

The Society of Physics Students Presents...

THE INAUGURAL SDSU ZONE MEETING



April 21st and 22nd
Faculty Staff Club &
GMCS 333

SDSU | ZONE MEETING

OPTICS | QUANTUM | DARK MATTER | ASTROPHYSICS | MACHINE LEARNING

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Foreword From the Presidents

Dear Zone Meeting Participants,

We are thrilled to welcome you to the inaugural SDSU Society of Physics Students zone meeting. Over the next two days, you will have the chance to meet other physics students in the greater San Diego area, learn about their research, and discover some of the different opportunities that a physics background can offer you. We urge you to take full advantage of the program and to feel comfortable asking questions, sharing experiences, and establishing new connections.

We also recognize that you are part of a new generation that has the power to shape diversity, equity, and inclusion in the sciences. We firmly believe that addressing these social justice issues is crucial for the long-term health and success of the scientific community. Together, we can make a positive impact and create a more inclusive and equitable future in the field of physics.

We are excited to be part of your scientific journey, and we hope this meeting can serve as a stepping stone in your career. You are an incredible group of people, and we hope you enjoy meeting each other over the next two days. We are certainly excited to meet you all.

Faith Poutoa & Ky Putnam
Society of Physics Students Co-Presidents

Conference Schedule

Friday, April 21st

5:00 pm Reception | Faculty Staff Club
6:00 pm Doc Morris Lecture | GMCS 333

Saturday, April 22nd

11:00 am Luncheon | Faculty Staff Club
12:00 pm Undergraduate Talks | GMCS 333
1:15 pm Break
1:25 pm Graduate Student Panel | GMCS 333
2:40 pm Imposter Syndrome Workshop | P-148
3:45 pm Break
4:00 pm 'Just Chatting' with Dr. Matt Anderson | GMCS 333
5:00 pm Debrief and Closing Statements

Tribute to Doc Morris

In 2007, the SDSU Department of Physics named its Annual Public Lecture the “Doc Morris Public Lecture Series” in honor of its most senior faculty member Prof. Richard H. Morris, who joined the SDSU Physics faculty over 50 years ago (his original hire date is August 30, 1957). Doc was the longest-serving faculty member at SDSU! And one of the longest-serving in the entire California State University system.

Doc Morris received his Ph.D. in Nuclear Physics from the University of California, Berkeley, in 1957. He supervised well over thirty graduate theses and dozens of undergraduate thesis projects in electromagnetism and optics. His PHYS 357 Advanced Physical Measurement class was legendary amongst our graduates.



Artist sketch of Doc Morris by Courtney Parker.

'Doc Morris Lecture' Keynote Speaker: Dr. Alex Frañó

Alex Frañó is an assistant professor at the University of California, San Diego. He obtained his bachelor's degree in physics from the National University of Honduras in Tegucigalpa. Then, after pursuing a career in music in Mexico City and other places, he returned to physics to work on his master's degree at the University of Stuttgart. He did his Ph.D. research at the Max Planck Institute for Solid State Research. He is the assistant director of an "Energy Frontier Research Center" funded by the Department of Energy to study "Quantum Materials for Energy Efficient Neuromorphic Computing" with the goal of developing a new materials platform for a computing paradigm inspired by the brain.



His other research interests include strongly correlated electron systems, self-assembly in polymer-grafted nanoparticles and various forms of x-ray scattering tools to probe their properties. Outside of physics, Alex is involved in music composition and sound design, as well as executive-producing movies that portray the difficulties that Latin immigrants face.

How the 'quantumness of electrons in materials can lead us to a machine that works like the brain

Presented by Dr. Alex Frañó

Abstract

The computational revolution of the last seven decades propelled one of the most important technological advances in history. The key breakthrough was the realization that a material such as silicon features electronic properties that can carry out the task of a transistor-the basic building block of a computer. But the mysteries and surprises of the quantum mechanical behavior of electrons in solids continue to surprise researchers, revealing fascinating new possibilities for a new technological revolution. In this talk, I will survey the behavior of "quantum materials," a new generation of materials whose quantum mechanical properties defy even the most advanced understanding. What are these materials, and what makes them so interesting? How can they be useful to society? Then, I will show you a new computational paradigm that will emerge in the next decades based on quantum materials, "neuromorphic computing," which mimics the human brain.

Undergraduate Talks

12:00 pm – 12:15 pm

Faith Poutoa, SDSU, Research: Optics

The early identification of oil spills is vital in minimizing their detrimental effects on the environment. Numerous detection methods are currently in use, but most cannot be effectively used on a 24-hour basis. Rapid emergency response and mitigation measures, such as the immediate cessation of the leak and implementing other damage control strategies, are essential in minimizing the spill's impact. In this work, we develop a fluorescence-based method that will enable improvements in next-generation oil sensors, particularly in chemical specificity. Our primary method of detection is through phase-sensitive detection using a lock-in amplifier. The phase-sensitive detection technique is an effective method of noise negation because it pulls out frequencies that match the reference signal, allowing for an efficient method of fluorescent signal detection. Optical signals from up to 60 meters away from the light source are received using a telescope, photodiode, and a UV light source. Varying light intensity levels are experimentally generated and compared to the results of computer simulations, showing excellent agreement.

12:15 pm – 12:30 pm

Myra Khandelwal, UCSD, Research: Dark Matter

Dark matter is an essential concept in understanding large-scale phenomena in the universe such as evolution of structure in the universe, high orbital speeds of stars in spiral galaxies, and distortion of light from distant galaxies and galaxy clusters. With the growing need to understand the behavior of dark matter, several theories postulate the type of particle dark matter can be. This is critical for understanding dark matter's role in the Standard Model (which is incomplete), thus putting forth various potential candidates that may constitute dark matter. Dark matter can be made of one or several new particles, which are expected to be electrically neutral, uncolored, weakly-interacting, and stable. This paper reviews the role of dark matter in the physics of the universe while also presenting the possible candidates from publications that theorize the type of particle dark matter may be.

12:30 pm – 12:45 pm

Tiffany Liou, UCSD, Research: Astrophysics

In the currently favored cold dark matter (CDM) model, dark matter is concentrated into gravitationally bound clumps known as halos and subhalos. Dark matter is only known to interact gravitationally, making subhalos difficult to detect unless they contain baryons. Stellar streams, extended tails of stars formed from the tidal disruption of globular clusters or low-mass galaxies, are extremely sensitive to changes in the gravitational potentials in which they orbit. Thus, stellar streams are ideal candidates for studying dark matter substructures. This work focuses on two Milky Way streams: GD-1 and Palomar 5. They show variations in density and width distributions that are best explained by gravitational perturbations. We analyzed sets of simulated stream data that contain varying amounts of subhalo populations ranging from no subhalos to three times the expected number of subhalos in CDM. We compute the stellar density, width, velocity dispersion, and stream track as a function of position along the streams to determine the effect of subhalo interactions on the streams. In looking at these kinematic effects on stellar streams, we observe that subhalo interactions induce density gaps, higher velocity dispersions, and wider stream widths. Quantifying these gravitational effects with additional simulations can allow us to better identify stream perturbations to ultimately constrain the subhalo mass function.

12:45 pm – 1:00 pm

Kevin Obregon, SDSU, Research: Machine Learning

Band gap is a way to determine whether a material is a conductor or an insulator. By using material simulation of 2D and 3D materials, we can extract valuable structural data called "Crystallographic Information Framework" (CIF) and feed it into a machine learning algorithm. The purpose of this algorithm is to take in the given data, perform a series of calculations, and output a predicted value of the band gap. We already know what the band gap value should be, but the algorithm does not, so ideally, we want to get as close to that value as possible. The accuracy of predicting these band gap values in the algorithm is based on the value and the mean squared error (MSE). Achieving good accuracy with the algorithm allows us to potentially use it to discover new 2D and 3D material combination.

Graduate Student Panelists

Hosted by Kevin Obregon



Ngara Bird is a second-year Medical Physics Masters student and President of the SDSU Women in Physics chapter. Her research interests are in magnetic resonance imaging and image processing. After graduation, she plans on attending Duke University, where she will continue her studies in a two-year medical physics residency program.



Spencer Raines is a second-year Astronomy Masters student at San Diego State University. His current research interests center around analyzing the evolution of core-collapse supernova geometry over time. Spencer enjoys sleeping on the beach and caring for his son: a cat named Bean.



Leonardo Barba is a second-year Astronomy Masters student at San Diego State University. His research interests include both instrumentation and galaxy formation/evolution. Leonardo will be attending graduate school at New Mexico Tech to pursue his Ph.D. in physics; he hopes to work as a researcher at a national lab.



Ashley Lemasters is a second-year Astronomy Masters student at San Diego State University. Her research interests include galaxy evolution, formation, and mergers. She is passionate about education and public outreach. Ashley also hosts planetarium shows, operating SDSU's Spitz AP3 optomechanical star projector.

Imposter Syndrome Workshop

Hosted by Ky Putnam

Imposter syndrome is a common experience among students, especially those from underrepresented and marginalized backgrounds. The feeling of not belonging, the fear of being exposed as a fraud, or the belief that one's accomplishments are due to luck rather than hard work and ability. It can have a negative impact on academic performance and career prospects, but it doesn't have to.

This workshop will have a discussion-based format with the goal of providing a safe and supportive space for you to share your experiences and learn strategies for overcoming imposter syndrome.



Ky Putnam is a senior at San Diego State University, about to graduate with a Physics B.S. They are currently serving as Co-President of the Society of Physics Students while working on research projects in nuclear theory and observational cosmology. Next Fall, Ky will be beginning an astrophysics Ph.D. at CU Boulder, where they intend to continue to do research in observational cosmology through instrumentation and simulation. Ky is a recipient of the 2023 NSF GRFP.

'Just Chatting' with Dr. Anderson

Hosted by Faith Poutoa

A unique opportunity to learn more about Dr. Matt Anderson's illustrious career, which evolved from being an undergraduate student at UC San Diego to becoming a Senate distinguished professor, CEO of Learning Glass Solutions, and acclaimed YouTuber.

Bio

Matt Anderson is a Senate distinguished Associate professor at San Diego State University. He obtained his bachelor's degree in physics from the University of California, San Diego. He did his Ph.D. research at the University of Oregon. His research centers on the physics of ultrashort pulsed laser light. Dr. Anderson's current research interests include the development of a hydrocarbon remote sensor, which has applications in the early detection of oil slicks. In addition to his research in applied physics, Dr. Anderson is also working on a physics education project that studies the impact of virtual reality in the classroom.



Apart from physics, Dr. Anderson is the Co-founder and CEO of Learning Glass Solutions. The Learning Glass has gained popularity in various educational settings, from K-12 schools to higher education institutions, as well as in corporate training and professional development. It has been used for a wide range of subjects. It is a powerful tool for creating engaging educational content that can be easily shared in online or blended learning environments. The Learning Glass is a major character in Dr. Anderson's youtube channel (@yoprofmatt), which has amassed over 14 million views and 160k subscribers!

Acknowledgments and Special Thanks

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Dr. Matt Anderson

Dr. Arlette Baljon

Dr. Sanjay Behura

Dr. Calvin Johnson

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Hilary Scalisi, Department of Physics

Sarah White, College of Sciences Dean's Office

Panelists, Speakers, and Moderators

Dr. Alex Frañó, UCSD

Myra Khandelwal, UCSD

Tiffany Liou, UCSD

Leonardo Barba, SDSU

Ngara Bird, SDSU

Ashley Lemasters, SDSU

Spencer Raines, SDSU