

DUSTON WETZEL

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Research Interests

Nanoscale Physics, Nanotechnology, Spintronics, Magnetoresistance (MR), Thin Films and Heterostructures, Magnetism, Novel Quantum Materials, Metamaterials, 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 Magneto-optical Properties of $Mn_{3-x}Fe_xSn$ Thin Films
- Current GPA: 3.8/4.0
- Expected defense date: May 30, 2024

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

- Advisor: Prof. Dipanjan Mazumdar
- Thesis title: "ROOM TEMPERATURE MAGNETORESISTANCE IN LARGE AREA Co/Bi₂Se₃ 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, Origin, Mathematica, Fortran, Python

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

Thin Films and Heterostructures Experimentally Studied

- Co, Fe, Bi₂Se₃, Co/Bi₂Se₃, Co/Ta, Co/Cr, Fe₂MnSn, Mn₂FeSn, Mn₃Sn, FeMn, (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 Fe₂MnSn thin films" | 2022 (poster)
- "Effect of substrate on polycrystalline hexagonal Fe₂MnSn films grown by magnetron sputtering method" | 2024 (poster)
- Magnetic, Magnetotransport, and Anomalous Hall Effect Behavior in Polycrystalline Hexagonal Mn₂FeSn Thin Films | 2024 (oral)

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
<https://gallery.bridgesmathart.org/exhibitions/2023-bridges-conference/duston-wetzel>
- Posted preprint of "Triply Periodic Helical Weaves" <https://arxiv.org/ftp/arxiv/papers/2402/2402.07849.pdf> | 2024
- Wolfram Staff Picks "Triply Periodic Helical Weaves" <https://community.wolfram.com/groups/-/m/t/3126212> | 2024
- Had 10 sculptures accepted to be displayed at Bridges international mathematics/art conference in Richmond, VA | 2024
<https://gallery.bridgesmathart.org/exhibitions/bridges-2024-exhibition-of-mathematical-art/duston-wetzel>
- Helical weaves portfolio at <https://www.instagram.com/wetzelsweaves>

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 | 2015
- High School Valedictorian | 2013
- Eagle Scout | 2010

Publication

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