

Zachary Bednarke

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EDUCATION

UNIVERSITY OF WASHINGTON

PHYSICS PHD STUDENT

9/2017 - Present

Seattle, WA

VANDERBILT UNIVERSITY

BACHELOR OF MUSIC

Trumpet Performance

Completed Spring 2017

Nashville, TN

MAJOR IN PHYSICS

Completed with Honors

Thesis: "Relativistic Beltrami Fields"

Thesis Adviser: T. W. Kephart

Major GPA: 3.93 / 4.00

LINKS

Github:// [Bednarke](#)LinkedIn:// [zbednarke](#)[VU Personal Website](#)

PUBLICITY

[MyVU article on me](#)

COMPUTING SKILLS

Python

C++

Java

Processing (3D Imaging)

EXPERIENCE

SYBBURE | SEARLE UNDERGRADUATE RESEARCH PROGRAM

May 2014 - May 2017 | Nashville, TN

- **SyBBURE** is a fully funded year-round research program embedded in VU's Department of Physics and Astronomy **VIIBRE**.
- All students perform their independent research under the guidance of faculty advisers
- SyBBURE organizes multidisciplinary programs in entrepreneurship, technology development, etc., to enrich students' exposure to the scientific world parallel to research.

SWYFT HEALTH | COFOUNDER

May 2015 - March 2016 | Nashville, TN

- **Swyft Health** integrated point of care diagnostics with cloud technology with the goal of moving data from the field to the lab as fast as possible.
- I worked on back-end development and have pitched Swyft Health to leaders of the TN Dept. of Health and members of the VU Institute for Global Health.

RESEARCH

NOURMOHAMMAD GROUP | GRADUATE RESEARCH ASSISTANT

December 2017 - Present | Göttingen, Germany

I work with **Armita Nourmohammad** to study information processing in rapidly evolving biological systems. I am interested in formulating and solving optimal control problems for these systems. Though the mathematical theory of stochastic control was developed in the 20th century, its connections to statistical physics and information theory are not yet understood. We are using the theoretical tools of physics to understand these connections and develop analytical and numerical methods that would allow researchers to compute and subsequently implement these protocols in the real world.

I-LABS MEG PHYSICS GROUP | GRADUATE RESEARCH ASSISTANT

December 2017 - Present | Seattle, WA

I work with **Samu Taulu** in the **UW Institute for Learning and Brain Sciences** to study the physics of magnetoencephalography (MEG). Our work centers on the challenge of inferring the mechanisms of learning in the brains of developing infants. To this end, I developed a **novel information-theoretic metric** to quantify the amount of true and false information yielded by a sensor array of arbitrary configuration perturbed by calibration errors. We are applying this to determine acceptable error bounds for current and next-generation magnetometer arrays.

VU PARTICLE AND FIELD THEORY GROUP | THESIS RESEARCH

October 2015 - April 2017 | Nashville, TN

I worked with **Thomas Kephart** and **Roman Buniy** to extend their generalization of the Beltrami equation to relativistic perfect fluids. Over the past year, I developed the Beltrami equation for Abelian fluids in the Minkowski spacetime. Our work generated novel questions regarding the role of gauge potentials in plasma physics.

VU HIGH ENERGY PHYSICS GROUP | UNDERGRADUATE RESEARCHER

April 2015 - August 2015 | Nashville, TN

I performed research under the guidance of **Alfredo Gurrola** and **VU JSWHEP** as a part of the CMS analysis effort during summer 2015. I worked on data analysis in the search for $Z' \rightarrow \tau\tau$ decays and participated in a week-long, on-site Fermilab tau lepton final state reconstruction workshop. My work has yielded two publications.

OTHER RESEARCH

DARPA CHALLENGE: RAPID THREAT ASSESSMENT | UNDERGRADUATE RESEARCHER

May 2015 – August 2015 & October 2016 - December 2016 | Nashville, TN

I performed research under the guidance of **Prof John Wikswo** in the VU systems biology institute **VIIBRE**. Our goal was to assign putative functionality to “orphan” genes in order to develop hypotheses regarding their roles in the mechanism of action of arbitrary biological entities. We coupled hierarchical clustering of high dimensional data with statistical analysis of the members of these clusters to identify the “orphan” genes with the most apparent functionality. This work is summarized in the resulting paper: [10.1021/acs.jproteome.6b01004](https://doi.org/10.1021/acs.jproteome.6b01004).

PUBLICATIONS & TALKS

- 2018 “Beltrami Flows in Relativistic Fluids”
Contributed talk: Shanks Workshop on Mathematical Aspects of Fluid Dynamics at Vanderbilt University
- 2016 “Search for heavy neutrinos or third-generation leptoquarks in final states with two hadronically decaying τ leptons and two jets in proton-proton collisions at $\sqrt{s} = 13$ TeV”
doi:10.1007/JHEP03(2017)077
- 2016 “Search for heavy resonances decaying to tau lepton pairs in proton-proton collisions at $\sqrt{s} = 13$ TeV”
doi:10.1007/JHEP02(2017)048

OTHER TRAINING

- 2018 The Beg Rohu Summer School: Deep Learning and Statistical Physics
Webpage
- 2017 ICTP Summer School on Particle Physics
Indico agenda
- 2016 Boston City Limits Summer School on the Geometric Analysis of Waves and Fluids
Webpage
- 2015 Fermilab Tau HATS
One week summer school hosted at Fermilab focusing on the reconstruction of events with τ lepton final states
Indico agenda

HONORS AND AWARDS

- 2017 Vanderbilt Underwood Memorial Award
- 2016 MIT Scholarship to **Summer School on Geom. Anal. of Waves and Fluids**
- 2016 National Sigma Pi Sigma Physics Honors Society
- 2013 Vanderbilt Dean’s Honor Scholarship
- 2013 Vanderbilt Academic Achievement Scholarship
- 2013 Vanderbilt Del Sawyer Trumpet Scholarship
- 2013 Wisconsin Wisconsin Academic Excellence Scholar
- 2013 National National AP Scholar
- 2013 National National Merit Scholar
- 2012 Wisconsin UW Full Tuition Music Scholarship Winner