also held weekly office hours.

EDUCATION

Doctor of Philosophy in Physics, May 2025
William and Mary, Williamsburg, VA, GPA 3.92

Master of Science in Physics, May 2022
William and Mary, Williamsburg, VA, GPA 3.92

Bachelor of Science in Physics, May 2020
Ohio State University, Columbus, OH, GPA 3.742
Magna Cum Laude, Honors

Bachelor of Science in Mathematics, May 2020
Ohio State University, Columbus, OH, GPA 3.742
Magna Cum Laude, Honors

RELEVANT COURSEWORK

William and Mary, August 2020 – May 2023
Quantum Field Theory (2 semesters), Quantum mechanics (2 semesters), Electricity & Magnetism (2 semesters), General Relativity, Mathematical Physics, Statistical Mechanics, Classical Mechanics, Standard Model, Nonlinear & Quantum Optics, Differential Geometry for Physics, Teaching Physics.

Ohio State University, August 2016 – May 2020
Honors Probability Theory, Honors Combinatorics, Honors Abstract Algebra (2 semesters), Honors Analysis (2 semesters), Computational Physics, Introduction to C++, Linear Algebra & Differential Equations, Differential Geometry, Advanced Physics Lab, Experimental Physics and Instrumentation Lab, Theoretical Mechanics, Microeconomics.

AWARDS & ACHIEVEMENTS

Roy L. Champion Award, October 2024
William and Mary Department of Physics, Williamsburg, VA
This award is offered annually to a continuing physics graduate student who has demonstrated outstanding research achievement.

DAAD RISE Fellowship, June 2018
DAAD, Bonn, Germany
I was selected from a national pool of applicants to conduct research for three months at a German university. I worked on an ultra-high vacuum chamber to collect atomic level data regarding the surface structure and composition of various crystallin substrates in Prof. Michael Farle's experimental physics group at the University of Duisburg-Essen.

Germany for STEM Students, December 2015
Goethe Institute, Chicago, IL
I engineered a water filtration device that could be used in third-world countries and submitted my project to the Goethe Institute. After being reviewed by a panel of experts, my project was selected out of a national pool of applicants, and I was awarded a weeklong experience exploring scientific institutions in Germany.

JOURNAL PUBLICATIONS:

C.D. Carone and N.L. Donald, "Tuning towards the edge of a dark abyss: Implications of a tuning paradigm on the hierarchy between the weak and dark scales", Phys. Rev. D 111, no. 3, 035021 (2025), arXiv:2412.04609 [hep-ph].

C.D. Carone and N.L. Donald, "Towards a quantum field theory description of nonlocal spacetime defects", Class. Quantum Grav. 41, 095003 (2024), arXiv:2310.04319 [gr-qc].

J. Boos, C.D. Carone, N.L. Donald, and M.R. Musser, "Asymptotically safe dark matter with gauged baryon number," Phys. Rev. D 107, no. 3, 035018 (2023), arXiv:2209.14268v2 [hep-ph].

J. Boos, C.D. Carone, N.L. Donald, and M.R. Musser, "Asymptotic safety and gauged baryon number," Phys. Rev. D 106, no. 3, 035015 (2022), arXiv:2206.02686 [hep-ph].