Curriculum Vitae

Hannah Richards

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Education

August 2016—
May 2020

Degree: Bachelor of Science in Physics
Where: University of Alabama, Tuscaloosa, AL
GPA: 4.0 of 4.0
Summa cum laude
Minors in Linguistics and Mathematics

Research

February 2017—
August 2019

Project: Signal–Background Discrimination in EXO–200
Where: University of Alabama, Tuscaloosa, AL
Advisor: Igor Ostrovskiy
Contributions:

- I trained convolutional neural networks (CNNs) for recognizing neutrinoless double beta decay signals against background events. I found that they had higher accuracy than conventional methods, such as binary decision trees, in my preliminary results.

- I administered two Linux GPU computing servers. My duties included managing user accounts, data, hardware, and software on these systems.

- I worked on statistically interpreting an event-by-event classifier (e.g., a CNN) to calculate the sensitivity of the method and confidence intervals.

- I gained experience working with photomultiplier tubes and digitizers for a muon detection project.

May 2019—
July 2019

Project: Neutrino Physics REU
Where: Duke University, Durham, NC
Advisor: Kate Scholberg
Contributions:

- I searched for candidates for neutrino detector materials based on their charged–current interaction energy thresholds.

- I found two isotopes, ^{181}Ta and ^{160}Gd, that have desirable properties. I ran preliminary calculations for interaction cross sections and event rates, greenlighting further study.

May 2018— *August 2018*	**Project:** Experimental Nuclear Structure REU **Where:** Vanderbilt University, Nashville, TN **Advisor:** Joseph Hamilton **Contributions:**

- Using double and triple coincidence counting, I measured the frequency at which ^{252}Cf spontaneously fissions into certain isotopes. I performed these measurements for two separate element pairs: tellurium–palladium and strontium–neodymium.

- I tabulated my results into yields matrices, finding that the most common number of neutrons evaporated during these decays was 3 or 4, with immeasurably small yields above 5 neutrons. This is evidence that a previously studied case, that of barium–molybdenum, is unique since it has an unusually high probability of evaporating between 7 and 10 neutrons.

Teaching

January 2017— *December 2019*	**Position:** Learning Assistant **Where:** Department of Physics and Astronomy, University of Alabama

I worked as an undergraduate teaching assistant in introductory physics courses from the spring of my freshman year until my senior year. I assisted with labs, proctored exams, and presented extra credit problems for the classes.

Publications

- Brooks M. Musangu et al. "Anomalous neutron yields confirmed for Ba-Mo and newly observed for Ce-Zr from spontaneous fission of ^{252}Cf". In: *Phys. Rev. C* 101 (3 Mar. 2020), p. 034610. DOI: 10.1103/PhysRevC.101.034610. URL: https://link.aps.org/doi/10.1103/PhysRevC.101.034610

- Sébastien Delaquis et al. "Deep neural networks for energy and position reconstruction in EXO-200". In: *Journal of Instrumentation* 13.08 (Aug. 2018), P08023. URL: http://stacks.iop.org/1748-0221/13/i=08/a=P08023

Presentations

- T. H. Richards and Kate Scholberg. "Finding a Material with a Low Energy Threshold for Charged–Current Neutrino Interactions". In: *86th Annual Meeting of the Southeastern Section of the American Physical Society (SESAPS)*. Nov. 2019. URL: https://meetings.aps.org/Meeting/SES19/Session/D04.18

- T. H. Richards and Kate Scholberg. "Finding a Material with a Low Energy Threshold for Charged–Current Neutrino Interactions". In: *2019 Fall Meeting of the APS Division of Nuclear Physics*. Oct. 2019. URL: http://meetings.aps.org/Meeting/DNP19/Session/HA.117

- T. H. Richards. "Signal–Background Discrimination in EXO–200 with Deep Learning". In: *APS April Meeting 2019*. Vol. 64. 12. Apr. 2019. URL: https://meetings.aps.org/Meeting/APR19/Session/L10.8

- T. H. Richards et al. "Determining Yields of Fragment Pairs from the Spontaneous Fission of Californium–252". In: *5th Joint Meeting of the APS Division of Nuclear Physics and the Physical Society of Japan*. Vol. 63. 12. Oct. 2018. URL: http://meetings.aps.org/link/BAPS.2018.HAW.HA.74

Technical experience

Hardware
PMTs, digitizers, breadboarding

Software
TensorFlow/Keras, Linux shell, Python, LaTeX, C/C++, ROOT, Fortran
Winner of UA's Large Hadron Collider Machine Learning Hackathon (2019)

Honors and awards

- Goldwater Scholarship (2019)

- Outstanding First Year Physics Student (2017)

- Computer–Based Honors Program Fellowship (2016)

- University of Alabama Presidential Scholarship (2016)