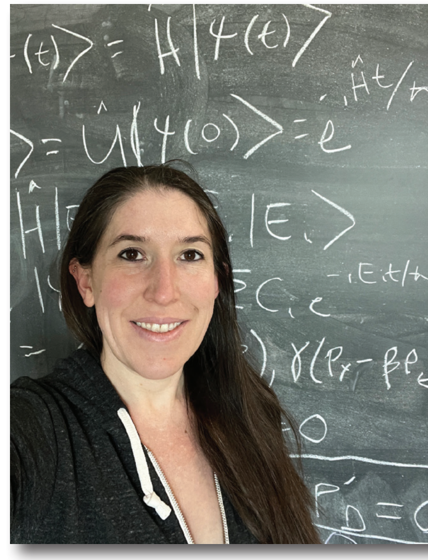
THE PHYSICS MAJOR
Department of Physics and Astronomy
SONOMA STATE UNIVERSITY

Physics & Astronomy Department About to Experience GROWTH

Courtesy of SSU NewsCenter



Sonoma State Professor Alexandra Miller, in partnership with Associate Professor Wing To of Stanislaus State was awarded a $950,000 grant from the Department of Energy's Reaching a New Energy Sciences Workforce (RENEW) program to teach high energy physics and engage students in research and internship opportunities.

It is the first Department of Energy Grant ever awarded to either University.

The nearly $1 million for the pair's proposal, Growth and Research Opportunities With Traineeships in High Energy Physics at Minority Serving Institutions (GROWTH-MSI), will support 10 students per year beginning in January 2024. Each student will receive up to $19,000 in scholarship and stipend support during their junior and senior years.

"College life is especially challenging for many students at CSUs because they need to work many hours in addition to going to school in order to support themselves," Miller said. "Our traineeship is designed to pay students to complete professional development activities and start research, setting themselves up for success in the future. Ideally, our students will not need to work at all in addition to the traineeship."

To and Miller expect to find participants, not only from their own campuses, but also from students of Marteen Golterman at San Francisco State, Kathryn Grimm at Cal State East Bay, Yongsheng Gao at Fresno State and Anna Nierenberg at UC Merced. All four provided input to the GROWTH-MSI proposal.

Applications will be accepted in the fall and the program will launch with a gathering in January 2024, likely at Stanislaus State, where students, faculty mentors and industry scientists, who will serve as mentors and research leaders, will meet for the first time.

"Having these consortiums, with students from different universities who are in the same place as them, gives them a sense of belonging, a physics identity and structure and other support," To said.

Students will receive up to $3,000 for each of their last three semesters and $6,400 for their summer research coupled with a $3,600 housing allowance. In return, students are required to commit 15 hours per week to the program.

During the first semester of the program, students will attend 12 to 15 sessions with professionals sharing virtual presentations on work they are doing at various labs. Those will help students determine their interests as they select a summer project at either Lawrence Berkeley National Laboratory, Lawrence Livermore National Laboratory, SLAC National Accelerator Laboratory, UC Berkeley or UC Santa Barbara.

They'll also be required to take an introduction to particle physics course during that first semester. To and Miller will co-teach it, with To teaching it in person at Stanislaus State and other students participating on Zoom. Future courses may be offered as well.

Once they've done their summer internship, students will likely spend more time working on their project during their senior years and will write a capstone paper to present at a public event.

Miller and To modeled GROWTH-MSI on Cal Bridge, a program offered to students in Science, Technology, Engineering and Math fields and funded by the National Science Foundation and the State of California.

Serving as mentors and members of Cal Bridge's steering committee is how Miller and To met.

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They understand the uphill climb CSU students face.

"The field of high energy physics is really lacking in diversity, which means it is missing out on a range of unique perspectives that science could benefit from," Miller said. "This DOE initiative is aimed at bringing these important viewpoints to the table by training students from Minority Serving Institutions."

Sonoma State and CSU Stanislaus Collaborative Grant to Support High Energy Particle Physics Study and Research Opportunities.

GROWTH-MSI is not just for students contemplating earning advanced degrees.

"Having an introductory level version as an undergraduate class not only gives students who are graduate-school bound a taste of what high energy physics is about, but it also gives undergraduates who are not PhD-bound a chance to learn this material. If they are interested in working as a technician in high-energy physics, they will have some background on why an experiment is designed that way," To said. "It's useful for workforce development and academically driven students."

Developing a workforce is the goal of the Department of Energy.

"They want to encourage underrepresented students to pursue STEM careers, not just physics, but all STEM careers," To said.

Keeping Busy in Retirement

Joseph S. Tenn, Professor Emeritus

My academic activities this year have all centered around the Astronomy Genealogy Project (AstroGen: *https://astrogen.aas.org*), which I founded in January 2013 and have been working on ever since. The Project continues to grow and now includes well over 42,000 people, all of whom have earned astronomy-related doctorates or supervised them. There are 37 countries we deem "nearly complete" at this time. At a meeting of the American Astronomical Society (AAS) in Pasadena last June, I presented a talk, "Astronomy's Lingua Franca", at a session of the Historical Astronomy Division. A majority of the world's astronomy dissertations are now written in English, and it is possible for a student who knows only that language to earn a doctorate in about 30 countries. (In some cases, you would need to earn a master's degree first.)

In January, I observed the tenth anniversary of the founding of AstroGen by presenting an iPoster on ten ways anyone can use it at the AAS meeting in Seattle.

I then expanded that into an article and submitted it to the Journal of Astronomical History and Heritage, an online journal. I hope it will be accepted and will appear in the June issue. I will also describe the project to a different group of historians of astronomy at the Fifteenth Biennial History of Astronomy Workshop at the University of Notre Dame in June.

Capstone Research:
Neurodiversity in STEM Education - Teaching heliophysics to students on the autism spectrum
By Katie Toman

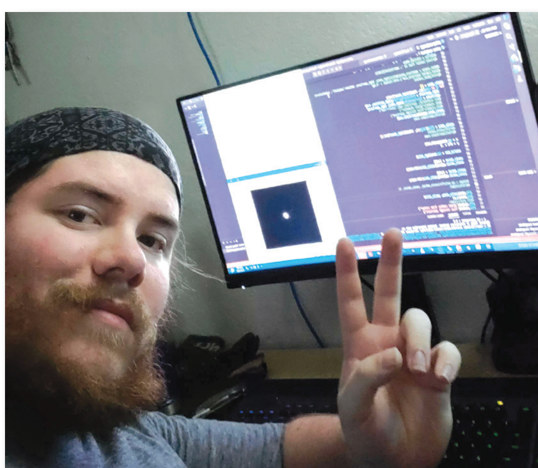
One of over 50 projects funded by NASA's Science Activation program, NASA's Neurodiversity Network (N3) is an SSU-led project whose objective is to provide a pathway to STEM employment and participation for neurodiverse learners. Through this program, we are creating a heliophysics curriculum for neurodiverse Bay Area high school students focusing on those on the autism spectrum. In this project, students will learn through different modalities such as PowerPoints, worksheet-based activities, and through direct observations of the Sun by building their own devices to record Solar data. They will then provide feedback to help ensure that the lessons meet their needs. This process will create a resource for teaching students on the autism spectrum that meets California high school standards while also providing authentic NASA experiences for STEM learners.

This project has become a passion project by allowing me to combine my different interests in an impactful way. In high school, I had wanted to be a special education teacher but developed an enthusiasm for astronomy. Until this project, I had no experience or knowledge of how to tie those two things together. I am proud to be part of this community that truly cares about the resources available for teaching and providing hands-on engineering experiences for all types of minds. I look forward to seeing how far and wide this project will spread across the country after being introduced to the local high schools.

After graduation, I plan to join the workforce doing something related to STEM education, astronomy outreach, or a more engineering-based job. I am currently looking for and applying to jobs in the Southwest and Hawaii. After working for a few years, I will apply to Ph.D. programs in Astronomy Education Research.

Capstone Research:
Performing Non-parametric Tests on Model JWST Galaxies
By Erazmus Bish

For my capstone project I worked in conjunction with my advisor Professor Thomas Targett and classmate Pedro Jesus Quiñonez who was working on an associated project of generating galaxies. To do my project I was given a test image formatted in the same output method used by real computer telescope imagery systems. Working off the base of the test image I had to figure out how to write code that could progressively measure the amount of light present in the image. I was working in the Python3 coding language which is built to be modular with many different libraries of referenceable code and I was able to find an aperture photometry library that could measure the light in specified regions of the image. From there I inserted that code into a loop structure so that it could progressively change the size of its collecting area which would give me what is called the curve of growth of the galaxy. After the counting process completes, the code takes the values it calculated and arranges them into callable lists which I use to graphically plot the representation of the data. After that, the plan is to make it generate a linear fit equation that I can use to determine a feature of galaxies called their half-light radius, which is just the distance from the center of the galaxy that contains half of the light it emits. This is a tool astronomers use to approximate the size of galaxies since they don't have hard borders.



The most interesting part of developing this code was that, apart from a couple prior coding classes, this is my first major self-directed coding project and while I had Professor Targett as a resource solving what problems arose in my code were mine to puzzle through alone. I had many times where I was stuck on a certain error or roadblock of being uncertain where to go next. Once I had my eureka moment, it was very satisfying. I think I'm most proud of how I've managed to make the code itself generic enough that it will be able to take in any properly formatted image and perform the calculations without any changes to how it works. This means it is not limited to working with the test image I used as the base to program it.

I'm hoping that after I graduate I can take a bit of time for myself and relax after this semester. However, I will be looking into local tech companies and businesses at which I could apply what I learned from my degree.

SSU Physics Graduate Wins National Science Foundation Fellowship

By Delfin Vigil, SSU NewsCenter

It may have been while staring at gummy bears in kindergarten when Alex Vasquez realized his path was destined to be different than most. While other kids in his Novato elementary school were doing one-to-one counting with gummy bears, Alex was already working on square roots and multiplication tables. At the same time, five-year-old Alex was still learning how to compose sentences and words, as he struggled with verbal communications and severe social anxiety.

His mother, Rose, a teacher, educated in developmental psychology and experienced in working with children with disabilities, helped seek an early diagnosis of autism for Alex. With a supportive family and network of a homeschool community in Sonoma County, Alex excelled in academics – to the point where a 13-year-old Alex had to enroll at Santa Rosa Junior College to match his formidable math skills.

The academic accolades continue to add up. Alex, who recently turned 25, graduated last year from SSU with a degree in Physics and is now a graduate student in the Physics & Astronomy department at UC Irvine. More recently, Alex won a National Science Foundation graduate research fellowship – becoming only the second SSU physics graduate in the Department's history to receive that prestigious award. Alex's story also inspired a $5.5 million NASA program aimed at helping autistic students that was created by his SSU Physics and Astronomy professor Dr. Lynn Cominsky.

"Alex really opened my eyes to the possibilities that working with autistic learners can offer. Through the opportunities presented by NASA's Neurodiversity Network, I wanted to demonstrate that although Alex has amazing abilities in physics, mathematics and engineering design, he is not unique. There are many other autistic learners that can excel in college and who dream to someday work for NASA. NASA's Neurodiversity Network provides opportunities and support to autistic high school students to work with real NASA scientists and engineers, and we are creating life changing experiences for many of our interns, " said Dr. Lynn Cominsky. Learn more about SSU's N3 internship program here.

We caught up with Alex Vasquez to learn more about his journey from SSU to UCI and what he hopes the stars have planned for him.

You have an inspiring quote: "One of the most important things for me is the ability to focus on my strengths and interests, not my challenges." When did you have that realization?

That came up early on during homeschooling. I'm very good at mathematics, physics, and want to devour as much of that as possible. With the things that I'm not so strong at – like public speaking and talking to people, I prefer to do those at my own pace, rather than being forced and then have stress and anxiety that might interfere with things that I'm passionate about and interested in.

What are you most passionate about and interested in?

Physics and space sciences! At SSU,I majored in physics with a concentration of astrophysics, and a minor in math. At UC Irvine, where I'm currently in graduate school, I am in the ChAMP program, which is a cross-disciplinary program with chemistry and material science and physics. I want to combine my material science and interest in astrophysics by working on solar panels.

When is the first time you heard that term, "autism," and understood what it meant?

Probably around age three. That's when I got my first official diagnosis. But when I first understood what it means to be autistic was probably around age five or six. I was still in public school at the time. I was essentially going through a speech therapy program and talking with various school psychologists having… um! How do I properly describe it? Essentially, programs to help improve my behavior. Because, when you're young with autism, you have trouble with emotional regulation. This very much comes up during things like board games. We played a lot of board games like Candy Land and (Alex laughs) it always irked me because (A) they had these very dumb rules like, oh, you can only win in the game with Candy Land or Snakes and Ladders if you roll the exact numbers that land on the final spot, which just makes it completely random. You go for the entire game, get to that end point and just lose because you kept rolling the wrong number. Also, for the positive reinforcement, they gave you licorice. And, I'm not sure what your position is, but no one I know likes licorice. Unless maybe you're in a movie theater. When someone offers you candy, you're not going to say, "Oh, can you get me a Red Vine?" This is not a dig at Red Vines, but, come on, no one asks for Red Vines!

Let's talk about your academic journey. Your higher ed started at Santa Rosa Junior College at age 13. What was that like?

That experience was odd! After homeschooling I took the math placement exam at 13, and started in the fall quarter 2011. SRJC essentially became my high school. At first, I was too socially nervous and anxious, and not good enough at communication to even order a muffin there. Apparently, my mom had conspired with the cafe staff to essentially socially script, the process of me getting a muffin. They were even looking out for me back then, but I wasn't aware of that. They were very supportive, and it was very helpful. I went through the entire math program. Thought, that was interesting. How do I apply this? Decided to apply it by doing all the physics classes there. Got to the end of that and thought, well how do I apply this? I did the same thing with engineering and the same thing with machine-tool technology… because I wanted to know mechanics and how the assembly process worked. I want to go to NASA. I wanted to design and build rockets. I eventually narrowed it down to astronomy. I also went through all the required courses at SRJC, so, when I got to SSU, I only had to focus on math and physics.

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What subjects are the hardest for you?

This is going to sound weird because it's not public speaking. I had the most fantastic public speaking teacher, Prof. Hal Sanford, and I really enjoyed that class. I think it contributes to why I'm so comfortable speaking at conferences now. There was a differential equations STEM class at SRJC, which was very high-level mathematics. I did get help from another homeschool student, Sarah Muehleck, who helped me a lot.

How has SSU helped you in your journey? Do you have a favorite memory here?

SSU has been an incredibly helpful and safe environment for me to develop my physics and academic skills, especially the Physics and Astronomy Department. I've had wonderful mentors and overall, it's been a fantastic time here. My favorite SSU memory is having been able to work with both the Education and Public Outreach and the EdgeCube Satellite teams. Being able to work with these incredible teams, including having the mentorship of Dr. Lynn Cominsky and Dr. Garrett Jernigan, I simply would not be where I am now without them, and can't thank them enough.

What made you choose UC Irvine?

One of my friends in the homeschool community, his grandfather is Dr. Kenneth Ford, who actually helped found the UCI physics department, and I got a really special opportunity while I was looking at graduate schools, to interview him and ask him about his experiences, and it was a really good experience getting to learn about his early time with meeting all these famous physicists, and how they inspired him, and that inspired me to decide on UCI as my primary choice.

Can you talk about an experiment you're working on now, or one that you're excited about?

I have been jumping around a couple of labs right now. My first year at UCI was with Dr. Matt Law in his lab, where the project I was working on was quantum dots which are these nano-scale electrically conductive material that's essentially a single atomic layer thick that carries charge efficiently from Point A to point B. And this area is very good for creating new optical devices, and also for optics which I'm very interested in it because I want to take this technology and apply it to solar panels.

What's your goal for when you finish school? Have you got your stars already mapped out?

I want to work on solar panels either with NASA or a privatized company. I want to help forward that technology. I want to do something that's applicable in space science, but also is applicable here on Earth… so that it can be used for clean energy here on Earth, while also helping under-powered communities and increasing the accessibility to clean energy – but also be used for space sciences like student cube satellites or NASA's greater satellite projects.

What's your spirit animal?

A whale. That's probably not the right answer, because my immediate thought is being the biggest presence of the room, which is absolutely not correct. Probably a whale because of the symbiotic relationship with the rest of the environment, and I would not have gotten to where I am without the support of everyone around me. Whales, at least the massive ones I'm thinking of, are not super social, they're sort of doing their own thing.

What's your go-to Karaoke song?

I'm going to have to go with "Hello, Cold World" by Paramore. First off, "Hello, World" is like a defaults programming statement. It's also a song about growing up and being thrust into a world that you're very confused but very excited about. It's a crazy world down there, you don't know what's going on, but you're very passionate about getting into it.

Do you have any advice for other students with autism?

Follow your special interests and your passions, because that is going to take you as far as you want to go.

EdEon Spring Update 2025

By Hannah Hellman and Laura Peticolas

NASA's Neurodiversity Network (N3)

As part of NASA's Neurodiversity Network (N3), students at SSU working with EdEon engaged in the development and redesign of science curriculum in astronomy, heliophysics and rocketry. EdEon received additional funding from NASA this year so that we could track the ways that our program is supporting interns as they finish the program and move into their careers. The new funding will also support our team members as they give talks to scientific groups who want to learn more about working in neurodiverse teams and will double the number of autistic high school interns that we can support. N3 staff have given several talks (in-person and virtual) across the nation, spreading the awareness of our project and autism to various groups at NASA. Finally, we have completed drafting lessons in solar science which are being rolled out with input from science teachers at our four partner high schools that support autistic teens.

Learning by Making (LbyM)

Our second largest project, Learning by Making (LbyM) reached 7 schools this year, three of which are participating in a Department of Education randomized control trial to measure the ways that our curriculum helps students learn and engage in science in the classroom. Throughout the school year our teachers participate in Professional Learning Experiences (PLEs), allowing teachers to come together with EdEon staff and support one another. PLEs provide the opportunity for our teachers to supplement their knowledge of our curriculum and hone the skills they bring to their classrooms for their students - ***https://lbym.sonoma.edu***

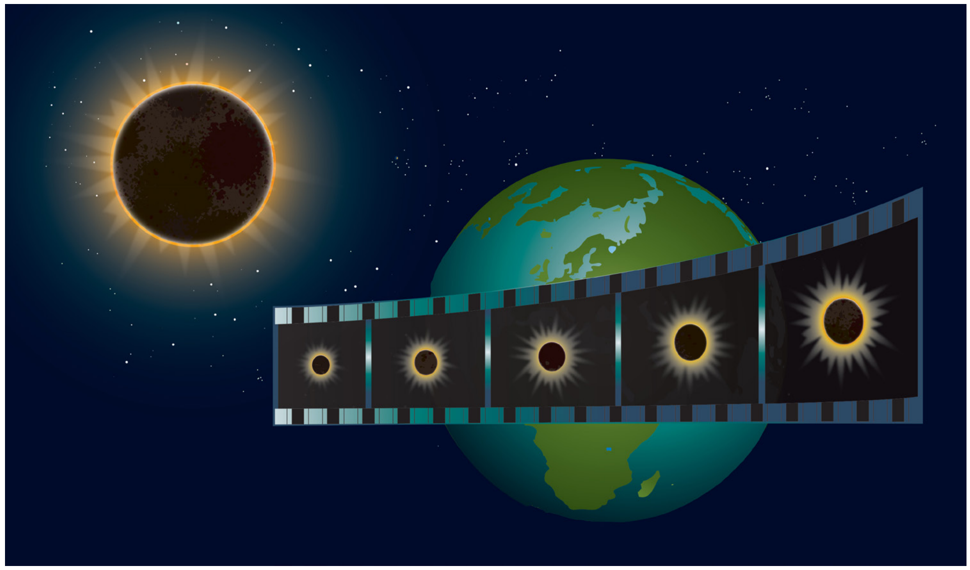
Interstellar Mapping and Accelerating Probe (IMAP)

NASA's IMAP Student Collaboration $3U^3$ project brings Physics, Engineering, and Computer Science students together at EdEon. This project is aimed at SSU undergraduates, and employs the most number of students. This year, our students (Aaron Russell, Alexandria Walker, Erika Diaz Ramirez, Haley Joerger, Jonathan Perez, and Onasis Mora) have been working on a variety of different CubeSat tasks. Specifically, Russell has worked on lifetime calculations of orbiting 3U CubeSats (small satellites) to characterize the parameters that influence when they will fall out of Earth's orbit due to atmospheric drag. Diaz Ramirez and Walker have been working on the ground station located at the top of the Schulz Information Center. They have been replacing, calibrating, and maintaining the antenna that will be used to communicate with the satellite once it is in space. Once the repairs and maintenance are done, our ground station will be able to send and receive signals, rather than simply receive them. Additionally, Joerger and Perez are working with NASA JPL's F Prime (F') software to determine if it is a suitable solution to the flight software needs. F' is a software framework for the rapid development and deployment of embedded systems and spaceflight applications, and is used primarily for CubeSats, instruments, and deployables. For example, in December, Joerger completed a code written in C++ to read in the first line of TLE (two-line element, part of the calculation of a spacecraft orbit) and parse out the date and time. Mora has started to review the hardware for the FlatSat, which has arrived from the company, Endurosat. Several of these students and EdEon mentors, Dr. Laura Peticolas and Jeffery Reedy (SSU Physics Graduate, 2020) attended the annual Cal Poly CubeSat Developers Workshop in April 2023.

$3U^3$ SSU and University of New Hampshire (UNH) students and mentor at the CalPoly CubeSat Workshop in San Luis Obispo. From left to right: Erika Diaz Ruiz, Alex Walker, Dr. Laura Peticolas, Kaiden Bedell (UNH), Kelly Bisson (UNH), and Haley Joerger. Credit: Doug Clarke.

Eclipse Megamovie NASA grant

By Laura Peticolas



Dr. Laura Peticolas and Prof. Tom Targett received a 3-year NASA grant with Dr. Juan Carlos Martinez Oliveros from University of California, Berkeley, to study plasma transients in the solar corona during the total solar eclipse on April 8th, 2024. The project, Eclipse Megamovie 2024 (EM2024), is a citizen science project using two methodologies for engaging with community members throughout the U.S. in this research: i. collecting images of the solar corona during the total solar eclipse and ii. using Artificial Intelligence (AI) to support analysis of the images to reveal the plasma transients within collections of photographs. Photographers will be trained to use their own cameras to obtain scientific data, leveraging over 100 volunteers who participated in the Eclipse Megamovie 2017 project. Computer programmers and scientists will support the AI analysis work, together with the SSU and Berkeley teams, including SSU Physics alumnus, Hunter Mills.

Visit *https://eclipsemegamovie.org* to learn more and to sign up as a volunteer!

EM2024 builds on our previous project, the Eclipse Megamovie 2017 project goal was to create a movie of the solar corona on August 21, 2017 taken by photographers from Oregon to Idaho to Nebraska and so forth all the way to North and South Carolina, as the moon's shadow traversed the country over a 90-minute time period. An extensive outreach effort was undertaken for over a year, which included tours in towns that would experience the total solar eclipse, outreach presentations, articles in popular science magazines, news interviews, and a website (*https://2017.eclipsemegamovie.org*) Approximately 2,000 volunteers submitted 50,000 images soon after the total solar eclipse had finished. Images were processed in order to align the circular image of the moon in each image with each and every image. Images were not rotated to align with the solar coronal structure in the first movie release just hours after the total solar eclipse. Several months later, another movie was released after the science team rotated images such that photographs could be aligned using the star, Regulus, which could be seen through the solar corona in the images. Over several years, further image processing was implemented to create High Dynamic Range (HDR) images to capture the structures within the high dynamic range of the solar corona from the Sun's photosphere out ~3 solar radii. A plasma plume has been identified within the HDR images, as seen by other DSLR camera research from 2017. The new grant will allow the team to publish these results and improve on the 2017 process and data collection effort.

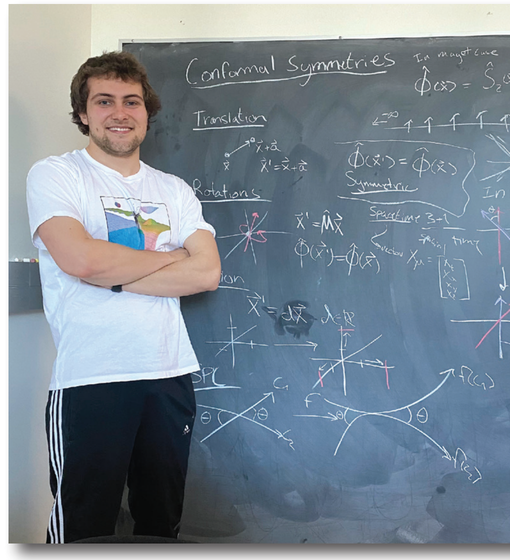
Capstone Research:
Creating Better Worksheets for PHYS 114: Intro to Physics 1

By Cody Kojima

For my capstone project, I created new worksheets to assign as homework to the students of SSU's spring 2019 PHYS 114 class. The original goal of the project was to determine if these new worksheets were superior to that of the old online worksheets through analysis of the past and current grades of students. However, I found this to not be feasible as there was a large difference in the classes grade distributions. So instead, I sought out to determine whether completion of the new homework had any effect on current students' average exam scores. The idea behind this is that any good homework should help supplement students' understandings which will reflect in their exams.

The most interesting experience during my capstone journey was the fact that I had a plan that didn't fall through and had to readjust my way of thinking to come up with an effective way to show my results of the new worksheets I have created. Not only was this a challenge, but a great life lesson. As an aspiring pilot after graduation, this capstone gave me the opportunity to adapt to a problem and demonstrate some critical thinking as this is an important quality to have as an aviator. After I graduate, I plan to travel back to Hawaii and apply to serve as a pilot in Hawaii's Air National Guard.

Capstone Research:
A Conformal Field Theory Primer
By Andrew M. Evans



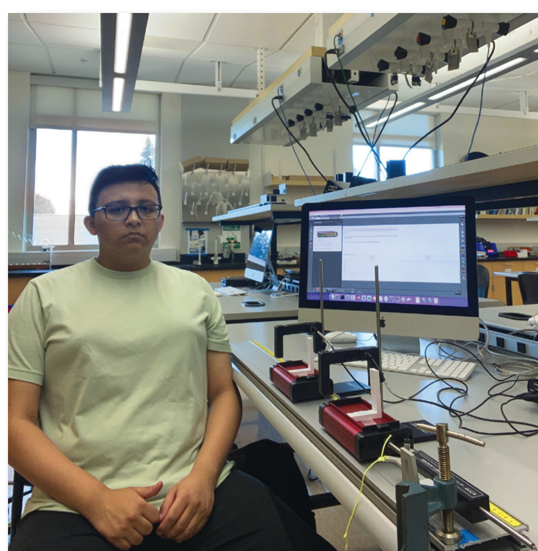
Conformal field theory (CFT) is a mathematical tool used to solve problems in systems with scale invariant symmetries. The subject has a deficit of under graduate level resources, a gap which my capstone project aims to fill through the creation of a CFT primer. To understand CFT, we explore what physicists mean by fields. A field is a function that takes in a position and returns some mathematical object. A good example of a field is a temperature field. In the temperature field each point in space would have a number value corresponding to the temperature at that point. The word conformal in CFT refers to a family of symmetry the field must obey. If the coordinates the field is built over can be translated, rotated, dilated, or locally rotated and dilated without change to the output the field is said to be a conformal field. My primer on CFT is aimed at undergraduate physics majors who have interest in theoretical physics, but are not yet ready for graduate level material.

Working on this project exposed me to the world of theoretical physics research. I spent a large part of my time reading papers and writing, a much different experience to the previous physics research I had been a part of. I am excited to do more theoretical physics research in the future. I have been accepted into a PhD physics program at University of California Irvine. I hope to study theoretical high energy physics with a focus on physics beyond the standard model. I am looking forward to applying what I have learned here at Sonoma State to my PhD studies at Irvine.

Capstone Research:
Instructional Design: How to Improve the Collisions Lab
By Kevin Vasquez

When an elastic collision occurs, there should be no loss of total kinetic energy and total momentum in principle. When students take the introductory mechanics lab in Physics 116 and 209A, however, Dr. Shi often notices that results vary greatly from one student group to another even if they are all following the same lab procedure to work on the same head-on elastic collision experiment. The loss of total kinetic energy is often as high as 30%. Our project is to understand what has caused such a big discrepancy between the theory and the experimental results. We have discovered that factors such as whether or not the track on which the collisions take place is clamped to the table, the friction between the moving carts and the track, and the distance between the photogates are all responsible for such a big discrepancy. The goal of this project is to revise the lab write-up to help the students better understand physics principles.

Throughout this semester this project has allowed me to gain experience in the mechanics part of the labs. Every week I had to assemble the equipment onto the track and test if everything was in good working order. There were times when I had difficulty such as the initial velocity of the cart not being consistent, the positions of two photogates being either too close or too far, and the capstone program not catching the data points. I would like to thank Dr. Shi and the Department for giving me this opportunity to gain more hands-on experience. After graduation, I plan to move back home to Monterey and get my teaching credential. I would like to become a high school science teacher and give back help to the public school district that helped me get into college and show students that being a first generation college student is possible.

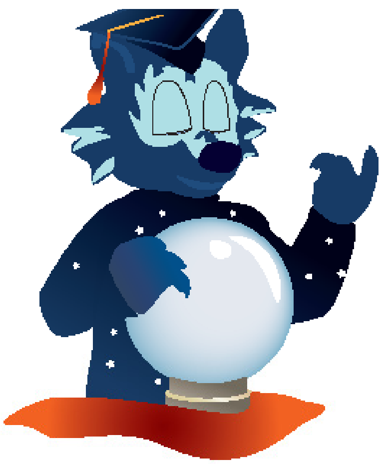


Capstone Research:
Simulating High Redshift Galaxies for JWST
By Pedro Jesus Quiñonez

The JWST is the next class of space telescope, built to see further out than humanity has ever seen before to study the earliest galaxies in the universe. JWST has already taken beautiful images, but how is meaningful science extracted from these images? One way is to create a theoretical model of what we should see and compare it to real data to test if our underlying understanding is correct. That is exactly what I have done in my project: I used the Sérsic model, which is commonly used to model current galaxies, to simulate the earliest galaxies and how JWST would see them. This would be a test of how well our current models of galaxy light profiles are consistent across time.

Some of the more difficult parts of this project were thinking less like a physicist and more like a computational astrophysicist. I was generating such large images that, while the science was sound, the code would run for hours. So I had to put a lot of work into optimizing my code and even had to test how small I could shrink the image without losing any information. Still, it was one of my favorite research projects I've worked on because of how applicable it will be to my future work and because it was the first time I was able to create simulations

I will be graduating from Sonoma State University this semester with a Bachelors of Science in Physics with Concentration in Astrophysics. Afterwards, I will be going to graduate school, and after a long and difficult application process, I have decided to pursue my PhD in Astrophysics at UC Santa Cruz. There are a lot of amazing research opportunities at UC Santa Cruz, from transients to cosmology, but I hope to study similar topics to my project, creating simulations to study the high redshift universe with JWST.



Each year we ask the graduate with the highest GPA to predict an area of research that will be important in the future. This year's graduate with the highest GPA is Pedro Jesus Quinonez, who has also received an NSF Graduate Research Fellowship to support his future graduate studies.

My predictions for future scientific breakthroughs
By Pedro Jesus Quiñonez

The universe is expanding due dark energy, a phenomenon we know little about. The expansion rate of the universe is described using a single constant, the Hubble constant, often called H0. The Planck Collaboration found an H0 value of 67.4 km/s/Mpc by fitting the cosmic microwave background data to the lambda-CDM model. The SH0ES Collaboration found an H0 value of 73.2 km/s/Mpc by making direct measurements using standard candles. This disagreement between the two main ways to measure H0 is called the Hubble tension. This means that one of two things is wrong: how we explain everything in the universe or how we measure everything in the universe. Before we could even begin to figure out why these values are different, it'd be useful to know which one is closer to the true value of H0.

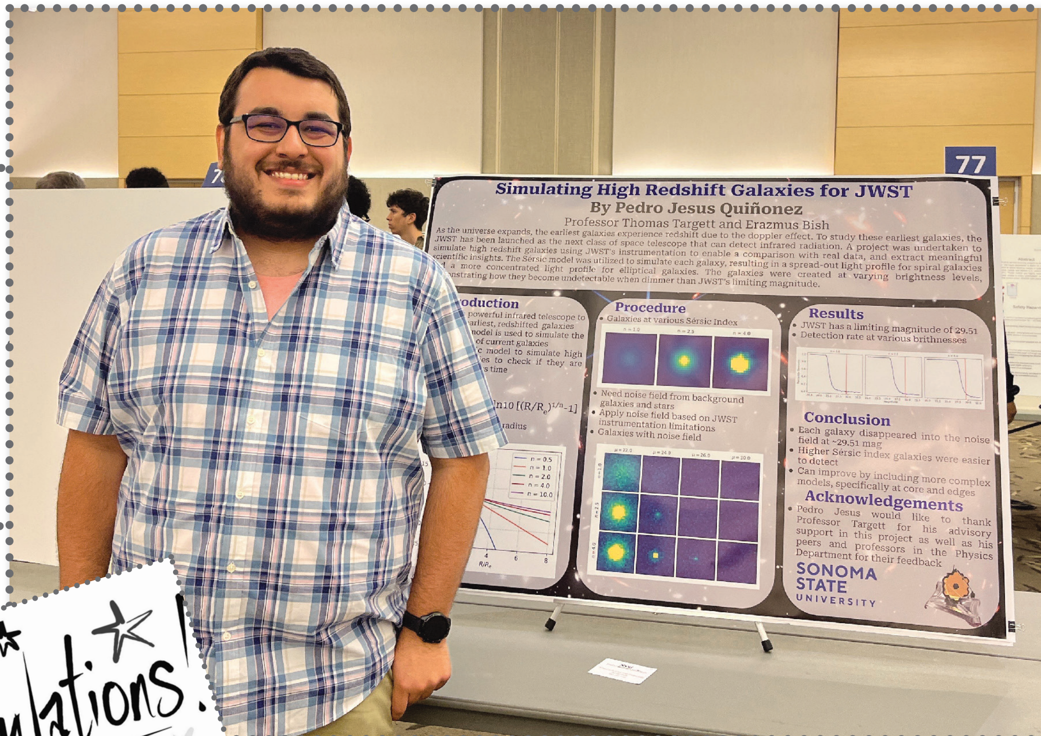
After LIGO detected the first kilonova with gravitational waves in 2017, UC Santa Cruz then followed up and found it using light. Combining the distance data from the gravitational wave and redshift from its host galaxy, this event gave a measurement of H0, though not yet competitive with the previous measurements because of its high uncertainties. My work while at UC Santa Cruz's summer research program focused on a similar subject, using gravitational waves to make a statistical measurement of H0. The following summer, I then created a pipeline to assess the candidates in gravitational wave follow up. In May 2023, LIGO will begin its 4th observation run. If it finds kilonovae, and there are successful electromagnetic follow ups, this independent measurement of H0 can become certain enough to be competitive with the previous methods. I am excited that the tools I've built at UC Santa Cruz will aid in these measurements, and that we are so close to making major discoveries in this field in which I have spent several years. I believe in the next few decades, this third measurement of H0 can begin to chip away at the mysteries of the Hubble Tension, helping us understand dark energy and grounding our understanding of our place in this expanding universe.

Breaking News: Physics and Astronomy Department Students Win Big at SST Science Symposium!

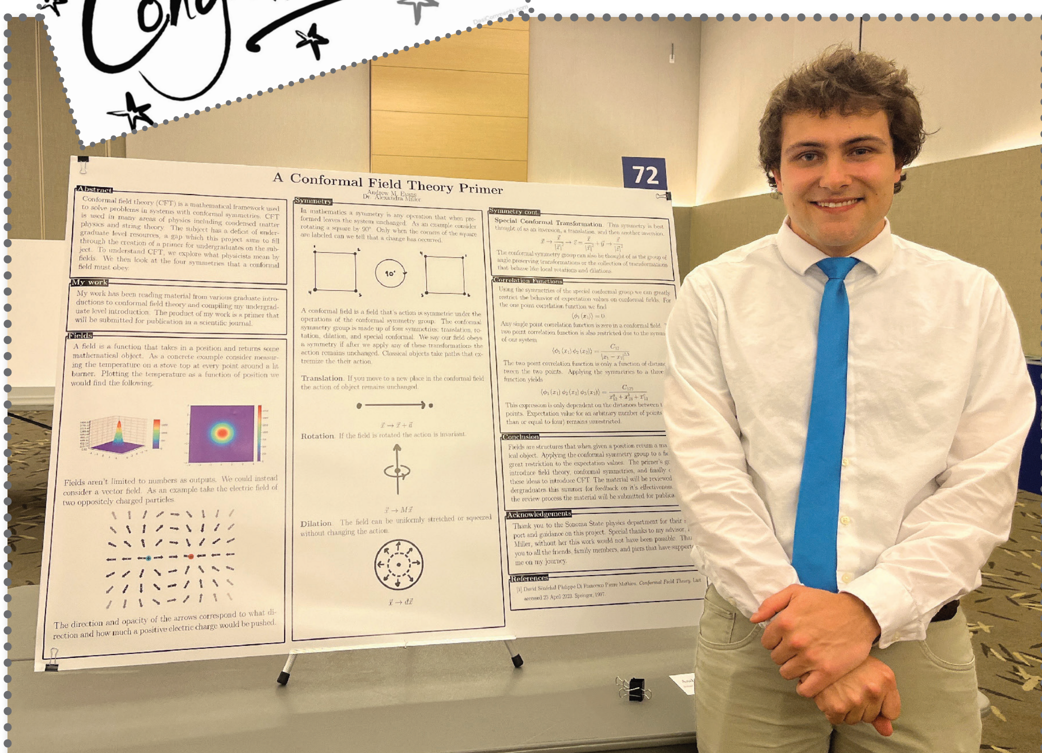
By Prof. Alexandra Miller

Two Department of Physics and Astronomy students took home big prizes at the Spring 2023 SSU School of Science and Technology Science Symposium. Pedro Jesus Quiñonez won the "Big Picture" award for his work with Dr. Thomas Targett: "Simulating High Redshift Galaxies for JWST."

Andrew Evans won the "Bright Idea" award for his work with Dr. Alexandra Miller: "A Conformal Field Theory Primer." Katie Tolman's poster on Neurodiversity and Heliophysics won second place in the "Bright Idea" competition. All projects were completed for the students' senior capstones and are described in the articles written by Pedro Jesus (p.9), Andrew (p.8) and Katie (p.3).



Pedro Jesus Quiñonez



Andrew Evans

Thank You for Your Support!

We thank our ongoing student research assistantships contributors.

Research is thriving within the Department, and funded research experiences have provided our students with incredible opportunities. Other scholarship funds also support and provide students with opportunities they would not have if not for the generosity of donors.

Our public programs remain vital, including the "What Physicists Do" lecture series and the Public Viewing Nights at the SSU Observatory. These are partially supported through donations and grants from SSU's Instructional Related Activities Fund. WPD remains the longest-lived public lecture series on campus. To subscribe to the Public Email List, contact the Department at: *PAdept@sonoma.edu*. If you would like to support our program and students, please see: *phys-astro.sonoma.edu/giving*

Or contact the SSU Development Office at (707) 664-2712 or contact the Department at (707) 664-2119 or *PAdept@sonoma.edu*.

Gifts In Kind:

Thank you Diane Hichwa for your generous donation of the Physics Library of Professor Emeritus Bryant Hichwa. These books have a good home in the Department of Physics & Astronomy!

Current Funds:

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Established by Joe Tenn to honor his parents.
Prof. Emeritus Joe and Eileen Tenn

#E0305 Joseph S. Tenn Scholarship
Dr. Richard De Freez ('80) and Ms. Toni Kristensen

Remembering Jesse Garrett Jernigan
By Prof. Lynn Cominsky

Jesse Garrett Jernigan, Jr., known to all as Garrett, and husband to Prof. Lynn Cominsky, passed away unexpectedly on May 9, 2022 in Petaluma, California. Most of Jernigan's career was spent at UC Berkeley's Space Sciences Laboratory, where he worked until his retirement in 2011. After retiring from UC Berkeley, he began volunteering at Sonoma State University where he provided technical management and scientific direction for several small satellites ("CubeSats") that could be built by undergraduates. The first SSU small satellite was the successful launch of T-Logo-Qube in 2013, in partnership with Prof. Bob Twiggs from Morehead State University (Kentucky). SSU physics majors Kevin Zack, Ben Cunningham and Hunter Mills all contributed to the T-LogoQube's success, and helped to operate it for its two month lifetime. Jernigan's work with SSU students continued through the launch of EdgeCube in 2020, and in developing prototypes for NASA's IMAP Student Collaboration Satellite, known as 3U3 (planned for launch in 2025). The microcontroller developed for SSU's CubeSat program became the initial hardware platform for SSU's hands-on ninth-grade STEM curriculum "Learning by Making", which aims to help rural high school students think, experiment, and learn how to utilize the technology that is quickly shaping the world around them. He was inspiring, stubborn, creative, and determined. Garrett firmly believed that if one could not solve a problem in 3 hours or less, it was best to consult an expert: and he was very often the expert consulted on many projects throughout his life. Shortly before his passing, Garrett was project scientist and creative driving force on a team that included long-time research collaborators Brian Silverman and John Doty, along with engineer Phil Jobson, that won first place in NASA's "Honey I Shrunk the Payload" contest for a miniature x-ray spectrometer known as "Sun Slicer". The Sun Slicer team's work will be launched to the moon, adding to the many other pieces of his legacy that will continue on amongst the stars.

Garrett was a kind and loyal man, caring deeply not only for his beloved wife, but for his friends, students, and all his animals at the Little H-bar Ranch near Petaluma. Donations in Garrett's memory may be made to Sonoma State University, fund number (580090-QZ059-1042-QB125PI) to support the Learning by Making program.
Read Garrett's full obituary at the American Astronomical Society: *https://baas.aas.org/pub/2022i054/release/1*

Department of Physics & Astronomy

- B.S. Physics
- B.S. Astrophysics
- B.A. Physics
- B.A. Physical Science

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