



Vandalizing the Universe



University of Idaho
Department of Physics

Home of Physics and Astronomy on the Idaho Palouse

Newsletter Issue No. 4

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Editor: J.R. Hiller

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Message from the Chair

With the pandemic in recession, many activities have returned. First up was an international workshop for the computational Einstein Toolkit for solving the general relativistic equations for gravity, especially for black hole mergers and gravitational waves. More about that later in the newsletter.

Next was a Star Party for our new telescope. The 20-inch aperture may not be the second largest in Idaho (as incorrectly reported in the previous newsletter), but it is still quite impressive and one of the largest. This main scope and several smaller ones were available for viewing during the party at the dome. The second night did get smoked out (like being rained out but drier and harder to breathe) after a heavily attended first. Many thanks to the College of Science staff for making things run and to Facilities for sprucing up the dome!



Observatory dome during the Star Party.

This was in September. Later in February, from the same location but only a smart phone, Kaylee Maret and Sam Callos were able to capture an aurora display.



Aurora over Moscow
(photo by S. Callos)

accelerations induced by Vandal hits. Yes, the model helmet does have the insignia of the opposing team; we wouldn't want this to be Vandal on Vandal!



Postdoc Leo Rosa Werner
takes accelerometer data.
(photo by J. DeWitt)



Angular momentum conservation
at the Homecoming Tailgate event.
(photo by J. DeWitt)

This was followed in October by a Homecoming tailgating event where Physics had the honor of representing the College to potential students and their parents. Various activities were available, including a spinning wheel and stool combo to experience angular momentum conservation and an instrumented football helmet for measuring

In the spring we were well represented at the College awards reception. Our Department Manager, Jessica DeWitt, received the Outstanding Staff award, partly for her hard work on arranging the Toolkit workshop and help with the Star Party.



Jessica DeWitt receives her Outstanding
Staff award from Dean Ginger Carney.
(photo by T. Evans)



Andreas Vasdekis accepts his Renfrew
Fellowship
(photo by T. Evans)

Andreas Vasdekis was awarded the Malcolm and Carol Renfrew Faculty Fellowship for his work on cell metabolic processes, using quantitative phase imaging, light-sheet microscopy, machine learning (for image processing), and microfluidics (for cell manipulation). This past summer Professor Vasdekis' lab was visited by two interns from Clarkston High School who stayed on our campus for a week doing research in the lab; this was in collaboration with STEM ACCESS at UI. Professor Vasdekis also did some calibration work in the cleanroom, which was moved from the Mines building to EP in 2019.



Summer high-school interns in the biophysics lab.



Calibration experiments in the cleanroom facility.

The Department had its own awards ceremony, at our first post-pandemic Awards Banquet. Rabindra Khanal received the Best TA award. Steven Kreyche's award for Graduate Research was announced but he was not able to attend, being already employed with Aerospace Corporation in Colorado Springs to analyze orbital mechanics for the military. Steve's thesis advisor, Jason Barnes, accepted for him. Samantha Callos walked away with all the other awards, though not literally because she was interviewing for the Physics graduate program at the University of Oregon (her fall destination). Matt Hedman accepted for her the Undergraduate Research Award, the George and Della Luke award for highest graduating gpa, and the Outstanding Graduating Physics Senior Award.



Rabindra Khanal accepts the Best TA award from Department Chair John Hiller (photo by Viola DeWitt)



Matt Hedman accepts Sam Callos' certificates for her multiple awards (photo by Viola DeWitt)

Our guest speaker that night was Professor Xiaoli Etienne, from the UI Depart-

ment of Agricultural Economics and Rural Sociology, where she holds the Idaho Wheat Commission Endowed Chair in Commodity Risk Management. She joined UI in a dual hire with our own Zach Etienne. Her topic that night was particularly timely: “From Farm to Fork: What’s Happening to Food Prices?” We learned quite a bit about factors that drive food price cycles.



Steve Kreyche, Dean's Graduate Award



Professor Xiaoli Etienne speaking at the Awards Banquet
(photo by Viola DeWitt)

The College had a second awards reception, following the spring commencement ceremony. This time Sam Callos was in town and received her Dean's Undergraduate Award in person. Steve Kreyche was unable to attend, but his Dean's Graduate Award was announced.

Last but not least we were visited by Rebecca Bishop (BS '96) who gave a talk about space weather, on her way to receiving her Silver and Gold Alumni Award at a reception that took place at the University Inn. Dr. Bishop is a Principal Scientist in the Space Science and Applications Laboratory at The Aerospace Corporation with expertise in understanding the near-Earth space environment, specifically the ionosphere (90-2000 km), and its impact on space/ground assets and in the development of space-weather instrumentation. Her research areas include ionospheric dynamics, ionosphere coupling to hurricanes/typhoons, and the ionosphere/thermosphere interactions.

Finally, although last year was the one filled with moose, it was this year that one was captured on 'film,' while driving home from campus on a snowy day. This year is, of course, the year of the rabbit, even though it was last year's newsletter that had the rabbit photo; here he is again in a trailcam photo, confronting a wild guy who tunneled into our rabbit compound.



Sam Callos accepts her Dean's Award from Science Dean Ginger Carney.



Roadside moose down from the mountain.



← A Wild One encounters El Toro
in the dark.

Wishing you a safe and productive
(academic!) year.

Best regards,

A handwritten signature in blue ink, appearing to be 'John', is written in a cursive style.

University of Idaho Hosts Successful 2022 North American Einstein Toolkit Workshop

by Zach Etienne

Last summer, the University of Idaho proudly hosted the 2022 North American Einstein Toolkit Workshop, which brought together researchers and students to explore the latest advancements in relativistic astrophysics and gravitational physics. The Workshop, open to both in-person and virtual attendees, featured an engaging mix of talks and tutorials tailored to accommodate users of all experience levels.

Participants benefited from discussions on cutting-edge science cases and recent developments in numerical relativity. Moreover, the event concluded with a conversation about the future of the Einstein Toolkit, a community-driven software platform designed to facilitate research in this critical

scientific field.

A special highlight of this year's workshop was an exclusive field trip for in-person attendees to the nearby LIGO Hanford facility on June 15. This observatory made history in 2015 when it detected gravitational waves from a merging pair of black holes, earning a Nobel Prize in Physics. During the visit, participants had the opportunity to witness the preparations for O4 (Observing Run 4), which is slated to happen later in 2023.



Einstein Toolkit Workshop field trip to
LIGO.

Update from a recent grad

by Justin Ferrera, University of Idaho '16

I graduated from the University of Idaho with degrees in Physics and Finance in 2016. While physics was what brought me to Moscow, finance represented a practical application of the problem-solving skills that I was honing in my physics classes – an opportunity to apply that skill set in an environment that was dynamic with short feedback

loops – an intriguing proposition!

After graduation, I completed a 15-month rotational program at a large asset management firm. Going in, although I thought I had an idea what I wanted to do, I had limited experience (typical for a recent graduate), and the rotational program allowed me to get a better grasp of the asset management industry and how I might fit in. Over the 15 months, I spent time be-

ing on the front-line of retail client interactions, working with researchers considering larger scale investment questions (asset allocation, behavioral finance, etc.), being a resource for financial advisors on technical topics and methodology, and working with fund managers as they handled the day-to-day management of actively managed mutual funds. The most important lesson I learned was to define my interests in terms of the type of environment I wanted to work in, rather than the specific job. For me, that meant being somewhere with steep learning curves in a dynamic environment with a small and highly collaborative team – somewhere I could learn and have the support I needed to apply that knowledge.

After the rotational program, I began working in municipal credit research, where I have been for the past 5 years. I am part of a team of municipal bond credit analysts, portfolio managers, and traders that are responsible for various actively managed bond mutual funds. I predominately work in the structured finance space, where we analyze bonds issued in the tax-exempt market by

issuers like state housing authorities, with the proceeds of the debt going towards originating mortgages for affordable multifamily housing or low and moderate-income first-time home buyers. I also work in the health-care sector, where we have a team of analysts responsible for maintaining fundamental credit outlooks for the non-profit hospitals across the country that issue debt in the municipal market. We take both a qualitative and quantitative approach to understanding the issuers we cover to develop fundamental opinions that we can then communicate to portfolio managers and traders to turn into investment decisions.

While municipal finance is far from the most quantitative area of finance, I continually use the mathematics and problem-solving base I learned in physics. Whether that be working from boundary conditions for a new bond structure, improving analytics methodologies, or writing code to improve operational challenges that help our team be more efficient, the building blocks I learned in my U of I physics classes have served me well.

SPS Activities

by Connor O'Neill, SPS President

For fall of 2022, SPS participated in the grand opening star party for the new observatory telescope, where we were able to observe the moon, Jupiter, Saturn, and some star clusters! SPS also visited LIGO in Hanford Washington. LIGO detected the first evidence of gravitational waves rippling through space in 2015, which won the team running the observatory a Nobel prize in physics! While we were there, we were given a tour of the facility and listened to a presentation about how it all works. We also had a talk from Dr. Etienne about his research simulating black hole collisions.



Physics Club also visits LIGO

For spring of 2023, we hosted a UIIdaho Bound table where we met some new incoming physics majors. We also hosted talks from Dr. Berven and Dr. Vasdekis about their research. For our last meeting of the year, we checked out the 1-kilometer scale model of the solar system made by local elementary schoolers along the Bill Chipman trail!

Faculty

Astrophysics and Planetary Science

Gwen Barnes, Research Associate Professor, Ph.D. University of Arizona 2007

Jason Barnes, Professor and Dyess Faculty Fellow, Ph.D. University of Arizona 2004

Zachariah Etienne, Associate Professor, Ph.D. University of Illinois 2009

Matthew Hedman, Associate Professor and Director of Graduate Studies, Ph.D. Princeton University 2002

Biological Physics

Andreas Vasdekis, Associate Professor, Ph.D. University of St. Andrews 2008

F. Marty Ytreberg, Professor and Associate Director of the Institute for Modeling Collaboration and Innovation, Ph.D. University of Maine 2000

Condensed Matter Physics

Leah Bergman, Professor, Ph.D. North Carolina State University 1995

Christine Berven, Associate Professor, Ph.D. University of Oregon 1995

You Qiang, Professor, Ph.D. University of Freiburg 1997

Hadronic Physics

Sophia Chabysheva, Clinical Assistant Professor, Ph.D. Southern Methodist University 2009

John Hiller, Professor and Chair, Ph.D. University of Maryland 1980

Ruprecht Machleidt, University Distinguished Professor, Ph.D. University of Bonn 1973

Francesca Sammarruca, Professor and Secretary of the University Faculty, Ph.D. Virginia Polytechnic Institute 1988

Staff

Reynaldo Carson, Scientific Instrument Maker

Samuel Cupp, Ph.D., Postdoctoral Fellow

Jessica DeWitt, Department Manager

Eric Foard, Ph.D., Director of Physics Laboratory Education

Ramachandran Kasu, Ph.D., Postdoctoral Fellow

Nicholas Kutsop, Ph.D., Postdoctoral Fellow

Leo Rosa Werneck, Ph.D., Postdoctoral Fellow

Mirsaeid Sarollahi, Ph.D., Postdoctoral Fellow

Transitions

Gwen Barnes promoted to Research Associate Professor.

Reynaldo Carson joined the Department as Shop Foreperson.

Jessica DeWitt promoted to Department Manager.

Brian Petty is now Machine Shop Manager for the Engineering College.

New postdocs: Samuel Cupp, Nicholas Kutsop, Mirsaeid Sarollahi.

Awards in 2023

Dean's Award: Samantha Callos
Outstanding Graduating Physics Senior:
Sam Callos
Outstanding Undergraduate Physics Research: Sam Callos
George and Della Luke Award: Sam Callos
Hill Research Fellowships: William Auten,
Joey Perko
Dean's Graduate Award: Steven Kreyche
Graduate Physics Research: Steven Kreyche
Best Physics TA: Rabindra Khanal
Outstanding CoS Staff Award: Jessica DeWitt
Malcolm and Carol Renfrew CoS Faculty Fellowship: Andreas Vasdekis
UI Alumni Silver and Gold Award: Rebecca Bishop (BS 1996)



Spring 2023 Physics Bachelors
C. Goode, A. Hahn, C. Stegner,
J. Mansanarez (photo by M. Nielsen)

New Graduates

Caleb Goode (B.A. 2023)
Samantha Callos (B.S. 2022)
Augustus Hahn (B.S. 2023)
Kaylee Maret (B.S. 2022)
Connor Stegner (B.S. 2023)
An Ngoc Khanh Vo (B.S. 2022)
John Mansanarez (Applied B.S. 2023)
Dustin Taylor (Applied B.S. 2022)
Michael Heslar (M.S. 2022)
Advisor: Jason Barnes
William Miller (M.S. 2022)
Advisor: Jason Barnes
Steven Kreyche (Ph.D. 2022)
Advisor: Jason Barnes
Thesis title: Planetary obliquity evolution: excited retrograde rotators and tidal resonant encounters.
Sanjoy Saha (Ph.D. 2022)
Advisor: Ruprecht Machleidt
Thesis title: Local position-space two-nucleon potentials from leading to fourth order of chiral effective field theory.

New Willmes Scholarship

Cathryn Willmes, widow of former Department Chair Henry Willmes, has established an endowment for a physics scholarship in honor of Professor Willmes. Once the endowment has reached a sufficient balance, the Henry Willmes Physics Scholarship will be awarded annually to a deserving

student, with preference given to international graduate students. Contributions to the endowment are welcome from anyone who wishes to honor Professor Willmes, who served as Chair for seventeen years and was a UI faculty member from 1969 to 2002. He mentored many international students in his work on applied nuclear physics.

Donations

If you would like to donate to the Physics Department, please contact Eric Bennett, the Director of Development for the College of Science at ebennett@uidaho.edu, 208-885-9106, or Univer-

sity of Idaho College of Science, 875 Perimeter Drive, MS 3025, Moscow, ID 83844-3025. Online donations can be made at <https://www.uidaho.edu/giving/way-to-give>. Entering 'Physics' in the designation field will present you with a list of funds associated with the Department. Thank you!!

Summer Graduate Research Projects 2023

Borhanul Alam (Bergman)

Synthesis and studies of wide bandgap semiconductors

Bisheswor Archaya (Qiang)

Magnetic and electrical responses of nanoclusters under irradiation

Elizabeth Atang (G. Barnes)

Evolution of the upper lunar surface

Jeremiah Chapleski (Ytreberg)

Protein binding and predictions of efficacy

Jonah Haw (Berven)

Lateral oscillations of levitating permanent magnet arrays over type II superconductors

Mahfujul Islam (Vasdekis)

Quantitative phase microscopy to measure the crowding levels of bacteria cells

Rabindra Khanal (Qiang)

Soft magnetic nanofilms produced by aligned ellipsoidal iron core-shell nanoparticles

Dillon Morehouse (Berven)

Preparation of PhD dissertation.

Rani Preeti (Hedman)

Investigate the spectra of icy moons in the outer solar system

Completed Thesis Projects

Sanjoy Saha

PhD thesis: Local position-space two-nucleon potentials from leading to fourth order of chiral effective field theory.

Abstract: We present local, position-space chiral NN potentials through four orders of chiral EFT ranging from leading order (LO) to next-to-next-to-next-to-leading order (N^3LO , fourth order) of the Δ -less version of the theory. The long-range parts of these potentials are fixed by the very accurate π -N low-energy constants as determined in the Roy-Steiner equations analysis. At the highest order (N^3LO), the NN data below 190 MeV laboratory energy are reproduced with the acceptable χ^2/datum

of 1.45. These NN potentials may serve as a solid basis for systematic *ab initio* calculations of nuclear structure and reactions that allow for a comprehensive error analysis. In particular, the order by order development of the potentials will make possible a reliable determination of the truncation error at each order. Our new family of local position-space potentials differs from existing potentials of this kind by a weaker tensor force as reflected in relatively low D-state probabilities of the deuteron (PD $\sim < 4.0$ % for our N^3LO potentials) and predictions for the triton binding energy above 8.00 MeV (from two-body forces alone). As a consequence, our potentials may lead to different predictions when applied to light and intermediate-mass nuclei in *ab initio* calcu-

lations and, potentially, help solve some of the outstanding problems in microscopic nuclear structure.

Steven Kreyche

PhD thesis: Planetary obliquity evolution: excited retrograde rotators and tidal resonant encounters

Abstract: The search for extraterrestrial life along with our desire to understand the necessary conditions for the development of life are large motivators in the field of astronomy. Although the Earth remains as our sole data point, it seems overwhelmingly likely that either other Solar System bodies or distant exoplanets had, have, or will have the capacity to host life of their own. Nonetheless, the assessment of a world's potential for habitability is a complex problem that requires thorough study of many contributing aspects. One key aspect is the value and evolution of a planet's obliquity, or axial tilt, which sets the nature of its seasons and long-term climate by governing the distribution of solar flux across its surface. Although we enjoy a pleasant climate thanks to the Earth's stable moderate obliquity, other planetary bodies may be either even better off or severely challenged in compari-

son. In my dissertation, I help build toward a more complete picture of habitability by studying planetary obliquity evolution with the use of numerical simulations of planetary systems. Beginning with Chapter 1, I provide a brief background of the dynamics that drive obliquity evolution and describe previous work that establishes our current understanding moving forward. In Chapter 2, I discuss a threatening secular spin-orbit resonance that can destabilize the obliquities of retrograde rotators (planets with obliquities greater than 90 degrees). Next, in Chapter 3 I introduce SMERCURY-T, a tool that allows for the study of planetary obliquity evolution under the influence of tidal forces. Finally, in Chapter 4 I apply SMERCURY-T to study the tidal obliquity evolution of a moonless Earth and a potentially habitable early Venus. Each of these chapters provides wider contributions past their individual results by urging direction to future studies, releasing publicly available software, or identifying trends and process that may be important to the obliquity evolution of extrasolar planets. These findings can ideally be applied to such exoplanet systems in the future and further our capability to detect and characterize their spin states.

Recent Publications (2022-23)

Student authors are underlined.

Astrophysics and Planetary Science

(the large number of LIGO publications are not included)

I. J. Daubar, C. Dundas, A. S. McEwen, A. Gao, D. Wexler, S. Piqueux, G. S. Collins, K. Miljkovic, T. Neidhart, J. Eschenfelder, G. D. Bart (Barnes), K. Wagstaff, G. Doran, L., (2022). "New Craters on Mars: An Updated Catalog." *Journal of Geophysical Research: Planets*, 127, e2021JE007145.

Daniel Coulter; Jason W. Barnes; Fortney, Jonathan, "Jupiter and Saturn as Spectral Analogs for Extrasolar Gas Giants and Brown Dwarfs", *The Astrophysical Journal Supplement*, 2022 November 9.

Chandler, Clayton K.; Radebaugh, Jani; McBride, John H.; Morris, Thomas H.; Arnold, Karl; Lorenz, Ralph D.; Barnes, Jason W.; Hayes, Alexander G.; Narteau, Clement; Rodriguez, Sebastien; Rittenour, Tammy, "Near-Surface Structure of a Large Linear Dune and an Associated Crossing Dune of the Northern Namib Sand Sea from Ground Penetrating Radar: Implications for the History of Large Linear Dunes on Earth and Titan", *Aeolian Research*, 2022 August 1.

Sebastien Rodriguez; Sandrine Vinatier; Daniel Cordier; Gabriel Tobie; Richard K. Achterberg; Carrie M. Anderson; Sarah V. Badman; Jason W. Barnes; Erika L. Barth; Bruno Bézard; Nathalie Carrasco; Benjamin Charnay; Roger N. Clark; Patrice Coll; Thomas Cornet; Athena Coustenis; Isabelle Couturier-Tamburelli; Michel Dobrijevic; F. Michael Flasar; Remco R.J. de Kok; Caroline Freissinet; Marina Galand; Thomas Gautier; Wolf D. Geppert; Caitlin A. Griffith; Murthy S. Gudipati; Lina Z. Hadid; Alexander G. Hayes; Amanda R. Hendrix; Ralf Jaumann; Donald E. Jennings; Antoine Jolly; Klara Kalousova; Tommi T. Koskinen; Panayotis Lavvas; Sebastien Lebonnois; Jean-Pierre Lebreton; Alice Le Gall; Emmanuel Lellouch; Stephane Le Mouelic; Rosaly M.C. Lopes; Juan M. Lora; Ralph D. Lorenz; Antoine Lucas; Shannon MacKenzie; Michael J. Malaska; Kathleen Mandt; Marco Mastrogiuseppe; Claire E. Newman; Conor A. Nixon; Jani Radebaugh; Scot C. Rafkin; Pascal Rannou; Ella M. Sciamma-O'Brien; Jason M. Soderblom; Anezina Solomonidou; Christophe Sotin; Katrin Stephan; Darrell Strobel; Cyril Szopa; Nicholas A. Teanby; Elizabeth P. Turtle; Veronique Vuitton; Robert A. West, "Science Goals and New Mission Concepts for a Future Exploration of Titan's Atmosphere, Geology and Habitability: Titan Polar Scout/orbiter and In situ lake lander and DrONE explorer (POSEIDON)", *Experimental Astronomy*, 1-63, 2022 January 11.

F. G. Lopez Armengol, Z. B. Etienne, S. C. Noble, B. J. Kelly, L. R. Werneck, *et al.* Handing off the outcome of binary neutron star mergers for accurate and long-term postmerger simulations. *Phys. Rev. D* **106**, 083015 (2022).

T. Assumpcao, L. R. Werneck, T. Pierre Jacques, Z. B. Etienne. Fast hyperbolic relaxation elliptic solver for numerical relativity: Conformally flat, binary puncture initial data. *Phys. Rev. D* **105**, 104037 (2022).

J.A. A'Hearn, M.M. Hedman, C.R. Mankovich, H. Aramona, M. S. Marley. 2022. Ring Seismology of the Ice Giants Uranus and Neptune *PSJ* 3:194.

C. Paranicas, E. Roussos, K. Dialynas, P. Kollmann, N. Krupp, M.M. Hedman, R.C. Allen, G. Hospodarsky. 2022. The Electric Field outward of Saturn's Main Rings *ApJ* 934:11.

M.M. Hedman, P.D. Nicholson, M. El Moutamid, S. Smotherman. 2022. Reading the Recent History of Saturn's Gravity Field in its Rings. *PSJ* 3:61.

I.J. Cohen, C. Beddingfield, R. Chancia, G. DiBraccio, M.M. Hedman, S. MaKenzie, B. Mauk, K.M. Sayanagi, K.M. Soderlund, E. Turtle, C. Ahrens, C.S. Arridge, S.M. Brooks, E. Bunce, S. Charnoz, A. Coustenism, R.A. Dillman, S. Dutta, L.N. Fletcher, R. Harbison, R. Helled, R. Holme, L. Jozwiak, Y. Kasaba, P. Kollmann, S. Luzcz-Cook, K. Mandt, O. Moussism A. Mura, G. Murakami, M. Parisim A. Rymer, S. Stanley, K. Stephan, R.J. Vervack, M.H. Wong, P. Wurz. 2022. The Case for a New Frontiers-Class Uranus Orbiter: System Science at an Underexplored and Unique World with a Mid-scale Mission. *PSJ* 3:58.

M. Parisi, M. Vaquero, M.M. Hedman, M.S. Tiscareno. 2022. Gravity Investigation of Saturn's Inner System with the Innovative Skimmer Concept. *PSJ* 3:19.

Biological Physics

G. Kukal, A. E. Vasdekis, and A. G. McDonald, "Raman-probes for monitoring metabolites and nutrient fate in *Yarrowia lipolytica* using deuterated glucose", *Biocatalysis and Agricultural Biotechnology* **39**, 102241 (2022).

- S. Nemati, A. Singh, S. Dhuey, A. G. McDonald, D. Weinreich, A. E. Vasdekis, “Density Fluctuations Yield Distinct Growth and Fitness Effects in Single Bacteria”, *Communications Biology* **5**, 397 (2022).
- L. Dunn, H. Luo, N. R. Subedi, R. Kasu, A. G. McDonald, D. Christodoulides, A. E. Vasdekis, “Video-Rate Raman-based Metabolic Imaging by Airy Light-Sheet Illumination and Photon-Sparse Detection”, *PNAS* **120**, e2210037120 (2023).
- Barnes JE, Lund-Andersen P, Patel JS, Ytreberg FM, “The effect of mutations on binding interactions between the SARS-CoV-2 receptor binding domain and neutralizing antibodies B38 and CB6,” *Sci. Rep.*, **12**:18819 (2022).
- Li S, Patel JS, Yang JM, Crabtree AB, Rubenstein BM, Lund-Andersen P, Ytreberg FM, Rowley PA, “Defining the HIV Capsid Binding Site of Nucleoporin 153,” *mSphere*, **7**:e00310-22 (2022).
- Barnes JE, Miller CR, Ytreberg FM, “Searching for a mechanistic description of pairwise epistasis in protein systems,” *Proteins* **90**:1474 (2022).
- Beach SS, Hull M, Ytreberg FM, Patel JS, Miura TA, “Molecular modeling predicts novel antibody escape mutations in respiratory syncytial virus fusion glycoprotein,” *J Virol* **96**:e00353 (2022).

Condensed Matter Physics

- Amrah Canul, Isiaka Lukman, and Leah Bergman, “The Gaussian nature of the band-edge of ZnO microcrystalline thin films”, *AIP Advances* **12**, 125201 (2022)

Hadronic Physics

- S. S. Chabysheva and J. R. Hiller, “Tadpoles and vacuum bubbles in light-front quantization,” *Phys. Rev. D* **105**, 116006 (2022).
- J. Flores, S. S. Chabysheva and J. R. Hiller, “Reduced nuclear helicity amplitudes for deuteron electrodisintegration and other processes,” *Phys. Rev. C* **107**, 045205 (2023).
- R. Machleidt, “Phenomenology and Meson Theory of Nuclear Forces,” in: Tanihata, I., Toki, H., Kajino, T. (eds) *Handbook of Nuclear Physics*. Springer, Singapore. (2022).
- R. Machleidt, “Alternative Facts in Microscopic Nuclear Structure,” *Proc. 39th International Workshop on Nuclear Theory, Rila Mountains, Bulgaria, July 2022*, edited by M. Gaidarov and N. Minkov (Heron Press, Sofia, 2022) p. 156.
- S. K. Saha, D. R. Entem, R. Machleidt and Y. Nosyk, “Local position-space two-nucleon potentials from leading to fourth order of chiral effective field theory,” *Phys. Rev. C* **107**, 034002 (2023).
- F. Sammarruca, “Neutron skin systematics from microscopic equations of state,” *Phys. Rev. C* **105**, 064303 (2022).
- F. Sammarruca, “The equation of state of neutron-rich matter at fourth order of chiral effective field theory and the radius of a medium-mass neutron star,” *Proc. 39th International Workshop on Nuclear Theory, Rila Mountains, Bulgaria, July 2022*, edited by M. Gaidarov and N. Minkov (Heron Press, Sofia, 2022).
- F. Sammarruca, “The Symmetry Energy: Current Status of *Ab Initio* Predictions vs. Empirical Constraints,” *Symmetry* **15**, 450 (2023).

Recent Presentations (2022-23)

Astrophysics and Planetary Science

- G. Barnes, “New Impact Craters on Mars,” Jet Propulsion Laboratory, Mars Forum, Pasadena, CA. February 4, 2022.
- AE Etgen, GD Bart (Barnes), IJ Daubar, 2022. “Contribution of Individual Blast Zone Features to Martian Surface Albedo Changes.” 53rd Lunar and Planetary Science Conference, held 7-11 March, 2022 at The Woodlands, Texas. LPI Contribution No. 2678, 2022, id.2375.
- EFM Atang, GD Bart (Barnes), 2022. “Measurements of Regolith Depth from a Young Mare Surface on the Moon.” 53rd Lunar and Planetary Science Conference, held 7-11 March, 2022 at The Woodlands, Texas. LPI Contribution No. 2678, 2022, id.2554.
- IJ Daubar, C Dundas, AS McEwen, A Gao, D Wexler, S Piqueux, GS Collins, K Miljković, T Neidhart, J Eschenfelder, GD Bart (Barnes), K Wagstaff, G Doran, L Posiolova, G Speth, D Susko, A Werynski, M Malin, 2022. “New Craters on Mars: Results from a Complete Catalog of 1,203 Recent Impacts.” 53rd Lunar and Planetary Science Conference, held 7-11 March, 2022 at The Woodlands, Texas. LPI Contribution No. 2678, 2022, id.1590
- J. Barnes, “Dragonfly: NASA’s Titan Rotorcraft Lander”, invited colloquium for the University of Alaska, Fairbanks, 2022 August 12.
- Z. Etienne, “Advancing Multimessenger Astrophysics with Next-Generation Black Hole and Neutron Star Binary Merger Simulations,” Albert Einstein Institute, Potsdam, Germany, 25 May 2022; University of Lisbon, Portugal, 13 June 2022.
- M.M. Hedman, The Uranian Ring-Moon System. 2022 Fall Meeting of the American Geophysical Union.
- H. Sharma, M.M. Hedman, S. Vahidinia. New Insights into Enceladus Plume Particle Launch Velocities. 2022 Fall Meeting of the American Geophysical Union.
- V. Afigbo, M.M. Hedman. What Makes Saturn Ring? A Quest to Quantify the Amplitudes of Saturn’s Planetary Normal-Mode Oscillations using Ring Seismology. 2022 Fall Meeting of the American Geophysical Union.
- S. Callos, M.M. Hedman, D. Hamilton. A Comprehensive Survey of Spokes in Cassini Images of Saturn’s B ring. 2022 meeting of the Division for Planetary Sciences.
- M.M. Hedman, I. Regan, T. Becker, S. Brooks, S. Jarmak. New information about Uranus’ dusty rings from Voyager 2 images. 2022 meeting of the Division for Planetary Sciences.
- K. Denny, M.M. Hedman, D. Bockelee-Morvan, G. Filacchione, F. Capaccioni. Possible Water Vapor Emission Feature in Near-Infrared Enceladus Plume Spectra from Cassini-VIMS. 2022 meeting of the Division for Planetary Sciences.
- J. A’Hearn, M.M. Hedman, C. Mankovich, H. Aramona, M.S. Marley. Ring Seismology of the Ice Giants Uranus and Neptune. 2022 meeting of the Division for Dynamical Astronomy.
- M.M. Hedman, P.D. Nicholson, M. El Moutamid. Using disk structures as historical records: A case study involving Saturn’s rings. 2022 meeting of the Division for Dynamical Astronomy.

Biological Physics

- A. Vasdekis, American Physical Society, Las Vegas, Nevada (2023).
- F.M. Ytreberg, Simon Fraser University Biophysics and Soft Matter Seminar, Burnaby, BC, Canada, Apr 2022.
- F.M. Ytreberg, Washington State University Physics Colloquium, Pullman, WA, Jan 2022.
- F.M. Ytreberg, Biophysical Society Annual Meeting, Feb 2022.

Condensed Matter Physics

- L. Bergman, “Temperature Response of the Optical Properties of Ultra-Wide Bandgap β -Ga₂O₃ Films,” APS March meeting presentation, Bulletin of the American Physical Society 2022.
- Y. Qiang, Keynote presentation on “Advanced Radiation Nano-detector for Nuclear Energy Application” at 5th Global Webinar on Applied Science, Engineering and Technology, October 22, 2022.
- Y. Qiang, Keynote talk at International InovSciTech conference, WEBAS, November 2022.
- Y. Qiang, Keynote Speaker at CMPFORUM2023 February 06-08, 2022, Porto, Portugal, virtual talk.

Hadronic Physics

- J. Hiller, “Gravity and Quantum Mechanics: Newton-Schrödinger and Einstein-Klein-Gordon solitons,” UI Physics Department colloquium, 23 January 2023.
- J. Hiller, “Light-front effective potential between static sources,” contributed virtual talk, April meeting of the American Physical Society (2023).
- R. Machleidt, “Alternative facts in microscopic nuclear structure,” Invited Talk, 39th International Workshop on Nuclear Theory, Rila Mountains, Bulgaria, July 2022.
- F. Sammarruca, “The equation of state of neutron-rich matter at fourth order of chiral effective field theory and the radius of a medium-mass neutron star,” invited talk (virtual) given at the 39th International Workshop on Nuclear Theory, Rila Mountain, Bulgaria, July 4-8, 2022.
- F. Sammarruca, “Neutron stars: The most bizarre laboratory for nuclear physics,” invited talk (virtual) at the 2022 North American Einstein Toolkit Summer School, University of Idaho, Moscow, Idaho, June 13-17, 2022.

Current External Funding

Astrophysics and Planetary Science

- G.D. Barnes, NASA Mars Data Analysis, Blasting Mars: What Factors Enable Detection of New Impact Sites?, 2021-2023, \$466,258.

- C. J. Cline, G.D. Barnes (Co-I), J. Anderson, M. Cintala, O. Barnouin, R. Daly, Solar System Workings, NASA, The role of small-scale target heterogeneities in the formation and morphology of small craters, 2020-2023, \$1,071,913 (\$132,086 for UIIdaho).
- PI: Jason W. Barnes (UIIdaho), Co-I Shannon M. MacKenzie (JHU/APL), Co-I Michael J. Malaska (JPL/Caltech), Co-I Rajani D. Dhingra (JPL/Caltech), Titan Surface Phase Functions, NASA Cassini Data Analysis Program, 2022-2024, \$589,380 (\$377,771 to UIIdaho)
- Elizabeth Turtle (JHU/APL), Deputy PI Jason W. Barnes (UIIdaho). Dragonfly. NASA New Frontiers, 2018-2038, \$849,000,000 (\$4,000,000 for UIIdaho).
- Z. Etienne, superB: Numerical Relativity for LISA & 3G Detectors, NASA Astrophysics Theory Program, \$409,021, 2022-2025.
- Z. Etienne, Boosting Algorithmic Efficiency: Numerical Relativity in Dynamical, Curvilinear Coordinates, NSF Gravitational Physics–Theory, 2021-2024, \$174,803.
- Z. Etienne, Collaborative Research: WoUMMA: Toward Binary Neutron Star Mergers on a Moving-mesh, NSF Windows on the Universe: The Era of Multi-Messenger Astrophysics, 2021-2024, \$483,465 (\$226,347 to Etienne).
- Z. Etienne, Collaborative Research: Measuring G with a Magneto-Gravitational Trap, NSF Gravitational Physics—Experiment, 2020-2023, \$567,990 (\$118,517 to Etienne).
- Z. Etienne, Collaborative Research: Frameworks: The Einstein Toolkit ecosystem: Enabling fundamental research in the era of multi-messenger astrophysics, NSF OAC, 2020-2024, \$2,300,415 (\$335,902 to Etienne).
- Z. Etienne, COVID Augmentation on “Advancing Computational Methods to Understand the Dynamics of Ejection, Accretion, Winds and Jets in Neutron Star Mergers” award, NASA COVID, \$28,609 to Z. Etienne, 2021-2023.
- P.D. Nicholson (PI Cornell University), M. El Moutamid (Co-I Cornell University), R. French (Co-I Wellesley College), M.M. Hedman (Co-I University of Idaho), M. Tiscareno (Collab. SETI Institute), G. Stewart (Collab U. Colorado). Vertical Structure in Saturn’s Rings. NASA Cassini Data Analysis Program 2023-2025. Total Budget \$619,197. Total funds for UI: \$158,229.
- M.M. Hedman (PI University of Idaho), M. Marley (Co-I U. Arizona), J. Fortney (Collaborator UCSC). Seismological Studies of the Ice Giants. NASA Cassini Data Analysis Program, 2021-2024, \$242,783 (\$178,271 to UIIdaho).
- M.M. Hedman (PI University of Idaho), R. French (Co-I SETI Institute), D.P. Hamilton (Co-I U. Maryland). The Recent History of Saturn’s Dusty Rings. NASA Cassini Data Analysis Program, 2021-2024, \$543,223 (\$275,386 to UIIdaho).

Biological Physics

- A.E. Vasdekis, National Science Foundation, PI, 2041523, Collaborative Research: Multidimensional single-cell phenotyping for elucidating genome to phenome relationships, \$362,000, 03/21 – 03/24.
- A.E. Vasdekis, National Science Foundation, senior personnel, (PI: T. Xing), CBET-2019231, MRI: Acquisition of a 3D Printer for Studying Biofluids and Biomechanics, \$252,542 (total award), 09/20 – 08/23.

A.E. Vasdekis, Department of Energy, Genomic Sciences Program, PI, DE-SC0022282, Integrative Imaging of Plant Roots during Symbiosis with Mycorrhizal Fungi, \$1,700,000, 09/21 – 08/24.

A.E. Vasdekis, Department of Energy, Genomic Sciences Program, co-PI (PI: G. Stephanopoulos), Improving Fermentation Robustness by Cellular Noise Engineering, \$430,000 (awarded to Vasdekis), 09/21 – 08/24.

A.E. Vasdekis, Department of Energy, Genomic Sciences Program, co-PI (PI: C. J. Marx), Converting methoxy groups on lignin-derived aromatics from a toxic hurdle to a useful resource: a systems-driven approach, \$150,000, 09/21 – 08/24.

Wichman HA (PI), Ytreberg FM (associate director) “Center for Modeling Complex Interactions,” NIH COBRE, 2020-2025, \$10,999,565.

Condensed Matter Physics

L. Bergman, Co-PI with Matt McCluskey WSU (PI), Department of Energy, Response of gallium oxide to pressure, temperature and alloying, Total \$451,299, \$213,095 to UI. (6/1/22 – 5/31/25).

C. Berven, Co-PI, PI H. Hess, USDOT University Transportation Center for Federal Region 10, “Interfacing Major Subsystems for a Resilient Electric Vehicle Charging System for Remote Locations”, \$40,000 total/ \$20,000 CB, 3/01/2022 to 3/31/2023.

Hadronic Physics

F. Sammarruca and R. Machleidt, Department of Energy, Nuclear Theory at the University of Idaho, 2021-2023, \$240,000.

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