



Physics Freshman Seminar 2026

What this year's graduates wish they had known.

Your Physics Career at WVU

- Early Physicists (before you complete Physics 112)
- Mid-Career Physicist (not any of the other categories)
- Real Juniors (will graduate by summer next year)
- Real Seniors (will graduate by this summer)



Early Physicist

Before completing Physics 112

Learn to be a Successful Student

- Research is important but learn to be an effective student first.
- Get mostly “A”s in all your classes, especially math and physics classes.
- Make yourself at home in the building – get a key to the undergraduate physics lounge and use it.
- Join the Society of Physics Students (SPS) or the WVU Astronomy club (or both) and attend some events.

Get to Know Your Physics Professors – Attend Office Hours

- Dr. Miller and Stewart teach 1000 students a semester. Unless you make an effort, you are just a face in the crowd.
- Come to office hours and talk with your professors.
- I have had to decline letters of recommendation for “A” physics students in Physics 112 because I simply didn’t know them. A professor cannot write an effective letter of recommendation for a student based on a grade only.

Make Sure Your Adviser Knows You

- Develop a relationship with your physics adviser. Discuss your goals, challenges, and concerns. Ask about various career paths and advice on selecting a research adviser. If you are not getting what you need, request a change in adviser.
- Your adviser is not always your best letter of recommendation, but they should be a possible letter. They must know you as a person to write the letter.
- From a former SPS leader, after 4 years his or her adviser did not know him or her well enough to write an effective letter. They had to use a letter from another institution (REU).

The Temptation of Double Majors

- There is a lot of time left in your undergraduate career. Should you consider a minor or double major?
- Yes. If you are considering a career path and additional course work would formalize skills.
- Yes. If you are considering graduate school in the second major.
- Yes. If you truly enjoy the subject material of the second major.
- No. If the second major will substantially lower your GPA (say from 3.8 to 3.5).
- No. If the second major will prevent you from fully participating in a research experience.
- Do not elect a second major just because you think it will look good on a grad application.

When to start research?

- Once you are being successful in classes and have developed connections with the department and fellow students, you can start thinking about finding a research group.
- Remember, research takes time (~10 hours per week) so it takes time away from academics. If starting research too early lowers GPA, it was a mistake.
- It needs to be a reliable 10 hours a week.
- As an Early Physicist, there is no pressure to select a research group at this time.
- The SPS suggests the SURE program at WVU as a possible research experience the summer after freshman or sophomore year. (It is not as hard to get into as people make out).



Learning to be a successful student.

How do I do that

Basics

- Check email each morning and respond promptly.
- Find out location and time of office hours.
- Find out course due dates.
- Start assignments and studying early so you have time to get help.
- Read (or skim) material before coming to class. Quiz yourself after reading to test understanding.
- Don't rote memorize.
- Work independently before getting help (or using the internet!!!!).
- Limit use of AI.
- Plan to invest 2 hours studying per week for each credit of the class.
- Study to build understanding and see the connections between different parts of the material and the real world, not just to get the grade.
- Study a little a lot (the more frequently you come back to the material each week, the more connections you will build).
- Re-write your notes to make them your own.
- Take care of yourself (sleep, eat well, manage stress, exercise).



Mid Career Physicist

After completing Physics 112, but not yet a real junior or senior.

The middle years

- Continue to be successful in classes.
- Continue to develop relationships with your professors and advisers.
- Have a presence in the building.
- Select a research group.
- Consider a leadership role in the SPS or the astronomy class.
- Apply for a Research Experience for Undergraduates (REU) or an internship for the summer (I will discuss these in the fall townhall).
- Start thinking about your career – what you want to do after graduation.

Selecting a Research Group

- Look on the department website; most faculty maintain research pages.
- Look up a couple of articles written by faculty; read the intro and the conclusion.
- Attend colloquium on the topic.
- If you are interested, email the professor and ask to attend their group meeting (most will say yes). Attend reliably and punctually demonstrating interest.
- If you are still interested, asked to be considered for an opening in the group. The faculty member may say they do not have space in the near future.



Real Juniors

Will graduate next year.

One year to graduation

- The general and physics?? GRE is taken in the fall of your senior year. You should begin preparing well in advance.
- The junior year is when you should seriously focus on getting research done.
- Consider applying to a Research Experience for Undergraduates program after your junior year (applications in the spring of your junior year).



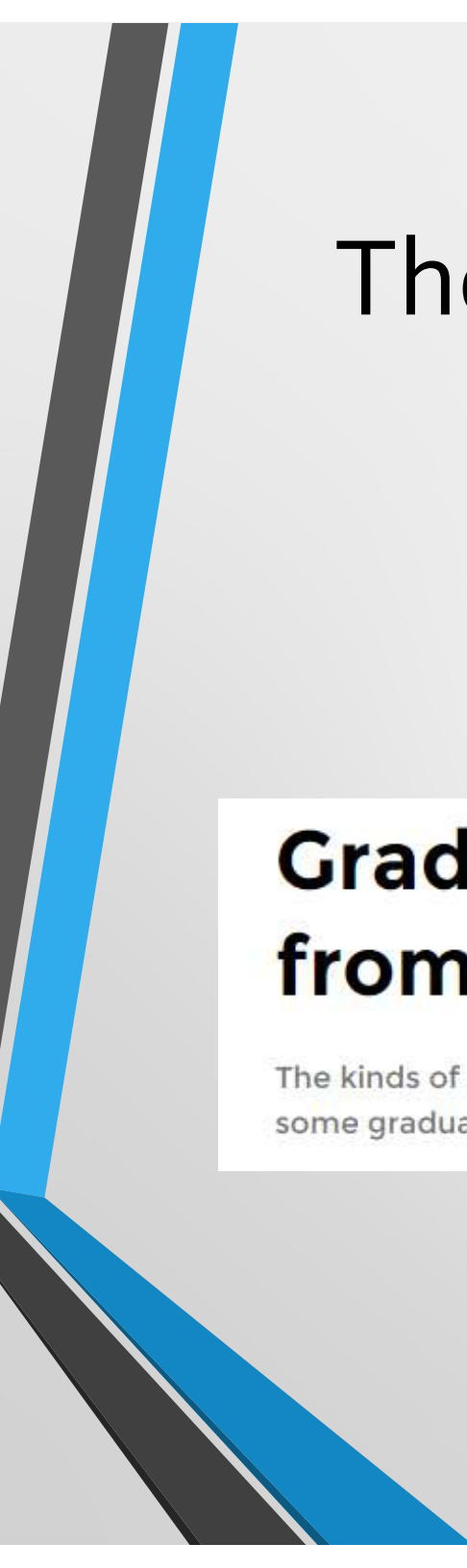
Real Seniors

Will graduate now.



The GRE

Graduate Record Examination



The GRE is not such a sure thing anymore

Graduate departments move away from GREs

The kinds of concerns that are driving schools to disregard test scores during the pandemic have inspired some graduate programs to make permanent changes.

General and Subject GRE

- The GRE comes in two pieces and some graduate schools require both.
- Many fields require the general GRE and there are quite a number of study materials for the test. You should select one and prepare. The general GRE is like the ACT on steroids.
- The subject test is a different matter. There are almost no useful preparation materials for the Physics Subject GRE.
- Both tests are administered by ETS, the Educational Testing Service.

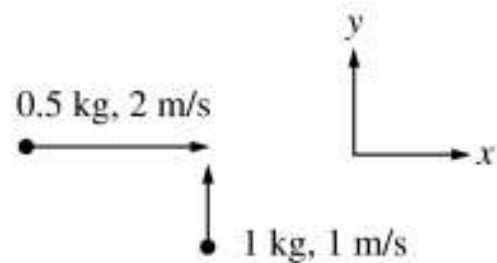
Beware The General GRE

- The general GRE contains a test of verbal reasoning, quantitative reasoning, and a writing component.
- Generally graduate programs ignore the general GRE because everyone does very well.
- You don't want to have a low score that stands out on any of the three parts (don't shoot yourself in the foot).
- You have to practice the general GRE and take it seriously.

The Subject Test

- The Subject Test has 100 multiple-choice physics questions.
- You have 170 minutes to complete it.
- Calculators are not allowed.
- There is a VERY limited formula sheet.

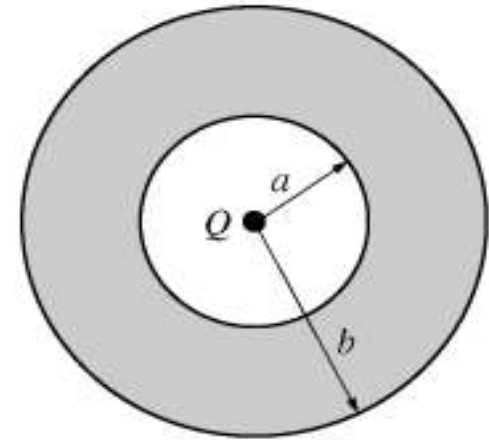
Published Problems



2. Two objects sliding on a frictionless surface, as represented above, collide and stick together. How much kinetic energy is converted to heat during the collision?

- (A) $\frac{1}{9}$ J
- (B) $\frac{1}{6}$ J
- (C) $\frac{1}{2}$ J
- (D) $\frac{3}{4}$ J
- (E) $\frac{5}{6}$ J

Published Problems



38. A point charge Q is placed at the center of a hollow, conducting spherical shell of inner radius a and outer radius b , as shown above. A net charge q is placed on the conducting shell. If the electric potential is assumed to be 0 at infinity, the magnitude of the electric potential at r , where $a < r < b$, is

(A) 0

(B) $\frac{Q}{4\pi\epsilon_0 r}$

(C) $\frac{Q + q}{4\pi\epsilon_0 r}$

(D) $\frac{Q}{4\pi\epsilon_0 a}$

(E) $\frac{Q + q}{4\pi\epsilon_0 b}$

63. The operators for the total angular momentum and its three projections are $\hat{\mathbf{J}}$ and $\hat{J}_x, \hat{J}_y, \hat{J}_z$, respectively. The commutator between two operators $\hat{A}$ and $\hat{B}$ is $[\hat{A}, \hat{B}] \equiv \hat{A}\hat{B} - \hat{B}\hat{A}$. Which of the following is true?

- (A) $[\hat{\mathbf{J}}^2, \hat{J}_z] = 0$
- (B) $[\hat{\mathbf{J}}^2, \hat{J}_z] = i\hbar\hat{J}_y$
- (C) $[\hat{J}_x, \hat{J}_y] = 0$
- (D) $[\hat{J}_x, \hat{J}_z] = i\hbar\hat{J}_z$
- (E) $[\hat{J}_x + i\hat{J}_y, \hat{J}_z] = 0$

Published Problems

What Do You Need?

- Scores range from 440 to 990
- Less than 500 and you're probably out.
- 600 will probably get you in (somewhere).
- 700 will probably get you in someplace you want to go.
- 800 and some of your sins are forgiven and you will be accepted at more schools.
- Subject GRE scores are being de-emphasized across the country; if you take it and do well, it will help. If you take it and do poorly, don't report your scores. If you don't take it, there will still be plenty of graduate options.

What does that mean?

Score conversion in back of test.

TOTAL SCORE			
Total Correct	Scaled Score	Total Correct	Scaled Score
84-100	990	43	590
83	980	42	580
82	970	41	570
81	960	40	560
80	950	38-39	550
79	940	37	540
78	930	36	530
77	920	35	520
76	910	33-34	510
75	900	32	500
74	890	31	490
73	880	30	480
72	870	28-29	470
71	860	27	460
70	850	26	450
69	840	25	440
68	830	23-24	430
67	820	22	420
66	810	21	410
65	800	20	400
64	790	18-19	390
63	780	17	380
62	770	16	370
61	760	14-15	360
60	750	13	350
59	740	12	340
58	730	11	330
57	720	9-10	320
56	710	8	310
55	700	7	300
54	690	6	290
53	680	5	280
52	670	4	270
51	660	1-3	260
50	650	0	250
49	640		
48	630		
47	620		
46	610		
44-45	600		



Graduate School

Grad School

- Many physics graduates attend graduate school in physics or some other technical discipline.
- A master's degree should increase your yearly salary by at least \$10,000 and take two years to obtain.
- A PhD takes 5-6 years, provides a larger bump in salary, and marks you as someone who is meant to drive innovation (or as a college professor).
- For most students, graduate school is free. Grad students attending WVU receive a full tuition waiver and a stipend of \$29,000.



Applying Graduate School

When?

- Graduate school application deadlines begin as early as December 1st with many on January 1st and deadlines continuing into February.
- Generally, weaker schools have deadlines later than Jan 15th.

How many?

- I recommend applying to 10 graduate programs.
- 1 pie-in-the-sky programs (Rank 1-15)
- 7 solid programs (Rank 15 – 100)
- 2 backup schools (Rank > 100)

How much?

- Application fees are not cheap. You should plan on spending upwards of \$1000 on the application process for 10 schools. Many schools have programs to help with financial hardship.

Letters

- You will need usually 3, sometimes 4, letters of recommendation.
- Plan to use your research adviser, your academic adviser, and faculty from which you have had advanced classes.
- If you have a double major, you may use one letter writer from the other major.

GRE

- Most schools require the general GRE.
- GRE requirements now vary strongly by school; get together a list of schools you plan to apply to and see what they require.
- There are also many schools who do not require a subject GRE score.
- There is currently a push in physics to deemphasize the subject score.

Researching Graduate Schools

- Google “US News and World Report Graduate Physics Rankings”
- West Virginia University is 86.
- To be a professor at WVU you probably have to go to a graduate school in the top 40, preferably the top 25.
- The good news is that you will be paid to go to graduate school – no scholarship needed – and WVU students can get into excellent graduate schools.
- Ask your professors for suggestions.



Physics

Ranked in 2014 | [Physics Rankings](#)
[Methodology](#)

SPONSORED BY:

[Click here for the GRE study guide](#)  sponsored by

Graduate schools for physics typically offer a range of specialty programs, from quantum physics to relativity, as well as plentiful research opportunities to bolster a science education. These are the best physics schools. Each school's score reflects its average rating on a scale from 1 (marginal) to 5 (outstanding), based on a survey of academics at peer institutions.

Specialty

Rank	School name	Score
#1	Massachusetts Institute of Technology Cambridge, MA	5.0
#2 Tie	California Institute of Technology Pasadena, CA	4.9
#2 Tie	Harvard University Cambridge, MA	4.9
#2 Tie	Princeton University Princeton, NJ	4.9
#2 Tie	Stanford University Stanford, CA	4.9
#2 Tie	University of California—Berkeley Berkeley, CA	4.9
#7 Tie	Cornell University Ithaca, NY	4.7
#7 Tie	University of Chicago Chicago, IL	4.7
#9	University of Illinois—Urbana-Champaign Urbana, IL	4.6

Does it matter that your undergrad is from WVU not Harvard?

- No. Once you have a PhD, no one cares where you went to undergrad.
- WVU is a major state school and you are in a good position to apply anywhere.

Getting Accepted-What Matters?

- College GPA (most importantly math and physics).
- Essays
- Letters of Recommendation
- Research Experience
- General and Subject GRE
- Special circumstances
- Special accomplishments

Weaknesses in one thing on the list can be made up for with strengths in another; your overall package will be considered.

Do you have to be perfect from the start?

- No, graduate schools will consider a positive progression of grades, particularly if there were circumstances influence early low grades.
- Make sure your letter writers understand the circumstances.



Graduate School

What is it like?



Graduate School

Graduate school will be one of the best times of your life.

You will enter with a cohort of students passionate about physics.

You will all take the same classes and prepare for the qualifying exam.

All physics graduate programs teach the same stuff, so if you get into a great program it won't be tons harder than a weaker program.

Most will TA for large introductory classes the first year.

Most will join a research group after the first year and no longer have to TA.

It will take you about 5.5 years to graduate. Enjoy them.

Qualifying Exam

- Most graduate programs require you to pass a Qualifying or Candidacy Exam to advance to a PhD.
- This exam usually tests mechanics, E+M, and quantum at the first year graduate level.
- Most programs give you 2 attempts at each topic with a free attempt as you enter.
- Consider preparing for the free attempt and getting some of the qual out of the way as you enter.

The background of the image is a high-angle shot of a classroom. It features several black plastic chairs with a wooden desk attached to the side. The chairs are arranged on a light-colored wooden floor. A semi-transparent black rectangle is overlaid on the right side of the image, containing white text.

Tired of School –
Options other than
graduate school.

**BUT I LOVE LEARNING AND
TALKING PHYSICS, BUT DON'T
LIKE RESEARCH**

Consider Teaching

HIGH SCHOOL TEACHER

- If you want a job that allows you to make a difference in peoples lives, gives you personal flexibility, is secure, and lets you live where you want, consider high school teaching.
- To become a high school teacher at a public school, you need a teaching certification.
- There is currently no clear certification path at WVU; however, many paths to certification after your undergrad degree exist.
- We are still figuring these out.

COLLEGE TEACHER

- It is possible to get college teaching jobs, generally with at least a master's degree, which do not require that you perform research.
- Some of these jobs are great (like Dr. Miller's), but most are awful with huge teaching loads, low pay, and low job security.
- In almost all cases, high school teaching is a better career.

Secondary STEM Education

Minor Contact

- [Jeffrey Carver](#)

Minor Code - U184

A minimum GPA of 2.75 is required in coursework applied to the minor.

ARSC 120	Inquiry Approaches to Teaching	1
ARSC 220	Inquiry-Based Lesson Design	1
UTCH 221	Knowing and Learning in Mathematics and Science	3
UTCH 322	Classroom Interactions in Math and Science	3
UTCH 420	Project-Based Instruction in Mathematics and Science	3



Scholarships

Physics Department Scholarships

The department has many, often large scholarships, that we often struggle to give out. Consider applying. See the scholarship page for info. Applications due in the spring (you will get an email).

 **West Virginia University**
DEPARTMENT OF PHYSICS AND ASTRONOMY

WVU Home **Eberly Home** Apply Now

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Home / Students / Undergraduate Students

Undergraduate Students

Do you have questions about the WVU Physics and Astronomy undergraduate program? If so, you can email us at physicsugradadvising@mail.wvu.edu.

The Department of Physics and Astronomy at West Virginia University is dedicated to the study of the physical world and the processes that govern it. Our faculty train students in the a wide-range of

Undergraduate Students

- [Typical Plans of Study](#)
- [Changes of Majors or Transfers](#)
- [Career Opportunities](#)
- [Financial Aid and Scholarships](#)
- [Research and Internships](#)
- [Student Organizations](#)

Graduate Students

Physics

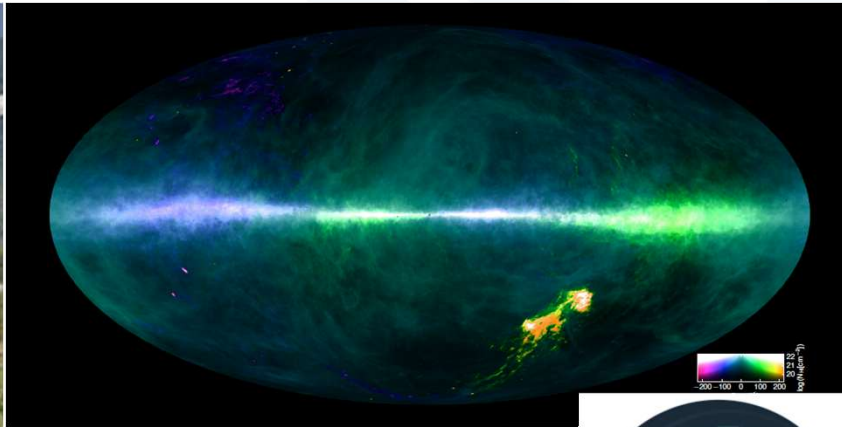
A bit of what we are and do for the majors and potential majors.

PHYSICS AND ASTRONOMY AT WEST VIRGINIA UNIVERSITY

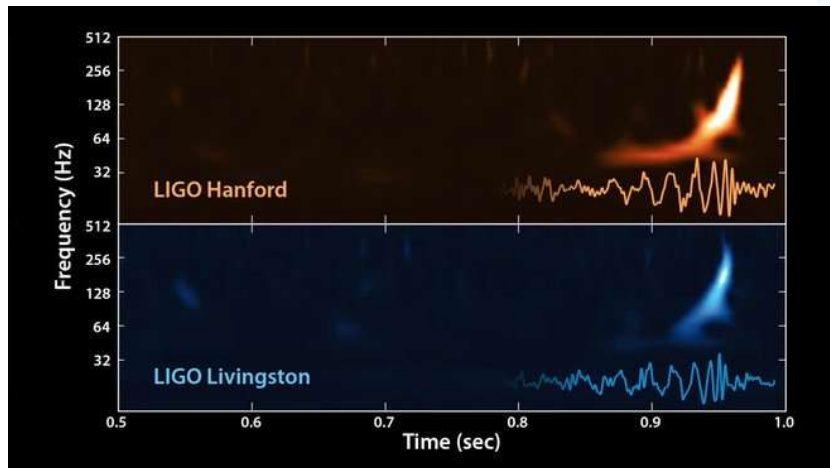


<https://physics.wvu.edu>

Department of Physics and Astronomy



Research opportunities: Astronomy & Astrophysics



Gravitational Wave
Astrophysics



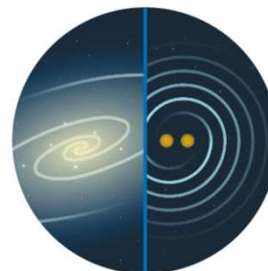
Interstellar Medium



Galaxy Formation and
Evolution



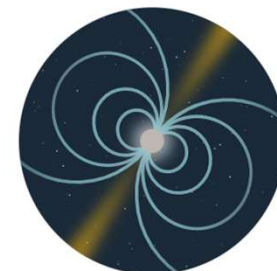
Cosmology



Multi-Messenger
Astronomy



Fast Radio Bursts



Neutron Stars



Radio Instrumentation

Department of Physics and Astronomy

A SPACE SCIENTIST

Virginia Cunningham (BS 2015)

PhD from University of Maryland in Astronomy 2021

Postdoc, STScI (Space Telescope Science Institute),
Baltimore



ERICA CHWALIK

- Erica Chwalik (with an undergraduate student from Oberlin) at the Institute for Mathematical Sciences in Chennai, India, where they traveled for research abroad through a NANOGrav IRES program grant.
- They are now a physics graduate student at Montana State University.



Weird Stuff at high voltage – The fourth state of matter

PLASMA PHYSICS



Plasma Physics

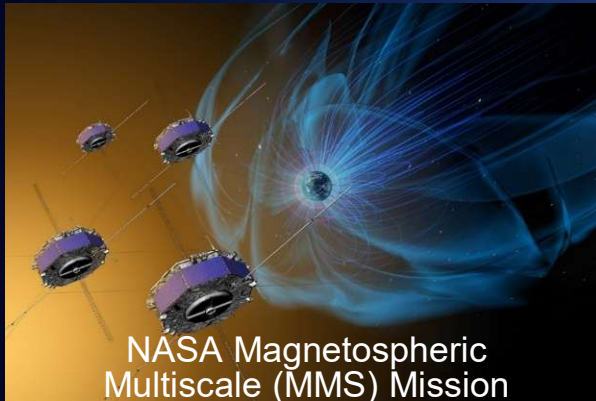


Plasma Physics at WVU

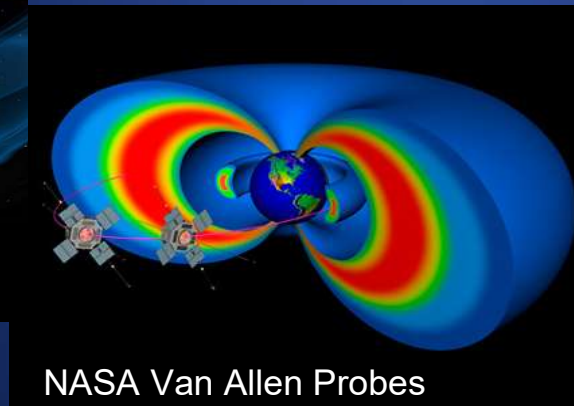
- **Laboratory Experiment**
 - Koepke, Scime, Shi
- **Satellite and Terrestrial Observations**
 - Fowler, Goodrich, Scime, Tu
- **Theory and Numerical Simulations**
 - Cassak, Tu



WVU PHase Space Mapping
experiment (PHASMA)



NASA Magnetospheric
Multiscale (MMS) Mission



NASA Van Allen Probes



General Atomics
"DIII-D" tokamak

SOMEONE WHO ESCAPED TO CHEMISTRY
AFTER GRADUATION



Scott Cushing
(BS 2011, PhD 2015)

Postdoc at UC Berkeley

Assistant Professor of
Chemistry at **Caltech**

CHRIS DOSS

- Used supercomputers to simulate how an ambient flow of hot plasma affects the process called magnetic reconnection, the explosive phenomena behind solar flares and aurora-producing geomagnetic substorms
- Published two papers that predicted the amount that reconnection is slowed down by the ambient flow
 - The research led to the conclusion that the ambient flow likely has little effect on reconnection in Earth's magnetic bubble
 - The two papers have been cited over 50 times
- Got Honorable Mention for an APS Apker Award for "outstanding achievements in physics by undergraduate students"
- Went to grad school at UC Boulder



3 GOLDWATER SCHOLARS

- Left - Ryan Murphy PhD at U Mich and went on to postdoc at Sandia National Labs.
- Middle Forrest Doss - grad school at Cambridge and U Mich. Hired at Los Alamos into a theory position without a postdoc. Leading theorist in the field.
- Right - Anna Zaniewski, postdoc at Arizona State after PhD at Berkeley. Dual outreach and Condensed Matter postdoc research. Now CTO of Advent Diamond, world leader in diamond detector development.

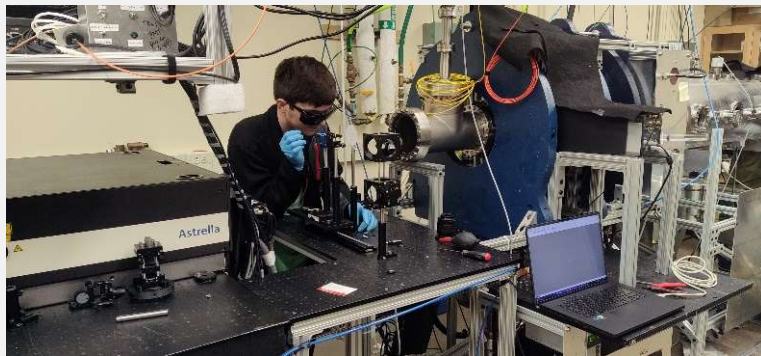


A FEW MORE PLASMA STUDENTS

- Seated - Melanie Blackburn, PhD at U Mich. Currently GOES-R Flight Software Engineer at NASA/NOAA
- Behind her standing - Brian Kent (Goldwater scholar), PhD at Cornell. Staff scientist at NRAO.
- Front right, Rick Soulsby (Goldwater scholar).
no grad school, currently an actuary.



PHYSICS 112 STUDENT



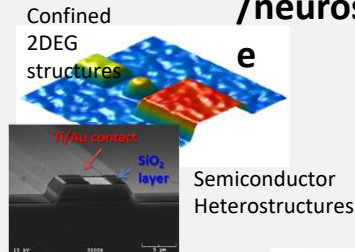
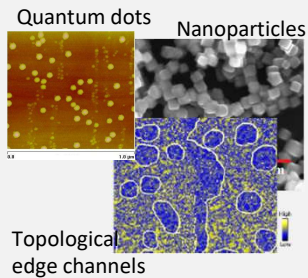
Second year undergraduate, Samuel Stalnaker, directs ultra-violet (UV) light from a pulsed dye laser into the Compant HElicon for Waves and Instabilities Experiment (CHEWIE) plasma chamber. The UV laser beam reveals the motion of ions or neutral particles in a plasma via a laser spectroscopic technique known as dark-pulse optical tagging.

CONDENSED MATTER

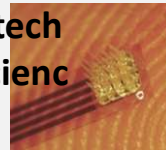
The science that makes computer chips (and pretty much everything else)



Low-Dimensional Systems



Bionanotech /neuroscienc

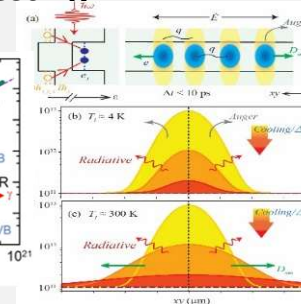
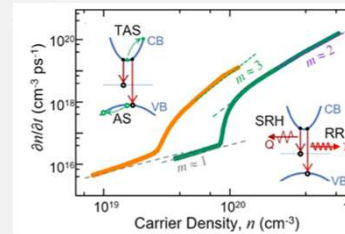


Condensed Matter Physics

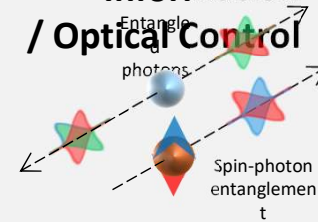
Department of Physics and Astronomy
West Virginia University



Energy- Efficient/Solar Light Harvesting Devices

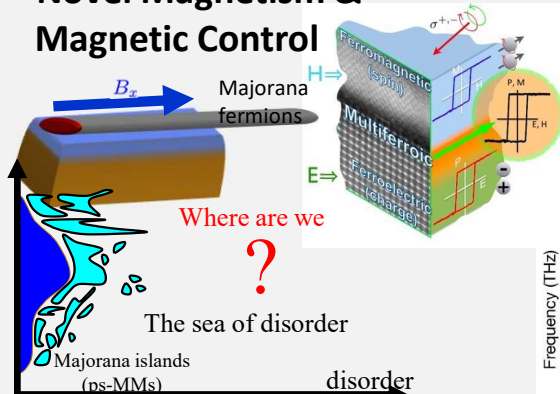


Quantum Information / Optical Control

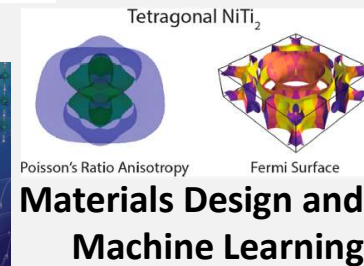
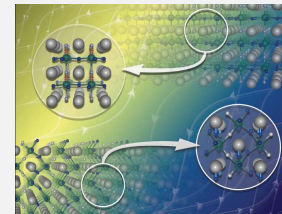
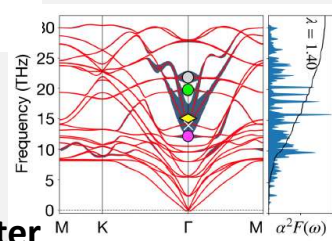


FALL 2022

Novel Magnetism & Magnetic Control

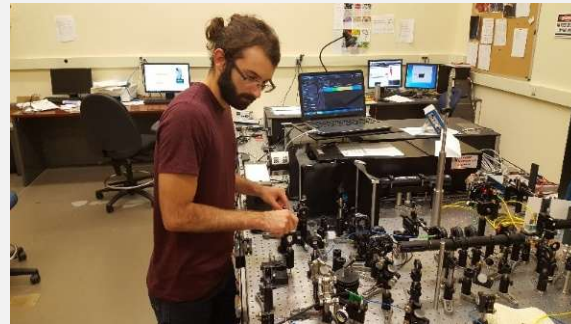


Topological and Quantum Matter



CONDENSED MATTER- CAINAN NICHOLS

- He's working at the optical table in my lab, aligning a Fabry-Perot interferometer.
- He went on to get a master's from Eastern Michigan University in 2020.
- He is now a Principal Systems Engineer at Northrup Grumman, testing propulsion systems for aircraft carriers and submarines at the manufacturing site in San Francisco and onboard the ships.

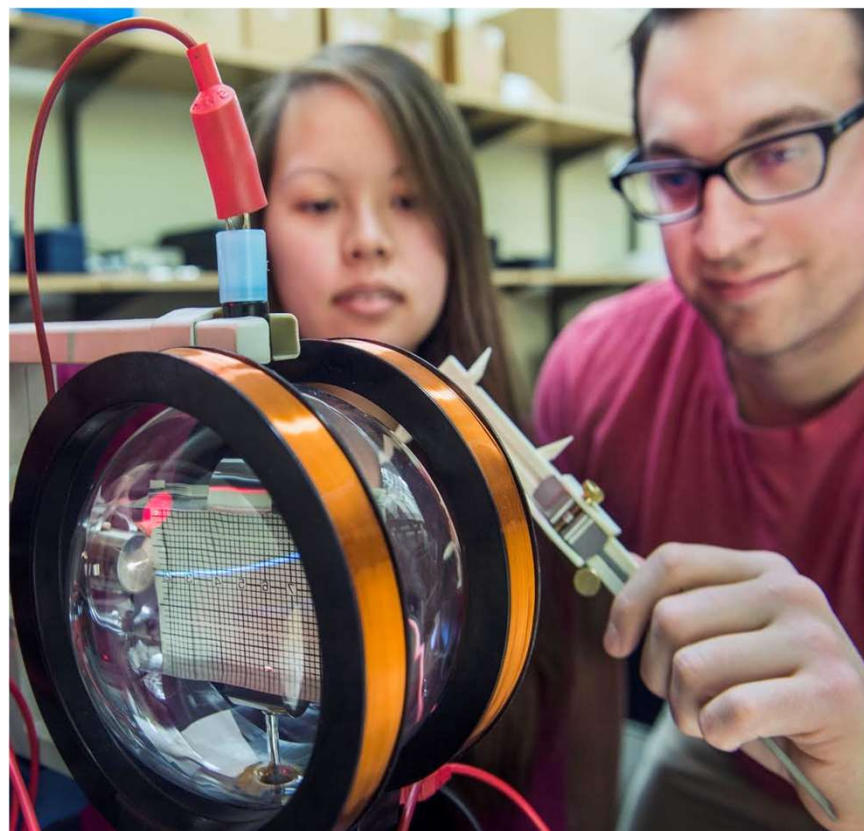


Advanced-Undergraduate Laboratory offers career-benefiting learning outcomes

This lab course consists of a **writing** component (lab notebook and technical report), an emphasis on **uncertainty quantification** (measurement uncertainty, least-squares fitting, and error propagation), and **oral-communication** skill building (poster presentations & talk).

The student's primary activity is conducting lab experiments (**prelab planning, data acquisition, post-lab analysis, technical report**) alone or with a lab partner.

The student will be able to **document** thoroughly in a lab book the conceptual, experimental, and analytical steps carried out during a project, **evaluate comparisons of one's results with a hypothesis** using charts, graphs, tables, theory, and statistics, and **articulate the results** clearly in written and oral forms.



**In 1989, Rob McTaggart became one of the first two Goldwater Scholars ever at WVU.
For 2019-2020, Society of Physics Students named McTaggart Outstanding Chapter Advisor.**

WVU graduation in 1991, for B.S.

Penn State graduation in 1999 for PhD.

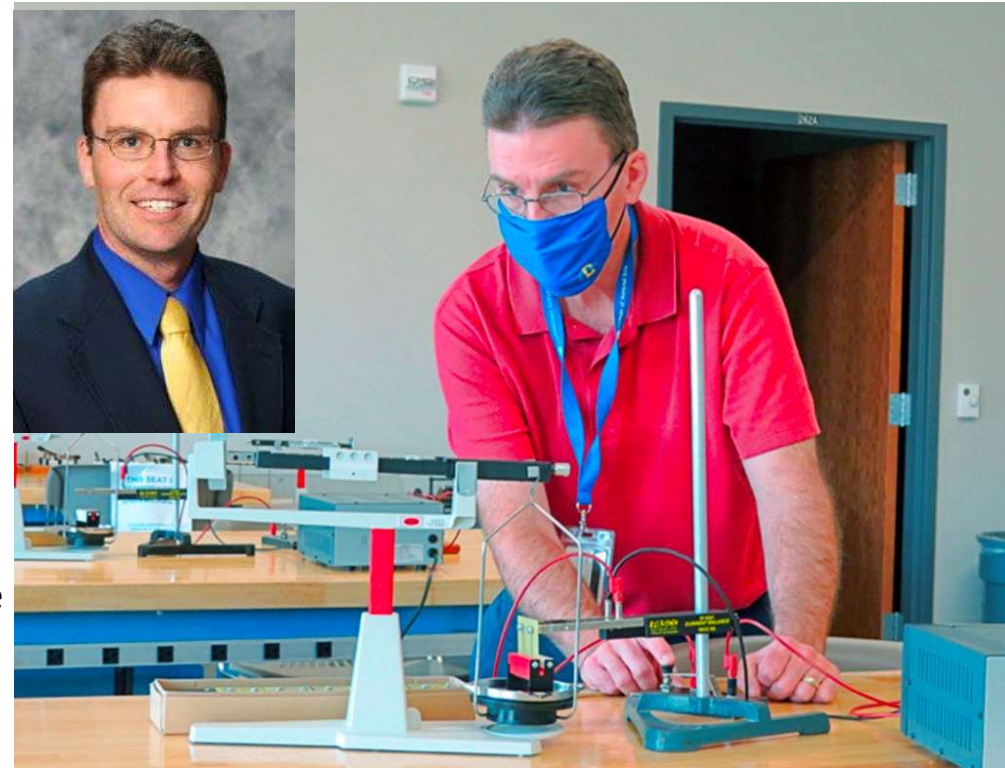
Dissertation characterized the **bound state of a charm quark and an anti-charm quark** that provides insight into the nature of the strong nuclear force that keeps nuclei together.

Since 2004, Rob has taught at S. Dakota State Univ (SDSU) and is now an Associate Professor.

He supports experiments to search for **dark matter, neutrinoless double beta decay**, and **neutrino oscillation** experiments at the Sanford Underground Research Facility (SURF), an underground physics laboratory just north of Mount Rushmore.

He is the **SDSU Coordinator of Nuclear Education**, overseeing the 18-hour Minor in Nuclear Engineering that he helped establish.

He recently served as **President of the North Central Chapter of the Health Physics Society**, which includes North Dakota, South Dakota, Iowa, Wisconsin, and Minnesota.



David M. Hartley, Associate Prof of Pediatrics, Cincinnati Children's Hospital Medical Center.

Infectious disease epidemiology; public health surveillance; mathematical and computer modeling

WVU graduation in 1989, for B.S.

Univ. Maryland-Baltimore graduation in 1996 for PhD.

Dave researches the factors governing the emergence and transmission of infectious diseases by applying mathematical modeling, computer simulation and data analytics.

He strives to use team-based, interdisciplinary research to **improve child health**.

He used math & computer simulation to understand the HIV epidemic in the early 1990s. That interest grew into mathematical disease ecology and research on **how environmental variables affect the emergence & spread of different infectious disease**.

Interest in public health surveillance followed from his study of epidemics, so he also **studies the spread of ideas and cooperation in learning healthcare systems** *using mathematical tools like those applied to measuring and modeling epidemics*.

Recent Publication: Impact of the COVID-19 pandemic on hospitalizations of children with neurologic impairment. Thomson, Richardson, Auger, Brady, Hall, Hartley, Schondelmeyer, Shah. *Journal of Hospital Medicine* (Online). 2023; 18:33-42.

