



# GUSTAVUS PHYSICS

Physics Department Newsletter

September 2021

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## Important Fall Dates:

Classes Begin	Sep. 3
Last Day to Register for Fall Classes	Sep. 20
Nobel Conference	Oct. 5-6
January Term Registration Begins	Nov. 1
Spring Registration Begins	Nov. 8
Final Exams Begin	Dec. 17

## Pandemic Year Proves the Resilience of the Physics Department

Here is one student's perspective on how and why the physics department had a successful 2020-2021:

"Over the last year and a half or so we all have been battling Covid-19. There have been many challenges in trying to work around the stipulations and circumstances that have been thrown at us. Solving problems and pushing through the challenges are two great skills we learn as physicists, and these skills were put to the test during this difficult time.

"First, I want to give a big shout out to all the professors of the department. Their quick thinking, dedication, and enthusiasm showed through. We started out the 2020-2021 year online. With short notice the professors were able to make quick adjustments to their classes. For the Experimental Modern course, **Chuck Niederriter** was able to change the lab schedule around to move critical in-person labs to later in the semester. We even got experience controlling instruments remotely, something that we don't normally do. What a great skill to have out in the research world! Once we were

back in person, everyone found a way to make group problems accessible and hold classes while maintaining social distancing.

"Second, I want to thank all of the students. Everyone was willing to go with the flow and recognize that things were not going to be perfect. They adapted well and showed their resilience. I also want to thank them for being responsible. While we were working together, everyone did so in a safe manner, and these actions allowed the physics case rate to stay at a couple of students. While we couldn't do everything we wanted, we were still able to get work done while having fun doing it.

"It will be a time none of us ever forget, and a time where we can reflect and learn a lot about ourselves. Everyone in the department played their role brilliantly. Thanks, everyone, and congratulations on a job well done."

**Tommy Myers '23**

## Student News

### Departmental Awards for 2021-2022

As we do every year, the department is recognizing a number of returning majors with awards.

**Alex Florea '22 and Ana Zaalishvili '22** are the winners of the 2021-2022 Milward T. Rodine Memorial Physics Award. Named for the long-time Gustavus professor of physics, who taught here from 1933-1969, it is awarded annually, on the basis of interests and scholarly achievements, to physics majors who have completed the junior year.

In consultation with the Physics Department, the Department of Mathematics, Computer Science and Statistics has chosen **Bryce Knutson '22** as the winner of the John Borneman Prize Par Excellence in Mathematics. This award was designated in memory of John Borneman (a 1955 Gustavus graduate) by his family. It is presented annually to an outstanding student in the fields of mathematics and physics.

**Tommy Myers '22** has received the Gerald and Julia Swanson Scholar-

ship in Physics. This endowed scholarship was established to honor the work of the physics department faculty who provided Gerald Swanson with a background that prepared him for graduate study in physics and for a career with Bendix Corporation. It is intended to encourage physics students of promise who are enrolled full-time at the College.

**Zane Michael '22** was awarded the John Chindvall Scholarship in Physics. This endowed scholarship was established in memory of 1970 Gustavus graduate John Chindvall by his parents and friends. It is awarded annually to a student majoring in physics.

**Anna Teurman '22** was selected as the winner of the Julian A. Crawford Memorial Prize in Physics. The prize is named in memory of the former chair (1967-69) of the Gustavus physics department and awarded to the student with "the greatest potential for contributing to physics and society."

**Emma Erickson '24** received the Harold Q. Fuller Memorial Award in Physics, which is given to the first-year student who had the highest overall record in physics courses. This award was established in 1997 by the late Professor of Physics **Richard M. Fuller** (who taught at Gustavus from 1968-1999) and his wife, Judith. It honors Richard's father "HQ" for his lifetime commitment to teaching young people.

**Justin Portner '22** received the "Positive Derivative Award", as a physics major within his class who showed great improvement during the 2020-21 academic year.

**Matthew Keeley '22 and Maya Lengvenis '22** will serve as the Physics Departmental Assistants for Fall Semester 2021. These positions have a nominal expectation of four hours per week in research, course development or other activities that will assist in the work of the department.

### Inductions into the National Physics Honor Society

At the department picnic on Sunday, May 2, this year's Sigma Pi Sigma induction ceremony took place.

$\Sigma\Pi\Sigma$  is the national physics honor society, and it exists to honor outstanding scholarship in physics.

Five graduating seniors from the class of 2021 were inducted into the Gustavus Chapter of  $\Sigma\Pi\Sigma$ . They are (L to R in photo): **Espen Fredrick, Mitch Donoughue, Alex Woitas** and (on the laptop) **Lawrence Hiquiana**. Not pictured is **Kyle Krippner**.

At Gustavus, election to membership in the Sigma Pi Sigma chapter requires a minimum 3.0 physics GPA, involvement in the Society of Physics Students, and nomination by two different professors. In addition, each nominee must have fulfilled the requirements for one of three induction tracks: academic, research or departmental service.

Congratulations to all of the inductees!



The 2021 Sigma Pi Sigma inductees



## Student Summer Internships

Despite the pandemic year, a number of our students worked on physics-related internships this summer.

**Alex Florea '22** writes, "I spent this summer at the Mayo Clinic in Rochester, MN, as a summer undergraduate research fellow (SURF) conducting research in MRI imaging. Our work focused on identifying an optimal set of parameters that would allow us to reconstruct images along the sagittal plane from axial body scans in order to significantly cut down on scan time. MRI imaging is an incredibly complex technique with many parameters you can adjust, and when you gain something in one area, you, more often than not, lose in another. My work has focused on developing a program that would allow us to easily play with these parameters, generate lots of data quickly, and help us quantitatively identify sets that would produce optimal reconstructed images preferred by radiologists.

"This summer there was a 2 week online summer foundations in research course to allow us to self quarantine. The course included online modules going through different types of research studies, data analysis methods, and good experimental practices."

**Grant Hietpas '23** says, "This summer, I have been doing research at the U of MN under NASA's Minnesota Space Grant Consortium. Our team has been investigating the competency of a new control system in a physically-simulated rocket launch. The control system was written by the PhD student on our team, and it's been my job to help design a quadcopter-based system that will

adequately simulate a rocket during launch. Our design consists of a 1.5 meter inverted pendulum mounted on top of the drone, which has a flexible beam and a hanging weight system attached at the top to imitate fuel slosh. To maximize the disturbances our control system will need to cope with, all slosh, flex, and vibrational are designed so that their various modes couple at a low enough frequency to be observed and corrected for by our control system.



**Grant and His Inverted Pendulum and Quadcopter Drone**

"I've spent my Summer using Matlab to match vibrational and slosh mode frequencies, designing original parts based on those findings, and using numerous fabrication techniques to assemble those designs into a final, airworthy apparatus. It's been a blast to dive headfirst into the

design/engineering process, learn from the really smart and experienced professors at the U of MN, and tap into the University's vast resources to come up with a final product that I'm really proud of."

**Maya Lengvenis '22** writes, "I have been on campus this summer working with **Darsa Donelan** to bring a radio Astronomy research project to Gustavus. This project (Radio JOVE) observes both Jupiter and the sun by looking at their radio wave spectra instead of visible light. We've constructed an antenna array out by the ultimate frisbee field behind Southwest Hall. I've spent time figuring out how to incorporate Arduino-controlled components into the radio receiver, so that we can tune the antennae and collect data remotely."

**Thomas Myers '22** worked with **Elizabeth Boatman** this summer using the Richard M. Fuller Research Endowment Fund. He worked on revising the labs for the condensed matter course as well as working with cadmium selenide quantum dots. He writes "It was a hodgepodge of projects I was working on. From superconductor to quantum dots, I was always busy doing something new. It was great to see the skills I have developed over the past three years really shine through. I was characterizing the quantum dots for the emittance and absorbance properties in relation to reaction time and size. I had to come up with my own methods for analysing peaks in the fluorometer and spectrophotometer data. There were some hiccups, but it was fun to work through

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## Faculty News

**Liz Boatman** writes, “This summer I worked with four physics students to undertake various projects. I coached physics major **Katelyn Espe ’23** through the engineering design process to design and build a computerized numeric controlled (CNC) router, which will be available in the department’s machine shop later this semester for wood-working projects.

“Physics majors **Justin Sehlin ’23** and **Anna Teurman ’22** worked with me on a project investigating the role of fluoride in the fossilization process of bones. Meanwhile, I collaborated with geology major Theo Wilson and their senior thesis advisor Julie Bartley on another investigation, exploring the evolutionary relationship of the megalodon shark to modern mako and great white lineages via tooth ultrastructural and mechanical property features. Collectively, these studies took us, several times, to the University of Minnesota’s CharFac and Macalester College for use of a nano indenter for mechanical-property determination and a Fourier-transform infrared spectrometer and scanning electron microscope for chemical analysis.

“Funded through the Fuller Scholars Fund, **Tommy Myers ’22** helped me to revise several labs from my first time teaching Condensed Matter this past spring so that they will be in even better shape the next time around.

“Lastly, **Darsa Donelan** and I worked together to bring the new first-year course “Physics and Engineering for a Sustainable World” to life, just in time for deployment this fall (with our sizable incoming class!) One major change from the



**What happens in the world of Zoom meetings if you let the physics faculty members each choose their favorite screen background? L to R, Top row: Chuck Niederriter, Tom Huber and Paul Saulnier; Middle row: Darsa Donelan, Jessie Petricka and Liz Boatman; Bottom: Steve Mellema**

previous fall first-year course is the incorporation of a team-based engineering design project. We will pilot the first iteration of this course with several campus partners so that the students have a chance to see their project deliverables come to life.”

**Darsa Donelan** says, “This summer I worked with **Maya Lengvenis ’22** on NASA’s Radio JOVE project. You can read more about that work in Maya’s contribution to this newsletter.

“I co-ran a free virtual monthly workshop series “Physics in an Astronomy Context” as part of my work with the AAPT/Temple NASA Heliophysics Education Activation Team (HEAT). The topics of these workshops included: coronal mass ejections, sunspot science, stellar composition, exoplanet atmospheres, and planetary magnetism. These virtual gatherings each had about 50 teachers (high school and college). Each session consisted of an astrophysics mini-lecture, small group engagement with the core ac-

tivity, and exploration and group discussion time. We will be continuing this workshop series through the Fall with the topics of energy in a magnetic field, solar flares, auroral currents, and habitable-zone planets.

“I also worked with **Maya Lengvenis ’22** and **Rose Paddock ’23** on telescope guiding software so that the observatory can be accessible remotely, which we discovered is very important during a pandemic. Below is a picture of my observatory assistants hard at work.”



**Rose, Maya (and Uzi) Working on Telescope Guidance Software**

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## Student Summer Activities

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the challenges and see the end result. It was also fun working being around the other students this summer. Even though we were on different projects, it was cool to talk about what each of us were doing, and it really helps liven up the atmosphere working with others.”

**Rose Paddock '23** writes, “This summer, I had the enormous privilege to be an intern at NASA Langley Research Center in Hampton, Virginia, for a 10-week session. I was one of ten interns working on the landing gear for the Artemis mission presentation. Our mentors split us up into two groups of three and one group of four to work on various sections of the landing gear. I was put in a group of four that worked on the footpad.

“All internships at NASA LaRC were virtual unless interns had to test materials or designs. I went onsite twice. Working from home was an interesting adjustment, especially because the other interns in my group were from all over the country. Our group leader lives in California, two members live in the Midwest, and I live in Virginia. Time zone differences and not working in the same space were challenges this summer. We had weekly meetings on Microsoft Teams and communicated regularly on Discord, Teams, and through texting.

“Despite our physical distance, we were able to crank out a few deliverables, including a 3D printed section of the footpad at half-scale. Our design included an auxetic structure to help make the landing more able to withstand sharp rocks. An auxetic

structure is like a honeycomb structure, except its shape is designed to get more dense or the same density when pressed instead of less dense.

“An example of non-auxetic structures would be a rubber band, which gets thinner in the middle when the ends are stretched. Auxetic structures are seldom found in nature.

One of the other group mates and I went onsite and tested multiple auxetic structures to see what would be better and more manufacturable. We decided on the hexagonal chiral structure, which consists of triangles and small circles in the corners to help with flexibility. We felt rather accomplished to show physically printed objects as part of our final presentation. I am fortunate to have worked with such intelligent and diversely skilled teammates and mentors.”

**Jack Stonecipher '23** writes, “This summer I was accepted into a Bio-Physics REU with the Department of Physics at Purdue University in Indiana. I have been working under the direction of Dr. Srividya Iyer-Biswas in the Iyer-Biswas lab which is focused on the physical principles that govern stochastic cell behavior. The primary project I've been working on tracks and quantifies cell size and cell divisions under different conditions. Most of my summer I have been analyzing cell data processed by a computer program, identifying the cell size, and making necessary edits. The data is collected by a chemostat with a camera that captures images at various positions of the cell culture at even time intervals. Cell division is controlled in a manner that keeps the cells from cluster-

ing and interfering with accurate data collection. This project is important because it deals with fundamental physics applied to processes of cellular growth. It has been a wonderful experience for me to work in this interdisciplinary field where I have been learning and applying physics, computer science, and biology.”

**Ana Zaalishvili '22** writes, “This summer I am taking part in the Laney Graduate School (LGS) - Summer Opportunity for Academic Research (SOAR) program at Emory University. I am working in Dr. Justin Burton's lab, which is a soft-matter physics laboratory studying various topics. My topic is mechanical detection of liquid sorption and evaporation in thin deposited solid films. This encompasses two projects. First, I am examining how nanoscale wetting of materials compares to macro scale contact angle measurements. Both of these measurements are looking at hydrophobicity of materials. My second project involves studying how trapped solvent evaporates from thin deposited solid films. For both of the projects I am utilizing Quartz Crystal Microbalances (QCMs) to take the measurements. During this summer I have learned many experimental techniques and have gotten to talk to professors and graduate students, which has been very helpful in making decisions for when I graduate from Gustavus. I have written my abstract and am now preparing a poster for a symposium at the end of the program.”





## The (Masked) Graduating Class of 2021

On Thursday, May 13, the Gustavus Commencement ceremony for the class of 2021 was held outdoors on Hollingsworth Field. And, for the first time in College history, the commencement address was delivered by a graduating physics major, **Lawrence Hiquiana '21**. Given the restrictions due to the COVID-19 pandemic, the physics department did our best to replicate our annual, post-Commencement reception for the physics graduates and their families, and it was held outdoors on a (fortunately) beautiful day.

The photo above shows faculty members and graduates at the reception. Although theirs is (numerically) the smallest physics graduating class in more than two decades, their perseverance and commitment are already paying off in their immediate post-graduation opportunities. Some of them have written to share their memories and future plans as well as advice for future classes of Gustie physics majors.

**Maheemah Bokhoree** is pursuing a graduate degree in Chemical Physics at the University of Minnesota.

**Mitch Donoughue** says, "I thought the SPS events and rocket club were a lot of fun and added value to my time at GAC."

"My immediate future plans are to complete my PhD in mechanical engineering at Purdue University."

"As for future advice: get things done early and don't forget to have fun when possible."

**Espen Fredrick** writes "To me, the physics community at Gustavus is more than anyone could ever ask for. From the very beginning of my time at Gustavus and up until the very end I have always felt that the



**Graduation for the Class of 2021 (L to R, Back Row, Faculty: Chuck Niederritter, Darsa Donelan, Liz Boatman, Tom Huber, Jessie Petricka and Steve Mellema. Front Row, Graduating Students: Mitch Donoughue, Alex Woitas, Espen Fredrick, Kyle Krippner, Lawrence Hiquiana, Kate McGregor, Maheemah Bokhoree, Eric Carlson and Greg Norton. On the ground: Jared Zaun)**

department was there to support me and give me the best education possible while also making learning fun. There is no doubt in my mind that I've made lifelong friends during the long hours stuck in advanced lab or in the student offices. I'm excited to take what I've learned with me into the future, and this fall I will be attending the University of Texas at Arlington to pursue a physics PhD program focused on modeling solar plasma interactions with the Earth's magnetic field. Still, as I've learned along the way, life is unpredictable and plans change. Where this path may lead in the future is uncertain, but I am willing to follow it headfirst whichever direction it takes me. To those who are younger: please make every moment worth it. Go to every class. Attend every event. Time goes by faster than you think and there isn't a single day now where I miss my friends in Olin Hall."

**Lawrence Hiquiana** says, "I owe a lot to my Gustavus experience. It challenged me in so many different ways, but also supported me through all of those things. I met some amazing people, especially in the Physics program and I wish I had more time to do everything GAC has to offer."

"I am attending Rensselaer Polytechnic Institute for my PhD in Electrical Engineering."

"Do your best to find balance while at Gustavus. Balance the way you spend your time, balance the communities you choose to belong to, balance the classes you take. Gustavus is a liberal arts school for a reason, find balance! Best of luck to you all, you all will do amazing things."

**Kyle Krippner**, who left us in 2020, is now completing our 3-2 Dual-Degree Engineering program with Washington University in St. Louis.

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**Alex Woitas** writes, "I am currently working as a test technician at Donaldson Company. I am hoping to eventually move into a research and development role at Donaldson or will apply to some other companies for either process or manufacturing engineering."

"I also want to thank you for pushing me to be ready for a career and for improving my problem solving skills. I've been at Donaldson two months now as a contract hire and they already want to hire me full time and want to give me more difficult projects to work on."

"One thing I wish I did more of at

Gustavus is ask more questions/go to office hours. It took me till work to finally realize people are more than happy to help with any question whether its a simple or complex one."



## Faculty Activities

(Continued from page 4)

This summer, **Tom Huber** worked with **Bryce Knutson '22** on ultrasound research. The goal of this project was to use deep learning for noise reduction of ultrasound signals. A computational neural network was "taught" what high-resolution, low noise ultrasound signals looked like, and then this trained network was applied to noisy signals. (For those of you interested in programming, this involved extensive programming in Python using Google Colab, along with MATLAB).

After serving for the last three years as department chair, Tom is looking forward to returning to a normal teaching load this academic year. This fall he will be teaching an FTS on Energy, the 2<sup>nd</sup>-year Math Methods class, and a General Physics lab. In addition to other departmental service, Tom is serving as Education Department liaison. If you have an interest in K-12 teaching in science or physics, please see Tom.

**Steve Mellema** and his wife, Shirley, were able to take two enjoyable trips this summer. After more than 30 years of working at Gustavus, Shirley retired from her job at the Linnaeus Arboretum on June 30. On July 1,

then, they flew to San Francisco to visit family and friends for two weeks. In August they took a road trip to Illinois, primarily to visit their son, **Dan Mellema '11**, who works in Chicago.



**The Mellemas Eat Chinese Food at an Outdoor Restaurant in Chicago**

**Chuck Niederriter** had a relaxing summer, taking a break from mentoring summer students. He travelled a lot with family, making trips to the San Juan Islands in June, Pictured Rocks National Lakeshore in August, and three trips to Pennsylvania. There was plenty of time for gardening and working around the house, as well as sailing on local lakes.

Chuck will be teaching Electromagnetic Universe and the associated lab this fall. He will be the physics department chair and continues serving, along with colleague Jeff Jeremiason, as interim director of the Johnson Center for Environmental Innovation.

This summer **Jessie Petricka** and family spent time camping and relaxing. In addition to the usual hiking and visiting national parks, new this summer was backpacking, where they spent eight days in Pictured Rocks National Lakeshore (shown below).



**Jessie at Painted Rocks National Lakeshore**

This fall Jessie will be teaching Mechanics, Thermal and Statistical Physics Senior Seminar, and hosting for the Nobel Conference.

**Paul Saulnier** is on sabbatical leave for the entire 2021-2022 academic year.





## In Memoriam: Richard M. Fuller

### **Emeritus Professor of Physics**

**Richard M Fuller** (“Dick” to most of us) passed away on January 20, 2021 after a brief struggle with acute effects of congestive heart failure.

A graduate of DePauw University, the University of Minnesota, and Michigan State University, Richard enjoyed teaching and supporting others in their teaching. Richard was a physics professor and department chair at Gustavus Adolphus College from 1969 -1999, where he was a beloved mentor to students and colleagues. He was deeply interested in the intersections of physics, philosophy, and human values, and he continued to explore, volunteer, and teach informally in those areas after retirement.

Dick Fuller retired in May of 1999 after 30 years of teaching physics at Gustavus. In fact, we consider Dick to be the “father” of the current Physics Department. When he came to Gustavus in 1968, he brought with him an active research program in condensed matter physics and an unmatched enthusiasm for teaching physics. His hiring was the spark that ignited the explosive growth in physics at Gustavus, leading to the hiring of most of the current faculty, the expansion of the department, and an emphasis on student/faculty research. Dick was Chair of the department for a number of years and



acting Dean of the College for one year. In 1971, he was the first ever recipient of the Edgar M. Carlson Award for Distinguished Teaching. In addition to being Professor of Physics, Dick was also Director of Curriculum II (now the Three Crowns Curriculum), General Education, and Interdisciplinary Studies, and the Dorothy Peterson, Mildred Peterson Hanson, and Arthur Jennings Hanson Professor of Liberal Studies. It took at least three people to replace him when he retired.

After several retirement parties, Dick and his wife Judy, left for Ocean University of Qingdao in the People's Republic of China in August of 1999. Judy began teaching there in the fall and Dick picked up some work in the physics and engineering areas to keep from getting bored. They stayed in China for four years, making many friends. When they returned they moved into Coffman Condominiums in Falcon Heights, Minnesota, an active community for

independent living, designed specifically for people who have worked at the University of Minnesota at some time during their career. For many years Dick and Judy organized the contingent that came to Nobel Conference, including teaching classes to provide background on the conference topic through the Osher Lifelong Learning Institutes (OLLI). In August 2017, he moved with Judy to Saint Anthony Park Home.

Richard was a private person, who did not readily reach out for support from others, but welcomed contact and requests for support from others. He was very proud of all the people he knew, a diverse group of humans that included family members, work colleagues, neighbors and students. Whether you knew it or not, he was telling others about you and your accomplishments.

On April 24, a virtual memorial service was held, at which many of Dick's former Gustavus students and colleagues paid tribute to him and celebrated his legacy to the College. That legacy includes two endowed funds: the Harold Q. Fuller and Richard M. Fuller Award in Physics, given to the first-year student majoring in physics who has compiled the highest overall physics grade record; and the Richard Fuller Scholars program, which provides financial support for students to engage in summer research.

*This Newsletter is issued at the beginning of the fall semester for the benefit of students, alumni, faculty and others interested in the physics program.*

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