Jacob A. Carroll
Curriculum Vitae

2887 Walls Branch Road
Blacksburg, Virginia 24060
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EDUCATION

Doctor of Philosophy, Physics — Expected May 2019
Virginia Tech, Blacksburg, VA

Master of Science, Physics — May 2016
Virginia Tech, Blacksburg, VA

Bachelor of Science, Physics — December 2014
Virginia Tech, Blacksburg, VA

Bachelor of Science, Mathematics — December 2014
Virginia Tech, Blacksburg, VA

TECHNICAL SKILLS

Programming Languages:	C++, Python, R, JavaScript, OpenMP, MPI, OpenCV, OpenGL, Mathematica, Octave/MatLab, LaTeX, MySQL
Software:	PetaVision, SVN, git, Microsoft Office
Computational Methods:	K-means clustering; DBSCAN; Monte Carlo methods; Feed forward, Convolutional and SOM neural networks
HPC Systems:	Blue Waters (Cray XK6, XK7), SLURM, MOAB
Operating Systems:	Unix/Linux, Microsoft Windows, macOS

RESEARCH EXPERIENCE

Los Alamos National Lab, Parallel Computing Summer Research Internship — Summer 2017
Research Intern

- Designed and programmed highly parallelized convolutional neural networks using the C++ neural network package PetaVision on the IBM Power8 CPU and Tesla P100 GPU for the purpose of creating sparse reconstructions of images.
- Analysed the sparse structure of these neural networks and identified a phase transition at a critical value of sparsity that allowed us to optimize the performance of these neural networks for any number of neurons.

Virginia Tech, Center for Soft Matter and Biological Physics — Spring 2015 - Present
Graduate Researcher

- Programmed C++ neural network software to analyze the learning dynamics of recurrent Hebbian networks, and explored how the global activity of these networks reacts to perturbations of individual neurons.
- Analyzed the dynamics of ligand receptor bonds in surface plasmon resonance cells using Monte Carlo methods, and highlighted the failings of a mean field analysis.

Virginia Tech, Department of Physics — Spring 2015 - Present
Graduate Teaching Assistant

- Directed undergraduates through physics experiments designed to convey an in depth understanding of elementary physics concepts.
- Mentored undergraduate students and provided individual tutoring and assistance as needed to help reinforce key concepts of physics from an introductory to graduate level.

Virginia Tech, Department of Physics Fall 2013 - Fall 2014
Undergraduate Research Assistant

- Located and integrated applicable theorems into a newly proposed framework of quantum mechanics using research skills coupled with knowledge of high level mathematics.

PUBLICATIONS

(2016) **Carroll J.**, Raum M., Forsten-Williams K. and Täuber U. C. "Ligand-receptor binding kinetics in surface plasmon resonance cells: a Monte Carlo analysis." *Physical Biology* 13: 066010.

TALKS & PRESENTATIONS

Phase Transitions in Sparsely Coded Neural Networks (Talk and Poster)
Los Alamos National Laboratory, Computing Division of Student Symposium Summer 2017

Avalanches in Neural Networks (Poster)
Virginia Tech, Center for Soft Matter and Biological Physics Symposium Spring 2017

Ligand-Receptor Binding Kinetics in Surface Plasmon Resonance Cells: A Monte Carlo Analysis (Talk)
APS March Meeting & Virginia Tech, Second Molecular Biophysics Symposium Spring 2017

Ligand Binding Dynamics in Surface Plasmon Resonance Cells (Poster)
Virginia Tech, Center for Soft Matter and Biological Physics Symposium Spring 2016

An Introduction to Neural Networks (Talk)
Virginia Tech, Condensed Matter Theory Seminar Spring 2016

Binding kinetics of ligands in surface plasmon resonance cells (Talk)
APS March Meeting Spring 2016

Ligand binding kinetics in surface plasmon resonance devices: A Monte Carlo simulation analysis (Talk)
University of Virginia, Third Annual Virginia Soft Matter Workshop Fall 2015

HONORS & AWARDS

Award of Recognition for Best Poster Awarded Summer 2017
Los Alamos National Laboratory, Computing Division of Student Symposium

First Place Short Talk Award Awarded Spring 2017
Virginia Tech, Second Molecular Biophysics Symposium

Lubna R. Ijaz Scholarship Awarded Spring 2017
Physics Education Scholarship, Virginia Tech

Virginia Tech CSMB Student Travel Award Awarded Spring 2017
Graduate Physics Award, Virginia Tech

William E. Hassinger Graduate Fellowship Awarded Spring 2016
Graduate Physics Scholarship, Virginia Tech

SOCIETIES & ORGANIZATIONS

President:
Graduate Physics Students Society, Virginia Tech Summer 2015 - Present

Member:
Phi Beta Kappa, US National Honors Society Inducted Fall 2014
Sigma Pi Sigma, US National Physics Honors Society Inducted Spring 2014
Pi Mu Epsilon, US National Mathematics Honors Society Inducted Spring 2014
Phi Theta Kappa, US National Honors Society Inducted Spring 2012

VOLUNTEER WORK

Virginia Tech, Department of Physics Spring 2013 - Fall 2014
Student Representative

- Guided prospective students around the Virginia Tech campus, and provided them with information and advice on academic life as a physics major.

Virginia Tech, Department of Physics Fall 2012
Physics Outreach Demonstrator

- Set up and ran physics demonstrations for students in High Schools and Elementary Schools, while explaining the concepts behind the demonstrations and encouraging the students to interact the models and experiments.