Vandalizing the Universe

University of Idaho
Department of Physics

Home of Physics and Astronomy on the Idaho Palouse

Newsletter Issue No. 1 MMXX Editor: J.R. Hiller
URL: https://www.uidaho.edu/sci/physics/news/physics-newsletter

Message from the Chair

To say that this has been quite a year would seem unnecessary. It has been quite a year for everyone. All the various disruptions and hardships induced by the pandemic came so fast that being reactive was usually the only course of action. For the University of Idaho, this came on top of months spent dealing with budget cuts, not to mention my own summer-long effort to relocate from Minnesota.

However, through it all (and continuing today, as we prepare for a fall semester in the new normal), the Department has kept its focus on our dual core missions of teaching and research. We pivoted to fully online instruction in March, with only the week of Spring "break" to prepare. This included a massive effort by our new Lab Director, Eric Foard, assisted by Amrah Canul, to produce videos to replace the in-person lab experience. Faculty quickly trained themselves in the use of Zoom and launched synchronous and asynchronous versions of their courses. Any diligent student should have been as successful in that semester as in any other.

In the process, much was learned about the technology that is now the foundation for our fall-semester preparations, as we plan to deliver several courses in hybrid remote/in-class combinations that accommodate social distancing. Only small classes that fit safely within their rooms will be delivered in the fully traditional fashion, and those only until the Thanksgiving break. After that break, all instruction will again be fully online for the remainder of the semester, to prevent students from returning with new infections.

The budget cuts and spending restrictions have not impacted the Department too severely. We did lose the position held by Bernard Stumpf upon his retirement, but we

did gain a dedicated Chair position that had been filled by interim Chairs from outside the Department. The College as a whole has lost several faculty lines and staff positions. We have been fortunate to be joined by Jessica DeWitt, coming over from Statistical Science, to replace KarlaRose Erhard-Hudson as the Department Administrative Assistant.

Gift accounts have been instrumental in weathering the temporary spending restrictions. The generosity of our donors has given us the financial independence to maintain our support for students, through scholarships, instructional equipment and research opportunities, and support for faculty creativity.

My own odyssey began in Duluth, Minnesota, where I was a Professor in the Department of Physics and Astronomy at the local campus of the University of Minnesota, having been Department Head from 1995 to 2007. There was a house to empty, upgrade, and sell; a house to buy in Idaho; and, the highlight of the process, a drive across North Dakota and Montana with a dog, a cat and eight rabbits packed into a cargo van. We camped along the way and got everybody here, except the cat, who slipped his tether and jumped ship into a North Dakota corn field. With the help of a microchip, a cat person, and a pet transport service, we got him back.

So, now we look to the future. The pandemic will continue to have impact, including additional strains on the University budget, but the new instructional infrastructure and training have opened new possibilities for course delivery and research collaboration. Instead of traditional lectures, the new technologies facilitate the flipped classroom approach, with short lecture videos viewed in advance and class time used for broad interaction with students through examples, questions, and discussion. Despite the severe limitations on travel (meaning, I haven't traveled at all), I have had more contact with other physicists around the country and the globe than I would in most previous years, Zooming to meetings that I would not have reached otherwise.

I hope that you, too, can look forward to a productive year with good health. Stay safe. And, if you have another moment, please consider filling out and returning the response form on the last page.

Best regards,

PS: Here's a building you might remember.

Faculty

Astronomy and Planetary Science

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

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

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

Jessica DeWitt, Administrative Assistant

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

Brian Petty, Scientific Instrument Maker

Nava Subedi, Ph.D., Postdoctoral Fellow

Dinesh Thapa, Ph.D., Lecturer

Awards in 2020

Dean's Award: Sam Myers

John B. George Award: Sam Myers

Deans Graduate Award: Lokendra Khanal

Best Physics TA: Elizabeth Atang

College of Science Staff Outstanding Service Award: Brian Petty

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 University 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!!

Transitions

Bernard Stumpf retired from his faculty position.

Eric Foard joined the Department as the new Director for the instructional laboratories.

John Hiller arrived from the University of Minnesota-Duluth as the new Chair.

Sophia Chabysheva came to the Department as a non-tenure-track Assistant Professor.

Andreas Vasdekis was promoted to Associate Professor with Tenure.

KarlaRose Erhard-Hudson chose to move to a different path after many years of faithful service as the Department's Administrative Assistant.

Jessica DeWitt switched from a similar position in Statistical Science to take KarlaRose's place.

New Graduates

Caitlin Buchanan (B.A. 2020)

Gunnar Edwards (B.A. 2020)

Nicholas Brubaker (Applied B.S. 2020)

Anthony Wright (Applied B.S. 2020)

Zach Berfanger (B.S. 2020)

Lochlann Dunn (B.S. 2020)

Mason Footh (B.S. 2019)

Dylan Martin (B.S. 2020)

Samuel Myers (B.S. 2020), Planetary Science Ph.D. program at the University of Arizona

Eduardo Ramos-Arteaga (B.S. 2019)

Matthew Young (B.S. 2020)

Steven Kreyche (M.S. 2020)

Dillon Morehouse (M.S. 2019)

Jeff Lapp (M.S. 2020)
Thesis advisor: L. Bergman

Amrah Canul (Ph.D. 2020)
Thesis advisor: L. Bergman

Robert Chancia (Ph.D. 2019), currently at RIT pursuing degree in image analysis.
Thesis title: Dusty, Dense, Bright, Dark, Narrow, and Broad: the Rings in our Solar System and a Few of the Things They Can Tell Us
Thesis advisor: M. Hedman

Rajani Dhingra (Ph.D. 2019), NASA Postdoctoral Program fellow at NASA/Caltech Jet Propulsion Laboratory.
Thesis title: Understanding the Surface-Atmosphere Interactions on Titan
Thesis advisor: J. Barnes

Lokendra Khanal (Ph.D. 2020) placed at Intel.
Thesis advisor: Y. Qiang

Christopher Ali Mirabzadeh (Ph.D. 2019), now a Research Data Scientist at Aon in Spokane, WA.
Thesis title: Optimization Problems in Computational Physics: From Atoms to Molecular Assemblies
Thesis advisor: F. Ytreberg

Kyle Martin (Ph.D. 2020), now a postdoc at the pharmaceutical company Boehringer Ingelheim.
Thesis advisor: F. Ytreberg

Shahla Nemati (Ph.D. 2020)
Thesis title: Eliciting the Effects of Cellular Noise on Growth and Antibiotic Response with Precision Single-Cell Microfabricated Assays
Thesis advisor: A. Vasdekis

Negar Rajabi (Ph.D. 2019)
Thesis advisor: L. Bergman

SPS Activities

by Matt Young and Sam Callos
photos by Matt Young

In October of 2019, the University of Idahos Society of Physics Students (SPS) visited the Laser Interferometer Gravitational-Wave Observatory (LIGO Hanford) located in Richland, Washington. There are currently two observatories stationed in the United States, we visited the one in Washington - only a three hour drive from the U of I campus, and another in Livingston, Louisiana. On our tour we learned that LIGO is meant to detect and record findings of gravitational waves caused by large-scale collisions of supermassive bodies such as black holes and neutron stars. Here's the group on tour at LIGO:

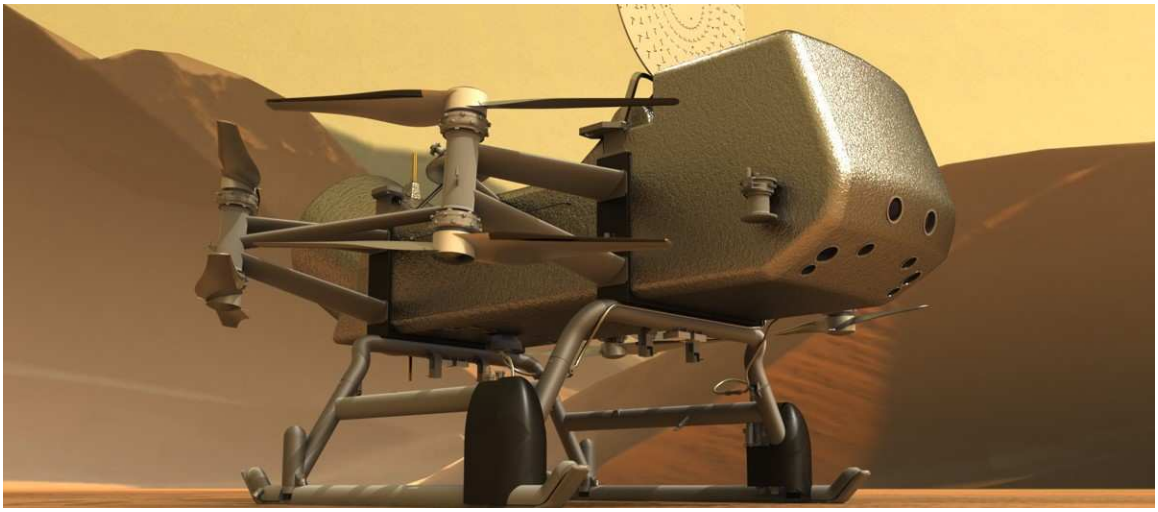
The facility consists of two large concrete tubes protecting interferometers that meet at a right angle (each a staggering 4 km long!) where all of the data can be processed. The idea of the two arms being perpendicular is to find a discrepancy in the two measured lengths which would show the deformation of space-time caused by one of these colossal events. The photo shows one of the arms running almost to the horizon.

In between, when the weather was non-cooperative or test season was upon us, we would spend time during meetings working on course work and talking about current news in the physics community while enjoying some pizza. On occasion, we would also do a crash-course on a computer language when one of the upperclassmen had the ability to share tips and tricks.

Our former president Matt Young graduated in May 2020 and Samantha Callos will lead the SPS group as the new president going into her 2nd year.

This coming semester, with the reopening of the University's observatory, we plan on becoming more familiar with the equipment inside it, so we can hold a star viewing event. We look forward to utilizing this resource after it being inaccessible for a number of years now. However, we must follow University regulations regarding Covid-19, but there are some mountable telescopes that can be stationed outdoors and spaced apart accordingly.

In this time of uncertainty, we hope all of our fellow SPS members and physics majors are staying safe and healthy. Wear your masks!



Dragonfly

NASA Rotorcraft Lander Mission to Saturn's Moon Titan

by J. Barnes

The University of Idaho is part of a team that won the competition to design NASAs latest planetary probe. Professor of Physics Jason W. Barnes is the deputy principal investigator of the mission. U of I alumna Shannon M. MacKenzie (Physics PhD 2017) helped draft the winning proposal and is on the science team as one of the missions co-investigators.

The spacecraft, named Dragonfly, will visit Titan, a giant ice moon orbiting Saturn. Titan is the only moon with a thick atmosphere. Within that atmosphere, sunlight drives carbon chemistry to produce complex hydrocarbon molecules. When those hydrocarbons mix with liquid water from Titan's vast interior ocean or in impact melt pools on the moon's surface, the resulting primordial soup resembles the shallow pools in which life formed on Earth four billion years ago. Because geologic activity has erased evidence of how life formed here, Dragonfly will explore Titan to search for chemical evidence that life may have formed there, and, if it hasn't, how far prebiotic chemistry has progressed toward becoming biology.

With a budget of around $1 billion, NASA's New Frontiers program represents the largest single competed scientific opportunity offered by the U.S. Government. Dragonfly now proceeds to its final design phase, followed by fabrication and launch on a rocket from Florida in April 2026. After cruising through space for over eight years, it will arrive at Titan in December 2034, landing on sand dunes near the moons equator.

Instead of driving on wheels like a Mars rover, Dragonfly uses eight propellers arranged in an over-under dual-quadcopter configuration to fly through Titans thick atmosphere and under its low gravity (1/7th Earth's). After landing, it will embark on one of the most epic adventures in human history, flying between interesting sites on the surface of this alien moon for just under three Earth years.

Completed Thesis Projects

Robert O. Chancia

The observations of planetary rings acquired by the Cassini and Voyager missions and from the Earth have launched large advancements in our knowledge of planetary ring formation, evolution, and dynamics. Today, the study of the ring systems around our giant planets has evolved further into using the rings themselves as a tool to learn about their home planetary systems. We used two of the narrow rings of Uranus to probe for unseen nearby small moons who gravitationally interact with the rings and produce wake-like structures. These small moons both provide a possible solution for the confinement of their neighboring narrow rings and may represent a subset of the upper end of the ring particle size distribu-

tion. We detected the effects of a resonant induced radial mode in the Uranian η ring. The amplitude of the radial oscillations observed in the η ring allow us to estimate the mass of the perturbing moon Cressida. This is the first such measurement of small inner Uranian moons mass and density. We tracked the presence and strength of periodic brightness variations in Saturns dusty Roche Division and find that they are most likely caused by the seasonally varying planetary period oscillations of Saturns magnetic field. This is just one of many ways in which the rings of Saturn have been found to be interacting with their magnetospheric environment.

Rajani Dhingra

With a thick atmosphere, a methane-based hydrological cycle, stable bodies of standing liquid at its surface, and many active surface processes, Saturn's largest moon Titan is surprisingly Earth-like. Methane rain makes it the only place, other than Earth, where rain interacts with the surface. Looking at Titan is like looking back in time to understand the evolution of present day Earth from early-Earth.

My Ph.D. research combined several studies related to Titan's hydrologic system, particularly the ways fluid interacts with the surface of Titan. Understanding this atmosphere-surface interaction is of great importance to understand Titan's meteorology and evolution.

We found that the possible reason behind Ontario Lacus (72°S, 183°W) being the solo lake in the south pole of Titan is it's large catchment area that extends to southern mid-latitudes (40°S) that is coupled with the sustained observation of clouds in those latitudes.

We also discovered the 'Bright Ephemeral Features' on the north pole of Titan that are akin to wet sidewalks on the Earth. We observed broad specular reflection (glint) in the 5 micron channel of the Visual and Infrared Mapping Spectrometer on board Cassini. Our analysis suggested that these features could be recently rain-wetted surfaces or near surface fogs.

While the presence of a hydrological cycle might help explain how the depressions on Titan's surface are filled with liquid methane, the formation mechanisms of the depressions still remain a mystery at the end of Cassini in 2017. We addressed this question using a morphometric measurement methodology (EFDA–Elliptical Fourier Descriptor Analysis) to quantify the shapes of Titan's lakes. The strength and application of this methodology is across disciplines and over cross-planetary geomorphic features.

Leah Bergman's research group

In Summer 2019, Negar Rajabi graduated with a Ph.D. degree. Her research was on the electronic and optical properties of ZnO thin films and nano-wires. Nano-materials are the building blocks for technologies that enable devices with extreme small sizes. These materials can come in various shapes such as nano-wires and nano-springs. Negar studied the impact of size and shape on the electronic and optical properties and investigated routes to improve these properties via growth techniques.

In the Spring of 2020, Jeff Lapp graduated with an M.S. degree. His research focused on the enhancement of the UV-light emission from oxide semiconductors. The oxide semiconductors are environmentally friendly and cost effective. Modern technological applications require high performance materials. Specifically, efficient light emission in the UV is a desirable property for the realization of novel light sources at that part of the spectrum. Jeff found that a specific type of coating can significantly enhance the UV-intensity of the oxide semiconductors, making them suitable for various optical applications.

In the Spring of 2020, Amrah Canul graduated with a Ph.D. degree. His research combined experimental and theoretical approaches to gain knowledge on defects in UV semiconductor thin films. Defects, that come in many types and forms, can deteriorate electronic transport as well as optical properties such as absorption and emission of light. His main finding was that the structural quality of the material is the most important type of defect in the studied semi-

conductors. Upon improving the structural quality, the properties of these semiconductors was found to significantly improved.

A previous student of Leah, Dr. John Morrison is now an associate professor at Lewis-Clark State College in the Natural Sciences & Mathematics Division. Recently John has been recognized for his outstanding teaching in the inaugural Idaho GEM Innovative Educator Awards, presented by the Idaho State Board of Educations General Education Committee and Capital Educators Credit Union (CECU).

In the summer of 2019, Leah Bergman received a renewal grant from the Department of Energy, to conduct research on ultra-bandgap materials with optical properties in the deep-UV. This research is in collaboration with Dr. Matt McCluskey from the department of physics at Washington State University. This research involves the growth of the materials, conducting optical experiments, and modeling.

Shahla Nemati

Cellular noise represents a non-genetic phenomenon that enforces randomness in almost all cellular reactions. Two less understood aspects of cellular noise pertains to metabolism and survival against antibiotics. This thesis focused on both developing advanced experimental methods and applying them to investigate these two aspects. Our findings unmasked previously unseen cellular growth mechanisms and the randomness of death upon antibiotic treatment.

Recent Publications (2019-20)

Student authors are underlined.

Astronomy and Planetary Science

Bart (Barnes), G.D., I.J. Daubar, B.A. Ivanov, C.M. Dundas, A.S. McEwen, (2019). "Dark Halos Produced by Current Impact Cratering on Mars." Icarus 328, 45-57.

Ahlers, John P.; Barnes, Jason W.; Myers, Samuel A., "Dealing with δ-Scuti Stars: Transit Light Curve Analysis of Planets Orbiting Rapidly Rotating, Seismically Active A/F Stars," AJ 158:88, 2019 August.

Dhingra, Rajani; Barnes, Jason W.; Hedman, Matthew M.; Radebaugh, Jani, "Using Elliptical Fourier Descriptor Analysis (EFDA) to Quantify Titan Lake Morphology," AJ 158:230, 2019 December.

Lorenz, Ralph D.; Imanaka, Hiroshi; Trainer, Melissa; Osiander, Robert; Hunter, Gary; Mastandrea, Andrew; Turtle, Elizabeth; McKay, Christopher; Barnes, Jason W.; Makel, Darby, "Hydrogen Sensing in Titans Atmosphere: Motivations and Techniques," Planetary and Space Science, Vol. 174, 2019 September 15.

Lopes, Rosaly M. C.; Wall, Stephen D.; Elachi, Charles; Lorenz, Ralph D.; Solomonidou, Anezina; Birch, Samuel; Mastrogiuseppe, Marco; Poggiali, Valerio; Notarnicola, Claudia; Neish, Catherine; Mitri, Guiseppe; Zebker, Howard; LeGall, Alice; Paillou, Philippe; Tosi, Federico; Janssen, Michael; Wood, Charles; Paganelli, Flora; Lunine, Jonathan; Radebaugh, Jani; Rodriguez, Sebastien; Hayes, Alex; Todi, Federico; Hofgartner, Jason D.; Coustenis, Athena; Schoenfeld, Ashley; Malaska, Michael J.; Soderblom, Jason M.; Stogan, Ellen R.; Farr, Thomas G.; Mitchell, Karl L.; Paul, Ries A.; Zhang, Z.Z.; Turtle, Elizabeth; Alberti, Giovanni; Barnes, Jason W.; Callegari, Mattia; Casarano, Domenico; Grima, Cyril; Hemingway, Doug; Karatekin, Ozgur; Lucas, Antoine; Ori, Gian Gabriele; Orosei, Roberto; Riccio, Daniele; Schaller, Emily; Ventura, Bartolomeo; Wye, Lauren, "Titan as Revealed by the Cassini RADAR," Space Science Reviews, Volume 215 Issue 4 #33, 2019 June.

Kreyche, Steven M.; Barnes, Jason W.; Quarles, Billy L.; Lissauer, Jack J.; Chambers, John E.; Hedman, Matthew M., "Orbital Eccentricity Influence the Obliquity Stability of Retrograde-Rotating Planets," The Planetary Science Journal, Volume 1, Issue 1, 2020 April 14.

MacKenzie, Shannon M.; Barnes, Jason W.; Hedman, Matthew M.; Lucas, Antoine; Turtle, Eliza- beth P.; Sotin, Christophe; Hofgartner, Jason; Birch, Samuel, "The Case for Seasonal Surface Changes at Titans Lake District," Nature Astronomy, Vol 1, 2019 April 15.

Dhingra, Rajani; Barnes, Jason W.; Brown, Robert H.; Buratti, B. J.; Clark, R. N.; Soderblom, J. M.; Jaumann, Ralph; Rodriguez, Sebastien; LeMouelic, Stephane; Turtle, Elizabeth P.; Perry, Jason; Cottini, Valeria; Jennings, Don, "Rain-wetted Surface at the North Pole of Titan from the "Wet-sidewalk Effect"," Geophysical Research Letters, Volume 46, pp1205-1212, 2019 February 16.

Le Moulic, Stphane; Cornet, Thomas; Rodriguez, Sebastien; Sotin, Christophe; Seignovert, Benoit; Barnes, Jason W.; Brown, Robert H.; Baines, Kevin H.; Buratti, Bonnie J.; Clark, Roger N.; Nicholson, Philip D.; Lasue, J.; Soderblom, Jason M., "The Cassini VIMS archive of Titan: from browse products to global infrared color maps," Icarus, Vol. 319, pp121-132, 2019 February.

J.A. A'Hearn, M.M. Hedman, M. El Moutamid. Dynamics of multiple bodies in a corotation resonance: Conserved quantities and relevance to ring arcs. ApJ 882:66 (2019)

M.S. Tiscareno, P.D. Nicholson, J.N. Cuzzi, L.J. Spilker, C.D. Murray, M.M. Hedman, J.E. Colwell, J.A. Burns, S.M. Brooks, R.N. Clark, N.J. Cooper, E. Deau, C. Ferrari, G. Filacchione, R.G. Jerousek, S. Le Mouelic, R. Morishima, S. Pilorz, S. Rodriguez, M.R. Showalter, S.V. Badman, E.J. Baker, B.J. Buratti, K.H. Baines, C. Sotin. 2019. "Close-range remote sensing of Saturn's rings during Cassini's ring-grazing orbits and Grand Finale." Science 364:eaau1017

S.M. MacKenzie, J.W. Barnes, J.D. Hofgartner, S.P.D. Birch, M.M. Hedman, A. Lucas, S. Rodiquez, E.P. Turtle, C. Sotin. 2019. "The case for seasonal surface changes at Titans lake district." Nature Astronomy 3:506-510.

R.O. Chancia, M.M. Hedman, S.W.H Cowley, G. Provan, S.-Y. Ye. 2019. "Seasonal structures in Saturns dusty Roche Division correspond to periodicities of the planets magnetosphere." Icarus 330:230-255.

M.M. Hedman. 2019. "Using cosmogenic Lithium, Beryllium and Boron to determine the surface ages of icy objects in the outer solar system." Icarus 330:1-4.

M.M. Hedman, P.D. Nicholson, 2019. "Axisymmetric density waves in Saturns rings." MNRAS 485:13-29.

M.M. Hedman, 2019. "Bright clumps in the D68 ringlet near the end of the Cassini Mission." Icarus 323:62-75.

M.M. Hedman, P.D. Nicholson, R.G. French, 2019. "Kronoseismology IV: Six previously unidentified waves in Saturns middle C ring." AJ 157:18.

R.G. French, C.A. McGhee-French, P.D. Nicholson, M.M. Hedman, 2019. "Kronoseismology III: Waves in Saturns inner C ring." Icarus 319:599-626.

M. Ciarniello, G. Filacchione, E. DAversa, F. Capaccioni, P.D. Nicholson, J.N. Cuzzi, R.N. Clark, M.M. Hedman, C.M. Dalle Ore, P. Cerroni, C. Plainaki, L.J. Spilker, 2019. "Cassini-VIMS observations of Saturns main rings: II. A spectrophotometric study by means of Monte Carlo ray- tracing and Hapkes theory." Icarus 317:242-265.

Biological Physics

A.E. Vasdekis, H. Alanazi, A. M. Silverman, C. J. Williams, A. J. Canul, J. B. Cliff, A. C. Dohnalkova, G. Stephanopoulos, "Eliciting the impacts of cellular noise on metabolic trade- offs by quantitative mass imaging," Nature Communications 10, 848 (2019).

J. A. Lee, S. Riazi, S. Nemati, J. V. Bazurto, A. E. Vasdekis, B. J. Ridenhour, C. H. Remien, C. J. Marx, "Microbial phenotypic heterogeneity in response to a metabolic toxin: Continuous, dynamically shifting distribution of formaldehyde tolerance in Methylobacterium extorquens populations," PLoS Genetics 15, e1008458 (2019).

Martin, Kyle P.; MacKenzie, Shannon M.; Barnes, Jason W., Ytreberg, F. Marty, "Protein Stability in Titan's Subsurface Water Ocean," Astrobiology, Volume 20, Number 2, 2020 February.

Patel JS, Quates CJ, Johnson EL, Ytreberg, FM, "Expanding the watch list for potential Ebola virus antibody escape mutations," PLoS One, 14:e0211093 (2019)

Mirabzadeh CA, Ytreberg FM, "Implementation of adaptive integration method for free energy calculations in molecular systems," PeerJ, 6:e264 (2020)

Yang J, Naik N, Patel JS, Wylie CS, Gu W, Huang J, Ytreberg FM, Naik MT, Weinreich DM, Rubenstein BM, "Predicting the viability of beta-lactamase: How folding and binding free energies correlate with beta-lactamase fitness," PLoS One 15:e0233509 (2020)

Condensed Matter Physics

Jesse Huso, Leah Bergman, Matthew D. McCluskey. "Band gap of cubic ZnS1xOx from optical transmission spectroscopy," Journal of Applied Physics. 125, 075704; Special issue on highly mismatched alloys. (2019).

Jesse Huso, Jacob R. Ritter, Leah Bergman, Matthew D. McCluskey. "High Order Oxygen Local Vibrational Modes in ZnS1-xOx," Physica Status Solidi B, 1800607 (2019).

Amrah Canul, Dinesh Thapa, Jesse Huso, Leah Bergman, Richard Williams, and Ruprecht Machleidt, "Mixed-strategy approach to band-edge analysis and modeling in semiconductors," Phys. Rev. B **101**, 195308 (2020).

D. Morehouse, David Arnett, Herbert Hess, and Christine Berven, "Dynamic Behavior of Superconductor-Permanent Magnet Levitation With Halbach Arrays for Flywheel Design and Control," IEEE TRANSACTIONS ON APPLIED SUPERCONDUCTIVITY, VOL. 29, NO. 5, AUGUST 2019

D Zhang, D Zhou, W Jiang, Q Lu, W Liu, M Yue, Y Qiang; "Coercivity Enhancement and Uncoordinated Deformation in PrCu-Doped PrFeB/PrCo5 Hybrid Magnets." J. of Magnetism and Magnetic Materials, 2019, 165898

Z Lei, S Yan, Z Cao, Z Guo, P Song, Y Qiang, J Wang, W Zhao, Q Leng; "High TMR for both in-plane and perpendicular magnetic field justified by CoFeB free layer thickness for 3-D MTJ sensors." AIP Advances 9 (8), 085127.

LR Khanal, M Ahmadzadeh, JS McCloy, Y Qiang, "Relationship between nanostructure-magnetic property induced by temperature for iron oxide nanoparticles in vacuum, Ar and O2 environments," J. of Magnetism and Magnetic Materials, 166158, 2019

LR Khanal, JA Sundararajan, Y Qiang, "Advanced Nanomaterials for Nuclear Energy and NanoTechnology," Energy Technology, 1901070, 2019.

Hadronic Physics

F. Sammarruca and R. Millerson, "Nuclear Forces in the Medium: Insight From the Equation of State," Front. in Phys. **7**, 213 (2019)

F. Sammarruca, R. Machleidt, and R. Millerson, "Temperature effects on the neutron matter equation of state obtained from chiral effective field theory," Mod. Phys. Lett. A **35**, 2050156 (2020)

D. R. Entem, R. Machleidt, and Y. Nosyk, "Nucleon-nucleon scattering up to N^5LO in chiral effective field theory," Front. in Phys. **8**, 57 (2020)

R. Machleidt and F. Sammarruca, "Can chiral EFT give us satisfaction?," Eur. Phys. J. A **56**, 95 (2020)

R. Cruz-Torres *et al.* [Jefferson Lab Hall A Tritium], "Comparing proton momentum distributions in $A = 2$ and 3 nuclei via ^{2}H ^{3}H and ^{3}He $(e, e'p)$ measurements," Phys. Lett. B **797**, 134890 (2019)

Y. Y. Cheng, T. T. S. Kuo, R. Machleidt and Y. M. Zhao, "Unitary limit and linear scaling of neutrons in harmonic trap with tuned CD-Bonn and square-well interactions," Phys. Lett. B **797**, 134815 (2019)

L. E. Marcucci, F. Sammarruca, M. Viviani and R. Machleidt, "Momentum distributions and short-range correlations in the deuteron and ^{3}He with modern chiral potentials," Phys. Rev. C **99**, 034003 (2019)

A. Usselman, S. S. Chabysheva and J. R. Hiller, "Convergence of the light-front coupled-cluster method in a quenched scalar Yukawa theory," Phys. Rev. D **99**, 116011 (2019)

Recent Presentations (2019-20)

Astronomy and Planetary Science

G.D. Barnes, The Moons craters: What do they tell us?, Boise State University, colloquium. Dec 6, 2019, in Boise, Idaho.

G.D. Barnes, The Physics of Impact Cratering, University of Idaho, Department of Physics, colloquium. April 22, 2019, in Moscow, Idaho.

S. Kreyche, graduate student poster, Orbital Eccentricity Influences the Obliquity Stability of Retrograde-Rotating Planets", European Planetary Science Congress / Division for Planetary Science meeting (EPSC/DPS), Geneva, Switzerland, 2019 September 19.

M. Heslar, graduate student poster, Evidence for Tital Currents in Titanian Seas from Observations of Persistent Wave Activity, European Planetary Science Congress / Division for Planetary Science meeting (EPSC/DPS), Geneva, Switzerland, 2019 September 19.

J. Barnes, Dragonfly: NASAs Rotorcraft Lander mission to Saturns Moon Titan, Creare, Inc., Hanover, New Hampshire, 2019 November 26; Physics colloquium University of Idaho, Moscow, Idaho, 2019 October 7; Physics colloquium at Oklahoma State University, Stillwater, Oklahoma, 2019 October 3; Physics colloquium at University of British Columbia, Vancouver, British Columbia, Canada, 2019 September 5; Renfrew Interdisciplinary colloquium at University of Idaho, Moscow, Idaho, 2019 August 27.

J. Barnes, Age of the Universe, New Saint Andrews College, Moscow, Idaho, 2019 May 2.

J. Barnes, The Dragonfly Mission Proposal: Prebiotic Chemistry and a search for Biosignatures on Saturns Moon Titan, New Quests in Stellar Astrophysics IV: Astrochemistry, Astrobiology, and the Origin of Life, Puerta Vallarta, Mexico, 2019 April 5.

J. Barnes, Wavelength Choice for Titan Surface Imaging from a Future Orbital Mission, European Planetary Science Congress / Division for Planetary Science meeting (EPSC/DPS), Geneva, Switzerland, 2019 September 19.

J. Barnes, When and Where does it Rain on Titan?, European Planetary Science Congress / Division for Planetary Science meeting (EPSC/DPS), Geneva, Switzerland, 2019 September 19.

J. Barnes, Using Gravity Darkening and Asteroseismology to Measure the Misalignment of KOI-972.01, Eu- ropean Planetary Science Congress / Division for Planetary Science meeting (EPSC/DPS), Geneva, Switzerland, 2019 September 19.

M.M. Hedman, R.O. Chancia, G. Provan, S. Cowley, S. Ye. Using dusty rings to trace asymmetries in Saturns magnetosphere. 2019 meeting of the American Geophysical Union, San Francisco, CA.

M.M. Hedman, P. Helfenstein, R.O. Chancia, E. Roussos, C. Paranicas, A. Verbiscer. Some of Saturns Small Satellites have Surprisingly Stygian Surfaces: Evidence for Proton-Induced Darkening in the Saturn System. 2019 European Planetary Science Conference/Division of Planetary Science, Geneva, Switzerland.

M.M. Hedman. Constraining the Surface Ages of Icy Objects in the Outer Solar System with Cosmogenic Lithium, Beryllium and Boron. 2019 Lunar and Planetary Science Conference, Houston, TX.

H. Sharma, M.M. Hedman, D.H. Wooden, A. Colaprete, A. Cook. Constraining low-altitude lunar dust from the LADEE/UVS data. 2019 European Planetary Science Conference/Division of Planetary Science, Geneva, Switzerland.

J. AHearn, M.M. Hedman, D.P. Hamilton. Are moonlets hidden among the clumps in Saturns innermost ringlet? 2019 European Planetary Science Conference/Division of Planetary Science, Geneva, Switzerland; 2019 meeting of the Division for Dynamical Astronomy, Boulder CO.

R. Chancia, M.M. Hedman. Re-examining the rings of Uranus in the Voyager 2 Images. 2019 meeting of the Division for Dynamical Astronomy, Boulder, CO.

Biological Physics

S. Nemati, A. E. Vasdekis, Live or dead? Eliciting the stochastic nature of antibiotic survival, American Physical Society Northwest Section, Bellingham, Washington, oral presentation (05/2019).

S. Nemati, D. Weinreich, A. E. Vasdekis, Investigating the Impact of Phenotypic Heterogeneity on Antibiotic Response via 1D Microfluidic Confinement of Single Bacteria, Biophysical Society Meeting, poster presentation (02/2019).

A. E. Vasdekis, Imaging the Competition Between Growth and self-assembled of Lipid Droplets at the Single-Cell Level, SPIE Imaging Biomaterials (Munich, June 2019).

A. E. Vasdekis, Cellular Noise in Metabolism, American Physical Society Northwest Section (Bellingham, 2019).

A. E. Vasdekis, Imaging Cellular Noise, colloquium, University of Central Florida (Orlando, April 2019).

Condensed Matter Physics

Dinesh Thapa, Jesse Huso, Jeffrey Lapp, Amrah Canul, Matthew McCluskey, and Leah Bergman. MgxZn1-xO metastable alloy films: growth and properties, the American Physical Society, Northwest Section, Bellingham, Washington, May 2019.

Amrah Canul, Dinesh Thapa, Jeffrey Lapp, Jesse Huso, and Leah Bergman. Novel Application of Gaussian Model of the Band-edge in the Study of Defect Dynamics in ZnO Thin Films, the American Physical Society, Northwest Section, Bellingham, Washington, May 2019.

Jeffrey Lapp, Dinesh Thapa, Jesse Huso, Matthew McCluskey, and Leah Bergman. Enhancement of the UV Luminescence of ZnO and MgZnO Thin Films, International Conference on Defects in Semiconductors (ICDS), Seattle WA July 2019.

Amrah Canul and Leah Bergman. The effect of disorder on the thermos-optical interactions at the band-edge in ZnO films, College of Science Student Research Exposition, October 2019.

C. Berven, Flywheel Energy storage and levitation physics: A physicist visits Engineering land, University of Idaho Physics Colloquium; Oct. 28, 2019

Y. Qiang, New Radiation Detector Made by Nanoclusters for Nuclear Energy Application, ISSPIC 2019 conference, HangZhou, China, August 12-17, 2019.

Y. Qiang, Grain Boundary Effect in Nanomaterials for Radiation Tolerance for Spintronics Memory Devices, 4th Workshop on Spintronic Memory and Logic & 5th Anniversary Symposium of Fert Beijing Institute, May 20-22, 2019. Beijing, China.

Y. Qiang, Magnetic Nanomaterials for Perpendicular Recording Media at 1 Tbit/in2, Qingdao Institute of Physics, Qingdao, China. June 9, 2019.

Hadronic Physics

F. Sammarruca, Gender Equity and Science: Cultural and Institutional Issues, UI Physics Department Colloquium, March 2019.

F. Sammarruca, L.E. Marcucci, Michele Viviani, and R. Machleidt, Short-Range Correlations in Nuclei and Nuclear Matter, contribution presented at the APS April Meeting 2019, Mini-Symposium Short Range Nuclear Structure I, Denver, Colorado, April 13-16, 2019.

F. Sammarruca, Theoretical Studies of Short-Range Correlations in Nuclei and Nuclear Matter, invited talk given at Lepton Interactions with Nucleons and Nuclei (ELBA XV), Marciana Marina, Isola dElba, Italy, June 23-28, 2019.

R. Millerson and F. Sammarruca, Predictions of the canonical-mass neutron star radius based on chiral Effective field theory, contribution presented at the 20th Meeting of the APS Northwest Section, May 16-18, 2019, Western Washington University, Bellingham, Washington.

R. Machleidt, Modern Theories of Nuclear Forces and their Applications in ab initio Nuclear Structure, Contribution presented at the 2019 April Meeting of the American Physical Society, Mini-Symposium Short Range Nuclear Structure I, April 13-16, 2019, Denver, Colorado.

R. Machleidt, Recent progress in Nuclear Interactions from Chiral Effective Field Theory, Workshop on Lepton Interactions with Nucleons and Nuclei, Marciana Marina, Isola dElba, Italy, June 24-28, 2019.

R. Machleidt, Historical Perspective and Future Prospects for Nuclear Forces, University of Idaho Physics Colloquium, September 2019.

R. Machleidt, The Never-Ending Dream of Mankind: The Theory of Everything, University of Idaho Physics Colloquium, January 2020.

R. Machleidt, Nuclear Forces, a series of six invited lectures delivered virtually, Department of Physics, Tohoku University, Sendai, Japan, April-June 2020.

J.R. Hiller, Models and Many-Body Problems in Strong-Interaction Physics, University of Idaho Physics Colloquium, April 2019.

External Funding

Astronomy and Planetary Science

G.D. Barnes, I.J. Daubar (co-I), S. Quintana (co-I), Mars Data Analysis Program (MDAP), NASA Blasting Mars: Surface Halos Produced by Current Impact Cratering, 20182021, $284,998.

G.D. Barnes, NASA Mars Data Analysis, 2021-2023, $466,258.

Elizabeth Turtle (JHU/APL), Deputy PI Jason W. Barnes (UIdaho). Dragonfly. NASA New Frontiers, 2018-2038, $849,000,000, $4,000,000 for UIdaho

Shannon MacKenzie (JHU/APL), Co-I: Jason W. Barnes (UIdaho). Exploring Titans "Wet Sidewalk Effect." NASA Cassini Data Analysis Program, 2019-2021, $337,619

Jason W. Barnes (UIdaho), Co-I Jonathan J. Fortney (UCSC). Jupiter and Saturn as Brown Dwarf Analogs. NASA Cassini Data Analysis Program, 2019-2020, $134,926

Jason W. Barnes (UIdaho), Co-I Jack J. Lissauer (NASA Ames), Co-I Billy Quarles (University of Oklahoma). Tidal Obliquity Variations of Potentially Habitable Planets. NASA Habitable Worlds, 2018-2020, $211,096

Jason W. Barnes (UIdaho), Co-I Jason M. Soderblom (MIT), Co-I Christophe Sotin (JPL/Caltech). Waves and Rain on Titan from Specular Sun Glints. NASA Cassini Data Analysis Program, 2015-2020 $404,571.10

Jason W. Barnes (UIdaho), Co-I Elizabeth Turtle (JHU/APL), Ralph Lorenz (JHU/APL), Co-I Jason Perry (U. Arizona). Archival of Cassini VIMS, ISS, and RADAR Global Datamap Products for Titan. NASA Planetary Data Archiving, Restoration, and Tools, 2015-2020, $242,225

M.M. Hedman (PI University of Idaho), S. Vahidinia (Co-I NASA Ames), D. Dhingra (Collaborator). Investigating the Enceladus plume with Cassini-VIMS remote-sensing data. Characterizing Dusty Spokes in Saturns main rings. NASA Cassini Data Analysis Program, 2018-2021, $330,244.

D.P. Hamilton (PI University of Maryland), M.M. Hedman (Co-I, University of Idaho. NASA Cassini Data Analysis Program, 2018-2021, $439,191.

M.M. Hedman (PI University of Idaho), R.G. French (Co-I Wellesley College), M. El Moutamid (Collaborator Cornell U), J. Fuller (Collaborator, Caltech), P.D. Nicholson (Collaborator Cornell U.) Using Saturns rings to probe oscillations and asymmetries in the planets interior. NASA Cassini Data Analysis Program, 2017-2019, $323,937.

Biological Physics

A.E. Vasdekis, Department of Energy, Genomic Sciences Program, PI, DE-SC0019249, Imaging metabolome and enzyme dynamics for co-optimizing yields and titers in biofuel producing microorganisms, 2018-2021, $1,500,000

A.E. Vasdekis, Department of Energy, Genomic Sciences Program, co-PI: C. Marx, Using gene editing and an accumulated bioproduct as a reported for genotypic and phenotypic heterogeneity in growth-vs-production for M. extorquens conversion of aromatics to butanol, 2018-2021, $300,000

Ytreberg FM (PI), Ogbunugafor CB (Co-PI), Miller CR (Co-PI), Weinreich DM (Co-PI) RII Track-2 FEC: Using Biophysical Protein Models to Map Genetic Variation to Phenotypes, NSF EPSCoR, 2017 - 2021, $6,000,000, with $181,000 awarded to A.E. Vasdekis as senior personnel

Wichman HA (PI), Ytreberg FM (associate director) Center for Modeling Complex Interactions, NIH COBRE, 2015 - 2020, $10,572,579; 2020-2025, $10,999,565

Condensed Matter Physics

Matt McCluskey WSU PI and Leah Bergman Co-PI. Defects in Gallium Oxide. Department of Energy. DOE Office of Science Program Office, Division of Materials Science and Engineering, 2019-2022, $450,279 with $187,291 for Bergman.

Matt McCluskey WSU PI and Leah Bergman Co-PI, Acceptor Defects in ZnO and Related Materials, DOE Office of Science, 2016-2019, $143,705

Samrat Choudhury PI and You Qiang Co-PI, Advanced Nanomaterials for Next Generation Neutron Radiation Detection Using Machine Learning Approach, NASA EPSCoR, 2020-2021, $41,991

Hadronic Physics

F. Sammarruca and R. Machleidt. Nuclear Theory at the University of Idaho, DOE Office of Science, 2018-2021, $339,000

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Please send your reply to John Hiller at the Department of Physics, MS 0903, University of Idaho, 875 Perimeter Drive, Moscow, ID 83843 or by e-mail to jhiller@uidaho.edu.

Thanks!! We'll enjoy hearing from you!