

# DUSTON WETZEL

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## Research Interests

Nanoscale Physics, Nanotechnology, Spintronics, Magnetoresistance (MR), Thin Films and Heterostructures, Magnetism, Novel Quantum Materials, Metamaterials, 3D Helical Weaves, Wire-woven Cellular Metals

## Education

**Ph. D. Candidate, Applied Physics** | PhD student May 2021 – Present | Southern Illinois University | Carbondale, IL

- Advisor: Prof. Dipanjan Mazumdar
- Dissertation topic: Magnetotransport and Micromagnetic Properties of  $Mn_{3-x}Fe_xSn$  Thin Films and Heterostructures
- Current GPA: 3.8/4.0

**M.S. Physics** | May 2021 | Southern Illinois University | Carbondale, IL

- Advisor: Prof. Dipanjan Mazumdar
- Thesis title: "ROOM TEMPERATURE MAGNETORESISTANCE IN LARGE AREA  $Co/Bi_2Se_3$  BILAYERS"
- GPA: 3.8/4.0

**B.S. Nanoscience: Nanoscale Physics** | April 2017 | Northwest Missouri State University | Maryville, MO  
GPA: 3.6/4.0 | Honors Program Graduate

## Professional Experience

**Research Assistant** | April 2021 – present | SIU Department of Physics and Applied Physics | Carbondale, IL

- Primarily study magneto-transport in the Novel Materials and Heterostructures Laboratory (member since Fall 2018)

**Teaching Assistant** | January 2018 – April 2021 | SIU Department of Physics and Applied Physics | Carbondale, IL

- Taught 100 and 200 level physics introduction, mechanics, and electromagnetism laboratory courses

**Technology Support Assistant** | August 2013 – December 2015 | NWMSU, Maryville, MO

- Repaired student issued laptop hardware and gave technical assistance in university library

**GIS Digitizer** | December 2013 – August 2017 | Midland GIS Solutions, Maryville MO

- Digitized tax map dimensions and water, forest, and soil-type boundaries

**Aquatics Director/Staff Member** | Summers 2013-2016 | Camp Geiger, St. Joseph, MO

- 4 summers teaching swimming, boating, lifeguarding; 2 summers managing pool staff (8-10 people) and maintaining pool

## Research Experience

### Magneto-transport

- Designed, built, and automated three magneto-transport experimental setups (in-plane, out-of-plane, rotational)
- Regularly make 4-probe measurements with micropositioners (blanket, Van der Pauw, Hall bars)
- Experience with Physical Properties Measurement Systems and wire bonding

### Instrument Implementation and Automation

- Regularly develop LabVIEW VIs (Keithley, KEPCO, DATAQ, Stanford Research instruments)

### Thin Film Device Optimization

- Designed hall bar and contact pad sputtering stencils with autoCAD
- Designed and built magnetic annealing station
- Experience with X-ray Reflection and X-ray Diffraction

### Magnetron Sputtering

- Understanding of theory and experience with film deposition
- Experience maintaining and upgrading vacuum chambers (cleaning, target replacement, in situ residual gas analyzer implementation, vacuum pump upgrades)

### Magneto-optics

- Assisted in design and implementation of Magneto-Optical Kerr Effect microscopy experimental setup

### Experiment Development

- Experience prototyping and troubleshooting new experiments.
- Experience machining custom aluminum pieces for optical table

### Data Analysis

- Experience analyzing and displaying data with Excel, Mathematica, Fortran, Python, Origin

### Electromagnetism Theory

- Contributed to calculation of magnetostatic interaction energy between point magnet and ring magnet.
- Experience solving analytical and numerical problems related to the Casimir Effect

## Research Accomplishments

### Magneto-transport and Magneto-optics Effects Experimentally Studied

- Hall Effect, Planar Hall Effect, Anomalous Hall Effect
- Ordinary MR
- Anisotropic MR (longitudinal, transverse, angular)
- Giant MR
- Novel unidirectional MR
- Magnetic Phase Transitions
- Magneto-optical Kerr Effect

### Novel Materials and Heterostructures Experimentally Studied

- $\text{Bi}_2\text{Se}_3$ ,  $\text{Co/Bi}_2\text{Se}_3$ ,  $\text{Co/Ta}$ ,  $\text{Co/Cr}$
- $\text{Fe}_2\text{MnSn}$ ,  $\text{Mn}_2\text{FeSn}$ ,  $\text{Mn}_3\text{Sn}$ ,  $\text{FeMn}$
- $(\text{Fe/Cr})_{x>20}$  GMR device

## Presentations

### American Physical Society March Meeting

- "Large Unidirectional Magnetoresistance in Topological Insulator/Ferromagnet Bilayers" | 2020 (poster)
- "Magnetotransport properties of polycrystalline  $\text{Fe}_2\text{MnSn}$  thin films" | 2022 (poster)

### SIU Department Seminars

- "The Premelting of Ice due to Dispersion Forces" | SIU Physics - Fall 2018  
Presented numerical calculation of the thickness of a liquid water layer formed on nanoscopic ice sphere due to differences in dielectric properties of ice and water
- "How to build a Gyroid: Exploring the Minimal Surface and its Lattice" | Physics - Fall 2019, Mathematics - Spring 2020  
Presented discovery of novel self-stable triply periodic arrangement of helices related to the gyroid minimal surface
- "From Gyroid to the Triply Periodic Helix Linkages" | Mathematics – Spring 2023  
Presented 5 3D arrangements of woven helices  
(<https://echo360.org/public/media/2e33ccac-8756-409c-abb5-0c2faa097955>)
- "Triply Periodic and Polyhedral Helical Weaves" | Mathematics – Fall 2023  
Presented 25 physical and/or simulated helical weaves: 2D, triply periodic, and polyhedral (featured collaborators' work)  
(<https://echo360.org/public/media/b55fed07-add6-4b7d-b1c8-ddf20f52fa97>)

### Physics Demonstrations

- Lead several physics demonstrations for visiting high school and college students from SIU, Rend Lake College, John A. Logan College | 2019-2023
- Built and demonstrated stability in inverted pendulum
- Demonstrated Meissner effect, electroscope, conservation of angular momentum

## Other Scholastic Activities and Interests

### Casimir Effect Physics

- Attended workshop at Norwegian University of Science and Technology in Trondheim, Norway | June 2018  
assisted in investigation of the role of zero point energy in promoting ice formation in a spherical drop of water  
(<https://doi.org/10.1103/PhysRevResearch.1.033210>) – advised by Dr. K.V. Shajesh, Physics
- participated in weekly theory meetings investigating stability in magnetic levitation | Summer 2021 – Spring 2023

### Helical Weaves and Gyroid

- Assisted in assembly of "Yellow Moon Gyroid" art installation in SIU Morris Library | 2022
- Displayed "Minimally Entwined" sculpture and attended Bridges international mathematics/art conference in Halifax | 2023
- Posted preprint of "Triply Periodic Helical Weaves" <https://arxiv.org/ftp/arxiv/papers/2402/2402.07849.pdf> | 2024

## Honors and Awards

- SIU Dissertation Research Assistantship Award | 2023
- NWMSU Honors Program Graduate | 2017
- NWMSU Distinguished Scholar Scholarship | 2013 – 2017
- Missouri Bright Flight Scholarship | 2013 – 2017
- Camp Geiger (Boy Scouts) Staff Member of the Year | 2016
- High School Valedictorian | 2013
- Eagle Scout | 2010

## Publication

"Magnetostatic interaction energy between a point magnet and a ring magnet". Niranjana Warnakulasooriya, Dinuka H. Gallaba, John Joseph Marchetta, Duston Wetzell, Prachi Parashar, and K.V. Shajesh. *Physics Open*, 15, 100140 (2023)