

Physics & Astronomy

WESTERN WASHINGTON UNIVERSITY

Fall 2018

From the Chair



Fall brings the beginning of the new academic year and it is also my 4th year as the Chair of the department. That means the 4-year term will end this June and we might have a new Chair next year, but we'll see. Stay tuned.

As always, I would like to reflect a little bit on an exciting previous academic year. We graduated 23 students and have a rather large class of 25 students entering their senior year. Our outstanding graduate last year was Elle Ojala who was (obviously) an academically very strong student, but also was involved in a variety of outreach activities including working as a tutor and mentor, participating in the Women in Physics club and GEMS (Girls in Engineering, Math, and Science) events. She also was an undergraduate researcher in Prof. Kevin Covey's group and worked on an REU (Research Experience for Undergraduates) project at Lehigh University. As you can see, Elle is a very remarkable student and will accomplish a lot after her time at WWU, wherever that will be. Talking about remarkable students, for the third year in a row, a student from our department was chosen as the Presidential Scholar from the College of Science and Engineering. Dalton Jones was honored with this award; he also was involved in various outreach projects (mostly through NASU – the Native American Student Union) and conducted research in Prof. Armin Rahmani's group. He is continuing his education at UCLA and is enrolled in their Ph.D. program. All the best to these two amazing graduates and the rest of the graduating class 2018.

As you can see, the involvement of undergraduate students in faculty research is a major component of the quality education physics majors at WWU get. We were fortunate enough, through your generous donations last year, to provide four undergraduates with a paid research scholarship during the Summer. Thank you all who gave, through the Viking Funder or other avenues, to our designated fund for Undergraduate Summer Research. Hopefully, with your help we can provide this opportunity again next Summer. More details about our fundraising efforts can be found in the newsletter.

Lastly, I would like to draw your attention to an exciting event this upcoming Spring. WWU and the Department of Physics & Astronomy will host the annual meeting of the APS Northwest section here in Bellingham. This meeting will have around 10 plenary talks with additional invited and contributed talks in all

areas of physics and astronomy. The dates are May 17th & 18th which coincides with the end of WWU's Scholars Week and Alumni weekend. Hopefully, we will see some of you at this meeting.

Enjoy the newsletter and as always I'm looking forward hearing from you about your life after leaving WWU.

Our Seniors 2017-2018

Our seniors have a wide range of post-WWU plans including graduate programs at UCLA, Emory University, Lehigh University, Oregon State University, University of Oregon, and University of Otago (New Zealand). Several have already found jobs in industry and others are planning on simply taking a well-deserved break!



Left to Right, Front row: Rachel Benson, Victoria Highly, Elle Ojala, Dalton Jones, Noah Harris, Nathan Chintagavongse, Second row: Jessica Reyna, Derek Thedell, Geordan Brewer, Reuben Szabo, Nicholas Cemenenkoff, Third row: Zachery Laycock, Richard Ballantyne, Sam Stansell, Jo'Elen Hagler, Graham Roberts, Scott Copas, Back row: David De Varona, Nicholas Saether, Jacob Skinner, Missing from photo: Linnea Bavik, Cade Gollub, and Joseph Smith.

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New faces in the Department

Assistant Professor Dimitri Dounas-Frazer



Dr. Dimitri Dounas-Frazer is an Assistant Professor in the Physics and Astronomy Department and the Science, Mathematics, and Technology Education (SMATE) Program. He has interdisciplinary expertise in experimental atomic physics and education research. He primarily studies three aspects of physics laboratory coursework: students' use of model-based reasoning in experimental physics contexts, instructors' beliefs and practices regarding teaching and learning laboratory skills, and classroom factors that cultivate student ownership of research projects. His interests also include students' development of non-cognitive skills, like resilience to failure, through self-reflection and personalized feedback. Additionally, Dr. Dounas-Frazer is an active member of local and national physics diversity initiatives. He completed his Ph.D. in 2012 at the University of California Berkeley, where he performed high-precision measurements of weak nuclear effects in atomic systems. His postdoctoral experience includes teacher preparation at the California Polytechnic State University San Luis Obispo and education research at the University of Colorado Boulder.

Instructor Phillip Roser



Dr. Phillip Roser received his PhD from Clemson University in 2016 and has taught at a number of community and technical colleges in Whatcom and Skagit counties before joining WWU. He holds an undergraduate degree from the University of Oxford and an M.Sc. from Imperial College London. Prior to commencing his PhD program he spent a year developing data-processing algorithms for the European Space Agency's ACES experiment. Philipp's research concerns the "problem of time" in quantum gravity: Why does combining quantum mechanics with general relativity lead to a "frozen" universe and a host of other technical and conceptual problems? In particular, Philipp is investigating how relational approaches to mechanics and gravity, possibly together with trajectory-based quantization frameworks, might lead to a consistent theory that would adequately describe the observed physics on both cosmological and microscopic scales. More recently, he has also become interested in the implications of such relational theories of gravity for galactic rotation curves.

American Physical Society meeting coming to WWU!

The Northwest Section of the APS will be hosted by the WWU Department of Physics and Astronomy May 16-18, 2019. The Section was officially founded in 1998 and now numbers over 1100 members. It works to facilitate the exchange of physics information and discussion among members living in the Pacific Northwest. Members include physicists from Alaska, Alberta, British Columbia, Idaho, Montana, Oregon, Washington, and Wyoming. The Section places emphasis on including students and physicists who work in education, research, and in industry.

The meeting will be held on the WWU campus and will include two full days of plenary and parallel sessions as well as a poster session. We expect roughly 150 participants. Plenary talks will be held in the Old Main theatre and parallel sessions in the Communications Facility and Academic Center West. Meals will be available on campus and a special conference rate is being offered at several local hotels. The registration cost will be less than \$100 per person. Financial support for the conference will be available in the form of student travel grants and grants to offset childcare costs.

The conference will be a great opportunity to catch up with what is going on in Physics and Astronomy in the Northwest. It would be great to see you there!

20th Annual Meeting May 16-18, 2019 Northwest Section American Physical Society

**Western Washington University
Bellingham, WA**

Plenary speakers

Poster session

Banquet

Invited and contributed talks on:

Astrophysics and gravitational physics

Atomic, molecular, and optical physics

Biophysics

History of physics

Nuclear physics

Particle Physics

Physics education

And other areas of physics

Abstract submission deadline:
April 5, 2019

For more information visit
www.cse.wvu.edu/physics/

Student Research in the Department

Undergraduate student involvement in faculty research continues to be a hallmark of the WWU program in Physics and Astronomy. This past summer saw 17 students working on research projects with faculty! Many of these projects were funded thanks to the generosity of alumni and other friends of the department who contributed to our **Undergraduate Summer Research Funding Campaign**. Please read about the campaign on the Viking Funder website (<https://www.vikingfunder.com/project/8248>).

Here are descriptions of a few faculty mentored projects to give you a flavor of what our students are involved in:

Janelle Leger

The Physics and Astronomy Department was very fortunate to have a number of students win scholarships from either the College of Science and Engineering or from the Department to support their research this past summer. Two of those students worked with Dr. Janelle Leger, who splits her time between physics and the Advanced Materials Science and Engineering Center, where she currently serves as Director. **Ariel Garcia** focused on synthesizing a polymerizable ionic liquid for application to polymer light-emitting electrochemical cells, and **Corbit Sampson** worked to apply these materials to the development of polymer fixed-junction solar cells.

Thanh Le

Grace Baker and **Philip Reilly** investigated student strategy use and flexibility when approaching physics problems. **Grace**, a recipient of the WA NASA Summer Research Award, focused on understanding student coordinate system choices for equilibrium force problems. She conducted interviews and analyzed the transcripts to describe the processes that can support or inhibit student use of the most appropriate strategy for a given problem. **Philip** focused on understanding student system choices for energy conservation problems. Informed by his analysis of student written responses from pre-existing tasks, Philip designed an interview protocol to explore student flexibility in using different system choices to apply energy conservation for the same problem.

Kevin Covey

During the last year students advanced several projects based on data collected by the Sloan Digital Sky Survey's APOGEE project: **Jacob Skinner** published results from his work to identify and characterize 44 low-mass binary star systems, **Jessica Reyna** led the development of algorithms to detect thousands of such binaries in the survey's 14th data release, and **Richard Ballantyne** analyzed Hydrogen emission lines detected in the spectra of young stars to measure the temperature and density of the accreting gas. More than 10 WWU students and faculty will be attending and presenting results at the NWxSW meeting, including several students who have started new research projects: stay tuned for next year's update on those projects!

Brandon Peden

Supported by a P&A department summer research stipend, undergraduate **Nathan Chapman** conducted research on the theoretical description of an ultracold quantum gas of rotating molecules interacting via quadrupole-quadrupole interactions. Quadrupole moments are induced in the molecules by applying a gradient electric field, and the molecule are confined to move around in a two-dimensional trapping plane. Nathan solved for the mean-field ground state of the molecular gas as a function of both field gradient and interaction strength. By mapping out the properties of the ground state by varying both of these parameters, he was able to identify a second-order phase transition between liquid-crystal like uniaxial and biaxial nematic phases. In the uniaxial phase, the quadrupole moments of the molecules are "aligned" perpendicular to the trapping plane, and the single-particle wave function is rotationally symmetric about this axis, whereas in the biaxial phase, the rotational symmetry about the uniaxial axis is spontaneously broken, and the wave function "deforms" in a direction parallel to the trapping plane. This research is intended to guide experiments that are expected to come online in the next ten years or so.

Melissa Rice

The "Mars Lab" has several active research projects using data from NASA's Mars Science Laboratory Curiosity rover, orbital spacecraft, and laboratory studies. Physics student **Mason Starr** was awarded the 2018 Elwha Summer Research Stipend from the College of Science and Engineering for a project using Mastcam multispectral images from the Curiosity rover. Mason developed software using Python to perform comprehensive analyses of the full Mastcam spectral dataset, and he presented this work at a Mars Science Laboratory Team Meeting at Caltech in September. Geophysics student **Lena Gibbs**, funded by WWU's Advanced Materials Science and Engineering Center (AMSEC), worked in the lab this summer characterize Mars analog rocks with scanning electron microscopy and reflectance spectroscopy. Geophysics student **Katelyn Frizzell** spent the summer as an intern at the John Hopkins University Applied Physics Laboratory, where she worked on image processing for the CRISM instrument on the Mars Reconnaissance Orbiter; Katelyn is continuing this work as her senior thesis at WWU this year. Looking ahead, we'll soon be focusing on preparing for the next big mission: the Mars2020 Rover. In December, some students and I will help test and calibrate the cameras that will be flying to Mars. Launch is planned for the summer of 2020 – we'll be there and will report back, stay tuned! In the meantime, you can follow what the Western Mars Lab is up to on our new webpage (<https://wp.wvu.edu/mars/>).

Andreas Riemann

The Riemann research group is investigating the adsorption geometries and energies of spiropyran-based molecules. The goal is to carry out reversible switching experiments between spiropyran and merocyanine molecules, and computationally predict the reaction pathways. Last Summer, **Hunter Goff** worked on Computational Chemistry methods using a variety of spiropyran and merocyanine conformers. **AJ Calder** is looking at this system from an experimental standpoint. After the arrival of a new molecular evaporator in a few weeks, AJ will be able to carry out structural and electronic measurement using LEED and Auger Electron Spectroscopy. This Fall, **Lucas Browning** joined the group in order to calculate adsorption energies of naphtho-merocyanine molecular conformers on graphene substrates.

Armin Rahmani

Four students, **Scott Copas**, **David Seaman**, **Matt Scoggins**, and **Ethan Cohen** worked in my group this summer. **Scott** and **David** have recently graduated. **Scott** worked on finalizing the results and writing a paper on a new practical measure of distance between quantum states (based on the minimum time needed to transform them into each other with a permissible set of Hamiltonians). He has fully characterized this measure of distance for a particular system of two experimentally relevant superconducting qubits. **David** worked on organizing his code and results on the quantum conductance of a disordered polymer-nanoparticle memory device (in collaboration with Janelle Leger) so we can pass them to the next student who will join the project. **Matt** has been working on optimal-control-based quantum simulation of strongly correlated models with many-body systems of superconducting qubits and has made significant progress in developing the original Mont Carlo code needed for this research. **Ethan** has worked on determining the phase diagram of two coupled interacting chains of Majorana fermions. He has made significant progress in learning the advanced theoretical background and adapting a density-matrix-renormalization-group code to the problem at hand.

Please join us at upcoming events!

Department seminars: most Thursdays at 4pm.

WWU Scholars week: May 13-17, 2019

<http://www.wwu.edu/scholars/>

NW Section meeting of APS: May 16-18, 2019

P&A Undergrad Conference: May 16, 2019

P&A Annual Picnic: June 2019

To contact us for details on these and other events:

phone: (360)650-3818

email: physics@wwu.edu

webpage: cse.wwu.edu/physics



Faculty News

Kevin Covey presented results from Jessica Reyna & Richard Ballantyne's work at the Cool Stars 20 conference in Boston last July, and will be presenting results from a collaboration with Prof. Larson to study the dust around the young star AA Tau at this fall's NWxSW astronomy meeting.

Andreas Riemann recently received a \$233k grant from NSF to study Photoisomerization Potential of Molecular Switches on Surfaces.

Several faculty and undergraduates attended the regional astronomy meeting in Vancouver, BC November 3-4. In January, the American Astronomical Society is meeting in Seattle and several WWU undergraduates will present posters on their research results at the meeting.

Kristen Larson is now listed as a "major contributor" to the dust_extinction code, an affiliated package of Astropy. This is a python package to provide models of interstellar dust extinction curves. Extinction models are used to model or correct the effects of dust on observations of a single star.

Armin Rahmani gave a talk on "Variational quantum simulation of interacting models using Pontryagin's minimum principle" at the "Conference on Quantum Dynamics of Disordered Interacting Systems," at the International Center for Theoretical Physics, in Trieste, Italy. Armin was also a recipient of the 2018 "Google Quantum Innovation Award" for a proposal entitled "Optimal control for general-purpose quantum simulation of strongly correlated materials with gmon qubits," which included \$10,000 of funding.

Alumni News

Kodiak Murphy ('16) and Layla Masri ('16) were married on September 15, 2018 in Tacoma WA! You can find photos of the wedding at <https://www.zola.com/wedding/kodiakandlayla>

Valerie Brogden ('10) is an applications scientist with FEI Company in Eindhoven, Netherlands. She provides Scanning Electron Microscope and Focused Ion Beam demonstrations to scientists and engineers

Mons Lee ('06) is a senior metrology engineer at SpaceX in Hawthorne, CA. His specialties include precision calibration, data analysis, experimental setup, test procedure writing, measurement uncertainty and risk analysis.

Mix it Up, sponsored by the College of Science and Technology, was the 6th annual event focused on celebrating science, technology, engineering and math (STEM) at Western Washington

University. Each year has a new theme with a goal of showing the world that anyone can enjoy STEM and the people who are part of the STEM community are diverse and multifaceted. This year's event was on November 8 and featured PhD Science and Technology Candidate and rapper SAMMUS!



"Working to dismantle the scientist stereotype"