

## Hannah Richards

Pronouns: she/her/hers

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### Education

*August 2016—  
Present*

**Degree:** Bachelor of Science in Physics  
**Where:** University of Alabama, Tuscaloosa, AL  
**GPA:** 4.0 of 4.0  
Expected graduation in May 2020  
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 performed slightly better 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 looked for candidates for neutrino detector materials based on their charged–current interaction energy thresholds.
- I found two isotopes,  $^{181}\text{Ta}$  and  $^{160}\text{Gd}$ , 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  $^{252}\text{Cf}$  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 at about 6+ 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 sometimes 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  $^{252}\text{Cf}$ ”. 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 (2018), P08023. URL: <http://stacks.iop.org/1748-0221/13/i=08/a=P08023>

**Presentations**

- Thomas 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>
- Thomas 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>

- Thomas 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>
- Thomas 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, L<sup>A</sup>T<sub>E</sub>X, 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)